

新生儿叩背器

技术领域

[0001] 本发明涉及一种叩背器,尤其是一种适合医院新生儿重症监护室(NICU)住院患儿使用的新生儿叩背器,它能够根据患儿日龄、体重、疾病特点改变叩击振幅、频率和力度。

背景技术

[0002] 近年来,随着新生儿医学的迅猛发展,NICU诊治水平的提高,高危儿的存活率也明显提高,但早产儿、低体重儿成为新生儿死亡的第一原因。而在早产和极低体重儿中,呼吸系统的疾病成为死亡最为常见的原因,这是因为新生儿呼吸系统发育不完善,感染的发生率较高。众所周知,对于呼吸系统感染的新生儿,除了全身用药以外,有效的气道护理也是一个重要手段。气道护理是新生儿呼吸系统感染护理的重要组成部分,及时有效地排除分泌物及代谢废物,是加快病情恢复的有效手段。但由于新生儿本身的特殊性,其自主排痰能力较差,不能自主翻身,护理起来具有一定的难度。尤其对于分泌物稠厚、无自主咳嗽或自主咳嗽能力较差的患儿,单靠体位重力引流效果不理想,选择正确有效的叩背排痰方式,才能使痰液有效排出,从而改善通气功能。目前,叩背排痰主要包括胸部叩击和机械振动排痰两种:

第一,胸部叩击法,包括五指叩击法和面罩叩击法。(1)五指叩击法——病人侧卧位或在他人协助下取坐位,叩击者两手手指弯曲并拢,使掌侧呈杯状,以手腕力量,从肺底自下而上、自外向内、迅速而有节律地叩击胸壁,震动气道、促进痰液排出。(2)面罩叩击法——采用大小不同的面罩,封闭其进出气孔,叩在手上直接对胸背部进行叩击。胸部叩击法和面罩叩击法手掌直接接触背部,远端指腹往往先着落,靠近腕关节的大小鱼际最后着落,不能使整只手掌同时着落,并且由于新生儿体格较小,成人手掌面积相对大且固定,当成人手掌为其叩背时,往往不能全手掌叩击住患儿背部手掌所叩的空气相对少,所产生的共振力相对小,不能起到充分叩拍肺部及呼吸道,使痰液松动,从而不利于痰液的排出,而影响到吸痰的效果,进而影响肺通气的质量,不利于改善呼吸及血氧饱和度,并且容易拍到肾区,一旦需要叩击胸背的新生儿多,操作者的手臂就会酸痛,感觉很吃力,叩击的效果也不佳。且传统叩背排痰频率难以控制,力量不均匀、不持久,并且护士自我感觉劳动强度大,甚至导致职业性腰肩痛、腰椎间盘突出等,给护理人员带来沉重压力。面罩叩背法因面罩罩口较小,周围平整,虽克服了传统用手叩背法的缺陷,缩小了叩击部位,整个面罩同时着落,使叩击更彻底、有效,使附着在支气管壁及肺泡周围的痰液松动脱落,但该方法仍依靠护士手臂力量,长期使用仍存在频率难以控制,力量不均匀、不持久的缺陷。

[0003] 第二,机械振排痰法,包括体外振动排痰机、按摩器等。应用胸部物理治疗原理,通过机械振动代替传统人工胸部叩击、震颤、定向挤推等手法以促进排痰的方法。方法是通过机械振动排痰机的叩击头在病人身体表面进行垂直方向叩击和震颤,以及水平方向的震颤、定向推挤,达到帮助气道分泌物松解,促进排出的治疗目的。每次治疗时间为10~15分钟。日前体外振动排痰机已在国内的大中型医院使用,如G2000型排痰机、海豚按摩器。

[0004] 上述两种方法较胸部叩击法有了较大的改进,对患者背部进行按摩,有振动、加热

等功能,可用于全身各个部位。但是仍存在以下不足:(1)现有技术的排痰仪器未根据患儿的日龄、体重、疾病特点设计相应的叩击振幅、频率和力度。如淄博芙莱特医疗设备有限公司生产的振动排痰机,在用于新生儿时仅设计了单一的新生儿固定模式,使用时接上叩击接合器,护士一手扶稳患儿身体,另一手持叩击头手柄直接叩击背部不同部位。但不同病症、日数和体重的新生儿对于叩击力度的要求不同,单一设计已不能满足患儿的需求。(2)现有的体外震荡排痰机多为大中型仪器规格,比较笨重,需应用火电启动才能使用,且价格昂贵。因此,设计一种能够根据患儿日龄、体重、疾病特点改变叩击振幅、频率和力度的新生儿叩背器,是目前需要解决的技术问题。

发明内容

[0005] 本发明所要解决的技术问题是提供一种能够根据患儿日龄、体重、疾病特点改变叩击振幅、频率和力度的新生儿叩背器。

[0006] 本发明解决其技术问题的技术方案是:

新生儿叩背器,包括壳体,壳体为L型壳体,在壳体的手持部内设有电池和电机,在壳体的手持部的腔壁上设有电源开关,电机和电池通过电源开关连接成可控闭合电路,在壳体的振子部内安装有仿人工叩背振子,在电机的电机轴上设有振动源,仿人工叩背振子与振动源振动连接,在仿人工叩背振子上设有可拆卸可更换叩头。

[0007] 作为本发明的一种优选方案,所述的仿人工叩背振子由十字形活塞、平衡弹簧I和平衡弹簧II构成,十字形活塞的中部最大直径略小于壳体的振子部的内径,在壳体的振子部的中部有内凸缘,十字形活塞的左段的直径略小于内凸缘的内径,在壳体的振子部的端部有透盖,十字形活塞的左段的直径略小于透盖内径,十字形活塞的左端向左伸出透盖外,十字形活塞的右端向右伸出内凸缘外,平衡弹簧I套装在十字形活塞的左段上,平衡弹簧I的左端与透盖接触,平衡弹簧I的右端与十字形活塞的中部左端面接触,平衡弹簧II套装在十字形活塞的右段上,平衡弹簧II的左端与十字形活塞的中部右端面接触,平衡弹簧II的右端与内凸缘的左端面接触,所述的振动源为凸轮,自由状态下,十字形活塞的右端面距电机轴的中心线的距离小于凸轮最远端距电机轴的中心线的距离,凸轮最远端距电机轴的中心线的距离与自由状态下十字形活塞的右端面距电机轴的中心线的距离之差为振幅,电机的转速即为振动频率。当开启电源开关,电机带动凸轮旋转,凸轮带动十字形活塞做伸缩运动,模仿人工叩背动作。

[0008] 作为本发明的一种优选方案,在十字形活塞的右端部嵌装有用于调整振幅的电磁伸缩装置I,在壳体的手持部的腔壁上设有调幅开关,电源开关充当小振幅调幅开关。

[0009] 作为本发明的一种优选方案,在凸轮的远端部嵌装有用于调整振幅的电磁伸缩装置II,电磁伸缩装置II的伸出量大于电磁伸缩装置I的伸出量,所述的调幅开关为4个,4个调幅开关按振动幅度的大小分为四个档,其中4档振幅最大、3档次之、2档再次之、1档振幅最小,振幅最小的1档即电源开关,电磁伸缩装置I伸出时对应2档,当电磁伸缩装置II伸出时对应3档,当电磁伸缩装置I和电磁伸缩装置II均为伸出回状态时对应振幅最大的4档;电机的电机轴为空心轴,在电机轴上设有导电滑环,为电磁伸缩装置II供电的电线通过空心轴和导电滑环与电源连接。

[0010] 作为本发明的一种优选方案,所述的电机为直流调频电机,在壳体内设有调频模

块,在壳体手持部的腔壁上设有调频开关。

[0011] 作为本发明的一种优选方案,在十字形活塞的左端部有螺纹盲孔,叩头上有螺纹盲孔匹配的连接用螺纹杆,叩头的螺纹杆旋装在螺纹盲孔内,所述的叩头根据直径的大小配备有若干个,根据新生儿的日龄更换大小合适的叩头。

[0012] 作为本发明的一种优选方案,所述的电池为可充电电池,在壳体的下端内部设有充电单元,充电单元的输出端与可充电电池连接,充电单元的输入端连接有插头。

[0013] 作为本发明的一种优选方案,所述的电池为可充电电池,在壳体的下端内部设有充电单元,充电单元的输出端与可充电电池连接,在壳体的下端内部设有充电感应线圈Ⅰ和感应磁铁,还包括充电器,在充电器内设有充电感应线圈Ⅱ,在充电器的壳体上设有供电插座,充电器的凹槽与壳体手持部匹配,壳体手持部插进充电器的凹槽内并将充电器的供电插座与市电连接即可充电。

[0014] 作为本发明的一种优选方案,在壳体腔壁上嵌装有显示器,在壳体腔内设有振幅感应器,在电机的电机轴上设有频率感应器,振幅感应器、频率感应器和显示器均与电池电连接,振幅感应器和频率感应器与显示器信号连接,振幅感应器、频率感应器、显示器和电池构成显示电路。

[0015] 与现有技术相比,本发明能够根据患儿的出生体重、日龄、疾病特点,选择不同的叩背振幅、节律,使用简便,不单一依赖火电启动,对新生儿康复、并发症的预防起到至关重要的作用,缩短了患儿住院日,节约了卫生资源和社会资源,减轻了患儿的家庭负担。同时,节约了护理工作量,提高了工作效率。

附图说明

[0016] 图1为本发明的结构示意图(总装图-爆炸图);

图2为图1的局部剖视图(振子部);

图3为本发明的电路原理图。

具体实施方式

[0017] 如图所示,新生儿叩背器,包括壳体4,其特征在于,壳体4为L型壳体,在壳体4的手持部4-1内设有电池和电机9,在壳体4的手持部4-1的腔壁上设有电源开关6,电机9和电池通过电源开关6连接成可控闭合电路,在壳体4的振子部4-2内安装有仿人工叩背振子2,在电机8的电机轴上设有振动源9-1,仿人工叩背振子2与振动源9-1振动连接,在仿人工叩背振子2上设有可拆卸可更换叩头1。

[0018] 所述的仿人工叩背振子2由十字形活塞2-1、平衡弹簧Ⅰ2-2和平衡弹簧Ⅱ2-3构成,十字形活塞2-1的中部最大直径略小于壳体4的振子部4-2的内径,在壳体4的振子部4-2的中部有内凸缘4-0,十字形活塞2-1的左段的直径略小于内凸缘4-0的内径,在壳体4的振子部4-2的端部有透盖3,十字形活塞2-1的左段的直径略小于透盖3内径,十字形活塞2-1的左端向左伸出透盖3外,十字形活塞2-1的右端向右伸出内凸缘4-0外,平衡弹簧Ⅰ2-2套装在十字形活塞2-1的左段上,平衡弹簧Ⅰ2-2的左端与透盖3接触,平衡弹簧Ⅰ2-2的右端与十字形活塞2-1的中部左端面接触,平衡弹簧Ⅱ2-3套装在十字形活塞2-1的右段上,平衡弹簧Ⅱ2-3的左端与十字形活塞2-1的中部右端面接触,平衡弹簧Ⅱ2-3的右端与内凸缘4-0的左端面

接触,所述的振动源9-1为凸轮,自由状态下,十字形活塞2-1的右端面距电机轴的中心线的距离小于凸轮最远端距电机轴的中心线的距离,凸轮最远端距电机轴的中心线的距离与自由状态下十字形活塞2-1的右端面距电机轴的中心线的距离之差为振幅,电机的转速即为振动频率。

[0019] 在十字形活塞2-1的右端部嵌装有用于调整振幅的电磁伸缩装置I2-4,在壳体4的手持部4-1的腔壁上设有调幅开关7,电源开关6充当小振幅调幅开关。

[0020] 在凸轮的远端部嵌装有用于调整振幅的电磁伸缩装置II 9-2,电磁伸缩装置II 9-2的伸出量大于电磁伸缩装置I2-4的伸出量,所述的调幅开关7为4个,4个调幅开关按振动幅度的大小分为四个档,其中4档振幅最大、3当次之、2档再次之、1档振幅最小,振幅最小的1档即电源开关6,电磁伸缩装置I2-4伸出时对应2档,当电磁伸缩装置II 9-2伸出时对应3档,当电磁伸缩装置I2-4和电磁伸缩装置II 9-2均为伸出同状态时对应振幅最大的4档;电机9的电机轴为空心轴,在电机轴上设有导电滑环,为电磁伸缩装置II 9-2供电的电线通过空心轴和导电滑环与电源连接。

[0021] 所述的电机9为直流调频电机,在壳体4内设有调频模块,在壳体4的手持部4-1的腔壁上设有调频开关10。

[0022] 在十字形活塞2-1的左端部有螺纹盲孔,叩头1上有螺纹盲孔匹配的连接用螺纹杆,叩头1的螺纹杆旋装在螺纹盲孔内,所述的叩头1根据直径的大小配备有若干个,根据新生儿的日龄更换大小合适的叩头1。

[0023] 所述的电池为可充电电池,在壳体4的下端内部设有充电单元,充电单元的输出端与可充电电池连接,充电单元的输入端连接有插头。

[0024] 所述的电池为可充电电池,在壳体4的下端内部设有充电单元,充电单元的输出端与可充电电池连接,在壳体4的下端内部设有充电感应线圈I和感应磁铁,还包括充电器8,在充电器8内设有充电感应线圈II,在充电器8的壳体上设有供电插座,充电器8的凹槽与壳体4的手持部4-1匹配,壳体4的手持部4-1插进充电器8的凹槽内并将充电器8的供电插座与市电连接即可充电。

[0025] 在壳体4腔壁上嵌装有显示器5,在壳体4腔内设有振幅感应器,在电机9的电机轴上设有频率感应器,振幅感应器、频率感应器和显示器5均与电池电连接,振幅感应器和频率感应器与显示器5信号连接,振幅感应器、频率感应器、显示器5和电池构成显示电路。

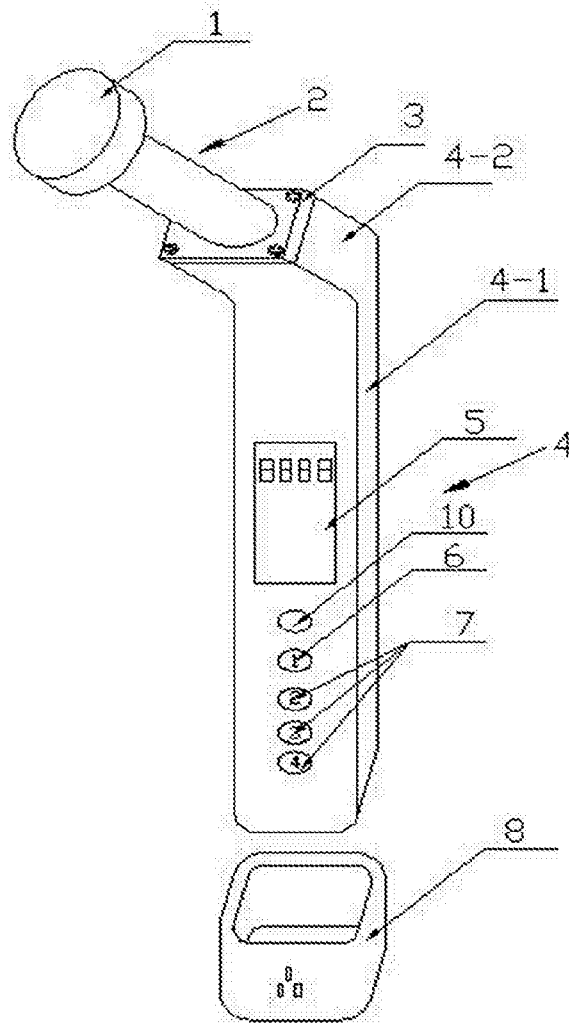


图1

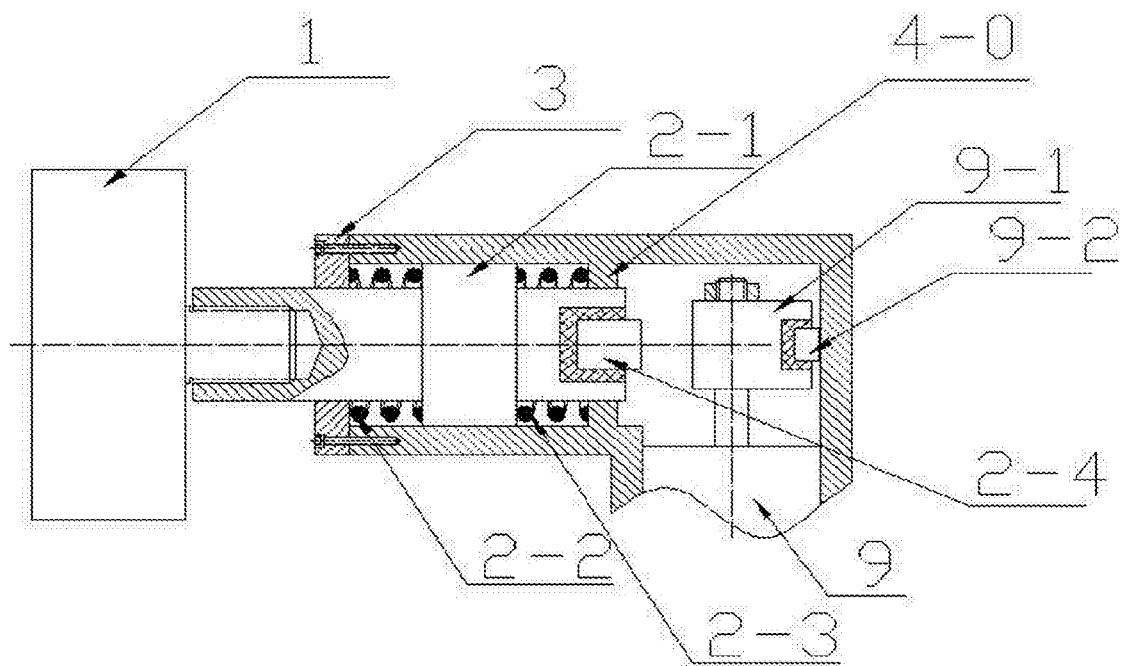


图2

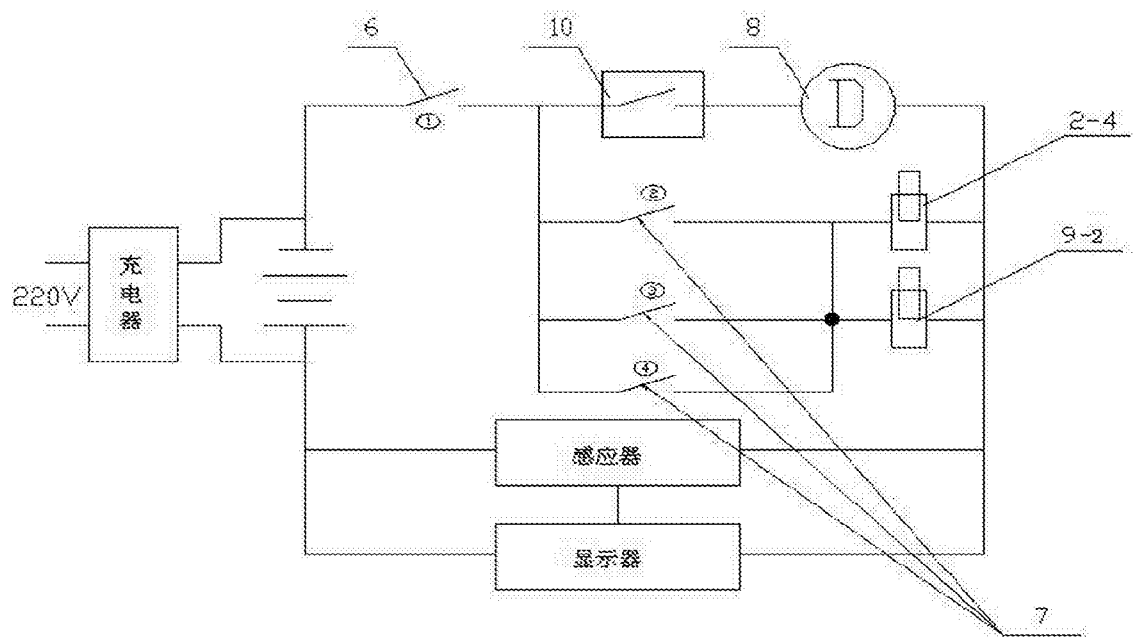


图3

List of publications



Application number 2016C.
CN206333979 U Regi...

Publication date
2017-07-18



Abstract

The utility model provides a wireless electric toothbrush, it includes electric brush head and brush holder, the wireless power receiving module who is equipped with control circuit, battery in the brush holder and is connected with the battery electricity, electric toothbrush is still including the built -in toothbrush base who has wireless power sending module, electric toothbrush still establishes the toothbrush lid in the first periphery of electric brush including the cover, the brush hair desicator sets up at the toothbrush lid just to the position of brush hair, the brush holder is provided with the speed governing key of being connected with control circuit electricity that is used for controlling toothbrush vibration frequency, still is provided with a plurality of LED pilot lamp on the brush holder. The utility model discloses compact structure is practical, and sanitary safety is durable comfortable, and its adopts the wireless power supply technique, the inconvenience of having avoided the wired power supply of traditional electric toothbrush to bring, and it is more convenient to use, and design such as adopt that the brush hair is dried and is prevented dust can keep brush hair clean and dry, has improved the durability of toothbrush, the utility model discloses controlling, instructing and place the improvement of structure, make its operation more humanized, it is more convenient comfortable to use.

English Abstract (Native or MT)

The utility model provides a wireless electric toothbrush, it includes electric brush head and brush holder, the wireless power receiving module who is equipped with control circuit, battery in the brush holder and is connected with the battery electricity, electric toothbrush is still including the built -in toothbrush base who has wireless power sending module, electric toothbrush still establishes the toothbrush lid in the first periphery of electric brush including the cover, the brush hair desicator sets up at the toothbrush lid just to the position of brush hair, the brush holder is provided with the speed governing key of being connected with control circuit electricity that is used for controlling toothbrush vibration frequency, still is provided with a plurality of LED pilot lamp on the brush holder. The utility model discloses compact structure is practical, and sanitary safety is durable comfortable, and its adopts the wireless power supply technique, the inconvenience of having avoided the wired power supply of traditional electric toothbrush to bring, and it is more convenient to use, and design such as adopt that the brush hair is dried and is prevented dust can keep brush hair clean and dry, has improved the durability of toothbrush, the utility model discloses controlling, instructing and place the improvement of structure, make its operation more humanized, it is more convenient comfortable to use.

Other Abstracts

种无线电动牙刷，它包括电动刷头和刷柄，所述刷柄内设有控制电路、电池以及与电池电连接的无线电能接收模块，所述电动牙刷还包括内置有无线电能发送模块的牙刷底座；所述电动牙刷还包括套设在电动刷头外周的牙刷盒盖，所述刷毛干燥器设置在牙刷盒盖正对刷毛的部位；刷柄设置有与控制电路电连接的用于控制牙刷振动频率的调速键，刷柄上还设置有若干个LED指示灯。本实用新型结构紧凑实用，卫生安全，耐用舒适，它采用无线供电技术，避免了传统电动牙刷有线供电带来的不便，使用更加便捷，采用刷毛烘干以及防尘等设计，能够保持刷毛清洁干燥，提高了牙刷的耐用性，本实用新型控制、指示以及放置结构的改进，使其操作更加人性化，使用更方便舒适。

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Application Numbers & Dates	CN201620918918U 2016-08-22 [2016CN-U918918]
Priority Numbers & Dates	CN201620918918U 2016-08-22 [2016CN-U918918]
Technology domain	Medical technology
IPC codes	A61C-017/34*
Notes	Number of Claims: 6 Number of Pages: 5 Gazette number: 33-2901 Gazette date: 2017-07-18

Claims

1. A wireless power toothbrush, comprising an electric head (1) and handle (2), characterized in, is provided with a control circuit within the (2) handle, and is electrically connected to the battery of the battery module (201), capable of receiving radio electric toothbrush further includes toothbrush of the base (3). sending module (301) incorporating a wireless electrical energy
2. A wireless electric toothbrush according to claim 1, characterized in, electric toothbrush also includes bristles. dryer (5)
3. A wireless electric toothbrush according to claim 2, characterized in, electric toothbrush also includes a coil, the outer periphery of the brush (1) head provided in the electric toothbrush box cover (4) disposed on the brush bristles of the toothbrush bristles dryer (5) box cover (4) the positive region.
4. A wireless electric toothbrush according to claim 3, characterized in, is provided with a control circuit electrically connected to the (2) handle for controlling the vibration frequency of the toothbrush. bond (6) the governor
5. A wireless electric toothbrush according to claim 4, characterized in, several LED indicator (7) lights, the brush holder (2) is also provided with LED indicator (7) lamp includes at least a low-speed indicator light vibrating

toothbrush, and indicator lights at a high speed vibration brush charging indicator light.

6. Claim 1-5 as claimed in any wireless electric toothbrush, characterized in, card handle handle (2) of the toothbrush base (3) is provided with a slot for.

Original Claims

1.一种无线电动牙刷，它包括电动刷头(1)和刷柄(2)，其特征在于，所述刷柄(2)内设 有控制电路、电池以及与电池电连接的无线电能接收模块(201)，所述电动牙刷还包括内置 有无线电能发送模块(301)的牙刷底座(3)。

2.如权利要求1所述的无线电动牙刷，其特征在于，所述电动牙刷还包括刷毛干燥器 (5)。

3.如权利要求2所述的无线电动牙刷，其特征在于，所述电动牙刷还包括套设在电动刷 头(1)外周的牙刷盒盖(4)，所述刷毛干燥器(5)设置在牙刷盒盖(4)正对刷毛的部位。

4.如权利要求3所述的无线电动牙刷，其特征在于，所述刷柄(2)设置有与控制电路电 连接的用于控制牙刷振动频率的调速键(6)。

5.如权利要求4所述的无线电动牙刷，其特征在于，所述刷柄(2)上还设置有若干个LED 指示灯(7)，所述LED指示灯(7)至少包括牙刷振动低速指示灯、牙刷振动高速指示灯以及充 电指示灯。

6.如权利要求1-5中任意一项所述的无线电动牙刷，其特征在于，所述牙刷底座 (3)上 设有用于卡接刷柄(2)的卡槽。

Description

Wireless electric toothbrush

Technical Field

The present utility model relates to a toothbrush, in particular to a wireless electric toothbrushes.

Background Art

An electric toothbrush through rapid rotation of the motor core or vibration, high-frequency vibrations of the brush head creation, instant the toothpaste is broken down into a fine foam, deep-cleaning between teeth; at the same time, vibration of the bristles capable of promoting blood circulation of the oral cavity, an unexpected massage effect to the gingival tissue; electric toothbrush as compared to an ordinary toothbrush, more effective science, it allows for more thorough removal of plaque, reduced gingivitis, periodontal disease and oral diseases such as gum bleeding, an electric toothbrush in its convenient comfortable use experience continues to be popular.

The present electric toothbrush type and a function more, wherein more advanced such as Chinese patents disclosed ZL201080012694.0 electric toothbrush, electric toothbrush of the current is produced by a wired power supply or battery power supply can be replaced, if the electrical energy depletion, line charging or replacement of the battery to be connected, it is inconvenient for use, the comfort of the affect the operation thereof; since after use of the toothbrush, the bristles tend to be more moist, dirt and

bacterial growth is likely to a non-stick, so as to affect the service life of the toothbrush.

Utility model content

Is an object of the present utility model is to provide a wireless electric toothbrushes, it has a compact structure, is convenient to use and sanitary advantage of durability.

The present utility model are achieved in, one wireless electric toothbrushes, comprising an electric toothbrush head and handle, characterized in, handle is provided with a control circuit, electrically connected to the battery and battery with wireless power receiving module, the electric toothbrush further comprises a built-in with a radio capable of transmitting module of the toothbrush base.

The electric toothbrush further comprises bristles dryer. The electric toothbrush also includes a coil provided in the electric toothbrush box cover the outer circumference of the head, the bristles of the toothbrush bristle portion of the box cover facing the dryer is provided.

The handle is provided with a control circuit is electrically connected to control the speed key the frequency of vibration of the toothbrush.

A number of LED indicator lights are also provided on the handle, the indicator light LED at least includes the brush vibration low-speed indicator light, indicator light and a high-speed vibration brush charging indicator light.

It is preferred that: the base is provided with a slot for card handle handle of the toothbrush.

The present utility model has the advantages of: the present utility model structure compact utility, sanitary and safe, durable and comfortable, it uses the wireless power supply technique, to avoid the inconvenience of the conventional electric toothbrush wired power supply, more convenient to use, with the bristles dry and dust and the like design, it is possible to maintain the bristles clean dry, improves the durability of the toothbrush, the present utility model control, indicates an improved structure and placed, so that handling is more humanized, using a more convenient and comfortable.

Description of Drawings

FIG. 1 a schematic diagram of the structure of the present utility model one embodiment.

In the figure, 1, electric brush head 2, the handle 3, base 4 of the toothbrush, the toothbrush box cover 5, 6 bristles dryer, the governor key 7, LED indicator lights.

Embodiment

A specific embodiment of the present utility model in the description which will be further described.

As shown in FIG. 1, the present utility model are achieved in this way, a wireless electric toothbrush includes an electric brush head 1 and handle 2, which is characterized structure, the handle 2 is provided with a control

circuit, electrically connected to the battery and battery with wireless power receiving module 201, the electric toothbrush further comprises a built-in with a radio capable of transmitting module 301 of the toothbrush base 3; the present utility model overcomes the conventional wired power supply to the electric toothbrush using the defect, through a wireless power supply problem that the conventional electric toothbrush charging and inconvenient to use, it can be transmitted by radio with a wireless power receiving module 201 301 of radio energy delivery modules, as battery charging, and the wireless power transmission module 301 is integrated into the toothbrush in the base 3, convenient and safe charging can be the-box and put.

In order to improve safety and enhance the service life of the toothbrush sanitation, the electric toothbrush further comprises bristles dryer 5; in a specific implementation, the electric toothbrush also includes a coil provided in the electric toothbrush brush head box cover 4 of the outer periphery 1, the bristles of the toothbrush bristles 4 facing the dryer box cover 5 is disposed a site; by the brushes dryer after the bristles of the brush 5 is able to wet to be dried in a timely manner, to avoid stains and bacterial growth, and the drying of the bristles also increases the ease of use; bristles dryer heating wire or the like may be used 5 electric heating or electric heating device, when installed, it could be integrated to the toothbrush in the box cover 4, the drying of the bristles is achieved on the one hand, may also be provided in the electric toothbrush 1 the brush box cover 4 set through the outer periphery, has a good dust-proof effect.

In order to improve convenience of use, the present utility model in a specific implementation, the handle 2 is provided with a control circuit for controlling the frequency of vibration of the toothbrush is electrically connected to the governor key 6; the handle 2 is also provided with a number of LED indicator lights 7, LED indicator light indicating lamp 7 at least including a toothbrush vibration at a low speed, high-speed vibration brush and charging indicator light indicating lamp; with the governor key 6 and indicator lights, visual operation of the electric toothbrush can be conveniently achieved; for easier placement operation, the brush base 3 is provided in the slot of the card handle handle 2, this ensures that the toothbrush is held upright seating, easy to take out.



(12)实用新型专利

(10)授权公告号 CN 206333979 U

(45)授权公告日 2017.07.18

(21)申请号 201620918918.9

(22)申请日 2016.08.22

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(51)Int. Cl.

A61C 17/34(2006.01)

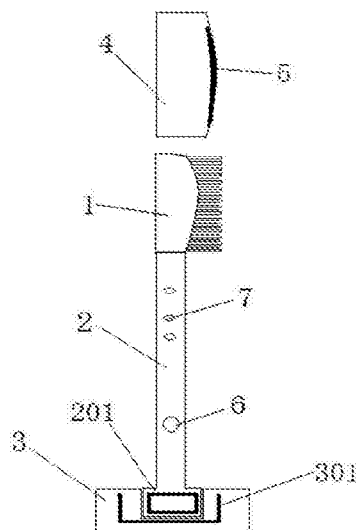
权利要求书1页 说明书2页 附图1页

(54)实用新型名称

一种无线电动牙刷

(57)摘要

一种无线电动牙刷,它包括电动刷头和刷柄,所述刷柄内设有控制电路、电池以及与电池电连接的无线电能接收模块,所述电动牙刷还包括内置有无线电能发送模块的牙刷底座;所述电动牙刷还包括套设在电动刷头外周的牙刷盒盖,所述刷毛干燥器设置在牙刷盒盖正对刷毛的部位;刷柄设置有与控制电路电连接的用于控制牙刷振动频率的调速键,刷柄上还设置有若干个LED指示灯。本实用新型结构紧凑实用,卫生安全,耐用舒适,它采用无线供电技术,避免了传统电动牙刷有线供电带来的不便,使用更加便捷,采用刷毛烘干以及防尘等设计,能够保持刷毛清洁干燥,提高了牙刷的耐用性,本实用新型控制、指示以及放置结构的改进,使其操作更加人性化,使用更方便舒适。



CN 206333979

MassagerPriorArt0000213

1. 一种无线电动牙刷, 它包括电动刷头(1)和刷柄(2), 其特征在于, 所述刷柄(2)内设有控制电路、电池以及与电池电连接的无线电能接收模块(201), 所述电动牙刷还包括内置有无线电能发送模块(301)的牙刷底座(3)。

2. 如权利要求1所述的无线电动牙刷, 其特征在于, 所述电动牙刷还包括刷毛干燥器(5)。

3. 如权利要求2所述的无线电动牙刷, 其特征在于, 所述电动牙刷还包括套设在电动刷头(1)外周的牙刷盒盖(4), 所述刷毛干燥器(5)设置在牙刷盒盖(4)正对刷毛的部位。

4. 如权利要求3所述的无线电动牙刷, 其特征在于, 所述刷柄(2)设置有与控制电路电连接的用于控制牙刷振动频率的调速键(6)。

5. 如权利要求4所述的无线电动牙刷, 其特征在于, 所述刷柄(2)上还设置有若干个LED指示灯(7), 所述LED指示灯(7)至少包括牙刷振动低速指示灯、牙刷振动高速指示灯以及充电指示灯。

6. 如权利要求1-5中任意一项所述的无线电动牙刷, 其特征在于, 所述牙刷底座(3)上设有用于卡接刷柄(2)的卡槽。

一种无线电动牙刷

技术领域

[0001] 本实用新型涉及牙刷,尤其涉及一种无线电动牙刷。

背景技术

[0002] 电动牙刷通过电动机芯的快速旋转或震动,使刷头产生高频震动,瞬间将牙膏分解成细微泡沫,深入清洁牙缝;与此同时,刷毛的颤动能促进口腔的血液循环,对牙龈组织有意想不到的按摩效果;电动牙刷与普通牙刷相比,更为科学有效,它可以更彻底清除牙菌斑、减少牙龈炎、牙周病和牙龈出血等口腔疾病,电动牙刷以其便利舒适的使用体验不断得到普及。

[0003] 目前的电动牙刷种类和功能较多,其中较为先进的如中国专利ZL201080012694.0公开的电动牙刷,当前的电动牙刷大多采用有线供电或可更换电池供电,若电能枯竭,需要连接线路充电或更换电池,使用并不方便,影响其操作的舒适性;由于牙刷使用后,刷毛往往较为湿润,极易粘黏污渍和滋生细菌,进而影响牙刷的使用寿命。

实用新型内容

[0004] 本实用新型的目的是提供一种无线电动牙刷,它具有结构紧凑,使用方便和卫生耐用的优点。

[0005] 本实用新型是这样来实现的,一种无线电动牙刷,它包括电动刷头和刷柄,其特征在于,所述刷柄内设有控制电路、电池以及与电池电连接的无线电能接收模块,所述电动牙刷还包括内置有无线电能发送模块的牙刷底座。

[0006] 所述电动牙刷还包括刷毛干燥器。所述电动牙刷还包括套设在电动刷头外周的牙刷盒盖,所述刷毛干燥器设置在牙刷盒盖正对刷毛的部位。

[0007] 所述刷柄设置有与控制电路电连接的用于控制牙刷振动频率的调速键。

[0008] 所述刷柄上还设置有若干个LED指示灯,所述LED指示灯至少包括牙刷振动低速指示灯、牙刷振动高速指示灯以及充电指示灯。

[0009] 优选的是:所述牙刷底座上设有用于卡接刷柄的卡槽。

[0010] 本实用新型的有益效果为:本实用新型结构紧凑实用,卫生安全,耐用舒适,它采用无线供电技术,避免了传统电动牙刷有线供电带来的不便,使用更加便捷,采用刷毛烘干以及防尘等设计,能够保持刷毛清洁干燥,提高了牙刷的耐用性,本实用新型控制、指示以及放置结构的改进,使其操作更加人性化,使用更方便舒适。

附图说明

[0011] 图1为本实用新型一个实施例的结构示意图。

[0012] 在图中,1、电动刷头 2、刷柄 3、牙刷底座 4、牙刷盒盖 5、刷毛干燥器 6、调速键 7、LED指示灯。

具体实施方式

[0013] 下面结合附图对本实用新型的具体实施方式作进一步说明。

[0014] 如图1所示,本实用新型是这样来实现的,所述无线电动牙刷包括电动刷头1和刷柄2,其结构特点是,所述刷柄2内设有控制电路、电池以及与电池电连接的无线电能接收模块201,所述电动牙刷还包括内置有无线电能发送模块301的牙刷底座3;本实用新型克服了传统有线电源的电动牙刷使用缺陷,通过无线供电解决了传统电动牙刷充电和使用不便的问题,它利用无线电能接收模块201与无线电能发送模块301进行无线电能传送,为电池充电,且将无线电能发送模块301集成到牙刷底座3中,可以随取随放且充电方便安全。

[0015] 为了提高卫生安全性和提高牙刷的使用寿命,所述电动牙刷还包括刷毛干燥器5;在具体实施时,所述电动牙刷还包括套设在电动刷头1外周的牙刷盒盖4,所述刷毛干燥器5设置在牙刷盒盖4正对刷毛的部位;利用刷毛干燥器5能够对刷牙后的潮湿刷毛及时进行干燥,避免污渍和细菌滋生,且干燥的刷毛也提高了使用的舒适性;所述刷毛干燥器5可采用电热片或电热丝等电热器件,在安装时,可将其集成到牙刷盒盖4中,这样一方面实现了刷毛的干燥,还可通过牙刷盒盖4套设在电动刷头1外周,具有很好的防尘效果。

[0016] 为了提高使用的便利性,本实用新型在具体实施时,所述刷柄2设置有与控制电路电连接的用于控制牙刷振动频率的调速键6;所述刷柄2上还设置有若干个LED指示灯7,所述LED指示灯7至少包括牙刷振动低速指示灯、牙刷振动高速指示灯以及充电指示灯;利用调速键6以及指示灯,可方便地实现电动牙刷的可视化操作;为了便于安放操作,所述牙刷底座3上设有用于卡接刷柄2的卡槽,这样可保证牙刷保持直立安放,便于拿放。

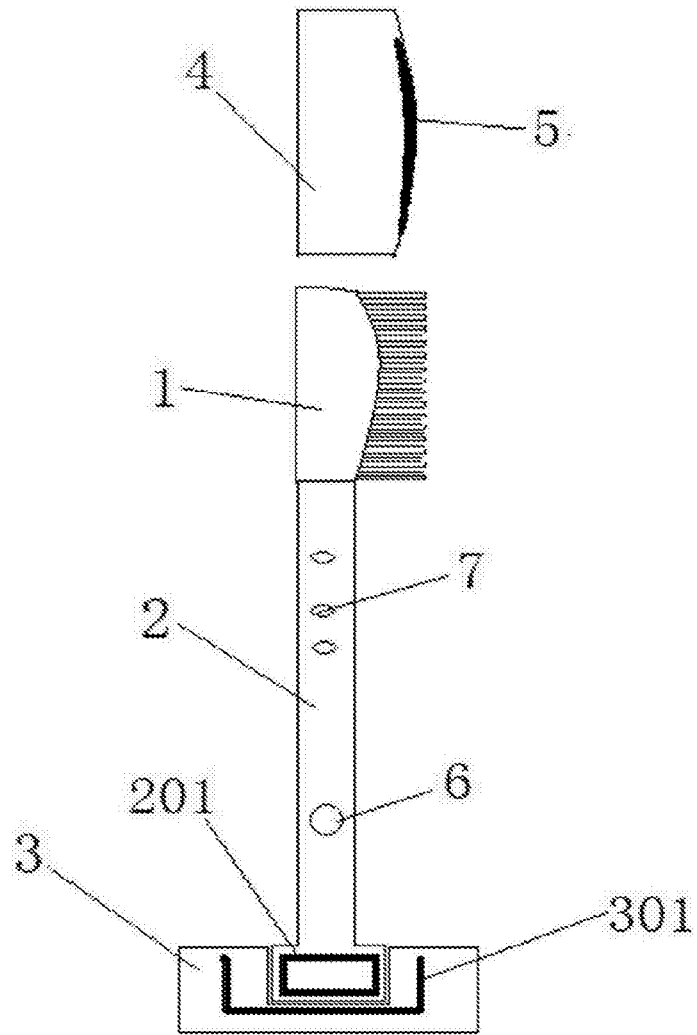


图1

Eye massage device capable of securing visibility

List of publications



Application number 2012K...
KR101315314 B1 Pat...

Publication date
2013-10-14



Abstract

PURPOSE: An eye massage device is provided to reduce the accumulation of fatigue due to the use of arms.

CONSTITUTION: An eye massage device comprises a case (120) in which a switch (124) is installed, a probe which is installed on the front of the case and delivers vibration generated from a vibrator, and a massage unit (140) which connects to the probe, contacts the skin of the pupils, and vibrates the skin. The massage unit includes a contact block (142) which forms a cyclic rim (141) and is formed with a through-hole (143) in the center thereof, a cap (144) which is integrated with the contact block and is detachable from a probe, and an acupressure protrusion (146) which is formed along the circumference of the contact block.

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English Abstract (Native or MT)

PURPOSE: An eye massage device is provided to reduce the accumulation of fatigue due to the use of arms.

CONSTITUTION: An eye massage device comprises a case (120) in which a switch (124) is installed, a probe which is installed on the front of the case and delivers vibration generated from a vibrator, and a massage unit (140) which connects to the probe, contacts the skin of the pupils, and vibrates the skin. The massage unit includes a contact block (142) which forms a cyclic rim (141) and is formed with a through-hole (143) in the center thereof, a cap (144) which is integrated with the contact block and is detachable from a probe, and an acupressure protrusion (146) which is formed along the circumference of the contact block.

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Other Abstracts

본 발명은 눈 마사지기에 관한 것으로, 진동을 발생시키는 바이브레이터와, 상기 바이브레이터와 함께 바이브레이터의 작동을 제어하는 스위치가 설치되는 케이스와, 상기 바이브레이터에서 발생하는 진동이 전달되는 케이스의 선단에 구비되는 프로브 및 상기 프로브와 연결되며 눈동자 주위의 피부와 접촉하여 피부를 진동시키는 마사지부로 이루어진 마사지기에 있어서, 상기 마사지부는 환형의 테를 이루며 그 중심에 통공이 형성된 접촉 블록과, 상기 접촉 블록과 일체로 형성되며 프로브와 탈착되는 캡 및 상기 접촉 블록의 둘레를 따라 형성되는 지압 돌기를 포함하는 것을 특징으로 하는 눈 마사지기가 개시된다. 이에 따라, 휴대가 간편하여 사무실에서 업무 중 또는 차량의 운전 중과 같은 틈새 시간에 눈 주위의 피부를 마사지할 수 있을 뿐만 아니라 마사지 중에도 접촉 블록에 형성된 통공을 통해 사용자 전방의 시야를 확보할 수 있어 안전사고의 발생을 미연에 발생할 수 있다.

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Application Numbers & Dates KR20120063276 2012-06-13 [2012KR-0063276]

Priority Numbers & Dates KR20120063276 2012-06-13 [2012KR-0063276]

Technology domain Medical technology

IPC codes A61H-023/02* A61F-009/00 A61H-005/00A61H-039/04

CPC codes A61F-009/00 A61H-005/00 A61H-023/02/54*A61H-039/04 A61H-2201/0153 A61H-2201/1215A61H-2205/024

Notes Number of Claims: 7
Number of Pages: 13

Cited Search Report [Examiner]

Patents -KR0127999 (Y1) [KR200127999U] HYUN SUNG YUN; -KR200427986 (Y1) [KR200427986U]; -JPH07194666 (A) [JP07194666] DAISEE KOGYO KK; -JPH0644538
Examiner citations
-KR200127999 (Y1) [KR200127999U]; -KR200427986 (Y1) [KR200427986U]; -JP07194666 (A) [JP7194666]; -JP06044538 (U) [JP6044538]; Unspecified source
-KR200127999 (Y1)

MassagerPriorArt0000170

Claims

1. Generating a vibration with a vibrator (110), the vibrator (110) together with a switch to control (124) the operation of the vibrator (110) is installed in the casing (120), the vibration occurring at the vibrator (110) is delivered at the end of a casing (120) of the probe (130) and the probe (130) is connected to the contact with the skin and the skin around the pupil vibrating section (140) consisting of the massage machine massage, the massage unit (140) is, for making annular rim of (141) the center of the aperture (143) is formed; contact block (142) is integrally formed with the contact block (142) and detachment of the probe (130) and cap (144); and the contact block (142) is formed along a circumference of the acupressure protrusions (146); characterized in that it comprises an eye massager.
2. Method according to claim 1, wherein the contact block shows its cross section of a circular shape such (141) as to massage the eye.
3. Method according to claim 1, wherein the aperture (143) is formed on both sides of the contact block (142) length is greater than the length of an elliptical shape vertically and massage eye.
4. Method according to claim 1, wherein the contact block (142) is from the axis of the (120) case is formed obliquely to the eye massager.
5. Claim 1 apparatus according to any one of the method according to claim 4, wherein the contact block (142) is made of soft and consisting of an eye massager.
6. Method according to claim 1, wherein the (144) cap is in the shape of the HORN to massage the eye.
7. Method according to claim 1, wherein the acupressure protrusions (146) is, of the perforations (143) located in upper elliptical protrudes in the form of such (141) as to massage the eye.

Original Claims

1. 진동을 발생시키는 바이브레이터(110)와, 상기 바이브레이터(110)와 함께 바이브레이터(110)의 작동을 제어하는 스위치(124)가 설치되는 케이스(120)와, 상기 바이브레이터(110)에서 발생하는 진동이 전달되는 케이스(120)의 선단에 구비되는 프로브(130) 및 상기 프로브(130)와 연결되며 눈동자 주위의 피부와 접촉하여 피부를 진동시키는 마사지부(140)로 이루어진 마사지기에 있어서, 상기 마사지부(140)는, 환형의 테(141)를 이루며 그 중심에 통공(143)이 형성된 접촉 블록(142); 상기 접촉 블록(142)과 일체로 형성되며 프로브(130)와 탈착되는 캡(144); 및 상기 접촉 블록(142)의 둘레를 따라 형성되는 지압 돌기(146);를 포함하는 것을 특징으로 하는 눈 마사지기.
2. 청구항 1 에 있어서, 상기 접촉 블록의 테(141)는 그 단면이 원형인 것을 특징으로 하는 눈 마사지기.
3. 청구항 1에 있어서, 상기 접촉 블록(142)에 형성된 통공(143)은 양측의 길이가 상하의 길이보다 긴 타원형인 것을 특징으로 하는 눈 마사지기.
4. 청구항 1에 있어서, 상기 접촉 블록(142)은 상기 케이스(120)의 축선으로부터 경사지게 형성되는 것을 특징으로 하는 눈 마사지기.
5. 청구항 1 내지 청구항 4 중 어느 한 항에 있어서, 상기 접촉 블록(142)은 연질의 재질로 이루어진 것을 특징으로 하는 눈 마사지기.
6. 청구항 1에 있어서, 상기 캡(144)은 혼(HORN)의 형상을 갖는 것을 특징으로 하는 눈 마사지기.
7. 청구항 1에 있어서, 상기 지압 돌기(146)는, 상기 통공(143)의 상하에 위치하는 테(141)에 타원형의 형태로 돌출 형성되는 것을 특징으로 하는 눈 마사지기.

Description

TECHNICAL FIELD

[0001] The present invention relates generally relates to an eye massager, and more particularly to a vibration is not transmitted to the pupil directly to the skin around the eyes to a fine tremor stimulation by massage, the skin around the eyes with respect to the skin around the eyes to improve blood

circulation to help improve the health and visual acuity of the eye to the massage machine disclosed embodiment of the invention.

BACKGROUND ART

[0002] Generally the face in the skin around the eye has a small number of sebum secretion to lines and is liable to occur, without being exposed to elasticity to the movement of sagging is easily generated due to the reasons described below.

[0003] The reason why such a phenomenon occurs where the skin while excessive exposure of the keratinocytes to ultraviolet light from the thickening of the skin loses the feeling of transparency while at the same time as the metabolism of the skin is lowered moisture and nutrient supply because it does not smoothly made the present invention.

[0004] Thus, in order to solve this conventional various methods are used for the skin around the eye by the portable device and the management is performed. For example, the nutrition supply functional cosmetic were applied at the same time so that the user can maintain moisture on the skin of the cross balafilcon moisturizing agents and the like cycle.

[0005] In addition, a more efficient for skin care visit to a specialist beauty shop regular peeling that died removed horny skin function and metabolism is lowered due to activate the growth of a healthy skin and others.

[0006] The professional as above beauty shop by managing the skin using the depending on the healthy skin can be maintained while the, in skin care should be invested a large amount of time required for the skin because of an epoxy group to be managed young women due to include any combination of social life temporal margin to disregarding in skin care as well as to the number of outlets, the skin beauty shop according to the utilization of take up much management cost economically there is no available wtpm and beauty shop professional people using within the prohibitive skin management is that it was impossible.

[0007] Thus, professional eye directly without the aid of the second massage can be massaged has been developed. This prior art from the eye of the utility model registration "No. 20-0127999" acupressure massage machine the spigot for a possible embodiment of the invention. This will be described on the basis of 1 and Fig. 2 will be described below.

[0008] Fig. 1 is an exploded perspective view showing a massage machine of the prior art, Fig. 2 shows a conventional use of a massage machine shown in a state diagram for use. Will now be described with reference to the drawings, an oscillating weight (40) on top of the massage machine of the conventional case which (10) is installed in an eccentric motor mounted to (30) the lower surface of the cover (20) and is being attached and detached by accommodating the (11) dry battery by forming in an acupressure massage machine, the outer periphery of a circular acupressure rod (51) having a large number of the indentation (52) is formed at the center thereof and the (50) cap is rotated the naeseol further (40) connected to an upper part of the case (10) has a structure.

[0009] Such a conventional motor (30) of the massage machine supplying power to the eccentric to the rotation of the oscillating weight (40) by which the case (10) and to vibrate, wherein the such a vibration is communicated to the cap (50). In this way massage to the vibration of the cap (50) can be lightly on the eye when fitted over the outer surface of the cap (50) of the button allows the virus to contact the eye and the spigot acupressure rod (51) is located at a site, the center of the cap (50) of the indentation (52) is a pupil of the eye is wound is located massaging the spigot for the eye without the pain of the pupil of the apparatus according to the invention.

[0010] However, the massage machine of the prior art mentioned above as shown in Fig. 2 the user has a case (10) with one hand wrapped around the front side of the rat eye in a state where the cap (50) is oriented toward the massager is to be placed in the horizontal direction which causes inconvenience to be used because it to be used therein.

[0011] In other words, massage and to the front face of the eye to be cap (50) is positioned, wherein the (50) cap at the rear of the case (10) is located in the eye since a user's hand and the horizontal to be located on the much larger amount of the by the arm to be raised, arm muscle force caused by the use of a problem of fatigue is developed in the.

[0012] In addition, the conventional cap (50) of the massage machine of the indentation (52) formed in the periphery of the pattern formed by acupressure rod (51), at the time of the entire circumference of the pupils massage since

the acupressure rod (51) tightly around the pupil relative to the total of only a portion which cannot be any massage the problems which are discussed below.

[0013] Then, by using a conventional eye of the massage machine massage in the event that the indentation (52) of the cap (50) and is closed, case (10), and the like arm of a user since the user's vision obscuring an eye on the front of a user when the user massages the risk for the condition cannot be visually sensed safety problems which are discussed below.

SUMMARY OF INVENTION

TECH PROBLEM

[0014] The present invention relates to such as the days in order to solve the problems, the secretion of sebum is less effective to cause sagging of the skin around the eyes is the appearance or to a fine vibration stimulation for promoting blood circulation can be maintained in a resiliently into the skin of the clearance time is used to as well as by the user who can be massaged around the pupil of the eye to provide a massage machine object of the present invention.

[0015] In addition, pupil periphery upon lifting the arm massage operation is reduced to decrease the muscle force of the arm according to usage to minimize the fatigue accumulation eye that can be massager for its purpose to provide thereto can be used.

[0016] And, a massage around the pupil when so as not to obstruct the view or the occurrence of an accident does not know to be visually sensed eye that can be used to provide a massage machine thereto can be used for its purpose.

TECH SOLUTION

[0017] In order to achieve the above object of the present invention include an technical idea, generating a vibration with a vibrator, together with the vibrator or a vibrator and controls the operation of a switch is installed to a case and, wherein the vibrator to the transmission of the vibration occurring at the tip end of a casing provided in the probe and the probe that is connected with the skin around the pupil are in contact with the skin to vibrate in to the massage machine consisting of a massaging part, wherein the massage unit being made up to the annular rim of a contact block and formed with an aperture in the center thereof, wherein the contact block is integrally formed with the probe and the detachment of the cap and the contact block is formed along a circumference of the acupressure protrusions characterized in that it comprises a attained by the eye to the massage machine.

[0018] Here, the contact block such as a circular shape of its cross section is to be preferred.

[0019] Also, the contact block length that is vertically formed on both sides of the aperture is longer than the length of an elliptical shape are preferred over the others.

[0020] In addition, the contact block further comprises a probe and a binding from the axis of the cap that are made by rotation of the acrylic acid is preferably used.

[0021] Then, the contact block is made of soft materials are preferably selected from the consisting of.

[0022] In addition, the cap may be present (HORN) having the shape of the horn are preferably as follows.

ADVANTAGEOUS EFFECTS

[0023] In the present invention massage machine eye by a portable device which is simple and is in the office or at work such as during a driver of a vehicle at the time of the crevices of the skin around the eyes a massage massage can be even during as well as the contact block formed of the user through the bores of the field of view of the front can be ensured in an occurrence of safety accidents can be generated.

[0024] Also, the eye massager of the present invention of a casing included in the massage unit is formed on the tip end of the massaging part contact block out of the casing is formed in an inclined manner so that the user is arm does not lift height and massaged muscle force can be caused by the use of the arm to minimize the fatigue accumulation can be convenient for use.

DESCRIPTION OF DRAWINGS

[0025] Fig. 1 is a exploded perspective view showing the conventional massage machine of the present invention. Fig. 2 shows a conventional use

of a massage machine state diagram for the indicated user. Fig. 3 is a perspective view showing the eye massager according to the invention the present invention. Fig. 4 illustrates a massage machine according to the present invention exploded perspective view showing the eye of the present invention. Fig. 5 illustrates a sectional view showing the eye massager according to the invention of the present invention. Fig. 6 is a massage machine according to the present invention showing use of the eye is a state diagram for use. Fig. 7 is a massage machine according to the present invention in the eye of the acupressure protrusions showing still another example of a perspective view.

DESCRIPTION OF EMBODIMENTS

[0026] As used in the present specification and claims the term or word which are customary or dictionary sense with respect to and should not be construed as limited to, the inventor believes that the own most aspect of the present invention in the best way in order to explain the concept of the terms defined appropriately can be made in accordance with a principle of the present invention means a technical matching the concept of the concepts must be interpreted.

[0027] The following appended with reference to the drawings showing a preferred embodiment of the present invention will be described in detail for the sake of conciseness.

[0028] Fig. 3 is a schematic eye according to the invention perspective view illustrating a massage machine, Fig. 4 illustrates a eye massager according to the present invention shown in an exploded perspective view, Fig. 5 illustrates a sectional view showing the eye massager according to the invention of the present invention.

[0029] Referring to the drawings to be explained in detail, the eye massager (100) according to the present invention is greatly generating a vibration with a vibrator (110), the vibrator (110) of a vibrator (110) together with controlling the operation of the switch (124) is installed in the casing (120), wherein the vibrator (110) for the transfer of vibration occurring at the tip end of a casing (120) provided in the probe (130) and said probe (130) can be connected with the pupil and around in contact with the skin of the skin to be vibrated is composed of the massage unit (140).

[0030] Wherein the vibrator (110) is a vibration energy to electric energy is converted through the probe (130) in contact with the skin around the eye of a user of a massaging part (140) in the heat transfer to stimulate the skin, wherein the vibrator (110) is an eccentric weight (116) to a rotational axis (114) of the drive motor (112) is provided on a depending on the operation of the drive motor (112) to the center of gravity of the rotation shaft rotates (114) an eccentric weight (116) according to the movement consist in a structure where vibration occurs.

[0031] Depending on the case, wherein the vibrator (110) is supplied with electrical energy of the rod and the linear reciprocating motion to the linear motor may also be allowed to and generating vibrations by the of this disclosure.

[0032] Such a vibrator (110) is a dry battery (150) to store electric energy are accommodated in the support being mounted on the inside of the casing (120), wherein the dry (150) battery and a vibrator (110) is electrically connected by means of a switch (124) for on/off of the switch by the electric energy from the dry (150) battery and for receiving the vibrator (110) to generate vibration by operating the apparatus according to the invention.

[0033] Wherein the (120) case illustrates that the user can be wrapped rat with one hand so that the columns having a predetermined length and a diameter in the inside thereof and has the same shape of the drive motor (112) and dry (150) battery are accommodated in the accommodation space (121) is formed therein.

[0034] As such case (120) in the accommodation space (121) is formed on the inside of the front end of the case (120) also gradually formed so as to narrow and, at the proximal end of the case (120) is open such that the proximal end of the dry (150) battery through apparatus according to the invention is to be replaced.

[0035] In this way is at the proximal end of the open case (120) is a finishing comprises at the proximal end of the cover (122). The dry battery (150) wherein said (122) cover and a vibrator is (110) adapted to be connected electrically to the lead (123) is led out from the proximal end of the case (120) to the cover (122) when assembled into a vibrator (110) to the lead (123) is

electrically connected thereto. In addition, the cover includes a (122) lead pin (123) dry (150) battery by and electrically connected to a vibrator is (110) a switch for switching (124) is installed.

[0036] In other words, Fig. 4 and Fig. 5 as shown in the receiving space is (121) of a case of the (120) first eccentric weight (116) to a rotational axis (114) of the drive motor (112) is installed on the installation comprises a vibrator (110) is provided and dry (150) battery, after the cover (122) is combined in sequential order of the one constituting the electric circuit can be calculated as follows.

[0037] At this time, the receiving space (121) of the case (120) having been previously set in the first drive motor (110) 1 of the ground terminal (112a) of the anode (+) is a dry battery (150) being in contact, the lead (123) mounted to the cover (122) by the negative electrode of the dry (150) battery (-) of the drive motor (112) 2 (112b) the first contact with the ground terminal can be calculated as follows.

[0038] In such a state may be mounted to the cover (122) to the lead (123) switch (124) is the vibrator (110) ground or the negative pole of the dry battery to control the actuation of the short circuit can be calculated as follows.

[0039] On the other hand, said case (120) is provided with a tip of the probe (130) of the vibrator (110) and the vibration generated by the operation of delivered to the probe (130). In this way probe (130) vibration is delivered to the massage unit (140) massaging parts (140) may be transferred into the skin which is in contact with the bottom plate by vibration stimulus to improve blood circulation to help improve skin health and visual acuity can be calculated as follows.

[0040] Comes into direct contact with the skin a massaging part (140) is an annular rim of a (141) large aperture (143) is formed in the center thereof and is in contact block (142) and, wherein the contact block (142) and integrally formed with the probe (130) and detachment of the cap (144) and the contact block (142) formed along a circumference of which is composed of the acupressure protrusions (146).

[0041] Incidentally, to have a contact block preferably includes (142) an annular rim of a (141) circular sectional shape to equilibrate with the ambient pressure of the eye according to the facial skeleton in conformity to the bending through close contact, vibration that is transmitted to the massage unit (140) in the delivery to the skin. Particularly, wherein the contact block (142) is angled in such (141) as the annular rim of a (141) since the curved surface formed on is formed can be effortlessly with the skin in contact with the apparatus according to the invention.

[0042] At this time, the contact block (142) is made of soft materials is preferred to be made. In other words, the contact block (142) is formed of a silicon, synthetic resin, rubber such as an elastic restoring force is exerted if a soft material selected from steel, if the user around the eye contact block (142) is brought into close contact strongly to when with bending of the contact block (142) to the user's face surrounding the eyes is deformed to be in contact with the skin around the eyes more effectively block (142) will come into contact apparatus according to the invention.

[0043] In addition, the contact block (142) attached closely around the pupil when the eye position is allowed to be added to the pattern formed by the aperture (143), the iris and the perimeter of the skin is in contact with and adhered closely to the block (142), in such a state vibrator (110) to generate vibration in vibration is operating even if not delivered directly to the pupil can be calculated as follows.

[0044] In other words, the contact block (142) in contact with the eye pupil is located within the aperture to (143) at the time when the user is consciously aware because the eye does not sensing the user can be assured in the field of view for the front of the apparatus according to the invention.

[0045] In this way, the contact block (142) formed on both sides of the through hole (143) is the length of that is vertically long elliptical shape than the length of the consisting preferably is formed so as to, as such through (143) hole is a long elliptical shape on both sides of the contact block (142) is formed of an annular rim (141) around the lens on the eye when contacting the annular rim (141) around the eye and further increase of the adhesion to the skin with the result that the annular rim (141) and increase the contact area with the skin around the eyes to effectively be a massage apparatus according to the invention.

[0046] For example, contact block (142) which does not form the holes (143) in the shape of a plate when brought in contact block (142) can be allowed to contact block (142) in contact with the eye pupil is most first comes into contact with the iris are vibrations directly transmitted to the pupil thereby according to the tremors of dizziness, transient vision decline or the like is generated can be calculated as follows.

[0047] However, as in the present invention if it is made of the holes (143) in contact block (142) as shown in Fig. 6 as formed in the contact block (142) within the aperture to (143) the skin around the eyes and the pupil is located in a border of the (141) contact block (142) is in contact with the vibrator (110) thereby enabling the large upon actuation of the skin around the eyes the vibration delivered to the skin around the eyes and thereby efficiently can be a massage apparatus according to the invention.

[0048] On the other hand, the contact block (142) is inclined at an angle from the case (120) formed in such a manner are preferred over the others. Incidentally, the contact block further comprises a (142) probe (130) and bound to the surface of the cap (144) for being formed obliquely from the axis of the, in this way contact block (142) out of the casing (120) is formed to be inclined at an angle if the user is wrapped and which includes a case (120) with one hand to the eye of a contact block (142) murine upon contacting with a specific distance between the hands and face can be secured and freely moving the hand may be the skin around the eyes for a massage apparatus according to the invention.

[0049] As such case (120) formed at the leading end of the probe (130) and the massage unit (140) is connected by a cap (144), the cap (144) may be integral with the contact block (142) of the massaging part (140) formed therein. At this time, the cap may be present (144) (HORN) essentially consisting of a shape of the horn.

[0050] In other words, the cap may be present (144) in the probe (130) contact block (142) toward the narrower the diameter approximately cone comes to have the shape of the pillar. As such a cap is (144) with the shape of the of the horn vibrations which are transferred from the probe (130) when the cap is (144) centered at the contact block (142) state by being conveyed, eventually contacting the vibration of the block (142) can be obtained and the effect of improving, this improved by vibrations on the skin around the eyes in contact with the contact block (142) to slightly shakes the skin around the eyes so as to health and vision to help improve to a massage apparatus according to the invention.

[0051] On the other hand, the contact block (142) are formed which include the acupressure protrusions (146), wherein the acupressure protrusions (146) which includes an annular rim of a (141) protruded along the skin around the eyes for pressurizing apparatus according to the invention. In this way, contact block (142) projecting in the rim of a (141) acupressure protrusions (146) is a contact block (142) along the rim of a (141) distributed into different shapes can be formed.

[0052] For example, the contact block formed of (142) acupressure protrusions (146) is a as shown in the figures contact block (142) of a predetermined height from the surface of the protruded hemisphere can also be configured in the form of, such the acupressure protrusions (146) is in contact with the obverse and reverse faces of a block (142) are formed thereof.

[0053] In this way, the contact block (142) formed on the rim of a (141) acupressure protrusions (146) eye indicates that the contact block (142) is attached closely around the of the annulus (141) when the surface and the skin is in part in contact with the acupressure protrusions (146) is compared to the more strongly a portion formed with the skin to push the massage effect can be obtained in the apparatus according to the invention.

[0054] The present invention having the same configuration as with the eye of the massage (100) machine for use of their based on Fig. 6 will be described below.

[0055] Fig. 6 is a schematic eye according to the present invention showing the use of a massage machine state diagram for use. Will now be described with reference to the drawings, if the user in order to massage the skin around the eyes for the first case (120) in a state where the rats encompassed by a hand of the massaging part (140) contact block (142) can be calculated as follows placement in the eye.

[0056] At this time, the contact block formed of (142) pupil within the through hole (143) in a pulled back position mounted to the cover (122) of the case (120) manipulates a switch (124) to actuate the vibrator (110) apparatus according to the invention. As such a vibrator is (110) actuated vibration is probe (130) and through the cap (144) delivered to the contact block (142) and the skin becomes finely dithered, such as the fine acoustical diaphragms located in the skin by the stimulus to the circulation of blood is improved in the example according to the skin around the eyes health and blood circulation to help improve vision can be calculated as follows.

[0057] In particular, such as the eye massager (100) according to the present invention is cellular is simple in offices or at work such as during a driver of a vehicle at the time of the crevices of the skin around the eyes a massage as well as can be formed in the contact block (142) even during massage to the user through the aperture to (143) ensure a field of view in front of the light can be in an occurrence of safety accident can be generated.

[0058] In addition, eye massager (100) of the present invention designates a case (120) in which the tip of the massage unit (140) is formed on the contact block (142) is inclined from the casing (120) of the massaging part (140) is formed so as to height where the user does not lift the arm and can be used to massage the muscle force of the arm according to minimize the fatigue accumulation can be convenient for use.

[0059] On the other hand, the present invention is not limited to the example described above but without departing from the gist of the present invention in the range in which modifications and variations can be carried out by, such variation and modification is applied to the technical scope of the present invention that belongs to the of the appended claims.

[0060] For example, the contact block formed of the acupressure protrusions shown in the foregoing description and drawings without being limited to those shown variously modified can be carried out in the same. This will be described on the basis of the 7 embodiment of the invention.

[0061] Fig. 7 is a schematic eye massager according to the present invention in a perspective view showing another embodiment of the acupressure protrusions of the present invention. Will now be described with reference to the drawings, wherein the contact block formed of (142) acupressure protrusions (146) is wrapped circumferentially around an of the aperture to (143) form a rim (141) formed in the, wherein the acupressure protrusions (141) is located up and down of the aperture to (143) form a rim (141) in the form of an oval formed to protrude from a preferably as short as possible.

[0062] In this way, the perforations (143) of the upper and lower parts of the acupressure protrusions (146) is formed, at the time of a pupil of the eye massaging acupressure protrusions (146) between the eyebrows respectively beneath the crow's feet with the skin of the resulting from the generation of a dark circle massage the skin so as to be, according to the improvement of blood circulation to help improve the skin health and visual acuity can be calculated as follows.

REFERENCE SIGNS LIST

[0063] 100: Eye massager 110: vibrator 112: drive motor 114:116 and the axis of rotation: an eccentric weight 120: case 121: accommodation space 122: cover 123: lead wire 124: switch 130: probe 140: massaging part 141:142 such as: contact block 143: seating hole 144: cap 146:150 the acupressure protrusions: dry battery



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(45) 공고일자 2013년10월14일
(11) 등록번호 10-1315314
(24) 등록일자 2013년09월27일

(51) 국제특허분류(Int. Cl.)
A61H 23/02 (2006.01) A61H 5/00 (2006.01)
A61H 39/04 (2006.01) A61F 9/00 (2006.01)
(21) 출원번호 10-2012-0063276
(22) 출원일자 2012년06월13일
심사청구일자 2012년06월13일
(56) 선행기술조사문헌
KR200127999 Y1
KR200427986 Y1
JP07194666 A
JP06044538 U

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전체 청구항 수 : 총 7 항

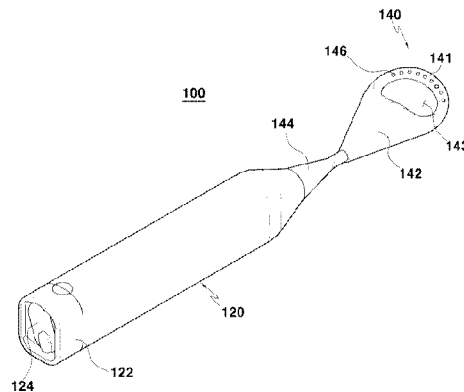
심사관 : 박환수

(54) 발명의 명칭 눈 마사지기

(57) 요약

본 발명은 눈 마사지기에 관한 것으로, 진동을 발생시키는 바이브레이터와, 상기 바이브레이터와 함께 바이브레이터의 작동을 제어하는 스위치가 설치되는 케이스와, 상기 바이브레이터에서 발생하는 진동이 전달되는 케이스의 선단에 구비되는 프로브 및 상기 프로브와 연결되며 눈동자 주위의 피부와 접촉하여 피부를 진동시키는 마사지부로 이루어진 마사지기에 있어서, 상기 마사지부는 환형의 테를 이루며 그 중심에 통공이 형성된 접촉블록과, 상기 접촉블록과 일체로 형성되며 프로브와 탈착되는 캡 및 상기 접촉블록의 둘레를 따라 형성되는 지압돌기를 포함하는 것을 특징으로 하는 눈 마사지기가 개시된다. 이에 따라서, 휴대가 간편하여 사무실에서 업무 중 또는 차량의 운전 중과 같은 틈새 시간에 눈 주위의 피부를 마사지할 수 있을 뿐만 아니라 마사지 중에도 접촉블록에 형성된 통공을 통해 사용자 전방의 시야를 확보할 수 있어 안전사고의 발생을 미연에 발생할 수 있다.

대표도 - 도3



특허청구의 범위

청구항 1

진동을 발생시키는 바이브레이터(110)와, 상기 바이브레이터(110)와 함께 바이브레이터(110)의 작동을 제어하는 스위치(124)가 설치되는 케이스(120)와, 상기 바이브레이터(110)에서 발생하는 진동이 전달되는 케이스(120)의 선단에 구비되는 프로브(130) 및 상기 프로브(130)와 연결되며 운동자 주위의 피부와 접촉하여 피부를 진동시키는 마사지부(140)로 이루어진 마사지기

는, 상기 마사지부(140)는,

환형의 테(141)를 이루며 그 중심에 통공(143)이 형성된 접촉 블록(142);

상기 접촉 블록(142)과 일체로 형성되며 프로브(130)와 탈착되는 캡(144); 및

상기 접촉 블록(142)의 둘레를 따라 형성되는 지압 돌기(146);를 포함하는 것을 특징으로 하는 눈 마사지기.

청구항 2

청구항 1 에 있어서,

상기 접촉 블록의 테(141)는 그 단면이 원형인 것을 특징으로 하는 눈 마사지기.

청구항 3

청구항 1에 있어서,

상기 접촉 블록(142)에 형성된 통공(143)은 양측의 길이가 상하의 길이보다 긴 타원형인 것을 특징으로 하는 눈 마사지기.

청구항 4

청구항 1에 있어서,

상기 접촉 블록(142)은 상기 케이스(120)의 축선으로부터 경사지게 형성되는 것을 특징으로 하는 눈 마사지기.

청구항 5

청구항 1 내지 청구항 4 중 어느 한 항에 있어서,

상기 접촉 블록(142)은 연질의 재질로 이루어진 것을 특징으로 하는 눈 마사지기.

청구항 6

청구항 1에 있어서,

상기 캡(144)은 혼(HORN)의 형상을 갖는 것을 특징으로 하는 눈 마사지기.

청구항 7

청구항 1에 있어서,

상기 지압 돌기(146)는,

상기 통공(143)의 상하에 위치하는 테(141)에 타원형의 형태로 돌출 형성되는 것을 특징으로 하는 눈 마사지기.

명세서

기술분야

- [0001] 본 발명은 눈 마사지기에 관한 것으로, 더욱 상세하게는 눈동자에 직접 진동이 전달되지 않고 눈 주위의 피부를 미세한 떨림으로 자극해 마사지함으로써, 눈 주위의 피부에 대한 혈액 순환을 개선해 눈 주위의 피부 건강 및 시력 개선에 도움을 주는 눈 마사지기에 관한 것이다.

배경기술

- [0002] 일반적으로 얼굴 피부 중 피지 분비가 적은 눈 주위는 잔주름이 생기기 쉽고, 탄력 없이 푸석푸석해지면서 늘어짐이 쉽게 발생하게 된다.
- [0003] 상기와 같은 현상이 발생하는 이유는 피부가 자외선에 과다하게 노출되면서 각질이 두꺼워져 피부가 투명감을 잃어 버리면서 피부의 신진대사가 저하됨과 동시에 수분 및 영양분 공급이 원활하게 이루어지지 않기 때문이다.
- [0004] 따라서, 이를 해결하기 위해 종래에는 다양한 방법에 의한 눈 주위의 피부관리가 이루어지고 있다. 예를 들어, 기능성 화장품을 발라 영양을 공급함과 동시에 촉촉함을 유지할 수 있도록 피부에 보습제 등을 발라주기도 한다.
- [0005] 또한, 좀더 효과적인 피부 관리를 위하여 전문 뷰티샵을 방문해 정기적인 필링으로 죽은 각질을 제거해 저하된 피부기능과 신진대사를 활성화시켜 건강한 피부를 가꾸고 있다.
- [0006] 상기와 같이 전문 뷰티샵을 이용하여 피부를 관리함에 따라 건강한 피부를 유지할 수 있는 반면, 피부 관리에 필요한 시간을 많이 투자해야 하기 때문에 피부를 관리해야 할 시기의 젊은 여성들로서는 사회생활로 인한 시간적 여유가 없어 피부 관리에 소홀할 수 밖에 없을 뿐만 아니라, 뷰티샵 이용에 따른 피부 관리 비용이 많이 소요되어 경제적으로 여유가 없는 사람들로서는 전문 뷰티샵을 이용한 피부 관리는 엄두를 낼 수가 없었다.
- [0007] 따라서, 전문가의 도움 없이 직접 눈을 마사지할 수 있는 마사지기가 등장하였다. 이러한 선행기술로 등록실용신안 제20-0127999호의 "눈 언저리용 지압 마사지기"가 있다. 이를 도 1 및 도 2에 의거하여 설명한다.
- [0008] 도 1은 종래의 마사지기를 나타낸 분해 사시도이며, 도 2는 종래 마사지기의 사용을 나타낸 사용 상태도이다. 도면을 참조하여 설명하면, 종래의 마사지기는 케이스(10)의 상부에 회전추(40)가 편심 설치된 모터(30)를 내설하고 하부에는 덮개(20)가 착탈되는 건전지 수납함(11)을 형성하여 된 지압 마사지기에 있어서, 외주면에 원형의 지압봉(51)이 다수 형성되고 그 중앙에 요입부(52)가 형성된 캡(50)이 회전추(40)가 내설된 케이스(10)의 상단에 결합된 구조를 갖는다.
- [0009] 이와 같은 종래의 마사지기는 모터(30)에 전원을 공급하여 편심된 회전추(40)의 회전에 의해 케이스(10)가 진동하게 되고, 상기와 같은 진동은 캡(50)에 전달된다. 이렇게 진동하는 캡(50)을 마사지할 눈 위에 가볍게 접촉시키게 되면 캡(50)의 외주면에 돌설된 지압봉(51)은 눈 언저리 부위에 위치하며, 캡(50)의 중앙 요입부(52)는 감은 눈의 눈동자가 위치하여 눈동자의 통증 없이 눈 언저리를 마사지할 수 있게 된다.
- [0010] 그러나, 상기와 같은 종래의 마사지기는 도 2에 도시된 바와 같이 사용자가 한 손으로 케이스(10)를 감싸 쥔 상태에서 눈의 정면으로 캡(50)이 향하도록 마사지기를 수평으로 위치시켜야 하기 때문에 사용에 불편함이 있다.
- [0011] 즉, 마사지할 눈의 정면으로 캡(50)이 위치하고, 상기 캡(50)의 후방으로 케이스(10)가 위치하기 때문에 사용자의 손과 눈이 수평 상에 위치하게 되어 그만큼 팔을 많이 들어올려야 함으로써, 팔의 근력 사용에 따른 피로가 발생하는 문제가 있다.
- [0012] 또한, 종래의 마사지기는 캡(50)에 형성된 요입부(52)의 둘레로 지압봉(51)이 형성됨으로써, 마사지 시 눈동자 전체 둘레에 지압봉(51)이 밀착되기 때문에 눈동자 주위의 전체에 대한 어느 한 부분만을 마사지할 수 없는 문제가 있다.
- [0013] 그리고, 종래의 마사지기를 이용하여 눈을 마사지하게 되는 경우 캡(50)의 요입부(52)가 막혀 있고, 케이스

(10), 사용자의 팔 등이 사용자의 시야를 가리기 때문에 눈을 마사지할 때 사용자의 진방에 대한 위험을 시각적으로 감지할 수 없어 안전상의 문제가 있다.

발명의 내용

해결하려는 과제

- [0014] 본 발명은 상기와 같은 문제점을 해결하기 위한 것으로, 피지 분비가 적어 잔주름 또는 늘어지기 쉬운 눈 주위의 피부를 미세한 진동으로 자극해 혈액 순환을 촉진시켜 탄력 있는 피부로 유지시킬 수 있을 뿐만 아니라 틈새 시간을 이용하여 사용자 스스로 눈동자 주위를 마사지할 수 있는 눈 마사지기를 제공하는데 그 목적이 있다.
- [0015] 또한, 눈동자 주위에 대한 마사지 시 팔을 들어올리는 동작을 감소시켜 팔의 근력 사용에 따른 피로 누적을 최소화시킬 수 있는 눈 마사지기를 제공하는데 그 목적이 있다.
- [0016] 그리고, 눈동자 주위를 마사지할 때 시야를 가리지 않도록 하여 발생할지 모를 사고를 시각적으로 감지할 수 있는 눈 마사지기를 제공하는데 그 목적이 있다.

과제의 해결 수단

- [0017] 상기와 같은 목적을 달성하기 위한 본 발명의 기술적 사상으로는, 진동을 발생시키는 바이브레이터와, 상기 바이브레이터와 함께 바이브레이터의 작동을 제어하는 스위치가 설치되는 케이스와, 상기 바이브레이터에서 발생하는 진동이 전달되는 케이스의 선단에 구비되는 프로브 및 상기 프로브와 연결되며 눈동자 주위의 피부와 접촉하여 피부를 진동시키는 마사지부로 이루어진 마사지기에 있어서, 상기 마사지부는 환형의 테를 이루며 그 중심에 통공이 형성된 접촉 블록과, 상기 접촉 블록과 일체로 형성되며 프로브와 탈착되는 캡 및 상기 접촉 블록의 둘레를 따라 형성되는 지압 돌기를 포함하는 것을 특징으로 하는 눈 마사지기에 의해 달성된다.
- [0018] 여기서, 상기 접촉 블록의 테는 그 단면이 원형인 것이 바람직하다.
- [0019] 또한, 상기 접촉 블록에 형성된 통공은 양측의 길이가 상하의 길이보다 긴 타원형인 것이 바람직하다.
- [0020] 또한, 상기 접촉 블록은 상기 프로브와 결속된 캡의 축선으로부터 경사지게 형성되는 것이 바람직하다.
- [0021] 그리고, 상기 접촉 블록은 연결의 재질로 이루어진 것이 바람직하다.
- [0022] 또한, 상기 캡은 혼(HORN)의 형상을 갖는 것이 바람직하다.

발명의 효과

- [0023] 본 발명에 의한 눈 마사지기는 휴대가 간편하여 사무실에서 업무 중 또는 차량의 운전 중과 같은 틈새 시간에 눈 주위의 피부를 마사지할 수 있을 뿐만 아니라 마사지 중에도 접촉 블록에 형성된 통공을 통해 사용자 진방의 시야를 확보할 수 있어 안전사고의 발생을 미연에 발생할 수 있다.
- [0024] 또한, 본 발명의 눈 마사지기는 케이스의 선단에 마사지부가 형성되되 상기 마사지부의 접촉 블록이 케이스로부터 경사지게 형성되어 사용자가 팔을 높이 들어올리지 않고 마사지할 수 있어 팔의 근력 사용에 따른 피로 누적을 최소화시킬 수 있어 사용이 편리하다.

도면의 간단한 설명

- [0025] 도 1은 종래의 마사지기를 나타낸 분해 사시도이다.
- 도 2는 종래 마사지기의 사용을 나타낸 사용 상태도이다.
- 도 3은 본 발명에 따른 눈 마사지기를 나타낸 사시도이다.
- 도 4는 본 발명에 따른 눈 마사지기를 나타낸 분해 사시도이다.

도 5는 본 발명에 따른 눈 마사지기를 나타낸 단면도이다.

도 6은 본 발명에 따른 눈 마사지기의 사용을 나타낸 사용 상태도이다.

도 7은 본 발명에 따른 눈 마사지기 중 지압 돌기의 다른 실시예를 나타낸 사시도이다.

발명을 실시하기 위한 구체적인 내용

- [0026] 본 명세서 및 청구범위에 사용된 용어나 단어는 통상적이거나 사전적인 의미로 한정해서 해석되어서는 아니 되며, 발명자는 자신의 발명을 가장 최선의 방법으로 설명하기 위해 용어의 개념을 적절하게 정의할 수 있다는 원칙에 입각하여 본 발명의 기술적 사상에 부합하는 의미와 개념으로 해석되어야만 한다.
- [0027] 이하 첨부된 도면을 참조하여 본 발명의 바람직한 실시예를 상세히 설명하기로 한다.
- [0028] 도 3은 본 발명에 따른 눈 마사지기를 나타낸 사시도이고, 도 4는 본 발명에 따른 눈 마사지기를 나타낸 분해 사시도이며, 도 5는 본 발명에 따른 눈 마사지기를 나타낸 단면도이다.
- [0029] 도면을 참조하여 설명하면, 본 발명에 따른 눈 마사지기(100)는 크게 진동을 발생시키는 바이브레이터(110)와, 상기 바이브레이터(110)와 함께 바이브레이터(110)의 작동을 제어하는 스위치(124)가 설치되는 케이스(120)와, 상기 바이브레이터(110)에서 발생하는 진동이 전달되는 케이스(120)의 선단에 구비되는 프로브(130) 및 상기 프로브(130)와 연결되며 눈농자 주위의 피부와 접촉하여 피부를 진동시키는 마사지부(140)로 구성된다.
- [0030] 상기 바이브레이터(110)는 전기 에너지를 진동 에너지로 변환하여 프로브(130)를 통해 사용자의 눈 주위의 피부와 접촉하는 마사지부(140)에 전달하여 피부를 자극하는 것으로, 상기 바이브레이터(110)는 구동 모터(112)의 회전축(114)에 편심추(116)가 설치되어 구동 모터(112)의 작동에 따라 회전축(114)이 회전하여 편심추(116)의 무게 중심이동에 따른 진동이 발생하는 구조로 이루어진다.
- [0031] 경우에 따라서는, 상기 바이브레이터(110)가 전기 에너지를 공급받아 로드가 직선왕복 운동하는 리니어 모터에 의해 진동을 발생시킬 수도 있을 것이다.
- [0032] 이와 같은 바이브레이터(110)는 전기 에너지를 저장한 건전지(150)가 수납되는 케이스(120)의 내부에 설치되며, 상기 건전지(150)와 바이브레이터(110)는 스위치(124)에 의해 전기적으로 연결되어 스위치의 on/off에 의해 건전지(150)로부터 전기 에너지를 공급받아 바이브레이터(110)가 작동하여 진동을 발생시키게 된다.
- [0033] 상기 케이스(120)는 사용자가 한 손으로 잡힐 수 있도록 소정의 길이와 직경을 갖는 기둥의 형상을 갖고 그 내부에 구동 모터(112) 및 건전지(150)가 수납되는 수납 공간(121)이 형성된다.
- [0034] 이와 같이 케이스(120)의 내부에 형성된 수납 공간(121)은 케이스(120)의 선단으로 갈수록 점진적으로 좁아지도록 형성되며, 기단은 개방되어 케이스(120)의 기단을 통해 건전지(150)를 교체할 수 있게 된다.
- [0035] 이렇게 기단이 개방된 케이스(120)는 기단을 마감하는 커버(122)를 포함한다. 상기 커버(122)는 건전지(150)와 바이브레이터(110)가 전기적으로 연결되도록 리드 선(123)이 인출되어 케이스(120)의 기단에 커버(122)가 조립되었을 때 리드 선(123)이 바이브레이터(110)와 전기적으로 연결된다. 또한, 상기 커버(122)에는 리드 선(123)에 의해 건전지(150)와 바이브레이터(110)가 전기적으로 연결되는 것을 단속하는 스위치(124)가 설치된다.
- [0036] 즉, 도 4 및 도 5에 도시된 바와 같이 케이스(120)의 수납 공간(121)에는 먼저 구동 모터(112)의 회전축(114)에 편심추(116)가 설치된 바이브레이터(110)가 마련되고 이후 건전지(150), 커버(122)가 순차적으로 결합되어 하나의 전기 회로를 구성하게 된다.
- [0037] 이때, 케이스(120)의 수납 공간(121)에 먼저 설치된 구동 모터(110)의 제 1 접지단자(112a)에 건전지(150)의 양극(+)이 접촉하게 되며, 커버(122)에 설치된 리드 선(123)에 의해 건전지(150)의 음극(-)이 구동 모터(112)의 제 2 접지단자(112b)와 접촉하게 된다.
- [0038] 이와 같은 상태에서 커버(122)에 설치된 스위치(124)는 리드 선(123)을 건전지의 음극에 접지 또는 단락시켜 바이브레이터(110)의 작동을 제어하게 된다.
- [0039] 한편, 상기 케이스(120)의 선단에는 프로브(130)가 구비되어 바이브레이터(110)의 작동에 의해 발생하는 진동이 프로브(130)로 전달된다. 이렇게 프로브(130)로 전달된 진동은 마사지부(140)로 전달되어 마사지부(140)와 접

촉하는 피부가 진동에 의해 자극을 받아 혈액 순환을 개선해 피부 건강 및 시력 개선에 도움을 주게 된다.

- [0040] 피부와 직접 접촉하게 되는 마사지부(140)는 크게 환형의 테(141)를 이루며 그 중심에 통공(143)이 형성된 접촉 블록(142)과, 상기 접촉 블록(142)과 일체로 형성되며 프로브(130)와 탈착되는 캡(144) 및 상기 접촉 블록(142)의 둘레를 따라 형성되는 지압 돌기(146)로 구성된다.
- [0041] 부연하자면, 환형의 테(141)를 이루는 접촉 블록(142)은 그 단면 형상이 원형을 이루게 되어 눈 주위의 안면 골격에 따른 굴곡에 맞추어 밀착됨으로써, 마사지부(140)에 전달되는 진동을 피부에 전달하게 된다. 특히, 상기 접촉 블록(142)이 환형의 테(141)를 이루기 때문에 테(141)에 곡면이 형성되어 피부와 무리 없이 접촉할 수 있게 된다.
- [0042] 이때, 상기 접촉 블록(142)은 연질의 재질로 이루어지는 것이 바람직하다. 즉, 상기 접촉 블록(142)이 실리콘, 합성수지, 고무와 같은 탄성 복원력이 발휘되는 연질의 재질로 이루어지게 되면, 사용자가 접촉 블록(142)을 눈 주위에 강하게 밀착시켰을 때 눈 주위의 안면 굴곡에 따라 접촉 블록(142)이 변형되어 더욱 효과적으로 눈 주위의 피부에 접촉 블록(142)이 접촉할 수 있게 된다.
- [0043] 또한, 상기 접촉 블록(142)이 눈 주위에 밀착될 때 눈동자가 위치할 수 있게 통공(143)이 형성됨으로써, 눈동자 주위의 피부가 접촉 블록(142)에 밀착되고, 이러한 상태에서 바이브레이터(110)가 작동하여 진동을 발생시키더라도 진동이 눈동자에 직접 전달되지 않게 된다.
- [0044] 즉, 상기 접촉 블록(142)을 눈에 접촉시켰을 때 통공(143) 내에 눈동자가 위치하기 때문에 사용자가 의식적으로 눈을 감지 않는 한 사용자 전방에 대한 시야를 확보할 수 있게 된다.
- [0045] 이렇게, 상기 접촉 블록(142)에 형성된 통공(143)은 양측의 길이가 상하의 길이보다 긴 타원형으로 이루어지도록 형성하는 것이 바람직한데, 이와 같이 통공(143)이 양측으로 긴 타원형으로 형성되면 접촉 블록(142)의 환형 테(141)를 눈 주위에 접촉시킬 때 환형 테(141)와 눈 주위에 대한 밀착을 더욱 증가시켜 결국 환형 테(141)와 피부에 대한 접촉 면적이 증가하여 효과적으로 눈 주위의 피부를 마사지할 수 있게 된다.
- [0046] 예를 들어, 접촉 블록(142)에 통공(143)이 형성되지 않고 플레이트의 형상을 갖게 되면 접촉 블록(142)을 눈에 접촉시킬 때 접촉 블록(142)에 눈동자가 가장 먼저 접촉하게 되어 진동이 눈동자에 그대로 전달됨으로써 눈동자의 떨림에 따른 어시럽증, 일시적인 시력 저하 등이 발생하게 된다.
- [0047] 그러나, 본 발명과 같이 접촉 블록(142)에 통공(143)이 형성되면 도 6에 도시된 바와 같이 접촉 블록(142)에 형성된 통공(143) 내에 눈동자가 위치하고 눈 주위의 피부에 접촉 블록(142)의 테(141)가 접촉하게 됨으로써 바이브레이터(110)의 작동시 그 진동이 눈 주위의 피부로 전달됨으로써 효과적으로 눈 주위의 피부를 마사지할 수 있게 된다.
- [0048] 한편, 상기 접촉 블록(142)은 케이스(120)로부터 일정 각도로 경사지게 형성되는 것이 바람직하다. 부연하자면, 상기 접촉 블록(142)은 상기 프로브(130)와 결속된 캡(144)의 축선으로부터 경사지게 형성되는데, 이렇게 접촉 블록(142)이 케이스(120)로부터 일정 각도로 경사지게 형성되면 사용자가 한 손으로 케이스(120)를 감싸 쥐고 눈 주위를 접촉 블록(142)을 접촉시킬 때 손과 안면 사이로 일정 거리를 확보할 수 있어 자유롭게 손을 움직여 눈 주위의 피부를 마사지할 수 있게 된다.
- [0049] 이와 같이 케이스(120)의 선단에 형성된 프로브(130)와 마사지부(140)는 캡(144)에 의해 연결되는데, 상기 캡(144)은 마사지부(140)의 접촉 블록(142)과 일체로 형성된다. 이때, 상기 캡(144)은 혼(HORN)의 형상으로 이루어진다.
- [0050] 즉, 상기 캡(144)은 프로브(130)에서 접촉 블록(142)으로 갈수록 그 직경이 좁아지는 대략 원뿔 기둥의 형상을 갖게 된다. 이와 같이 캡(144)이 혼의 형상을 갖게 되면 프로브(130)로부터 전달되는 진동이 캡(144)에서 집중된 상태로 접촉 블록(142)으로 전달됨으로써, 결국 접촉 블록(142)의 진동을 향상시키는 효과를 얻을 수 있고, 이러한 향상된 진동에 의해 접촉 블록(142)과 접촉하는 눈 주위의 피부를 미세하게 떨리게 하여 눈 주위의 피부 건강 및 시력 개선에 도움을 주는 마사지를 할 수 있게 된다.
- [0051] 한편, 상기 접촉 블록(142)에는 지압 돌기(146)가 형성되는데, 상기 지압 돌기(146)는 환형의 테(141)를 따라 돌출되어 눈 주위의 피부를 가압하게 된다. 이렇게, 접촉 블록(142)의 테(141)에서 돌출된 지압 돌기(146)는 접촉 블록(142)의 테(141)를 따라 여러 형태로 분포되어 형성될 수 있다.
- [0052] 예를 들어, 상기 접촉 블록(142)에 형성된 지압 돌기(146)는 도면에 도시된 바와 같이 접촉 블록(142)의 표면으

로부터 일정한 높이로 돌출된 반구 형태로 형성될 수도 있으며, 이러한 지압 돌기(146)가 접촉 블록(142)의 앞면과 뒷면에 형성된다.

- [0053] 이렇게, 상기 접촉 블록(142)의 테(141)에 형성된 지압 돌기(146)는 접촉 블록(142)이 눈 주위에 밀착되었을 때 테(141)의 표면과 피부가 접촉하는 부분에 비해 지압 돌기(146)가 형성된 부분은 더욱 강력하게 피부를 가압하게 되는 마사지 효과를 얻을 수 있게 된다.
- [0054] 상기와 같은 구성을 갖는 본 발명의 눈 마사지기(100)에 대한 사용을 도 6에 의거하여 설명한다.
- [0055] 도 6은 본 발명에 따른 눈 마사지기의 사용을 나타낸 사용 상태도이다. 도면을 참조하여 설명하면, 사용자가 눈 주위의 피부를 마사지기 위해 먼저 케이스(120)를 한 손으로 감싸 쥔 상태로 마사지부(140)의 접촉 블록(142)을 눈에 위치시키게 된다.
- [0056] 이때, 상기 접촉 블록(142)에 형성된 통공(143) 내에 눈동자를 위치시킨 상태에서 케이스(120)의 커버(122)에 설치된 스위치(124)를 조작해 바이브레이터(110)를 작동시키게 된다. 이와 같이 바이브레이터(110)가 작동되면 진동이 프로브(130)와 캡(144)을 통해 접촉 블록(142)에 전달되어 피부가 미세하게 떨리게 되고, 상기와 같은 미세한 떨림에 의해 피부가 자극을 받아 혈액순환이 개선되어 눈 주위의 피부 건강과 혈액 순환에 따른 시력 개선에 도움을 주게 된다.
- [0057] 특히, 상기와 같은 본 발명에 따른 눈 마사지기(100)는 휴대가 간편하여 사무실에서 업무 중 또는 차량의 운전 중과 같은 틈새 시간에 눈 주위의 피부를 마사지할 수 있을 뿐만 아니라 마사지 중에도 접촉 블록(142)에 형성된 통공(143)을 통해 사용자 전방의 시야를 확보할 수 있어 안전사고의 발생을 미연에 발생할 수 있다.
- [0058] 또한, 본 발명의 눈 마사지기(100)는 케이스(120)의 선단에 마사지부(140)가 형성되 상기 마사지부(140)의 접촉 블록(142)이 케이스(120)로부터 경사지게 형성되어 사용자가 팔을 높이 들어올리지 않고 마사지할 수 있어 팔의 근력 사용에 따른 피로 누적을 최소화시킬 수 있어 사용이 편리하다.
- [0059] 한편, 본 발명은 앞서 설명한 실시예로 한정되는 것이 아니라 본 발명의 요지를 벗어나지 않는 범위 내에서 수정 및 변형하여 실시할 수 있고, 그러한 수정 및 변형이 가해진 것도 본 발명의 기술적 사상에 속하는 것으로 보아야 한다.
- [0060] 예를 들어, 상기 접촉 블록에 형성된 지압 돌기는 앞서 설명 및 도면에 도시된 것으로 한정되지 않고 다양하게 변형되어 실시될 수 있다. 이를 도 7에 의거하여 설명한다.
- [0061] 도 7은 본 발명에 따른 눈 마사지기 중 지압 돌기의 다른 실시예를 나타낸 사시도이다. 도면을 참조하여 설명하면, 상기 접촉 블록(142)에 형성된 지압 돌기(146)는 통공(143)의 둘레를 감싸는 테(141)에 형성되는데, 이때 상기 지압 돌기(141)는 통공(143)의 상하에 위치하는 테(141)에 타원형의 형태로 돌출되도록 형성하게 된다.
- [0062] 이렇게, 상기 통공(143)의 상하에 지압 돌기(146)가 형성되면, 눈 마사지 시 지압 돌기(146)가 각각 눈동자와 눈썹 사이의 피부와 눈가 밑으로 생기는 다크서클이 발생하는 피부를 마사지하게 됨으로써, 혈액 순환 개선에 따른 피부 건강 및 시력 개선에 도움을 주게 된다.

부호의 설명

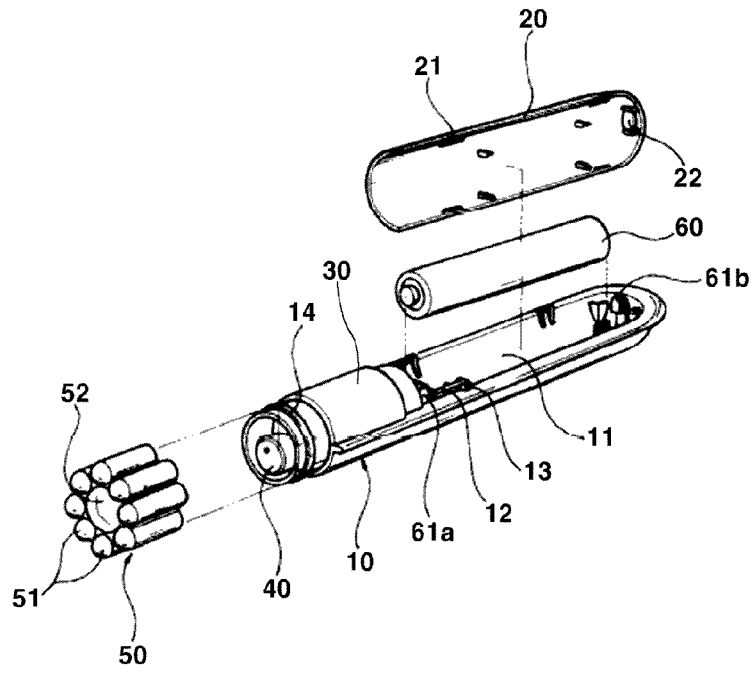
- [0063]
- | | |
|--------------|--------------|
| 100 : 눈 마사지기 | 110 : 바이브레이터 |
| 112 : 구동 모터 | 114 : 회전축 |
| 116 : 편심추 | 120 : 케이스 |
| 121 : 수납 공간 | 122 : 커버 |
| 123 : 리드 선 | 124 : 스위치 |
| 130 : 프로브 | 140 : 마사지부 |
| 141 : 테 | 142 : 접촉 블록 |
| 143 : 통공 | 144 : 캡 |

146 : 지압 돌기

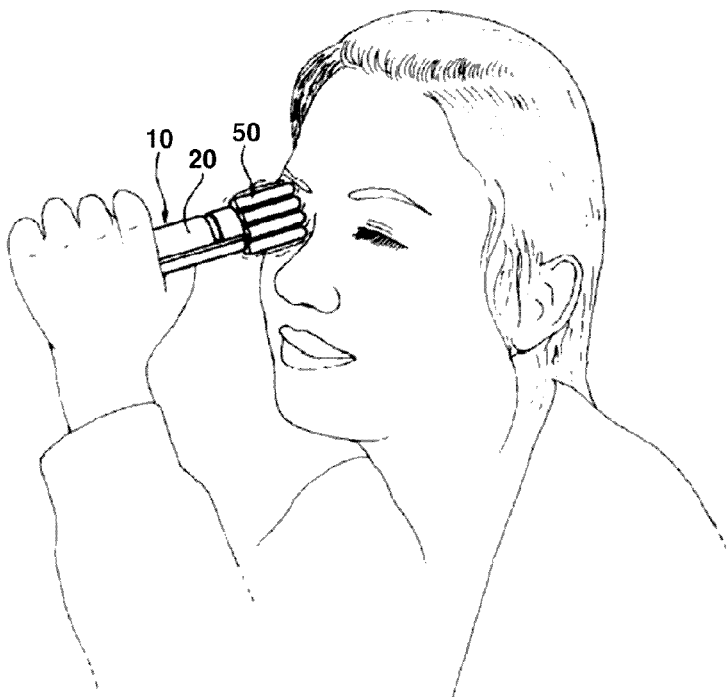
150 : 건전지

도면

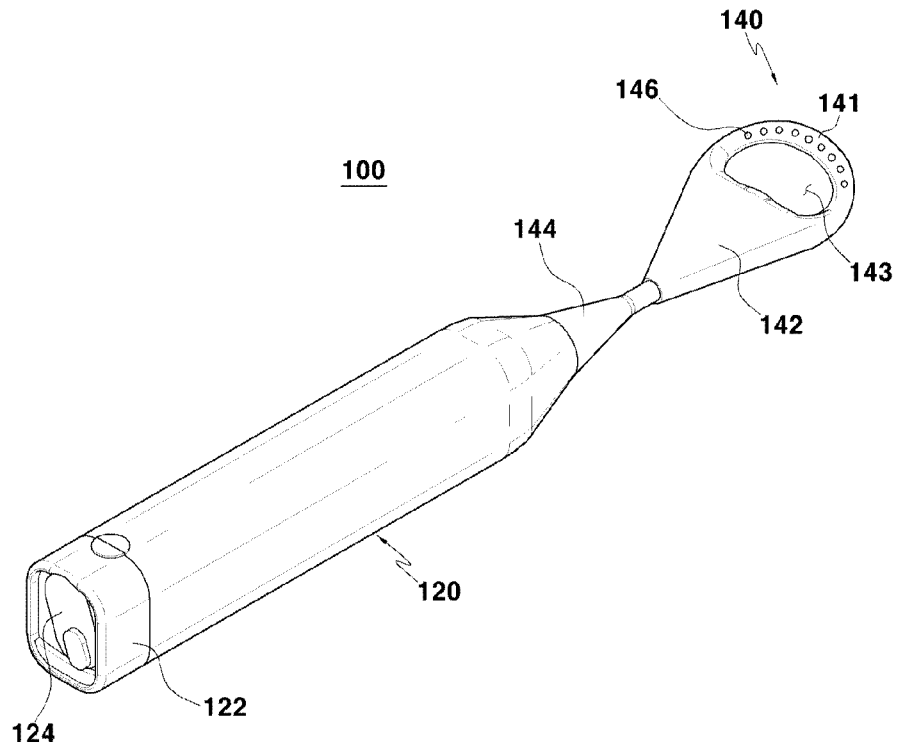
도면1



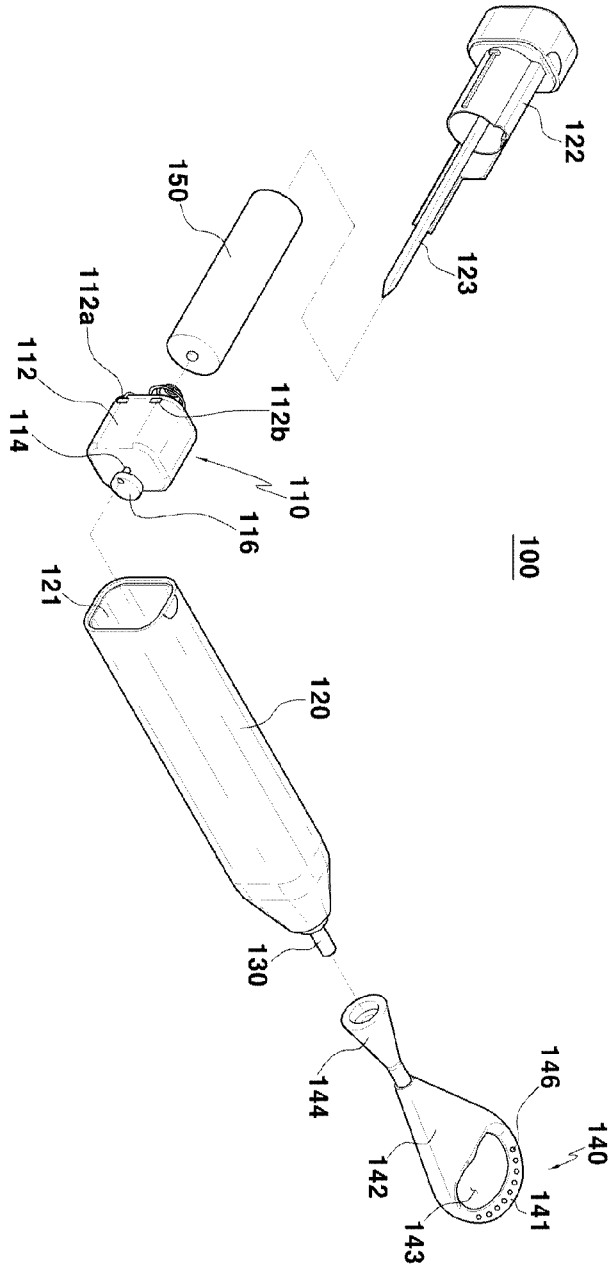
도면2



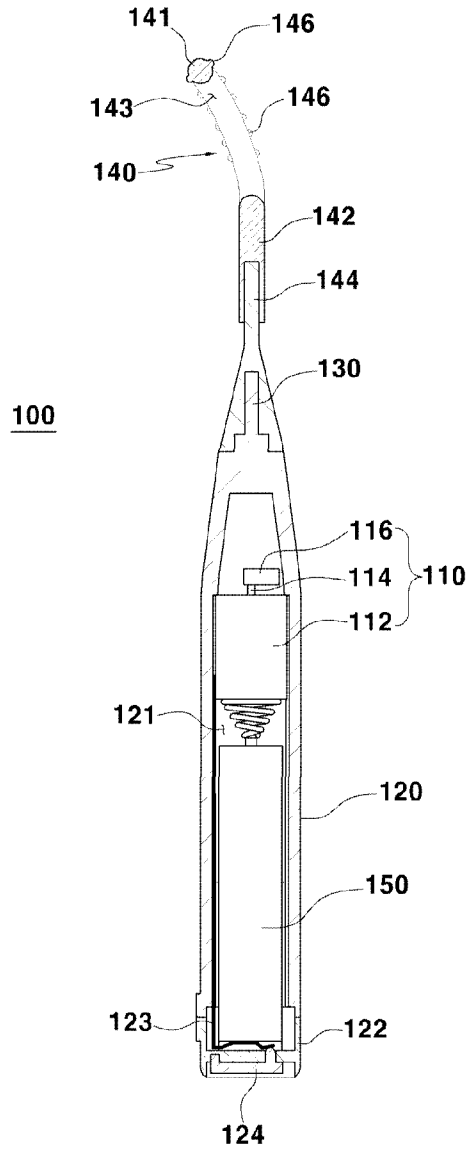
도면3



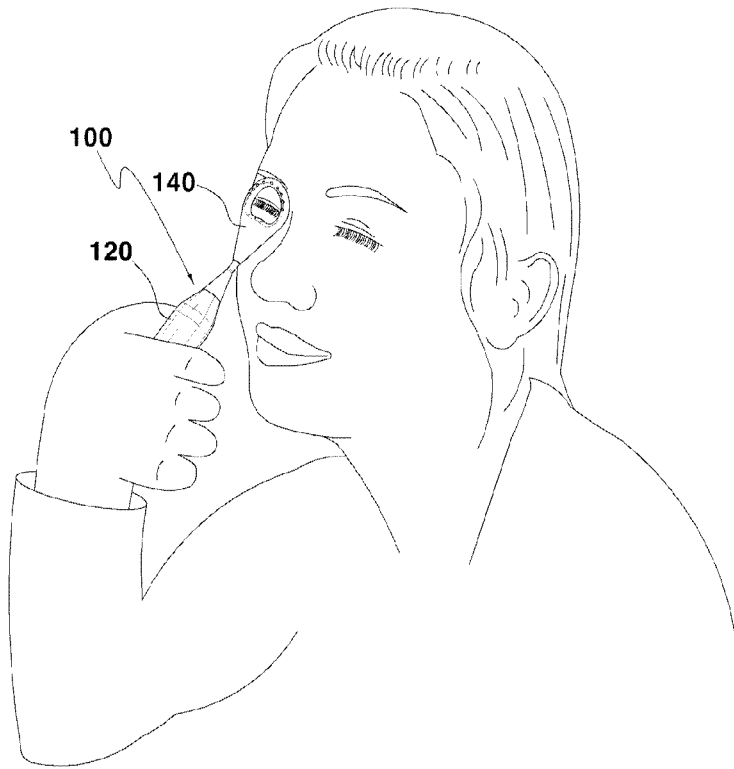
도면4



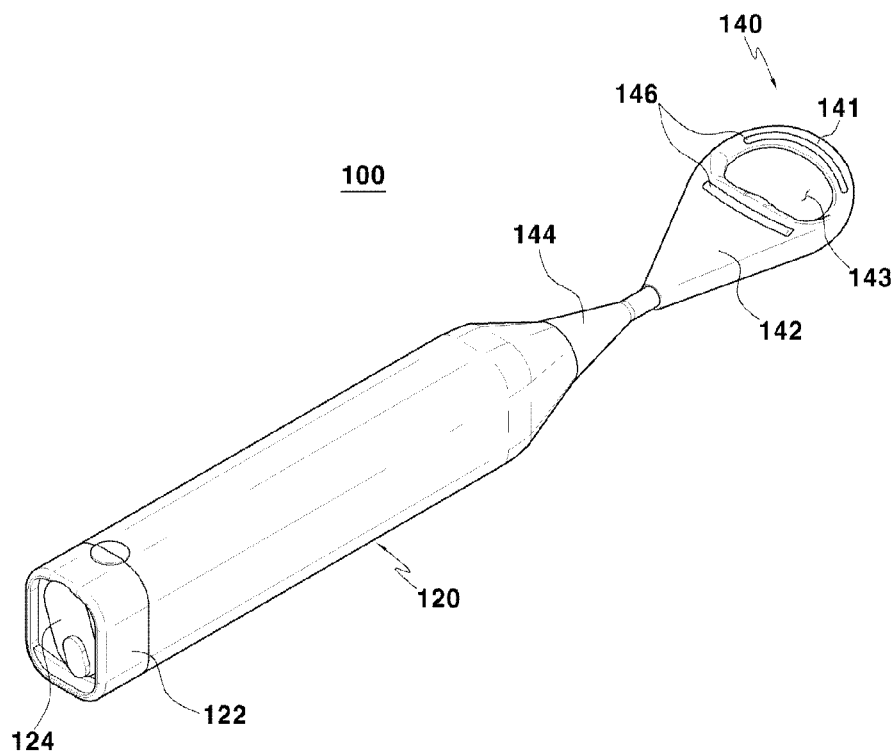
도면5



도면6



도면7



【심사관 직권보정사항】

【직권보정 1】

【보정항목】 청구범위

【보정세부항목】 청구항5

【변경전】

청구항 1 내지 4 중 적어도 어느 한 항에 있어서

【변경후】

청구항 1 내지 4 중 어느 한 항에 있어서

Bibliographic Data

Int.Cl.	A61H 39/08
Application No.	1020040113418
Application Date	20041228
Unexamined Publication No.	1020060074625
Unexamined Publication Date	20060703
Inventor	shindaechul
Applicant	shin dae chul

발명의 명칭

전동침

Title of Invention

electric acupuncture

요약

본 발명은 통상의 출혈침에 모터(22)를 이용해 연사사가 되는 기능을 추가함으로써 짧은 시간에 시침이 가능하여 환자의 긴장상태와 고통을 짧게 느낄 수 있게 하는 동시에 치료하는 사람의 반복되는 노동을 줄일 수 있고, 또 인체공학적인 디자인으로 설계되어 그립(grip)잡기가 편하고 미려하며, 용도에 맞게 투명뚜껑(12)이나 일회용 침(11)을 교환하여 사용할 수 있도록 하였고, 압진기를 설치하여 시침에 편리함을 더하였으며, 무엇보다도 작동버튼만 누르면 자동으로 연사되어 편리함을 제공하는 것을 특징으로 하는 전동침(10)이 제공된다.

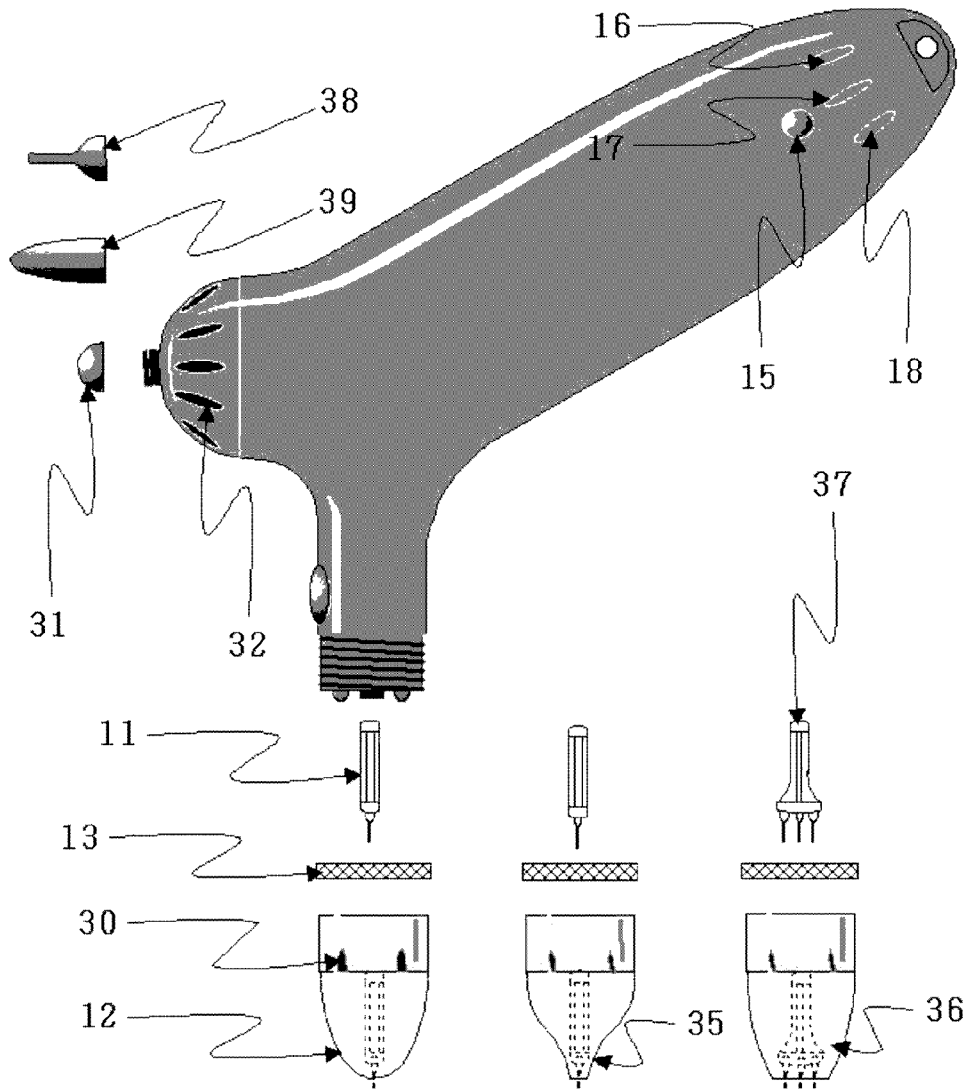
침, 사혈 침, 전동 침, 사혈, 전동, 출혈침

Abstract

The invention provides the electric needle (10) which could reduce the repeated labor of the human the hour hand was possible in the time to be short and feeling the state of tension and pain of the patient and since it added the function in which the strand corp. was by using the motor (22) for the normal bleeding needle treated at the same time and comfortable to be designed to the design which was and, the ergonomic and grasp the grip and beautiful and it exchanged the transparency lid (12) or the single-use needle (11) according to the use and the human used and it set up suppression and it added the convenience to the hour hand and it is twined with the automatically if the operating button above anything else presses and provides the convenience.

The needle, the depletion needle, the electric needle, depletion, electric, the bleeding needle

대표도면(Representative drawing)



청구의 범위

청구 1항:

사혈을 할 때 사용되는 출혈용 침에 있어서; 상기 작동수단을 손가락이 아닌 모터(22)를 활용해 자동으로 작동시키고, 전체구조는 본체 몸통을 중심으로 세 부위로 갈라진 손잡이 부와 모터 부, 침부로 나누어지고; 상기 손잡이 단부에는 고리(33)가 설치되고, 그 아래에 3개의 램프(16, 17, 18)와 전원버튼(15)이 설치되며, 반대쪽에는 건전지(20)를 교환할 수 있는 건전지뚜껑(21)이 있는 것과; 상기 모터 부에는 전동 모터(22)가 내장되어있고 단부에는 환기구(32)가 설치되며; 상기 침부에는 투명 뚜껑(12)과 침 길이조절링(13)내부에 나사산이 있고 외부에 나사산이 있는 본체에 차례대로 조립되는 것과, 그 관통된 중앙부에는 일회용 침(11)이 침 꽃이에 결합되고, 수직연결대(26)와 행정연결대(25), 휠(24), 회전축(23), 모터(22) 순으로 연결된 구조를 가지고 있으며, 모터의 회전운동이 왕복운동으로 바뀌어 침이 재봉틀처럼 작동되는 것을 특징으로 하는 전동침(10).

Scope of Claims

Claim 1:

The electric needle in which the single-use needle (11) is combined in the needle prod in the penetrated central part ; it has with the structure of being connected to the vertical connecting belt (26) and administration connection stick (25), wheel (24), rotary shaft (23), motor (22) net ; and the rotary motion of the motor is changed to the reciprocatory movement and the needle is operated like the sewing machine. It is boiled in the needles inside the transparent lid (12) and needle length adjustment ring (13) in the main body in which the screw thread is in the outside it has the screw thread in order the ventilation opening (32) is installed in end the electric motor (22) is built in the motor unit it has the battery cover (21) exchanging the dry cell (20) in the opposite side lamps (16, 17, 18) and power button (15) of 3 are installed the ring (33) is installed in the grasping end the overall structure is divided into the handle part divided into the force site and motor unit, and the needles around the main body body the actuating means is automatically operated as to the needle for the bleeding which is used it depletes blood the motor (22) which is not finger is utilized (10).

청구 2항:

1항에 있어서, 일회용 침 하나에 여러 개의 바늘을 갖고, 그 모양에 따라 투명뚜껑(12)의 개방된 구멍의 크기가 넓어진 것을 특징으로 하는 전동침(10).

청구 3항:

1항에 있어서, 투명뚜껑(12)의 주둥이가 이침에 사용할 수 있게 뾰족한 것을 특징으로 하는 전동침(10).

청구 4항:

1항에 있어서, 투명뚜껑(12)의 주둥이가 도장침을 사용할 수 있게 구멍이 넓게 뚫린 것을 특징으로 하는 전동침(10).

청구 5항:

1항에 있어서; 일회용 침(11)하나에 여러 개의 바늘이 달린 것을 특징으로 하는 일회용 도장침(11).

청구 6항:

1항에 있어서, 본체 몸통을 중심으로 세 부위로 갈라진 구조로, 손잡이 부와 모터 부, 침부로 나누어지고; 상기 본체를 시침할 부위에 따라 권총을 잡을 때의 그립(grip), 연필을 잡을 때의 그립(grip)두 가지 형태로 쥐고 작동시킬 수 있는 것을 특징으로 하는 전동침(10).

청구 7항:

1항에 있어서, 고정뚜껑(31)을 압진기로 사용할 수 있게 한 것을 특징으로 하는 전동침(10).

청구 8항:

1항에 있어서, 투명뚜껑(12)내부에 전구(29)를 장착하여 시침 시 환부의 조도를 높여줄 수 있게 한 것을 특징으로 하는 전동침(10).

청구 9항:

2항에 있어서, 일회용 침 하나에 여러 개의 바늘을 갖은 것을 특징으로 하는 일회용 도장침(37)

Claim 2:

The electric needle in which it has several needles on the single-use needle one as to claim 1 ; and the size of the opened hole of the transparency lid (12) widens according to the shape (10).

Claim 3:

The electric needle in which the spout of the transparency lid (12) is pointed as to claim 1 to use in this needle (10).

Claim 4:

The electric needle in which the hole is widely opened so that the spout of the transparency lid (12) can, can use the coating needle as to claim 1 (10).

Claim 5:

The single-use coating needle in which several needles run to the single-use needle (11) one as to claim 1 (11).

Claim 6:

The electric needle which can be divided into the handle part and motor unit, and the needles and which hold the main body to the grip when catching gun according to the *** site, and the grip two form when catching the pencil and can operate to the structure of being divided into the force site as to claim 1 around the main body body (10).

Claim 7:

The electric needle using the fixing lid (31) as suppression as to claim 1 (10).

Claim 8:

The electric needle mounting the bulb (29) as to claim 1 inside the transparency lid (12) and enhances the illumination of the affected part in the hour hand (10).

Claim 9:

The single-use coating needle having several needles on the single-use needle one as to claim 2 (37)

배경기술

본 발명은 통상의 출혈침에 모터(22)를 이용해 연사가 되는 기능을 추가함으로써 짧은 시간에 시침이 가능하여 환자의 긴장상태와 고통을 짧게 느낄 수 있게 하는 동시에 치료하는 사람의 반복되는 노동을 줄일 수 있다, 또 인체공학적인 디자인으로 설계되어 환자의 부위에 따라 도 13이나 도 14와 같이 잡기가 편리한 방식을 선택하여 시침 할 수 있고 미려하며, 용도에 맞게 투명뚜껑(12)이나 일회용 침(11)을 교환하여 사용할 수 있도록 하였고, 무엇보다도 작동버튼만 누르면 자동으로 연사되어 편리함을 제공하는 전동침에 관한 것이다.

Background Art

The present invention relates to the electric needle which when could reduce the repeated labor of the human the hour hand was possible in the time to be short and feeling the state of tension and pain of the patient and by adding the function of being twined by using the motor (22) for the normal bleeding needle treated at the same time it selected the method in which was convenient that it was designed to the design which was and, the ergonomic and caught according to the site of the patient like the figures 13 or 14 and the hour hand could be named and beautiful and it exchanged the transparency lid (12) or the single-use needle (11) according to the use and the human used and it is twined with the automatically if the operation

일반적으로 출혈침은 혈자리나 환부에 출혈을 목적으로 사용되며, 급체시나 구급 시에 혈자리를 자극하여 응급처치를 하고, 근래에는 대체의학으로 널리 사용되어 많은 사람들이 활용하고 있는데, 의사나 시침을 하는 사람들은 여러 환자를 상대하는 경우와, 한 부위에 수차례 연속적으로 시침을 하는 경우 때문에, 그 반복되는 노동으로 스트레스를 받는다.

침을 맞기를 좋아 하는 사람은 없을 것이다, 더군다나 여러 차례 침을 같은 부위에 놓는다면 대부분 사람들은 맞으려고 하지 않아 시침을 하는 데 어려움이 있다. 또 경험해본 사람들은, 침을 맞는 긴 시간동안 아픔을 동반한 긴장상태 때문에 다시는 맞으려고 하지 않는 문제점이 있다.

상기 압진기는 침을 놓기 전에 침놓을 자리를 마사지하여 침을 맞는 고통을 줄일 수 있도록 한 것으로서 일반적으로 별도의 압진기를 구매하여 사용하여야 하는 불편함이 있었다.

발명의 내용

발명의 효과

상술한 바와 같이 본 발명은 종래의 제반 문제점을 해소하기 위하여 안출한 것으로, 인체공학적 디자인으로 설계되어 환자의 부위에 따라 도 13이나 도 14와 같이 시침하기 편리한 그립(grip)방식을 선택할 수 있고, 세련되고 미려하며, 용도에 맞게 투명뚜껑(12)이나 일회용 침(11), 고정뚜껑(31)을 교환하여 사용할 수 있도록 하였고, 상기 고정뚜껑(31)은 압진기 대체용으로 침을 놓기 전에 침놓을 자리를 마사지하여 침을 맞는 고통을 줄일 수 있도록 한 것으로서, 일반적으로 별도의 압진기를 구매하여 사용하여야 했으나 전동침(10)에는 자체에 압진기가 장착되어 전동침(10)만 있으면 시침은 물론 압진기의 역할까지 할 수 있는 효과가 있다. 무엇보다도 작동버튼만 누르면 자동으로 연사되어 시간을 절약하고, 시침하는 사람이 전동의 힘을 빌려 반복되는 같은 동작에서 해방이 되며, 일회용 침이 피부를 통과하는 순간이 눈 깜짝 할 사이에 이루어짐으로써 통증도 줄고, 스피드하게 시술할 수 있는 효과를 갖는다.

기술적 과제

이에 본 발명은 상기한 바와 같은 종래의 제반 문제점을 해소하기 위하여 안출한 것으로, 그 목적은 침을 맞지 않는 것이 아니라 스피드하게 맞고, 시침하는 사람도 전동의 힘을 빌려 반복되는 같은 동작에서 해방이 되며, 바늘이 피부에

g button above anything else presses and provides the convenience.

Generally, the bleeding needle is bleeding used for the blood aperture or the affected part as the purpose and the blood aperture is stimulated in the sudden stomach disorder time or relief and it gives first aid and many people which is recently widely used to the alternative medicine and utilizes. The hour hand the stress is consecutively therefore received in the case, where the people deciding on the doctor or the hour hand deals with the some patient and one site in case as the repeated labor with several times.

It is good to have the needle and there will be no human doing. Many sides that furthermore places the several times needle on the same site the people mostly tries to fit and the hour hand is decided on but human has the difficulty. And there is a problem that the people experienced therefore again tries to fit the state of tension accompanying the pain for the long time to have the needle.

It had the inconvenience with it reduced the pain massaging the place and had the needle generally of purchasing the separate suppression and to using *** before suppression acupuncture.

Summary of Invention

Effects of the Invention

As described above, the present invention has the effect that it devised the conventional overall problem was raveled. It was designed to the design which was the ergonomic and the grip mode which was convenient to *** could be selected according to the site of the patient like the figures 13 or 14 and it was polished and it was beautiful and the transparency lid (12) or the single-use needle (11), and the fixing lid (31) were exchanged according to the use and the patient used and the pain which massages the place *** before the fixing lid (31) acupunctures for the suppression substitution and has the needle is reduced. Generally the separate suppression was purchased and it had to use but suppression is mounted on itself in the electric needle (10) and itself can do to the role of suppression as well as the hour hand if it has the electric needle (10). Above anything else, if the operating button presses, it is twined with the automatically and time is economized in and it is free from the operation of being the same of the *** human renting the power of electric and being repeated and since the moment when the single-use needle passes through skin is comprised of the interval which it eye is with surprise called the pain decreases and it has the effect that speed it can perform an operation.

Technical Task

Thus, the invention is to provide the electric needle (10) which it devises it cancels the conventional overall problem as described above and the purpose fit the needle but it speeds it fits and it is free from the operation of being the same of the *** human borrowin

시침될 때 짧은 순간에 이루어짐으로써 고통도 덜 수 있는 전동침(10)을 제공함에 있다.

g the power of electric and being repeated and the pain can remove by being made at the moment when it is short when the needle acupunctures to skin.

발명의 구성 및 작용

상기와 같은 목적을 달성하기 위해서, 본 발명은 본체 케이스하부에 투명뚜껑(12)을 열면 일회용 침(11)을 끼우는 침꽃이(28)와 수직 작동하는 연결부를 갖고 스프링(27)과 모터(22)를 활용해 자동으로 작동시키고; 상기 본체 몸통을 중심으로 세 부위로 갈라진 구조로, 손잡이 부와 모터 부, 침부로 나누어지고; 상기 손잡이 단부에는 고리(33)가 설치되고, 그 아래에 3개의 램프(16, 17, 18)와 전원버튼(15)이 설치되며, 반대쪽에는 건전지(20)를 교환할 수 있는 건전지뚜껑(21)이 있는 것과; 상기 모터 부에는 전동 모터(22)가 내장되어있고 단부에는 환기구(32)가 설치되며; 상기 침부에는 투명뚜껑(12)과 침 길이조절 링(13)내부에 나사산이 있고 외부에 나사산이 있는 본체에 차례대로 조립되는 것과, 그 관통된 중앙부에는 일회용 침(11)이 침꽃이(28)에 결합되고, 수직연결대(26)와 행정연결대(25), 휠(24), 회전축(23), 모터(22) 순으로 연결된 구조를 가지고 있으며, 모터의 회전운동이 왕복운동으로 바뀌어 침이 재봉틀처럼 작동되는 것을 특징으로 하는 것이다.

이하, 첨부된 도면을 참조로 하여 본 발명의 바람직한 실시예를 상세히 설명한다.

도 1에 도시한 바와 같이 본 발명에 따른 전동침(10) 조립도로 본 발명의 조립되는 구성을 살펴보면, 상기 본체 케이스하부에 투명뚜껑(12)은 전구(29)를 장착하여 시침 시 환부의 조도를 높여줄 수 있게 투명한 소재를 선택하였으며, 일회용 침(11)과 더불어 환부에 따라 교환하여 사용할 수 있도록 하였고, 기본적인 일반형 투명뚜껑(12)과 주둥이가 뾰족한 깔때기형 투명뚜껑(35), 구멍이 크게 뚫린 도장형 투명뚜껑(36)이 있다, 일반형은 기본적인 타입으로 일회용 침(11)을 사용할 때 장착하고, 깔때기형 투명뚜껑(35)은 이침(耳針)이나 움푹한 곳에 침을 놓을 때 장착하며, 도장형 투명뚜껑(36)은 일회용 침에 바늘이 여러 개 나와 있는 도장침(37)을 사용할 때 장착하는 것으로 한 부위에 여러 개의 침을 놓을 때 사용한다. 또 고정 뚜껑(31)은 기본적인 일반형과 빗살무늬토기형 뚜껑(39) 그리고 긴 깔때기형 뚜껑(38)이 있다, 일반형은 기본적인 타입으로 공이 반 절단된 모양을 하고 있고, 빗살무늬토기형 뚜껑(39)은 럭비공을 반 절단한 모양을 하고 있으며, 긴 깔때기형 뚜껑(38)은 깔때기 모양 끝에 구슬 같은 볼 형태의 돌기가 만들어져, 압진기 역할을 한다. 상기 압진기는 침을 놓기 전에 침놓을 자리를 마사지하여 침을 맞는 고통을 줄일 수 있도록 한 것으로서 일반적으로 별도의 압진기를 구매하여 사용하여야 했으나 전동침(10)에는 자체에 압진기가 장착되어 전동침만 있으면 시침은 물론 압진기의 역할까지 할 수 있게 하였다.

Structure & Operation of the Invention

To achieve the object, it has the connection part operating with the needle prod (28) and the perpendicularity inserts the single-use needle (11) if the, the invention opens the transparency lid (12) at the lower part of the main case and the spring (27) and motor (22) are utilized and it automatically operates and it is divided into the handle part and motor unit, and the needles and the ring (33) is installed around the main body in the structure of being divided into the force site in the grasping end and lamps (16, 17, 18) and power button (15) of 3 are installed and the single-use needle (11) is combined in the penetrated central part in the needle prod (28) and it has the battery cover (21) exchanging the dry cell (20) in the opposite side the ventilation opening (32) is installed in end it is boiled in the needles inside the transparency lid (12) and needle length adjustment ring (13) in the main body which has the screw thread and in which the screw thread is in the outside in order the structure has as with the structure of being connected to the vertical connecting belt (26) and administration connection stick (25), wheel (24), rotary shaft (23), motor (22) net and the rotary motion of the motor is changed to the reciprocatory movement and the needle is operated like the sewing machine.

The embodiment doing with the desirable of the invention it does with reference to the drawing attached below is particularly illustrated.

As shown in Figure 1, as to the electric needle (10) assembly drawing according to the present invention the configuration of being assembled of the invention, the transparent material was selected to the transparency lid (12) mount the bulb (29) at the lower part of the main case and could enhance the illumination of the affected part in the hour hand and it exchanged with the single-use needle (11) according to the affected part and it used and the material has the funnel form transparency lid (35) in which the primary general type transparency lid (12) and spout are pointed, and the stamp type transparency lid (36) in which the hole is opened. It mounts when the general type uses the single-use needle (11) as the primary type and when the funnel form transparency lid (35) acupunctures on this needle or the sunken place, it mounts and when with it mounts when the stamp type transparency lid (36) uses the coating needle (37) in which the needle comes out in the single-use needle with the some placing the needle of the some part on one site, it uses. And the primary general type, *** type lid (39) and the long funnel form lid (38) have the fixing lid (31). The protrusion of the form looked such as the funnel form lid (38) it has the shape cut down with the pestle half and it has the shape that *** type lid (39) cuts the rugby ball with half and long. Is the bead after the funnel shape as to the general type, is made of the primary type and it serves as suppression. Before suppression acupunctured with the pain massaging the place and had the needle was reduced generally t

도 2에 도시한 바와 같이 본 발명에 따른 전동침(10)의 A-A종단면도로 전반적인 전동침(10)의 내부를 표현하고 있다. 상기 일회용 침(11)을 끼우는 침 꽃이(28)는 침을 기울 때 유동이 없도록 침 모양과 닮은꼴로 되어있고, 원통형으로 된 상부가 막혀있는 삽입공 모양을 하고 있으며, 하부에서부터 수직으로 서있는 원통의 한 면이 갈라져 있어 일회용 침(11)을 끼우고 뺄 때 헐렁하지 않으면서 자연스럽게 삽입되고 빼낼 수 있도록 되어있는 것과; 상기 침 꽃이(28)의 원기둥 바깥쪽으로 스프링(27)이 끼워져 전동침(10)이 작동 하지 않을 때는 노출되지 않고 항상 투명뚜껑(12)안쪽에 머물러 있도록 하는 역할을 한다, 상기 침 꽃이(28)위에서 잡아주는 수직연결대(26)는 행정연결대(25)와 침 꽃이(28)를 연결하고; 상기 행정연결대(25)는 수직연결대(26)와 휠(24)을 연결하며 상하 한쪽으로 ㄷ자를 이루며 연결축이 튀어 나와 있고; 상기 휠(24)은 모터의 회전축과 연결되어 모터에서 나오는 동력을 수직 상하왕복운동으로 바꾸어 주는 역할을 한다. 또 상기 모터에는 건전지(20)에서 나오는 전력으로 동력을 일으키며, 여기서는 1.5v AA size 건전지 두개를 사용 하였으나 AC로도 활용할 수 있고, DC를 사용하여 휴대하기 편리 하게 축전지를 활용할 수도 있다.

도 3에 도시한 바와 같이 본 발명에 따른 전동침(10)의 B-B횡단면도로, 상기 도 2의 발명의 구성에서 상세히 설명이 되었으며, 모터(22)의 동력이 휠(24)로 연결되어 회전운동에너지가 상하 왕복운동에너지로 변환되는 과정을 보여준다(참조로 도 6에 도시한바와 같이 화살표를 따라 행정이 이루어진다.). 추가로 보충 설명할 것은 스프링(27)의 역할과 침 길이조절 링(13)의 역할로서 상기에서는 스프링(27)을 단순히 전동침(10)이 작동 하지 않을 때는 노출되지 않고 항상 투명뚜껑(12)안쪽에 머물러 있도록 하는 역할을 하는 것으로만 설명되었으나 항상 스프링(27)이 긴장상태를 유지하고 있어, 침이 피부에 삽입되었다가 빠질 때 스프링(27)도움을 받아 가장 빠른 속도로 빠져나와 통증을 최소화 할 수 있도록 하여 주고, 침 길이조절 링(13)은 시침 시 환자의 고통을 호소하면 침 길이조절 링(13)을 돌려 침의 길이를 통증과 반비례하게 조절하여 사용한다, 다시 말하자면 많이 아파하는 사람은 조금만 침이 삽입되게 침 길이조절 링(13)을 풀어 사용하고, 피부에 혈이 돌지 않아 통증을 느끼지 못하는 환자는 빠른 효과를 위하여 침 길이조절 링(13)을 조여 침이 피부에 깊이 삽입되게 하여 사용한다.

he separate suppression was purchased and *** had to be used but suppression was mounted on itself in the electric needle (10) and if it had the electric needle, itself did to the role of suppression as well as the our hand.

As shown in Figure 2, the inside of the overall electric needle (10) is expressed in the A-A cross-sectional view of the electric needle (10) according to the present invention. When inclining, the needle prod (28) inserting the single-use needle (11) becomes the needle to the needle shape and similar shape so that there is no flow and it has the insertion hole shape that of the upper portion composed of *** is choked and when the spring (27) is inserted to the cylinder outside of the needle prod (28) and when one page which perpendicularly stands in the lower part of the cylinder being divided and the single-use needle (11) being inserted and taking out, it is not baggy and the cylinder can be inserted and it can lure the electric needle (10) does not operate, it is not exposed and it always stays in the transparency lid (12) inside. While the vertical connecting belt (26) caught in the needle prod (28) connects the administration connection stick (25) and needle prod (28) and the administration connection stick (25) connects the vertical connecting belt (26) and wheel (24) the power the connection splashes and it comes out and in which above wheel (24) is connected to the rotary shaft of the motor and while being comprised ㄷ shape with the high-low limit side coming out from the motor is changed into perpendicular up down back and forth motion. And in the motor, the power is generated to the electricity of coming from the dry cell (20) and here 1.5v AA size dry cell two was used but it can utilize as AC and the storage battery can be utilized to be convenient to carry using DC.

As shown in Figure 3, in the B-B cross-sectional view, of the electric needle (10) according to the present invention the above is the construction of the Invention of 2, it was particularly explained and the power of the motor (22) is connected to the wheel (24) and the process where the rotational kinetic energy is transformed to up down back and forth motion energy is shown (as shown in the reference furnace is 6, the administration is made according to the arrow). In the above case, only by that when the electric needle (10) just did not operate the spring (27) as the role of the spring (27) and role of the needle length adjustment ring (13), role were not exposed and it always stayed in the transparency lid (12) inside it was explained but to the additionally add an explanation the spring (27) always maintains the state of tension and when the needle being inserted into skin and coming off, the spring (27) help is accepted and it frees from to the speed which is most fast and the pain is minimized and if the pain of the patient is complained of, the needle length adjustment ring (13) turns the needle length adjustment ring (13) in the hour hand and the length of the needle is controlled to be in inverse proportion to the pain and the patient uses. The needle length adjustment ring (13) is loosened so that as to the human, who namely very much feels a pain the needle be a little inserted and the human, uses and the needle length adjustment ring (13) is tightened for the fast effect and the needle is deeply inserted into skin and the patient in which the hole does not go round in skin and who is unable to feel the pain uses.

도 4에 도시한 바와 같이 본 발명에 따른 전동침(10) 동력 전달 구조 A#39#종단면도로, 도 2를 확대 하여 디테일하게 표현한 도면이다.

도 5에 도시한 바와 같이 본 발명에 따른 전동침(10) 동력 전달 구조 B#39#종단면도로, 도 3을 확대 하여 디테일하게 표현한 도면이다.

도 6에 도시한 바와 같이 본 발명에 따른 전동침(10) 동력 전달 구조 회전축(23)의 진행상태를 나타낸 도면으로, 도 3의 발명의 구성에서 자세히 설명되어 있다.

도 7, 도 8, 도 9, 도 10, 도 11, 도 12에 도시한 바와 같이 본 발명에 따른 전동침(10)의 앞뒤상하좌우입면도로, 육면체의 유리관에 넣고 여섯 면에서 바라본 그림이다, 전체가 현대감각에 맞게 유선형디자인으로 설계되었으며, 의료기인 만큼 청결하고 시술이 용이하며 시침 시 편리한 인체공학적인 모양으로 설계되었다. 도 7의 정면도에서 고리(33) 아래쪽에는 3개의 램프(16, 17, 18)와 전원버튼(15)이 있는데 손잡이 내부에 있는 제어판(19)과 연결되어 제어가 되며, 전원버튼(15)을 길게 누르면 전원램프(16)에 점등이 되고 작동준비 상태를 알리며, 나머지 수동램프(17)와 자동램프(18)는 전원버튼을 짧게 누를 때 마다 번갈아 점등되고, 다시 길게 누르면 소등이 됨과 동시에 OFF상태가 된다.

도 13에 도시한 바와 같이 본 발명에 따른 전동침(10)의 손잡이 부를 잡은 상태를 나타낸 입면도로, 권총을 잡을 때의 그립(grip)이다. 침부를 잡을 때의 그립(grip)보다 손목에 무리를 주지 않으며 장시간 시침을 하거나 많은 사람을 시술할 때 편리하며, 검지로 작동버튼(14)을 누를 수 있다.

도 14에 도시한 바와 같이 본 발명에 따른 전동침(10)의 침부를 잡은 상태를 나타낸 입면도로, 연필을 잡을 때의 그립(grip)이다. 손잡이 부를 잡을 때의 그립(grip)보다 섬세한 시침을 할 때 유리하며, 검지로 작동버튼(14)을 누를 수 있다.

As shown in Figure 4, it is drawing which it expresses to enlarge fig. 2 into the electric needle (10) power transmitting structure A' cross-sectional view according to the present invention and detail.

As shown in Figure 5, it is drawing which it expresses to enlarge fig. 3 into the electric needle (10) power transmitting structure B' cross-sectional view according to the present invention and detail.

As shown in Figure 6, in the construction of the Invention of the drawing, showing the progress of the electric needle (10) power transmitting structure rotary shaft (23) according to the present invention fig. 3, it is explained in detail.

As shown in Figure 12, the fig. 7, fig. 8, fig. 9, fig. 10, fig. 11 was drawing which put in the glass tube of the cube and looked in 6 to front and back up and down/left and right elevation of the electric needle (10) according to the present invention. Whole was projected according to *** to the streamlined shape design and whole was designed to the shape that was the ergonomic clean and in which the procedure was facilitated and which was convenient as the medical instruments phosphorus in the hour hand. In the front view of fig. 7, it has lamps (16, 17, 18) and power button (15) of 3 but it is connected in the ring (33) downside to the control panel (19) having inside the handle and it is controlled and if the power button (15) is lengthways pressed, it is turned on and the functioning ready state is informed the power lamp (16) of and it is turned on by the alternately whenever the rest manual lamp (17) and automatic lamp (18) briefly press the power button and with being put out if it again lengthways presses it becomes the OFF state.

As shown in Figure 13, it is the grip when catching gun to the elevation showing the state catching the handle part of the electric needle (10) according to the present invention. When while not giving the unreasonable to the wrist than the grip when catching the needles the long time hour hand being decided on or performing an operation on many human, it is convenient and the operating button (14) can be pressed to the scanning.

As shown in Figure 14, it is the grip when catching the pencil to the elevation showing the state catching the needles of the electric needle (10) according to the present invention. When deciding on the hour hand which is delicate than the grip when catching the handle part, it is advantageous and the operating button (14) can be pressed to the scanning.

도면에 대한 간단한 설명

도 1은 본 발명에 따른 전동침(10) 조립도,

도 2는 본 발명에 따른 전동침(10) A-A종단면도,

도 3은 본 발명에 따른 전동침(10) B-B횡단면도,

도 4는 본 발명에 따른 전동침(10)동력전달 구조 A#39#종단면도,

도 5는 본 발명에 따른 전동침(10)동력전달 구조 B#39#종단면도,

Brief explanation of the drawing

Figure 1 is a state elevation in which the electric needle (10) assembly drawing , and

2 the electric needle (10) A-A cross-sectional view according to the present invention , and

3 the electric needle (10) B-B cross-sectional view according to the present invention , and

4 the electric needle (10) power transmitting structure A' cross-sectional view according to the present invention , and

도 6은 본 발명에 따른 전동침(10)의 휠(24) 동력전달 구조 진행상태 도면,
 도 7은 본 발명에 따른 전동침(10) 정면도,
 도 8은 본 발명에 따른 전동침(10) 배면도,
 도 9는 본 발명에 따른 전동침(10) 우측면도,
 도 10은 본 발명에 따른 전동침(10) 좌측면도,
 도 11은 본 발명에 따른 전동침(10) 저면도,
 도 12는 본 발명에 따른 전동침(10) 상면도,
 도 13은 본 발명에 따른 전동침(10)의 손잡이 부를 잡은 상태 입면도,
 도 14는 본 발명에 따른 전동침(10)의 침부를 잡은 상태 입면도.

* 도면의 주요부분에 대한 부호 설명

10 : 전동침
 11 : 일회용 침
 12 : 투명뚜껑
 13 : 침 길이조절 링
 14 : 작동버튼
 15 : 전원버튼
 16 : 전원램프
 17 : 수동램프
 18 : 자동램프
 19 : 제어판
 20 : 건전지
 21 : 건전지뚜껑
 22 : 모터
 23 : 회전축
 24 : 휠
 25 : 행정연결대
 26 : 수직연결대
 27 : 스프링
 28 : 침 꽃이
 29 : 전구

5 the electric needle (10) power transmitting structure B' cross-sectional view according to the present invention , and
 6 the wheel (24) power transmitting structure progress drawing of the electric needle (10) according to the present invention , and
 7 the electric needle (10) front view according to the present invention , and
 8 the electric needle (10) rear elevation according to the present invention , and
 9 the electric needle (10) right side view according to the present invention , and
 10 the electric needle (10) left side view according to the present invention , and
 11 the electric needle (10) bottom view according to the present invention , and
 12 the electric needle (10) top view according to the present invention , and
 13 catches the handle part of the electric needle (10) according to the present invention, and the state elevation in which
 14 catches the needles of the electric needle (10) according to the present invention according to the invention.

* the code description

toward the main part of drawing 10: the electric needle
 11: the single-use needle
 12: the transparency lid
 13: the needle length adjustment ring
 14: the operating button
 15: the power button
 16: the power lamp
 17: the manual lamp
 18: the automatic lamp
 19: the control panel
 20: the dry cell
 21: the battery cover
 22: the motor
 23: the rotary shaft

30 : 통기구
31 : 고정뚜껑
33 : 환기구
34 : 힌지
35 : 깔때기형 투명뚜껑
36 : 도장형 투명뚜껑
37 : 도장침
38 : 긴 깔때기형 뚜껑
39 : 빗살무늬형 뚜껑
40 : 나사못

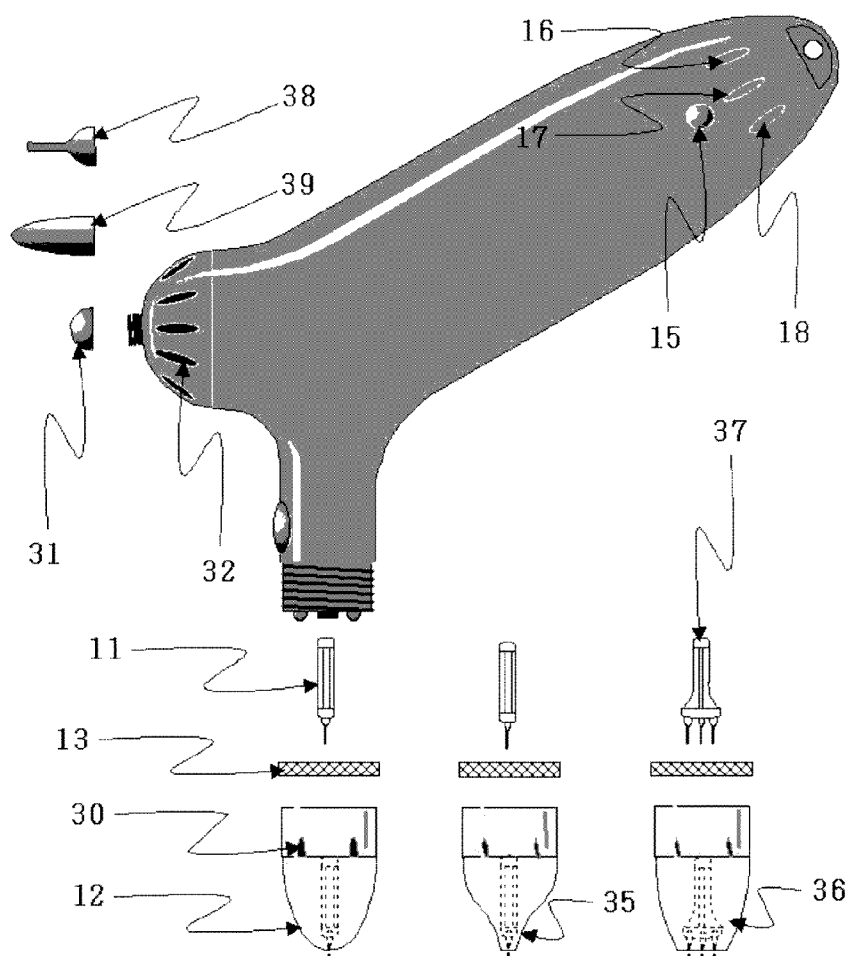
24: the wheel
25: the administration connection stick
26: the vertical connecting belt
27: the spring
28: the needle prod
29: the bulb
30: the ventilation hole
31: the fixing lid
33: the ventilation opening
34: the hinge
35: the funnel form transparency lid
36: the stamp type transparency lid
37: the coating needle
38: the long funnel form lid
39: the teeth of a comb type lid
40: the screw spike

Disclaimer

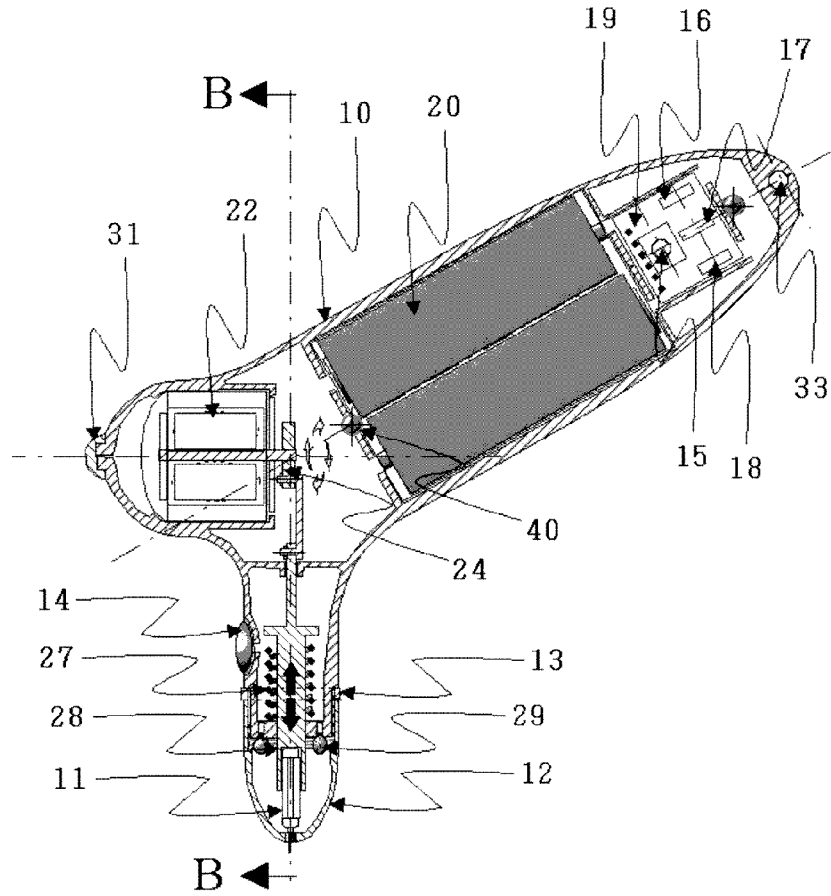
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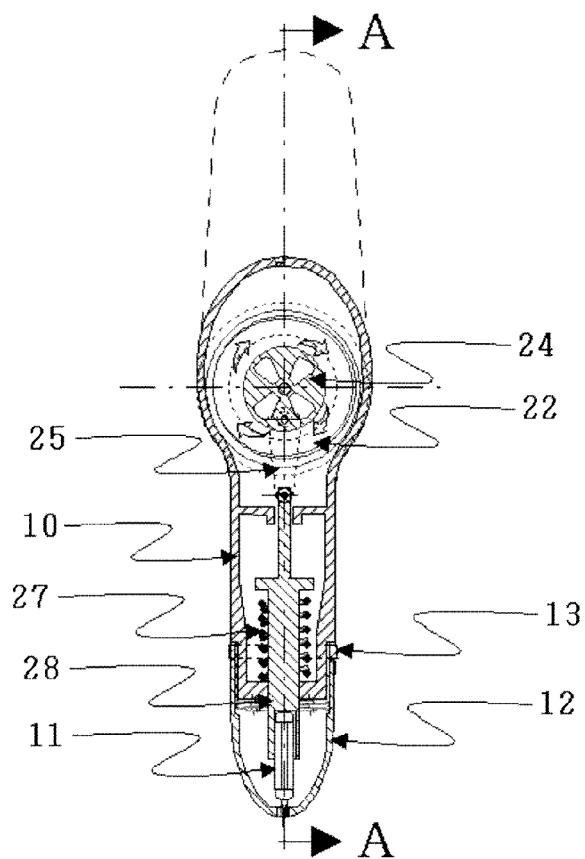
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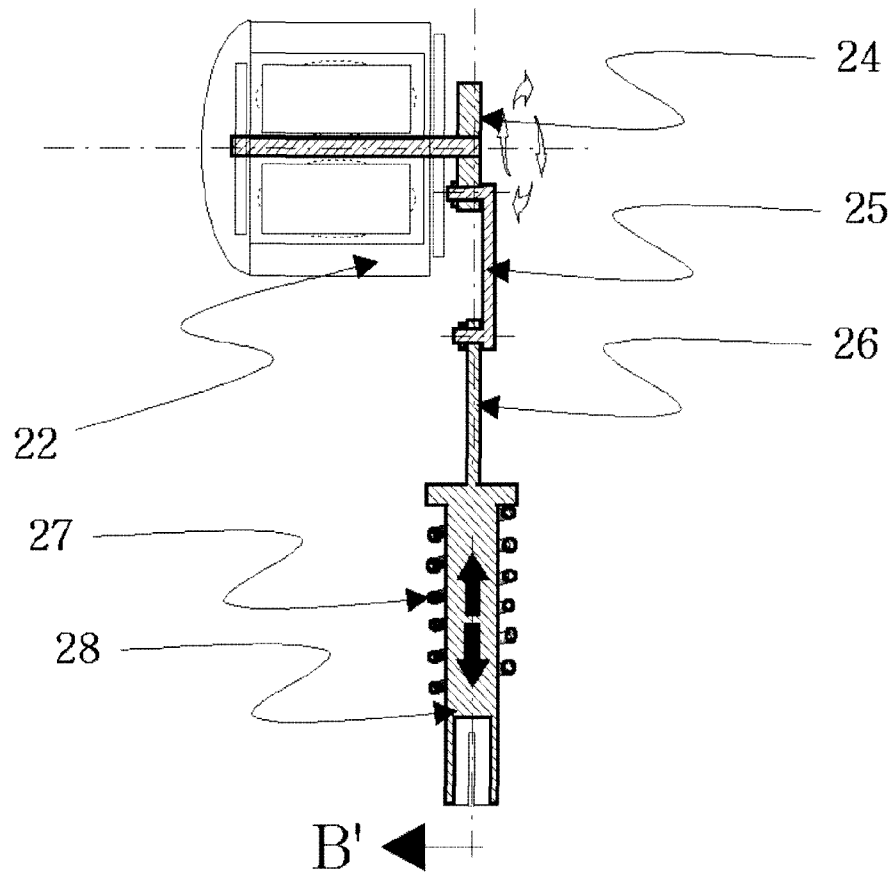
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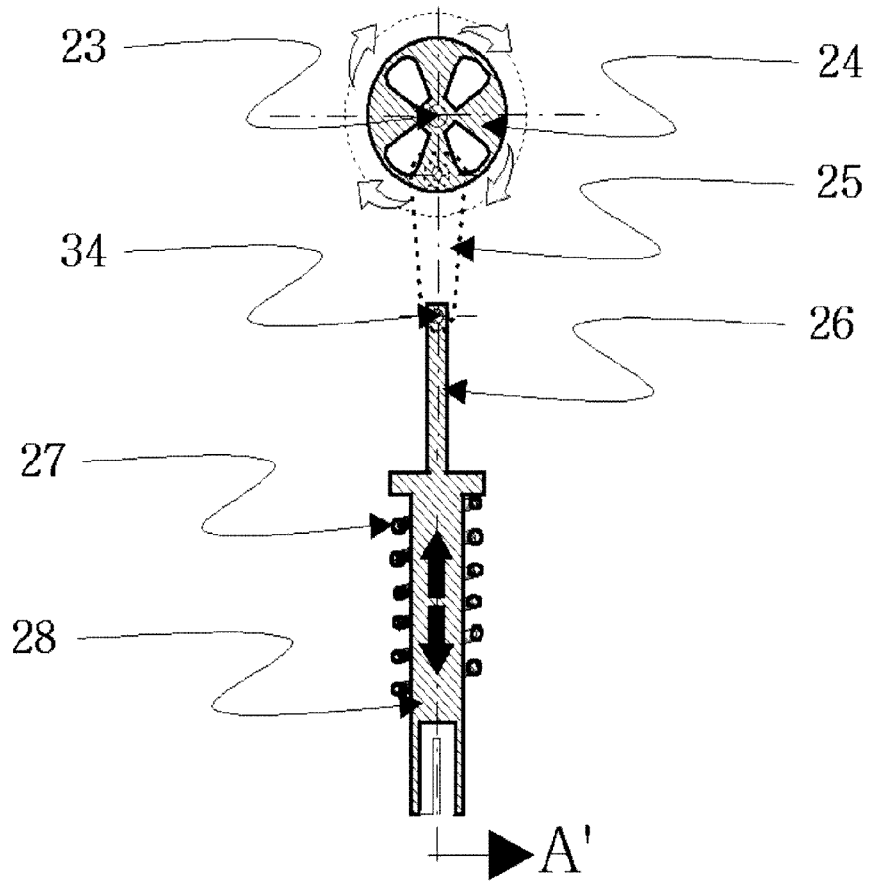
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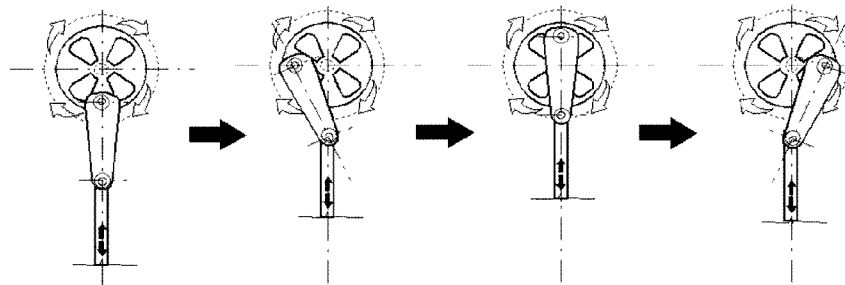
도면4



도면5



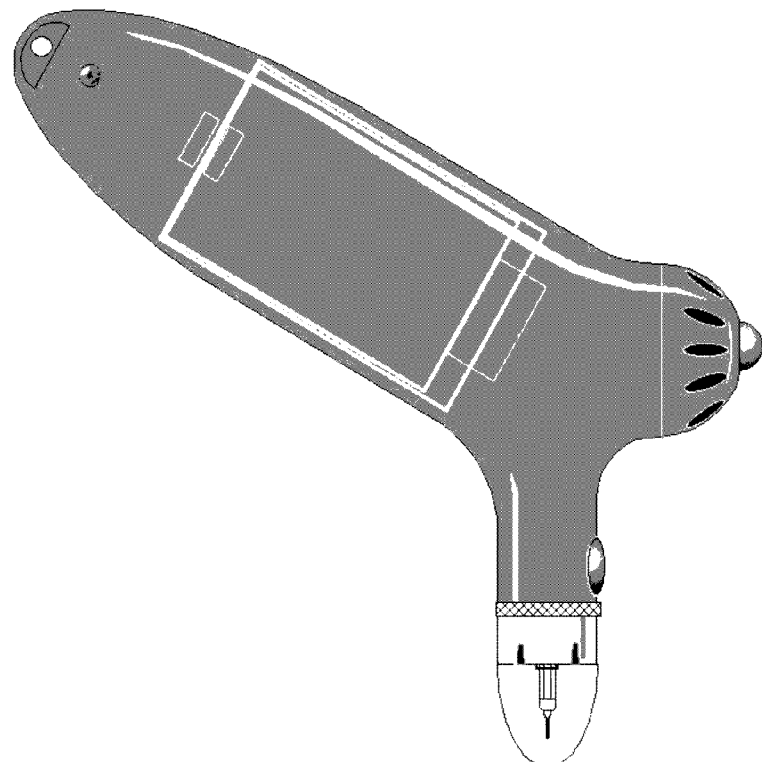
도면6



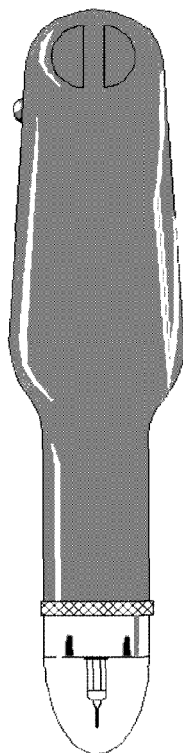
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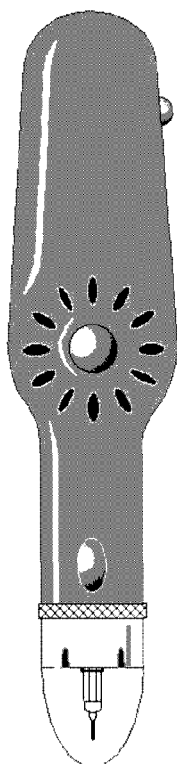
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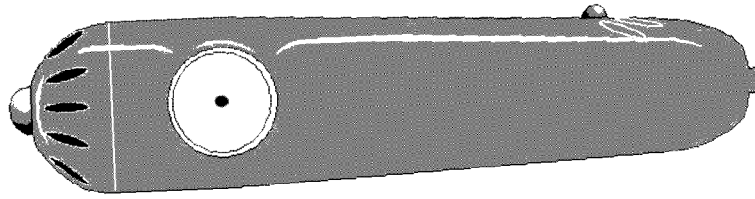
도면9



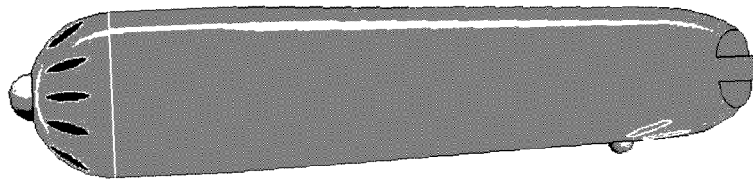
도면10



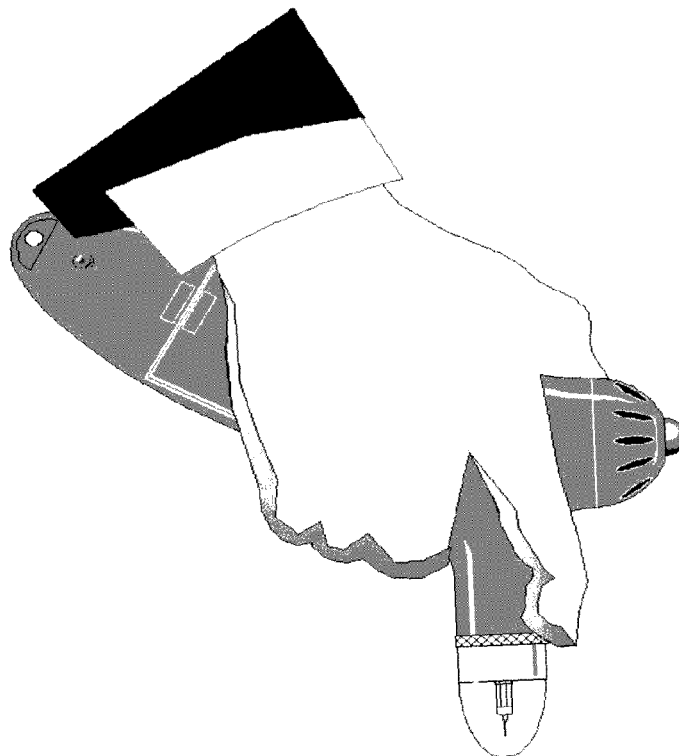
도면11



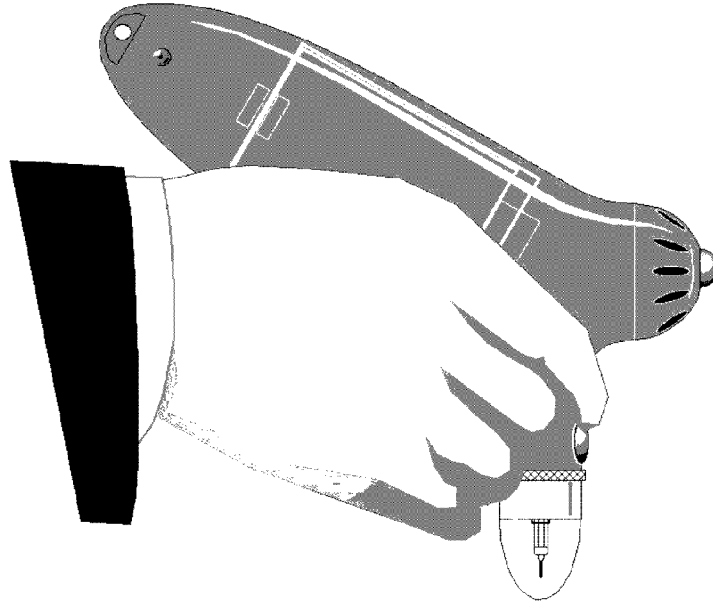
도면12



도면13



도면14



(19)대한민국특허청(KR)
(12) 공개특허공보(A)(51) 。 Int. Cl.
A61H 39/08 (2006.01)(11) 공개번호 10-2006-0074625
(43) 공개일자 2006년07월03일(21) 출원번호 10-2004-0113418
(22) 출원일자 2004년12월28일(71) 출원인 신대철
경기 안양시 동안구 관양동 1495-35(72) 발명자 신대철
경기 안양시 동안구 관양동 1495-35

심사청구 : 없음

(54) 전동침

요약

본 발명은 통상의 출혈침에 모터(22)를 이용해 연사사가 되는 기능을 추가함으로써 짧은 시간에 시침이 가능하여 환자의 긴장상태와 고통을 짧게 느낄 수 있게 하는 동시에 치료하는 사람의 반복되는 노동을 줄일 수 있고, 또 인체공학적인 디자인으로 설계되어 그립(grip)잡기가 편하고 미려하며, 용도에 맞게 투명뚜껑(12)이나 일회용 침(11)을 교환하여 사용할 수 있도록 하였고, 압진기를 설치하여 시침에 편리함을 더하였으며, 무엇보다도 작동버튼만 누르면 자동으로 연사되어 편리함을 제공하는 것을 특징으로 하는 전동침(10)이 제공된다.

대표도

도 1

색인어

침, 사혈 침, 전동 침, 사혈, 전동, 출혈침

명세서

도면의 간단한 설명

도 1은 본 발명에 따른 전동침(10) 조립도,

도 2는 본 발명에 따른 전동침(10) A-A종단면도,

도 3은 본 발명에 따른 전동침(10) B-B횡단면도,

도 4는 본 발명에 따른 전동침(10)동력전달 구조 A'종단면도,

도 5는 본 발명에 따른 전동침(10)동력전달 구조 B'종단면도,

도 6은 본 발명에 따른 전동침(10)의 휠(24) 동력전달 구조 진행상태 도면,

도 7은 본 발명에 따른 전동침(10) 정면도,

도 8은 본 발명에 따른 전동침(10) 배면도,

도 9는 본 발명에 따른 전동침(10) 우측면도,

도 10은 본 발명에 따른 전동침(10) 좌측면도,

도 11은 본 발명에 따른 전동침(10) 저면도,

도 12는 본 발명에 따른 전동침(10) 상면도,

도 13은 본 발명에 따른 전동침(10)의 손잡이 부를 잡은 상태 입면도,

도 14는 본 발명에 따른 전동침(10)의 침부를 잡은 상태 입면도.

* 도면의 주요부분에 대한 부호 설명

10 : 전동침

11 : 일회용 침

12 : 투명뚜껑

13 : 침 길이조절 링

14 : 작동버튼

15 : 전원버튼

16 : 전원램프

17 : 수동램프

18 : 자동램프

19 : 제어판

20 : 건전지

21 : 건전지뚜껑

22 : 모터

23 : 회전축

24 : 휠

25 : 행정연결대

26 : 수직연결대

27 : 스프링

28 : 침 꽃이

29 : 전구

30 : 통기구

31 : 고정뚜껑

33 : 환기구

34 : 힌지

35 : 깔때기형 투명뚜껑

36 : 도장형 투명뚜껑

37 : 도장침

38 : 긴 깔때기형 뚜껑

39 : 빗살무늬형 뚜껑

40 : 나사못

발명의 상세한 설명

발명의 목적

발명이 속하는 기술 및 그 분야의 종래기술

본 발명은 통상의 출혈침에 모터(22)를 이용해 연사가 되는 기능을 추가함으로써 짧은 시간에 시침이 가능하여 환자의 긴장상태와 고통을 짧게 느낄 수 있게 하는 동시에 치료하는 사람의 반복되는 노동을 줄일 수 있다, 또 인체공학적인 디자인으로 설계되어 환자의 부위에 따라 도 13이나 도 14와 같이 잡기가 편리한 방식을 선택하여 시침 할 수 있고 미려하며, 용도에 맞게 투명뚜껑(12)이나 일회용 침(11)을 교환하여 사용할 수 있도록 하였고, 무엇보다도 작동버튼만 누르면 자동으로 연사되어 편리함을 제공하는 전동침에 관한 것이다.

일반적으로 출혈침은 혈자리나 환부에 출혈을 목적으로 사용되며, 급제시나 구급 시에 혈자리를 자극하여 응급처치를 하고, 근래에는 대체의학으로 널리 사용되어 많은 사람들이 활용하고 있는데, 의사나 시침을 하는 사람들은 여러 환자를 상대하는 경우와, 한 부위에 수차례 연속적으로 시침을 하는 경우 때문에, 그 반복되는 노동으로 스트레스를 받는다.

침을 맞기를 좋아 하는 사람은 없을 것이다, 더군다나 여러 차례 침을 같은 부위에 놓는다면 대부분 사람들은 맞으려고 하지 않아 시침을 하는 데 어려움이 있다. 또 경험해본 사람들은, 침을 맞는 긴 시간동안 아픔을 동반한 긴장상태 때문에 다시는 맞으려고 하지 않는 문제점이 있다.

상기 압진기는 침을 놓기 전에 침놓을 자리를 마사지하여 침을 맞는 고통을 줄일 수 있도록 한 것으로서 일반적으로 별도의 압진기를 구매하여 사용하여야 하는 불편함이 있었다.

발명이 이루고자 하는 기술적 과제

이에 본 발명은 상기한 바와 같은 종래의 제반 문제점을 해소하기 위하여 안출한 것으로, 그 목적은 침을 맞지 않는 것이 아니라 스피드하게 맞고, 시침하는 사람도 선동의 힘을 빌려 반복되는 같은 동작에서 해방이 되며, 바늘이 피부에 시침될 때 짧은 순간에 이루어짐으로써 고통도 덜 수 있는 전동침(10)을 제공함에 있다.

발명의 구성 및 작용

상기와 같은 목적을 달성하기 위해서, 본 발명은 본체 케이스하부에 투명뚜껑(12)을 열면 일회용 침(11)을 끼우는 침 꽃이(28)와 수직 작동하는 연결부를 갖고 스프링(27)과 모터(22)를 활용해 자동으로 작동시키고; 상기 본체 몸통을 중심으로 세 부위로 갈라진 구조로, 손잡이 부와 모터 부, 침부로 나누어지고; 상기 손잡이 단부에는 고리(33)가 설치되고, 그 아래에 3개의 램프(16, 17, 18)와 전원버튼(15)이 설치되며, 반대쪽에는 건전지(20)를 교환할 수 있는 건전지뚜껑(21)이 있는 것과; 상기 모터 부에는 전동 모터(22)가 내장되어있고 단부에는 환기구(32)가 설치되며; 상기 침부에는 투명뚜껑(12)과 침 길이조절 링(13)내부에 나사산이 있고 외부에 나사산이 있는 본체에 차례대로 조립되는 것과, 그 관통된 중앙부에는 일회용 침(11)이 침 꽃이(28)에 결합되고, 수직연결대(26)와 행정연결대(25), 휠(24), 회전축(23), 모터(22) 순으로 연결된 구조를 가지고 있으며, 모터의 회전운동이 왕복운동으로 바뀌어 침이 재봉틀처럼 작동되는 것을 특징으로 하는 것이다.

이하, 침부된 도면을 참조로 하여 본 발명의 바람직한 일실시예를 상세히 설명한다.

도 1에 도시한 바와 같이 본 발명에 따른 전동침(10) 조립도로 본 발명의 조립되는 구성을 살펴보면, 상기 본체 케이스하부에 투명뚜껑(12)은 전구(29)를 장착하여 시침 시 환부의 조도를 높여줄 수 있게 투명한 소재를 선택하였으며, 일회용 침(11)과 더불어 환부에 따라 교환 하여 사용할 수 있도록 하였고, 기본적인 일반 형 투명뚜껑(12)과 주둥이가 뾰족한 깔때기형 투명뚜껑(35), 구멍이 크게 뚫린 도장형 투명뚜껑(36)이 있다, 일반 형은 기본적인 타입으로 일회용 침(11)을 사용할 때 장착하고, 깔때기형 투명뚜껑(35)은 이침(耳針)이나 움푹한 곳에 침을 놓을 때 장착하며, 도장형 투명뚜껑(36)은 일회용 침에 바늘이 여러 개 나와 있는 도장침(37)을 사용할 때 장착하는 것으로 한 부위에 여러 개의 침을 놓을 때 사용한다. 또 고정 뚜껑(31)은 기본적인 일반 형과 빗살무늬토기형 뚜껑(39) 그리고 긴 깔때기형 뚜껑(38)이 있다, 일반 형은 기본적인 타입으로 공이 반 절단된 모양을 하고 있고, 빗살무늬토기형 뚜껑(39)은 럭비공을 반 절단한 모양을 하고 있으며, 긴 깔때기형 뚜껑(38)은 깔때기 모양 끝에 구슬 같은 볼 형태의 돌기가 만들어져, 압진기 역할을 한다. 상기 압진기는 침을 놓기 전에 침놓을 자리를 마사지하여 침을 맞는 고통을 줄일 수 있도록 한 것으로서 일반적으로 별도의 압진기를 구매하여 사용하여야 했으나 전동침(10)에는 자체에 압진기가 장착되어 전동침만 있으면 시침은 물론 압진기의 역할까지 할 수 있게 하였다.

도 2에 도시한 바와 같이 본 발명에 따른 전동침(10)의 A-A절단면도로 전반적인 전동침(10)의 내부를 표현하고 있다. 상기 일회용 침(11)을 끼우는 침 꽃이(28)는 침을 기웠을 때 유동이 없도록 침 모양과 닮은꼴로 되어있고, 원통형으로 된 상부가 막혀있는 삽입공 모양을 하고 있으며, 하부에서부터 수직으로 서있는 원통의 한 면이 갈라져 있어 일회용 침(11)을 끼우고 뺄 때 험형하지 않으면서 자연스럽게 삽입되고 빼낼 수 있도록 되어있는 것과; 상기 침 꽃이(28)의 원기둥 바깥쪽으로 스프링(27)이 끼워져 전동침(10)이 작동 하지 않을 때는 노출되지 않고 항상 투명뚜껑(12)안쪽에 머물러 있도록 하는 역할을 한다, 상기 침 꽃이(28)위에서 잡아주는 수직연결대(26)는 행정연결대(25)와 침 꽃이(28)를 연결하고; 상기 행정연결대(25)는 수직연결대(26)와 휠(24)을 연결하며 상하 한쪽으로 ㄷ자를 이루며 연결 축이 되어 나와 있고; 상기 휠(24)은 모터의 회전축과 연결되어 모터에서 나오는 동력을 수직 상하왕복운동으로 바꾸어 주는 역할을 한다. 또 상기 모터에는 건전지(20)에서 나오는 전력으로 동력을 일으키며, 여기서는 1.5v AA size 건전지 두개를 사용 하였으나 AC로도 활용할 수 있고, DC를 사용하여 휴대하기 편리 하게 축전지를 활용할 수도 있다.

도 3에 도시한 바와 같이 본 발명에 따른 전동침(10)의 B-B절단면도로, 상기 도 2의 발명의 구성에서 상세히 설명이 되었으며, 모터(22)의 동력이 휠(24)로 연결되어 회전운동에너지가 상하 왕복운동에너지로 변환되는 과정을 보여준다(참조로 도 6에 도시한바와 같이 화살표를 따라 행정이 이루어진다.). 추가로 보충 설명할 것은 스프링(27)의 역할과 침 길이조절 링(13)의 역할로서 상기 에서는 스프링(27)을 단순히 전동침(10)이 작동 하지 않을 때는 노출되지 않고 항상 투명뚜껑(12)안쪽에 머물러 있도록 하는 역할을 하는 것으로만 설명되었으나 항상 스프링(27)이 긴장상태를 유지하고 있어, 침이 피부에 삽입되었다가 빠질 때 스프링(27)도움을 받아 가장 빠른 속도로 빠져나와 통증을 최소화 할 수 있도록 하여 주고, 침 길이조절 링(13)은 시침 시 환자의 고통을 호소하면 침 길이조절 링(13)을 돌려 침의 길이를 통증과 반비례하게 조절하여 사용한다, 다시 말하자면 많이 아파하는 사람은 조금만 침이 삽입되게 침 길이조절 링(13)을 풀어 사용하고, 피부에 혈이 돌지 않아 통증을 느끼지 못하는 환자는 빠른 효과를 위하여 침 길이조절 링(13)을 조여 침이 피부에 깊이 삽입되게 하여 사용한다.

도 4에 도시한 바와 같이 본 발명에 따른 전동침(10) 동력전달 구조 A'종단면도로, 도 2를 확대 하여 네테일하게 표현한 도면이다.

도 5에 도시한 바와 같이 본 발명에 따른 전동침(10) 동력전달 구조 B'종단면도로, 도 3을 확대 하여 디테일하게 표현한 도면이다.

도 6에 도시한 바와 같이 본 발명에 따른 전동침(10) 동력전달 구조 회전축(23)의 진행상태를 나타낸 도면으로, 도 3의 발명의 구성에서 자세히 설명되어 있다.

도 7, 도 8, 도 9, 도 10, 도 11, 도 12에 도시한 바와 같이 본 발명에 따른 전동침(10)의 앞뒤상하좌우입면도로, 육면체의 유리판에 넣고 여섯 면에서 바라본 그림이나, 전체가 현대감각에 맞게 유선형디자인으로 설계되었으며, 의료기인 만큼 청결하고 시술이 용이하며 시침 시 편리한 인체공학적인 모양으로 설계되었다. 도 7의 정면도에서 고리(33)아래쪽에는 3개의 램프(16, 17, 18)와 전원버튼(15)이 있는데 손잡이 내부에 있는 제어판(19)과 연결되어 제어가 되며, 전원버튼(15)을 길게 누르면 전원램프(16)에 점등이 되고 작동준비 상태를 알리며, 나머지 수동램프(17)와 자동램프(18)는 전원버튼을 짧게 누를 때 마다 번갈아 점등되고, 다시 길게 누르면 소등이 됨과 동시에 OFF상태가 된다.

도 13에 도시한 바와 같이 본 발명에 따른 전동침(10)의 손잡이 부를 잡은 상태를 나타낸 입면도로, 권총을 잡을 때의 그림(grip)이다. 침부를 잡을 때의 그림(grip)보다 손목에 무리를 주지 않으며 장시간 시침을 하거나 많은 사람을 시술할 때 편리하며, 검지로 작동버튼(14)을 누를 수 있다.

도 14에 도시한 바와 같이 본 발명에 따른 전동침(10)의 침부를 잡은 상태를 나타낸 입면도로, 연필을 잡을 때의 그림(grip)이다. 손잡이 부를 잡을 때의 그림(grip)보다 섬세한 시침을 할 때 유리하며, 검지로 작동버튼(14)을 누를 수 있다.

발명의 효과

상술한 바와 같이 본 발명은 종래의 제반 문제점을 해소하기 위하여 안출한 것으로, 인체공학적인 디자인으로 설계되어 환자의 부위에 따라 도 13이나 도 14와 같이 시침하기 편리한 그림(grip)방식을 선택할 수 있고, 세련되고 미려하며, 용도에 맞게 투명뚜껑(12)이나 일회용 침(11), 고정뚜껑(31)을 교환하여 사용할 수 있도록 하였고, 상기 고정뚜껑(31)은 압진기 대체용으로 침을 놓기 전에 침놓을 자리를 마사지하여 침을 맞는 고통을 줄일 수 있도록 한 것으로서, 일반적으로 별도의 압진기를 구매하여 사용하여야 했으나 전동침(10)에는 자체에 압진기가 장착되어 전동침(10)만 있으면 시침은 물론 압진기의 역할까지 할 수 있는 효과가 있다. 무엇보다도 작동버튼만 누르면 자동으로 연사되어 시간을 절약하고, 시침하는 사람이 전동의 힘을 빌려 반복되는 같은 동작에서 해방이 되며, 일회용 침이 피부를 통과하는 순간이 눈 깜짝 할 사이에 이루어짐으로써 통증도 줄고, 스피드하게 시술할 수 있는 효과를 갖는다.

(57) 청구의 범위

청구항 1.

사혈을 할 때 사용되는 출혈용 침에 있어서; 상기 작동수단을 손가락이 아닌 모터(22)를 활용해 자동으로 작동시키고, 전 체구조는 본체 몸통을 중심으로 세 부위로 갈라진 손잡이 부와 모터 부, 침부로 나누어지고; 상기 손잡이 단부에는 고리(33)가 설치되고, 그 아래에 3개의 램프(16, 17, 18)와 전원버튼(15)이 설치되며, 반대쪽에는 건전지(20)를 교환할 수 있는 건전지뚜껑(21)이 있는 것과; 상기 모터 부에는 전동 모터(22)가 내장되어있고 단부에는 환기구(32)가 설치되며; 상기 침부에는 투명 뚜껑(12)과 침 길이조절 링(13)내부에 나사산이 있고 외부에 나사산이 있는 본체에 차례대로 조립되는 것과, 그 관통된 중앙부에는 일회용 침(11)이 침 끝이에 결합되고, 수직연결대(26)와 행정연결대(25), 휠(24), 회전축(23), 모터(22) 순으로 연결된 구조를 가지고 있으며, 모터의 회전운동이 왕복운동으로 바뀌어 침이 재봉틀처럼 작동되는 것을 특징으로 하는 전동침(10).

청구항 2.

1항에 있어서, 일회용 침 하나에 여러 개의 바늘을 갖고, 그 모양에 따라 투명뚜껑(12)의 개방된 구멍의 크기가 넓어진 것을 특징으로 하는 전동침(10).

청구항 3.

1항에 있어서, 투명뚜껑(12)의 주둥이가 이침에 사용할 수 있게 뿔족한 것을 특징으로 하는 전동침(10).

청구항 4.

1항에 있어서, 투명뚜껑(12)의 주둥이가 도장침을 사용할 수 있게 구멍이 넓게 뚫린 것을 특징으로 하는 전동침(10).

청구항 5.

1항에 있어서, 일회용 침(11)하나에 여러 개의 바늘이 달린 것을 특징으로 하는 일회용 도장침(11).

청구항 6.

1항에 있어서, 본체 몸통을 중심으로 세 부위로 갈라진 구조로, 손잡이 부와 모터 부, 침부로 나누어지고; 상기 본체를 시침할 부위에 따라 권총을 잡을 때의 그립(grip), 연필을 잡을 때의 그립(grip)두 가지 형태로 쥐고 작동시킬 수 있는 것을 특징으로 하는 전동침(10).

청구항 7.

1항에 있어서, 고정뚜껑(31)을 압진기로 사용할 수 있게 한 것을 특징으로 하는 전동침(10).

청구항 8.

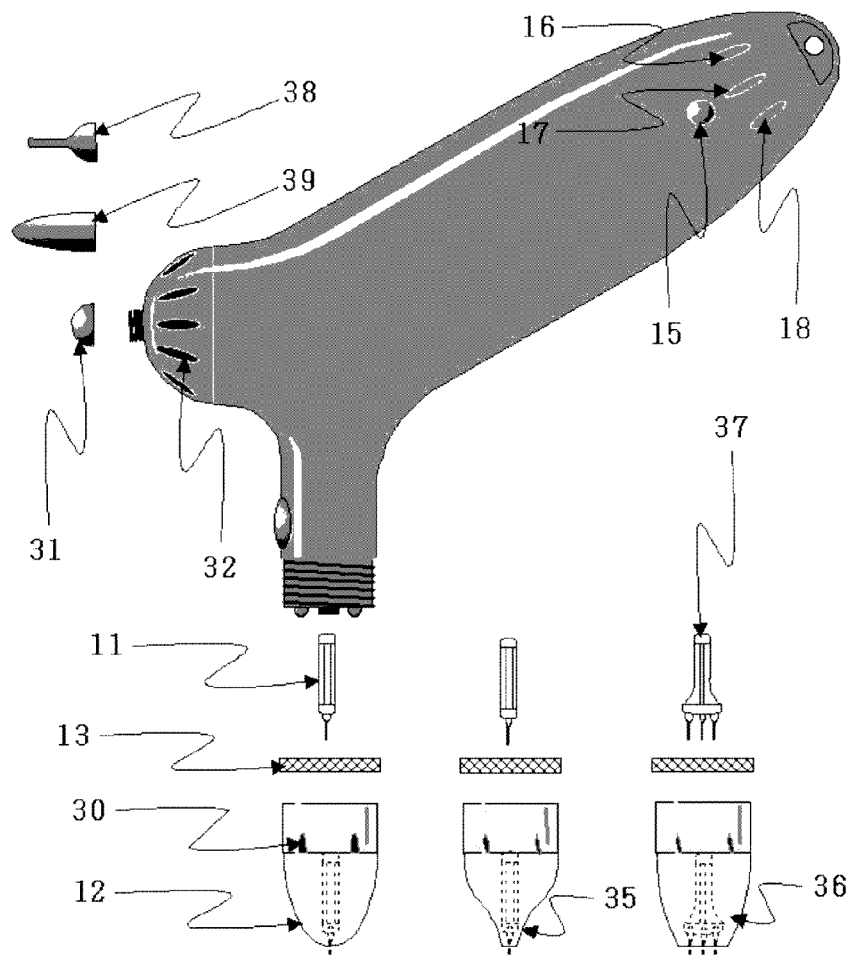
1항에 있어서, 투명뚜껑(12)내부에 전구(29)를 장착하여 시침 시 환부의 조도를 높여줄 수 있게 한 것을 특징으로 하는 전동침(10).

청구항 9.

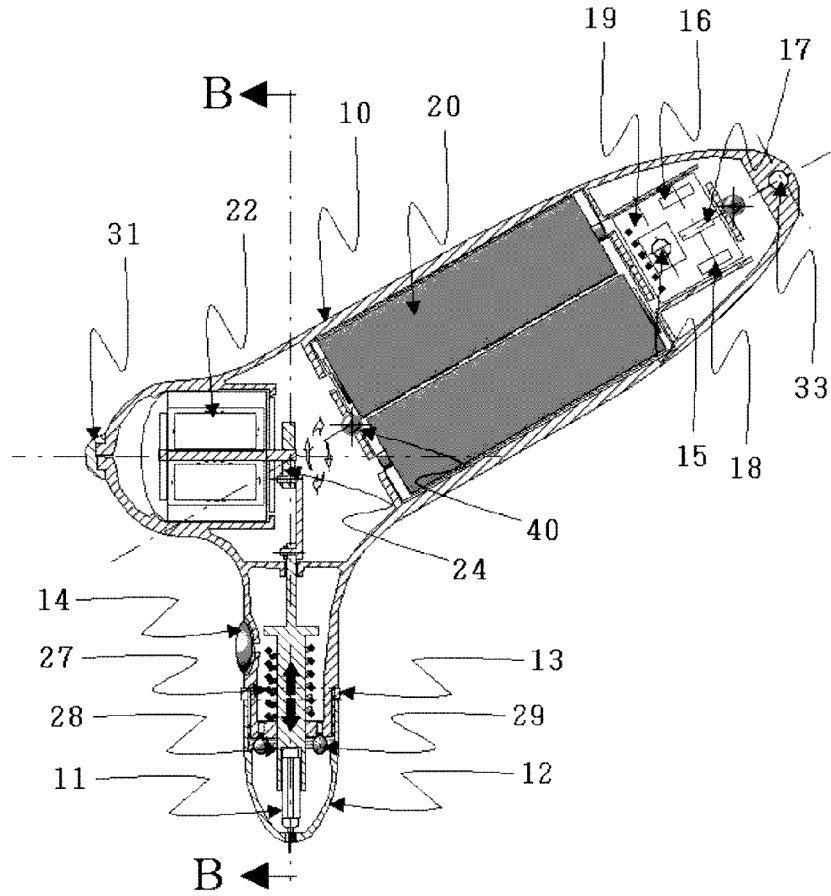
2항에 있어서, 일회용 침 하나에 여러 개의 바늘을 갖은 것을 특징으로 하는 일회용 도장침(37)

도면

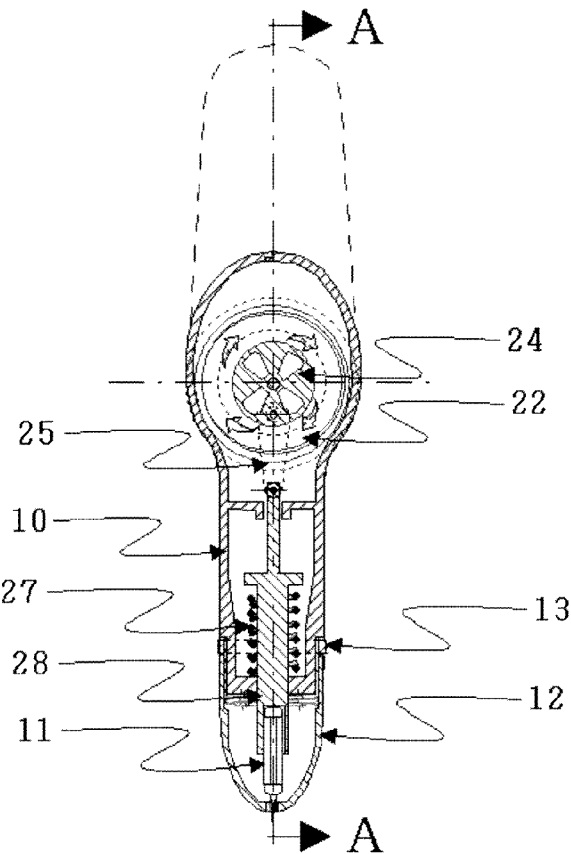
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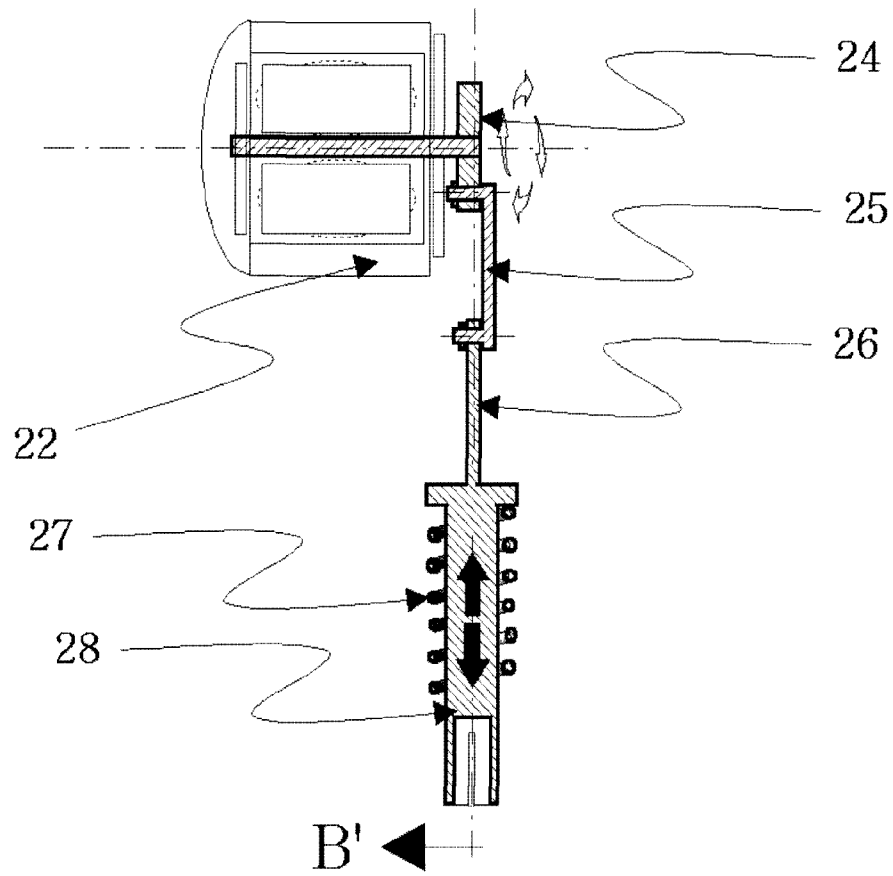
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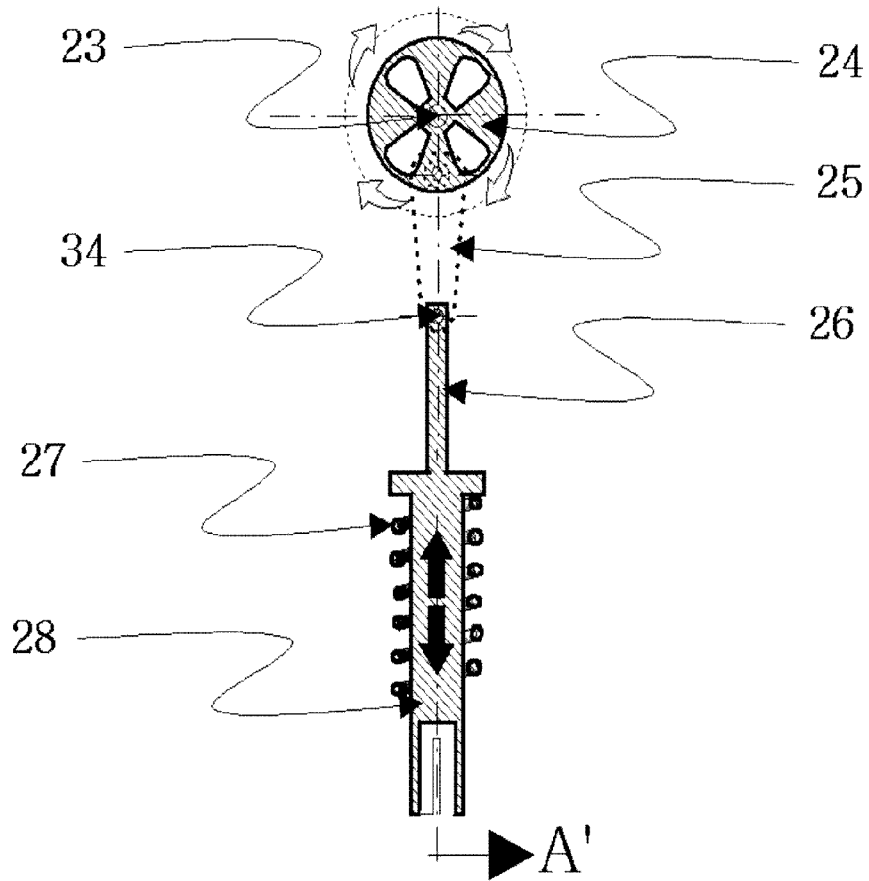
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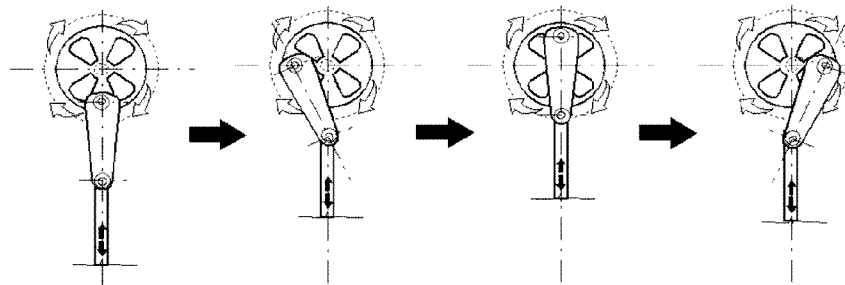
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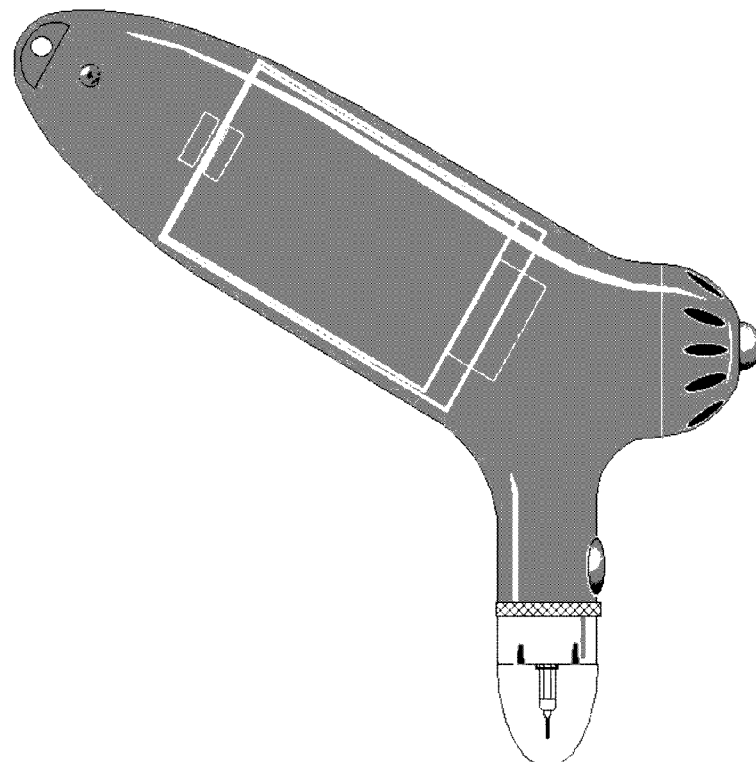
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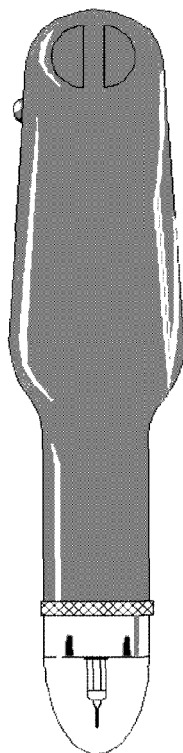
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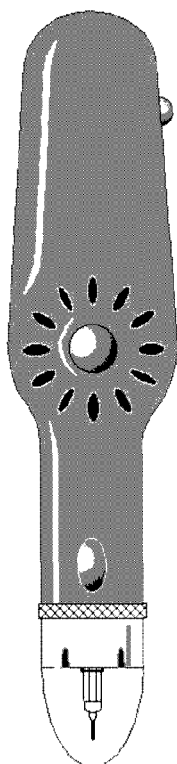
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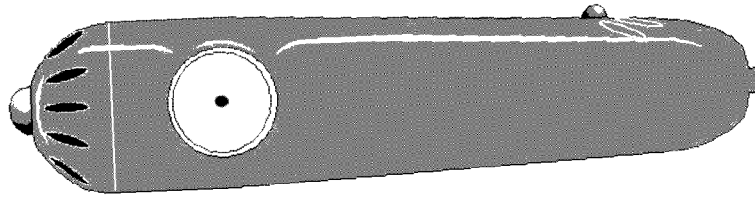
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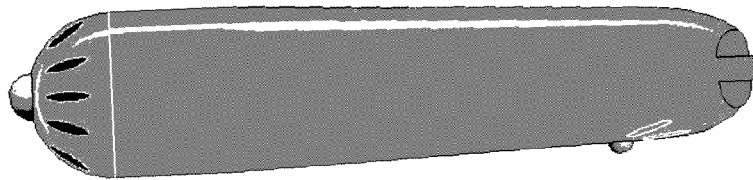
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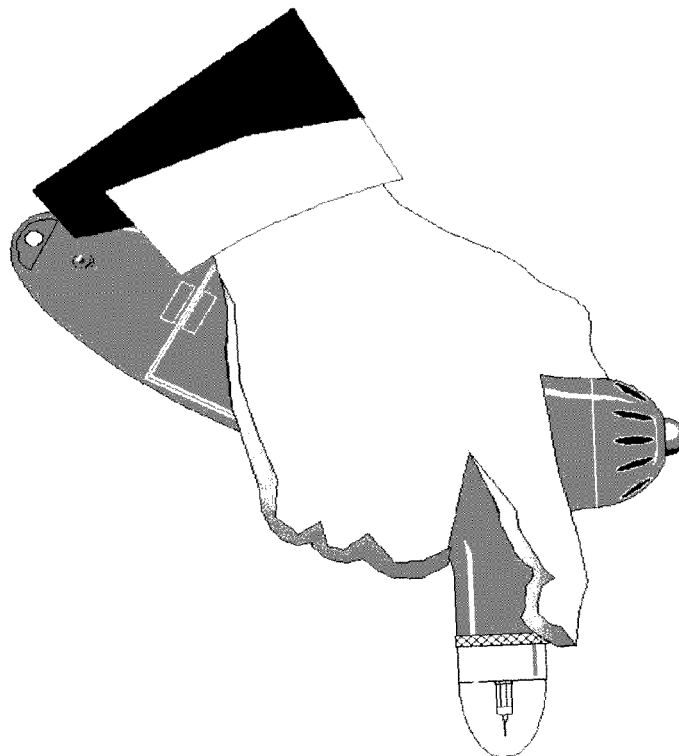
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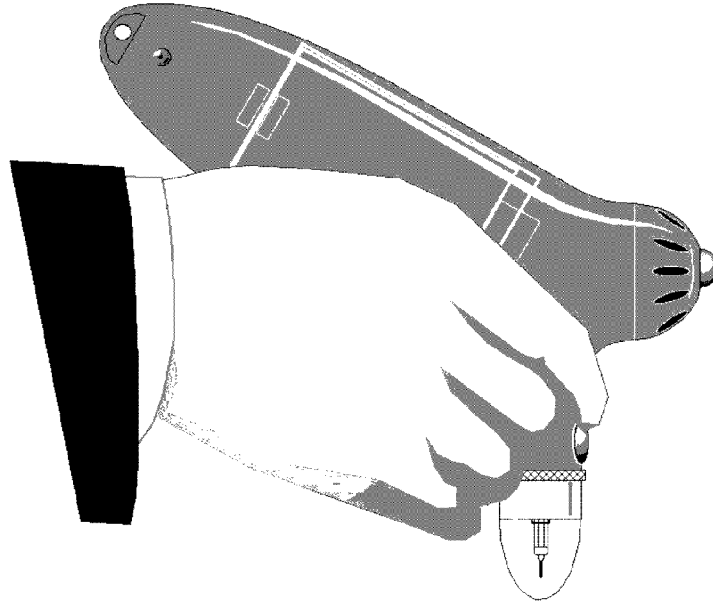
도면12



도면13



도면14



Hand-held foot multipurpose masseur

Abstract

A portable hand-held multifunctional massager for feet belongs to the field of health-care tools for feet. The utility model is characterized in that the massager is composed of a point-pressed vibratile magnet curing massaging head, a casing, a battery, a vibrating intensity adjusting switch and a laser illuminating switch, wherein the body surface of the point-pressed vibratile magnet curing massaging head is provided with a weave-shaped machinery massaging head and a circular laser massaging head, the casing is used as a handle as well as an outer casing, the battery is installed inside the handle, and the vibrating intensity adjusting switch and the laser illuminating switch are arranged on the casing. The utility model simultaneously has the four massaging functions of machinery massaging, vibrating massaging, laser massaging and magnet curing massaging. The geometric shape and area of each massaging head are designed by imitation of handle massaging method, being adaptable for the implement of different massaging method in the time of massaging feet. The utility model processes reflexotherapy and health-care massaging to all positions and acupuncture points of feet.

Description

The hand-held foot is used masseur more

Technical field:

A kind of portable hand-held foot is used masseur more, and it belongs to the foot massage health-caring equipment manufacturing technology field of foot reflexotherapy.

Background content:

Foot is " second heart of human body ", and the massage foot just is equivalent to massage each position of whole body and internal organs, not only can dredging the meridian, the operation QI and blood, can also improve the immunity of human body, reach ill and cure the disease, do not have the effect of disease and health. What be exclusively used in foot massage at present has foot bath massager, foot warmer, a foot movement masseur etc., is not easy to carry and uses flexibly, does not now see the report that the portable hand-held foot is used masseur more as yet.

Summary of the invention:

The purpose of this utility model is to provide a kind of and imitates multiple foot massage maneuver and be applicable to foot different parts and acupuncture point, and the small and exquisite hand-held foot of being convenient to flexibly carry is used masseur more.

Of the present utility model being characterised in that: it is that a kind of hand-held foot that has vibration massage function concurrently is used masseur more, it is designed to the circular massage head of massage head (1) (2) of undaform by body surface, and two vertical symmetrical housings of handgrip (3) shape, the point pressure type vibromassage head (4) that is linked closely by an end of above-mentioned housing, and magnet ring (5) is housed in the massage head (4), inboard fastening the semiconductor laser (6) of circular massage head (2) that the other end links closely, be installed in the adjustable vibromassage intensity switch of vibrating motor (8) in stage casing in the above-mentioned housing, semiconductor laser switch (9), and be installed in the interior battery of handgrip (3) (10) composition.

Use proof: this utility model has reached and has given the phase purpose.

Description of drawings:

In order in conjunction with example this utility model to be done detailed describing below, show as follows employed accompanying drawing number of present specification and title brief introduction:

Fig. 1: the hand-held foot is used the masseur longitudinal section more.

Fig. 2: the hand-held foot is used the masseur right side view more.

Fig. 3: the hand-held foot is used the masseur left side view more.

The specific embodiment:

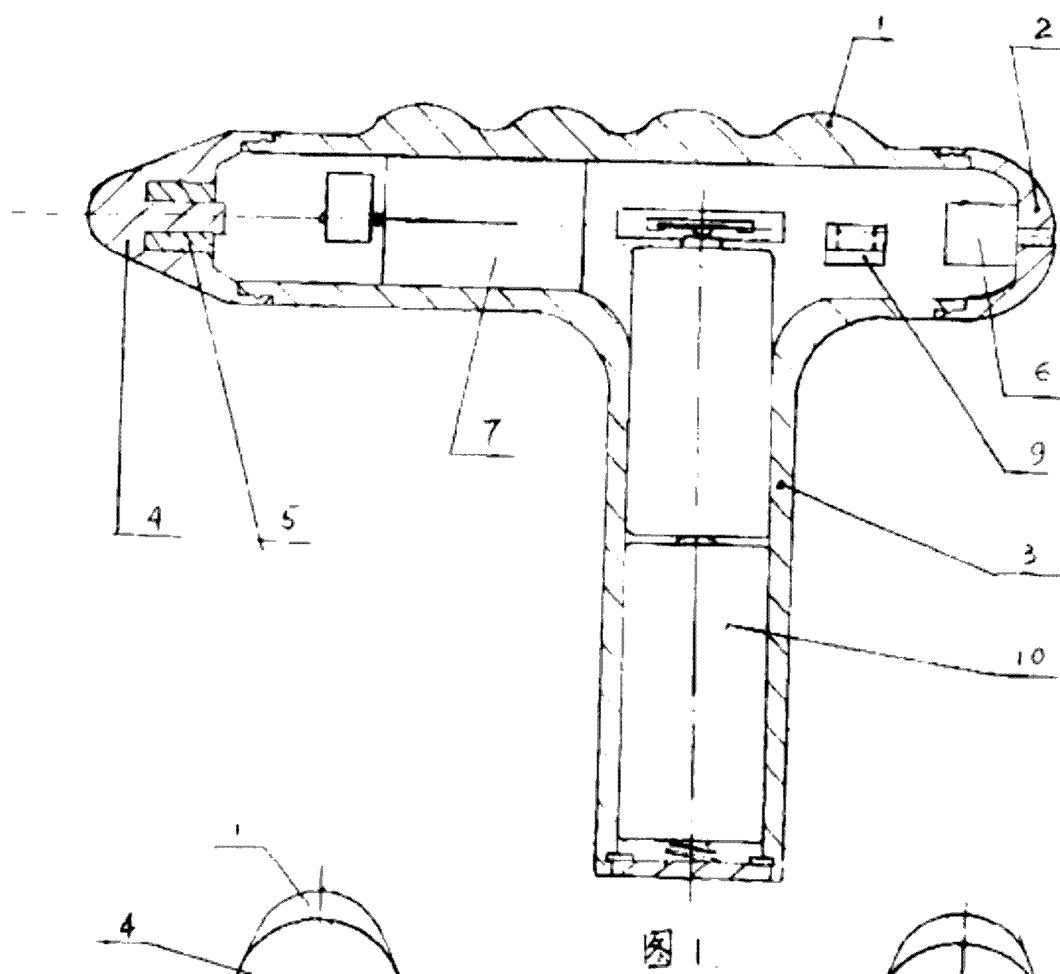
Ask for an interview Fig. 1-3. Design has waveform massage head (1), has circular massage head (2) and handgrip (3), puts the vibrating motor (7) that pressure type vibromassage head (4) is fastened by above-mentioned two housing stage casings on the symmetrical half-open housing, and the electric wire of motor is connected with scalable oscillation intensity switch (8) and battery machine. The semiconductor laser electric wire of circular massage head (2) internal fixation on the above-mentioned vertical symmetrical housing is connected with switch (9) and battery. Vibromassage intensity switch (8), semiconductor laser switch fix with vertical symmetrical housing. Above-mentioned each massage head and housing are all made by rubber and plastic.

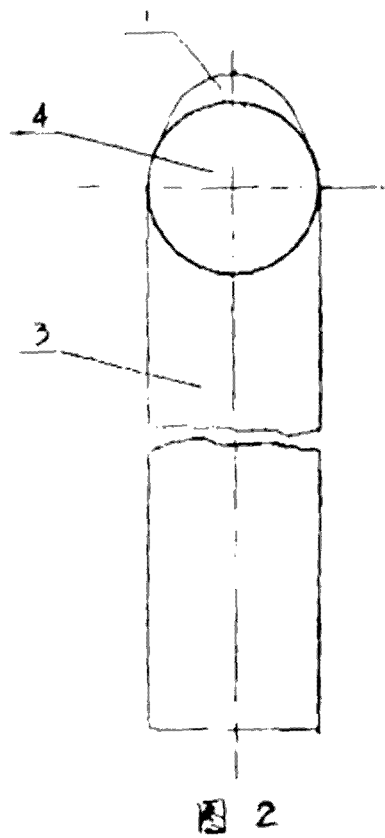
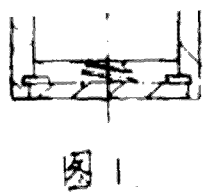
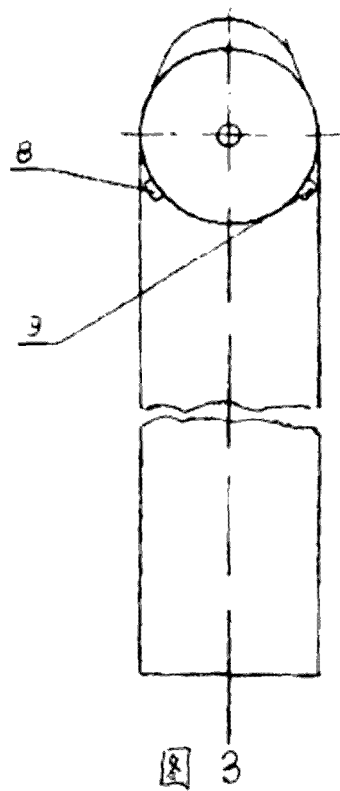
During use, open switch (8) vibrating motor (7) and rotate the generation vibration, a drive point pressing massage head (4), wave massage head (1) are done vibromassage, and its intensity can be controlled by by-pass cock (8). Turn on and off power supply by semiconductor laser switch (9), make circular massage head (2) can do or not have the laser irradiation massage. Can use waveform massage (1) to carry out the large tracts of land massage for vola portion, carry out

magnetic massage simultaneously carrying out a pressing massage with the some pressure type massage head (4) that magnet ring (5) is housed.

This shows that this utility model has vibromassage, magnetic massage, laser irradiation massage and four kinds of functions of mechanical massage concurrently. And the geometry of each massage head and area are imitation staff massage designs, apply to different position of foot and acupuncture point. Can carry out the large-area massage in point pressing, part and vola, can realize reaching foot is carried out reflexotherapy and self health care with different massage manipulations. It is easy to carry, and safe in utilization is the ideal health care apparatus of a kind of various crowds of being suitable for and place massage.

Drawings







[12] 实用新型专利说明书

[21] ZL 专利号 01275009.3

[45] 授权公告日 2003 年 3 月 26 日

[11] 授权公告号 CN 2540948Y

[22] 申请日 2001.11.23 [21] 申请号 01275009.3

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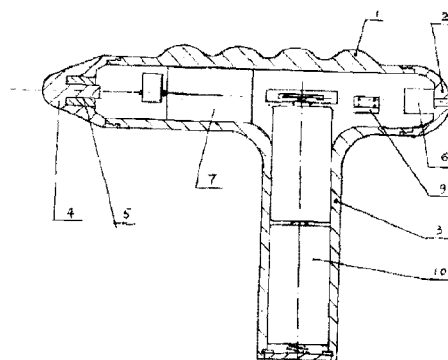
[72] 设计人 董 军

权利要求书 1 页 说明书 3 页 附图 1 页

[54] 实用新型名称 手持式足部多用按摩器

[57] 摘要

便携式手持足部多用按摩器属于足部保健用具领域，其特征在于：它由体表带有波浪形机械按摩头、圆形激光按摩头、点压式可振动的磁疗按摩头，手把兼外壳的壳体，且手把内可装入电池、壳体上有振动强度调节开关、激光照射开关构成。它同时具有机械、振动、激光和磁疗四种按摩功能。其各按摩头的几何形状及面积是模仿人手按摩手法设计的，适用足部按摩时实施不同按摩手法，对足部所有部位和穴位进行反射疗法及保健按摩。



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MassagerPriorArt0000343

- 1、一种便携式手持足部按摩器，由两个按摩头、手柄和壳体组成，其特征在于：将按摩器顶端设计成波浪形，一端为圆形按摩头，另一端为点压式磁疗振动按摩头，手柄在按摩器中间部分，壳体内安装振动电机，壳体上还装有可调节振动按摩强度的开关，手柄内安装有电池盒。
- 2、如权利要求 1 所述的便携式手持足部按摩器，其特征在于圆形按摩头中安装有半导体激光器，半导体激光器的开关置于手柄上。

手持式足部多用按摩器

技术领域：

一种便携式手持足部多用按摩器，它属于足部反射疗法的足部按摩保健器材制造技术领域。

背景内容：

足部是“人体的第二心脏”，按摩足部就相当于按摩全身各个部位及脏器，不但可以疏通经络、运行气血、还可以提高肌体的免疫力，达到有病治病、无病健身的作用。目前专用于足部按摩的有足浴按摩器、脚炉、足部运动按摩器等，不便于随身携带和灵活使用，现尚未见到便携式手持足部多用按摩器的报导。

发明内容：

本实用新型的目的在于提供一种可模仿多种足部按摩手法适用于足部不同部位和穴位，并小巧灵活便于随身携带的手持式足部多用按摩器。

本实用新型的特征在于：它是一种兼具振动按摩功能的手持式足部多用按摩器，它由体表被设计成波浪型的按摩头(1)圆形按摩头(2)、和手把(3)形状的两个纵对称壳体、被上述壳体的一端紧扣住的点压式振动按摩头(4)、且按摩头(4)内装有磁环(5)，另一端紧扣的圆形按摩头(2)内侧紧固着半导体激光器(6)、安装在上述壳体内中段的振动电机可调振动按摩强度开关(8)、半导体激光器开关(9)，且安装在手把(3)内电池(10)组成。

使用证明：本实用新型达到了预期目的。

附图说明：

为了在下面结合实例对本实用新型作详尽描绘，现把本申请文件所使用的附图编号及名称简介如下：

图 1：手持式足部多用按摩器纵剖视图。

图 2：手持式足部多用按摩器右侧视图。

图 3：手持式足部多用按摩器左侧视图。

具体实施方式：

请见图 1—3。相互对称的半开的壳体上设计有波浪形按摩头 (1)、带有圆形按摩头(2)和手把(3)、点压式振动按摩头(4)被上述两个壳体中段所扣住的振动电机(7)，电机的电线与可调节振动强度开关 (8)及电池机连接。上述纵对称壳体上的圆形按摩头(2)内固定的半导体激光器电线与开关 (9)及电池连接。振动按摩强度开关(8)、半导体激光器开关与纵对称壳体相固定。上述各按摩头及壳体皆由橡塑制成。

使用时，打开开关(8)振动电机(7)转动产生振动，带动点压按摩头(4)、波浪按摩头(1)作振动按摩，其强度可通过调节开关(8)来控制。通过半导体激光器开关(9)接通或关断电源，使圆形按摩头(2)可作有或无激光照射按摩。对于足底部可使用波浪形按摩(1)进行大面积按摩，在用装有磁环(5)的点压式按摩头(4)进行点压按摩同时进行磁疗按摩。

由此可见，本实用新型兼具振动按摩、磁疗按摩、激光照射按摩和机械按摩四种功能。且各按摩头的几何形状和面积是模仿人手按摩设计的，运用于足部不同的部位和穴位。可进行穴位点压、局部和足底大面积的按摩，可实现用

不同按摩手法达到对足部进行反射疗法及自我保健。其携带方便，使用安全是一种适用各种人群及场所按摩的理想的医疗保健用具。

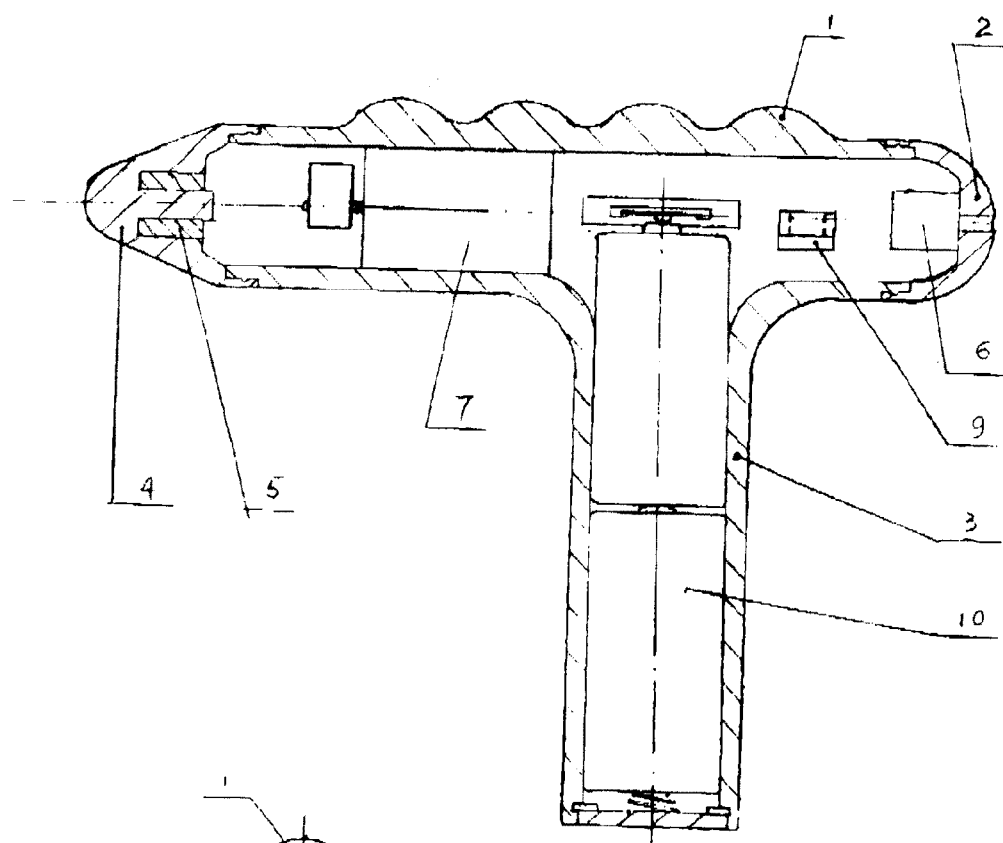


图 1

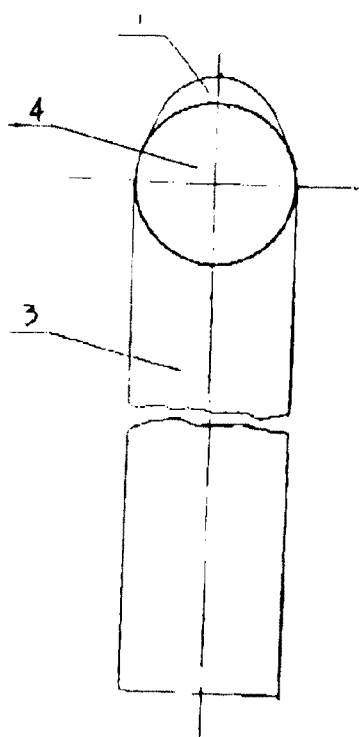


图 2

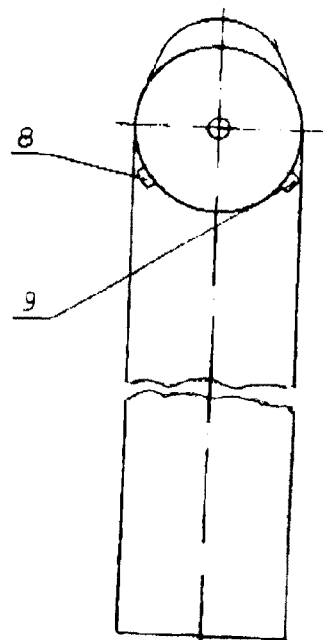


图 3

(19)



(11)

EP 2 510 891 B1

(12)

EUROPEAN PATENT SPECIFICATION

(45) Date of publication and mention
of the grant of the patent:
01.06.2016 Bulletin 2016/22

(51) Int Cl.:
A61B 17/32 ^(2006.01) **H01M 2/10** ^(2006.01)

(21) Application number: **12164202.9**

(22) Date of filing: **15.04.2012**

(54) **Battery-powered hand-held ultrasonic surgical cautery cutting device**

Batteriebetriebene handgehaltene chirurgische Ultraschall-Kauterisationsbrenneisenvorrichtung

Dispositif de découpe de cautère chirurgical ultrasonique portable alimenté par batterie

(84) Designated Contracting States:
**AL AT BE BG CH CY CZ DE DK EE ES FI FR GB
GR HR HU IE IS IT LI LT LU LV MC MK MT NL NO
PL PT RO RS SE SI SK SM TR**

(30) Priority: **15.04.2011 US 201161476022 P**
30.11.2011 US 201113307750

(43) Date of publication of application:
17.10.2012 Bulletin 2012/42

(60) Divisional application:
16166034.5

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EP-A1- 2 200 145 WO-A2-2006/119376
US-A1- 2006 087 286 US-A1- 2006 206 100

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Description**Field of the Invention**

5 **[0001]** The present invention relates generally to an ultrasonic cutting device and, more particularly, relates to a battery-powered, hand-held, ultrasonic surgical cautery cutting device.

Description of the Related Art

10 **[0002]** Ultrasonic instruments are effectively used in the treatment of many medical conditions, such as removal of tissue and cauterization of vessels. Cutting instruments that utilize ultrasonic waves generate vibrations with an ultrasonic transducer along a longitudinal axis of a cutting blade. By placing a resonant wave along the length of the blade, high-speed longitudinal mechanical movement is produced at the end of the blade. These instruments are advantageous because the mechanical vibrations transmitted to the end of the blade are very effective at cutting organic tissue and, simultaneously, coagulating the tissue using the heat energy produced by the ultrasonic frequencies. Such instruments are particularly well suited for use in minimally invasive procedures, such as endoscopic or laparoscopic procedures, where the blade is passed through a trocar to reach the surgical site.

15 **[0003]** For each kind of cutting blade (e.g., length, material, size), there are one or more (periodic) driving signals that produce a resonance along the length of the blade. Resonance results in movement of the blade tip, which can be optimized for improved performance during surgical procedures. However, producing an effective cutting-blade driving signal is not a trivial task. For instance, the frequency, current, and voltage applied to the cutting tool must all be controlled dynamically, as these parameters change with the varying load placed on the blade and with temperature differentials that result from use of the tool.

20 **[0004]** FIG. 1 shows a block schematic diagram of a prior-art circuit used for applying ultrasonic mechanical movements to an end effector. The circuit includes a power source 102, a control circuit 104, a drive circuit 106, a matching circuit 108, a transducer 110, and also includes a handpiece 112, and a waveguide 114 secured to the handpiece 112 (diagrammatically illustrated by a dashed line) and supported by an outer, tubular cannula 120. The waveguide 114 terminates into a blade 116 at a distal end. A clamping mechanism 118, is part of the overall end effector and exposes and enables the blade portion 116 of the waveguide 114 to make contact with tissue and other substances. Commonly, the clamping mechanism 118 is a pivoting arm that acts to grasp or clamp onto tissue between the arm and the blade 116. However, in some devices, the clamping mechanism 118 is not present.

25 **[0005]** The drive circuit 106 produces a high-voltage self-oscillating signal. The high-voltage output of the drive circuit 106 is fed to the matching circuit 108, which contains signal-smoothing components that, in turn, produce a driving signal (wave) that is fed to the transducer 110. The oscillating input to the transducer 110 causes the mechanical portion of the transducer 110 to move back and forth at a magnitude and frequency that sets up a resonance along the waveguide 114. For optimal resonance and longevity of the resonating instrument and its components, the driving signal applied to the transducer 110 should be as smooth a sine wave as can practically be achieved. For this reason, the matching circuit 108, the transducer 110, and the waveguide 114 are selected to work in conjunction with one another and are all frequency sensitive with and to each other; this can be referred to as being matched or tuned.

30 **[0006]** Because a relatively high-voltage (e.g., 100 V or more) is required to drive a typical piezoelectric transducer 110, the power source that is available and is used in all prior-art ultrasonic cutting devices is an electric mains (e.g., a wall outlet) of, typically, up to 15A, 120VAC. Therefore, all known ultrasonic surgical cutting devices resemble that shown in FIGS. 1 and 2 and utilize a countertop box 202 with an electrical cord 204 to be plugged into the electrical mains 206 for supply of power. Resonance is maintained by a phase locked loop (PLL), which creates a closed loop between the output of the matching circuit 108 and the drive circuit 106. For this reason, in prior art devices, the countertop box 202 always has contained all of the drive and control electronics 104, 106 and the matching circuit(s) 108. A typical retail price for such boxes is in the thousands of dollars.

35 **[0007]** A supply cord 208 delivers a sinusoidal waveform from the box 202 to the transducer 110 within the handpiece 112 and, thereby, to the waveguide 114. The prior art devices present a great disadvantage because the cord 208 has a length, size, and weight that restricts the mobility of the operator/surgeon. The cord 208 creates a tether for the operator and presents an obstacle for the operator and those around him/her during any surgical procedure using the handpiece 112. In addition, the cord must be shielded and durable and, therefore, is very expensive. Finally, because the box 202 is not sterilized, both the box 202 and the supply cord 208 must be cleaned and maintained in a sterile condition for use in a surgical environment.

40 **[0008]** Another disadvantage exists in the prior art due to the frequency sensitivity of the matching circuit 108, the transducer 110, and the waveguide 114. By having a phase-locked-loop feedback circuit between the output of the matching circuit 108 and the drive circuit 104, the matching circuit 108 has always been located in the box 202, near the drive circuit 108, and separated from the transducer 110 by the length of the supply cord 208. This architecture

introduces transmission losses and electrical parasitics, which are common products of ultrasonic-frequency transmissions.

[0009] In addition, prior-art devices attempt to maintain resonance at varying waveguide 114 load conditions by monitoring and maintaining a constant current applied to the transducer (when operating with series resonance). However, without knowing the specific load conditions, the only predictable relationship between current applied to the transducer 110 and amplitude is at resonance (in some instances herein, amplitude is sometimes referred to as displacement when the term relates to the mechanical output). Therefore, despite a constant current being applied, the amplitude of the wave along the waveguide 114 may not be constant across all frequencies. When prior art devices are under load, therefore, operation of the waveguide 114 is not guaranteed to be at resonance and, because only the current is being monitored and held constant, the amount of movement on the waveguide 114 can vary greatly. For this reason, maintaining

[0010] Furthermore, in the prior art, handpieces 112 and transducers 110 are replaced after a finite number of uses, but the box 202, which is vastly more expensive than the handpiece 112, is not replaced. As such, introduction of new, replacement handpieces 112 and transducers 110 frequently causes a mismatch between the frequency-sensitive components (108, 110, and 112), thereby disadvantageously altering the frequency introduced to the waveguide 114. The only way to avoid such mismatches is for the prior-art circuits to restrict themselves to precise frequencies. This precision brings with it a significant increase in cost.

[0011] Therefore, a need exists to overcome the problems associated with the prior art, for example, those discussed above.

[0012] Document EP1594209 discloses a battery pack including at least one battery cell, a discharge switch coupled to at least one battery cell and control circuitry responsive to a position of a trigger to provide control signal to the switch.

Summary of the Invention

[0013] Briefly, in accordance with exemplary embodiments, the present invention includes a battery-powered device that produces high frequency mechanical motion at the end of a waveguide for performing useful work, specifically, to cut and seal tissue during surgery. A piezoelectric transducer is used to convert electrical energy into the mechanical energy that produces the motion at the end of the waveguide. Particularly, when the transducer and waveguide are driven at their composite resonant frequency, a large amount of mechanical motion is produced. The circuit components of the present invention include, among others, a battery power supply, a control circuit, a drive circuit, and a matching circuit - all located within a handpiece of the ultrasonic cutting device and all operating and generating waveforms from battery voltages. The components are selected to convert electrical energy from the battery power supply into a high voltage AC waveform that drives the transducer. Ideally, the frequency of this waveform is substantially the same as the resonant frequency of the waveguide and transducer. The magnitude of the waveform is selected to be a value that produces the desired amount of mechanical motion.

[0014] Advantageously, the present invention, according to several embodiments, allows components of the device to be removed, replaced, serviced, and/or interchanged. Some components are "disposable," which, as used herein, means that the component is used for only one procedure and is then discarded. Still other components are "reusable," which, as used herein, means that the component can be sterilized according to standard medical procedures and then used for at least a second time. As will be explained, other components are provided with intelligence that allows them to recognize the device to which they are attached and to alter their function or performance depending on several factors.

[0015] The invention provides a cordless hand-held ultrasonic cautery cutting device that overcomes the hereinbefore-mentioned disadvantages of the heretofore-known devices and methods of this general type and that allows disposal of inexpensive components but permits advantageous reuse of costlier components that are significantly cheaper than prior art reusable components.

[0016] Although the invention is illustrated and described herein as embodied in a cordless, battery-powered, hand-held, ultrasonic, surgical, cautery cutting device, it is, nevertheless, not intended to be limited to the details shown because various modifications and structural changes may be made therein without departing from the spirit of the invention and within the scope and range of equivalents of the claims. Additionally, well-known elements of exemplary embodiments of the invention will not be described in detail or will be omitted so as not to obscure the relevant details of the invention.

[0017] While the specification concludes with claims defining the features of the invention that are regarded as novel, it is believed that the invention will be better understood from a consideration of the following description in conjunction with the drawing figures, in which like reference numerals are carried forward. Accordingly, the apparatus components and method steps have been represented where appropriate by conventional symbols in the drawings, showing only those specific details that are pertinent to understanding the embodiments of the present invention so as not to obscure the disclosure with details that will be readily apparent to those of ordinary skill in the art having the benefit of the description herein. The figures of the drawings are not drawn to scale.

[0018] Other features that are considered as characteristic for the invention are set forth in the appended claims. As required, detailed embodiments of the present invention are disclosed herein; however, it is to be understood that the disclosed embodiments are merely exemplary of the invention, which can be embodied in various forms. Therefore, specific structural and functional details disclosed herein are not to be interpreted as limiting, but merely as a basis for the claims and as a representative basis for teaching one of ordinary skill in the art to variously employ the present invention in virtually any appropriately detailed structure. Further, the terms and phrases used herein are not intended to be limiting; but rather, to provide an understandable description of the invention.

Detailed Description of the Drawings

[0019] The accompanying figures, where like reference numerals refer to identical or functionally similar elements throughout the separate views and which together with the detailed description below are incorporated in and form part of the specification, serve to further illustrate various embodiments and to explain various principles and advantages all in accordance with the present invention.

FIG. 1 is a diagrammatic illustration of components of a prior-art ultrasonic cutting device with separate power, control, drive and matching components in block-diagram form.

FIG. 2 is a diagram illustrating the prior-art ultrasonic cutting device of FIG. 1.

FIG. 3 is an elevational view of a left side of an ultrasonic surgical cautery assembly in accordance with an exemplary embodiment of the present invention.

FIG. 4 is a perspective view from above a corner of a battery assembly in accordance with an exemplary embodiment of the present invention.

FIG. 5 is an elevational left side view of a transducer and generator ("TAG") assembly in accordance with an exemplary embodiment of the present invention.

FIG. 6 is a schematic block diagram of a cordless, battery-powered, hand-held, ultrasonic, surgical, cautery cutting device in accordance with an exemplary embodiment of the present invention.

FIG. 7 is a schematic block diagram of a battery assembly of the device of FIGS. 3 and 4 in accordance with an exemplary embodiment of the present invention.

FIG. 8 is a schematic block diagram of a handle assembly of the device of FIGS. 3 and 4 in accordance with an exemplary embodiment of the present invention.

FIG. 9 is a schematic block diagram of the transducer and generator assembly of the device of FIGS. 3 to 5 in accordance with an exemplary embodiment of the present invention.

FIG. 10 is a schematic block diagram of the generator of FIG. 9 in accordance with an exemplary embodiment of the present invention.

FIG. 11 is a schematic block diagram of the battery controller of the device of FIGS. 3 and 4 in accordance with an exemplary embodiment of the present invention.

FIG. 12 is a schematic block diagram illustrating an electrical communicating relationship between the battery assembly and the transducer and generator assembly of the device of FIGS. 3 to 5 in accordance with an exemplary embodiment of the present invention.

FIG. 13 is graph illustrating a square waveform input to a matching circuit in accordance with an exemplary embodiment of the present invention.

FIG. 14 is graph illustrating a sinusoidal waveform output from a matching circuit in accordance with an exemplary embodiment of the present invention.

FIG. 15 is a diagrammatic illustration of the effect that a resonant sine wave input to a transducer has on a waveguide of the ultrasonic cutting device in accordance with an exemplary embodiment of the present invention with the sinusoidal pattern shown representing the amplitude of axial motion along the length of the waveguide.

FIG. 16 is a fragmentary, schematic circuit diagram of an elemental series circuit model for a transducer in accordance with an exemplary embodiment of the present invention.

FIG. 17 is a fragmentary, schematic circuit diagram of an inventive circuit with the circuit of FIG. 16 and is useful for monitoring a motional current of a transducer in accordance with an exemplary embodiment of the present invention.

FIG. 18 is a fragmentary, schematic circuit diagram of an elemental parallel circuit model of a transducer in accordance with an exemplary embodiment of the present invention.

FIG. 19 is fragmentary, schematic circuit diagram of an inventive circuit with the circuit of FIG. 18 and is useful for monitoring the motional current of a transducer in accordance with an exemplary embodiment of the present invention.

FIG. 20 is a fragmentary, schematic circuit diagram of an inventive circuit with the circuit of FIG. 16 and is useful for monitoring the motional current of a transducer in accordance with an exemplary embodiment of the present invention.

FIG. 21 is a fragmentary, schematic circuit diagram of an inventive circuit with the circuit of FIG. 18 and is useful for monitoring the motional voltage of a transducer in accordance with an exemplary embodiment of the present invention.

FIG. 22 is a schematic circuit diagram modeling a direct digital synthesis technique implemented in accordance with an exemplary embodiment of the present invention.

FIG. 23 is a graph illustrating an exemplary direct output of a digital-to-analog converter (DAC) positioned above a filtered output of the DAC in accordance with an exemplary embodiment of the present invention.

FIG. 24 is a graph illustrating an exemplary direct output of a digital-to-analog converter (DAC) with a tuning word shorter than the tuning word used to produce the graph of FIG. 23 positioned above a filtered output of the DAC using the same shortened tuning word in accordance with an exemplary embodiment of the present invention.

FIG. 25 is a graph illustrating an exemplary direct output of a digital-to-analog converter (DAC) with a tuning word longer than the tuning word used to produce the graph of FIG. 23 positioned above a filtered output of the DAC using the longer tuning word in accordance with an exemplary embodiment of the present invention.

FIG. 26 is block circuit diagram of exemplary components comprising the current control loop in accordance with an exemplary embodiment of the present invention.

FIG. 27 is a block circuit diagram of the device of FIG. 3 in accordance with an exemplary embodiment of the present invention.

FIG. 28 is a perspective view from above the front of the battery assembly of FIG. 4 in accordance with an exemplary embodiment of the present invention.

FIG. 29 is a fragmentary, perspective view from a left side of the battery assembly of FIG. 4 with one half of the shell removed exposing an underside of a multi-lead battery terminal and an interior of the remaining shell half in accordance with an exemplary embodiment of the present invention.

FIG. 30 is a fragmentary, perspective view from a right side of the battery assembly of FIG. 4 with one half of the shell removed exposing a circuit board connected to the multi-lead battery terminal in accordance with an exemplary embodiment of the present invention.

FIG. 31 is an elevated perspective view of the battery assembly of FIG. 4 with both halves of the shell removed exposing battery cells coupled to multiple circuit boards which are coupled to the multi-lead battery terminal in accordance with an exemplary embodiment of the present invention.

FIG. 32 is an elevated perspective view of the battery assembly shown in FIG. 31 with one half of the shell in place in accordance with an exemplary embodiment of the present invention.

FIG. 33 is an elevated perspective view of the battery assembly of FIG. 4 showing a catch located on a rear side of the battery assembly in accordance with an exemplary embodiment of the present invention.

FIG. 34 is an underside perspective view of the handle assembly of FIG. 3 exposing a multi-lead handle terminal assembly and a receiver for mating with the battery assembly of FIG. 4 in accordance with an exemplary embodiment of the present invention.

FIG. 35 is a close-up underside perspective view of the handle assembly of FIG. 3 exposing a multi-lead handle terminal assembly and a receiver for mating with the battery assembly of FIG. 4 in accordance with an exemplary embodiment of the present invention.

FIG. 36 is an underside perspective view illustrating an initial mating connection between the handle assembly and the battery assembly in accordance with an exemplary embodiment of the present invention.

FIG. 37 is a perspective view of the battery assembly fully connected to the handle assembly in accordance with an exemplary embodiment of the present invention.

FIG. 38 is a close-up perspective view of the exterior surface of the battery assembly of FIG. 4 illustrating a release mechanism for coupling the battery assembly to the handle assembly in accordance with an exemplary embodiment of the present invention.

FIG. 39 is a close-up perspective view of the multi-lead handle terminal assembly in accordance with an exemplary embodiment of the present invention.

FIG. 40 is a close-up perspective view of the ultrasonic surgical cautery assembly of FIG. 1 with one half the shell of the handle assembly removed providing a detailed view of the mating position between the multi-lead handle terminal assembly and the multi-lead handle battery assembly in accordance with an exemplary embodiment of the present invention.

FIG. 41 is a fragmentary, cross-sectional and perspective view of a pressure valve of the battery assembly of FIG. 3 in accordance with an exemplary embodiment of the present invention viewed from a direction inside the battery assembly.

FIG. 42 is a fragmentary, cross-sectional view of the pressure valve of FIG. 41 viewed from a side of the valve.

FIG. 43 is a perspective view of the pressure valve of FIG. 41 separated from the battery assembly.

FIG. 44 is a graph illustrating pressure states of the pressure valve of FIG. 41 in accordance with an exemplary embodiment of the present invention.

FIG. 45 is an elevational exploded view of the left side of the ultrasonic surgical cautery assembly of FIG. 3 showing the left shell half removed from the battery assembly and the left shell half removed from the handle assembly in accordance with an exemplary embodiment of the present invention.

FIG. 46 is an elevational right-hand view of the handle assembly of FIG. 3 with the right shell half removed showing controls in accordance with an exemplary embodiment of the present invention.

FIG. 47 is elevational close-up view of the handle assembly of FIG. 3 with the left shell half removed showing the trigger mechanism of FIG. 46 in accordance with an exemplary embodiment of the present invention.

FIG. 48 is an elevational close-up view of a two-stage switch in the handle assembly activated by the button of FIG. 46 in accordance with an exemplary embodiment of the present invention.

FIG. 49 is an elevational view of an example of a two-stage switch of FIG. 48 in accordance with an exemplary embodiment of the present invention.

FIG. 50 is an elevational side view of the TAG of FIG. 3 in accordance with an exemplary embodiment of the present invention.

FIG. 51 is an elevational underside view of the TAG of FIG. 50 in accordance with an exemplary embodiment of the present invention.

FIG. 52 is an elevational upper view of the TAG of FIG. 50 in accordance with an exemplary embodiment of the present invention.

FIG. 53 is an elevational view of the TAG of FIG. 50 with an upper cover removed revealing generator circuitry in accordance with an exemplary embodiment of the present invention.

FIG. 54 is an elevational underside view of the TAG of FIG. 50 with an underside cover removed revealing electrical coupling between the generator and the transducer in accordance with an exemplary embodiment of the present invention.

FIG. 55 is a perspective underside view of the TAG of FIG. 50 with an underside cover of the TAG removed and the transducer cover removed revealing components of the transducer in accordance with an exemplary embodiment of the present invention.

FIG. 56 is an elevational left side view of the handle assembly and the TAG, illustrating a coupling alignment between the handle assembly and the TAG in accordance with an exemplary embodiment of the present invention.

FIG. 57 is an elevational exploded view of the left side of the ultrasonic surgical cautery assembly of FIG. 3 showing the left shell half removed from handle assembly exposing a device identifier communicatively coupled to the multi-lead handle terminal assembly in accordance with an exemplary embodiment of the present invention.

FIG. 58 is a perspective enlarged view of a transducer with the outer shell removed in accordance with an exemplary embodiment of the present invention.

FIG. 59 is a perspective close-up view of the coupling relationship between the catch on the battery assembly and the receiver on the handle assembly as well as the sealing relationship between the multi-lead battery terminal assembly and the multi-lead handle terminal assembly in accordance with an exemplary embodiment of the present invention.

FIG. 60 is a perspective close-up transparent view of the sealing gasket of FIG. 59 in accordance with an exemplary embodiment of the present invention.

FIG. 61 is a perspective partial view of the handle assembly with the right-hand cover half removed, exposing a near-over-centering trigger mechanism in accordance with an exemplary embodiment of the present invention.

FIG. 62 is a perspective partial view of the near-over-centering trigger mechanism of FIG. 61, with the trigger slightly depressed, in accordance with an exemplary embodiment of the present invention.

FIG. 63 is a perspective partial view of the near-over-centering trigger mechanism of FIG. 61, with the trigger further depressed, in accordance with an exemplary embodiment of the present invention.

FIG. 64 is a perspective partial view of the near-over-centering trigger mechanism of FIG. 61, with the trigger fully depressed, in accordance with an exemplary embodiment of the present invention.

FIG. 65 is a perspective fragmentary view of a rotational lockout member and blade adjacent, but not engaging with, a waveguide assembly rotation-prevention wheel, in accordance with an exemplary embodiment of the present invention.

FIG. 66 is a perspective fragmentary view of the rotational lockout member and blade of FIG. 65 engaging the waveguide assembly rotation-prevention wheel in accordance with an exemplary embodiment of the present invention.

FIG. 67 is a perspective fragmentary view of a two-stage button in an undepressed state and in physical communication with the rotational lockout member of FIG. 65 in accordance with an exemplary embodiment of the present invention.

FIG. 68 is a perspective fragmentary view of the two-stage button in a first depressed state and physically engaging the rotational lockout member of FIG. 65 in accordance with an exemplary embodiment of the present invention.

FIG. 69 is a perspective fragmentary view of the two-stage button of FIG. 68 in a second depressed state and fully

engaging the rotational lockout member of FIG. 65, which, in turn, is engaging the waveguide assembly rotation-prevention wheel in accordance with an exemplary embodiment of the present invention.

FIG. 70 is a perspective fragmentary view of a rotational lockout member and dual blades adjacent, but not engaging with, a waveguide assembly rotation-prevention wheel, in accordance with an exemplary embodiment of the present invention.

FIG. 71 is a perspective fragmentary view of the rotational lockout member and dual blades of FIG. 70 engaging the waveguide assembly rotation-prevention wheel in accordance with an exemplary embodiment of the present invention.

FIG. 72 is a process flow diagram illustrating a start-up procedure in accordance with an exemplary embodiment of the present invention.

FIG. 72A is a process flow diagram illustrating a portion of the start-up procedure in accordance with an exemplary embodiment of the present invention.

FIG. 73 is a fragmentary, enlarged perspective view of an exemplary embodiment of an end effector according to the invention from a distal end with a jaw in an open position.

FIG. 74 is a fragmentary, enlarged perspective view of the end effector of FIG. 73 from below with an outer tube removed.

FIG. 75 is a fragmentary, enlarged cross-sectional and perspective view of the end effector of FIG. 73 from below with the section taken transverse to the jaw-operating plane through the waveguide.

FIG. 76 is a fragmentary, enlarged side cross-sectional view of the end effector of FIG. 73 with the jaw in a partially closed position.

FIG. 77 is a fragmentary, enlarged cross-sectional side view of the end effector of FIG. 73 with the section taken parallel to the jaw-operating plane with the waveguide removed.

FIG. 78 is a fragmentary, enlarged, side elevational view of the end effector of FIG. 73.

FIG. 79 is a fragmentary, enlarged, side elevational view of the end effector of FIG. 78 with the jaw in a substantially closed position.

FIG. 80 is a fragmentary, enlarged, perspective view of the end effector of FIG. 73 with the jaw in a partially closed position.

FIG. 81 is a fragmentary, enlarged cross-sectional side view of the end effector of FIG. 73 with the section taken in the jaw-operating plane.

FIG. 82 is an enlarged perspective view of a coupling spool of the end effector of FIG. 73.

FIG. 83 is a fragmentary, enlarged, cross-sectional view of the end effector of FIG. 73 with the section taken orthogonal to the longitudinal axis of the waveguide at a jaw pivot.

FIG. 84 is an enlarged, perspective view of a jaw liner of the end effector of FIG. 73 viewed from below a distal end.

FIG. 85 is an enlarged, cross-sectional and perspective view of a left portion of the jaw liner of FIG. 84 seated within a left portion of the jaw of FIG. 73 viewed from below a proximal end.

FIG. 86 is a fragmentary, enlarged, perspective view of a TAG attachment dock and a waveguide attachment dock of the handle assembly of FIG. 46 with a right half of the handle body, a rotation-prevention wheel, and a spring and bobbin of the jaw force-limiting assembly removed.

FIG. 87 is a fragmentary, enlarged, perspective view of the handle assembly of FIG. 86 with an outer tube removed and only a right half of the rotation-prevention wheel removed.

FIG. 88 is a perspective view of a torque wrench according to an exemplary embodiment of the invention.

FIG. 89 is a fragmentary, enlarged, perspective view of the end effector of FIG. 73 with the jaw in a closed position with liner wear.

FIG. 90 is an elevational right-hand view of the handle assembly of FIG. 3 with the right shell half removed showing controls in accordance with an exemplary embodiment of the present invention with the trigger in an unactuated state.

FIG. 91 is an elevational right-hand view of the handle assembly of FIG. 90 with the trigger in a partially actuated state.

FIG. 92 is an elevational right-hand view of the handle assembly of FIG. 90 with the trigger in a fully actuated state.

FIG. 93 is a fragmentary, enlarged, perspective view of a tube stop assembly in accordance with an exemplary embodiment of the present invention.

FIG. 94 is a graph illustrating blade deflection characteristics associated with the tube stop assembly of FIG. 93.

FIG. 95 is a perspective side view of half of a spindle assembly according to an exemplary embodiment of the invention.

FIG. 96 is a perspective view of a bobbin portion of a waveguide assembly according to an exemplary embodiment of the invention.

FIG. 97 is a fragmentary, perspective view of the bobbin of FIG. 96 connected to the waveguide.

FIG. 98 is a perspective side view of a yoke of a jaw control assembly according to an exemplary embodiment of the invention.

FIG. 99 is a fragmentary, horizontal cross-sectional view of a proximal portion of the waveguide assembly and a

distal portion of the handle according to an exemplary embodiment of the invention.

FIG. 100 is an exploded, bottom perspective view of an alternative exemplary embodiment of a jaw and liner according to the invention.

FIG. 101 is a fragmentary, exploded perspective view of the jaw assembly according to the invention in a first installation step.

FIG. 102 is a fragmentary, exploded perspective view of the jaw assembly according to the invention in a second installation step.

FIG. 103 is a fragmentary, exploded perspective view of the jaw assembly according to the invention in a third installation step.

FIG. 104 is a fragmentary, exploded perspective view of the jaw assembly according to the invention in a fourth installation step.

FIG. 105 is a fragmentary, side perspective view of an alternative exemplary embodiment of a spindle rotation prevention assembly of the handle according to the invention.

FIG. 106 is a fragmentary, side perspective view of another alternative exemplary embodiment of a spindle rotation prevention assembly of the handle according to the invention.

FIG. 107 is a fragmentary, enlarged, cross-sectional view of a portion of the battery assembly of FIG. 4 exposing an underside of a multi-lead battery terminal and an interior of a shell half in accordance with an alternative exemplary embodiment of the present invention in which a card edge connector is used to connect the contacts of the multi-lead battery terminal to one or more circuit boards.

FIG. 108 is a fragmentary, perspective view of an exemplary embodiment of a TAG assembly connector according to the invention.

FIG. 109 is a fragmentary, side perspective view of an exemplary embodiment of a battery connection portion of the flex harness according to the invention.

FIG. 110 is a fragmentary, bottom perspective view of an exemplary embodiment of a buzzer portion of the flex harness according to the invention.

Detailed Description of the Embodiments

[0020] It is to be understood that the disclosed embodiments are merely exemplary of the invention, which can be embodied in various forms. Therefore, specific structural and functional details disclosed herein are not to be interpreted as limiting, but merely as a basis for the claims and as a representative basis for teaching one skilled in the art to variously employ the present invention in virtually any appropriately detailed structure. Further, the terms and phrases used herein are not intended to be limiting; but rather, to provide an understandable description of the invention.

[0021] Before the present invention is disclosed and described, it is to be understood that the terminology used herein is for the purpose of describing particular embodiments only and is not intended to be limiting. In this document, the terms "a" or "an", as used herein, are defined as one or more than one. The term "plurality," as used herein, is defined as two or more than two. The term "another," as used herein, is defined as at least a second or more. The terms "including" and/or "having," as used herein, are defined as comprising (i.e., open language). The term "coupled," as used herein, is defined as connected, although not necessarily directly, and not necessarily mechanically. Relational terms such as first and second, top and bottom, and the like may be used solely to distinguish one entity or action from another entity or action without necessarily requiring or implying any actual such relationship or order between such entities or actions. The terms "comprises," "comprising," or any other variation thereof are intended to cover a non-exclusive inclusion, such that a process, method, article, or apparatus that comprises a list of elements does not include only those elements but may include other elements not expressly listed or inherent to such process, method, article, or apparatus. An element preceded by "comprises ..." does not, without more constraints, preclude the existence of additional identical elements in the process, method, article, or apparatus that comprises the element.

[0022] As used herein, the term "about" or "approximately" applies to all numeric values, whether or not explicitly indicated. These terms generally refer to a range of numbers that one of skill in the art would consider equivalent to the recited values (i.e., having the same function or result). In many instances these terms may include numbers that are rounded to the nearest significant figure. In this document, the term "longitudinal" should be understood to mean in a direction corresponding to an elongated direction of the object being described.

[0023] It will be appreciated that embodiments of the invention described herein may be comprised of one or more conventional processors and unique stored program instructions that control the one or more processors to implement, in conjunction with certain non-processor circuits and other elements, some, most, or all of the functions of ultrasonic cutting devices described herein. The non-processor circuits may include, but are not limited to, signal drivers, clock circuits, power source circuits, and user input and output elements. Alternatively, some or all functions could be implemented by a state machine that has no stored program instructions, or in one or more application specific integrated circuits (ASICs) or field-programmable gate arrays (FPGA), in which each function or some combinations of certain of

the functions are implemented as custom logic. Of course, a combination of these approaches could also be used. Thus, methods and means for these functions have been described herein.

[0024] The terms "program," "software application," and the like as used herein, are defined as a sequence of instructions designed for execution on a computer system. A "program," "computer program," or "software application" may include a subroutine, a function, a procedure, an object method, an object implementation, an executable application, an applet, a servlet, a source code, an object code, a shared library/dynamic load library and/or other sequence of instructions designed for execution on a computer system.

[0025] The present invention, according to one embodiment, overcomes problems with the prior art by providing a lightweight, hand-held, cordless, battery-powered, surgical cautery cutting device that is powered by and controlled with components that fit entirely within a handle of the device -- the set-top box and the shielded cord are entirely eliminated. The hand-held device allows a surgeon to perform ultrasonic cutting and/or cauterizing in any surgical procedure without the need for external power and, particularly, without the presence of cords tethering the surgeon to a stationary object and constricting the range of movement of the surgeon while performing the surgical procedure.

ULTRASONIC SURGICAL DEVICE

[0026] Described now is an exemplary apparatus according to one embodiment of the present invention. Referring to FIG. 3, an exemplary cordless ultrasonic surgical cautery assembly 300 is shown. The inventive assembly 300 can be described as including three main component parts: (1) a battery assembly 301; (2) a handle assembly 302 with an ultrasonic-cutting-blade-and-waveguide assembly 304 (only a proximal portion of which is illustrated in FIG. 3; see FIG. 8); and (3) a transducer-and-generator ("TAG") assembly 303. The handle assembly 302 and the ultrasonic-cutting-blade-and-waveguide assembly 304 are pre-coupled but rotationally independent from one another. The battery assembly 301, according to one exemplary embodiment, is a rechargeable, reusable battery pack with regulated output. In some cases, as is explained below, the battery assembly 301 facilitates user-interface functions. The handle assembly 302 is a disposable unit that has bays or docks for attachment to the battery assembly 301, the TAG assembly 303, and the ultrasonic-cutting-blade-and-waveguide assembly 304. The handle assembly 302 also houses various indicators including, for example, a speaker/buzzer and activation switches.

[0027] The TAG assembly 303 is a reusable unit that produces high frequency mechanical motion at a distal output. The TAG assembly 303 is mechanically coupled to the ultrasonic cutting-blade-and-waveguide assembly 304 and, during operation of the device, produces movement at the distal output of the ultrasonic-cutting-blade-and-waveguide assembly 304, i.e., the cutting blade. In one embodiment, the TAG assembly 303 also provides a visual user interface, such as, through a red/green/blue (RGB) LED or other display. As such, a visual indicator of the battery status is uniquely not located on the battery and is, therefore, remote from the battery.

[0028] The present invention's ability to provide all of the necessary components of an ultrasonic cutting tool in a hand-held package provides a great advantage over prior-art devices, which devices house substantially all of the device components within a very expensive and heavy desktop box 202, as shown in FIG. 2, and include an expensive tether 208 between the device's handpiece 112 and the desktop box 202, which, most significantly, is bulky and interferes with the surgeon's movements. Furthermore, the cord 208 must transit between the sterile field, where the device is present, and the non-sterile area where the generator rests. This sterile-to-non-sterile connection increases the risk of contamination of the sterile field and blurs the boundary between sterile and non-sterile.

[0029] In accordance with the present invention, the three components of the handheld ultrasonic surgical cautery assembly 300 are advantageously quickly disconnectable from one or more of the others. Each of the three components of the system is sterile and can be maintained wholly in a sterile field during use. Because each portion can be separated from one or more of the other components, the present invention can be composed of one or more portions that are single-use items (i.e., disposable) and others that are multi-use items (i.e., sterilizable for use in multiple surgical procedures). FIGS. 4 and 5 show the battery assembly 301 and TAG assembly 303 components, respectively, separate from the overall composite assembly shown in FIG. 3. The details of each of the components are shown and described throughout the remainder of the specification. These details include, *inter alia*, physical aspects of each component separate and as part of the handheld ultrasonic surgical cautery assembly 300, electronic functionality and capability of each component separate and as part of the overall assembly 300, and methods of use, assembly, sterilization, and others of each component separate and as part of the overall assembly 300. In accordance with an additional embodiment of the present invention, each of the components 301, 302/304, 303 is substantially equivalent in overall weight; each of these components 301, 302/304, 303 is balanced so that they weigh substantially the same. The handle 302 overhangs the operator's hand for support, allowing the user's hand to more freely operate the controls of the device without bearing the weight. This overhang is set to be very close to the center of gravity. This, combined with a triangular assembly configuration, makes the overall handheld ultrasonic surgical cautery assembly 300 advantageously provided with a center of balance that provides a very natural and comfortable feel to the user operating the device. That is, when held in the hand of the user, the overall assembly 300 does not have a tendency to tip forward or backward or side-to-side,

but remains relatively and dynamically balanced so that the waveguide is held parallel to the ground with very little effort from the user. Of course, the instrument can be placed in non-parallel angles to the ground just as easily.

[0030] FIG. 6 provides a general block circuit diagram illustrating the communicative coupling between the battery assembly 301, the handle assembly 302, and the TAG assembly 303. FIG. 6 also shows various power and communication signal paths 601a-n between the battery assembly 301 and the handle assembly 302. The handle assembly 302 provides additional power and communication signal paths 602a-n that continue on to the TAG assembly 303. These power and communication signal paths 601a-n facilitate operation, to name a few, of:

1. a buzzer, e.g., audio frequency signal, which provides an audible user interface;
2. a minimum button, e.g., 0 to 3.3 V and 0 to 25mA input signal, which is a user interface to activate ultrasound output at minimum displacement;
3. a maximum button, e.g., 0 to 3.3 V and 0 to 25mA, which is a user interface to activate ultrasound output at maximum displacement;
4. a first output voltage (Vout), e.g., 0 to 10 Volt and 0 to 6A output, from the battery assembly 301 to the TAG assembly 303 and provides power to the TAG assembly 303 to generate a transducer drive signal;
5. a ground or system common connection;
6. a second output voltage (Vbatt), which is a voltage output from battery for providing power for the system;
7. a first communication line (Comm+), which provides differential half duplex serial communications between the battery assembly 301 and the TAG assembly 303;
8. a second communication line (Comm-), which provides differential half duplex serial communications between the battery assembly 301 and the TAG assembly 303; and
9. a present line, which, when connected to the handle assembly 302, activates power in the battery assembly 301 and, thereby, to the entire system.

[0031] In accordance with an embodiment of the present invention, the above-described power and communication signal paths 601a-n are provided through a flex circuit that spans between a first multi-lead handle terminal assembly on the handle assembly 302 (where the battery assembly 301 electrically couples to the handle assembly 302) and a second multi-lead handle terminal assembly on the handle assembly 302 (where the TAG assembly 303 electrically couples to the handle assembly 302). Thus, the flex circuit electrically connects the battery assembly 301 to the TAG assembly 303.

I. BATTERY ASSEMBLY

[0032] FIG. 7 provides a general block circuit diagram illustrating battery assembly 301 and internal components included therein. The battery assembly 301 generally includes one or more battery cells 701, a battery protection circuit 702, and a battery controller 703. Various power and signal paths 704a-n run between the battery cells 701 and the battery protection circuit 702. Power and communication signal paths 706a-n run between the battery protection circuit 702 and the battery controller 703. The power and signal paths 704a-n and 706a-n can be simple direct connections between components or can include other circuit elements not shown in the figures. The power and communication signal paths 706a-n include, among others:

1. a SMBus clock signal (SCLK), which is used for communications between the battery controller 703 and the battery fuel gauge/protection circuit 702;
2. a SMBus data signal (SDAT), which is used for communications between the battery controller 703 and the battery fuel gauge/protection circuit 702; and
3. an enable switch that turns off the battery controller 703 when the battery assembly 301 is in a charger by removing power to the switching power supply within the battery controller 703 once grounded.

a. Battery Cells

[0033] The battery cells 701 include, in one embodiment, a 4-cell lithium-ion polymer (LiPoly) battery. There is, of course, no limit to the number of cells that can be used and no requirement that the cells be of the LiPoly type. Advantageously, manufacturers can produce LiPoly batteries in almost any shape that is necessary. These types of batteries, however, must be carefully controlled during the charging process, as overcharging LiPoly batteries quickly causes damages to the cells. Therefore, these batteries must be charged carefully. For this reason, the present invention utilizes an inventive battery protection circuit 702.

b. Battery Protection

[0034] The battery protection circuit 702 controls charging and discharging of the battery cells 701 and provides battery protection and "fuel gauge" functions, i.e., battery power monitoring. More particularly, the battery protection circuit 702 provides over-voltage, under-voltage, over-temperature, and over-current monitoring and protection during both the charging and discharging stages. If overcharged, LiPoly batteries cannot only be damaged but can also ignite and/or vent. The battery protection circuit 702 provides multiple levels of protection. For example, the battery protection circuit could provide a triple level of protection for each of current, voltage and temperature. The protection is redundant and uses active components for the first and second levels of protection, and uses passive or redundant components for the higher third level of protection. In one example, the multiple levels of protection provided by the battery protection circuit may utilize components that join the battery cells together, such as PTC devices, thermal fuses, current fuses, and resettable elements.

[0035] The "fuel gauge" function of the battery protection circuit 702 limits the discharge of voltage and current, both continuous and transient, on the output of the battery assembly 301. During charging of the battery cells 701, the fuel gauge can limit the current level fed to the battery cells 701. Alternatively, a battery charging unit can perform this current limiting function. The fuel gauge also monitors temperature and shuts down the battery assembly 301 when a temperature of the battery cells 701 exceeds a given temperature. The fuel gauge is further able to determine how much total energy is left in the battery cells 701, to determine how much previous charge has been received, to determine an internal impedance of the battery cells 701, to determine current and voltage being output, and more. By using this data, the present invention, through use of inventive algorithms, is able to determine the "State-of-Charge" (SOC) of the battery cells 701 based in part on the chemical attributes of the battery cells 701 and, in particular, to identify when there is not enough battery capacity to safely perform a surgical procedure as described in further detail below. The system has been programmed to include information regarding how much energy is needed to complete one cutting and cautery procedure safely. With that information stored, the fuel gauge compares that minimum amount of energy needed to the current state of charge of the battery when initially powered to begin a cut/cauterization or at a time during a procedure when a new cut/cauterization is to be performed. If the minimum threshold is not met (e.g., 1000 joules), then the device is not permitted to continue operating.

[0036] Furthermore, in order to ensure maximum energy delivery, efficiency and prevent overcharging of individual cells in the battery pack, it is important to verify that the State-of-Charge of all the cells is equal. A good indicator of the SOC is the cell voltage. Thus, during charging, cell voltage is monitored and the amount of current delivered to each cell is adjusted until the voltage of all cells is equalized. At this point, the cells are balanced.

[0037] In addition, a thermistor may be installed in the battery pack and located adjacent the battery cells (e.g., either in between two cells, in between all adjacent cells, or next to cells on any side) to provide an external device (e.g., a battery charger) with a measurement or way to monitor the cell temperature within the battery pack.

c. Battery Controller

[0038] FIG. 11 is a general block circuit diagram illustrating the internal components of the battery controller 703 of FIG. 7. As previously shown in FIG. 7, the battery controller 703 is fed signals and powered through power and communication signal paths 706a-n. Additionally, the battery controller 703 also provides output power and signals along power and communication signal paths 601a-n. The battery controller 703, according to one exemplary embodiment of the present invention, includes a power supply 1102, SMBus isolation switch(es) 1104, a microcontroller 1106, an audio driver 1108, a user buttons interface 1110, a serial communications transceiver 1112, and a buck converter 1114.

[0039] The power supply 1102 is composed of two subsystems: a buck switching power supply that first reduces the unregulated cell voltage to a substantially constant direct-current voltage, e.g., 4 VDC. A second linear power supply steps down and regulates the direct-current voltage to a level that is required by the low voltage components used in this device, e.g., 3.3 VDC. This two-step voltage reduction is implemented to ensure low battery consumption. Switching power supplies are inherently efficient, as compared to the traditional linear power supplies, but they tend to produce large output voltage ripple (noise), which could be problematic. Therefore, the voltage is first stepped down using an efficient switching regulator and is then fed to a linear regulator, which produces a better filtered and noise-free voltage to the digital components of the circuit. The output from the switching regulator is also used to feed the audio amplifier, which requires larger voltages and tends to generate additional noise -- which is undesirable in the digital section of the circuit.

[0040] The SMBus isolation switches 1104 (also referred to as relays) are provided as a way to prevent voltages originating from the operation of the battery protection and charge control circuit, which is ON during the charge process, to be fed into the rest of the battery circuit, which is OFF during the charge process. In an exemplary embodiment, the switches used are optically driven and turned on by the PRESENT circuit in the device (see 601a-n).

[0041] Microcontroller 1106 is a highly-integrated processing unit that controls the functions of the battery controller

703. In an exemplary embodiment, the microcontroller 1106 stores and executes the software that allows operation of the device. Given the computational demand imposed by the operation of the device, the microcontroller 1106 is state of the art, for example, including two independent microcontroller cores in one package. In this embodiment, a main core runs a main program, which controls the device. When the device is activated, sampling of the various parameters required to ensure proper and efficient operation are monitored by a second core, for example, the Control Law Accelerator (CLA) 1116, shown in FIG. 11. The CLA also can be used to provide proportional-integral-derivative ("PID") control loop operation, which is very computationally demanding. This configuration, therefore, effectively allows one core of the device to run a state machine at very high speeds to maintain full and immediate control of the system while, at the same time, the second core handles the demanding computations of gathering data and handling the control loop. Preferably, the microcontroller 1106 lends itself to low power consumption applications and, therefore, a 3.3 volt unit can be used. Internal oscillators allow device startup without the need of external (and power consuming) components. The microcontroller 1106 can also be configured to have its own internal non-volatile memory section to store program and diagnostic information. The battery microcontroller 1106 monitors input voltage, output voltage, output current, and the battery and buck temperatures to provide total control of the voltage converter functions.

[0042] Audio driver 1108 produces a signal that ultimately drives the buzzer 802 that is located in the handle assembly 302. In an exemplary embodiment, the audio driver 1108 is a simple, but powerful, two-stage class A square wave amplifier. The amplifier is fed directly from the buck switching power supply (e.g., 4 VDC) to ensure maximum power capability. The amplifier is able to drive an audio speaker (no internal driver). Feeding the audio driver 1108 from the buck switching power supply also insures that noise generated by the audio amplifier is not fed to the supply rail of the digital and analog components of the device, which ensures noise-free operation. Capability to regulate volume by changing a single resistor is provided in case adjustment is necessary.

[0043] The user buttons interface 1110 conditions the signals received from the minimum 804 and maximum 806 activation switches housed within the handle assembly 302. In an exemplary embodiment, the user buttons interface 1110 is operable to continuously measure impedance of the activation switches to prevent false activation, for example, in the case of fluid ingress at the button. The battery controller 703 measures the impedance of the switch(es) and will not activate the system until the impedance detected falls below a predetermined threshold. This configuration eliminates accidental activations due to fluid ingress, which are generally detected as higher impedances in the switch(es) than that of a fully closed switch. The PRESENT line works on a similar principle, ensuring that the PRESENT line is closed through a low enough impedance before the battery is turned on. This is done so that exposure of the PRESENT pin to any conducting fluid will not accidentally turn on the battery pack. The user buttons interface 1110 operates in this exemplary embodiment by injecting a known current level through the switch lines. When the button is open (no activation) the current source will maximize its voltage output and this voltage is measured by the microcontroller 1106. When the switch is closed, the current source will adjust its voltage output to generate its target programmed current. If the button is working at optimally low impedance, the voltage output will be low. However, in the case where fluid enters the button, the impedance seen by the current source will be high, and a proportionally equivalent voltage, higher than that generated for a closed button, will indicate to the microcontroller 1106 that activation should not occur.

[0044] The exemplary embodiment of the circuitry is equipped with a calibrated current source, which can be used to calibrate the programmable current source during startup and to provide a tighter detection window. This calibration that occurs during the device startup narrows the window or impedance range in which a positive activation is detected. The calibration is performed by switching the circuitry of the impedance circuit to a precision current source and measuring the voltage to calibrate the circuit. During the device startup procedure, the battery controller can self-calibrate the activation button impedance detection circuitry to reduce the impedance range required to discern between a true button closure (activation) and an inadvertent activation signal that is erroneously caused by fluid contamination of the button(s).

[0045] Activation button impedance is measured by flowing a pre-determined current level through the button lines using a current source. By measuring the voltage across the contacts, Ohm's Law (i.e. $R = V/I$) can be used to determine the resistance in the line. During calibration, two analog switches are used. The first switch connects the microcontroller serial communication lines to the programmable current source to be able to control the current source. The second switch connects the output of the current source to a set of precision resistors. The current flow is adjusted by the microcontroller until a given voltage measurement (i.e. calibration value) is achieved. Once adjusted, the first switch is changed to connect the microcontroller to the SMBus lines and the second switch connects the current source to the activation button(s) to resume normal operation.

[0046] The microcontroller can switch the SMBus lines to be connected to the analog switch or to the main SMBus line. This allows the switch (non SMBus) to function and, at the same time, allows the microprocessor to connect to the SMBus lines.

[0047] In an exemplary embodiment, the serial communications transceiver 1112 allows the battery 301 to establish communication with the TAG 303 and external devices that can be used to obtain diagnostic or calibration information from the device. The serial communications transceiver 1112 provides transmission and reception of differential half-duplex communications between the battery controller 703 and the generator 904. The transceiver 1112 is capable of

detecting loss of hardware connection for fault detection in addition to the explained software fault detection. An exemplary embodiment of the device used is configured to be compatible with USB communications for reliability and it can be used in a differential mode for common-mode noise rejection. Given the amount of data that the battery 301 exchanges with the TAG 303, a full-speed device is used (e.g., up to 12 Mbit/s).

[0048] Many possible fault conditions can be detected and responded to by the system, the responses sometimes taking the form of feedback to the user. For example, the system can issue a fault condition when a stuck switch condition exists. Such a condition can include when the high/low activation switch is improperly in the activated position at system start up, or where the high activation switch is activated but the low activation switch has not been activated, or where the high/low activation switch is in the activated position at the end of a use cycle. Other fault conditions exist when there is insufficient motional feedback or when the waveguide tip is in a stalled condition. Both low amplitude displacement and high amplitude displacement can cause a shutdown if detected. Various faults are associated with the TAG. For example, a fault condition exists where the output voltage is greater than a defined voltage limit. Another fault condition exists when the microprocessor temperature is greater than a given predefined range, for example, greater than approximately 100 degrees Celsius. Another fault occurs when the battery controller does not receive proper acknowledgement from the TAG either before, during ultrasonic start, or after ultrasonic start. Some fault conditions are associated with the battery. For example, if the battery charge is below any number of predefined thresholds or if a load requires more power than the system can deliver and the amplitude drops below the desired threshold, faults can be indicated. Other faults of the battery can include a failure of the battery's communications system, an over-temperature condition of the battery's microprocessor, fuel gauge, and/or regulator. Failure of the communications system can be through either or both of the TAG and battery. General faults of the system can be included as well. If the CLA ceases to function or functions inappropriately, a fault can be indicated. Failure to reset timers associated with the battery and the TAG can also indicate faults. Software failures also can trigger faults.

[0049] Lastly, in the exemplary embodiment, the buck converter 1114 provides step down voltage control to provide amplitude regulation. The buck converter 1114 steps down the battery voltage to produce a lower voltage for delivery to the TAG assembly 303 for generation of the ultrasound output signal to the transducer 902. The microcontroller 1106 controls the output of the buck regulator by varying or modulating the pulse widths of the input signals to the buck converter (i.e., pulse width modulation (PWM)). Off-phase PWM inputs are used for minimal output ripple. The device operates at 300 KHz for high efficiency using small inductors and capacitors. The buck converter 1114 is of a multi-phase synchronous design for maximum possible efficiency. The design utilizes high integrated components for small size and power consumption. The device includes internal current protection, output current sensing, output and input voltage sensing and over-temperature protection. The buck converter 1114 is capable of reacting at high speeds and step down voltages in the range of 2 VDC to 10.5 VDC.

[0050] The power supply 1102 produces various voltage levels at its output, which are used to power the various battery controller components shown in FIG. 11. The SMBus isolation switch(es) 1104 is/are used to disconnect the SMBus lines to the battery protection printed circuit board during charging and when the bus is used for other purposes within the battery controller.

[0051] As set forth in detail below, the battery controller 703 facilitates a user interface, e.g., a buzzer 802 and RGB LEDs 906, and converts the output voltage and current output of the buck converter 1114, which output powers the TAG assembly 303 through at least one voltage output path (V_{out}) 601 a-n.

II. HANDLE ASSEMBLY

[0052] FIG. 8 is a general block and schematic circuit diagram illustrating the handle assembly 302 shown in FIG. 3. The handle assembly 302 receives control and power signals over attached power and communication signal paths 601a-n. A second set of power and communication signal paths 602a-n connect to the TAG assembly 303 when it is attached to the handheld ultrasonic surgical cautery assembly 300. As is explained in detail below, the handle assembly 302 houses the ultrasonic waveguide assembly 304 and provides a portion of the pistol grip that the operator uses to grasp and operate the entire handheld ultrasonic surgical cautery assembly 300 using, for example, a two-stage switch of button 4608 and trigger 4606 (as introduced in FIG. 46). The handle assembly 302, according to one exemplary embodiment, is provided with a speaker/buzzer 802 capable of receiving a buzzer output signal from the battery assembly 301 through a signal path 601a-n and of producing an audible output, e.g., 65db, suitable for communicating specific device conditions to an operator. These conditions include, for example, successful coupling of assembly components (e.g., battery assembly 301 to handle assembly 302), high, low, or normal operation mode, fault conditions, low battery, device overload, mechanical failure, electrical failure, and others. The handle also includes a Min. Button switch 804 and a Max. Button switch 806 that, when activated, connects the respective button to ground (for example), which in an exemplary embodiment signals the battery controller to start the ultrasonic output in either low or high displacement mode. The handle assembly 302 also provides a pass-through interconnect for signals between the battery assembly 301 and the TAG assembly 303.

[0053] The speaker/buzzer 802 and the Min. and Max Button switches 804, 806 are all part of the flex circuit of the handle assembly 302. According to an exemplary embodiment of the present invention, the buzzer 802 is held in place within the handle assembly 302 with the use of an extra tab of flex material that protrudes outward past the edge of the buzzer 802. This tab 10802 can be seen in FIGS. 108 and 110. The handle assembly 302 includes a slot 11002 configured to receive the flexible tab 10802 of material during assembly. The buzzer 802 is protected from fluid ingress by a buzzer seal, for example, an acoustically transparent mesh with adhesive on both sides that bonds the buzzer into the handle assembly 802 while still allowing sound to exit and prevent fluid from entering into the buzzer 802.

III. TAG

[0054] FIG. 9 is a block and schematic circuit diagram illustrating the TAG assembly 303 of FIGS. 3 and 5, which houses the transducer 902 and the generator 904. The generator 904 converts DC power from the battery controller 703 into a higher-voltage AC signal that drives the transducer 902, which converts the electrical signal into mechanical motion.

a. Generator

[0055] FIG. 10 is a block circuit diagram illustrating the internal components of the generator 904. The generator 904, according to an exemplary embodiment of the present invention, includes a power supply 1002, a serial communications transceiver 1004, a microcontroller 1006, a numerically controlled oscillator ("NCO") 1008, a push/pull switching amplifier 1010, an output filter/matching network 1012, a motional bridge 1014, a feedback amplifier and buffer(s) 1016, an LED driver 1018, and indicators 906 (for example, RGB LEDs). The power supply 1002 receives power from the battery assembly 301 through lines Vbatt and GND of the power signal paths 602a-n and outputs various voltages that are used to power the generator 904. The serial communications transceiver 1004 provides transmission and reception communications between the battery controller 703 and the generator 904, here, through a serial data link Comm+/Comm- of the communications signal paths 602a-n, although this communication can occur through a single line or through a number of lines, in series or in parallel.

[0056] The microcontroller 1006 is a highly integrated processing unit that controls the functions of the generator 904 and is one of two microcontrollers in the system, the other being part of the battery controller 703. In the exemplary embodiment, a serial data link (Comm+, Comm-) exists between the two microcontrollers 1006, 1106 so they can communicate and coordinate their operation. The microcontroller 1006 in the TAG 303 controls generation of the high-voltage waveform driving the piezoelectric transducer 902. The microcontroller 1106 in the battery assembly 301 controls conversion of the DC voltage from the battery cells 701 to a lower DC voltage used by the TAG 303 when generating the high voltage AC to the transducer 902. The battery microcontroller 1106 regulates the DC output of the battery assembly 301 to control the amplitude of the mechanical motion, and the TAG microcontroller 1006 controls the frequency of the signal that drives the transducer 902. The battery microcontroller 1106 also handles the user interface, and the battery protection circuit 702 monitors the battery cells 701 during system operation. The microcontroller 1006 in the TAG 303 has a variable speed system clock that is adjusted constantly while the device is running in the high-power state in order to keep the microcontroller 1006 synchronized with the ultrasonic motion. The microcontroller 1106 in the battery assembly 301 runs at a fixed frequency while in the high-power state, regardless of the TAG clock. Because the system clock varies in frequency, a scale factor within the TAG microcontroller 1006 is changed along with the changing system clock to keep serial communication between the microcontrollers 1006, 1106 within the range of proper operation.

[0057] Direct digital synthesis ("DDS") is a technique used to generate a periodic waveform with a precise output frequency that can be changed digitally using a fixed frequency source. The numerically controlled oscillator ("NCO") 1008 is a signal source that uses the DDS technique, which can be performed through hardware or software. The fixed frequency input to the DDS is used to generate a clock for the NCO 1008. The output is a series of values that produce a time-varying periodic waveform. A new output value is generated during each clock cycle.

[0058] The DDS 2200, which is shown in schematic detail in FIG. 22, works by calculating the phase component of the output waveform that is then converted to amplitude, with a new phase value being generated each clock cycle. The phase value is stored in a variable register 2202, which register is referred to herein as the "phase accumulator." During each clock cycle, a fixed number is added to the number stored in the phase accumulator to produce a new phase value. This fixed number is often referred to as the frequency control word or frequency tuning word because it, along with the clock frequency, determines the output frequency. The value in the phase accumulator spans one cycle of the periodic output waveform from 0 to 360 degrees, with the value rolling over at 360 degrees.

[0059] The value in the phase accumulator is fed into a phase-to-amplitude converter 2204. For a sine wave, the amplitude can be computed using the arctangent of the phase value. For high speed applications, the converter usually uses a lookup table to generate the amplitude value from the phase value.

[0060] In a hardware implementation of DDS, the output of the amplitude converter is input to a digital-to-analog

converter (DAC) 2206 to generate an analog output signal f_{out} . The analog signal is usually filtered by a band pass or low pass filter to reduce unwanted frequency components in the output waveform.

[0061] As a first example, the value in the phase accumulator 2202 can be set to an integer from 0 to 359. If the frequency tuning word is 1, the value in the phase accumulator 2202 will be incremented by 1 each clock cycle. When the value reaches 359, it rolls over to zero. If the clock frequency is 360 Hz, the frequency of the output waveform will be 1 Hz. The output will, therefore, be a series of 360 points during each 1 second period of the output waveform. If the frequency tuning word is changed to 10, the value in the phase accumulator is incremented by 10 each clock cycle, and the output frequency will be 10Hz. The output will therefore be 36 points for each period of the output waveform. If the frequency tuning word is 100, the output frequency will be 100 Hz. In that case, there will be 3.6 points for each output period. Or, more accurately, some cycles of the output waveform will have 3 points and some will have 4 points, the ratio of cycles with 4 points versus 3 points being 0.6.

[0062] As a second example, the value in the phase accumulator 2202 can be a 10 bit number. The 10 bit number will have 1024 possible values. With a frequency tuning word of 50 and a clock frequency of 1 MHz, the output frequency will be $50 \times 1 \text{ MHz} / 1024 = 48.828 \text{ kHz}$. FIG. 23 illustrates the output 2300 of the DAC 2206 and what the filtered DAC output might look like.

[0063] If the frequency tuning word is 22, the output frequency is $22 \times 1 \text{ MHz} / 1024 = 21.484 \text{ kHz}$. In this case, FIG. 24 illustrates the output 2400 of the DAC 2206 and what the filtered DAC output might look like. When power is first applied to the generator, the state of the NCO 1008 may be undefined (or the output of the NCO 1008 may not be at a suitable frequency). This could lead to improper operation of the microcontroller. To ensure proper operation of the microcontroller, the NCO 1008 is not used to drive the clock frequency of the microcontroller when power is first applied. A separate oscillator is used. In one exemplary embodiment, the separate oscillator is integrated into the microcontroller 1006. Using this separate oscillator, the microcontroller initializes the various memory locations internal to the microcontroller and those in the NCO 1008. Once the NCO 1008 is operating at a suitable frequency, the microcontroller switches the source of its clock from the separate oscillator to the NCO 1008.

[0064] If the frequency tuning word is 400, the output frequency is $400 \times 1 \text{ MHz} / 1024 = 390.625 \text{ kHz}$. In this case, FIG. 25 illustrates the output 2500 of the DAC 2206 and what the filtered DAC output might look like. The output sometimes has 2 points per period and sometimes 3 points. The waveform in FIG. 25 clearly shows the need for a filter to obtain a clean sine wave.

[0065] Referring back to FIG. 10, the push/pull switching amplifier 1010 converts DC power from the battery controller 703 into a higher voltage square wave. The output filter/matching network is a passive filter that changes the square wave from switching amplifier 1010 into a smooth sinusoidal wave suitable for feeding to the transducer 902. The motional bridge 1014 is a circuit that produces a feedback signal in proportion to and in phase with the mechanical motion of the transducer 902 and waveguide assembly 304. The feedback amplifier and buffer(s) 1016 amplifies and buffers the motional feedback signal determined within the motional bridge 1014. As will be explained in greater detail below, the motional bridge 1014 allows the device to run with a constant displacement/amplitude mode and varies the voltage as the load varies. The motional bridge is used to provide amplitude feedback and, by virtue of using this type of feedback, i.e., motional feedback, the system is able to run with constant current.

[0066] In one embodiment, the TAG assembly 303 includes one or more red/green/blue (RGB) LEDs 906, which can be used for a variety of warning and communication purposes. For example, green can indicate the device is functioning normally whereas red indicates the device is not functioning normally. It is noted that the placement of the LEDs 906 at the generator 904 in FIG. 9 is only for illustrative purposes. The invention envisions placing the indicators anywhere at the TAG assembly 303.

[0067] Through communicative interaction between the handle assembly 302 and the TAG assembly 303, in particular, the speaker 802 and the LEDs 906, the inventive handheld ultrasonic surgical cautery assembly 300 provides full feedback to an operator during use to indicate a plurality of conditions associated with the ultrasonic surgical cautery assembly 300, whereby the feedback originates from the handle and not remotely. For instance, as mentioned above, the speaker/buzzer 802 can provide audible warnings and audible indicators of operational status of the ultrasonic surgical cautery assembly 300. A full class A or B amplifier (e.g., a full amplifier or an ON/OFF square-pulse amplifier) could be used to provide a broader frequency range to implement different sounds and/or audible messages. Similarly, the LEDs 906 can provide visual warnings and visual indicators of the operational status of the ultrasonic surgical cautery assembly 300. As an example, the LEDs 906 can provide an indication of an amount of power remaining within the battery cell(s) 701 or a lack of sufficient power to safely carry out a surgical procedure. For instance, a first color of the LEDs 906 indicates a fully charged battery cell(s) 701, while a second color indicates a partially charged battery cell(s) 701. Alternatively, various blinking patterns or constant on states of the LEDs 906 can provide condition indicators to the user. The LED driver 1018 that is shown in FIG. 10 is an exemplary configuration that provides a constant current when the LEDs 906 are illuminated. Importantly, all of the feedback indicators to the user are uniquely present on the handheld device and do not require the user to be within range of a remote feedback component that is away from the surgical field of vision or outside of the sterile field. This eliminates the requirement for the physician to shift his/her

attention from the surgical field to a remote location to verify the nature of the feedback signal.

[0068] However, should it prove useful to relay or transmit any of the feedback indications to a device that is external to the handheld device, circuitry can be implemented in the generator or battery board(s) to provide a radio-frequency link (or other forms of communications links) for downloading, transferring or transmitting user interface, diagnostics, or other relevant data from the handheld device to the external device. In this way, the external device allows for the surgical staff or others overseeing the procedure, but who are not inside the surgical field or within the immediate vicinity of the handheld device, to receive the same relevant indications or pieces of information that are being received by the physician. The external device may also function as a valuable backup source or data log for storing information pertaining to the use and diagnostics of the handheld device. The external device may also be utilized to provide a range of more powerful data processing or software applications or tools than can reasonably be implemented in the handheld device. For example, the external device may be able to provide analytical or diagnostic results from the information being received from the handheld device. The handheld device and the external device may also be equipped with bi-directional communications such that the external device could re-program the internal software of the handheld device or issue commands or controls to the handheld device in an advantageous manner.

b. Transducer

[0069] A transducer 902 is an electro-mechanical device that converts electrical signals to physical movement. In a broader sense, a transducer 902 is sometimes defined as any device that converts a signal from one form to another. An analogous transducer device is an audio speaker, which converts electrical voltage variations representing music or speech to mechanical cone vibration. The speaker cone, in turn, vibrates air molecules to create acoustical energy. In the present invention, a driving wave 1400 (described below) is input to the transducer 902, which then converts that electrical input to a physical output that imparts movement to the waveguide 1502 (also described below). As will be shown with regard to FIG. 15, this movement sets up a standing wave on the waveguide 1502, resulting in motion at the end of the waveguide 1502. For purposes of the present invention, transducer 902 is a piezo-electric device that converts electrical energy into mechanical motion.

[0070] As is known, crystals in piezoelectric transducers expand when voltage is applied. In a transducer configuration according to the invention, as illustrated for example in FIG. 55, the crystals are clamped into a crystal stack 5502. See also FIGS. 54 and 56 to 58. A clamp bolt 5504 in this configuration acts as a spring if it is set to pre-compress the crystal stack 5502. As such, when the crystal stack 5502 is caused to expand by imparting a voltage across the stack 5502, the clamp bolt 5504 forces the stack 5502 back to its original, pre-compressed position (i.e., it retracts). Alternatively, the clamp bolt 5504 can be torqued so that there is no pre-compression on the stack 5502 and, in such a case, the bolt will still act as a spring to pull the mass back towards its original position. Exemplary configurations of the transducer can be a so-called Langevin transducer, a bolt-clamp Langevin transducer, or a bolt-clamped sandwich-type transducer.

[0071] When an ultrasonic transducer is caused to vibrate, a standing wave is established at the distal portion of the transducer. This standing wave extending along the transducer 902 and the waveguide 1502, exhibits nodes (points of minimal vibration) and anti-nodes (points of maximum vibration). Placement of the nodes and anti-nodes is important. For example, the blade portion 7304 is positioned at an anti-node because greatest vibratory characteristics are desired there. The same is true for the distal-most end, the ultrasonic waveguide couple 5004 of the transducer 902 as the greatest vibratory characteristics are desired to be coupled into the waveguide 1502. In the exemplary embodiment of the transducer illustrated in FIGS. 54 to 58, the node (the point at which vibration movement is lowest) exists where it is secured to the TAG assembly 303. This is beneficial because imparting vibration onto/into the TAG assembly 303 is not desirable.

[0072] In the transducer 902, a step-down in diameter is referred to as a gain-step because downstream vibratory characteristics increase as the circumferential diameter decreases. In the cross-sectional view of FIG. 54, for example, two gain-steps can be seen between the crystal stack 5502 and the ultrasonic waveguide couple 5004. Also present in this view is the flange 5450 of the transducer 902, which is the contact point of the transducer 902 to its housing. This contact point 5450 is located at a node of the transducer 902.

[0073] In an alternative exemplary embodiment to the transducer, 902, the crystal stack 5502 can be displaced and, in doing so, provides a more efficient system. More specifically, by moving the crystal stack 5502 more proximally, the gain step that is adjacent to the crystal stack 5502 is moved closer to the node, thereby increasing the overall gain of the system. The required displacement of the crystals is less with greater gain. The further the crystal is away from the node the less it contributes to the power handling capability. Therefore, it is desirous to have the node within the crystal stack but also as close to the gain step as possible. When more than one crystal is placed on one side of the node they work in series, thereby increasing the total displacement. As the crystals move further from the node, their contribution to the displacement is decreased because of their distance from the node. When crystals are placed on both sides of the node, they work in parallel to increase the power capacity of the system but do not increase the overall displacement. This configuration, therefore, reduces how hard the crystals need to be driven to get the same output. As losses go with

the square of how hard the crystal are driven (current), lower current means it is more efficient. An amplitude versus power curve shows a typical squared relationship. From this, it can be seen that, in a space-limited system such as the TAG, such a configuration generates the most gain out of the system. In high drive conditions, there is an increased sensitivity to the losses in the crystals. But, by having the increased gain described here, the crystals do not have to be driven so close to the maximum power and, thereby, avoid this sensitivity. It is known that higher power through dielectric losses generates heat. Such heat leads to depolling and causes a frequency shift, which can result in a change in capacitance that move the nodes away from the normal supporting point(s), causing the output to decrease and to generate unwanted heat at other unforeseen places, which can further exacerbate this problem. Furthermore, with appropriate wiring, it is possible to selectively drive only a portion of the crystal stack, which increases efficiency when the load is low.

[0074] The transducer 902 of the invention is housed in a cylindrical casing 5430 that has an opening at the distal end to allow the horn 5002 to protrude. The transducer 902 also has two conductive rings 5406, 5408 that surround the transducer and carry the electrical signal from the generator 904 to the transducer 902. In an exemplary embodiment, the rings 5406, 5408 are single machined parts that are made as a flat part either by stamping or machining that, then, has a leg bent into the correct form. Alternatively, the leg can be a second part that is pressed or soldered into a flat ring. These ring/leg sets are overmolded to a distal housing portion 5434 of the transducer housing. The overmolding is not sufficient to create a gas-tight seal. Accordingly, a well is molded where the leg of the ring exits the plastic, which well can be filled with a potting material that creates the gas-tight seal. Alternatively, the leg can be a round pin. In such a case, an o-ring can be placed between the leg and the well to create the seal. The electrodes 5802, 5804 of the transducer crystal stack 5502 can be formed to have spade or pin style connector shapes that allow the electrical connection of the transducer to the leg to happen without solder. This simplifies manufacture and eliminates exposing the leg to heat from soldering, which could further compromise the seal. Portions of the connectors are illustrated in FIGS. 54 to 58 but are best seen in FIG. 58. The transducer 902 needs to be held by the flange 5450, which is at a node where no vibration occurs. The transducer 902 also needs to be rotationally locked to its housing, which can be accomplished with standard key-like features shown, for example, in FIG. 55, or can be done with four flats. By using flats, the wall thickness of the housing can be increased in the area of the contact rings, which increases the structure of this housing that will be exposed to repeated sterilization cycles. To create a seal between the transducer horn 5002 and the housing 5430, in an exemplary embodiment, the support flange is compressed against an o-ring 5452, which is supported by the distal housing portion 5434. To compress this seal sufficiently, the flange 5450 of the transducer 902 must be forcibly pushed against the o-ring 5452. To push on the interior face of the flange 5450, a pair of hermaphroditic pushers 5454 extend into the distal housing portion 5434 to allow the completion of the assembly to apply forward pressure through an elastomeric grommet. In an exemplary configuration, a pair of pusher parts is used to fit within a smaller diameter section of the horn because a single part would have to have clearance over the crystals and electrodes and, therefore, would force the overall housing diameter to be much larger. These pushers can also have crush pin features to join them together to facilitate easier installation. The pushers have geometries that lock them rotationally into the keying features of the housing. Further keying features on the proximal end of the pushers can key the proximal housing portion 5432 onto the assembly of the transducer 902 to align clearances within the proximal housing portion 5432 with the electrodes 5402, 5404 of the transducer 902. Mating of the proximal housing portion 5432 to the distal housing portion 5434 either with adhesive or welding or other bonding measures is done with sufficient pressure to drive the pushers forward into the grommet, which, in turn, pushes on the flange 5450 and compresses the o-ring 5452 between the flange 5450 and the distal housing portion 5434 to simultaneously create a seal and support the flange 5450 with elastomers on both sides, thereby reducing acoustical coupling between the transducer 902 and the housing 5430. Alternatively the proximal and distal housing portions 5432, 5434 can be joined with threads, the tightening of the threads creating compression of the above-described stack of parts. Alternative embodiments can accomplish the same result without the need to insert mold the contact rings by having other elastomeric seals between the rings 5406, 5408 and the housing 5434.

[0075] As described in further detail below, the transducer 902 is held in the TAG assembly 303 housing with a spiral ring or other retaining clip 5442 that is installed in a groove in a distal most portion of the distal housing portion 5434. Between the distal housing portion 5434 of the transducer 902, and the lower housing portion 5030 of the generator 904 is a ring of lubricious material, such as PTFE, that reduces rotational friction. Reduction of friction is important in this area because it is this force-bearing surface that holds the TAG assembly 303 into the handle 302 and compresses the seal around the electrical connection between the TAG assembly 303 and the handle 302.

IV. SIGNAL PATH

[0076] FIG. 12 is a block diagram illustrating the signal path between the battery assembly 301 and the TAG assembly 303. As described further below, the design characteristics of the signal path and the interconnecting circuit components are determined, in part, by the acute objective to protect the signal integrity and efficiency of the components at this

critical, and highly vulnerable, juncture between the power source and signal-generating circuitry.

[0077] First, a DC-DC step-down converter 1202 steps the voltage from the battery cells 701 down from a first voltage to a second, lower voltage. The DC-DC step-down converter 1202 includes the multi- or variable-phase (depending on the amount of power needed) buck converter 1114 and the battery microcontroller 1106, which are both shown in FIG. 11 within the battery assembly 301. The battery microcontroller 1106 controls the buck converter 1114 to regulate the DC voltage fed to the TAG assembly 303. Together, the buck converter 1114 and the microcontroller 1106 perform the DC-to-DC conversion function in the battery assembly 301. In an exemplary embodiment of the invention, a two-phase buck converter 1114 is used. Another exemplary embodiment can utilize a buck converter having additional phases. In such a case, phase shedding can be employed. The number of phases used can change dynamically to keep the converter operating at optimal efficiency, which is a consideration for a battery powered device. In other words, when less output power is required, the power losses internal to the converter can be reduced by reducing the number of active phases.

[0078] Uniquely, the generator printed circuit board is double-sided, in that the circuitry components are found on both sides of the board. In the exemplary embodiment, the power circuit components are installed on the top side of the PCB, the digital components are installed on the bottom of the board. A solid ground plane separates the two sides. Advantageously, by isolating the high-voltage power circuitry from the logic circuitry in this manner, the logic circuitry is effectively shielded from the injurious high-voltage noise that may be present in the power circuit.

[0079] The DC output voltage from the battery assembly 301 powers the push/pull switching amplifier 1010 in the TAG assembly 303, which assembly 303 converts the DC signal to a higher voltage AC signal. The TAG microcontroller 1006 controls the amplifier 1010. The output voltage of the push pull switching amplifier 1010 is, in general, a square wave, an example of which is shown in FIG. 13, which waveform 1300 is undesirable because it is injurious to certain components, in particular, to the transducer 902. Specifically, the abrupt rising and falling edges of a square wave cause corresponding abrupt starts and stops of the ultrasonic waveguide to produce a damaging "rattling" effect on the waveguide. The square wave 1300 also generates interference between components. For example, higher additional harmonic frequencies of a square wave can create unwanted electrical interference and undesired operation of the circuit(s). This is in contrast to a pure sine wave, which only has one frequency.

[0080] To eliminate the square wave, a wave shaping or matching circuit 1012 (sometimes referred to as a "tank circuit") is introduced. The tank circuit 1012 includes such components as, for example, an inductor, along with a capacitor in conjunction with the transducer capacitance, and filters the square wave into a smooth sine wave, which is used to drive the transducer 902 in a way that produces non-damaging ultrasonic motion at the waveguide. An exemplary sine wave 1400 suitable for driving the transducer 902 is shown in FIG. 14. The matching circuit 1012, in one exemplary embodiment of the present invention, is a series L-C circuit and is controlled by the well-known principles of Kirchhoff's circuit laws. However, any matching circuit can be used to produce a smooth sine wave 1400 suitable for driving the transducer 902. In addition, other driving signals can be output from the matching circuit 1012 that are not smooth sine waves but are useful for driving the transducer 902 in a way that is less injurious than a square wave.

[0081] Importantly, the design of the power filtering circuit is such that small variations in the inductance of the power inductor will not cause the system to operate outside its specifications. This configuration reduces sensitivity to variations in tuning of the LC filter and, thereby, eliminates the need to incorporate an adjusting screw.

[0082] In practice, the matching network 1012 is tuned to match a particular transducer to which it feeds. Therefore, transducers and matching networks are best matched if they remain as a pair and are not placed in combination with another device. In addition, if each transducer 902 had its own matching network, the smart battery 301 could feed different frequencies to the different transducers, the frequencies being respectively matched to a particular blade in a waveguide assembly 304. Two popular frequencies for ultrasonic surgery devices are 55kHz and 40kHz.

[0083] In addition, to prevent radio-frequency or electro-magnetic interference from entering the generator circuitry from the ultrasonic waveguide and transducer components, ferrite beads (or, coils) are installed in the generator output lines or traces to block the interference from reaching the circuitry.

[0084] Furthermore, the output traces of the generator are configured to be close to one another (e.g., in a triangular double trace) and in parallel to act as a common mode for filtering out any interference (i.e., to allow maximum common mode rejection).

V. RESONANCE

[0085] FIG. 15 is a diagrammatic illustration of the affect that a resonant sine wave input to the transducer 902 has on the waveguide 1502 of the ultrasonic cutting device. In accordance with an exemplary embodiment of the present invention, the sinusoidal pattern shown by the dotted lines in FIG. 15 represents the amplitude of axial motion along the length of the waveguide 1502, which is coupled to the transducer 902. Responding to a rising portion 1402 of the driving sine wave 1400 (shown in FIG. 14), the stack expands in a first direction 1508. During the negative portion 1404 of the driving wave 1400 (shown in FIG. 14), the pre-compression or the induced compression of the stack returns the stack

to its steady-state, i.e., the portion 1504 of the transducer 902 is moved in a second direction 1512. As stated above, a smooth sine wave 1400, in contrast to the square wave 1300, allows the transducer 902 and waveguide 1502 to slow before changing directions. The smoother movement is less injurious to the device's components.

[0086] The alternating movement 1508, 1512 of the transducer portion 1504 places a sinusoidal wave 1514 along the length of the waveguide 1502. The wave 1514 alternately pulls the distal end 1520 of the waveguide 1502 toward the transducer 902 and pushes it away from the transducer 902, thereby longitudinally moving the distal end 1520 of the waveguide 1502 along a distance 1518. The tip of the waveguide 1502 is considered an "anti-node," as it is a moving point of the sine wave 1514. The resulting movement of the waveguide 1502 produces a "sawing" movement along distance 1518 at the distal end 1520 of the waveguide 1502. (The wave 1514 and linear movement along distance 1518 are greatly exaggerated in FIG. 15 for ease of discussion.) This high-speed movement along distance 1518, as is known in the art, provides a cutting instrument that is able to easily slice through many materials, in particular, tissue and bone. The rapidly moving distal end 1520 of the waveguide 1502 also generates a great deal of frictional heat when so stimulated, which heat is absorbed by the tissue that the waveguide 1502 is cutting. This heat is sufficient to cause rapid cauterization of the blood vessels within the tissue being cut.

[0087] If the driving wave 1514 traveling along the waveguide 1502 is not a resonant wave, there will be no standing wave, which means that there are no nodes or antinodes. This means that there is very little motion. There also exists the possibility of operating the device at an incorrect resonant frequency. Operating at the wrong resonance can produce, for example, undesirable motion such as "slapping." In such a case, the distal end 1520 of the waveguide 1502 moves transverse to the longitudinal axis of the waveguide 1502. Any incorrect mode is not ideal and is unreliable for providing adequate cutting and surgical cautery. The invention, however, as is explained below, utilizes a phase locked loop (PLL) in the generator 904 to ensure that the movement 1508, 1512 of the waveguide 1502 remains resonant along the waveguide 1502 by monitoring the phase between the motional current and motional voltage waveforms fed to the transducer 902 and sending a correction signal back to the generator 904. The TAG microcontroller 1006 controls the frequency and ensures it is in the proper range so as not to excite an undesired resonant frequency. As an added feature, the present invention can be provided with piezo-electric crystal stacks 1504 that are cut in varying planes, thereby creating a torsional, or twisting motion of the blade rather than only a sawing motion. The present invention can easily be adapted to a full set of uses using requiring a drilling-type motion instead of or with the sawing motion just described.

[0088] As just explained, ideally, the transducer 902 and waveguide 1502 are driven at their resonant frequency. Resonance is achieved when current and voltage are substantially in phase at the input of the transducer 902. For this reason, the generator 904 uses the PLL and the signals derived from the current and voltage input to the transducer 902 to synchronize the current and voltage with one another. However, instead of simply matching the phase of the input current to the phase of the input voltage, the present invention matches the current phase with a phase of the "motional" voltage and/or matches the input voltage phase with a phase of the "motional" current. To accomplish this, a motional bridge circuit is used to measure the mechanical motion of the transducer and waveguide and to provide feedback to the operation of the transducer and waveguide. The motional feedback signal from the bridge is proportional to and in phase with the motion of the transducer 902 and waveguide 1502.

VI. MOTIONAL CONTROL

a. Transducer Circuit Model

[0089] FIG. 16 is a schematic circuit diagram of a model transducer 1600, such as transducer 902, which contains piezo-electric material. Piezo-electric transducers are well known in the art. The mass and stiffness of the piezo-electric material creates a mechanically resonant structure within the transducer. Due to the piezo-electric effect, these mechanical properties manifest themselves as electrically equivalent properties. In other words, the electrical resonant frequency seen at the electrical terminals is equal to the mechanical resonant frequency. As shown in FIG. 16, the mechanical mass, stiffness, and damping of the transducer 902 may be represented by a series configuration of an inductor/coil L , a capacitor C_2 , and a resistor R , all in parallel with another capacitor C_1 . The electrical equivalent transducer model 1700 is quite similar to the well-known model for a crystal.

[0090] Flowing into an input 1610 of the electrical equivalent transducer model 1600 is a transducer current i_A . A portion i_C of i_T flows across the parallel capacitor C_1 , which is of a type and value that, for the majority of the expected frequency range, retains a substantially static capacitive value. The remainder of i_T , which is defined as i_M , is simply $i_T - i_C$ and is the actual working current. This remainder current i_M is referred to herein as the "motional" current. That is, the motional current is that current actually performing the work to move the waveguide 1502.

[0091] Known prior-art designs regulate and synchronize with the total current i , which includes i_C and is not an indicator of the amount of current actually causing the motion of the waveguide 1502 by the transducer 902. For instance, when the blade of a prior-art device moves from soft tissue to denser material, such as other tissue or bone, the resistance R increases greatly. This increase in resistance R causes less current i_M to flow through the series configuration R - L -

C_2 , and more current i_C to flow across capacitive element C_1 . In such a case, the waveguide 1502 slows down, degrading its performance. It may be understood by those skilled in the art that regulating the overall current is not an effective way to maintain a constant waveguide displacement. As such, one novel embodiment of the present invention advantageously monitors and regulates the motional current i_M flowing through the transducer 902. By regulating the motional current i_M , the movement distance of the waveguide 1502 can be regulated easily.

b. Series Circuit Model

[0092] FIG. 17 is a schematic circuit diagram of an inventive circuit 1700 useful for understanding how to obtain the motional current i_M of the transducer 902. The circuit 1700 has all of the circuit elements of the transducer model 1600 plus an additional bridging capacitive element C_B in parallel with the transducer model 1600 of FIG. 16. However, the value of C_B is selected so that C_1/C_B is equal to a given ratio r . For efficiency, the chosen value for C_B should be relatively low. This limits the current that is diverted from i_M . A variable power source V_T is applied across the terminals 1702 and 1704 of the circuit 1700, creating a current i through the capacitive element C_B , a current i_T flowing into the model transducer 1600, a current i_C flowing through capacitor C_1 , and, finally, the motional current i_M . It then follows that $i_M = i_T - r \cdot i_B$. This is because:

$$i_B = C_B \cdot \frac{\Delta V_T}{\Delta t} = \frac{C_1}{r} \cdot \frac{\Delta V_T}{\Delta t}$$

and

$$i_C = C_1 \cdot \frac{\Delta V_T}{\Delta t}$$

Therefore, $i_C = r \cdot i_B$ and, substituting for i_C in the equation $i_M = i_T - i_C$, leads to: $i_M = i_T - r \cdot i_B$.

[0093] Now, by knowing only the total current and measuring the current through the bridge capacitor i_B , variations of the transducer's motional current i_M can be identified and regulated. The driver circuit, represented by block 2708 and the transformer 2710 in FIG. 27, is included in the push-pull switching amplifier 1010 of FIG. 10. The driver circuit, then, acts as a current controller and regulates the motional current i_M by varying an output of the driver circuit based on the product of the current flowing through the bridge capacitance C_B multiplied by the ratio r subtracted from a total current i_T flowing into the transducer 902. This regulation maintains a substantially constant rate of movement of the cutting blade portion of the waveguide 1502 across a variety of cutting loads - something that has not been possible to date. In one exemplary embodiment, sensing circuits 2714 measure the motional voltage and/or motional current. Current and voltage measuring devices and circuit configurations for creating voltage meters and current meters are known in the art. Values of current and voltage can be determined by the present invention in any way now known or later developed, without limitation.

[0094] Regulation of the motional current i_M is a true way to maintain the integrity of the instrument and ensure that it will operate at its peak performance under substantially all conditions expected in an operating environment. In addition, such regulation provides these advantages within a package small enough and light enough to be easily held in one hand - a configuration that has never occurred in the field.

c. Transducer Circuit Model

[0095] FIG. 18 shows another embodiment of the present invention, where the transducer 902 is schematically represented as a parallel configuration of a resistive element R , an inductive element L , and a capacitive element C_4 . An additional capacitive element C_3 is in a series configuration between an input 1702 and the parallel configuration of the resistive element R , the inductive element L , and the capacitive element C_4 . This parallel representation models the action of the transducer in a so-called "antiresonant" mode of operation, which occurs at a slightly different frequency. A transducer voltage V_T is applied between the input terminals 1702, 1704 of the transducer 902. The transducer voltage V_T is split between a voltage V_C across capacitive element C_3 and a motional voltage V_M across the parallel configuration of the resistive element R , the inductive element L , and the capacitive element C_4 . It is the motional voltage V_M that performs the work and causes the waveguide 1502 to move. Therefore, in this exemplary embodiment, it is the motional voltage that is to be carefully regulated.

d. Parallel Circuit Model

[0096] FIG. 19 shows an exemplary embodiment of an inventive circuit configuration 1900 according to the present invention including the transducer model 1800 of FIG. 18. The circuit configuration 1900 adds to the transducer model 1800 three additional capacitive elements C_5 , C_6 , and C_7 . Capacitive element C_5 is in series with the transducer model circuit 1800 of FIG. 18 while the capacitive elements C_6 and C_7 are in series with one another and, together, are in parallel with the series combination of the capacitive element C_5 and the transducer circuit model 1800.

[0097] This circuit is analogous to a Wheatstone bridge measuring instrument. Wheatstone bridge circuits are used to measure an unknown electrical resistance by balancing two legs of a bridge circuit, one leg of which includes the unknown component. In the exemplary circuit configuration shown in FIG. 19, a motional voltage V_M , which equals $V_T - V_C$, is the unknown. By determining and regulating the motional voltage V_M , the inventive configuration allows a consistent waveguide movement to be maintained as set forth below.

[0098] Advantageously, the capacitive element C_7 is selected so that its value is a ratio A of capacitive element C_3 , with A being less than one. Likewise, the capacitive element C_6 is selected so that its value is the same ratio A of the capacitive element C_5 . The ratio of C_5/C_3 is also the ratio A .

[0099] Because the ratio of C_3/C_7 is A and the ratio of C_5/C_6 is also A , the bridge is balanced. It then follows that the feedback voltage V_{fb} divided by the motional voltage V_M is also the ratio A . Therefore, V_M can be represented as simply $A \cdot V_{fb}$.

[0100] If the voltage across the model transducer 1800 is still V_T , an input voltage V_{in} equals V_T plus the voltage V_B across the capacitive element C_5 . The feedback voltage V_{fb} is measured from a first point located between capacitive elements C_6 and C_7 and a second point located between the transducer and the capacitive element C_5 . Now, the upstream components of the TAG assembly 303 act as a voltage controller and vary the power V_{in} to maintain a constant feedback voltage V_{fb} , resulting in a substantially constant motional voltage and maintaining a substantially constant rate of movement of the cutting blade portion of the waveguide 1502 across a variety of cutting loads. Again, unlike the prior art, the present invention is not simply regulating the input voltage V_{in} , it is varying the input voltage V_{in} for the purpose of regulating the motional voltage V_M -- which is novel in the art.

e. Transformer Series Monitoring

[0101] FIG. 20 shows another exemplary embodiment of the present invention where the transducer 902 is of the circuit configuration shown in FIG. 16. The configuration of FIG. 20 works similarly to that shown in FIG. 17 and as described above in connection with FIG. 17. However, in this circuit configuration 2000, a pair of transformers 2004 and 2008 is used to determine and monitor the motional current I_M . In this exemplary embodiment, a primary winding 2002 of the first transformer 2004 is in a series configuration with a bridge capacitor C_B . Similarly, a primary winding 2006 of the second transformer 2008 is in a series configuration with the model transducer 1600. The leads 2010, 2012 of the secondary winding 2014 of the first transformer 2004 are coupled through a resistor R_2 . The leads 2016, 2018 of the secondary winding 2020 of the second transformer 2008 are coupled through a resistor R_1 . In addition, the first lead 2010 of the secondary winding 2014 of the first transformer 2004 is directly connected to the first lead 2016 of the secondary winding 2020 of the second transformer 2008.

[0102] Current I_B passing through the primary winding 2002 of the first transformer 2004 induces a current in the secondary winding 2014 of the first transformer 2004. Similarly, the currents including i_C passing through the capacitive element C_1 of the transducer 1600 and the motional current i_M of the transducer 1600 combine and go through the primary winding 2006 of the second transformer 2008 to find ground 2022. The current in the primary winding 2006 induces a current on the secondary winding 2020. As noted by the dots (•) on the transformers 2004, 2008, the secondary windings 2014, 2020 are in opposite directions from one another, with reference to the primary windings 2002, 2006, respectively, and induce a voltage V_{fb} across resistors R_1 and R_2 . By selecting values for R_1 and R_2 so that a ratio of R_1/R_2 is equal to the ratio of the values C_B/C_1 , the feedback voltage V_{fb} will always be proportional to the motional current i_M . Now, the upstream components of the generator 904 act as a voltage controller and vary the input power (V_{in} and I_{in}) to maintain a constant feedback voltage V_{fb} , resulting in a substantially constant motional current i_M and maintaining a substantially constant rate of movement of the cutting blade portion of the waveguide 1502 across a variety of cutting loads. Again, unlike the prior art, the present invention is not simply regulating the input voltage V_{in} , it is varying the input current I_{in} for the purpose of regulating the motional current i_M -- which is novel in the art.

[0103] An alternative embodiment, which is not illustrated, substitutes use of the transformers 2004, 2008 with resistors. For example, with regard to FIG. 19, the capacitors C_6 and C_5 can be replaced with resistors, which are used to measure the currents I_b and I_t .

f. Transformer Parallel Monitoring

[0104] FIG. 21 shows another exemplary embodiment of the present invention where the model transducer 1800 is modeled by the circuit configuration shown in FIG. 18. The configuration of FIG. 21 works similarly to that shown in FIG. 19 and as described above in connection with FIG. 19. However, in this circuit configuration 2100, a transformer 2110 is used to determine and monitor the motional voltage V_M of the transducer 1800. In this embodiment, a primary winding 2106 of the transformer 2110 is in a series circuit configuration with an inductive element L_2 and a capacitive element C_1 . A voltage V_{in} is applied across input leads 2102, 2104 of the circuit formed by the primary winding 2106 of the transformer 2110, the inductive element L_2 , and the capacitive element C_1 . A current through the primary winding 2106 induces a corresponding current in the secondary winding 2108 of the transformer 2110. The secondary winding 2108 of the transformer 2110 is in a parallel configuration with a combination of the transducer 1800 and a bridge capacitor C_B . The two components forming the combination are in a series configuration.

[0105] In this embodiment, the secondary winding 2108 is tapped at a point 2112. By tapping the secondary winding 2108 at a point where a first portion of the secondary winding 2108 has m turns and a second portion of the secondary winding 2108 has n turns (where n is less than m), a selectable percentage of the induced voltage on the secondary winding 2108 appears from point 2112 to ground 2114.

[0106] Again, this circuit is analogous to a Wheatstone bridge measuring instrument. One leg is the first secondary winding m , the second leg is the second secondary winding n , the third leg is the transducer model 1800, and the fourth leg is the capacitor C_B . In the instant circuit configuration shown in FIG. 21, the voltage V_M is the unknown. By determining and regulating the motional voltage V_M , a consistent waveguide movement is maintained.

[0107] By selecting a value of the bridge capacitor C_B to be less than the transducer capacitance C_3 by the same percentage that the number of turns n is less than the number of turns m (i.e., $m/n = C_3/C_B$), the value of a feedback voltage will reflect the motional voltage V_M . The invention can determine whether the motional voltage V_M is changing by monitoring the feedback voltage V_{fb} for changes.

[0108] By using the equivalent-circuit transducer model 1800, which models a parallel-resonant (or "anti-resonant") transducer, the transducer may be driven in the parallel resonant mode of operation, where motion is proportional to voltage. The advantage of this mode of operation is that the required constant-voltage-mode power supply is simpler to design and safer to operate than a constant-current-mode power supply. Also, because the transducer has a higher impedance when unloaded (rather than a lower impedance when unloaded in the series-resonant mode of operation), it naturally tends to draw less power when unloaded. The parallel-resonant mode of operation, however, is more difficult to maintain because the resonant bandwidth is narrower than that of the series-resonant mode and has a slightly different natural resonant frequency; hence, the mechanical components of the device must be specifically configured to operate at either the series resonant or parallel-resonant mode of operation.

[0109] The present invention controls the voltage and varies the power V_{in} to maintain a constant feedback voltage V_{fb} , resulting in a substantially constant motional voltage V_M and maintains a substantially constant rate of movement of the cutting blade portion of the waveguide 1502 across a variety of cutting loads. Again, unlike the prior art, the present invention is not simply regulating the input voltage V_{in} , it is varying the input voltage V_{in} for the purpose of regulating the motional voltage V_M -- which is novel in the art.

[0110] In accordance with the present invention, the microcontroller 1006 in the TAG 303 monitors the feedback signal through motional bridge 1014 to generate the signal that goes to the primary side of the transformer 1010. The TAG microcontroller 1006 calculates (in the CLA 912) the phase difference between these signals and adjusts the NCO 1008 output to make the phase difference equal to zero. When the motional feedback signal is in phase with the output of the push-pull switching amplifier 1010, the system is operating at series resonance. The phase and magnitude of the motional feedback signal is computed using a discrete Fourier transform (DFT). In one exemplary embodiment of the present invention, the phase reference for the DFT computation is the drive signal for the push-pull amplifier 1010. The frequency can be changed to cause the push-pull drive signal to be in phase with the motional feedback signal.

[0111] According to one exemplary embodiment of the present invention, if the phase of the motional feedback signal is positive, it is an indication the running frequency is below the resonant frequency and the running frequency should be increased; if the phase is negative, it is an indication the running frequency is above the resonant frequency and the running frequency should be decreased; if the phase is close to zero, the running frequency is close to the resonant frequency of the transducer 902 and waveguide 1502. In the generator 904, the NCO 1008 (utilizing DDS) is used to alter the frequency appropriately.

[0112] Significantly, the NCO 1008 outputs a clock to the CPU's external clock input at a frequency, for example, 6 times less than the operating frequency of the TAG microcontroller 1006. The external frequency input is fed into the processor's Phase Lock Loop (PLL) and multiplied by a factor of 6 to obtain the CPU's SYSCLK. The NCO 1008 is controlled by the processor through an SPI interface. The SPI interface is used to write a 32-bit divisor to the NCO 1008 that is used to divide the 25-MHz fixed frequency clock to obtain the desired output frequency. By controlling the DDS 2200, the TAG provides synchronized operation of hardware with the oscillation frequency. In other words, to the main

processor 914, it appears as though the frequency is constant, thereby simplifying the sampling and calculation of the motion feedback phase.

VII. STARTUP OPERATION

[0113] Startup conditions are different than those during steady state operation, which is described in detail in the following section. At startup, the waveguide 1502 is initially at rest and, therefore, there is no waveguide motion. Accordingly, there is no immediate, ascertainable motional feedback signal that can be used to determine the composite resonant frequency of the transducer 902 and waveguide 1502. As a result, the inventive system has an ability to operate in a different mode during an initial startup period than during steady state.

[0114] A startup procedure according to an exemplary embodiment of the present invention is represented in the process flow diagram of FIG. 72, which illustrates an interchange between the battery controller 703 and the generator 904 of the TAG assembly 303. In this particular embodiment, as described in detail below, the relationship between the battery controller and generator can be described as a "master-and-slave" relationship, as the battery controller issues all commands to the generator 904 and the generator 904 receives all of its instructions from the battery controller 703. Alternatively, the generator 904 of the TAG assembly 303 could act as the "master" and issue all commands to the battery controller 703, or, the generator 904 of the TAG assembly 303 and the battery controller 703 may function as peers.

[0115] Prior to activation, both the battery controller 703 and the generator 904 are idle at steps 7201 and 7202, respectively. In step 7203, the battery controller 703 is awakened out of its idle condition, for example, by the user squeezing the button/trigger 4608. To begin the exchange between the battery controller 703 and the generator 904, the battery controller 703 relays a signal, such as an "ULTRASOUND ON" command 7205, to the generator 904 using the communication lines 602a-n (i.e., Comm+/Comm-). If operating properly, the generator acknowledges the command 7205 received from the battery controller 703 and, in return, signals a positive response 7204, such as an "ULTRASOUND ON" response, to the battery controller 703 using the communication lines 602a-n (i.e., Comm+/Comm-). However, if the generator 904 does not positively respond to the initial command 7205 from the battery controller 703 before a specific period of time has lapsed (e.g., 10 ms), the battery controller issues a fault condition at step 7207, such as a "FAILURE TO START" condition, and terminates the operation cycle at step 7209. At such time, appropriate indicators can be actuated.

a. Current and Amplitude Control

[0116] If there is a successful acknowledgment by the generator 904 of the "ULTRASOUND ON" command 7205 sent from the battery controller 703, the microcontroller 1106 in the battery controller 703 initiates a process for quickly and safely advancing the current rate in the TAG assembly 303 resulting in a resonant motion output from the TAG assembly 303 to the waveguide 1502. Advancement proceeds from an idle condition to a level predicted to be within a "ballpark window" for producing an ascertainable motional feedback signal and achieving a beginning resonant frequency condition. As shown in FIG. 11, the microcontroller 1106 in the battery controller 703 has two processing units. A first processing unit, the Control Law Accelerator ("CLA") 1116, handles a first, inner, current-control loop 2601 (see FIG. 26), and the second processing unit, a main processor 1118, handles a second, outer, amplitude-control loop 2602 (see FIG. 26). At the outset, in step 7213, microcontroller 1106 turns on the buck power supply 1114 and initializes the CLA 1116. The CLA 1116 uses a proportional-integral-derivative ("PID") control algorithm to compute a new duty cycle value for the Pulse Width Modulators ("PWMs") that are driving the two-phase buck converter 1114. At step 7215, the battery controller 703 starts the PWMs and begins, at step 7211, using a fast, non-linear PID control loop, to increase the output voltage of the DC-DC converter 1202. The increasing output voltage causes a corresponding increase in the input current to the push/pull amplifier 1010 of the generator 904. At step 7217, the output voltage increases, or is otherwise modified, until, at step 7219, the actual, measured input current reaches a predetermined reference current level, referred to herein as " I_{ref} ". I_{ref} is a calibrated value that is predicted to create a driving wave output from the transducer 902 that will achieve a displacement of the waveguide 1502 and place the resulting amplitude near a value sufficient to reach the target resonant frequency. I_{ref} is initially set by the battery microcontroller 703 in step 7225. This calibrated value for I_{ref} may be stored inside the TAG assembly 303 and read by the battery microcontroller 703 upon establishment of the communication link 7204. Simply put, I_{ref} is a way to not overdrive the system during startup so that with low motion during startup, the system does not overreact and overshoot. I_{ref} is the estimated current to drive the system at the target displacement. When the system gets close to target displacement, then the amplitude control takes over.

[0117] Table 1 below illustrates an example of a non-linear PID control loop or algorithm in accordance with the present invention, whereby the output voltage level is modified until the actual, measured input current reaches the reference current, I_{ref} . In this example, the non-linear PID control loop divides the percent error of the actual, measured input current versus the reference current I_{ref} into 5% bins, which are shown below as constants G_0 through G_n (where "n" is some number of the last step prior to reaching I_{ref}). Each bin has its own non-linear tuning coefficients (e.g., K_p , K_i , and

K_d). The non-linear tuning coefficients allow for the output voltage and, in turn, the actual input current, to initially advance quickly towards the reference current point I_{ref} when the input current is far away from the reference current point, and then slowly reach the reference current point I_{ref} once the input current value is close to reaching the reference current point. As a result, the system is less prone to being disturbed by noise. In this particular example, the non-linear PID within the CLA 1116 shapes the overshoot to no more than 15% greater than I_{ref} . It is desirable to have the control loop maintain current but not to allow over current for any significant time; in other words, the loop must make the current retract from an overcurrent state quickly. Accordingly, the non-linear PID loop of the CLA 1116 shapes the increase of the output voltage and input current in such a way that the input current advances quickly and accurately to the desired reference current level I_{ref} , but does so in such a way that is stable and avoids a dangerous "overcurrent" condition.

TABLE 1

Gain constant:	G_0	G_1	G_2	G_n	G_n	G_1	G_0
	-----	-----	-----	-----	-----	-----	-----
Percent away from I_{ref} :	50%	45%	40% ... 5%	I_{ref}	-5%	-10%	-15%

[0118] In the meantime, while the input current is steadily increasing under the control of the battery microcontroller 1106, the initial signal, i.e., the "ULTRASOUND ON" command 7205 from the battery controller 703, received by the generator, causes the TAG microcontroller 1006 to begin its own initialization process in parallel with the operation of the battery controller 703. As set forth above with regard to FIG. 9, the microcontroller 1006 in the TAG assembly 303 has two independent processing units: the CLA 912 and the main processor 914. Referring back to FIG. 72, at steps 7200 and 7206, upon receiving the initial command 7205 from the battery controller 703, the TAG microcontroller 1006 initializes the CLA 912 and starts the ultrasound PWMs that drive the ultrasonic frequency at a frequency within the operating frequency range of the waveguide and transducer. At this initial start up stage, any motional feedback signal that is present is weak and, therefore, it is desirable to use a high gain amplifier to provide a higher signal level because the signal level is initially very small. At step 7208, as the input current from the battery assembly is increasing, the amplitude (i.e., the displacement of the mechanical motion) is incrementing proportionally until it reaches a set point or level within 20% of a "target amplitude," which should produce a motional feedback signal and place the TAG assembly 303 in a "ballpark window" for achieving the resonant frequency. The "target amplitude" is a pre-determined, safe, threshold level. It is undesirable to surpass this threshold level and, when surpassed (e.g., by 10-12%), indicates an "over-amplitude" condition that is undesirable and causes the device to initiate a fault condition and control shutdown.

[0119] The battery controller 703 closely monitors the amplitude to regulate the displacement level of the TAG assembly 303. The battery controller 703 issues a command 7221 at frequent intervals (e.g., every 4 ms), such as an "AMPLITUDE REQ" command, to the TAG assembly 303 using at least one of the communication lines 602a-n (e.g., Comm+/Comm-). In response, the battery controller 703 receives a signal 7210, through at least one of the communication lines 602a-n (e.g., Comm+/Comm-), such as an "AMPLITUDE REQ" response, from the TAG assembly 303, which provides the battery controller 703 with a measurement of the displacement level of the TAG assembly 303. At each interval that a measurement of the displacement level is determined by the battery controller 703, the battery microcontroller 1106, at step 7223, makes one of several possible determinations based upon the displacement measurement. If the amplitude level has reached the level of within 20% of the "target amplitude" or, effectively, 80% of the "target amplitude," in step 7227 the power control is switched from the inner, current-control loop 2601 to the outer, amplitude-control loop 2602, which is described in further detail below. If the amplitude level has not yet reached 80% of the "target amplitude," in step 7229, the current control loop will maintain the current at the reference current level I_{ref} until the amplitude reaches the 80% point.

[0120] However, if the amplitude level still has not reached the 80% point within a set period of time (e.g., 250 ms), this indicates a "low amplitude" fault condition 7231 that may be due to, for example, a stalled blade of the waveguide 1502. In response, the battery microcontroller 1106 terminates the operation cycle at step 7209 and issues, for example, an "ULTRASOUND OFF" command 7233 to the generator 904. In return, the generator 904 relays a response 7212, such as an "ULTRASOUND OFF" response, indicating that it has ceased active operation. If the potentially dangerous condition occurs in which the amplitude level has actually surpassed the level of within 20% of the "target amplitude," the battery microcontroller 1106 immediately issues a fault condition 7235 and terminates the operation cycle at step 7209, as described above, due to this "over-amplitude" condition.

b. Frequency Lock

[0121] Now, referring to FIG. 72A, as previously mentioned, upon initialization, the TAG microcontroller 1006 controls

the frequency of the signal that drives the transducer 902 based upon its detection of the motional feedback signal. At the beginning of the startup process, in step 7206, the operating frequency is set at a fixed value that is within the operating frequency range of the transducer 902 and waveguide 1502 (e.g., 55.2 kHz). If present at that set frequency, a motional feedback signal from the bridge circuit is routed to a high and low gain buffer. Each of these signals is fed into the analog-to-digital converter ("ADC") 908 of the microcontroller 1006 in the TAG assembly 303. Initially, the high-gain, buffered-feedback signal is selected as the motional feedback signal will initially be small. A main function of the CLA 912 is to take the output from the ADC, perform the Discrete Fourier Transform ("DFT") calculations, and pass the results to the main processor 914. Shown as step 7218, the results from the DFT calculations are the phase and magnitude of the motional feedback ("MF") signal, as well as the real and imaginary terms for the signal.

[0122] A tuning loop is called once per ultrasound cycle. If, at step 7214, it is determined that a valid motional feedback signal does not exist at the set frequency, the system simply waits until there is a valid motional feedback signal. However, if a fixed period of time has been exceeded as determined by a cycle timeout timer, and there is still no valid motional feedback signal, a cycle activation limit "timeout" is triggered at step 7216 and the generator 904 turns off.

[0123] Initially, at step 7222, the system employs a high-gain-buffered A-to-D channel such that the high-gain-buffered feedback signal is selected. This allows the system to lock at a lower motional feedback signal level. A determination of whether or not the motional feedback signal has reached a defined "THRESHOLD" value is made at step 7220. If the motional feedback signal has reached the defined "THRESHOLD" value, the amplitude of the motional feedback signal has increased to the point that a valid motional feedback signal has emerged from any obstructive noise such that the DFT calculations in the CLA 912 are reliable. At this point, in step 7224, the system switches to the low-gain channel. However, should the system fall below this "THRESHOLD" value, the A-to-D channel can switch back to the high-gain channel as shown in step 7226. By having the ability to switch to the low-gain channel at this point, a higher resolution A/D converter is beneficially not required.

[0124] At step 7228, if the motional feedback signal is above a starting threshold value, the generator 904 enters a frequency-tuning mode for locking the set frequency onto the resonant frequency of the TAG assembly 303 in parallel with the current and amplitude controls described above. In accordance with an exemplary embodiment of the present invention, the process for achieving resonant frequency is not a process of sweeping for the optimum frequency, but rather is uniquely a tracking or tuning process for locking onto the optimum frequency. However, the present invention may also employ a frequency sweeping mode, whereby the initial operating or set frequency is chosen to be at a lower boundary of the "ballpark window" of the predicted resonant frequency and is steadily incremented until it reaches the resonant frequency or vice versa.

[0125] Once frequency tuning mode is entered, the main processor 914 of the TAG microcontroller 1006 uses the results of the DFT calculation (i.e., the phase and magnitude of the motional feedback signal) to control the running frequency of the generator. The tuning algorithm is divided into two states: STARTING and LOCKING. In the STARTING phase at step 7230, a determination is made of whether or not the motional feedback signal has reached a defined "STARTUP THRESHOLD" value. If the motional feedback signal has reached the defined "STARTUP THRESHOLD" value, the amplitude of the motional feedback signal has increased to the point that the system can actively begin moving towards resonance at step 7232. If the determination at step 7230 is that the motional feedback signal has not reached the defined "STARTUP THRESHOLD" value, the process moves to step 7234. At step 7234, the STARTING phase simply waits until the point is reached whereby there is a large enough motional feedback signal to allow locking.

[0126] In the LOCKING phase 7236, the sine of the phase offset between the motional feedback signal and the driving signal is used along with the differential of the sine to determine the size and direction of the frequency step to adjust the output frequency to move the system to resonance. Although the phase is naturally a tangent function, the sine of the phase is used to determine the frequency step because it is bounded by the value ± 1 and closely approximates the phase value at small angles, whereas a tangent function has the undesirable, unbounded range of $\pm \infty$.

[0127] In step 7238, a PID loop is used to calculate the frequency step in either a plus or minus direction. The PID loop is non-linear, whereby the value of the sine is used to determine a bin number. That bin number is used as an index to access the tuning coefficients used by the PID. An index table contains the proportional gain, the integral gain, and the differential gain. In addition, the entry sine value to enter a bin differs from the value to exit a bin. This introduces hysteresis to prevent oscillations near the bin transitions.

[0128] As previously explained, a non-linear PID is used to achieve a rapid frequency lock. Table 2 below illustrates an example of a non-linear, asymmetric PID loop or algorithm in accordance with the present invention whereby the size in frequency step is staggered until it reaches the target resonance frequency, f_{res} . In this example, the gain constants PID_0 through PID_n (whereby "n" is some number of the last frequency step prior to reaching f_{res}) are separated by non-linear increments. The gain values have been chosen to move the system toward resonance quickly when the system is far from resonance and slowly when the system is close to or at resonance. It is important to step slowly when close to or at resonance in order to avoid inducing frequency modulation, which would cause undesirable effects on the amplitude. During startup, the value for the maximum frequency step size is greater than during steady state operation; it is, for example, set to 8 Hz. If the phase is positive, it is an indication that the running frequency is below the resonant

frequency of the transducer and needs to be increased. If the phase is negative, it is an indication the running frequency is above the resonant frequency and the running frequency should be decreased. If the phase is close to zero, the running frequency is close to the resonant frequency of the transducer 902 and waveguide 1502. The numerically controlled oscillator 1008 utilizing direct digital synthesis is used to change the frequency at step 7240.

TABLE 2

Gain constant:	PID ₀	PID ₁	PID ₂	PID ₃ ...	PID _n	PID _n ...	PID ₃	PID ₂	PID ₁	PID ₀	
Driving frequency:	$f_{\min}$									$f_{\max}$	
Phase (sine func.; 90° shift):	+1	+0.6	+0.4	+0.1	+0.03	0	-0.2	-0.4	-0.6	-0.8	-1

[0129] The DDS 2200 (see FIG. 22) provides synchronized operation of hardware with the oscillation frequency. In other words, to the main processor 914, it appears as though the frequency is constant. Here, the clock frequency of the main processor 914 is a multiple of the oscillation frequency. The invention alters the PWM frequency in a unique and novel way. With the invention, PWM is performed inside the main processor 914. Because of this, the present invention actually increases/decreases the frequency of the main processor 914 - which has not been done before. The A/D converter 908 adjustments are automatic as well because the A/D converter 908 exists inside the microcontroller 1006. This inventive technique can be analogized to a singer adjusting a speed of a metronome to match the singer's tempo rather than, as is conventionally done, the singer changing her/his tempo to match the metronome.

[0130] At anytime during operation of the device, if the frequency reaches a pre-set minimum or maximum frequency limit, $f_{\min}$ and $f_{\max}$, respectively, the generator 904 turns off and a fault condition is triggered, as shown in step 7242. Exemplary lower and upper frequency limits for the invention are 54 kHz and 58 kHz, respectively. A number of various conditions can cause the frequency to reach the minimum or maximum limit, including breakage of a component (such as the waveguide 1502) or a situation in which the waveguide 1502 is under such a heavy load that the device is not able to input the amount of power needed to find resonance.

[0131] Once frequency lock is achieved, the transition begins into steady state operation.

VIII. STEADY STATE OPERATION

[0132] During steady state operation, the objective is to maintain the transducer and waveguide at resonant frequency and to control the displacement in response to any drifting that occurs as a result of a load on the waveguide 1502 during use of the device. When the transducer 902 and waveguide 1502 are driven at their composite resonant frequency, they produce a large amount of mechanical motion. The electrical energy from the battery is, in this state, converted into a high voltage AC waveform that drives the transducer 902. The frequency of this waveform should be the same as the resonant frequency of the waveguide 1502 and transducer 902, and the magnitude of the waveform should be the value that produces the proper amount of mechanical motion.

a. Amplitude Control

[0133] At resonance, the displacement is approximately proportional to the transducer current, and the transducer current is approximately proportional to the input current to the push/pull amplifier 1010. With constant current operation to maintain constant displacement, the output voltage will vary with a varying load. In other words, the voltage will increase if the output power requirement increases and vice versa.

[0134] As described above in relation to the startup process, shown in FIG. 26 are two control loops, an inner, current control loop 2601 and an outer, amplitude control loop 2602 for uniquely regulating the amplitude of the driving wave input to the transducer 902. The current control loop 2601 regulates the current from the battery assembly 301 going into the push/pull amplifier 1010. The amplitude control loop 2602 compensates for load differences or any other changes that occur in the transducer and/or waveguide. To accomplish this goal, the amplitude control loop 2602 uses the motional feedback signal to generate the desired reference current level, " I_{ref} ," that is used by the current control loop 2601 to alter the output voltage of the DC-DC converter as described above. To avoid interference-type interactions between the two loops, the current control loop 2601 operates at a higher frequency than the amplitude control loop 2602, e.g., approximately 300 KHz. The amplitude control loop 2602 typically operates, for example, at a frequency of 250 Hz.

[0135] To determine the desired reference current level, I_{ref} , the present amplitude value is subtracted from the desired

"target amplitude" to generate an amplitude percent error signal. This amplitude percent error signal is the input into the PID control algorithm of the amplitude control loop 2601 for generating the new, desired reference current level I_{ref} , based upon the operating conditions being experienced by the transducer 902 and waveguide 1502 at that particular time. In other words, the amplitude control loop 2602 changes the target or reference current value for the CLA 912 of the current control loop 2601 to reach the desired amplitude based on the percent error calculation. In this way, the output power is altered based on the variable need of the transducer 902 and waveguide 1502. The main processor 1118 of the battery controller 703 checks the new reference current value to make sure that it is not greater than the maximum output current value.

[0136] Based upon the new target or reference current value, I_{ref} , that is set by the amplitude control loop 2602, the current control loop 2601 proceeds to change the output voltage and input current to the push/pull amplifier 1010. A measurement of the actual current level 2603 of the battery pack output is fed into the ADC 1120 of the battery microcontroller 1106 (shown in FIG. 11). The CLA 1116 takes the value from the ADC 1120 and subtracts it from the target or reference input current level I_{ref} to generate the current error signal. As described above, the CLA 1116 uses the PID control algorithm to compute a new duty cycle value for the PWMs that are driving the two-phase buck converter 1114. The CLA 1116 also computes a maximum PWM duty cycle to limit the output voltage. The algorithm to compute the maximum duty cycle uses the measured battery voltage and assumes the buck converter 1114 is operating in continuous conduction mode.

[0137] It is noted that, by utilizing amplitude control, rather than only looking at the current for steadying the amplitude, the present invention uniquely allows for finely adjusting the output of the transducer based on the motional feedback signal, achieving a more precise amplitude control. The use of a current control loop allows for faster initial response that would not be possible with amplitude control alone. Also, having the two loops provides for redundancy and individual calibration of the transducer and generator during manufacture. This "amplitude calibration factor" is critical for dialing out a variation in the electrical and mechanical variations in the transducer/piezoelectric crystals and for adjusting for variation in the electrical components of the generator magnitude feedback system. Within the generator, through the analog-to-digital converters, the feedback voltage is converted with this calibration factor to result in a magnitude value that is directly related to displacement. During the calibration process, this calibration value is adjusted while measuring the actual system output displacement. This adjustment pairs a given transducer and generator together so that, as a system, they will develop the proper displacement. Defaults for this value is intentionally set low as a safety mechanism should the adjusted values be lost, corrupted, or inadvertently not programmed. In this way, the default displacement will be lower than the target, resulting in slower but still effective tissue performance. This calibration scheme simplifies manufacturing and reduces the burden of controlling tolerances of the transducer and the generator. Furthermore, because this calibration is done entirely in software, no additional adjustment of physical parts is required either in the transducer or the generator. In effect, two control loops are being used to regulate the amplitude of the driving wave input to the transducer, which provides synchronized operation of the hardware with the oscillation frequency. Redundancy is useful to ensure the device is operating correctly. A malfunction in one loop will usually be detectable because the other loop will be unable to operate properly and the improper operation of either loop is usually detectable. Improper operation can be caused by a hardware fault. The proper operation of both loops requires measurement of both current and amplitude. Different hardware is used to measure amplitude and current. In one embodiment, the battery microcontroller 1106 measures current and the TAG microcontroller 1006 measures amplitude. As the transducer heats up, the capacitance of the transducer and the coupling coefficient will shift and the displacement of the system will decline slightly. This change in temperature also comes with a shift in frequency. By monitoring the frequency, it is possible to provide an offset to more tightly control the displacement through heavy use. This can be accomplished with a comparison to the frequency at startup or to an absolute frequency reference. Alternatively, other measurable characteristics of the transducer can be used to control this offset. Alternatively, the amount of energy put into the transducer can be used to estimate the change and adjust accordingly.

b. Frequency Control

[0138] In a similar operation to the initial frequency lock performed during the startup process, the main processor 914 of the generator 904 uses the results of the DFT calculation to adjust the running frequency of the generator 904 based on the phase of the motional feedback signal in order to maintain a resonant frequency during steady state operation. The motional feedback signal from the bridge circuit is proportional to and in phase with the motion of the transducer 902 and waveguide 1502. When the motional feedback signal is in phase with the output of the push/pull switching amplifier 1010, the system is operating at the series resonance. Again, the phase and magnitude of the motional feedback signal is computed using a Discrete Fourier Transform ("DFT"). The phase reference for the DFT computation is the drive signal for the push/pull amplifier 1010. The frequency is, then, simply changed to cause the push/pull drive signal to be in phase with the motional feedback signal.

[0139] The DFT calculation is simplified and made more accurate if the ADC sample time interval is exactly an integer

multiple of the output frequency period. This technique is referred to herein as "coherent sampling." In one exemplary embodiment, the signals are sampled 12 times per output cycle such that the CLA 912 is sampling the motional feedback signal at 12 times the ultrasonic frequency. With coherent sampling, there are exactly 12 samples per cycle with each occurring at the same point in time relative to the phase of the drive signal. As shown in FIG. 9, the ADC sample clock is generated internally in the TAG microcontroller's 1006 system clock 916. Accordingly, for coherent sampling, the system clock 916 needs to be synchronized to the output. The PWM signal driving the metal-oxide field-effect transistors (MOSFETs) that, in turn, generate the output waveform, is also generated internally from the system clock 916. One exemplary embodiment of the present invention generates the system clock 916 from the DDS 1008. Advantageously, as the output frequency changes, the system clock 916 also changes.

[0140] It is also desirable not to sample shortly after the MOSFETs are switched on or off. This is when there is the largest amount of noise present in the system. Offsetting the sample time to avoid sampling shortly after the MOSFETs switch on or off minimizes the affect of transistor switching noise on the ADC sample. The two PWM outputs employ a deadband to ensure that both MOSFETs are never activated at the same time.

X. SIMPLIFIED CIRCUIT BLOCK DIAGRAM

[0141] FIG. 27 shows a simplified block circuit diagram illustrating another exemplary electrical embodiment of the present invention, which includes a microprocessor 2702, a clock 2730, a memory 2726, a power supply 2704 (e.g., a battery), a switch 2706 (e.g., a MOSFET powerswitch), a drive circuit 2708 (PLL), a transformer 2710, a signal smoothing circuit 2712 (also referred to as a matching circuit and can be, e.g., a tank circuit), a sensing circuit 2714, a transducer 902, and a waveguide assembly 304, which terminates at an ultrasonic cutting blade 1520, referred to herein simply as the waveguide 1502.

[0142] One feature of the present invention that severs dependency on high voltage (120 VAC) input power (a characteristic of all prior-art ultrasonic cutting devices) is the utilization of low-voltage switching throughout the wave-forming process and the amplification of the driving signal only directly before the transformer stage. For this reason, in one exemplary embodiment of the present invention, power is derived from only a battery, or a group of batteries, small enough to fit either within the handle assembly 302. State-of-the-art battery technology provides powerful batteries of a few centimeters in height and width and a few millimeters in depth. By combining the features of the present invention to provide an entirely self-contained and self-powered ultrasonic device, the capital outlay of the countertop box 202 is entirely eliminated - resulting in a significant reduction of manufacturing cost.

[0143] The output of the battery 2704 is fed to and powers the processor 2702. The processor 2702 receives and outputs signals and, as will be described below, functions according to custom logic or in accordance with computer programs that are executed by the processor 2702. The device 2700 can also include a main memory 2726, preferably, random access memory (RAM), that stores computer-readable instructions and data.

[0144] The output of the battery 2704 also is directed to a switch 2706 having a duty cycle controlled by the processor 2702. By controlling the on-time for the switch 2706, the processor 2702 is able to dictate the total amount of power that is ultimately delivered to the transducer 2716. In one exemplary embodiment, the switch 2706 is a MOSFET, although other switches and switching configurations are adaptable as well. The output of the switch 2706 is fed to a drive circuit 2708 that contains, for example, a phase detecting PLL and/or a low-pass filter and/or a voltage-controlled oscillator. The output of the switch 2706 is sampled by the processor 2702 to determine the voltage and current of the output signal (labeled in FIG. 27 as AD2 V_{in} and AD3 I_{in} , respectively). These values are used in a feedback architecture to adjust the pulse width modulation of the switch 2706. For instance, the duty cycle of the switch 2706 can vary from about 20% to about 80%, depending on the desired and actual output from the switch 2706.

[0145] The drive circuit 2708, which receives the signal from the switch 2706, includes an oscillatory circuit that turns the output of the switch 2706 into an electrical signal having a single ultrasonic frequency, e.g., 55 kHz (referred to as VCO in FIG. 27). As explained above, a smoothed-out version of this ultrasonic waveform is ultimately fed to the transducer 902 to produce a resonant sine wave along the waveguide 1502.

[0146] At the output of the drive circuit 2708 is a transformer 2710 that is able to step up the low voltage signal(s) to a higher voltage. It is noted that all upstream switching, prior to the transformer 2710, is performed at low (i.e., battery driven) voltages, something that, to date, has not been possible for ultrasonic cutting and cautery devices. This is at least partially due to the fact that the device advantageously uses low on-resistance MOSFET switching devices. Low on-resistance MOSFET switches are advantageous, as they produce lower switching losses and less heat than a traditional MOSFET device and allow higher current to pass through. Therefore, the switching stage (pre-transformer) can be characterized as low voltage/high current. To ensure the lower on-resistance of the amplifier MOSFET(s), the MOSFET(s) are run, for example, at 10 V. In such a case, a separate 10 VDC power supply can be used to feed the MOSFET gate, which ensures that the MOSFET is fully on and a reasonably low on resistance is achieved. In one exemplary embodiment of the present invention, the transformer 2710 steps up the battery voltage to 120V RMS. Transformers are known in the art and are, therefore, not explained here in detail.

[0147] In each of the circuit configurations described and shown in FIGS. 3-12, 16-21, and 27, circuit component degradation can negatively impact the entire circuit's performance. One factor that directly affects component performance is heat. Known circuits generally monitor switching temperatures (e.g., MOSFET temperatures). However, because of the technological advancements in MOSFET designs, and the corresponding reduction in size, MOSFET temperatures are no longer a valid indicator of circuit loads and heat. For this reason, according to an exemplary embodiment, the present invention senses with a sensing circuit 2714 the temperature of the transformer 2710. This temperature sensing is advantageous as the transformer 2710 is run at or very close to its maximum temperature during use of the device. Additional temperature will cause the core material, e.g., the ferrite, to break down and permanent damage can occur. The present invention can respond to a maximum temperature of the transformer 2710 by, for example, reducing the driving power in the transformer 2710, signaling the user, turning the power off completely, pulsing the power, or other appropriate responses.

[0148] In one exemplary embodiment of the invention, the processor 2702 is communicatively coupled to the end effector 118, which is used to place material in physical contact with the blade portion 116 of the waveguide 114, e.g., the clamping mechanism shown in FIG. 1. Sensors are provided that measure, at the end effector, a clamping force value (existing within a known range) and, based upon the received clamping force value, the processor 2702 varies the motional voltage V_M . Because high force values combined with a set motional rate can result in high blade temperatures, a temperature sensor 2736 can be communicatively coupled to the processor 2702, where the processor 2702 is operable to receive and interpret a signal indicating a current temperature of the blade from the temperature sensor 2736 and to determine a target frequency of blade movement based upon the received temperature.

[0149] According to an exemplary embodiment of the present invention, the PLL 2708, which is coupled to the processor 2702, is able to determine a frequency of waveguide movement and communicate that frequency to the processor 2702. The processor 2702 stores this frequency value in the memory 2726 when the device is turned off. By reading the clock 2730, the processor 2702 is able to determine an elapsed time after the device is shut off and retrieve the last frequency of waveguide movement if the elapsed time is less than a predetermined value. The device can then start up at the last frequency, which, presumably, is the optimum frequency for the current load.

XI. BATTERY ASSEMBLY-MECHANICAL

[0150] FIG. 28 shows an exemplary embodiment of the battery assembly 301 separate from the handle assembly 302. The battery assembly 301 includes an outer shell 2802 that comprises a first half 2802a and a second half 2802b. There is, however, no requirement that the shell 2802 be provided in two halves. In accordance with an exemplary embodiment of the present invention, when the outer shell 2802 is provided in two halves, the first half 2802a can be ultrasonically welded to the second half 2802b in a clamshell configuration. Ultrasonically welding the two halves of the shell 2802 eliminates the need for gaskets while providing a "hermetic" seal between the components within the shell 2802 and the environment. A "hermetic" seal, as used herein, indicates a seal that sufficiently isolates a compartment (e.g., interior of the shell 2802) and components disposed therein from a sterile field of an operating environment into which the device has been introduced so that no contaminants from one side of the seal are able to transfer to the other side of the seal. This seal is at least gas-tight, thereby preventing intrusion of air, water, vapor phase H_2O_2 , etc. Upon initial assembly, room air will be trapped in the enclosure with whatever moisture is present. This can easily be more moisture than is desirable in an electronics enclosure. Therefore, inclusion of a desiccant system inside the enclosure can serve two purposes. A primary purpose is to absorb any moisture that may ingress over the life of the device, but, if sized appropriately, the desiccant system will also serve to absorb any moisture that is trapped during assembly. Use of the desiccant system, therefore, simplifies assembly and eliminates the need to close the enclosure under any special environments.

[0151] FIG. 28 also shows a multi-lead battery terminal assembly 2804, which is an interface that electrically couples the components within the battery assembly 301 to an electrical interface of the handle assembly 302. It is through the handle assembly 302 that the battery assembly 301 is able to electrically (and mechanically) couple with the TAG assembly 303 of the present invention. As is explained above, the battery assembly 301, through the multi-lead battery terminal assembly 2804, provides power to the inventive ultrasonic surgical cautery assembly 300, as well as other functionality described herein. The multi-lead battery terminal assembly 2804 includes a plurality of contact pads 2806a-n, each one capable of separately electrically connecting a terminal within the battery assembly 301 to another terminal provided by a docking bay (see FIG. 34) of the handle assembly 302. One example of such electrical connections coupled to the plurality of contact pads 2806a-n is shown in FIG. 6 as power and communication signal paths 601a-n. In the exemplary embodiment of the multi-lead battery terminal assembly 2804, sixteen different contact pads 2806a-n are shown. This number is merely illustrative. In an exemplary embodiment, an interior side of the battery terminal assembly 2804 has a well formed on the molded terminal holder that can be filled with potting materials to create a gas tight seal. The contact pads 2806a-n are overmolded in the lid and extend through the potting well into the interior of the battery 301. Here a flex circuit can be used to rearrange the array of pins and provide an electrical connection to the circuit

boards. In the exemplary embodiment shown in FIG. 30, for example, a 4x4 array is converted to a 2x8 array.

[0152] FIG. 29 provides a view of the underside of an exemplary embodiment of the multi-lead battery terminal assembly 2804. In this view, it can be seen that the plurality of contact pads 2806a-n of the multi-lead battery terminal assembly 2804 include a corresponding plurality of interior contact pins 2906a-n. Each contact pin 2906 provides a direct electrical coupling to a corresponding one of the contact pads 2806. FIGS. 28 and 32 show two hemispherical depressions 2810 in the battery casing that, when combined with the hook feature 3302, a generally longitudinal void, can be used to retain the battery 301 into a charger. Such geometrical features are easy to fabricate and easy to clean and provide a simple way to capture the battery 301 in a charger in a way that does not require the releasing mechanism that normally is used to disconnect the battery 301 from the handle 302.

[0153] In the exemplary embodiment shown in FIGS. 28 to 33, the multi-lead battery terminal assembly 2804 is potted between the clam shell halves 2802a and 2802b of the shell 2802. More particularly, FIG. 29 provides a view of the multi-lead battery terminal assembly 2804 positioned inside an upper portion of the first shell half 2802a of the battery assembly 301. As is shown in the figure, an upper portion of the first shell half 2802a forms a mouth 2902 that accepts an outer peripheral edge 2904 of the multi-lead battery terminal assembly 2804.

[0154] FIG. 30 provides an additional view of the interior of the first shell half 2802a with the multi-lead battery terminal assembly 2804 inserted within the mouth 2902 of the first shell half 2802a and an exemplary embodiment of a first circuit board 3002 having a plurality of contact pads 3006 coupled to the contact pins 2906 of the multi-lead battery terminal assembly 2804. In such an embodiment, each of the contact pins 2906 is soldered to its respective contact pad 3006 of the circuit board 3002. The battery assembly 301, according to exemplary embodiments of the present invention, includes, as is shown in FIG. 31, in addition to the first circuit board 3002, additional circuit boards 3102 and 3104.

[0155] In accordance with one exemplary embodiment of the present invention, the multi-lead battery terminal assembly 2804 comprises a flex circuit that converts the illustrated 4 x 4 array of contact pads 2806a-n to two 1 x 8 arrays of conductors that are coupled to one or more of the circuit boards 3002, 3102, 3104.

[0156] In an alternative exemplary embodiment, rather than using a flex connector and soldering to connect the one or more circuit boards 3002, 3102, and 3104, a card edge connector 10701 could provide connectivity between the boards and the multi-lead battery terminal assembly 2804 as shown in FIG. 107, which is a cross-sectional view of a shell half of the battery assembly 301 beneath a sloping curvature of the exterior surface of the multi-lead battery terminal assembly 2804. In this exemplary embodiment, the angle of the slope of the multi-lead terminal assembly 2804 is greater than that shown in FIG. 4. For purposes of illustration, only one of the plurality of interior contact pins 2906a-n is depicted. One end of the contact pin 2906 is embedded into the body of the multi-lead battery terminal assembly 2804. The other end of the contact pin 2906 is formed into an "S"-shaped curve that gives the contact pin a degree of flex and forms an interior groove or channel 10702 between the contact pin and the body of the multi-lead battery terminal assembly 2804. The inherent flex of the "S"-shaped portion of the contact pin 2906 allows for any of the one or more circuit boards 3002, 3102, 3104 to be easily inserted into the interior groove or channel 10702 to establish a direct electrical connection between the contact pin 2906 and one or more traces of the circuit board 3002, 3102, 3104. To maintain this direct connection, a card edge connector 10704 secures the circuit board in place, thereby eliminating any need for soldering the contact pin 2906 to the circuit board. As a result, the features of the card edge connector 10704 are integrated into the underside of the multi-lead battery terminal assembly 2804. Accordingly, it is easier to remove the boards for troubleshooting and simplifies manufacturing by eliminating solder joints.

[0157] Further, more than or less than three circuit boards is possible to provide expanded or limited functionality. As shown in FIG. 31, the multiple circuit boards 3002, 3012, 3104 may be positioned in a stacked architecture, which provides a number of advantages. For example, due to the smaller layout size, the circuit boards have a reduced footprint within the battery assembly 301, thereby allowing for a smaller battery. In addition, in this configuration, it is possible to easily isolate power boards from digital boards to prevent any noise originating from the power boards to cause harm to the digital boards. Also, the stacked configuration allows for direct connect features between the boards, thereby reducing the presence of wires. Furthermore, the circuit boards can be configured as part of a single rigid-flex-rigid circuit to allow the rigid parts to be "fanned" into a smaller volumetric area. According to exemplary embodiments of the present invention, each circuit board 3002, 3102, and 3104 provides a specific function. For instance, circuit board 3002 can provide the components for carrying out the battery protection circuitry 702 shown in FIG. 7. Similarly, the circuit board 3102 can provide the components for carrying out the battery controller 703, also shown in FIG. 7. The circuit board 3104 can, for example, provide high power buck controller components. Finally, the battery protection circuitry 702 can provide connection paths for coupling the battery cells 701a-n shown in FIGS. 7 and 31. By placing the circuit boards in a stacked configuration and separating the boards by their respective functions, the boards may be strategically placed in a specific order that best handles their individual noise and heat generation. For example, the circuit board having the high-power buck controller components produces the most heat and, therefore, it can be isolated from the other boards and placed in the center of the stack. In this way, the heat can be kept away from the outer surface of the device in an effort to prevent the heat from being felt by the physician or operator of the device. In addition, the battery board grounds may be configured in a star topology with the center located at the buck controller board to reduce the noise

created by ground loops.

[0158] The strategically stacked circuit boards, the low thermal conductivity path from the circuit boards to the multi-lead battery terminal assembly, and a flex circuit 3516 are all features that assist in preventing heat from reaching the exterior surface of the device. The battery cells and buck components are thermally connected to the flex circuit 3516 within the handle 302 (i.e., the disposable portion of the device) so that the heat generated by the cells and buck components enter a portion away from the physician's hand. The flex circuit 3516 presents a relatively high thermal mass, due to its broad area of exposure and the advantageous conduction characteristics of the copper, which redirects, absorbs, and/or dissipates heat across a broader area thereby slowing the concentration of heat and limiting high spot temperatures on the exterior surface of the device. Other techniques may be implemented as well, including, but not limited to, larger heat wells, sinks or insulators, a metal connector cap and heavier copper content in the flex circuit or the handle 302 of the device.

[0159] Another advantage of a removable battery assembly 301 is realized when lithium-ion (Li) batteries are used. As previously stated, lithium batteries should not be charged in a parallel configuration of multiple cells. This is because, as the voltage increases in a particular cell, it begins to accept additional charge faster than the other lower-voltage cells. Therefore, each cell must be monitored so that a charge to that cell can be controlled individually. When a lithium battery is formed from a group of cells 701a-n, a multitude of wires extending from the exterior of the device to the batteries 701a-n is needed (at least one additional wire for each battery cell beyond the first). By having a removable battery assembly 301, each battery cell 701a-n can, in one exemplary embodiment, have its own exposed set of contacts and, when the battery assembly 301 is not present inside the handle assembly 302, each set of contacts can be coupled to a corresponding set of contacts in an external, non-sterile, battery-charging device. In another exemplary embodiment, each battery cell 701a-n can be electrically connected to the battery protection circuitry 702 to allow the battery protection circuitry 702 to control and regulate recharging of each cell 701 a-n. The battery assembly 301 of the present invention is provided with circuitry to prevent use of the battery assembly 301 past an expected term-of-life. This term is not only dictated by the cells but is also dictated by the outer surfaces, including the battery casing or shell and the upper contact assembly. Such circuitry will be explained in further detail below and includes, for example, a use count, a recharge count, and an absolute time from manufacture count.

[0160] Turning now to FIG. 33, at least one additional novel feature of the present invention is clearly illustrated. The battery assembly 301 shown in FIG. 33 shows a fully assembled battery assembly 301 that has been, for instance, ultrasonically welded so that the two shell halves 2802a and 2802b, as well as the potted multi-lead battery terminal assembly 2804, provide a hermetic seal between the environment and the interior of the battery assembly 301. The gap between the terminal assembly 2804 and the shell halves 2802a and 2802b is wide enough to allow for automated dispense of sealing materialssuch as light cure adhesives or epoxies. Although shown in several of the previous drawings, FIG. 33 illustrates an inventive catch 3300, which is formed by an extended portion of the shell 2802 that is shaped by a generally longitudinal void 3302 directly under the catch 3300, both being located at an upper portion of the exterior of the shell 2802. The catch 3300 is shaped to mate with a receiver 3400 in a lower battery dock 3401 of the handle assembly 302, which is shown in FIG. 34.

[0161] FIG. 35 illustrates an underside of the handle assembly 302 and provides an improved view of the receiver 3400 and the battery dock 3401. As is can be seen in FIG. 35, the receiver 3400 extends from the battery dock 3401 (formed by a handle shell 3500) and is shaped to mate with, i.e., fit within, the void 3302 of the battery assembly 301. In addition, the receiver 3400 is in close proximity to a multi-lead handle terminal assembly 3502, which includes a plurality of handle-connection pins 3504a-n. In the exemplary embodiment shown in FIG. 35, each handle contact pin in the multi-lead handle terminal assembly 3502 is a spring-type contact pin that is capable of being compressed while exerting an amount of force in a direction opposite the compression force and, thereby, maintaining a positive electrical connection between the handle-connection pin 3504a-n and the object applying the force. In addition, the handle-connection pins 3504a-n of the multi-lead handle terminal assembly 3502 are spaced so that each of the handle-connection pins 3504a-n physically aligns with a respective one of the contact pads 2806a-n of the multi-lead battery terminal assembly 2804.

[0162] To couple the inventive battery assembly 301 to the inventive handle assembly 302, the catch 3300 is contacted with the receiver 3400, as is shown in FIG. 36, and the battery assembly 301 is rotated with respect to the handle assembly 302, as is shown in the progression from FIG. 36 to FIG. 37. Although not limited to the exemplary embodiments shown in the figures of the instant specification, the physical shapes of the catch 3300 and receiver 3400 shown in FIGS. 33-35 (particularly the rounded corners 3305 shown in FIG. 33) cause the battery assembly 301 to align itself with the handle assembly 302 virtually regardless of the angle to which the battery assembly 301 approaches the receiver 3400, as long as the catch 3300 and receiver 3400 are in physical contact with each other. With any rotation of the battery assembly 301 between the position shown in FIG. 36 and the position shown in FIG. 37, the catch 3300, or rather, the void 3302, automatically seats upon the receiver 3400. This means that a user in the sterile field can easily connect the battery assembly 301 to the handle assembly 302 and, especially, can do so without actually viewing the two parts during connection efforts.

[0163] In accordance with one exemplary embodiment of the present invention, the multi-lead handle terminal assembly 3502, as shown in FIG. 35, includes a gasket 3512 that surrounds the handle-connection pins 3504a-n and is sealed to a flex circuit board 3514 that supports the handle-connection pins 3504a-n. In one exemplary embodiment, the gasket 3512 is part of a rigid-flex circuit that includes the flex circuit board 3514, a flex circuit or harness 3516 (to be connected to the TAG assembly 303), and the handle-connection pins 3504a-n. A portion of the flex circuit board 3514 is made relatively rigid or stiffer as compared to the rest of the flex harness 3516. When the gasket 3512 is compressed during connection of the battery assembly 301 to the handle assembly 302, rigid portions of the flex circuit board 3514 adjacent the gasket 3512 support the gasket 3512 and allow the gasket 3512 to be compressed without substantial movement when the battery assembly 301 is coupled to the handle assembly 302. When the multi-lead battery terminal assembly 2804 and the multi-lead handle terminal assembly 3502 are placed together, as shown in FIGS. 59 and 60, a seal exists between an outer periphery 3312 of the multi-lead battery terminal assembly 2804 and the gasket 3512 of the multi-lead handle terminal assembly 3502. The seal prevents moisture from penetrating the interior of the gasket 3512, i.e., reaching the handle-connection pins 3504a-n of the multi-lead handle terminal assembly 3502 or the contacts pads 2806a-n of the multi-lead battery terminal assembly 2804. This sealing method only requires that the portions of the contact pins that extend through the stiffener be insulated on the side opposite the gasket. Such a sealing method is also used on the TAG connector 5010 and on the handle 302 as described in further detail below. Such configuration allow for the production of a device where sealing all potential openings is not necessary, thereby resulting in a cost and complexity savings.

[0164] According to an exemplary embodiment of the present invention, the flex circuit board 3514 is made from two copper trace layers separated and insulated with polyimide. As provided above, portions of the flex circuit board 3514 can be made relatively stiffer. For example, certain portions of the flex circuit board 3514 may contain a stiffener, e.g., FR-4 stiffener, bonded to the flex circuit board 3514. The portions of the flex circuit board 3514 with the stiffener provide a mechanical way of rigidly holding components within the disposable handle assembly 302.

[0165] In accordance with another exemplary embodiment of the present invention, the two body halves 4503, 4603 of the handle assembly 302 hold the rigid sections therebetween within the handle assembly 302 under close tolerances. Where the flex circuit board 3514 has a stiffener 10902 in a horizontal orientation, and the flex circuit board 3514 transitions to a vertical orientation, as shown in FIG. 108, the flex circuit board 3514 can be damaged if not allowed to gradually transition. The rigid portions (e.g., 10902) of the flex circuit board 3514 are desired to be at or within a slot or track 10804 in the body material. Therefore, to hold the rigid portions firmly on all sides, a portion 10806 of the flex circuit board 3514 is designed to peel away from the rigid portion 10902 before reaching the end of the flex circuit board 3514. No adhesive is placed in this area. According to an exemplary embodiment of the present invention, on this battery side of the flex circuit board 3514, i.e., the stiffened board from which the battery contact pins 2906a-n protrude, has a custom connector made from, for example, FR-4 material or molded plastic. This can be seen, for example, in FIG. 60. The molded plastic can contain either insert molded metal contacts or the contacts can be inserted after molding and then potted for sealing purposes. The FR-4 or molded plastic is then bonded to the flex circuit board 3514 with an adhesive. In a molded configuration, the connector can be made to have rows of rigid material raised between the contacts or even a grid of material to protect the contact from mechanical damage.

[0166] As shown in FIG. 56 and explained in detail below, the rigid-flex circuit of the handle assembly 302 electrically couples the handle-connection pins 3504a-n to the handle assembly's TAG electrical connector 5602.

[0167] Referring briefly back to FIG. 35, the handle body 3500 of the handle assembly 302 is provided with an extended battery securing portion 3506. The extended battery securing portion 3506 is on a side of the multi-lead handle terminal assembly 3502 opposite the receiver 3400. It is noted that the particular exemplary embodiment of the handle-securing portion shown in FIG. 35 includes a pair of voids 3508 and 3510, which are not necessary to complete the battery-handle securing process. Referring now to FIG. 38, an additional feature of the battery assembly 301 is shown. In this view, a pair of bosses 3802, 3804 can be seen on an exterior side of the battery assembly shell 2802. The bosses 3802, 3804 are spaced and positioned to mate with the voids 3508, 3510 in the extended battery securing portion 3506 of the handle body 3500. This mating position is illustrated in FIG. 37. Referring still to FIG. 38, it can be seen that each of the bosses 3802, 3804 are provided with a sloped upper portion 3816 and an opposing sharp-edge bottom portion 3818. The sloped upper portion 3816 allows the bosses 3802, 3804 to easily slip into the voids 3508, 3510 in the extended battery securing portion 3506 of the handle assembly 302 when the battery assembly 301 is being secured to the handle assembly 302. The sharp-edge bottom portions 3818 secure and allow the bosses 3802, 3804 to remain seated within the extended battery securing portion 3506 of the handle assembly 302.

[0168] The combination of the mating between the catch 3300 and receiver 3400 at one side of the battery assembly 301 and the mating between the bosses 3802, 3804 and the voids 3508, 3510, respectively, at the other side of the battery assembly 301 provides a solid and secure attachment of the battery assembly 301 to the handle assembly 302 (see also FIGS. 3 and 37). In an exemplary embodiment, the two bosses 3802, 3804 are spaced as far apart from each other as is practical. This spacing improves the strength and stability of the attachment between the battery assembly 301 and the handle assembly 302. This stability is further improved by the overlap between the disposable and the

battery at faces 3520 and 3305, seen in FIGS. 35 and 33, respectively.

[0169] FIG. 38 also illustrates a release mechanism 3806 coupled to the exterior of the battery assembly shell 2802. The release mechanism 3806 is provided with peripheral edges 3808 that are secured by and slide within a pair of corresponding channels 3810, 3812 formed within the same exterior side of the battery assembly shell 2802 as the bosses 3802, 3804. The fit between the release mechanism 3806 and the battery casing 2802a, 2802b is loose so that water is able to flow between the mating parts for cleaning before sterilization. To assist in the cleanability of the release mechanism 3806, holes can be added; in the exemplary embodiment, two oval holes are present. Additionally, all edges of release mechanism 3806 are curved to limit the contacted surface area. A face of the release mechanism 3806 facing the battery casing has a concave cut down the center of it to further reduce the mated surface area. The release mechanism 3806 has a sloped nose region 3814 that is operable for moving toward and away from the bosses 3802 and 3804 and, in the particular embodiment shown in FIG. 38, extends between the bosses 3802 and 3804 when the release mechanism 3806 is slid in an upwardly direction. This nose 3814 also forces the battery latch down and out of the way during connection of the battery assembly 301. The release mechanism 3806 is made of a lubricious yet tough material that can supply low friction but also withstand the extended use of the battery assembly 301 -- a reusable portion of the device. Materials such as graphite and/or carbon-fiber reinforced PTFE are suitable, for example.

[0170] When the battery assembly 301 is securely coupled to the handle assembly 302, as is shown in FIG. 37, the release mechanism 3806 remains in a position within the channels 3810, 3812 that is furthest away from the handle assembly 302. When a user desires to remove the battery assembly 301 from the handle assembly 302, the release mechanism 3806 is slid within the channels 3810, 3812 in a direction toward the handle assembly 302. This sliding action causes the sloped nose region 3814 to enter the area between the battery assembly 301 and the lowermost portion of the extended battery securing portion 3506. As the sloped nose region 3814 moves forward, it forces the extended battery securing portion 3506 to ride up on the sloped nose region 3814 and flex away from the battery assembly 301. Stated differently, the extended battery securing portion 3506 bends away from the multi-lead handle terminal assembly 3502 and receiver 3400. To eliminate risk of inadvertently releasing the battery assembly 301 from the handle assembly 302 while the jaw is closed, the trigger 4606 is configured to cover or protect the battery release mechanism 3806. Therefore, with the trigger 4606 fully depressed, the battery release mechanism 3806 is fully covered, thereby preventing user actuation of the release mechanism 3806 to release the battery assembly 301.

[0171] Once the extended battery securing portion 3506 flexes to a certain degree, the bottom edges 3818 of the bosses 3802 and 3804 no longer engage with the voids 3508 and 3510 and the battery assembly 301 can easily be rotated from the orientation shown in FIG. 37 to that shown in FIG. 36 and, ultimately, separated from the handle assembly 302. The release mechanism 3806 is, of course, only one example of a mechanism that secures the battery assembly 301 to and releases the battery assembly 301 from the handle assembly 302. The release mechanism 3806 is advantageous in that it renders unintended detachment very unlikely. To release the battery assembly 301, an operator needs to move the release mechanism 3806 toward the handle while, at the same time, rotating the battery assembly 301 away from the handle assembly 302. These two oppositely-directed forces/actions are very unlikely to occur simultaneously unless they are performed intentionally. Application of these different forces also requires the user's hands to be in a position different than an in-use position during surgery. Such a configuration virtually ensures that accidental separation of the battery assembly 301 and handle assembly 302 does not occur.

[0172] The present invention also provides a significant advantage over prior art devices in the way the electrical connection between the multi-lead handle terminal assembly 3502 and the multi-lead battery terminal assembly 2804 is formed. More specifically, looking again to FIG. 33, it can be seen that, in the illustrated exemplary embodiment of the multi-lead battery terminal assembly 2804, sixteen contact pads 2806 are present -- the contact pads 2806a-d forming a first row 3304, contact pads 2806e-h forming a second row 3306, contact pads 2806i-l forming a third row 3308, and contact pads 2806m-p forming a fourth row 3310.

[0173] Similarly, as is shown in FIGS. 34 and 35, the multi-lead handle terminal assembly 3502 includes a plurality of handle-connection pins 3504a-n (only twelve of the sixteen pins 3504a-n are shown in the view of FIG. 35). The handle contact pins are configured so that, when the battery assembly 301 is coupled to the handle assembly 302, each handle-connection pin 3504a-n is aligned with an individual one of the contact pads 2806. Therefore, the handle-connection pins 3504a-n are also disposed, in the particular embodiment shown in the drawings, in four rows 3404, 3406, 3408, and 3410.

[0174] When the battery assembly 301 is to be attached to the handle assembly 302, the catch 3300 is first placed in contact with the receiver 3400 and the battery assembly 301 is then rotated toward the extended battery securing portion 3506 until the bosses 3802, 3804, respectively, engage the voids 3508, 3510 in the extended battery securing portion 3506. One significant result of the rotation is that the physical/electrical connection between the multi-lead handle terminal assembly 3502 and the multi-lead battery terminal assembly 2804 occurs sequentially, one row at a time, starting with battery row 3304 and handle row 3404.

[0175] According to an exemplary embodiment of the present invention, the first battery row 3304 includes a grounding contact pad and the last battery row 3410 includes at least one power contact pad. Therefore, the first contact between

the multi-lead battery terminal assembly 2804 and the multi-lead handle terminal assembly 3502 is a grounding connection and the last is a power connection. Installation of the battery assembly 301 will not cause a spark because the ground contact of the battery assembly 301 is a distance away from the last row 3410 of the multi-lead handle terminal assembly 3502 when the powered connection is made. As the battery assembly 301 is rotated into an attachment position (shown in FIG. 37), each battery row 3304, 3306, 3308, 3310 sequentially makes contact with each handle row 3404, 3406, 3408, 3410, respectively, but the power contact(s) is(are) only connected after a row having at least one grounding contact has been connected. In other words, as the battery assembly 301 is installed into the handle assembly 302, the battery assembly 301 is advantageously grounded before any power contacts are brought into contact with any portion of the handle assembly 302 -- a significant advantage over prior-art device power supply couples. In all known devices, the contacts supplying power (i.e., electric mains) are coupled simultaneously to other couplings, or randomly, depending on the approach orientation of the electric plug. This prior-art coupling leaves sparking or arcing as a persistent possibility. With the present invention, however, the possibility of sparking or arcing that is present in the prior art is entirely eliminated.

[0176] In addition, in accordance with one exemplary embodiment of the present invention, one or more pins in any of the first 3404, the second 3406, the third 3408, or the last row 3410 of the handle-connection pins 3504a-n are coupled to a battery presence detection circuit 3104. In particular, one of the contacts in the last row 3410 is used as a present pad. The battery presence detection circuit 3104, after detecting the proper connection of the grounding pin(s) and the present pin of the multi-lead handle terminal assembly 3502 to the multi-lead battery terminal assembly 2804, allows operation of the ultrasonic surgical assembly 300. In the embodiment where the battery present detection pad(s) is/are only in the last row, i.e., furthest away from the receiver 3400, the handle assembly 302 will not alter/change states until the battery assembly 301 is fully and securely installed, i.e., all contacts are properly connected. This advantageous feature prevents any improper operation of the overall assembly. Similarly, when disconnecting the battery assembly 301, the last row 3410 is the first row disconnected from the handle-connection pins 3504a-n. Therefore, the device immediately responds to the absence of the battery assembly 301 from the handle assembly 302.

[0177] In the exemplary embodiment, the battery protection circuit 702, i.e., the fuel gauge, monitors the present pad and waits for it to be grounded before powering the microprocessor 1006 within the TAG assembly 303. To do this, of course, the TAG assembly 303 must also be coupled to the handle assembly 302. More particularly, the TAG assembly 303 must be electrically coupled to the handle assembly's TAG electrical connector 5602. Once the TAG assembly 303 is coupled to the handle assembly's TAG electrical connector 5602 (see, e.g., FIGS. 36 and 37) and the battery assembly 301 is properly coupled to the multi-lead handle terminal assembly 3502 (see, e.g., the configuration shown in FIG. 37), communication between the battery assembly 301 and the TAG assembly 303 occurs. After such communication is established, the device is ready for use and the battery controller 703 can signal a "ready-for-use" state to the user, for example, by generating an indicative tone at the buzzer 802 within the handle assembly 302 and/or generating a visual indicator at the LEDs 906.

[0178] In one exemplary embodiment for establishing this communication, the battery protection circuit 702 senses the presence of a proper connection between the battery assembly 301 and the handle assembly 302 by periodically pulsing a low-voltage signal to the present pad. The battery protection circuit 702 monitors the present pad for a connection to ground, which ground is provided by the handle assembly 302 once the battery assembly 301 is properly connected thereto. However, because the battery assembly 301 may be exposed to bodily fluids or submerged in a solution, for example, water during cleaning, it is advantageous for the battery assembly 301 not to sense a false ground condition as if the battery assembly 301 has been properly connected to the handle assembly 301 when the ground condition is only due to the fluid or solution electrically coupling the present pad to ground. More specifically, when the device is being disinfected and cleaned, the contacts are exposed to electrolytes having a finite resistance. In such a case where protection circuitry is not provided, the circuit that turns on the battery pack will activate the boards in the presence of such electrolytes. Large currents are able to flow between the voltage-enabled pins to the battery ground. This current flow establishes a motion of metal ions that will cause pitting or electro-deposition in the contacts, which is undesirable because a brief exposure to electrolyte badly corrodes the contacts, rendering them unusable. Another undesirable situation could exist during battery installation. When a proper battery-handle contact closure is achieved, the resistance of the conductive lines sensed by the microcontroller is very low. But if fluid is present, a larger resistance exists. The microcontroller is so sensitive that such a large resistance could activate the device.

[0179] For these reasons, embodiments of the present invention provide a comparator, for example through software, that monitors the impedance between the present pad and ground (i.e., the GND line in the TAG assembly shown in FIG. 9). The comparator compares the impedance of a coupling between the present pad and ground to the reference impedance so that only when the impedance is less than a threshold impedance, i.e., less than that of a solution, will the battery assembly 301 operate. More specifically, the comparator circuit compares a reference voltage against the voltage generated both when the battery present contact is exposed to either a short-to-ground or to an electrolyte of finite resistance mentioned above. If the resistance is such that the voltage generated matches the reference voltage, then the battery will turn on. The reference voltage is adjusted so that fluids present during battery-handle contact will not allow the battery pack to turn on. The comparator circuit is configured with a strong hysteresis to prevent inadvertent

self turn-off due to noise and the sensitive nature of this circuit.

[0180] The illustrated design of the multi-lead handle terminal assembly 3502 provides even further advantages over the prior art. In particular, the inventive handle-connection pins 3504a-n, shown in the enlarged partial perspective view of FIG. 39, provide a physical connection along with a lateral displacement that ensures removal of any foreign substances from the contact region where the handle-connection pins 3504a-n of the multi-lead handle terminal assembly 3502 meet the contact pads 2806a-n of the multi-lead battery terminal assembly 2804. Specifically, FIG. 39 shows the first handle-connection pin 3504a in its at-rest, non-contact state. That is, the handle-connection pin 3504a has a spring force that places and retains it in the natural resting shape shown in FIG. 39. However, when the multi-lead battery terminal assembly 2804 is fully mated with the multi-lead handle terminal assembly 3502, the handle-connection pins 3504a-n compress. This compressed state is shown, for example, by handle-connection pins 3504b and 3504f in FIG. 39.

[0181] The compression placed on the handle-connection pin 3504a-n by the contact pad 2806 not only provides positive pressure to retain the electrical connection, but also causes the connecting surface of each handle-connection pin 3504a-n to move a distance D with respect to the longitudinal extent of the pin 3504. This distance D is illustrated in FIG. 39 by a first vertical line 3901 showing where an apex of a connecting surface of a first handle-connection pin 3504e exists when the pin 3504e is in its uncompressed state. A second vertical line 3902 shows where the apex of the connecting surface of the neighboring second handle-connection pin 3504f exists when the pin 3504f is compressed. The distance between the two lines defines a longitudinal distance D that the connecting surface of each pin 3504a-n translates when compressed. This movement is initiated when the handle-connection pin 3504a-n and the respective contact pad 2806 first make contact and continues until the battery assembly 301 is fully seated between the receiver 3400 and the extended battery securing portion 3506, as shown in the cutaway perspective view FIG. 40. The translation movement of the handle-connection pins 3504a-n produces a swiping motion that effectively wipes the contact pad 2806 clean, thus improving electrical connection therebetween. This wiping effect can prove highly advantageous when, for instance, a battery needs to be replaced in an operating environment and contaminant material, such as blood, comes into contact with the contact pads 2806 or when the pads are corroded from repeated use or due to exposure to cleaning agents.

[0182] The view of FIG. 35 shows yet another advantageous feature of the present invention. Therein, it can be seen that the multi-lead handle terminal assembly 3502 features flanged sides 3520 that protect the handle-connection pins 3504a-n of the handle assembly 302 from the left and right sides because they extend in a direction away from the plane of the pins 3504a-n. The receiver 3400 also extends in the direction away from the plane of the pins 3504a-n to protect the pins from the rear. Finally, the battery securing portion 3506 significantly extends in the direction away from the plane of the pins 3504a-n to protect the pins from the front. Users know from the ergonomic shape of the battery pack 301 and the handle 302 that the battery pack 301 is configured to attach to the handle 302 in a particular plane as illustrated clearly in FIGS. 36 and 37. Knowing this, the four extending sides of the lower battery dock 3401 are sized to prevent any injury to the pins 3504a-n when the user attempts to insert the battery 301 into the dock 3401. To illustrate this more specifically, two planes are defined, one for each of the battery 301 and the handle 302. These planes are parallel to the page including FIG. 3 and are coplanar when the battery 301 is installed in the handle 302. The plane relating to the handle 302 is referred to as a distal-to-proximal central handle plane and vertically bisects the handle like the page of the drawing of FIG. 3. Similarly, the plane relating to the battery 301 is referred to as the distal-to-proximal central battery plane and vertically bisects the handle like the page of the drawing of FIG. 3. With these planes defined, the pin safety feature is explained.

[0183] The receiver 3400 and the battery securing portion 3506 are shaped with a length that does not permit the front top corner 3008 of the battery from touching the pins 3504a-n when the distal-to-proximal central battery plane is within approximately 30 degrees of the distal-to-proximal central handle plane. Likewise, the receiver 3400 and the battery securing portion 3506 are shaped with a length that does not permit the rear top corner, i.e., the catch 3300, of the battery 301 from touching the pins 3504a-n when the distal-to-proximal central battery plane is within approximately 30 degrees of the distal-to-proximal central handle plane. This configuration ensures safe and easy connection of the battery 301 to the handle 302.

[0184] A further advantage of the present invention is that the entire battery assembly 301 can be sterilized. If there is a need for replacement during a medical procedure, the battery assembly 301 can be easily replaced with a new sterile battery assembly 301. The gas-tight construction of the battery assembly 301 allows it to be sterilized, for example, using low-temperature vapor phase Hydrogen Peroxide (H_2O_2) as performed by the sterilization devices manufactured by the Steris Corporation and referred to under the trade name V-PRO or manufactured by Advanced Sterilization Products (ASP), division of Ethicon, Inc., a Johnson & Johnson company, and referred to under the trade name STER-RAD®. Because the Lithium cells of the battery assembly 301 are damaged when heated above 60° C, non-heating sterilization commonly used in hospitals today makes the battery assembly 301 easily re-used in surgical environments.

a. Battery Pressure Valve

[0185] The battery assembly 301 of the present invention features yet another inventive feature. As shown in FIG. 37, the battery assembly 301 includes an exemplary embodiment of a pressure valve 3702 that, as will be explained below, prevents the influence of external atmospheric pressure—both positive and negative—on the battery assembly's internal pressure, while providing for emergency pressure relief for excess internal pressure, e.g., >30 psi. This valve 3702, advantageously, has a large enough opening to vent any internally accumulating gases quickly. Also advantageously, the inventive valve 3702 does not instantaneously open and close with small changes in pressure, as do some prior art venting devices. Instead, the opening and closing events of the valve 3702 have several defined stages. In an exemplary configuration of the valve 3702, during the first stage (< 30 psi), the valve 3702 remains sealed, as shown in FIGS. 41 and 42, and does not allow gas flow into or out of the battery compartment. This exemplary embodiment can be referred to as a so-called poppet valve. In stage 2, once the battery assembly's internal pressure has increased just enough to counter the force of a spring 4102 holding an O-ring 4104 surrounding a poppet 4106 against a valve seat 4202, shown in the cutaway view of FIG. 42, fluid/gas will begin to escape between the O-ring 4104 and the seat 4202. In stage 3, the internal pressure has pushed the valve 3702 open enough to allow a significant amount of fluid/gas to pass the seal 4104, 4202. At this point, and up to stage 4, internal pressure has forced the valve completely open, i.e., the O-ring 4104 has moved completely off of the seat 4202. Additional pressure has diminished effect on the flow because the valve cannot open further.

[0186] In stage 5, pressure on the valve 3702 begins to decrease and the poppet 4106 starts to shut. As the poppet 4106 retracts, it follows the same sequence as occurred during opening through hysteresis (i.e., retardation of an effect when forces acting upon a body are changed, dictating that a lag in closing occurs). As a result, when the poppet 4106 begins its return, it lags in position relative to the curve of FIG. 44 traversed when the poppet 4106 was opening. At stage 6, the O-ring 4104 just touches the seat 4202. The valve 3702 does not seal at this point, as there is no force pressing the O-ring 4104 into the seat 4202. In step 7, the force of the spring 4102 compresses the O-ring 4104 with sufficient force to seal the valve shut. The valve 3702 can now return to stage 1, shown in FIGS. 41 and 42. The valve 3702 is re-sealable multiple times as the sealing surface is tapered to minimize stiction.

[0187] For ease of testing the valve 3702, the poppet 4106 is formed with a tear-off handle 4108. The handle 4108 is operable to move the poppet 4106 (manually or automatically) to provide access within the battery assembly 301 for the purpose of testing the ultrasonic weld or the bonded shell halves 2802a, 2802b for leaks. For example, a user or leak-testing fixture can grasp the handle 4108 and move the poppet 4106 out and back within the valve dock 4204, which is shown in FIGS. 41 and 42 as located in one half of the outer shell 2802a or 2802b of the battery assembly 301. Alternatively, the handle 4108 may be used to provide access to the interior of the battery assembly 301 to back fill the battery compartment with inert gas or trace gas, e.g., helium, or even to pull a vacuum within the interior of the battery assembly 301. When testing is finished, the user, for example, the manufacturer, can tear off or otherwise remove the handle 4108 to prevent further user-controlled poppet 4106 movement. Removal of the handle 4108 is made easier with a narrowing 4110 formed at the base of the handle 4108. For example, the narrowing 4110, shown in FIGS. 41 to 43, includes sharp corners to provide a consistent and smooth breaking point.

[0188] In this exemplary embodiment, the handle 4108 has an arrowhead and tab configuration. As shown in FIGS. 41 to 43, the poppet 4106 includes clocking tabs 4112 on at least one side of the poppet 4106 to maintain the arrowhead in a desired orientation, e.g., horizontal to the ground when the ultrasonic surgical assembly 300 is in use, to facilitate machine or automated access to the inside of the battery assembly 301 for leak-testing operations. The arrowhead includes a gentle taper, which assists in the installation of the O-ring 4104—the O-ring 4104 is able to slide easily over the tapered arrowhead without breaking off the arrowhead tab.

[0189] In an exemplary embodiment, the O-ring 4104 is made of a STERRAD® compatible material having a durometer of between approximately 40 and approximately 60 (e.g., VITON®) as such materials seal more reliably on molded parts having irregular surface finishes.

[0190] In another exemplary embodiment, the poppet 4106 is formed from a different material than the battery shell 2802 to prevent sympathetic welding during ultrasonic welding of the battery shell halves 2802a, 2802b.

[0191] As shown in FIG. 37, the valve 3702 is advantageously disposed at the very bottom of the battery assembly 301. In this exemplary configuration, the valve 3702 remains outside the working area of the hand grip, i.e., the battery outer shell 2802, to prevent interference with the user's handling of the ultrasonic surgical assembly 300. Further, this positioning of the valve 3702 increases safety by preventing injury to the user's hand should venting occur through the valve 3702. At the same time, the user's hand does not block the valve 3702 from venting.

[0192] Also advantageously, the valve 3702 is easy to clean. The smooth outer surface of the poppet 4106 allows direct access to the O-ring 4104 seal area. Likewise, the blended smooth features of the poppet 4106 create no hidden areas in which dirt or grime could become trapped.

[0193] The battery assembly 301 of the present invention may include inventive features alternative to the valve 3702 described above. In one exemplary embodiment, the battery assembly 301 may include a non-illustrated burst plug

installed within a battery access hole or relief port in the bottom side of one of the shell halves 2802a, 2802b. In this exemplary configuration, the burst plug is formed from a molded flexible material and is able to be press fit into the access hole. Alternatively, the burst plug may be molded to the inside of the battery access hole. As installed, the burst plug is flush with the outer surface of the battery shell 2802 to prevent dirt or grime collection or interference with the user's hand. The burst plug provides emergency pressure relief for excess internal pressure, e.g., >30 psi. Such excess internal pressure forces the burst plug to exit the battery relief port and vent any internally accumulating gases quickly. In this exemplary embodiment, a T-tail on the inside end of the molded burst plug prevents the burst plug from detaching from the battery assembly 301 and becoming lost or potentially falling into a patient during a surgical procedure. Further, where the burst plug is retained to the battery with the T-tail, the dangling burst plug becomes an advantageous visual indicator to a user that adverse conditions in the battery assembly 301 have occurred.

[0194] In another exemplary embodiment, the battery assembly 301 may include a burst disk installed over the battery access hole or relief port in the bottom side of one of the shell halves 2802a, 2802b. In this exemplary embodiment, the burst disk may comprise a foil tape disk placed over the battery relief port, or a disk of material with known shear characteristics. The disk can be ultrasonically welded, bonded, or otherwise sealed in place over the battery relief port to serve as a blow-off relief valve. Advantageously, the relief port may include an array or grid of many small openings. Such a configuration prevents inadvertent rupture of the disk from external mechanical measures.

[0195] In yet another exemplary embodiment, one of the shell halves 2802a or 2802b of the battery assembly outer shell 2802 may include a molded blow-out or relief area where the molded material of the outer shell half 2802a or 2802b is particularly thinner than the rest of the outer shell 2802. The relief area of the outer shell 2801 is thus designed to fail when a pre-defined, undesirable pressure is reached within the interior of the battery assembly 301. Further, a pattern, e.g., a flower-petal pattern, may be scored onto the molded surface of one of the shell halves 2802a or 2802b to provide additional stress concentrators as well as serve as a hinge to prevent petal loss after pressure relief occurs, and thus prevent pieces of the ruptured molded material of the shell 2802 from detaching from the battery assembly 301 and possibly becoming lost or falling into a patient.

[0196] In again another exemplary embodiment, the battery assembly 301 may include a pressure relief configuration akin to a turkey popper valve. Rather than having a self-reseating valve, as described above with respect to the poppet valve 3702, the turkey popper valve is retained in an actuated position after relief of excess internal pressure within the battery assembly 301. This provides a visual indicator to the user that adverse conditions existed within the battery. In this configuration, the turkey popper valve may be selectively resealed to allow for further use of the battery assembly 301.

b. Intelligent Battery

[0197] In additional exemplary embodiments of the present invention, an intelligent or smart battery is used to power the surgical ultrasonic surgical cautery assembly 300. However, the smart battery is not limited to the ultrasonic surgical cautery assembly 300 and, as will be explained, can be used in a variety of devices, which may or may not have power requirements (i.e., current and voltage) that vary from one another. The smart battery, in accordance with an exemplary embodiment of the present invention, is advantageously able to identify the particular device to which it is electrically coupled. It does this through encrypted or unencrypted identification methods. For instance, a battery assembly 301 shown in FIG. 57 can have a connection portion, such as portion 5702. The handle assembly 302 can also be provided with a device identifier 5704 communicatively coupled to the multi-lead handle terminal assembly 3502 and operable to communicate at least one piece of information about the handle assembly 302. This information can pertain to the number of times the handle assembly 302 has been used, the number of times a TAG assembly 303 (presently connected to the handle assembly 302) has been used, the number of times a waveguide assembly 304 (presently connected to the handle assembly 302) has been used, the type of waveguide assembly 304 that is presently connected to the handle assembly 302, the type or identity of the TAG assembly 303 that is presently connected to the handle assembly 302, and/or many other characteristics. When the smart battery assembly 301 is inserted in the handle assembly 302, the connection portion 5702 within the smart battery assembly 301 makes communicating contact with the device identifier 5704 of the handle assembly 302. The handle assembly 302, through hardware, software, or a combination thereof, is able to transmit information to the smart battery assembly 301 (whether by self-initiation or in response to a request from the battery assembly 301). This communicated identifier is received by the connection portion 5702 of the smart battery assembly 301. In one exemplary embodiment, once the smart battery assembly 301 receives the information, the communication portion 5702 is operable to control the output of the battery assembly 301 to comply with the device's specific power requirements.

[0198] In an exemplary embodiment, the communication portion 5702 includes a processor, such as processor 1118, and a memory, which may be separate or a single component. The processor 1118, in combination with the memory, is able to provide intelligent power management for the handheld ultrasonic surgical cautery assembly 300. This embodiment is particularly advantageous because an ultrasonic device, such as handheld ultrasonic surgical cautery assembly 300, has a power requirement (frequency, current, and voltage) that may be unique to the handheld ultrasonic

surgical cautery assembly 300. In fact, handheld ultrasonic surgical cautery assembly 300 may have a particular power requirement or limitation for one dimension or type of waveguide 1502 and a second different power requirement for a second type of waveguide having a different dimension, shape, and/or configuration.

[0199] A smart battery 301 according to the invention, therefore, allows a single battery assembly to be used amongst several surgical devices. Because the smart battery 301 is able to identify to which device it is attached and is able to alter its output accordingly, the operators of various different surgical devices utilizing the smart battery 301 no longer need be concerned about which power source they are attempting to install within the electronic device being used. This is particularly advantageous in an operating environment where a battery assembly needs to be replaced or interchanged with another surgical device in the middle of a complex surgical procedure.

[0200] In a further exemplary embodiment, the smart battery 301 stores in a memory 5706 a record of each time a particular device is used. This record can be useful for assessing the end of a device's useful or permitted life. For instance, once a device is used 20 times, all such batteries 301 connected to the device will refuse to supply power thereto -- because the device is defined as a "no longer reliable" surgical instrument. Reliability is determined based on a number of factors. One factor can be wear, which can be estimated in a number of ways including the number of times the device has been used or activated. After a certain number of uses, the parts of the device can become worn and tolerances between parts exceeded. For instance, the smart battery 301 can sense the number of button pushes received by the handle assembly 302 and can determine when a maximum number of button pushes has been met or exceeded. The smart battery 301 can also monitor an impedance of the button mechanism which can change, for instance, if the handle gets contaminated, for example, with saline.

[0201] This wear can lead to an unacceptable failure during a procedure. In some exemplary embodiments, the smart battery 301 can recognize which parts are combined together in a device and even how many uses each part has experienced. For instance, looking at FIG. 57, if the battery assembly 301 is a smart battery according to the invention, it can identify both the handle assembly 302, the ultrasonic-cutting-blade-and-waveguide assembly 304, as well as the particular TAG assembly 303, well before the user attempts use of the composite device. The memory 5706 within the smart battery 301 can, for example, record each time the TAG assembly 303 is operated, and how, when, and for how long it is operated. If each TAG assembly 303 has an individual identifier, the smart battery 301 can keep track of each TAG assembly's use and refuse to supply power to that TAG assembly 303 once the handle assembly 302 or the TAG assembly 303 exceeds its maximum number of uses. The TAG assembly 303, the handle assembly 302, the ultrasonic-cutting-blade-and-waveguide assembly 304, or other components can include a memory chip that records this information as well. In this way, any number of smart batteries 301 can be used with any number of TAG assemblies, staplers, vessel sealers, etc. and still be able to determine the total number of uses, or the total time of use (through use of the clock 330), or the total number of actuations, etc. of each TAG assembly, each stapler, each vessel sealer, etc. or charge or discharge cycles.

[0202] When counting uses of the TAG assembly 303, in order to intelligently terminate the life of the TAG assembly 303, it becomes important to be able to accurately distinguish between completion of an actual use of the TAG assembly 303 in a surgical procedure and a momentary lapse in actuation of the TAG assembly 303 due to, for example, a battery change or a temporary delay in the surgical procedure. Therefore, as an alternative to simply counting the number of activations of the TAG assembly 303, a real-time clock (RTC) circuit can be implemented to keep track of the amount of time the TAG assembly 303 actually is shut down. From the length of time measured, it can be determined through appropriate logic if the shutdown was significant enough to be considered the end of one actual use or if the shutdown was too short in time to be considered the end of one use. Thus, in some applications, this method may be a more accurate determination of the useful life of the TAG assembly 303 than a simple "activations-based" algorithm, which for example, may provide that ten "activations" occur in a single surgical procedure and, therefore, ten activations should indicate that the counter is incremented by one. Generally, this type and system of internal clocking will prevent misuse of the device that is designed to deceive a simple "activations-based" algorithm and will prevent incorrect logging of a complete use in instances when there was only a simple de-mating of the TAG assembly 303 or the battery 301 that was required for legitimate reasons.

[0203] Although the battery and TAG assemblies of the device are reusable, it is desirable to set a finite number of uses of the device. This could be necessary since the device is subjected to harsh conditions during cleaning and sterilization. More specifically, the battery pack is configured to be sterilized. Regardless of the material employed for the outer surfaces, there is a limited expected life for the actual materials used. This life is determined by various characteristics which could include, for example, the amount of times the pack has actually been sterilized, the time from which the pack was manufactured, and the number of times the pack has been recharged, to name a few. Also, the life of the battery cells themselves is limited. Software of the invention incorporates inventive algorithms that verify the number of uses in both the TAG and battery assemblies and disables the device when this number of uses has been reached or exceeded. Analysis of the battery pack exterior in each of the possible sterilizing methods can be performed. Based on the harshest sterilization procedure, a maximum number of permitted sterilizations can be defined and that number can be stored in a memory of the battery assembly 301. If it is assumed that a charger is non-sterile and that

the battery pack 301 is to be used after it is charged, then the charge count can be defined as being equal to the number of sterilizations encountered by that particular pack.

[0204] It is also desirable to permanently disable the hardware in the battery pack to minimize or eliminate safety concerns due to continuous drain in from the battery cells after the pack has been disabled by software. A situation can exist where the battery's internal hardware is incapable of disabling the battery under certain low voltage conditions. In such a situation, in an exemplary embodiment, the charger can be used to "kill" the battery. Due to the fact that the battery microcontroller is OFF while the battery is in its charger, a non-volatile, SMBus-based EEPROM can be used to exchange information between the battery microcontroller and the charger. Thus, a serial EEPROM can be used to store information that can be written and read even when the battery microcontroller is OFF, which is very beneficial when trying to exchange information with the charger or other peripheral devices. This exemplary EEPROM can be configured to contain enough memory registers to store at least (a) a use-count limit at which point the battery should be disabled (Battery Use Count), (b) the number of procedures the battery has undergone (Battery Procedure Count), and/or (c) a number of charges the battery has undergone (Charge Count), to name a few. Some of the information stored in the EEPROM, such as the Use Count Register and Charge Count Register are stored in write-protected sections of the EEPROM to prevent users from altering the information. In an exemplary embodiment, the use and counters are stored with corresponding bit-inverted mirror registers to detect data corruption.

[0205] Any residual voltage in the SMBus lines could damage the microcontroller and corrupt the SMBus signal. Therefore, to ensure that the SMBus lines of the battery controller 703 do not carry a voltage while the microcontroller is OFF, relays are provided between the external SMBus lines and the battery microcontroller board.

[0206] During charging of the battery 301, an "end-of-charge" condition of the battery 301 is determined when, for example, the current flowing into the battery falls below a given threshold in a tapering manner when employing a constant-current/constant-voltage charging scheme. To accurately detect this "end-of-charge" condition, the battery microcontroller and buck boards are powered down and turned OFF during charging of the battery to reduce any current drain that may be caused by the boards and that may interfere with the tapering current detection. Additionally, the microcontroller and buck boards are powered down during charging to prevent any resulting corruption of the SMBus signal.

[0207] With regard to the charger, it is desirable to prevent insertion of the smart battery 301 into the charger in any way other than the correct insertion position. Accordingly, as shown in FIG. 28, for example, the exterior of the battery 301 is provided with charger-holding features 2810. A cup for holding the battery 301 securely in the charger is configured with a contour-matching taper geometry to prevent the accidental insertion of the battery pack 301 in any way other than the correct (intended) way. It is further contemplated that the presence of the battery assembly 301 may be detectable by the charger itself. For example, the charger may be configured to detect the presence of the SMBus transmission from the battery protection circuit, as well as resistors that are located in the protection board. In such case, the charger would be enabled to control the voltage that is exposed at the charger's pins until the battery assembly 301 is correctly seated or in place at the charger. This is because an exposed voltage at the charger's pins would present a hazard and a risk that an electrical short could occur across the pins and cause the charger to inadvertently begin charging.

[0208] In some exemplary embodiments, the smart battery 301 can communicate to the user through audio and/or visual feedback. For example, the smart battery 301 can cause the LEDs 906 to light in a pre-set way. In such a case, even though the microcontroller 1006 in the generator 904 controls the LEDs 906, the microcontroller 1006 receives instructions to be carried out directly from the smart battery 301.

[0209] In yet a further exemplary embodiment, the microcontroller 1006 in the generator 904, when not in use for a predetermined period of time, goes into a sleep mode. Advantageously, when in the sleep mode, the clock speed of the microcontroller 1006 is reduced, cutting the current drain significantly. Some current continues to be consumed because the processor continues pinging waiting to sense an input. Advantageously, when the microcontroller 1006 is in this power-saving sleep mode, the microcontroller 1106 and the battery controller 703 can directly control the LEDs 906. For example, a decoder circuit could be built into the generator board 5460 and connected to the communication lines such that the LEDs 906 can be controlled independently by the battery microcontroller 1106 while the TAG microcontroller is "OFF" or in a "sleep mode." This is a power-saving feature that eliminates the need for waking up the microcontroller 1006. Power is conserved by allowing the generator to be turned off while still being able to actively control the user-interface indicators.

[0210] Another exemplary embodiment slows down one or more of the microcontrollers to conserve power when not in use. For example, the clock frequencies of both microcontrollers can be reduced to save power. To maintain synchronized operation, the microcontrollers coordinate the changing of their respective clock frequencies to occur at about the same time, both the reduction and, then, the subsequent increase in frequency when full speed operation is required. For example, when entering the idle mode, the clock frequencies are decreased and, when exiting the idle mode, the frequencies are increased.

[0211] In an additional exemplary embodiment, the smart battery 301 is able to determine the amount of usable power left within its cells 701 and is programmed to only operate the surgical device to which it is attached if it determines there

is enough battery power remaining to predictably operate the device throughout the anticipated procedure. For example, the smart battery 301 is able to remain in a non-operational state if there is not enough power within the cells 701 to operate the surgical device for 20 seconds. According to one exemplary embodiment, the smart battery 301 determines the amount of power remaining within the cells 701 at the end of its most recent preceding function, e.g., a surgical cutting. In this embodiment, therefore, the battery assembly 301 would not allow a subsequent function to be carried out if, for example, during that procedure, it determines that the cells 701 have insufficient power. Alternatively, if the smart battery 301 determines that there is sufficient power for a subsequent procedure and goes below that threshold during the procedure, it would not interrupt the ongoing procedure and, instead, will allow it to finish and thereafter prevent additional procedures from occurring.

[0212] The following explains an advantage of the invention with regard to maximizing use of the device with the smart battery 301 of the invention. In this example, a set of different devices have different ultrasonic waveguides. By definition, each of the waveguides could have a respective maximum allowable power limit where exceeding that power limit overstresses the waveguide and eventually causes it to fracture. One waveguide from the set of waveguides will naturally have the smallest maximum power tolerance. Because prior-art batteries lack intelligent battery power management, the output of prior-art batteries must be limited by a value of the smallest maximum allowable power input for the smallest/thinnest/most-frail waveguide in the set that is envisioned to be used with the device/battery. This would be true even though larger, thicker waveguides could later be attached to that handle and, by definition, allow a greater force to be applied. This limitation is also true for maximum battery power. For example, if one battery is designed to be used in multiple devices, its maximum output power will be limited to the lowest maximum power rating of any of the devices in which it is to be used. With such a configuration, one or more devices or device configurations would not be able to maximize use of the battery because the battery does not know the particular device's specific limits.

[0213] In contrast thereto, exemplary embodiments of the present invention utilizing the smart battery 301 are able to intelligently circumvent the above-mentioned prior art ultrasonic device limitations. The smart battery 301 can produce one output for one device or a particular device configuration and the same battery assembly 301 can later produce a different output for a second device or device configuration. This universal smart battery surgical system lends itself well to the modern operating room where space and time are at a premium. By having a single smart battery pack operate many different devices, the nurses can easily manage the storage, retrieval, and inventory of these packs. Advantageously, the smart battery system according to the invention requires only one type of charging station, thus increasing ease and efficiency of use and decreasing cost of surgical room charging equipment.

[0214] In addition, other surgical devices, such as an electric stapler, may have a completely different power requirement than that of the ultrasonic surgical cautery assembly 300. With the present invention, a single smart battery 301 can be used with any one of an entire series of surgical devices and can be made to tailor its own power output to the particular device in which it is installed. In one exemplary embodiment, this power tailoring is performed by controlling the duty cycle of a switched mode power supply, such as buck, buck-boost, boost, or other configuration, integral with or otherwise coupled to and controlled by the smart battery 301. In other exemplary embodiments, the smart battery 301 can dynamically change its power output during device operation. For instance, in vessel sealing devices, power management is very important. In these devices, large constant current values are needed. The total power output needs to be adjusted dynamically because, as the tissue is sealed, its impedance changes. Embodiments of the present invention provide the smart battery 301 with a variable maximum current limit. The current limit can vary from one application (or device) to another, based on the requirements of the application or device.

XII. HANDLE ASSEMBLY-MECHANICAL

[0215] FIG. 45 illustrates an exemplary embodiment of a left-hand side of the handle portion 302 with the left shell half removed. The handle assembly 302 has four basic functions: (1) couple the battery assembly 301 to the multi-lead handle terminal assembly 3502; (2) couple the TAG assembly 303 to a TAG attachment dock 4502; (3) couple the ultrasonic-cutting-blade-and-waveguide assembly 304 to a waveguide attachment dock 4504; and (4) provide the triggering mechanics 4506 to operate the three components (battery assembly 301, TAG assembly 303, and ultrasonic-cutting-blade-and-waveguide assembly 304).

a. TAG Attachment Dock

[0216] The TAG attachment dock 4502 is exposed to the environment and shaped to interchangeably secure the TAG assembly 303 to the handle assembly 302. The waveguide attachment dock 4504 is shaped to align a proximal end of the waveguide 1502 to the transducer 902. When the transducer 902 is docked in the TAG attachment dock 4502 and the waveguide assembly 304 is docked in the waveguide attachment dock 4504, and the transducer 902 and waveguide 1502 are attached together, the waveguide 1502 and the transducer 902 are held at the handle assembly 302 in a freely rotatable manner.

[0217] As can be seen in FIGS. 45 and 46, the handle assembly 302 includes two clamshell-connecting body halves, the right half 4503 being shown in FIG. 45 and the left half being shown in FIG. 46. The two halves 4503, 4603 form at least a portion of the waveguide attachment dock 4504, which can be considered as being exposed to the environment when a waveguide rotation spindle 3704 is not present. A first couple 4602 is operable to selectively removably secure the ultrasonic waveguide assembly 304 to the handle assembly 302. In the exemplary embodiment shown, the waveguide rotation spindle 3704 has an intermediate annular groove 4610 shaped to receive an annular boss 4605. When the two halves 4503, 4603 are connected, the groove 4610 and boss 4605 form a longitudinal connection of the waveguide assembly 304 that is free to rotate. In an exemplary embodiment, the ultrasonic-cutting-blade-and-waveguide assembly 304 is not user-removable from the handle assembly 302.

[0218] The TAG attachment dock 4502 sits opposite the waveguide attachment dock 4504. The TAG attachment dock 4502 is exposed to the environment and has a second couple 4604 operable to removably secure the ultrasonic transducer 902 to the ultrasonic waveguide 1502 when the ultrasonic waveguide assembly 304 is coupled to the waveguide attachment dock 4504. The couples 4602 and 4604 can simply be aligned passageways or any other structure that place the waveguide 1502 into axial alignment with the transducer 902. Of course, the couples 4602 and 4604 can provide more structure, such as threads, that actually hold the waveguide 1502 and/or transducer 902 to the handle or to one another. Some examples of the couple 4604 include a rail, a dovetail, a T-slot, at least one pin, more than one pin, and an undercut slot.

b. Controls

[0219] Looking now to FIG. 46, a trigger 4606 and a button 4608 are shown as components of the handle assembly 302. The trigger 4606 activates the end effector 118, which has a cooperative association with the blade portion 116 of the waveguide 114 to enable various kinds of contact between the end effector 118 and blade portion 116 with tissue and/or other substances. As shown in FIG. 1, the end effector 118 is usually a pivoting jaw (see also, e.g., FIGS. 73 et seq.) that acts to grasp or clamp onto tissue disposed between the jaw and the blade 116. In an exemplary embodiment, an audible feedback is provided in the trigger that clicks when the trigger is fully depressed. The noise can be generated by a thin metal part that the trigger snaps over while closing. This feature adds an audible component to user feedback that informs the user that the jaw is fully compressed against the waveguide and that sufficient clamping pressure is being applied to accomplish vessel sealing.

[0220] The button 4608, when depressed, places the ultrasonic surgical assembly 300 into an ultrasonic operating mode, which causes ultrasonic motion at the waveguide 1502. In a first exemplary embodiment, depression of the button 4608 causes electrical contacts within a switch 4702, shown in FIG. 47, to close, thereby completing a circuit between the battery assembly 301 and the TAG assembly 303 so that electrical power is applied to the transducer 902. In another exemplary embodiment, depression of the button 4608 closes electrical contacts to the battery assembly 301. Of course, the description of closing electrical contacts in a circuit is, here, merely an exemplary general description of switch operation. There are many alternative embodiments that can include opening contacts or processor-controlled power delivery that receives information from the switch 4702 and directs a corresponding circuit reaction based on the information.

[0221] FIG. 47 shows the switch 4702 from a left-side elevational view and FIG. 48 provides a cutaway perspective view of the interior of the right side of the handle body, revealing different detail of the switch 4800. In a first exemplary embodiment, the switch 4800 is provided with a plurality of contacts 4804a-n. Depression of a plunger 4802 of the switch 4702 activates the switch and initiates a switch state change and a corresponding change of position or contact between two or more of the plurality of contacts 4804a-n. If a circuit is connected through the switch 4702, i.e., the switch 4702 controls power delivery to the transducer 902, the state change will either complete or break the circuit, depending on the operation mode of the switch 4702.

[0222] FIG. 49 shows an exemplary embodiment of the switch 4702 that provides two switching stages. The switch 4702 includes two sub-switches 4902 and 4904. The sub-switches 4902 and 4904 advantageously provide two levels of switching within a single button 4802. When the user depresses the plunger 4802 inward to a first extent, the first sub-switch 4902 is activated, thereby providing a first switch output on the contacts 4804a-n (not shown in this view). When the plunger 4802 is depressed further inward to a second extent, the second sub-switch 4904 is activated, resulting in a different output on the contacts 4804a-n. An example of this two-stage switch 4702 in actual use would be for the generator 904 to have two possible output power levels available, each resulting in a different motion displacement value of the waveguide 1502. Activation of the first sub-switch 4902 can, for example, initiate the first output power level from the generator 904 and activation of the second sub-switch 4904 could result in a second power level to be output from the generator 904. An exemplary embodiment of this two stage switch 4702 provides a low-power level for the first displacement and a high-power level for the second displacement. Configuring the sub-switches 4902 and 4904 in a stack, shown in FIG. 49, advantageously makes it easy and intuitive for an operator to move from the first switch mode, i.e., first power level, to the second switch mode, i.e., second power level, by simply squeezing the plunger 4802 of the

button 4702 with increased force.

[0223] In one embodiment of the sub-switches 4902 and 4904, spring force could be utilized, with each spring having a different spring-force rating. When the plunger 4802 is initially depressed, the first spring in the first sub-switch 4902 begins to compress. Because a second spring located in the second sub-switch 4904 is stiffer than the first spring, only the first sub-switch 4902 is caused to change switching states. Once the first sub-switch 4902 is depressed a sufficient distance to change switching states, further (greater) force applied to the plunger 4802 causes the second stiffer spring to depress and the second sub-switch 4904 to change states.

[0224] In practice, ultrasonic cutting devices, such as ones employing the present invention, encounter a variety of tissue types and sizes and are used in a variety of surgical procedure types, varying from precise movements that must be tightly controlled to non-delicate cutting material that requires less control. It is therefore advantageous to provide at least two ultrasonic cutting power levels that allow an operator to select between a low-power cutting mode and a higher-power cutting mode. For example, in the low-power cutting mode, i.e., only the first sub-switch 4902 is depressed, the tip of the waveguide 1502 moves at about 0.002 inches of displacement. In the higher-power cutting mode, i.e., both the first and second sub-switches 4902 and 4904 are depressed, the tip of the waveguide 1502 moves at about 0.003 inches of displacement, providing a more robust cutting tool that can move through tissue at a quicker rate or cut through tougher, denser matter quicker than the lower-power setting. For example, cutting through mesentery is generally performed at a more rapid rate at higher power, whereas vessel sealing can be performed at lower power and over a longer period of time.

[0225] The present invention, however, is in no way limited to stacked switches and can also include switches that are independent of one another. For instance, the shape of the button 4608 may have a first portion that makes contact with a first low-power switch and a second portion that, upon further movement of the button, makes contact with a second high-power switch. The present invention is to be considered as including any multiple-stage switch that engages different stages by movement of a single button.

[0226] In one exemplary embodiment of the present invention, the switch 4702, 4800 provides a physical resistance analogous to a compound bow. Compound bows, which are well known for shooting arrows at a high rate of speed, have a draw-force curve which rises to a peak force and then lets off to a lower holding force. By recreating this physical affect with the second sub-switch 4904, the user of the device will find moving into and engaging the first sub-switch 4902 to be rather easy, while moving into the higher-power mode, initiated by depression of the second sub-switch 4904 requiring a higher depression force, to be an occurrence that takes place only by the operator consciously applying an increased force. Once the higher depression force is overcome, however, the force required to maintain the second sub-switch 4904 in the depressed position decreases, allowing the operator to remain in the higher-power mode, i.e., keeping the button depressed, without fatiguing the operator's finger. This compound-bow-type effect can be accomplished in a variety of ways. Examples include an offset cam, overcoming a pin force or other blocking object, software control, dome switches, and many others.

[0227] In one exemplary embodiment of the present invention, the switch 4702 produces an audible sound when the switch 4702 moves from the first mode to the second higher-power mode. For example, the audible sound can be emanated from button, itself, or from the buzzer 802. The sound notifies the operator of entry into the higher-power mode. The notification can advantageously prevent unintended operation of the inventive ultrasonic device.

c. Waveguide Node Bumps

[0228] In accordance with an exemplary embodiment of the present invention, as shown in FIG. 57, at least one bump 5710 is/are provided at a node(s) of the ultrasonic waveguide 1502. In other words, the bumps 5710 are located at points along the waveguide 1502 where the waveguide 1502 does not exhibit ultrasonic motion at resonant frequency. The bumps 5710 are radially and longitudinally symmetrical and, therefore, the change in diameter of each bump 5710 and its physical waveguide characteristics of decreasing (radially larger) and then increasing (radially smaller) transmitted vibration does not adversely affect the waveguide's ability to resonate at an ultrasonic frequency or to transmit the desired vibration at the distal blade tip. The bumps are discussed in further detail with regards to FIG. 76.

d. Near-Over-Center Trigger

[0229] Referring now to FIGS. 61 to 64, an exemplary embodiment of a variable-pressure trigger will be shown and described. The components of the variable pressure trigger can be seen in the perspective partial view of the right hand side of the handle assembly 302 illustrated in each of FIGS. 61 to 64. In this view, several of the internal components are exposed and viewable because much of the shell of the handle assembly 302 is not present. In practice, many of the components shown in FIGS. 61 to 64 are covered by the shell, protected, and not viewable.

[0230] Looking first to FIG. 61, at least a portion of a trigger pivot assembly 6102 is shown. The assembly 6102 includes a first pivoting member 6104 and a second pivoting member 6106. In the following discussion, a comparison between

FIG. 61 and each of FIGS. 62 to 64 will be described that illustrates the interaction between the first pivoting member 6104 and the second pivoting member 6106 as the trigger 4606 is progressively squeezed by an operator.

[0231] The first pivoting member 6104 is an elongated structure and has a first end 6112 and a second end 6114. The first end 6112 of the first pivoting member 6104 is rotationally coupled to a first pivot pin 6116 while the second end 6114 is rotationally coupled to a second pivot pin 6118. In the perspective view of FIG. 61, the exemplary embodiment of the first pivoting member 6104 can be seen as including two separate halves, each half coupled to the first pivot pin 6116 and the second pivot pin 6118 and being connected together at a center section. In this embodiment, the center pivot is comprised of a round boss on the trigger that is captured by two links. The two links are hermaphroditic parts and are pressed together so that the boss is constrained by two holes, one on each link. This configuration creates the third pivoting section. There is, however, no requirement that this pivoting member comprise this configuration. The pivoting member can be any structure that couples the two pivot pins 6116 and 6118 and provides the proximally directed force at the first pivot pin 6116 to translate the actuator for the end effector 118, which end effector 118 will be described in further detail below. As can be seen in FIGS. 61 to 64, the first pivot pin 6116 rides within a longitudinally extending guide track 6130 shown on the left body half 4603 of the handle assembly 302, a mirror image of which is similarly present on the opposing right body half 4503. As the trigger 4606 is depressed, shown in the progression of FIG. 61 to FIG. 62 to FIG. 63 to FIG. 64, the first pivot pin 6116 translates in the proximal direction a sufficient distance to actuate the end effector 118 from an at-rest position (shown by the first pivot pin position in FIG. 61) to a fully actuated position (shown by the first pivot pin position in FIG. 64).

[0232] In accordance with the exemplary embodiment shown, the second pivot pin 6118 is coupled to and is part of the trigger 4606. In particular, the entire second pivoting member 6106, including the pivot pin 6118, actually comprises a furthest extent of the trigger 4606. This furthest extent of the trigger 4606 (the second pivoting member 6106) is, itself, rotationally coupled to a third (fixed) pivot pin 6110 within the handle assembly 302. This third pivot pin 6110 defines the axis about which the trigger 4606 rotates with respect to the handle assembly 302. The third pivot pin 6110 is shared by a sliding rotational-lockout member 6508, which works in conjunction with a rotational lockout blade. The purpose and details of the rotational lockout blade will be explained in the following section.

[0233] Because the position of the third pivot pin 6110 is fixed with respect to the handle assembly 302, when the trigger 4606 is squeezed by the operator, the first pivot pin 6116 moves away from the third pivot pin 6110. In addition, as the first pivot pin 6116 is moving away from the third pivot pin 6110, the second pivot pin 6118 traverses an arc starting at the positions shown in FIG. 61, where the second pivot pin 6118 is well below an imaginary line 6120 connecting the first pivot pin 6116 to the third pivot pin 6110, to the position shown in FIG. 64, where the second pivot pin 6118 is much closer to that imaginary line 6120 still connecting the first pivot pin 6116 to the third pivot pin 6110.

[0234] The movement of the trigger 4606 from the position shown in FIG. 61, through the positions shown in FIGS. 62 through 64 results in a clamping movement of the end effector 118 in a direction towards the waveguide 1502. In other words, squeezing the trigger 4606 causes the end effector 118 to move from an open position to a closed position (via movement of the outer tube 7302 as described below). Advantageously, interaction between the first pivoting member 6104 and the second pivoting member 6106, illustrated in a comparison of FIGS. 61 through 64, provides a trigger motion with varying requisite pressures to maintain trigger depression. This variable pressure linkage (6110, 6106, 6118, 6104, 6116) advantageously reduces fatigue on the operator's hand because, once fully depressed, it requires much less pressure to keep the trigger 4606 in the depressed position as compared to the pressure required to partially depress the trigger 4606 as shown, for example, in FIG. 62.

[0235] More specifically, when an operator first applies pressure to the trigger 4606, a first force is required to move the second pivot pin 6118 (with reference to the orientation shown in FIG. 61) upwards. The force required to actuate the end effector 118 is actually longitudinal because the first pivot pin 6116 must move proximally. This force moves the second pivot pin 6118 along an arc that, consequently, moves the first pivot pin 6116 away from the third pivot pin 6110 and defines two force vectors along the pivoting members 6104, 6106. The two force vectors, in the position shown in FIG. 61, are at an angle 6122 of approximately 100° and are indicated with a left-pointing black vector and a right-pointing white vector for clarity.

[0236] Turning now to FIG. 62, it can be seen that the trigger 4606 has been moved from the resting position shown in FIG. 61. This partial movement occurs when the trigger is squeezed during a typical medical procedure at first tissue contact. As the trigger 4606 is squeezed, i.e., moved toward the handle assembly 302, the first pivot pin 6116, the first pivoting member 6104, the second pivoting member 6106, and the second pivot pin 6118 all change positions. More specifically, the second pivoting member 6106 rotates about the third pivot pin 6110, which is fixed in its position. Because the third pivot pin 6110 is fixed, the second pivot pin 6118 begins to swing upward, i.e., toward the imaginary line 6120. As the second pivot pin 6118 swings upward, a force is applied to the first pivot member 6104, which translates along the first pivot member 6104 and is applied to the first pivot pin 6116. In response, the first pivot pin 6116 slides proximally in a direction away from the waveguide assembly 304. In this first stage of translation, shown in FIG. 62, the angle of the force vectors 6122 can be seen as having increased from that shown in FIG. 61.

[0237] In FIG. 63, the trigger 4606 is closed even further. As a result, further movement of the first pivoting member

6104, the second pivoting member 6106, the first pivot pin 6116, and the second pivot pin 6118 occurs. As this movement takes place, the second pivot pin 6118 moves even closer to the imaginary line 6120, i.e., closer to being collinear with the first 6116 and third 6110 pivot pins. As indicated by the force vectors 6122, the forces applied to the pivoting member's 6104, 6106 begin to significantly oppose each other. The exemplary angle between the vectors 6122 is, in this position,

approximately 150°. [0238] Finally, in FIG. 64 the trigger 4606 has been squeezed until it makes contact with the battery assembly holding portion of the handle assembly 302. This is the point of maximum translation of the first pivoting member 6104, second pivoting member 6106, and the first pivoting pin 6116. Here, the force vectors substantially oppose one another, thereby reducing the amount of force felt at the trigger 4606. That is, as is known in the field of mechanics, maximum force is required when two vector forces are additive, i.e., point in the same direction, and minimum force is required when two vector forces are subtractive, i.e., point in opposite directions. Because, in the orientation shown in FIG. 64, the vectors become more subtractive than additive, it becomes very easy for the user to keep the trigger 4606 depressed as compared to the position shown in FIG. 61. The ultimate closed position shown in FIG. 64 is referred to herein as a "near-over-centered" position or as "near over centering." When the trigger 4606 is in the near-over-centered position, the force required to keep the trigger depressed is approximately 45% or less than the force required to initially squeeze the trigger away from the position shown in FIG. 61.

e. Rotational Lock-Out

[0239] The present invention provides yet another inventive feature that prevents rotation of the waveguide assembly 304 whenever ultrasonic motion is applied to the waveguide 1502. This rotational lockout feature provides enhanced safety by preventing the cutting blade from unintentional rotational movement during a surgical procedure. In addition, prevention of rotation ensures that a solid electrical connection is maintained throughout operation of the device 300. More specifically, the electrical contacts 5402, 5404 (e.g., pogo pins) between the generator and the transducer do not have to slide along the transducer's contact rings 5406, 5408 in order to maintain electrical contact because a fixed electrical connection at one location along the contact rings 5406, 5408 is maintained during operation by virtue of the rotational lockout. The rotational lockout, according to one exemplary embodiment of the present invention, is accomplished through use of a rotational lockout member 6508 shown in FIGS. 65 and 66.

[0240] Referring first to FIG. 65, a perspective close-up view of the right hand side of handle assembly 302 is shown with the right-side cover removed. In this view, a rotational lockout member 6508 can be seen positioned adjacent a rotation-prevention wheel 6502 (which is rotationally fixed to the waveguide rotation spindle 3704 and, thereby, to the waveguide assembly 304). The waveguide assembly 304 is, therefore, able to rotate along its longitudinal axis only if the rotation-prevention wheel 6502 is unencumbered and also able to rotate upon that longitudinal axis.

[0241] To prevent revolution of the rotation-prevention wheel 6502, the rotational lockout member 6508 includes a wheel-engagement blade 6504 that extends therefrom in a direction toward the rotation-prevention wheel 6502. In the position shown in FIG. 65, the rotational lockout member 6508 does not interfere with the rotation prevention wheel 6502 because the wheel-engagement blade 6504 is at a distance from the outer circumference thereof. In such an orientation of the blade 6504, the rotation-prevention wheel 6502, as well as the waveguide assembly 304, can freely spin upon the longitudinal axis of the waveguide assembly 304.

[0242] Referring now to FIG. 66, the rotational lockout member 6508 has been displaced into a rotation blocking position. In this position, the wheel-engagement blade 6504 enters the space between two adjacent castellations 6602 on the outer circumference of the rotation-prevention wheel 6502 and engages the side surfaces of the castellations 6602 if the rotation-prevention wheel 6502 rotates. The rotational lockout member 6508 is fixed in its position within the handle assembly 302 and, because of this connection, the engagement between the wheel-engagement blade 6504 and the rotation-prevention wheel 6502 entirely prevent the rotation-prevention wheel 6502 from rotating about the longitudinal axis of the waveguide assembly 304. For example, with seventy-two castellations 6602 on the outer circumference, the rotation-prevention wheel 6502 has substantially no rotational play when rotationally locked. FIGS. 67 through 69 show that the wheel-engagement blade 6504 engages the rotation-prevention wheel 6502 only when the button 4608 is depressed, thereby preventing substantially all rotational movement of the waveguide assembly 304 when ultrasonic movement of the waveguide 1502 occurs.

[0243] FIG. 67 shows a perspective underside view of the rotational lockout member 6508 within the handle assembly 302. Once again, the right-hand cover of the handle assembly 302 is removed, thereby exposing several of the internal mechanical components of the handle assembly 302. These components include the button 4608, shown here in a transparent view, a U-shaped member 6702 that slidably engages with the rotational lockout member 6508, and a spring 6704 that biases the U-shaped member 6702 away from a bottom portion of the rotational lockout member 6508. FIG. 67 shows the rotational lockout member 6508, the U-shaped member 6702, and the spring 6704. In the position shown in FIG. 67, the spring 6704 is preloaded by pressure that is asserted by the U-shaped member 6702. The rotational lockout member 6508 is rotationally coupled to and pivots about a pivot pin 6706, which is fixedly coupled to the handle

assembly 302.

[0244] In addition, FIG. 67 shows a torsional spring 6708 that biases the rotational lockout member 6508 away from the castellations 6602 of the rotation-prevention wheel 6502. The torsional spring 6708 ensures that the natural resting position of the rotational lockout member 6508 is disengaged from the rotation-prevention wheel 6502. A spring force of the torsional spring 6708 is selected so that it is less than a spring force of the spring 6704. Therefore, movement of the rotational lockout member 6508 can occur prior to the spring 6704 being fully compressed.

[0245] In operation of the rotation prevention system, when the button 4608 is depressed after a short distance, a rear side of the button 4608 physically contacts the U-shaped member 6702 and moves the U-shaped member 6702 as further proximal button movement occurs. In other words, when depressed, the button 4608 imparts a proximal force on the U-shaped member 6702 in a direction against the biasing force of the spring 6704. This proximal force causes the spring 6704 to compress and allows the U-shaped member 6702 to move in a direction toward the rotational lockout member 6508. This movement is shown in FIG. 68, where the U-shaped member 6702 is closer to the rotational lockout member 6508 than the position shown in FIG. 67. In the view of FIG. 68, the spring 6704 is no longer visible because the U-shaped member 6702 has moved proximate to the rotational lockout member 6508 to a point that the lockout member 6508 completely obscures the spring 6704 in this view. Such contact without a rigid connection ensures that the lockout mechanism does not impede release of the activation button 4608, which is critical to safe operation of the device. Additionally, the connection helps to minimize force that the switch will have to release and reduces operator fatigue.

[0246] When the button 4608 is further depressed, as shown in FIG. 69, the rotational lockout member 6508 pivots around the pivot pin 6706 and swings upwardly toward the rotation-prevention wheel 6502. As this upward swing occurs, the wheel-engagement blade 6504 engages the castellations 6602 of the rotation-prevention wheel 6502. In other words, the position of the rotational lockout member 6508 shown in FIG. 69 corresponds to the position of the rotational lockout member 6508 shown in FIG. 66. Similarly, the position of the rotational lockout member 6508 shown in FIG. 67 corresponds to the position of the rotational lockout member 6508 shown in FIG. 65.

[0247] In some circumstances, when the button 4608 is depressed, the wheel-engagement blade 6504 lands on one of the castellations 6602 and does not fall between two of the castellations 6602. To account for this occurrence, a stroke distance, i.e., the distance the U-shaped member 6702 is able to move towards the rotational lockout member 6508 allows an electrical activation of the device without requiring actual physical movement of the rotational lockout member 6508. That is, the rotational lockout member 6508 may move slightly, but does not need to fit between two of the castellations 6602 for ultrasonic operation to occur. Of course, rotation is still prevented, as any rotational movement in either direction will cause the rotational lockout member 6508 to move up and into the castellations 6602.

[0248] In a further exemplary embodiment of the present invention, a rotational lockout member 7002, as shown in FIGS. 70 and 71, can be provided with one or more blades 7004, 7006 that engage with an outer surface 7008 of a rotation-prevention wheel 7001. In this particular embodiment, the rotation-prevention wheel 7001 does not have teeth on its outer circumference, as the embodiment of the rotation-prevention wheel 6502 of FIGS. 65 to 69. In the embodiment of FIGS. 70 and 71, the outer surface 7008 of the rotation-prevention wheel 7001 is sufficiently malleable to allow the blades 7004, 7006 to engage the outer surface 7008, for example, to actually cut into the outer circumference of the rotation prevention wheel 7001. However, in certain embodiments, where razor-type blades 7004, 7006 are utilized, the rotation-prevention wheel 7001 is sufficiently hard to prevent the blades 7004, 7006 from penetrating more than a predefined depth when an expected amount of force is applied. Furthermore, the lockout member 6508 and U-shaped member 6702 can be, instead, replaced with a single stamped/etched or wireformed lockout member that, within its geometry, replaces at least one of the springs with a flexing feature. FIGS. 105 and 106 show two exemplary embodiments of this alternative configuration.

[0249] Once the blades 7004, 7006 are driven into the outer surface 7008 of the rotation-prevention wheel 7001, as is shown in FIG. 71, the rotation-prevention wheel 7001 is rendered unable to rotate about the longitudinal axis of the waveguide assembly 304. Of course, a single blade or three or more blades can be used to prevent the rotation-prevention wheel 7001 from rotating. By separating and angling the blades 7004 and 7006 from one another, rotation prevention is enhanced in either rotational direction. In other words, when the blades 7004 and 7006 are angled away from one another, rotation of the rotation-prevention wheel 7001, in either direction, causes one of the blades 7004 or 7006 to dig deeper into the rotation-prevention wheel 7001. The lockout member 7002 disengages from the rotation-prevention wheel 7001 when pressure is removed from the button, for example, due to a button-return spring. In addition, in this particular embodiment of the rotational-lockout member 7002, a portion of the rotation-lockout member 7002 may capture the third pivot pin 6110. Additional ways of preventing the application of energy while rotating are present using electromechanical and electro-optical technologies. Any combination of sensors, such as magnetic position encoders or optical position sensors, could be used to stop application of energy to the waveguide 1502 if rotation is detected or can be used as a trigger to engage a mechanical lockout such as a solenoid or knife switch. These mechanical measures can also be used without the sensors and can lockout rotation during any energy application. Optical encoders could be placed within the generator housing and directed outward through windows to watch for motion of the transducer

housing. Magnetic encoders can be completely buried within the enclosures to further reduce leak path risk.

XIII. TAG -- MECHANICAL

5 [0250] Referring to FIG. 50, the reusable TAG assembly 303 is shown separate from the handle assembly 302. The inventive TAG assembly 303 includes a transducer horn 5002 with an ultrasonic waveguide couple 5004 that is configured to attach a waveguide securely thereto and, upon activation of the transducer horn 5002, to excite the attached waveguide, i.e., impart ultrasonic waves along the length of the waveguide.

10 [0251] In this exemplary embodiment, the waveguide couple 5004 is female and includes interior threads, which are used to secure the TAG assembly 303 to the waveguide 1502 (see, e.g., FIG. 45) by screwing an end of the waveguide 1502 onto the threads of the waveguide couple 5004 with a predefined amount of torque. The torque should be sufficient so that a mechanical connection created by the torque is not broken during normal operation of the device. At the same time, the torque applied to couple the threads should not exceed a force that will cause the threads to become stripped or otherwise damaged. During initial coupling of the transducer 902 and waveguide 1502, all that is needed is that one of the transducer 902 and waveguide 1502 remains relatively stationary with respect to the other. The waveguide rotation spindle 3704 is rotationally fixedly coupled to the transducer 902, which, together, are rotationally freely connected to the body 5005 of the TAG assembly 303. As such, the waveguide rotation spindle 3704 and the transducer 902 are both able to freely rotate with respect to the body 5005. To make the waveguide-transducer connection, therefore, the waveguide 1502 can be held stationary as the waveguide rotation spindle 3704 is rotated to couple the interior threads of the transducer horn 5002 with the corresponding male threads at the proximal end of the waveguide 1502. Preferably, the waveguide 1502 is coupled, i.e., screwed onto the threads of the waveguide couple 5004 to a point where the mechanical connection is sufficient to transfer the mechanical ultrasonic movement from the TAG assembly 303 to the waveguide 1502.

25 [0252] In one exemplary embodiment of the present invention, a torque wrench 8800 (see FIG. 88) couples to the waveguide rotation spindle 3704 and allows the user to rotate the spindle 3704 to a predetermined amount of torque. Once the rotational coupling pressure between the waveguide couple 5004 and the waveguide 1502 exceeds a predetermined amount of torque, the outer portion of the torque wrench 8810 slips about an inner portion 8820 and, thereby, the spindle 3704, and no further rotation of the spindle 3704 takes place. Through use of the inventive torque wrench 8800, an operator is able to apply precisely the proper amount of tension to the junction between the TAG assembly 303 in the waveguide 1502 and is also prevented from damaging the threads on either the waveguide couple 5004 or on the waveguide 1502.

30 [0253] This exemplary embodiment of the torque wrench also clips onto the spindle 3704 to prevent any possibility of the wrench slipping off of the TAG assembly 303 without outside force acting upon it. More specifically with regard to FIG. 50, the spindle 3704 is provided with wrench-gripping surfaces 5014 disposed circumferentially about the proximal end of the spindle 3704. In this exemplary embodiment, the wrench-gripping surfaces 5014 are indentations. The inner portion 8820 of the torque wrench 8800 is, conversely, provided with flexible tines 8822, each having an inner distal surface defining a spindle-gripping surface 8824. In this exemplary embodiment, the spindle-gripping surfaces 8824 have somewhat convexly hemispherical-shaped protrusions that have a corresponding shape to concavely hemispherical-shaped indentations of the wrench-gripping surfaces 5014. In this way, as the inner portion 8820 is coupled to the proximal end of the spindle 3704, each tine 8822 of the inner portion 8820 flexes outwardly and, then, snap back to place the corresponding protrusions 8824 of the tines 8822 within the respective indentations 5014. The user can, then, release the outer portion 8820 completely and the wrench 8800 remains on the spindle 3704 for as long as needed until removal is desired.

45 [0254] To enable coupling of the inner and outer portions 8810, 8820 of the torque wrench 8800 to remain rotationally coupled to one another until a predetermined amount of torque exists, the outer portion 8810 is provided with a ratchet gear 8812 and the inner portion 8820 is provided with a ratchet 8826. The slope and inward-extent of the gear 8812 and the outer circumference and tooth size of the ratchet 8826 are selected to slip at a predetermined amount of torque. With use of sufficiently resilient materials, the torque value at which the two portions 8810, 8820 slip with respect to one another, can be set with great accuracy. Through use of the inventive torque wrench 8800, an operator is able to apply precisely the proper amount of tension to the junction between the TAG assembly 303 in the waveguide 1502 and is also prevented from damaging the threads on either the waveguide couple 5004 or on the waveguide 1502.

50 To counter the torque of the torque wrench the operator must hold the rotation wheel while rotating the torque wrench. For this operation, in an exemplary embodiment, a lockout button can be integrated into the handle halves. This lockout button is depressed by the operator and, when depressed, engages the rotation prevention wheel, stopping the free rotation of the shaft assembly with minimal applied force.

55 [0255] The TAG assembly 303 also has a housing comprised of an upper housing portion 5020 and a lower housing portion 5030 that protects and seals the internal working components from the environment. See FIGS. 50 and 53. Because the TAG assembly 303 will be in the sterile field of the operating environment, it is sterilizable, advantageously,

by vapor phase hydrogen peroxide, for example. As such, the seal between the upper housing portion 5020 and the lower housing portion 5030 is aseptic and/or hermetic.

[0256] According to one exemplary, non-illustrated embodiment of the present invention, the transducer 902 is located entirely inside the housing 5005 - where it cannot be readily secured by the operator, for example, by holding it steady by hand when the waveguide assembly 304 is being secured. In such an embodiment, the TAG assembly 303 is provided with a transducer rotation lock. For example, the transducer rotation lock can be a button that slides into a recess in the housing 5005 or, alternatively, by fixing the rotation of the transducer 902 at a maximum rotational angle so that, once the maximum rotation is reached, for example, 360 degrees of rotation, no additional rotation is possible and the waveguide assembly 304 can be screwed thereon. Of course, a maximum rotation in the opposite direction will allow the waveguide assembly 304 to be removed as well. In another exemplary embodiment, the torque wrench is incorporated into the handle itself. This exemplary embodiment is not illustrated but can be understood from looking at FIGS. 87 and 88. As can be seen in FIG. 88, one possible torque-limiting device is configured with an inner ratchet portion 8826 and a ratchet gear 8812. This ratcheting assembly can be built into the rotation prevention wheel 6502, a portion of which is shown in FIG. 87. If this rotation prevention wheel 6502 is made of an inner radial part and an outer radial part, the two parts being able to rotate with respect to one another, then either can be formed with one of the inner ratchet portion 8826 with the other one being formed with the ratchet gear 8812. In this way, a user could hold the proximal knob of the transducer still and use rotation of the spindle 3704 to connect the waveguide and the transducer together. When the desired torque is reached, the inner ratchet portion 8826 and the ratchet gear 8812 would slip to prevent over torque. After the waveguide is connected to the transducer with the correct amount of torque, use of spindle rotation during a procedure will not be affected as the number of pounds needed to rotate the spindle 3704 is far less than the number of pounds that is required to overcome torque ratcheting feature.

[0257] The housing 5005 has a securing connection 5012 shaped to selectively removably secure to a corresponding connector part of the handle assembly 302. See, e.g., FIG. 56. The connection 5012 can be any coupling connection that allows the TAG assembly 303 to be removably attached and secured to the handle assembly 302, such as the exemplary "dove-tail" design shown in FIGS. 50 to 53 and 56. In FIG 56, a TAG-retention device 5604 is provided. The TAG-retention device 5604 is a mechanical feature that stops the TAG assembly 303 from sliding off of the handle assembly 302 under its own weight. The retention device 5604 imparts friction to the securing connection 5012 that makes it hard to pull the TAG assembly away from the disposable without overcoming at least a force greater than the weight of the TAG assembly 303. The TAG-retention device 5604 can be in the form of a finger, as shown in FIGS. 61 to 64 and 86, or one or more bumps that interfere with the slide rail. The force that is required to separate the two parts prevents accidental dropping of the TAG assembly 303 during exchange or removal. The area of contact between the handle assembly 302 and the TAG assembly 303 can be sealed so that, in the event of surgical fluids contacting the TAG assembly 303, they will not introduce themselves into the interior of the TAG attachment dock 4502.

[0258] It is advantageous for the TAG assembly 303 to be selectively removable from the handle assembly 302. As a separate component, the TAG assembly 303 can be medically disinfected or sterilized (e.g., STERRAD®, V-PRO®, autoclave) and reused for multiple surgeries, while the less-expensive handle assembly 302 itself may be disposable. In addition, the TAG assembly 303 can be used in multiple handles or in the same handle up to a desired maximum number of times before it is required to be disposed. In a further embodiment, the transducer 902 of the TAG assembly 303 can be selectively removable from the generator 904 allowing for better access for cleaning. In such an embodiment, the benefits provided by the invention to matching a transducer to a generator can be maintained by configuring the transducer with a communication system that sends to the generator the transducer's calibration coefficients.

[0259] FIGS. 51 and 52 provide two additional perspective views of the TAG assembly 303. FIG. 52 depicts an exemplary display window for a user display system (for example, RGB LED(s) 906) on the external surface of the housing 5005 of the TAG assembly 303. As explained above, the RGB LED 906 provides various signaling to the user indicating conditions and modes of the surgical assembly 300. Various conditions and modes displayed to the user can also include an indication that the battery level on installation is inadequate -- it does not have enough energy to perform the start-up check and initiate software -- or that the battery itself is bad. Positive displays can include proper start-up - that, upon connection of the battery to the TAG, there is proper power, verified by battery/TAG communications and, possibly, the amount of available TAG life or that the system is ready and idling for use. Activation of both the low and high modes can be displayed. With regard to the TAG, expiration of life or other TAG-related faults can be displayed. With regard to the battery, a low condition can be indicated after the battery is connected or during its use. The display can indicate, for example, if the battery only has approximately 20% of charge remaining when first attached. An end of battery charge or other battery faults can be indicated. Finally, various system faults including general faults, battery or TAG software being non-functional, can be displayed.

[0260] FIG. 53 provides a top view of the TAG assembly 303 with the upper housing portion 5020 removed, thereby exposing the generator circuitry of the TAG assembly 303, see, e.g., FIG. 9. In a further exemplary embodiment, the generator circuitry includes a memory electrically connected at least to the processor of the TAG assembly 303 or to the processor in the battery assembly 301 (or integrated in any circuit thereof). The memory can be used, for instance,

to store a record of each time the TAG assembly 303 is used. Other data relevant to the TAG assembly 303 and/or the waveguide assembly 304 and/or the housing assembly 302 and/or the battery assembly 301 can be stored as well for later access and analysis. This record can be useful for assessing the end of any part of the device's useful or permitted life, in particular, the TAG assembly 303 itself. For instance, once the TAG assembly is used twenty (20) times, the TAG assembly 303 or the battery assembly 301 can be programmed to not allow a particular handle or battery to function with that "old" TAG assembly (e.g., because the TAG assembly 303 is, then, a "no longer reliable" surgical instrument). The memory can also store a number of uses any of the device's peripherals. For an illustrative example only, after a certain number of uses, it is possible that one of the parts of the device can be considered worn, as tolerances between parts could be considered as exceeded. This wear could lead to an unacceptable failure during a procedure. In some exemplary embodiments, the memory stores a record of the parts that have been combined with the device and how many uses each part has experienced.

[0261] At times, it may be desirable to provide feedback to the user even when the TAG assembly 303 is disconnected from the battery assembly 301, such as the "end of life" or "no longer reliable" indications of the TAG assembly 303, which indications require that the TAG assembly 303 be taken out of circulation because it has exceeded its useful life and can no longer be used. As is often the case, the physician may not be the same person who is responsible for the proper assembly of the device or for removing the TAG assembly 303 from the device. Accordingly, the TAG assembly 303 can be beneficially configured to have a persistent indicator having its own power source separate from the battery assembly 301. This indicator provides an "end of life" termination warning following the most recent (or last) mating between the TAG assembly 303 and a battery assembly 301 to prompt an immediate disposal of the TAG assembly 303 before any wasteful energy is used in subsequently mating the spent TAG assembly 303 to the same or a different battery assembly 301 for use. Or, alternatively, the indicator could provide the warning immediately upon being subsequently mated to another battery assembly 301 so that it may be disposed of before starting up the device. In either implementation, the warning will be preserved for the party responsible for assembling the device. Multiple schemes can be devised to provide the end-of-life indication to the user, such as primary cells, super capacitors or displays that do not require or draw power. For example, a super capacitor and an ultra-low-power LED drive can be used to provide an strobing indicator. These circuits consume current in the microamp range and, therefore, can provide a reliable indication for a number of hours or even days.

[0262] In some exemplary embodiments, a memory exists at the battery assembly 301, and the handle assembly 302 is provided with a device identifier that is communicatively coupled at least to the battery assembly 301 and is operable to communicate to the smart battery 301 at least one piece of information about the ultrasonic surgical assembly 300, such as the use history discussed in the preceding paragraph, a surgical handle identifier, a history of previous use, and/or a waveguide identifier. In this way, a single smart battery assembly 301 can record use information on a number of different handle and TAG assemblies 302, 303. When the battery assembly 301 is placed into a charging unit, such a memory can be accessed and the data about each part of the system 301, 302/304, 303 can be downloaded into the charger and, if desired, transmitted to a central facility that is communicatively coupled (e.g., through the Web) to the charging station.

[0263] FIG. 54 shows one example of how the generator 904 and the transducer 902 are electrically and physically coupled so that a physical rotation of the transducer 902 with respect to the generator 904 is possible. In this example, the generator 904 has a pair of contacts 5402, 5404 protruding from its underside, adjacent the transducer 902. The contacts 5402, 5404 can be connected to the TAG housing in any way. The illustrated exemplary embodiment captures the contacts 5402, 5404 in place between the generator board and a portion of the TAG housing. As can be seen, the TAG housing is defined by an upper generator housing 5410 and a lower transducer housing 5430. The generator housing has an upper housing portion 5020 and a lower housing portion 5030. To install the contacts 5402, 5404, therefore, the contacts 5402, 5404 are placed into the lower housing portion 5030 and are sealed in place by o-rings (shown) or adhesive. The generator board 5460 is then set on top of the contacts 5402, 5404 and mated for electrical contact. As the upper housing portion 5020 placed on the TAG assembly, it has features that hold the generator board 5460 in place, thereby trapping the contacts 5402, 5404 from moving. These features on the upper housing portion 5020 can be, for example, fingers that push against the board 5460 itself or push on larger components on the generator board 5460. Additionally compressive materials can be used to take up tolerances therebetween and reduce the ability of the board to move around and potentially cause intermittent contact with the connections.

[0264] Proximity of the transducer 902 to the generator 904 places one of the pair of contacts 5402, 5404 in physical communication with a corresponding pair of contact rings 5406, 5408 on the body of the transducer 902 so that a driving signal can be steadily and reliably applied to the transducer 902 when needed. Advantageously, the pair of contacts 5402, 5404 maintains electrical contact regardless of the angle of rotation of the transducer 902. Therefore, in this exemplary embodiment, the transducer 902 can rotate without any limitation as to the maximum angle or number of rotations. Additionally, the rings 5406, 5408 and contacts 5402, 5404 ensure that the transducer 902 remains in electrical contact with the generator circuitry regardless of the point of rotation at which the torque wrench stops the tightening the transducer 902 to the waveguide 1502. In an exemplary embodiment that helps alleviate wear between the contact

rings and the contacts, the rings are provided with a highly polished surface finish. Also since the contacts are spring-loaded, the contacting spring force is minimized to reduce contact forces and, ultimately, friction. With a smooth surface and a low pin-pushing force, the friction is kept to a minimum, thereby minimizing wear between the two rotating parts. This, along with the plating process, ensures that electrical connection between the mating parts is not interrupted.

[0265] The transducer housing 5430 is also made of two parts, a proximal housing portion 5432 and a distal housing portion 5434. As can be seen well in FIG. 50, the lower housing portion 5030 has two housing rings 5416, 5418 that rotatably secure the transducer housing 5430 to the generator housing 5410. The proximal housing ring 5418 merely radially captures the circular outer-diameter proximal transducer portion 5432. It is the distal housing ring 5416 that both radially and longitudinally captures the transducer 902. More specifically, a proximal o-ring 5440 on the proximal side of the distal housing ring 5416 provides one part of the longitudinal capture and a fastener 5442 on the distal side of the distal housing ring 5416 provides the other part of the longitudinal capture. The fastener 5442 can be, for example, one or more snap rings. With this secure longitudinal capture, the two transducer contact rings 5406, 5408 become longitudinally aligned with the two contacts 5402, 5404 for a secure electrical connection between the generator 904 and the transducer 902.

[0266] As shown in FIG. 37, the surgical handle assembly 302 has a spindle 3704 attached to the waveguide assembly 304. The spindle 3704 has indentions that allow a surgeon to easily rotate the spindle 3704 with one or more fingers and, therefore, to correspondingly rotate the attached waveguide assembly 304 and the transducer 902 connected to the waveguide 1502. Such a configuration is useful for obtaining a desired cutting-blade angle during surgery.

[0267] FIG. 55 shows one exemplary embodiment of the TAG assembly 303 where the body 5005 and the transducer's shell have been removed. When a voltage is applied to the piezoelectric crystal stack 1504, the horn 5002 moves longitudinally within and relative to the housing 5020, 5030. In this embodiment, the waveguide coupler 5004 is female and includes internal threads (not visible in this view), which are used to secure the TAG assembly 303 to the waveguide 1502 (not illustrated here) by screwing the waveguide 1502 into the threads with an appropriate amount of torque.

[0268] A novel feature of the TAG assembly 303 is its ability to mechanically and electrically connect at the same time. FIG. 56 shows an exemplary embodiment of the TAG assembly 303 in the process of docking with the handle assembly 302. At the same time the transducer 902 is being coupled to a waveguide 1502 (attached to the handle assembly 302), the TAG assembly's electrical connector 5010 is brought into contact with the handle assembly's electrical connector 5602. The coupling of the TAG's electrical connector 5010 with the handle's electrical connector 5602 places the piezoelectric crystal stack 1504 in electrical communication (direct or indirect) with the battery assembly 301 docked with the handle assembly 302, as shown in FIG. 37 for example. This substantially simultaneous coupling can be configured to occur in all embodiments of the present invention. The pins of this connection are unique and are shown well in the left side of FIG. 54. Here, a single right angle pin is overmolded into the plastic generator housing 5030 to thereby create pins for the connector 5010. Likewise, these pins each extend upwards into the interior of the generator enclosure to make connection to the generator circuit board 5460. The circuit board connection can be accomplished with solder or, in a simpler form, through sockets mounted to the generator board 5460. In this way, the assembly process is simplified when combined with the sockets that make the connection to the electrodes (pogo pins) 5402, 5404 of the transducer 902. The assembly of the generator housing 5410, therefore, becomes a matter of merely placing the generator board 5460 over the arrays of vertical pins and sealing the housing 5410. Protrusions extending upward from the lower housing portion 5030 support the circuit board 5460 laterally and providing the upper housing portion 5020 with similar protrusions completely trap the generator board 5460 therebetween. Visual outputs from the generator 904 are made through translucent windows 5410 in the upper housing portion 5410. LEDs are strategically placed on the generator 904 to allow illumination of the windows. The space between the LEDs and the windows allows for the light to spread over a larger area and addition of diffusing materials at the windows makes the illumination even. In an exemplary embodiment, the windows wrap around the upper curved surface of the upper housing portion 5020 to be visible over a wide range of viewing and operating angles.

[0269] In accordance with further exemplary embodiments of the present invention, the TAG assembly 303 provides a mechanical connection prior to establishing an electrical connection. That is, when attaching the TAG assembly 303 to the handle 302, a mechanical connection is established between the waveguide 1502 and the ultrasonic waveguide couple 5004 prior to an electrical connection being made between the TAG assembly's electrical connector 5010 and the handle assembly's TAG electrical connector 5602. Advantageously, because an electrical connection is not made until after the mechanical connection is established, electrical "bouncing" is avoided in this embodiment. More specifically, as the threads 8604 of the waveguide 1502 couple to the ultrasonic waveguide couple 5004, the electrical connection being made after a solid mechanical connection insures that the TAG assembly's electrical connector 5010 and the handle assembly's electrical connector 5602 to the TAG are in a fixed positional relationship, at least momentarily, and instantaneous removal and reestablishment of the electrical connection will not take place. Similarly, when the assembly 300 is being disassembled, the electrical connection is broken prior to a full separation of the mechanical connection.

[0270] The electrical connector 5602 of the handle 302 is best shown in FIGS. 86 and 108. The electrical connection occurs as the TAG assembly 303 is being mechanically joined to the handle 302. The electrical connector 5010 of the

TAG assembly 303 can be seen in FIGS. 50 and 54 and includes a chamfered rectangular blind hole having conductive pins 5470 extend out from the bottom of the hole centered along the longitudinal extent of the hole. The electrical connector 5602 of the handle 302 can be seen in FIGS. 86 and 108 as including a conductor rail 8630, a soft gasket 8632, and a stiff backing 8634, which also is a stiffening part of the flex circuit harness 3516 electrically connecting the electrical connector 5602 of the handle 302 to the flex circuit board 3514 at the multi-lead handle terminal assembly 3502.

[0271] Contact occurs first between the electrical connector 5010 of the TAG assembly 303 and a soft gasket 8632. Further coupling compresses the gasket 8632, which compression against the stiffer portion 8634 of the flex harness 3516 creates a fluid-tight seal between the connector 5010 and the flex harness 3516. This connection fully surrounds the connector rail 8630 and prevents fluid from being able to enter any gap between the connector 5010 and the stiffener 8634. The pins 5470 of the connector 5010 that insert into the conductor rail 8630 are, themselves, potted to prevent fluid contact with the interior of the generator 904. This same configuration is used to create the seal between the handle 302 and the housing of the battery 301.

[0272] In accordance with other exemplary embodiments of the present invention, the ultrasonic surgical device 300 is able to accept and drive a plurality of waveguide types, e.g., having varying dimensions. Where the handheld ultrasonic surgical cautery assembly 300 is able to accept and drive waveguides 1502 of varying types/dimensions, the handheld ultrasonic surgical cautery assembly 300 is provided with a waveguide detector coupled to the generator 904 and operable to detect the type (i.e., the dimensions or characteristics) of the waveguide 1502 attached to the transducer 902 and to cause the generator 904 to vary the driving-wave frequency and/or the driving-wave power based upon the detected waveguide type. The waveguide detector can be any device, set of components, software, electrical connections, or other that is/are able to identify at least one property of a waveguide 1502 connected to the handheld ultrasonic surgical cautery assembly 300.

XIV. WAVEGUIDE ASSEMBLY

[0273] FIGS. 73 to 87 provide detailed illustrations of exemplary embodiments of the waveguide assembly 304. The waveguide assembly 304 receives ultrasonic movement directly from the transducer 902 when the waveguide 1502 is physically coupled to the TAG assembly 303. The blade portion 7304 of the waveguide 1502 transfers this ultrasonic energy to tissue being treated. The ultrasonically-moving blade portion 7304 facilitates efficient cutting of organic tissue and accelerates blood vessel clotting in the area of the cut, i.e., accelerated coagulation through cauterization.

[0274] Referring to FIG. 73, a perspective partial view of the distal end 7306 of the waveguide assembly 304 is shown. The waveguide assembly 304 includes an outer tube 7302 surrounding a portion of the waveguide 1502. A blade portion 7304 of the waveguide 1502 protrudes from the distal end 7306 of the outer tube 7302. It is this blade portion 7304 that contacts the tissue during a medical procedure and transfers its ultrasonic energy to the tissue. The waveguide assembly 304 also includes a jaw member 7308 that is coupled to both the outer tube 7302 and an inner tube (not visible in this view). The jaw member 7308, together with the inner and outer tubes 7302, 7402 and the blade portion 7304 of the waveguide 1052, can be referred to as an end effector. As will be explained below, the outer tube 7302 and the non-illustrated inner tube slide longitudinally with respect to each other. As the relative movement between the outer tube 7302 and the non-illustrated inner tube occurs, the jaw 7308 pivots upon a pivot point 7310, thereby causing the jaw 7308 to open and close. When closed, the jaw 7308 imparts a pinching force on tissue located between the jaw 7308 and the blade portion 7304, insuring positive and efficient blade-to-tissue contact.

[0275] FIG. 74 provides a perspective underside view of the distal end 7306 of the waveguide assembly 304 shown in FIG. 73 with the outer tube 7302 removed. In this view, a distal end 7306 of the inner tube 7402 can be seen coupled to the jaw 7308. This coupling is provided by, in the exemplary embodiment illustrated in FIG. 74, a union of a pair of bosses 7408 on the jaw 7308 with boss-engaging openings 7414 in each of a pair of clevis arms 7418, 7420 that capture the bosses 7408 when the jaw 7308 is inserted therebetween. This relationship is better shown in the cross-sectional perspective underside view of FIG. 75. From this view, it can be seen that the boss-engaging openings 7414 of the clevis arms 7418, 7420 of the inner tube 7402 are coined 7502. The coined clevis arms 7418, 7420 provide a solid connection between the inner tube 7402 and the jaw 7308. By coining the openings 7414, the inner tube 7402 is able to engage the bosses 7408 on the jaw 7308 without having to rely on the outer tube 7302 for structural pressure/support.

[0276] FIG. 75 also shows that the waveguide 1502 is separate from, i.e., not attached to, the jaw 7308 or inner tube 7402. In other words, the waveguide 1502, when energized with ultrasonic energy, will move relative to the inner tube 7402 and jaw 7308 but will not contact the inner tube 7402 and will only contact the jaw 7308 if the latter is pivoted against the blade portion 7304 without the presence of tissue therebetween. Features of the present invention that facilitate this independent movement of the waveguide 1502 will be described below.

[0277] Returning to FIG. 74, the jaw 7308 is provided with a pair of flanges 7422, 7424 at a proximal end 7426 thereof. The flanges 7422, 7424 extend and surround the waveguide 1502 on opposing sides thereof. Each one of the flanges 7422, 7424 has, at its end, a pivot control tab 7411, 7412, respectively, extending below the waveguide 1502 when the bosses 7408 of the jaw 7308 are secured within the boss-engaging openings 7414 in the clevis arms 7418, 7420. It is

not a requirement for the pivot control tabs 7411, 7412 to extend below the waveguide 1502 as shown in FIG. 74; this configuration exists in the exemplary embodiment shown.

[0278] The jaw 7308 may be lubricated to reduce friction between the pivot control tabs 7411, 7412 and the outer tube 7302, as well as the bosses 7408 and the inner tube 7402. Such lubrication permits smoother actuation and reduces wear between the mating faces. Lubrication also allows the proximal side of the pivot control tabs 7411, 7412 to have a tighter fit and a more precise profiling with the outer tube 7302, which reduces backlash on the jaw 7308. To avoid rapid displacing of topically applied lubricants, one exemplary embodiment of the lubricant is a baked-on PTFE lubricant. This exposed lubricant on the top surface of the jaw further aids in the insertion of the device through a trocar. In the exemplary embodiment depicted, the pivot control tabs 7411, 7412 are shown as two arms that straddle the waveguide 1502. However, the same function can be achieved with a single arm that wraps around the waveguide 1502 and interacts with the outer tube 7302 on a bottom centerline. In both cases, the bottom of the control tab(s) 7411, 7412 are rounded to match a maximum shaft diameter and allow for insertion into trocar, as well as reducing the presence of sharp edges.

[0279] Returning briefly back to FIG. 73, the elevational end view of the waveguide assembly 304 shows that the pivot control tabs 7411, 7412 of the flanges 7422, 7424 of the jaw 7308 engage a pair of openings 7311, 7312 in a distal portion 7306 of the outer tube 7302. These features are better illustrated in the fragmentary, cross-sectional side view of FIG. 77.

[0280] Because the view of FIG. 77 is a cross-sectional view, only one 7424 of the two flanges 7422, 7424 is shown and the surface shown is an inside surface of the flange 7424. Correspondingly, only one of the pivot control tabs 7412 is shown, as well as a single one of the pair of openings 7312 in the distal portion 7306 of the outer tube 7302. This view makes clear that the opening 7312 surrounds and captures the pivot control tab 7412. Therefore, if the outer tube 7302 is moved toward the jaw 7308, the opening 7312 will also move relative to the jaw 7308. Conversely, if the outer tube 7302 is moved away from the jaw 7308, the opening 7312 will also move relative to the jaw 7308 in the opposite direction. The captured pivot control tab 7412 nested within the opening 7312 causes a corresponding rotational movement of the jaw 7308 around the pivot point 7310.

[0281] FIG. 78 provides an elevational partial side view of the end effector of the waveguide assembly 304. This view shows the outer tube 7302 substantially covering the flange 7422 of the jaw 7308, leaving only the pivot control tab 7411 extending from the opening 7311. It should now be apparent that, when the outer tube 7302 is slid in a proximal direction 7702, i.e., in a direction away from the jaw 7308, the outer tube 7302 will pull the pivot control tabs 7411, 7412 in the proximal direction 7702. This action causes the jaw 7308 to pivot around the pivot point 7310 clockwise in FIG. 78 to close, i.e., clamp, toward the blade portion 7304 of the waveguide 1502. This closed position of the jaw 7308 is shown in FIG. 79. The configuration of the exemplary embodiment of the waveguide assembly 304 is advantageous because assembly can occur without riveting or welding; the parts are all mechanically captured - e.g., the pivot control tab 7411, 7412 falls into the opening 7311 to allow the waveguide to be locked in mechanically without riveting or welding. This assembly procedure is discussed in further detail below.

[0282] FIG. 80 provides another view of the distal end of the jaw 7308 in a slightly closed position where the jaw 7308 is about to be placed in contact with the blade portion 7304 of the waveguide 1502. The end effector traps tissue between an interior of the jaw member 7308 and an opposing surface of the blade portion 7304. Trapping tissue in this way advantageously places the tissue in solid physical contact with the waveguide 1502. Accordingly, when the waveguide 1502 moves ultrasonically, the movement of the waveguide is directly transferred to the tissue, causing a cut, a cauterization, or both. It has been discovered to be beneficial to create an interference that will account for a deflection of the blade portion 7304 of the waveguide 1502 under the clamping forces imparted at the end effector. Deflection of the waveguide 1502 is a combination of bending and compression of a distal seal (i.e., a coupling spool 8104). Even though the configuration of the distal seal of the invention minimizes a thickness of elastomeric support, deflection of the waveguide 1502 can be substantial. If the initial contact between the blade portion 7304 and a liner 7314 of the end effector jaw 7308 was parallel, a gap would open at the root of the jaw 7308 as the waveguide 1502 deflected. Therefore, the invention configures initial contact to apply force at the root of the jaw 7308 and come into parallel with the blade portion 7304 when the full clamping force is applied. FIG. 80 shows an exemplary embodiment of the cutting profile of the cutting blade 7304. To achieve desired tissue or vessel cutting and cauterizing/sealing (excluding clamp force, displacement, and frequency), the cutting blade 7304 contains a composite of high and low stress concentrations between the profile of the blade portion 7304 and the liner 7314 of the jaw 7308. For desired vessel sealing, the vessel needs to have a seam where the top and the bottom of the vessel are bonded to each other. The seam needs to be centrally cut and a relief volume is desired to allow tissue to flow when sealing and to not char or burn. The profile shown in FIG. 80 provides both desirable characteristics. First, the blade profile features a narrow, relatively flat spine section 8002 that concentrates pressure from the clamping force to a localized seam at a level that allows tissue to momentarily dwell to allow coagulation and eventual cutting. During this dwell time (i.e., the sealing process) adjacent tissue is displaced by providing a curved side profile 8004 away from the cut. The high stress seam on the top and bottom of the blade portion 7304 is used to aid dissection (i.e., back scoring). During the cutting/sealing of tissue or a vessel, it can be beneficial to track tissue/vessel integrity. The invention utilizes the metallic waveguide 1502 as one pole of a two-pole electrical circuit

to measure properties such as impedance and/or capacitance of the tissue at the blade portion 7304 of the waveguide 1502. The electrically conductive material of the waveguide 1502 is already electrically connected to the TAG. This connection forms the first of the two-pole measurement circuit. The opposing pole is part of the liner 7314 in the jaw 7308. In an exemplary embodiment, a separate electrically conductive lead or other electrically conductive components in the handle 302 can connect the liner 7314 to the TAG.

[0283] To facilitate outer tube 7302 translation, and with reference back to FIG. 74, one or more corsets 7404 are provided on the inner tube 7402. The corset 7404 is an area of the inner tube 7402 having a smaller diameter D' than the average outer diameter D of the inner tube 7402. See FIG. 74. In accordance with an exemplary embodiment of the present invention, the corset 7404 is/are provided at a node(s) of the ultrasonic waveguide 1502. In other words, the corsets 7404 are located at points along the waveguide 1502 where the waveguide 1502 does not exhibit ultrasonic motion at resonant frequency. Therefore, the decreased diameter of the inner tube 7402 and its physical coupling to an interior surface of the outer tube 7302 does not adversely affect the waveguide's ability to resonate at an ultrasonic frequency. As also illustrated in FIGS. 74 and 75, for example, a seal 7406 resides within the corset 7404. The seal 7406, according to one exemplary embodiment, is an elastomeric O-ring type seal. Of course, many other materials may be selected as well. The seal 7406 has an outer diameter sufficiently larger than the outer diameter D of the 7402 so that the sealing effect is maintained but not too much to prevent the outer tube 7302 and the inner tube 7402 from translating with respect to one another without substantial friction when the jaw 7308 is actuated.

[0284] As is also shown in FIGS. 74 and 75, a thickness of the seal 7406 is smaller than a longitudinal length of the corset 7404 in which the seal 7406 resides. This difference in dimension allows the seal 7406 to travel along the longitudinal extent of saddle 7426 when shaped, as shown, as an annulus having a substantially circular cross-section. In particular, this traveling feature of the seal 7406 takes place when the outer tube 7302 is translated with respect to the inner tube 7402. Even more specifically, the seal 7406 is dimensioned, i.e., has an annular height, to bridge a gap between an inner surface of the outer tube 7302 and the saddle 7426 of the inner tube 7402 as shown in FIGS. 75 and 77. By filling this gap completely, the seal 7406 at the distal end 7306 of the waveguide assembly 304 prevents intrusion of moisture or other contaminants within the region between the outer tube 7302 and the inner tube 7402. Nonetheless, as the outer tube 7302 is translated, the tight fit between the outer tube 7302, the inner tube 7402, and the seal 7406 causes the seal 7406 to translate (e.g., roll or slide) within the saddle 7426 while, at all times maintaining a water-tight seal between the outer tube 7302 and the inner tube 7402. This translation T is illustrated, for example, with the thick arrows in FIG. 77.

[0285] Referring now to FIG. 81, the distal end of the waveguide assembly 304 at the saddle 7426 is shown in cross-section. This view shows the outer tube 7302 surrounding the inner tube 7402 and the seal 7406 disposed therebetween in the saddle 7426 of the corset 7404. As explained, the deformable seal 7406 is a water-tight connection between the inner wall 8102 of the outer tube 7302 and the outer surface of the saddle 7426 to prevent moisture or other contaminants from passing from a distal side 8108 of the seal 7406 to a proximal side 8110 of the seal 7406. FIG. 81 also shows a cross-section a coupling or sealing spool 8104. The coupling spool 8104 encircles a distal portion of the waveguide 1502 and is disposed at substantially the same longitudinal location as the corset 7404. As stated above, the corset 7404 is located at or substantially near an ultrasonic-movement node of the waveguide 1502. Therefore, the coupling spool 8104 is also located at or substantially near that node of the waveguide 1502 and, likewise, does not couple with the waveguide 1502 to receive ultrasonic movement. The coupling spool 8104 provides a support structure that physically links the waveguide 1502 to an inner surface 8106 of the corset 7404. In the cross-sectional view of FIG. 81, the coupling spool 8104 has a barbell-shaped longitudinal cross-section. This reduced cross-section of elastomeric material reduces the amount of deflection of the waveguide 1502 when the jaw 7308 is clamping tissue against the waveguide 1502. The relatively thick cross-section of the barbell ends of the seal 8104 maintains a water tight seal when the middle section of the waveguide 1502 deflects during clamping. A non-metallic material such as, but not limited to, Ultem, PTFE, Rulon, and Graphite filled materials may be used as the rigid coupling spool 8104. The coupling spool 8104 being rigid limits the amount of waveguide 1502 deflection with respect to the jaw 7308 while still providing a non-metallic waveguide support and seal. It is important to design an interference to account for the deflection of the waveguide 1502 under such clamping forces. Deflection of the waveguide 1502 is a combination of bending and compression of the distal seal (7404, 7406). Even though the distal seal configuration minimizes a thickness of elastomeric support, deflection of the waveguide 1502 still can be substantial. If an initial contact between the waveguide 1502 and the jaw liner 7314 was parallel, the waveguide 1502 would deflect and a gap would open at the root of the jaw 7308. Therefore, the clamping assembly configures the initial contact to apply force at the root of the jaw 7308 and to later be parallel with the waveguide 1502 when the full clamping force is applied. With the aforementioned rigid material in the coupling spool 8104, the deflection and variation in parallelism is minimized. Also present in FIG. 81 is an inner sleeve 7610, which encircles the waveguide 1502. As set forth below in detail, the sleeve 7610 assists in preventing metal-to-metal contact between the waveguide 1502 and the inner tube 7402.

[0286] FIG. 82 provides a perspective view of an embodiment of the coupling spool 8104. In this view, an interior surface 8202 of the coupling spool 8104 can be seen. This interior surface 8202 is in direct physical contact with the

waveguide 1502 when the waveguide assembly 304 is assembled, as shown in FIG. 81, for example. The perspective view of FIG. 82 also reveals an exterior saddle shape 8204 of the coupling spool 8104 that substantially corresponds to the interior shape of the saddle 7426, which is illustrated in FIG. 81 too.

[0287] To help capture and retain tissue between the jaw member 7308 and the waveguide 1502, the jaw member 7308 includes a liner 7314 having a plurality of teeth 7316. This liner 7314 provides the jaw member 7308 with an increased ability to grip the tissue. This liner can be made of multiple non-metallic, high-temperature, lubricious materials such as, but not limited to, VESPEL®, RULON®, Modified PTFE, and glass filled and graphite filled versions of these. An exemplary embodiment of the liner 7314 is shown in the perspective views of FIG. 84 (from a distal-most end of the liner 7314) and FIG. 85 (from a proximal-most end of the liner 7314). In addition to the plurality of teeth 7316, the liner 7314 includes a distal-most surface 8402, a central smooth channel 8404 located between first 7316a and second 7316b longitudinal rows of the plurality of teeth 7316 on a lower surface 8403, a flat proximal clamping surface 8405, and an upper flange 8406 for securing the liner 7314 to the jaw member 7308. This central smooth channel 8404 may also contain a groove 10014 that originates from the proximal end and runs distally as shown, for example, in FIG. 100. This groove acts as an alignment feature between the liner 7314 and the waveguide 1502, which aids in evening the effect upon tissue while using the device. The distal-most surface 8402 is, as can be seen in FIG. 73, an exposed blunt front surface of the distal end of the waveguide assembly 304. FIG. 73 illustrates a channel 7318 of the jaw member 7308 in which the liner 7314 is disposed when assembled. The inner surfaces of the channel 7318 substantially correspond to the outer surfaces of the upper flange 8406 so that the liner 7314 may be retained in the jaw member 7308 in a substantially movement-free manner. In the exemplary embodiment of the channel 7318 illustrated, the distal end of the channel 7318 is narrower than the intermediate portion so that the liner 7314 may slide from a proximal end of the jaw member 7308 up to but not past the distal end of the channel 7318. Also shown in the exemplary embodiment of FIG. 85 is a retaining tab 8502 that, when the liner 7314 is placed in the jaw 7308 all the way distally, can be bent downward (towards the liner 7314) and below the top plane of the liner 7314. In such a bent configuration, the distal end of the retaining tab 8502 will oppose, and possibly rest against, the rear surface 8504 of the liner 7314 and/or flange 8406. With such an opposition, the liner 7314 is prevented from exiting the jaw 7308. This single retaining tab could be replaced with two smaller tabs on either side of the channel 7318 that are bent downwards below the top plane of liner 7314. Alternatively, the jaw liner 7314 can be made to be loaded from a distal end of the jaw 7308 with features that capture and retain the liner 7314 through a single surgical procedure. An exemplary embodiment of such a configuration is shown in FIG. 100. More specifically, the jaw 7308 is formed with a distal-entry passage or channel 10002 in which the distal-loading liner 10010 is loaded. To secure the liner 10010 in the channel 10002, the channel can define orifices 10004 that are shaped to catch and removably hold therein detents 10012 of the liner 10010. These opposing features can be reversed or changed in any equivalent way that removably secures the liner 10010 in the jaw 7308. Easy replacement of the liner 10010 allows for potential reprocessing of the handle and/or waveguide assembly with an easy change of this high-wear part for potential reprocessing of the device.

[0288] The offset between the proximal-most surface 8402 and the flange 8406, shown in FIG. 84, facilitates the placement of proximal-most surface 8402 at the distal most portion of the jaw member 7308. That is, the liner 7314 slides within the jaw member 7308 until it is fully seated within the jaw member 7308. It is, however, the flange 8406 that is physically secured by the jaw member 7308. More specifically, as is shown in FIGS. 84 and 85, the flange 8406 extends beyond the plurality of teeth 7316 on both sides thereof. However, the flange 8406 does not extend all the way to the proximal-most surface 8402. When the liner 7314 is slid inside the jaw member 7308, the extending side portions of the flange 8406 travel within the channel 7318 formed in the jaw member 7308. Because the flange 8406 does not extend all the way to the proximal-most surface 8402, when the flange 8406 reaches the end of the channel 7318, the proximal-most surface 8402 of the liner 7314 will extend beyond the channel 7318 up to the position shown in FIG. 73.

[0289] Focusing now on the exemplary embodiment of the teeth 7316, it can be seen in FIGS. 84 and 85 that the teeth 7316 do not extend completely across the lower surface 8408 of the liner 7314. Instead, in the embodiment of FIGS. 84 and 85, a first row of teeth 7316a and a second row of teeth 7316b, which oppose the first row of teeth 7316a, are separated by a central smooth channel 8404. The central smooth channel 8404 provides a solid smooth surface that lines up directly over the waveguide 1502. It is this smooth surface 8404 that comes into contact with the ultrasonically-moving waveguide 1502 during a procedure and helps seal the tissue by facilitating continued, non-impeded, ultrasonic movement of the waveguide 1502 with even pressure along its length. Due to the fact that the liner 7314 runs the full length of the jaw 7308 (from the root to the tip), contact over the entire length of the treatment portion (i.e., the blade portion 7304) of the waveguide 1502 is made with even pressure.

[0290] Moving now to FIG. 86, a fragmentary perspective view of an interior of the handle portion 302 is illustrated. This view shows a proximal-most end 8601 of the waveguide 1502, which features a set of threads 8604 used to couple the waveguide 1502 to the TAG assembly 303. As described above, the illustrated location of the proximal-most end 8601 of the waveguide 1502 within the handle portion 302 is substantially the location where the waveguide assembly 304 remains when it is coupled to the TAG assembly 303. When the TAG assembly 303 is inserted into the handle portion 302, see, for example FIG. 45, the transducer horn 5002 aligns with and thereby allows a secure longitudinal

coupling of the threads 8604 and the ultrasonic waveguide couple 5004.

[0291] The waveguide 1502 is surrounded by the inner tube 7402 and, then, the outer tube 7302. This view of the proximal-most end 8606 of the outer tube 7302 shows that the outer tube 7302 terminates at its proximal-most end 8606 with a flared section 8608. The flared section 8608 features a pair of channels 8610 and 8612 (8612 not fully shown in this view) forming a keyway. These channels are shown as opposing but need not be in this configuration. Residing within the channels 8610, 8612 is a torque adapter 8602 that is fixedly coupled to the waveguide 1502. The coupling of the torque adapter 8602 and the waveguide 1502 will be shown in more detail in the following figure, FIG. 87. Continuing with FIG. 86, it can be seen that the torque adapter 8602 is provided with a boss 8616 that extends out through the channel 8610. Although not shown in this view, the torque adapter 8602 is also provided with a second boss that extends likewise within the second opposing channel 8612. Engagement between the bosses 8616 of the torque adapter 8602 and the channels 8610, 8612 of the flared section 8608 provides a rotational-locking relationship between the waveguide 1502, the inner 7402, and the outer tube 7302. That is, because the bosses engage the channels 8610, 8612, any rotation of the waveguide 1502 is shared by both the inner tube 7402 and the outer tube 7302. The proximal end of the inner tube 7402 does not extend past the torque adapter 8602. The rotational connection between the torque adapter 8602 and the inner tube 7402 occurs through an internal feature of the waveguide rotation spindle 3704.

[0292] Focusing now on FIG. 87, a perspective view of an interior of the handle portion 302 is once again illustrated. In this view, however, the outer tube 7302 has been removed (along with a right half of the waveguide rotation spindle 3704). The removed outer tube 7302 exposes a majority of the torque adapter 8602. Although not viewable in either FIG. 86 or FIG. 87, the torque adapter 8602 is, in one exemplary embodiment of the present invention, symmetrical with a second boss extending in a direction substantially directly opposite the first boss 8616. The reason why the torque adapter 8602 is so-named is because it provides the structures for resisting rotational movement when the torque wrench 8800 is used to connect the waveguide coupler 5004 of the transducer horn 5002 to the waveguide 1502. As described above, rotation of the waveguide 1502 needs to be prevented as the torque wrench 8800 is used to rotate the spindle 3704 of the transducer 902.

[0293] To get an adequate holding force, the waveguide 1502 needs to be rotationally keyed. But, any rotationally keyed waveguide feature suffers from same drawbacks as other supports along the waveguide 1502 in that vibration is transmitted if the keyed feature is not located on a node of the waveguide 1502. As shown in FIGS. 86 and 87, for example, the keyed feature for torque transmission is located at the most proximal node, i.e., the node furthest from the blade and closest to the threads. The torque transmission feature of an exemplary embodiment of the invention is a plurality of splines or teeth 8702 in a radial pattern symmetrically disposed about the waveguide 1502. Each spline 8702 extends away radially from a central longitudinal axis 8706 of the waveguide 1502.

[0294] The torque adapter 8602 is provided with a plurality of interior keyways 8704, each keyway 8704 aligning with one of the extensions of the spline 8702 and having a shape substantially corresponding to a respective one of the splines 8702 so that, when connected as shown, the torque adapter 8602 securely rests at its shown longitudinal position on the waveguide 1502. This longitudinal position on the waveguide 1502, too, is located at an ultrasonic vibration node where movement is minimal/non-existent. This aligning and securing engagement between the keyways 8704 and the splines 8702 places the keyways 8704 and the splines 8702 in a fixed rotational relationship. In other words, as the waveguide 1502 rotates, so too must the torque adapter 8602.

[0295] The splines 8702 each protrude beyond average diameter of the waveguide 1502. The splines 8702 can be rectangular columns but they are not limited thereto; they can have angled faces. One exemplary embodiment of the splines 8702 has an overall shape of a frusto-rectangular pyramid but with the two side edges of the top plane being sloped and the distal and proximal edges of the top plane being square. The maximum spline outer diameter can be kept within the largest diameter of the waveguide material to allow for use of stock material having the lowest cost. The torque transmission splines 8702 on the waveguide 1502 are mated to the torque adapter 8602 with correspondingly shaped female keyways 8704. Assembly of the torque adapter 8602 occurs by pressing it onto the waveguide and finally to be constrained concentrically by the torque transmission faces of the splines 8702 and longitudinally by providing the keyways 8704 as blind holes, here on the non-illustrated end of the torque adapter of FIG. 87. To rotationally align the torque adapter 8602 with respect to the waveguide 1502 and always place the bosses 8616 inside a pocket 9504 of the spindle 3704 (see, e.g., FIG. 95), in an exemplary embodiment, some of the splines 8702 are removed selectively to permit only one correct component orientation (that can be symmetric but keyed to only be at 0 or 180 degrees). As such, when connecting the transducer 902 to the waveguide 1502, the spindle 3704 is grounded (e.g., by the user's hand) torque is generated on the spinner 3704 by the torque wrench 8800. The bosses 8616 are loaded and transmit the torque to the threads 8604 of the waveguide 1502. Overall geometry and mass of the torque adapter 8602 are tuned to reduce acoustic coupling from the waveguide 1502 through the torque adapter 8602 to the spindle 3704. The materials of the spindle 3704 and the torque adapter 8602 are selected to be different to further isolate any acoustic energy coupling. For example, a high-temperature, glass-filled polymer Radel (20% glass filled polyphenylsulfone PPSU) can be used for best acoustic energy impedance while still providing strength for torque transmission. A polymer filled with low friction materials such as Nylon or PTFE (Polytetrafluoroethylene) is also advantageous when minimizing acoustic

transmission. In addition, an elastomeric material can also be insert molded into the spindle 3704 at the torque transmission face to further isolate acoustic energy.

[0296] Referring back now to FIG. 66, it can now be seen that the channels 8610, 8612 of the flared section 8608 of the outer tube 7302 are the features that also engage the rotation-prevention wheel 6502. Due to this engagement, any rotation imparted on the waveguide rotation spindle 3704 by the user will result in a direct and corresponding rotation of the rotation-prevention wheel 6502, the outer tube 7302, the inner tube 7402, the torque adapter 8602, and the waveguide 1502. The following is a result of this connection configuration: when the rotational lockout number 6508 is engaged with the rotation-prevention wheel 6502, not only is the rotation-prevention wheel 6502 prevented from rotating, so too is the entire waveguide assembly 304, 3704, 7302, 7402, 8602, 1502. In the same sense, when the rotation-prevention wheel 6502 is not engaged with the rotational lockout number 6508, a user can freely rotate the spindle 3704, which is physically coupled to the rotation-prevention wheel 6502, and cause a rotation of the waveguide assembly 304 along a longitudinal axis 8706.

[0297] As shown in FIG. 95, the spindle 3704 has oval bosses 9502 on its interior. These bosses 9502 engage both the inner 7402 and outer 7302 tubes, which locks the tubes 7302, 7402 together rotationally while allowing only the inner tube 7402 to have longitudinal displacement. The area in which the bosses 9502 lock the tubes 7302, 7402 is shown well in FIG. 93. Looking at both of FIGS. 93 and 95 together, it can be seen that the protrusion of the boss 9502 is configured to enter the opening of the inner tube 7402 but not pass therethrough (to possibly contact the inner sleeve 7610 or to press the sleeve 7610 into the waveguide 1502). At the same time, the bosses 9502 are shaped to have a longitudinal length sufficient to prevent longitudinal displacement of the inner tube 7402 but to permit longitudinal translation (proximal-distal) of the outer tube 7302 for moving the jaw 7308. This complex locking feature, in conjunction with a pocket 9504 on a proximal end of the spindle 3704 that engages the torque adapter 8602, locks the tubes 7302, 7402 and the waveguide 1502 with respect to one another. In the exemplary embodiment, the torque adapter pocket 9504 has crush-features 9506 that force the torque adapter 8602 to center during assembly. Also in the pocket 9504 is a boss 9508 that traps the waveguide 1502 and prevents it from pulling out proximally. Assembly of the spindle 3704, therefore, occurs by pressing two hermaphroditic spindle halves together. Once pressed together, it is desirable to have minimum friction between the mating rotational faces: the exterior of the intermediate annular groove 4610 of the waveguide rotation spindle 3704 and the annular boss 4605 of the handle halves 4503, 4603. As shown in FIGS. 95 and 99, the mating rotational faces have a minimized contact area by chamfering the outer edges of the groove 4610 to set back the castellations on the proximal side and the finger grooves on the distal side of the spindle 3704 and by raising those contacting surfaces in the center of the groove 4610. Likewise, the outer faces of the boss 4605 are raised at the center portions thereof.

[0298] As can be seen from FIGS. 73, 74, and 78, and especially FIG. 84, the lower surface 8403, including the proximal clamping surface 8405, is flat and parallel to the upper surface of the blade portion 7304 of the waveguide 1502. This means that, when the jaw 7308 is clamped shut without any interposing material, the clamping surface 8405 will contact the blade portion 7304 at its proximal end first, as shown in FIGS. 79 and 80. As such, when the waveguide 1502 is ultrasonically actuated, it is possible for the blade portion 7304 to cut into the liner 7314 at least to a point the two parts are parallel as shown in FIG. 89. In the exemplary configuration of the jaw control device, however, it is possible for the jaw 7308 to pivot past parallel with respect to the waveguide 1502. Therefore, it is possible for the blade portion 7304 to cut entirely through the liner 7314. In such a case, the metallic blade portion 7304 would be vibrating against the metallic jaw 7308 -- a condition that is to be avoided as either or both parts will break within a short period of time.

[0299] An exemplary embodiment of the inventive system solves this problem by including an overstroke prevention device 9002 and outer tube stop 9012. The overstroke prevention device is comprised of a bobbin 9004, a nut 9006, an overstroke spring 9008, and a distal slider 9010. The bobbin 9004 is longitudinally fixed to the outer tube 7302 and translates along with the outer tube 7302 as the outer tube 7302 is moved with respect to the inner tube 7402 and waveguide 1502, the latter two of which are longitudinally fixed in position with respect to the handle assembly 302 as set forth above. An exemplary embodiment of the attachment mechanism for the bobbin 9004 is shown, for example, in FIG. 86, where two opposing windows 8614, 8618 exist in the proximal end of the outer tube 8608. The bobbin 9004 has a mushroom-shaped head 9602 on its distal end and a threaded portion 9604 on its proximal end for receiving the nut 9006 thereon and is illustrated, for example, in FIGS. 96 and 97. The nut 9006 and the bobbin 9004 are configured to have the nut tightened to a hard stop 9702 that, in conjunction with a consistent spring 9008 yields consistent clamp forces from device to device. The spring 9008 has a low rate so that variations in tissue thickness will still yield similar clamp forces. The low rate has a flatter force profile so, regardless of where the spring is on the profile, the user is as close to the desired force as possible. As illustrated in FIG. 97, the mushroom-shaped head 9602 connects longitudinally to the outer tube 7302, in this example, through two opposing windows. The slider 9010 is able to longitudinally slide upon the outer surface of the main body of the bobbin 9004 between the nut 9006 and the distal head of the bobbin 9004. As such, with the overstroke spring 9008 disposed between the movable slider 9010 and the stationary nut 9006, any movement of the slider 9010 will cause a compression of the spring 9008. As an aside, during assembly of the waveguide 1502 and tubes 7302, 7402, the proximal section of the outer tube 7302 can compress, due to the elongated

channel 8610, 8612 that runs out to the proximal end of the outer tube 7302. The compressed proximal end of the outer tube 7302 is able to fit into the distal opening 9606 of the bobbin 9004 and, in so doing, forces apart lockout fingers 9706 (radially outward). Once fully inserted, the outer tube 7302 returns to its normal full diameter. At this point, the fixed bosses 9502 in the bobbin 9004 engage distal windows 8620 in the outer tube 7302. At the same time, two rigid bosses 9608 extending from the interior surface of the bobbin 9004 engage the two opposing windows 8614, 8618 at the proximal end of the outer tube 7302 as the lockout fingers 9706 spring inwards to enter the opposing channels 8610, 8612 at the proximal end of the outer tube 7302. The inward movement of the lockout fingers 9706 prevents further compression of the outer tube 7302, thereby locking the bobbin 9004 onto the outer tube 7302.

[0300] A yoke 9014 connects the slider 9010 to the trigger 4606 as shown in FIGS. 90 to 92. The progression of FIGS. 90 to 92 shows how the yoke 9014, the slider 9010, the spring 9008, the bobbin 9004, and the outer tube 7302 move as the trigger 4606 is depressed to close the jaw 7308. The location where the yoke 9014 interfaces with the bobbin 9004 is a rotational interface and, therefore, it is desired to only have minimal friction forces that do not impede rotation of the spindle 3704. Minimizing such friction is achieved by including bumps 9802 on the yoke 9014. These bumps 9802 create a point-contact having a greatly reduced surface area for the bobbin/slider interface. In the trigger state shown in FIG. 90, the trigger 4606 is unactuated and the jaw 7308 is in the open, steady-state position (see, e.g., FIG. 73). In the trigger state shown in FIG. 91, the trigger 4606 is partially actuated and the jaw 7308 is in the closed position shown, e.g., in FIG. 79. In this position, the yoke 9014 has moved the slider 9010 proximally to compress the spring 9008 partially, thereby applying a proximally directed force to the nut 9006. As the nut is fixed longitudinally to the bobbin 9004 and the bobbin 9004 is fixed longitudinally to the outer tube 7302, trigger movement causes closure of the jaw 7308.

[0301] It is at this point that further closing of the jaw 7308 (rotation towards the waveguide) is not desired. To prevent the force from further movement of the outer tube 7302, an outer tube stop 9012 is located on an exterior surface of the inner tube 7402 as best shown in FIG. 93. In such a configuration, any attempt to move the outer tube 7302 further in a proximal direction will require a corresponding movement of the inner tube 7402.

[0302] But, the jaw 7308 and the blade portion 7304 are used to cut tissue disposed therebetween. This means that when the jaw 7308 is clamped shut, any load that is transferred into the blade portion 7304 from either tissue clamped by the jaw 7308, or by the liner 7314 itself, will deflect the blade portion 7304 both as a function of compressing the sealing spool 8104 and of bending the cantilevered beam of the blade portion 7304. As the blade portion 7304 is bent, its ultrasonic movement characteristics alter. It is, therefore, desirable, to prevent bending of the blade portion 7304 as much as possible.

[0303] When the trigger 4606 is closed, the spring 9008 is compressed. An exemplary nominal force spring load when clamped on nothing between the jaw 7308 and the blade portion 7304 is approximately 24 pounds. This load increases with the rate of the spring as the thickness of tissue in the jaw increases to a maximum, which, in this exemplary embodiment is approximately 28 pounds when the jaw 7308 is pinned fully open by the tissue. When clamped, any load that is transferred into the blade portion 7304 from the liner 7314 deflects the waveguide both as a function of compressing the distal sealing spool 8104 and of bending the cantilevered beam of the probe. The distal sealing spool 8104 compression creates a non-linearity in a force v. deflection curve at the beginning of compression, but once the load is over 10 pounds, the curve straightens out. FIG. 94 is a curve illustrating deflection of the waveguide blade portion 7304 as a function of input force. With the jaw 7308 fully clamped with no tissue, the load input through the spring is applied both into the clamping of the liner 7314 against the blade portion 7304 and into the outer tube stop 9012. The stop 9012 is attached (e.g., welded) with a strength able to withstand the maximum load. The placing of the stop is done in an already assembled system. The stop is tuned by placing the stop while a measured force is applied to the system to take up all of the tolerances and deflect the probe appropriately. As can be seen from the graph, the blade deflects at 10 pounds of force and continues deflecting until approximately 16 pounds of load. At this point, the outer tube 7302 contacts the stop 9012. As the load increases at the spring 9008, the stop 9012 begins to resist further motion of the outer tube 7302.

Any further increased load starts to be entirely borne by the stop 9012, with no additional load being imparted into deflecting the blade portion 7304. Once the force on the spring 9008 reaches approximately 22 pounds, any further increase in load does not translate into additional deflection of the blade portion 7304. On the other hand, however, as shown by the straight lines in the graph of FIG. 94, the load transfer to the blade portion 7304 continues linearly without the stop 9012, as does the deflection of the probe. This outer tube stop could be achieved in multiple configurations. In the exemplary embodiment shown, it is a fixed stop 9012 placed on the proximal end of the shaft assembly. This same affect could be achieved at the distal end. For example, a non-illustrated tab on the end of the outer tube 7302 or the inner tube 7402 can be bent into place and act as a stop against further jaw 7308 movement. Similarly, a non-illustrated tab on the jaw 7308 could oppose either or both of the tubes 7302, 7402 that is bent to interfere with this tube set, the tab could allow for assembly where jaw is moved past horizontal but prevents jaw movement past horizontal after assembly. Also, as opposed to a bend tab, a weld or a punch can be used to create a feature that acts as the stop. Furthermore, similar stopping features could be incorporated into the plastic of the handle.

[0304] As the invention is used in a procedure, the liner 7314 can wear. Meaning that the jaw 7308 will be free to pivot towards the blade portion 7304. This wear, therefore, allows the outer tube 7302 to translate proximally. With the stop

9012 in place, however, such motion is prevented and the position of the jaw 7308 relative to the outer tube 7302 quickly becomes limited (i.e., it cannot continue to pivot closer to the blade portion 7304). However, since the blade portion 7304 has already deflected away from the jaw 7308, the blade portion 7304 is made free to move less away from the jaw as the liner 7314 wears away. As this happens, the amount of blade deflection and force required to maintain that deflection declines. This reduction in force creates less friction and heating in the liner 7314 and prolongs the life of the liner 7314. With the invention, the maximum amount of deflection of the blade portion 7304 is between .030" and .035". The available thickness of the liner 7314 is made to be similar. Therefore, in an abusive condition with extended use without tissue (i.e., empty jaws), the worn liner 7314 might allow the metal jaw to touch the blade portion 7304, but after such wear the force between them will be minimal or non-existent.

[0305] As already describe herein, the waveguide 1502 is mechanically fixed in the handle portion 302 at the torque adapter 8602 - in a proximal area of the waveguide 1502, it is fixed concentrically within the handle portion 302 and the waveguide assembly 304 both rotationally and longitudinally; it is also fixed concentrically at a distal area of the waveguide 1502 by a coupling spool 8104 that acts as a distal seal. When the blade of the waveguide 1502 is placed under load during cutting and/or sealing, this relatively long waveguide beam (even though it is made of titanium in the exemplary embodiment) bends and can potentially contact the inner tube 7402 and, in such a case, it is probable that the touching will occur at acoustically active points along the waveguide 1052. When the waveguide 1502 is bent as such and is active, metal to metal contact occurs. Such contact causes audible high frequency sound (e.g., squeeling) and significant power loss by generating heat at the contact point. This contact is to be avoided. Accordingly, the invention provides a contact support in the form of a waveguide bump 5710 at the waveguide 1502, more particularly, at various locations along the waveguide 1502.

[0306] An ideal location for any contact/support along length of an active waveguide 1502 is at node locations. Node locations are points of high stress and no displacement along a standing acoustic wave generated by the transducer 902 in the waveguide 1502. Node lengths are infinitely short sections and displace about nominal (i.e., natural) locations due to drift of resonance frequency of standing wave. The bumps 5710 are larger diameter sections of the waveguide 1502 that extend virtually all the way to the innermost tube in the waveguide assembly 304. Because the nodes displace longitudinally about a node point due to the drift of resonance frequency of the standing wave, each bump 5710 is centered about the nominal/natural node locations and have longitudinal lengths that encompass any displacement of the node location. The larger diameter of the bumps 5710 relative to an outer diameter of the waveguide 1502 provides another advantageous feature. As is understood with regard to ultrasonic vibration in waveguides, an increase in diameter results in a reduction of waveguide displacement, referred to as an step of anti-gain and making node location less active. As such, if the bump 5710 possibly transmitted any vibration to what it was touching, the amplitude of the vibration would be reduced with respect to the remaining, narrower sections of the waveguide 1502. The number of the bumps 5710 are chosen selectively and do not equal the number of node locations along the waveguide 1502 in the exemplary embodiment of the invention, which is illustrated, for example, in FIG. 57 where four bumps 5710 are present. A minimum quantity of the bumps 5710 is chosen for ease of manufacturing and to prevent the above disadvantageous contact.

[0307] Even though the node locations are less active at the bumps 5710, the above mentioned metal to metal contact still can be an issue. Accordingly, to further prevent such contact, the invention provides an inner sleeve 7610 that encompasses the section of the waveguide 1502 within the inner tube 7402. The sleeve 7610 is made out of a low-coefficient of friction, high-temperature material (e.g., Teflon, PTFE, HDPE, Polyethylene). As can be seen in FIGS. 81 and 99, respectively, the sleeve 7610 is naturally fixed concentrically about the waveguide 1052 and is mechanically fixed against longitudinal translation by the torque adapter 8602 at a proximal end of the sleeve 7610 and by the sealing spool 8104 at the distal end of the sleeve 7610. The sleeve 7610 has an inner diameter selected to only contact the waveguide 1502 at the bumps 5710. The outer diameter of the sleeve 5710 is allowed to contact the inner surface of the inner tube 7402 but can be slightly smaller. An alternate configuration of the sleeve 7610 has the sealing spool 8104 and the sleeve 7610 as a single piece. These components can share material, providing the concurrent benefits of lower part count and simpler assembly. In this exemplary embodiment the integral distal spool 8104 and sleeve 7610 are constrained by the corset on the inner tube 7402.

[0308] When assembled the cross-sectional diameters of the waveguide 1502, the sleeve 7610, the inner tube 7402, and the outer tube 7302 are configured to allow an air gap for ETO sterilization, for example. Air gaps along the bumps 5710 also reduce the amount of acoustic energy that can be coupled to the sleeve 7610 from the waveguide 1502. Further, due to the low coefficient of friction of the material that makes up the sleeve (e.g., Teflon, PTFE), the acoustic energy that ever is imparted to the inner or outer tubes 7302, 7402 is virtually non-existent. As an alternative embodiment to the singular, smooth, tubular sleeve 7610, a more complex sleeve can be included that entirely eliminates the need to place the bumps 5710 on the waveguide 1502. For example, the sleeve 7610 can have longitudinally extending parts, e.g., two, clam-shell-like halves that surround the waveguide 1502 between the torque adapter 8602 and the sealing spool 8104. Each half can have inwardly protruding bosses and outwardly protruding bosses. The outwardly projecting bosses do not entirely surround the two outer surfaces of the halves to create gaps at each outer support point. These gaps permit penetration of ETO sterilization gasses all the way from the distal end to the proximal of the sleeve on the

outer surface next to the inner tube 7402. The outwardly projecting bosses can be staggered. The inwardly projecting bosses, on the other hand, are configured to contact the waveguide 1502 only at the nodes. As the longitudinal lengths of the bumps 5710 are sufficiently large, the inwardly projecting bosses can have smaller longitudinal lengths and the overall longitudinal length of the halves can extend all the way from the torque adapter 8602 to the sealing spool 8104 and, if desire, one can be integral with the sealing spool 8104. In this way, the sleeve remains longitudinally stable with the inwardly projecting bosses located on the waveguide nodes. Another configuration can have the sleeve be a blow-molded part with both the inwardly and outwardly projecting bosses and, yet another configuration has the sealing spool 8104 blow molded integrally with this sleeve.

[0309] All prior art node supports are greater than one in number and are fixed to the outer diameter of the respective waveguide with 100% contact (pressed, bonded, molded). As such, acoustic energy is always coupled to such supports, which results in a higher natural power draw and in high assembly complexity and manufacturing cost. In contrast, the bumps 5710 and sleeve 7610 waveguide support of the invention are simple and cost-effective. The sleeve's constraint and one-piece configuration lends itself to a far simpler and cost effective assembly. Also, the bump features are not far different than the average diameter of the waveguide 1502 and are less than the maximum diameter of the waveguide 1052 to make extra fabrication a non-issue.

[0310] Construction of the waveguide assembly 304 is described with reference to FIGS. 100 to 105. Initially, the liner jaw 7308, 10010 is inserted and secured in the jaw 7308. See, for example, FIGS. 100 and 101. The inner tube 7402 is shaped to be extended beyond the distal end of the outer tube 7302 sufficiently far to allow a flexing open (as shown by arrows A) of the clevis arms 7418, 7420 for receipt therein (arrow B) of the opposing bosses 7408 of the jaw in the progression of FIGS. 101 to 102. With the jaw 7308 assembled in the inner tube 7402, the jaw 7308 is pivoted below the centerline of the tubes 7302, 7402 and the inner tube 7402 is slid into the outer tube 7402 as shown in FIG. 103. This presents the pivot control tabs 7411, 7412 of the jaw 7308 into a position to enter the outer tube 7302. The jaw is, as shown in FIG. 104, pivoted open above the centerline of the tubes 7302, 7402 while the pivot control tabs 7411, 7412 are inserted into the openings 7311, 7312 of the outer tube 7302.

[0311] The waveguide 1502 is, then, inserted through the set of tubes 7302, 7402 to, thereby, trap the jaw 7308 therein -- because the jaw 7380 can no longer travel towards longitudinal centerline of the tubes 7302, 7402 due to the presence of the waveguide 1502. This final assembly position is illustrated in many figures of the drawings, for example, in FIGS. 73 and 76. Use of isopropyl alcohol, for example, allows the waveguide 1502 to be slid through distal dumbbell seal 8104 with ease. Thereafter, the alcohol evaporates so that no residue remains at the dumbbell seal 8104. As is apparent, this assembly process is unique because it does not require any operations other than mechanically positional joining. No welding, crimping, or deforming occurs nor are there needed any other parts for full assembly.

[0312] This assembly process has a significant benefit with regard to manufacture. Lubrication of the inner and outer tubes 7302, 7402 can occur at the tube manufacturer and not on the clean room assembly line, which prevents any contamination arising from such joining. Before coaxially fitting the inner and outer tubes 7302, 7402 together, the translating o-ring 7406 is placed in the corset 7404 of the inner tube 7402 and, then, the outer tube 7302 is slid onto the inner tube 7402 up to the o-ring 7406. Lubrication is placed on the o-ring 7406 and the outer tube 7302 is moved with respect to the inner tube 7402 (or vice versa) to have the o-ring 7406 roll and translate within the corset 7404. Moisture in the lubrication is allowed to dry, which leaves only lubricant between the tubes 7302, 7402 and around the o-ring 7406.

[0313] A common issue in developing displacement-dependant ultrasonic systems is the complexity and inaccuracies of measuring waveguide displacement. The most accurate measurement systems are laser vibrometers that cannot be calibrated by equivalent high-frequency dynamic standards and are expensive. One crude and simple calibration method is to observe displacement of reflected "spots" on the surface of a dynamic high-frequency system under magnification. Peak-to-peak displacement is observed and can be correlated to known length standards. The principal issue with magnification observation method is the randomness or inconsistencies of such "spots". In an exemplary embodiment of measuring waveguide displacement, the invention uses a controlled visual feature such as an intentionally applied spot, mark, artwork, machined hole, groove or the like to the blade portion 7304 of the waveguide 1502. Placing such a feature on the blade 7304 increases precision of magnified displacement observation and measurement.

XV. ADDITIONAL SAFETY FEATURES

[0314] In an exemplary safety embodiment for any of the configurations of the invention, the system can have a safety mechanism grounding the surgeon using the device to the handheld ultrasonic surgical cautery assembly 300. In the event the waveguide 1502 accidentally makes contact with the surgeon, the handheld ultrasonic surgical cautery assembly 300 senses this grounding and immediately ceases movement of the waveguide 1502, thereby instantly preventing the surgeon from cutting him/herself. It is possible to provide a safety circuit that can sense contact with the surgeon and interrupt ultrasonic power delivery because the hand-held instrument 300 is not connected to earth ground. For example, a capacitive contact patch located on the handle assembly 302 is connected to a capacitive-touch sensing circuit (such as is used for capacitive switching and known to those in the art) and disposed to detect contact of the

working tip with the surgeon. When such contact is detected, the drive circuit 904 of the instrument will be shut down to avoid applying cutting energy to the surgeon. Such a sensing circuit would be impractical in systems of the prior art, where the handpiece is connected to a large piece of earth-grounded electrical equipment.

[0315] Another exemplary embodiment allows the transducer to work in a receiving mode where vibrations in the waveguide are turned into a signal that the electronics of the device could monitor. For example, vibrations associated with blood flowing through a vessel could be detected and used to provide feedback to the user about the type of tissue that has been clamped. For instance, during clamping of the jaw, this detection is able to determine that significant blood flow existed just before clamping. A signal could alert the user that the device is clamped on heavy vasculature and, for example, that low power for sealings should be used. Alternatively, if heavy vasculature is detected, high energy activation could be prohibited as a safety mechanism.

[0316] In accordance with another exemplary embodiment of the present invention, after the battery assembly 301 is physically and electrically coupled to the handle assembly 302, the handheld ultrasonic surgical cautery assembly 300 will not operate until the button 4608 is changed from a depressed state to a released state, i.e., actively placed into a non-depressed position. This feature prevents the handheld ultrasonic surgical cautery assembly 300 from operating immediately upon connection of the battery assembly 301 to the handle assembly 302, which otherwise could occur if the operator was unintentionally depressing the button 4608 when connecting the battery assembly 301 to the handle assembly 302.

[0317] Because the present invention is comprised of three interconnected but separable components (i.e., the battery assembly 301, the handle assembly 302, and the TAG assembly 303), each having its own accessible (as well as selectively exposed) electrical connections, there is a danger of electrostatic discharge (ESD) occurring between or among the three separable components. Accordingly, in another exemplary embodiment, the invention employs an ESD protection strategy to prevent damage to the device and the possibility of latent failures. A wide range of solutions for implementing this type of protection is contemplated as being within the scope and spirit of the present invention. Examples include, but are not limited to, using discrete ESD protection components and spark gaps as well.

[0318] In yet another exemplary embodiment for protecting against injury or damage from the electrical components of the device, the battery cells may be positioned in such a way (e.g., inverted) that their connector tabs point away from the electrical boards. This configuration reduces a likelihood of creating accidental shorts, as well as allowing the use of a cell interconnect board, which facilitates the connection of the battery cell tabs to the circuitry.

[0319] As has been described, the present invention provides a small and efficient hand-held ultrasonic cutting device that is self-powered and, therefore, cordless, which eliminates entirely the expensive set-top box required by the prior art devices. Advantageously, the device of the invention allows a user to operate completely free of cords or other tethering devices. In addition to the advantages of reduced cost, reduced size, elimination of a tethering cord for supplying power and carrying signals, and providing a constant motional voltage, the instant invention provides unique advantages for maintaining the sterile condition in a surgical environment. As has been explained, the inventive device is comprised entirely of sterilizable components that are maintained wholly in a sterile field. In addition, all electronic controls of the inventive system exist within the sterile field. Therefore, any and all troubleshooting can take place inside the sterile field. That is, because the inventive device is not tethered to a desktop box, as required in the prior art, a user need never exit the sterile field to perform any function with the inventive handheld ultrasonic surgical cautery assembly 300 (e.g., troubleshooting, replacing batteries, replacing waveguide assemblies, etc.). Furthermore, the inventive two-stage button allows an operator complete control of any surgical task without requiring the operator to focus their visual attention on the instrument itself. In other words, the operator does not have to look to ensure (s)he is preparing to push the proper button, as only one button is used.

[0320] The invention also provides low-voltage or battery-voltage switching or wave-forming stages prior to the transformer voltage step-up stage. By "marrying" all of the frequency sensitive components within one place (i.e., the handle), the present invention eliminates any inductive losses that occur between prior art set-top boxes and hand pieces - a disadvantage suffered by all prior-art ultrasonic cautery/cutting devices. Because of the close coupling between the drive circuitry and the matching network 1012, the overall power modification circuit is tolerant of higher Q factors and larger frequency ranges.

[0321] Although specific embodiments of the invention have been disclosed, those having ordinary skill in the art will understand that changes can be made to the specific embodiments without departing from the scope of the invention. The scope of the invention is not to be restricted, therefore, to the specific embodiments, and it is intended that the appended claims cover any and all such applications, modifications, and embodiments within the scope of the present invention.

[0322] Accordingly the invention also relates to a battery assembly for use with a surgical device having a battery terminal and operational parameters including a housing having a shape formed to removably connect with the terminal. The housing contains a modular battery operable to supply power to the device at the terminal and has a control circuit with a microprocessor, a memory, and a real-time clock. The control circuit is communicatively coupled to the battery and is operable to detect an identity of the surgical device, to determine at least one piece of information pertaining to

at least one of the operational parameters of the surgical device based upon the detected identity, to record the piece of information at least in the memory, and to selectively allow or prevent the battery from supplying power to the surgical device dependent upon the piece of information.

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Claims

1. Cordless ultrasonic surgical device (300) having a battery assembly (301), the battery assembly (301) comprising:

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a housing (2802a, 2802b);

having an exterior shape formed to removably connect with a battery terminal of the surgical device; containing at least one modular battery (701) operable to supply power to the surgical device (300) at the battery terminal; and

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having a control circuit (703) comprising at least one microprocessor, a memory, and a real-time clock, the control circuit being communicatively coupled to the at least one modular battery and operable to:

detect an identity of the surgical device (300);

determine at least one piece of information pertaining to at least one operational parameter of the surgical device (300) based upon the detected identity;

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record the at least one piece of information at least in the memory (5706); and

selectively allow or prevent the at least one modular battery from supplying power to the surgical device (300) dependent upon the at least one piece of information;

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, wherein the surgical device (300) comprises:

a cordless ultrasonic-movement-generation assembly (304) operable to impart ultrasonic movement to an ultrasonic waveguide when the waveguide is connected thereto; and

a surgical handle (302) having

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the battery terminal; and

being operable to

removably secure the ultrasonic-movement-generation assembly to the surgical handle; and

electrically connect the battery assembly (301) to the ultrasonic-movement-generation assembly.

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2. Cordless ultrasonic surgical device (300) according to claim 1, further comprising an ultrasonic waveguide;

wherein the cordless ultrasonic-movement-generation assembly has:

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an output couple operable to impart ultrasonic movement to an ultrasonic waveguide; and

a securing connector; and

wherein the surgical handle has:

a waveguide attachment dock rotatably coupling the ultrasonic waveguide thereto; and

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an ultrasonic-movement-generation assembly dock being operable, when the securing connector of the ultrasonic-movement-generation assembly is removably secured at the surgical handle:

to electrically connect the battery assembly (301) to the ultrasonic-movement-generation assembly; and

to physically connect the ultrasonic waveguide to the output couple of the ultrasonic-movement-generation assembly.

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3. Cordless ultrasonic surgical device (300) according to claim 2, wherein the ultrasonic-movement-generation assembly comprises:

a driving-wave generation circuit having a generator output; and

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a transducer communicatively coupled to the generator output.

4. Cordless ultrasonic surgical device (300) according to any of the preceding claims, wherein the at least one piece of information is an actual use count of at least one portion of the surgical device.

5. Cordless ultrasonic surgical device (300) according to any of the preceding claims, wherein the control circuit is operable to record a total number of actual uses of the at least one portion of the surgical device.
6. Cordless ultrasonic surgical device (300) according to any of the preceding claims, wherein the control circuit is operable to prevent the at least one modular battery from supplying power to the surgical device (300) when the recorded total number of actual uses is at least a pre-defined maximum number of actual uses.
7. Cordless ultrasonic surgical device (300) according to any of the preceding claims, wherein the control circuit is operable to determine the actual use count by:
 - determining a length of time that has elapsed since the last of the actual uses of the at least one portion with the real-time clock; and
 - if the determined length of time exceeds a pre-defined threshold, incrementing the recorded total number of actual uses of the at least one portion contained in the memory.
8. Cordless ultrasonic surgical device (300) according to any of the preceding claims, wherein:
 - the at least one piece of information is a momentary lapse in use of at least a portion of the surgical device; and
 - the control circuit is operable to determine the momentary lapse in use by:
 - detecting a length of time that has elapsed since the last actual use of the at least one portion; and
 - if the detected length of time is less than a pre-defined threshold, determining that a momentary lapse in use of the at least one portion has occurred.
9. Cordless ultrasonic surgical device (300) according to any of the preceding claims, wherein the control circuit is operable to determine if either of an actual use and a momentary lapse in use of the surgical device (300) has occurred by:
 - detecting a length of time that has elapsed since a last use of the surgical device;
 - if the detected length of time meets or exceeds a pre-defined threshold, determining that an actual use has occurred; and
 - if the detected length of time is less than the pre-defined threshold, determining that a momentary lapse in use has occurred.
10. Cordless ultrasonic surgical device (300) according to any of the preceding claims, wherein the control circuit is operable to record a total number of actual uses of the surgical device.
11. Cordless ultrasonic surgical device (300) according to any of the preceding claims, wherein the control circuit is operable to prevent the at least one modular battery from supplying power to the surgical device (300) when the recorded total number of actual uses meets or exceeds a pre-defined maximum number of actual uses.
12. Cordless ultrasonic surgical device (300) according to claim 1, further comprising:
 - an ultrasonic waveguide having a proximal end for receiving ultrasonic movement thereat;
 - wherein the cordless ultrasonic-movement-generation assembly has:
 - a driving-wave generation circuit having a generator output; and
 - a transducer communicatively coupled to the generator output and having an ultrasonic-movement-producing end operable to removably connect to the proximal end of the ultrasonic waveguide; and
 - wherein the surgical handle has:
 - a waveguide attachment dock rotatably coupling the ultrasonic waveguide thereto; and
 - an ultrasonic-movement-generation assembly dock being operable, when the ultrasonic-movement-generation assembly is removably secured at the surgical handle:
 - to electrically connect the battery assembly (301) to the ultrasonic-movement-generation assembly; and
 - to physically connect the ultrasonic waveguide to the ultrasonic-movement-producing end of the ultra-

sonic-movement-generation assembly.

Patentansprüche

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1. Kabellose chirurgische Ultraschallvorrichtung (300) mit einer Batterieanordnung (301), wobei die Batterieanordnung (301) aufweist:

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ein Gehäuse (2802a, 2802b):

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mit einer äußeren Form, die zum lösbaren Verbinden mit einem Batterieanschluss der chirurgischen Vorrichtung geformt ist;
 wenigstens eine modulare Batterie (701) aufweisend, die betriebsbereit ist, um die chirurgische Vorrichtung (300) an dem Batterieanschluss mit Energie zu versorgen; und
 mit einer Steuerschaltung (703), die wenigstens einen Mikroprozessor, einen Speicher und eine Echtzeituhr aufweist, wobei die Steuerschaltung mit der wenigstens einen modularen Batterie kommunikativ verbunden und betriebsbereit ist, um
 eine Identität der chirurgischen Vorrichtung (300) festzustellen;
 wenigstens einen Informationsteil zu bestimmen, der wenigstens einen Betriebsparameter der chirurgischen Vorrichtung (300) betrifft, basierend auf der festgestellten Identität;
 den wenigstens einen Informationsteil wenigstens in dem Speicher (5706) zu erfassen; und
 selektiv zu ermöglichen oder zu verhindern, dass die wenigstens eine modulare Batterie die chirurgische Vorrichtung (300) mit Energie versorgt, abhängig von dem wenigstens einen Informationsteil;

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wobei die chirurgische Vorrichtung (300) aufweist:

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eine kabellose Ultraschallbewegungsgenerierungsvorrichtung (304), die betriebsbereit ist, um eine Ultraschallbewegung an einen Ultraschallwellenleiter weiterzugeben, wenn der Wellenleiter damit verbunden ist; und
 einen chirurgischen Handgriff (302) mit
 dem Batterieanschluss; und
 der betriebsbereit ist, um
 die Ultraschallbewegungsgenerierungsanordnung an dem chirurgischen Handgriff lösbar zu sichern; und
 die Batterieanordnung (301) mit der Ultraschallbewegungsgenerierungsanordnung elektrisch zu verbinden.

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2. Kabellose chirurgische Ultraschallvorrichtung (300) nach Anspruch 1, weiter aufweisend:

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einen Ultraschallwellenleiter;
 wobei die kabellose Ultraschallbewegungsgenerierungsanordnung hat:
 ein Ausgangspaar, das betriebsbereit ist, um eine Ultraschallbewegung an einen Ultraschallwellenleiter weiterzugeben; und
 einen Sicherungsverbinder; und

wobei der chirurgische Handgriff hat:

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ein Wellenleiterbefestigungsdock, das den Ultraschallwellenleiter daran lösbar verbindet; und
 ein Ultraschallbewegungsgenerierungsanordnungsdock, das betriebsbereit ist, um, wenn der Sicherungsverbinder der Ultraschallbewegungsgenerierungsanordnung an dem chirurgischen Handgriff lösbar gesichert ist:
 die Batterieanordnung (301) mit der Ultraschallbewegungsgenerierungsanordnung lösbar zu verbinden; und
 den Ultraschallwellenleiter mit dem Ausgangspaar der Ultraschallbewegungsgenerierungsanordnung physikalisch zu verbinden.

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3. Kabellose chirurgische Ultraschallvorrichtung (300) nach Anspruch 2, wobei die Ultraschallbewegungsanordnung aufweist:

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eine Ansteuerungswellengenerierungsschaltung mit einem Generatorausgang; und
 einen Wandler, der mit dem Generatorausgang kommunikativ verbunden ist.

4. Kabellose chirurgische Ultraschallvorrichtung (300) nach einem der vorangegangenen Ansprüche, wobei der we-

nigstens eine Informationsteil eine tatsächliche Nutzungszahl von wenigstens einem Abschnitt der chirurgischen Vorrichtung ist.

- 5 5. Kabellose chirurgische Ultraschallvorrichtung (300) nach einem der vorangegangenen Ansprüche, wobei die Steuerungsbereitschaft betriebsbereit ist, um eine Gesamtzahl von tatsächlichen Verwendungen von dem wenigstens einen Abschnitt der chirurgischen Vorrichtung zu erfassen.
- 10 6. Kabellose chirurgische Ultraschallvorrichtung (300) nach einem der vorangegangenen Ansprüche, wobei die Steuerungsbereitschaft betriebsbereit ist, um zu verhindern, dass die wenigstens eine modulare Batterie die chirurgische Vorrichtung (300) mit Energie versorgt, wenn die erfasste Gesamtzahl von tatsächlichen Verwendungen wenigstens eine vordefinierte maximale Zahl von tatsächlichen Verwendungen ist.
- 15 7. Kabellose chirurgische Ultraschallvorrichtung (300) nach einem der vorangegangenen Ansprüche, wobei die Steuerungsbereitschaft betriebsbereit ist, um die tatsächliche Nutzungszahl zu bestimmen durch:

Bestimmen einer Zeitdauer, die seit der Letzten von den tatsächlichen Verwendungen von dem wenigstens einen Abschnitt vergangen ist, mit der Echtzeituhr; und

wenn die bestimmte Zeitdauer einen vordefinierten Schwellenwert überschreitet, Erhöhen der erfassten Gesamtzahl von tatsächlichen Verwendungen von dem wenigstens einen Abschnitt, die in dem Speicher enthalten ist.
- 20 8. Kabellose chirurgische Ultraschallvorrichtung (300) nach einem der vorangegangenen Ansprüche, wobei:

der wenigstens eine Informationsteil ein vorübergehendes Aussetzen einer Verwendung von wenigstens einem Abschnitt der chirurgischen Vorrichtung ist; und

die Steuerungsbereitschaft betriebsbereit ist, um das vorübergehende Aussetzen einer Verwendung zu bestimmen durch:

Feststellen einer Zeitdauer, die seit der letzten tatsächlichen Verwendung von dem wenigstens einen Abschnitt verstrichen ist; und

wenn die festgestellte Zeitdauer kleiner als ein vordefinierter Schwellenwert ist, Bestimmen, dass ein vorübergehendes Aussetzen einer Verwendung von dem wenigstens einen Abschnitt stattgefunden hat.
- 30 9. Kabellose chirurgische Ultraschallvorrichtung (300) nach einem der vorangegangenen Ansprüche, wobei die Steuerungsbereitschaft betriebsbereit ist, um zu bestimmen, ob beides von einer tatsächlichen Verwendung und einem vorübergehenden Aussetzen einer Verwendung der chirurgischen Vorrichtung (300) stattgefunden hat, durch:

Feststellen einer seit einer letzten Verwendung der chirurgischen Vorrichtung verstrichenen Zeitdauer;

wenn die festgestellte Zeitdauer mit einem vordefinierten Schwellenwert übereinstimmt oder diesen überschreitet, Bestimmen, dass eine tatsächliche Verwendung stattgefunden hat; und

wenn die festgestellte Zeitdauer kleiner als der vordefinierte Schwellenwert ist, Bestimmen, dass ein vorübergehendes Aussetzen einer Verwendung stattgefunden hat.
- 40 10. Kabellose chirurgische Ultraschallvorrichtung (300) nach einem der vorangegangenen Ansprüche, wobei die Steuerungsbereitschaft betriebsbereit ist, um eine Gesamtzahl von tatsächlichen Verwendungen der chirurgischen Vorrichtung zu erfassen.
- 45 11. Kabellose chirurgische Ultraschallvorrichtung (300) nach einem der vorangegangenen Ansprüche, wobei die Steuerungsbereitschaft betriebsbereit ist, um zu verhindern, dass die wenigstens eine modulare Batterie die chirurgische Vorrichtung (300) mit Energie versorgt, wenn die erfasste Gesamtzahl von tatsächlichen Verwendungen mit einer vordefinierten maximalen Zahl von tatsächlichen Verwendungen übereinstimmt oder diese überschreitet.
- 50 12. Kabellose chirurgische Ultraschallvorrichtung (300) nach Anspruch 1, weiter aufweisend:

einen Ultraschallwellenleiter mit einem proximalen Ende zum daran Empfangen einer Ultraschallbewegung;

wobei die kabellose Ultraschallbewegungsgenerierungsanordnung hat:

eine Ansteuerungswellengenerierungsschaltung mit einem Generatorausgang; und

einen Wandler, der mit dem Generatorausgang kommunikativ verbunden ist und ein Ultraschallbewegungser-

zeugungsende hat, das für eine lösbare Verbindung mit dem proximalen Ende des Ultraschallwellenleiters betriebsbereit ist; und

wobei der chirurgische Handgriff hat:

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ein Wellenleiterbefestigungsdock, das den Ultraschallwellenleiter drehbar daran verbindet; und
eine Ultraschallbewegungsgenerierungsanordnungsdock, das betriebsbereit ist, um, wenn die Ultraschallbewegungsgenerierungsanordnung an dem chirurgischen Handgriff lösbar gesichert ist;
die Batterieanordnung (301) mit der Ultraschallbewegungsgenerierungsanordnung elektrisch zu verbinden; und
den Ultraschallwellenleiter mit dem Ultraschallbewegungserzeugungsende der Ultraschallbewegungsgenerierungsanordnung physikalisch zu verbinden.

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Revendications

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1. Dispositif chirurgical ultrasonore sans cordon (300) ayant un ensemble batterie (301), l'ensemble batterie (301) comprenant :

un boîtier (2802a, 2802b) :

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ayant une forme extérieure formée pour se connecter de manière amovible à une borne de batterie du dispositif chirurgical ;
contenant au moins une batterie modulaire (701) permettant d'alimenter le dispositif chirurgical (300) au niveau de la borne de batterie ; et
ayant un circuit de commande (703) comprenant au moins un microprocesseur, une mémoire et une horloge à temps réel, le circuit de commande étant couplé de manière communicative avec l'au moins une batterie modulaire et permettant de :

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détecter une identité du dispositif chirurgical (300) ;
déterminer au moins un élément d'informations se rapportant à au moins un paramètre fonctionnel du dispositif chirurgical (300) sur la base de l'identité détectée ;
enregistrer l'au moins un élément d'informations au moins dans la mémoire (5706) ; et
autoriser ou empêcher sélectivement l'au moins une batterie modulaire d'alimenter le dispositif chirurgical (300) en fonction de l'au moins un élément d'informations ;

30

35

dans lequel le dispositif chirurgical (300) comprend :

un ensemble de génération de mouvement ultrasonore sans cordon (304) permettant de conférer un mouvement ultrasonore à un guide d'ondes à ultrasons quand le guide d'ondes est connecté à celui-ci ; et
un manche chirurgical (302) ayant la borne de batterie ; et
permettant de
fixer de manière amovible l'ensemble de génération de mouvement ultrasonore au manche chirurgical ; et
connecter électriquement l'ensemble batterie (301) à l'ensemble de génération de mouvement ultrasonore.

40

45

2. Dispositif chirurgical ultrasonore sans cordon (300) selon la revendication 1, comprenant en outre un guide d'ondes à ultrasons ;
dans lequel l'ensemble de génération de mouvement ultrasonore sans cordon comporte :

un couple de sortie permettant de conférer un mouvement ultrasonore à un guide d'ondes à ultrasons ; et
un connecteur de fixation ; et

50

dans lequel le manche chirurgical comporte :

un socle d'attache de guide d'ondes couplant de manière rotative le guide d'ondes à ultrasons à celui-ci ; et
un socle d'ensemble de génération de mouvement ultrasonore permettant, quand le connecteur de fixation de l'ensemble de génération de mouvement ultrasonore est fixé de manière amovible au niveau du manche chirurgical ;

55

de connecter électriquement l'ensemble batterie (301) à l'ensemble de génération de mouvement ultrasonore ; et
de connecter physiquement le guide d'ondes à ultrasons au couple de sortie de l'ensemble de génération de mouvement ultrasonore.

5

3. Dispositif chirurgical ultrasonore sans cordon (300) selon la revendication 2, dans lequel l'ensemble de génération de mouvement ultrasonore comprend :

10

un circuit de génération d'ondes d'entraînement ayant une sortie de générateur ; et
un transducteur couplé de manière communicative à la sortie de générateur.

15

4. Dispositif chirurgical ultrasonore sans cordon (300) selon l'une quelconque des revendications précédentes, dans lequel l'au moins un élément d'informations est un compte d'utilisations réelles d'au moins une partie du dispositif chirurgical.

15

5. Dispositif chirurgical ultrasonore sans cordon (300) selon l'une quelconque des revendications précédentes, dans lequel le circuit de commande permet d'enregistrer un nombre total d'utilisations réelles de l'au moins une partie du dispositif chirurgical.

20

6. Dispositif chirurgical ultrasonore sans cordon (300) selon l'une quelconque des revendications précédentes, dans lequel le circuit de commande permet d'empêcher l'au moins une batterie modulaire d'alimenter le dispositif chirurgical (300) quand le nombre total enregistré d'utilisations réelles est au moins un nombre maximum prédéfini d'utilisations réelles.

25

7. Dispositif chirurgical ultrasonore sans cordon (300) selon l'une quelconque des revendications précédentes, dans lequel le circuit de commande permet de déterminer le compte d'utilisations réelles en :

30

déterminant une durée qui s'est écoulée depuis la dernière des utilisations réelles de l'au moins une partie avec l'horloge à temps réel ; et
si la durée déterminée dépasse un seuil prédéfini, incrémentant le nombre total enregistré d'utilisations réelles de l'au moins une partie contenue dans la mémoire.

35

8. Dispositif chirurgical ultrasonore sans cordon (300) selon l'une quelconque des revendications précédentes, dans lequel :

35

l'au moins un élément d'informations est un relâchement momentané lors de l'utilisation d'au moins une partie du dispositif chirurgical ; et
le circuit de commande permet de déterminer le relâchement momentané lors de l'utilisation en :

40

détectant une durée qui s'est écoulée depuis la dernière utilisation réelle de l'au moins une partie ; et
si la durée détectée est inférieure à un seuil prédéfini, déterminant qu'un relâchement momentané lors de l'utilisation de l'au moins une partie s'est produit.

45

9. Dispositif chirurgical ultrasonore sans cordon (300) selon l'une quelconque des revendications précédentes, dans lequel le circuit de commande permet de déterminer si l'un ou l'autre d'une utilisation réelle et d'un relâchement momentané lors de l'utilisation du dispositif chirurgical (300) s'est produit en :

50

détectant une durée qui s'est écoulée depuis une dernière utilisation du dispositif chirurgical ;
si la durée détectée correspond ou dépasse un seuil prédéfini, déterminant qu'une utilisation réelle s'est produite ; et
si la durée détectée est inférieure au seuil prédéfini, déterminant qu'un relâchement momentané lors de l'utilisation s'est produit.

55

10. Dispositif chirurgical ultrasonore sans cordon (300) selon l'une quelconque des revendications précédentes, dans lequel le circuit de commande permet d'enregistrer un nombre total d'utilisations réelles du dispositif chirurgical.

11. Dispositif chirurgical ultrasonore sans cordon (300) selon l'une quelconque des revendications précédentes, dans lequel le circuit de commande permet d'empêcher l'au moins une batterie modulaire d'alimenter le dispositif chirur-

gical (300) quand le nombre total enregistré d'utilisations réelles correspond ou dépasse un nombre maximum prédéfini d'utilisations réelles.

12. Dispositif chirurgical ultrasonore sans cordon (300) selon la revendication 1, comprenant en outre :

5

un guide d'ondes à ultrasons ayant une extrémité proximale pour recevoir un mouvement ultrasonore au niveau de celle-ci ;

dans lequel l'ensemble de génération de mouvement ultrasonore sans cordon comporte :

10

un circuit de génération d'ondes d'entraînement ayant une sortie de générateur ; et

un transducteur couplé de manière communicative à la sortie de générateur et ayant une extrémité de production de mouvement ultrasonore permettant de se connecter de manière amovible à l'extrémité proximale du guide d'ondes à ultrasons ; et

15

dans lequel le manche chirurgical comporte :

un socle d'attache de guide d'ondes couplant de manière rotative le guide d'ondes à ultrasons à celui-ci ; et

un socle d'ensemble de génération de mouvement ultrasonore permettant, quand l'ensemble de génération de mouvement ultrasonore est fixé de manière amovible au niveau du manche chirurgical :

20

de connecter électriquement l'ensemble batterie (301) à l'ensemble de génération de mouvement ultrasonore ; et

de connecter physiquement le guide d'ondes à ultrasons à l'extrémité de production de mouvement ultrasonore de l'ensemble de génération de mouvement ultrasonore.

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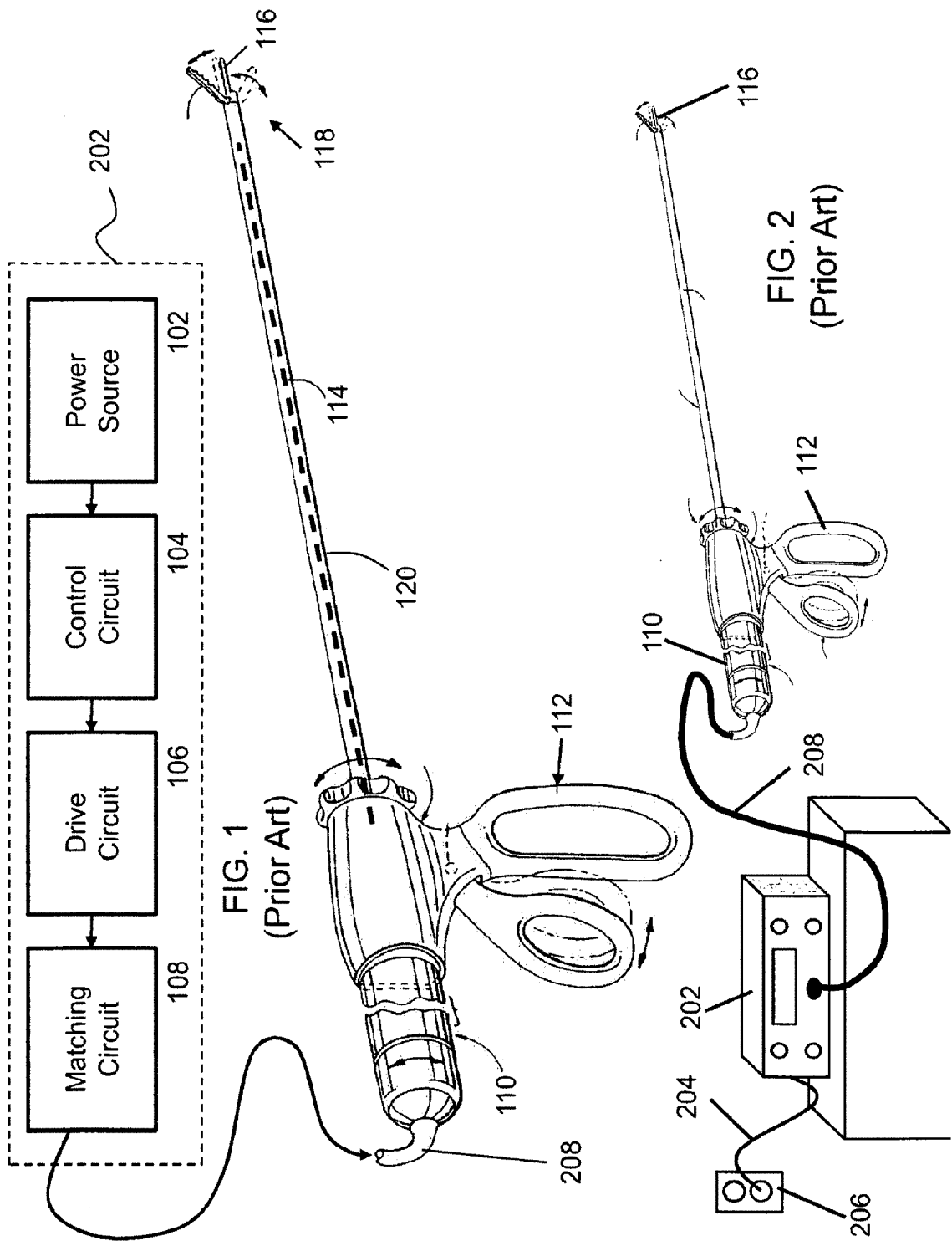
35

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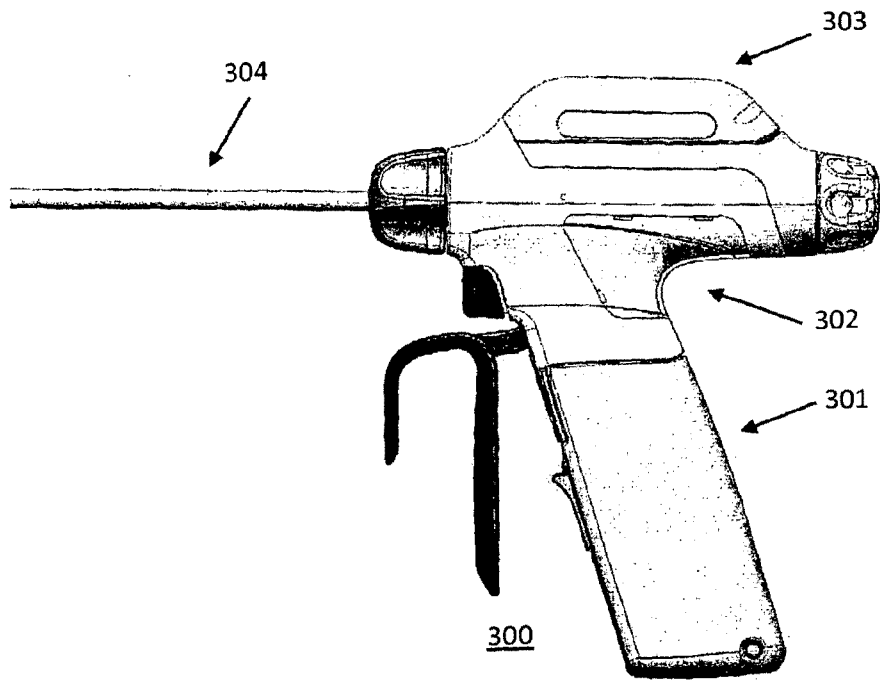


FIG. 3

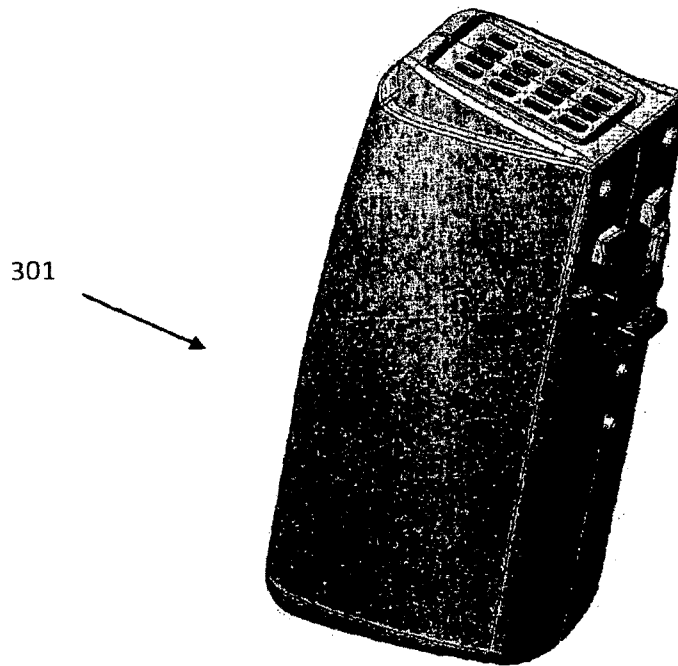


FIG. 4

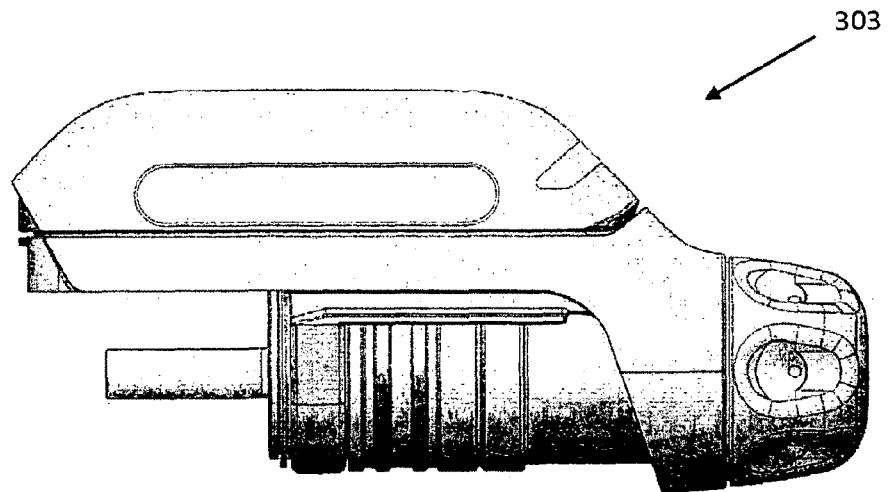


FIG. 5

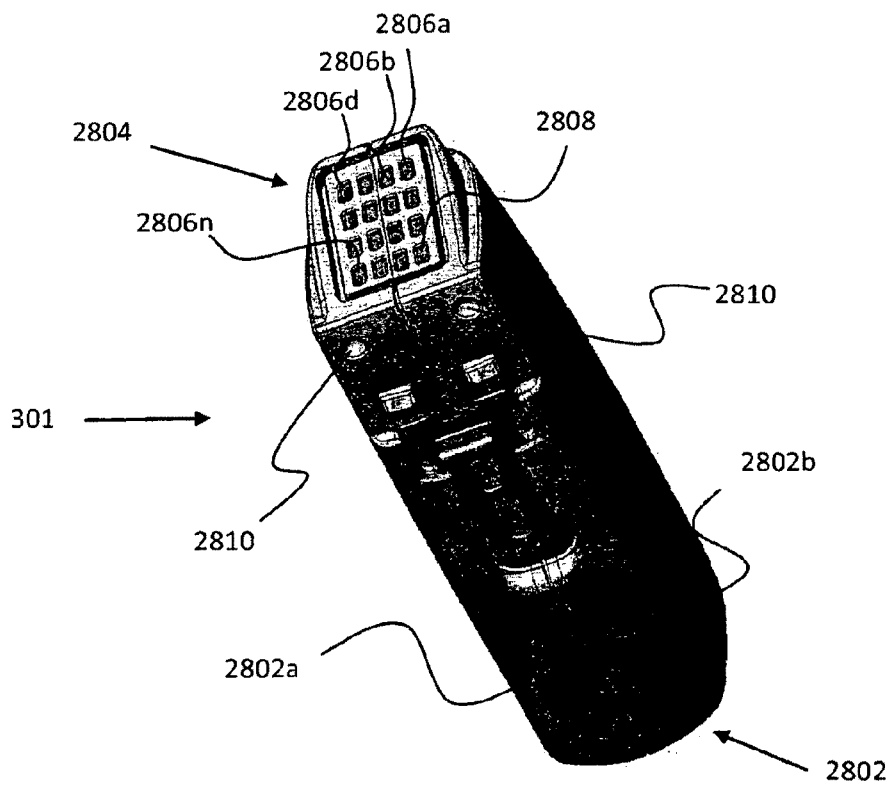


FIG. 28

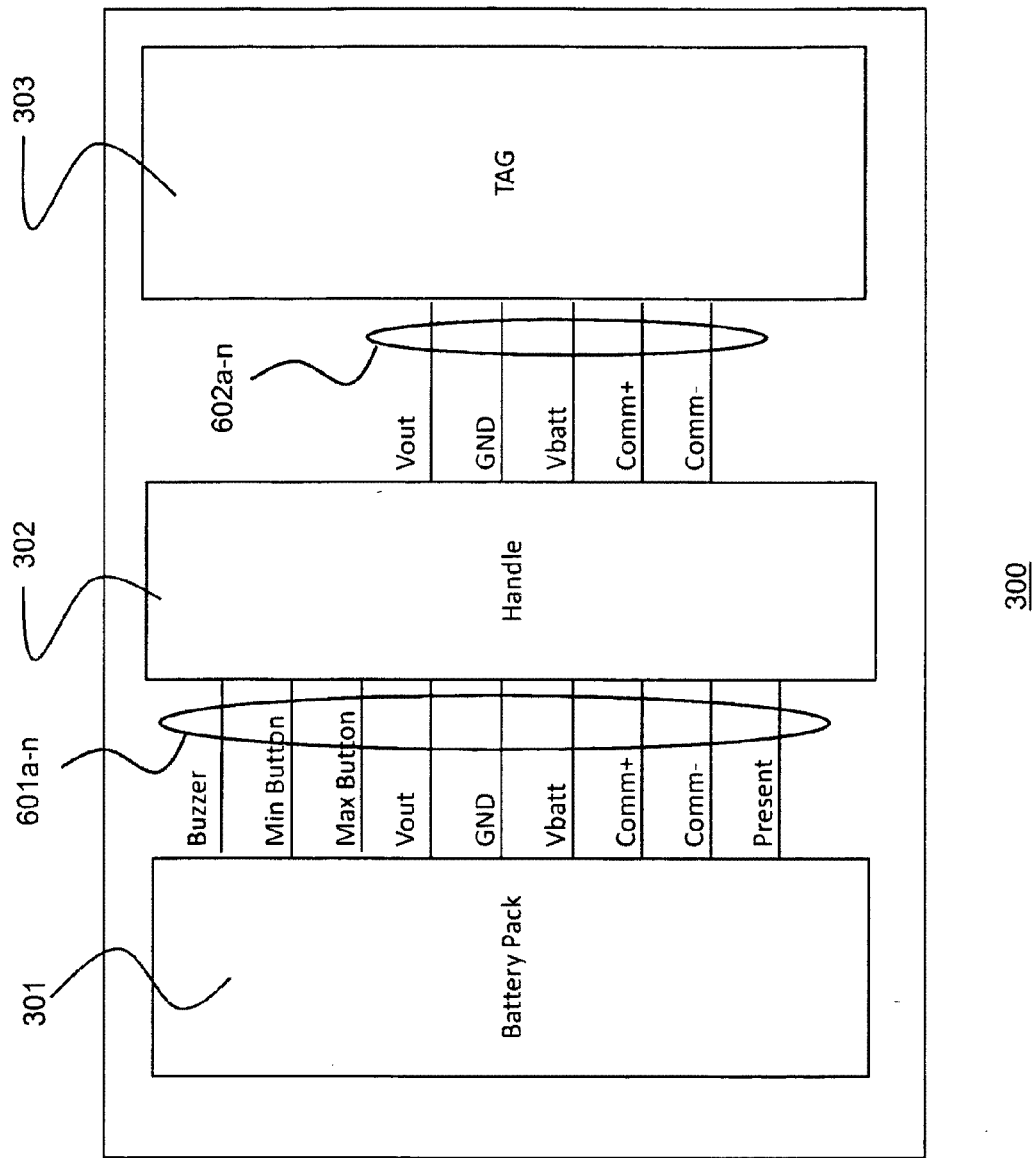


FIG. 6

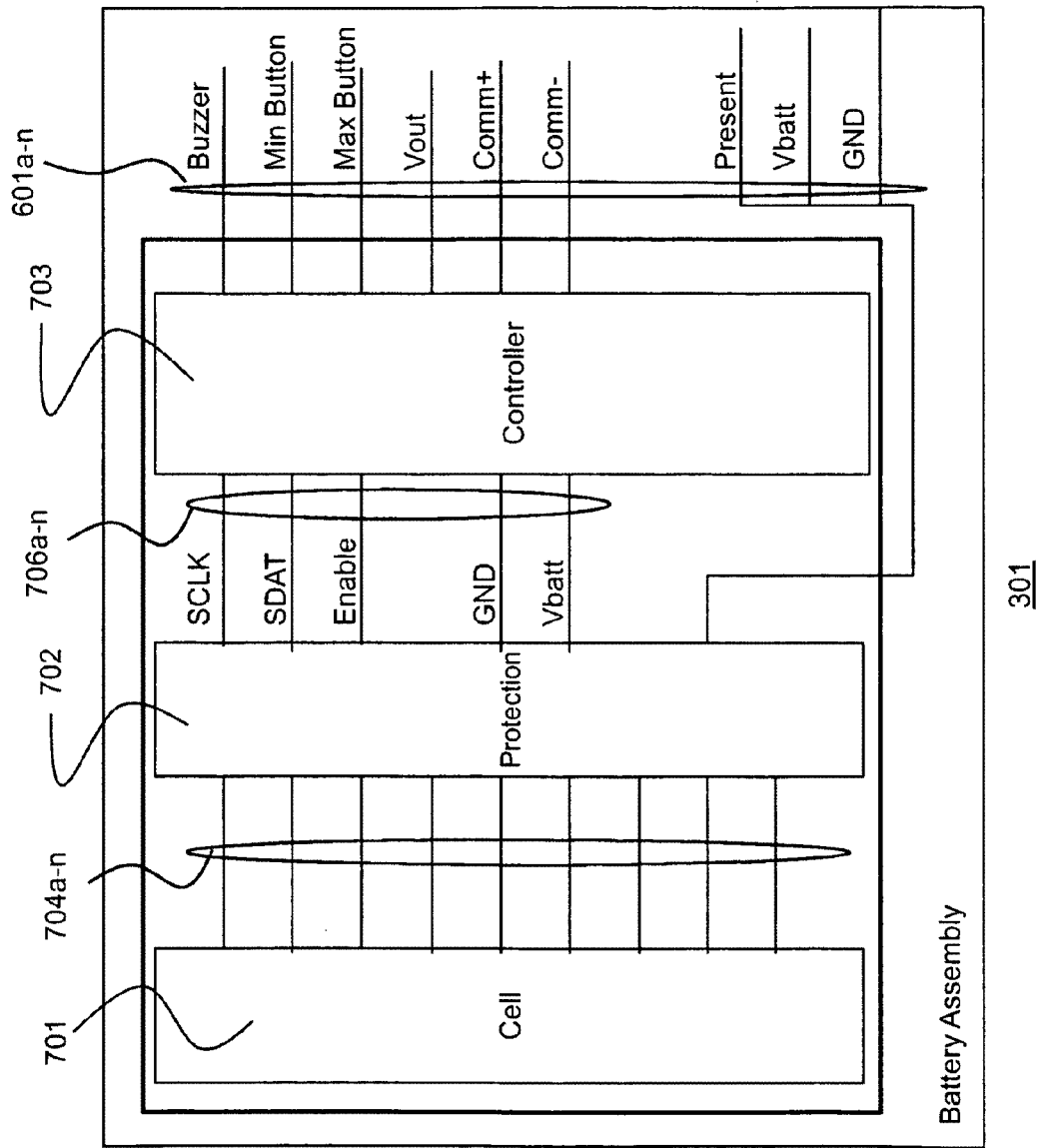
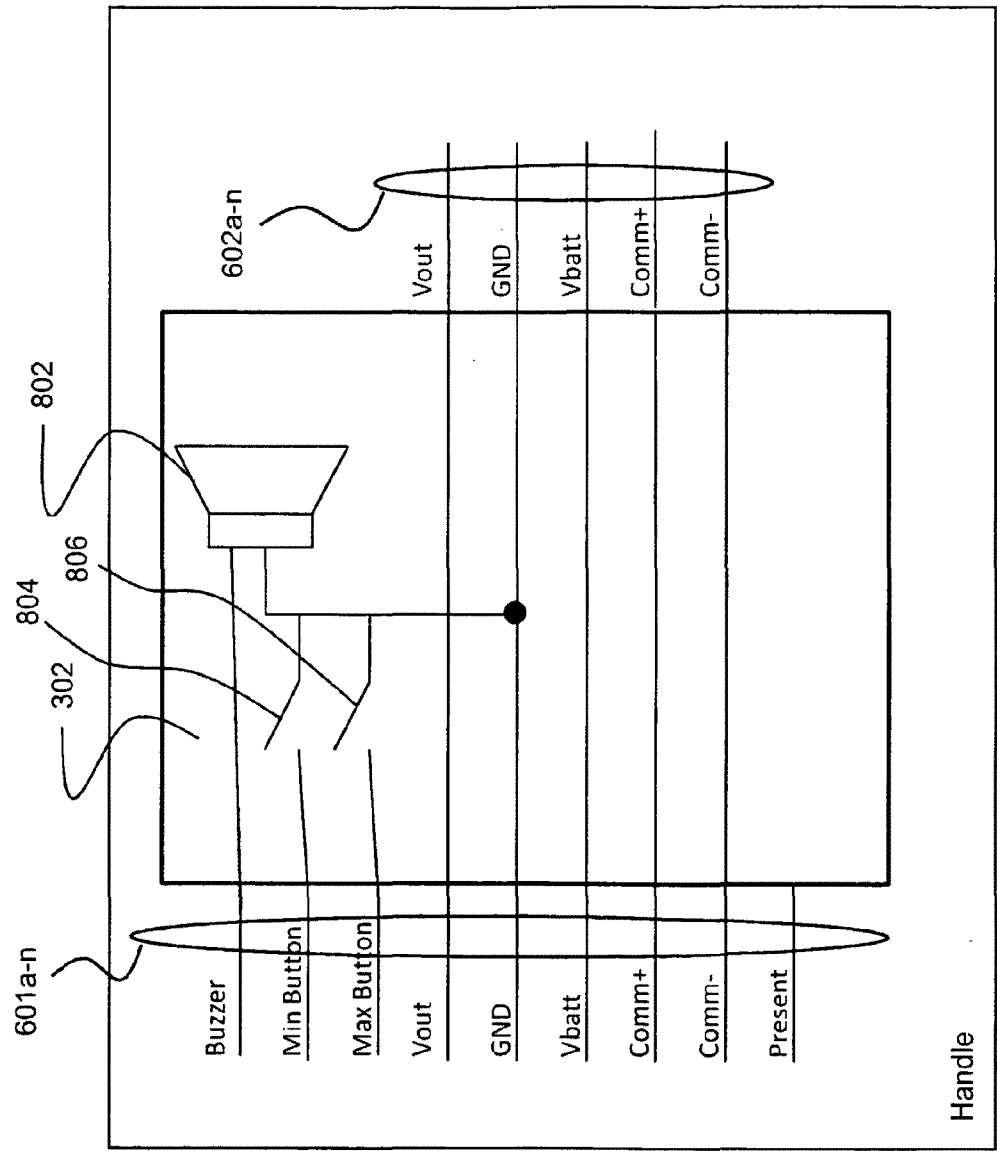


FIG. 7



302

FIG. 8

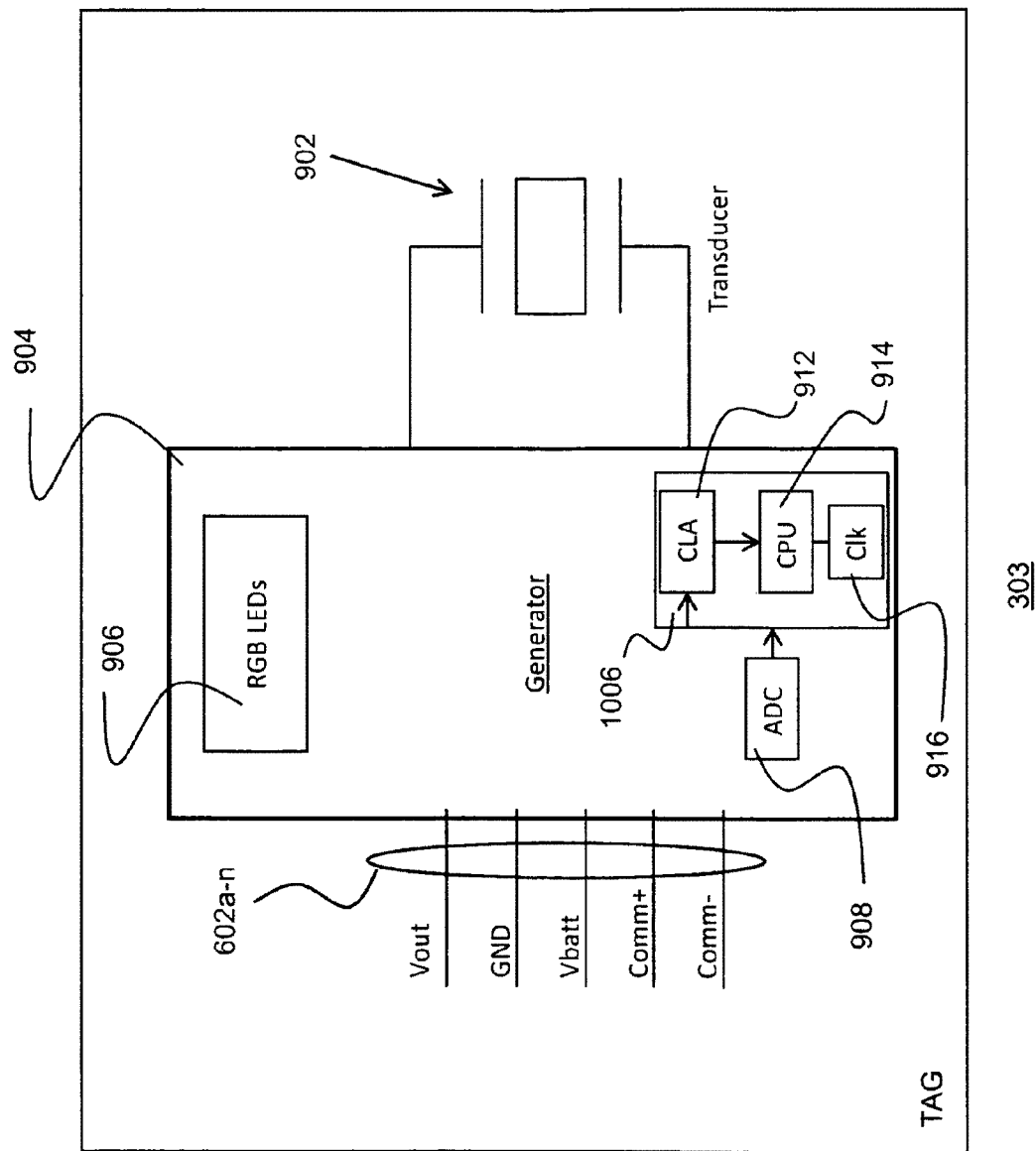


FIG. 9

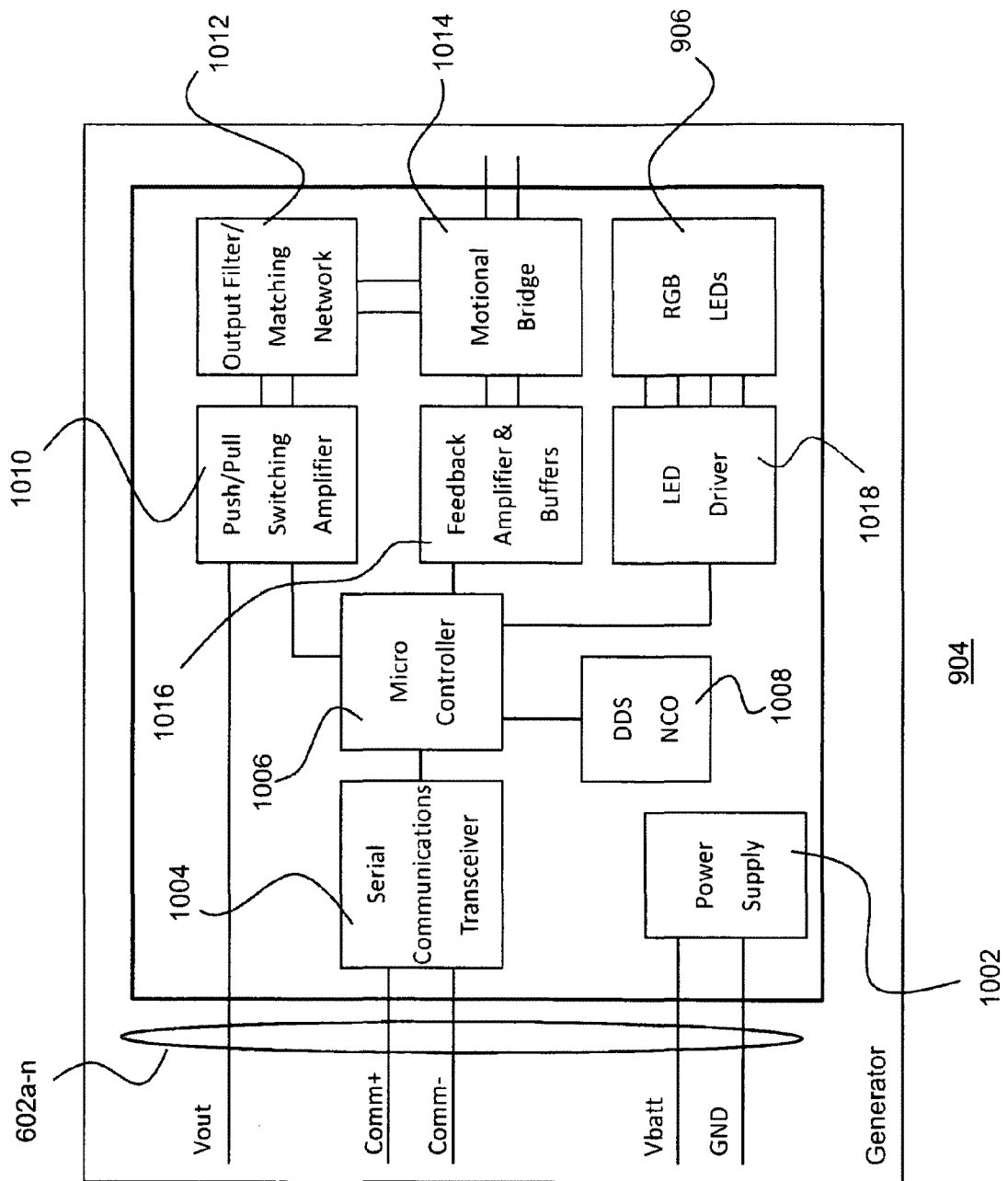


FIG. 10

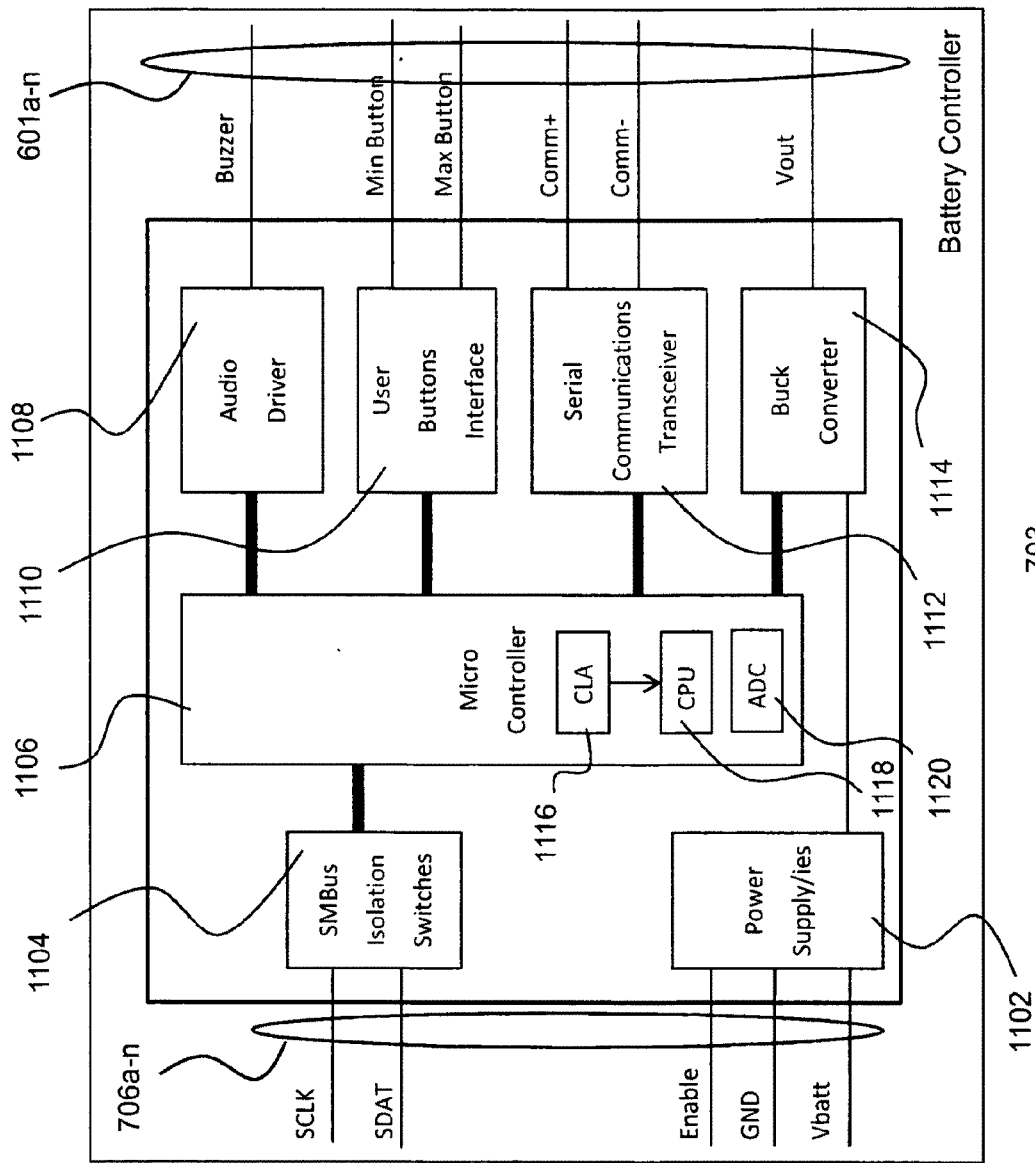


FIG. 11

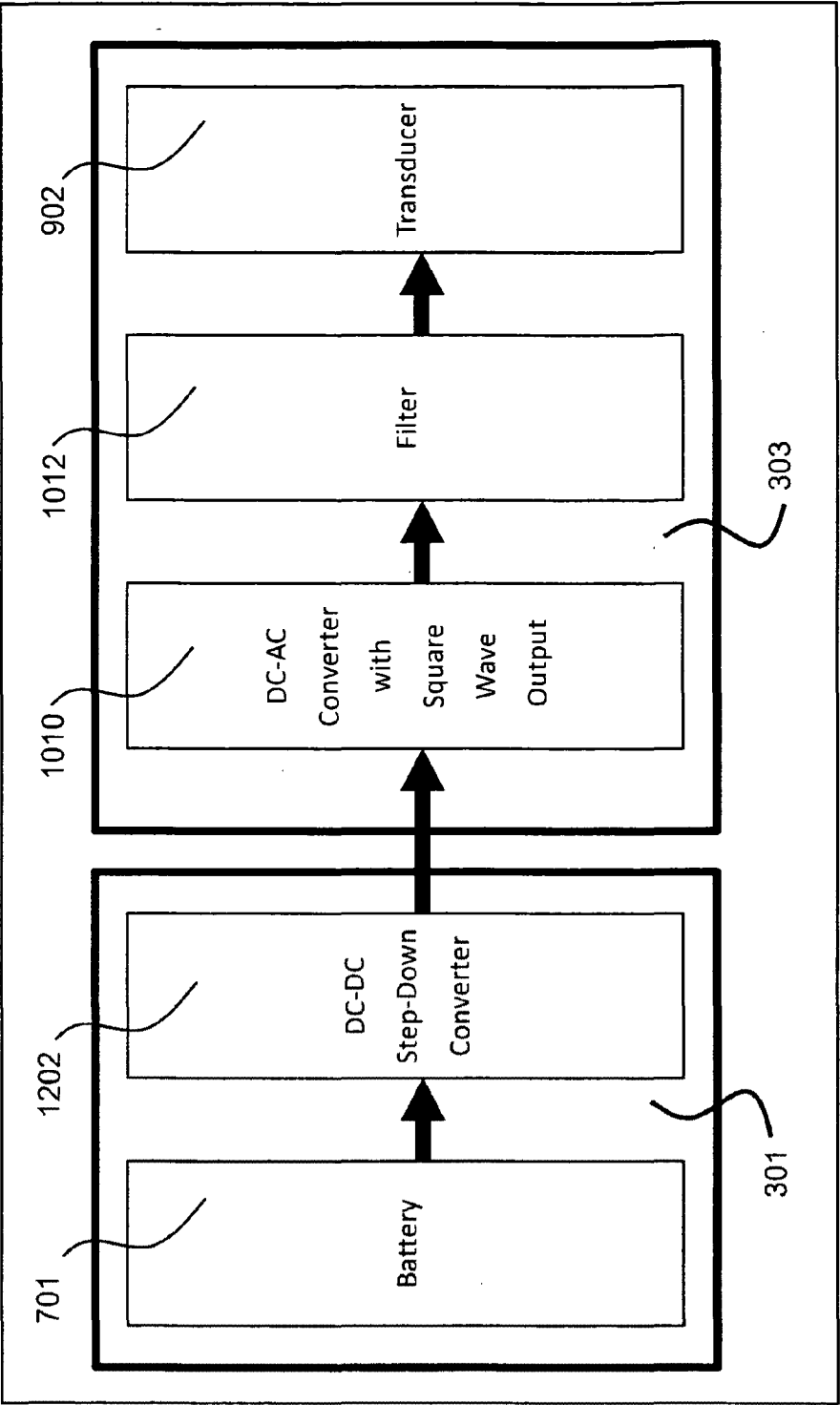
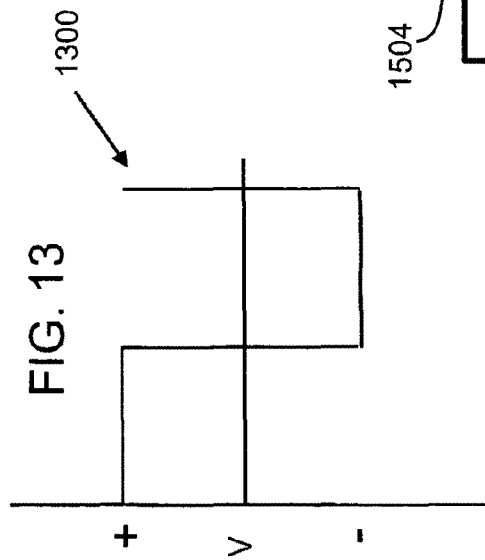
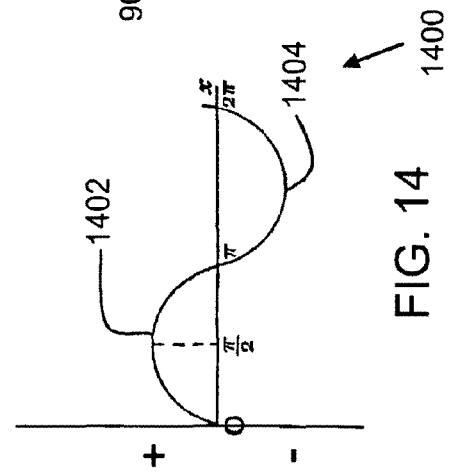
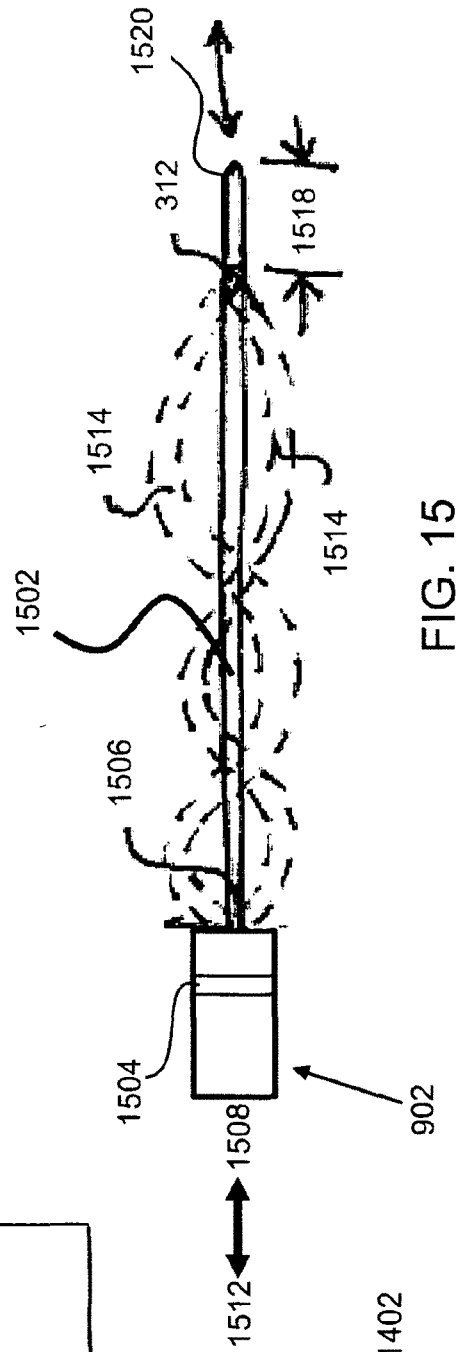


FIG. 12



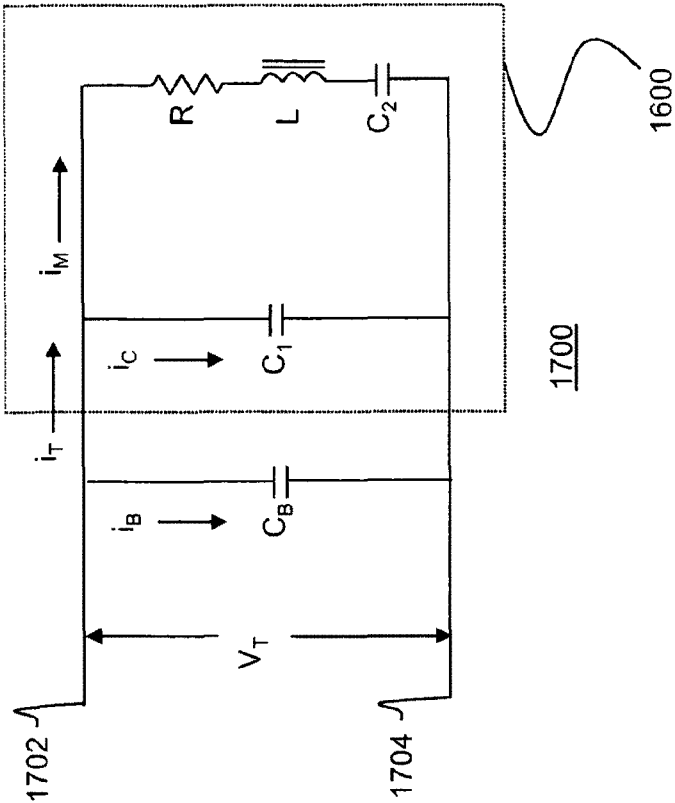


FIG. 17

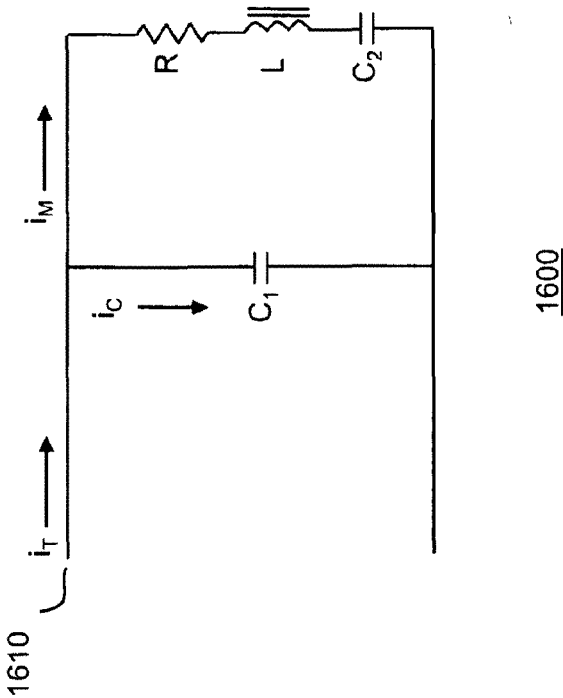


FIG. 16

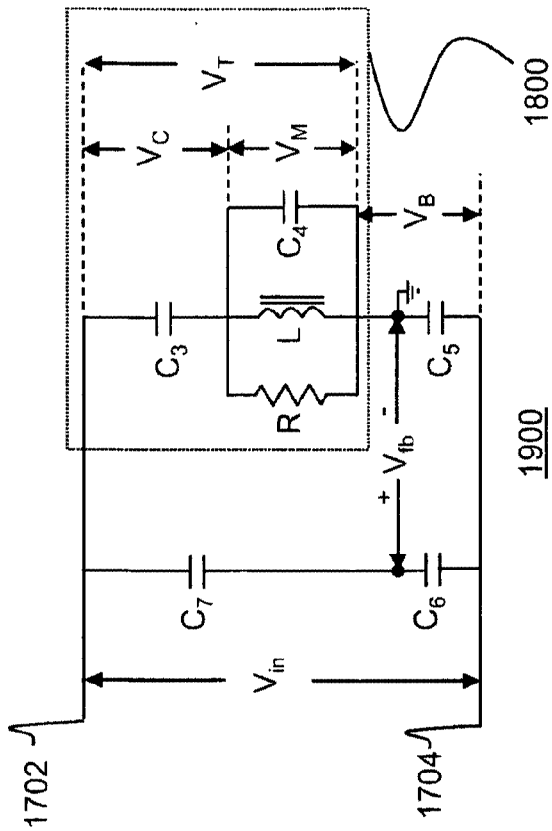


FIG. 19

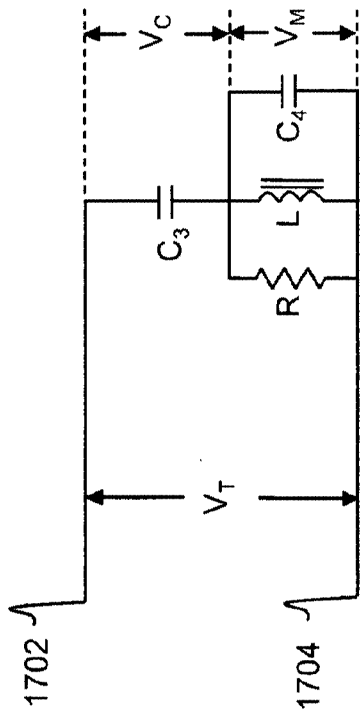


FIG. 18

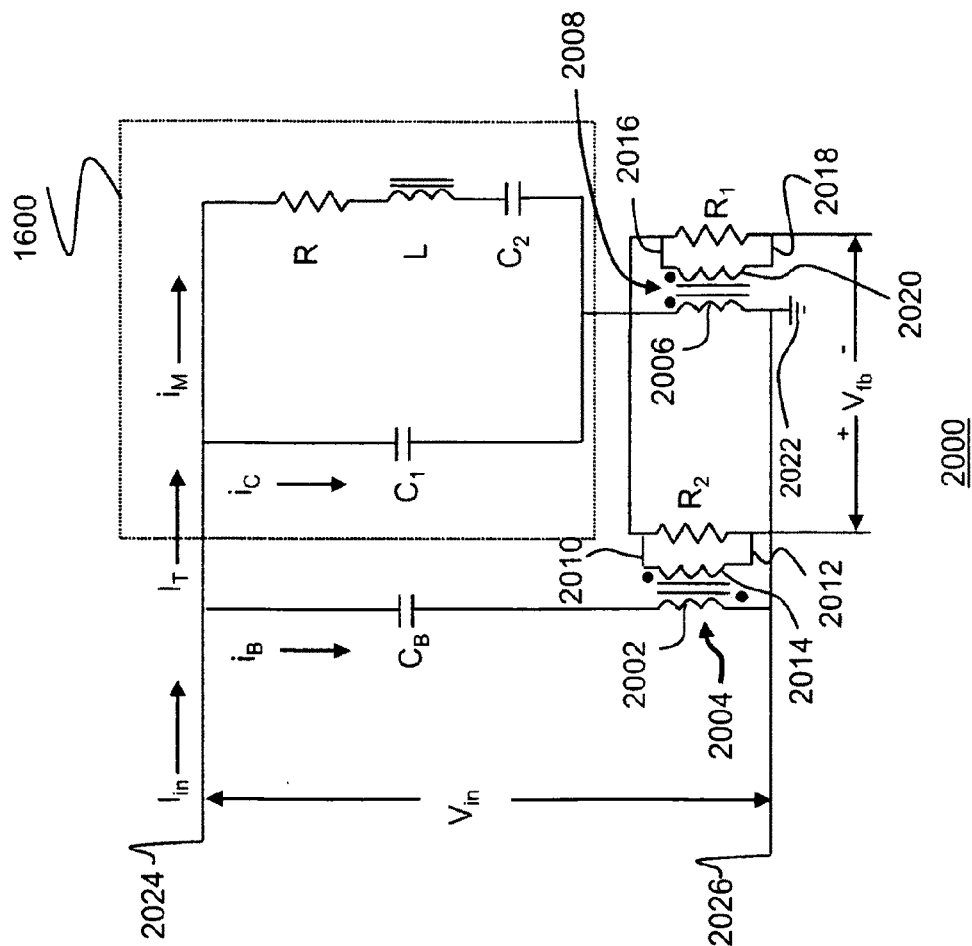


FIG. 20

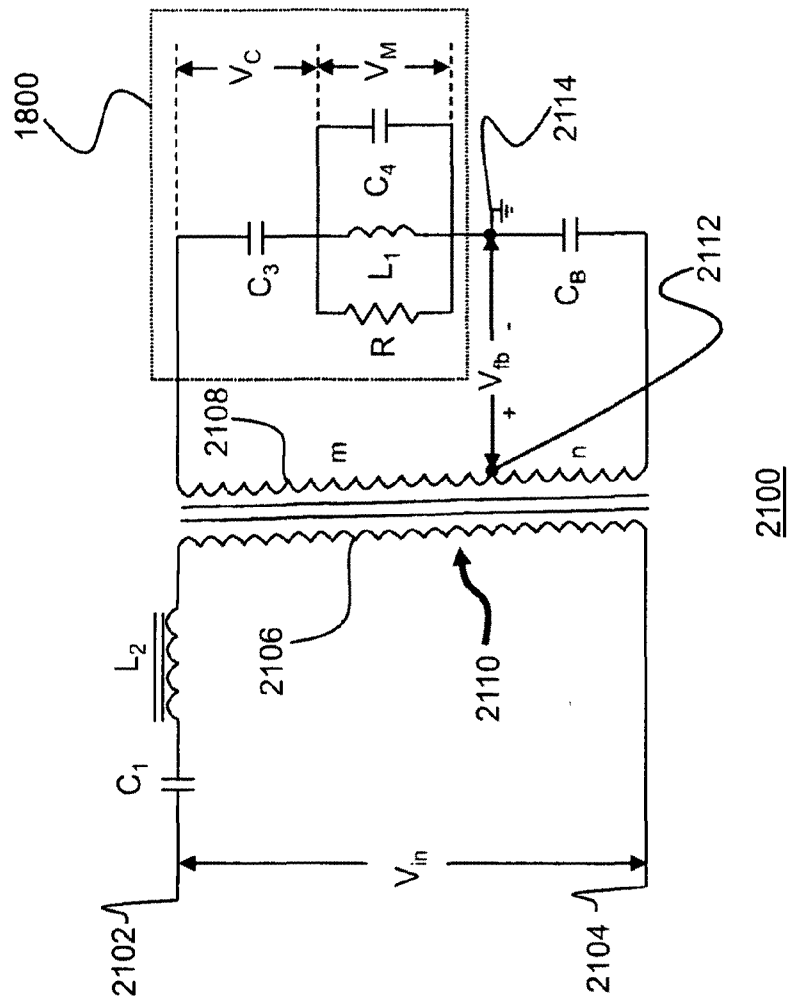
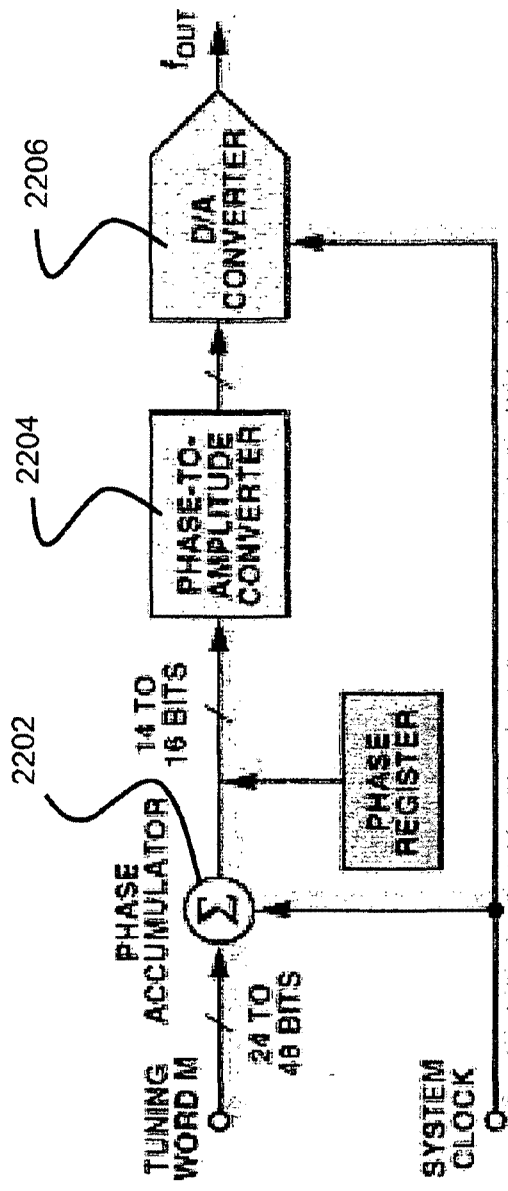
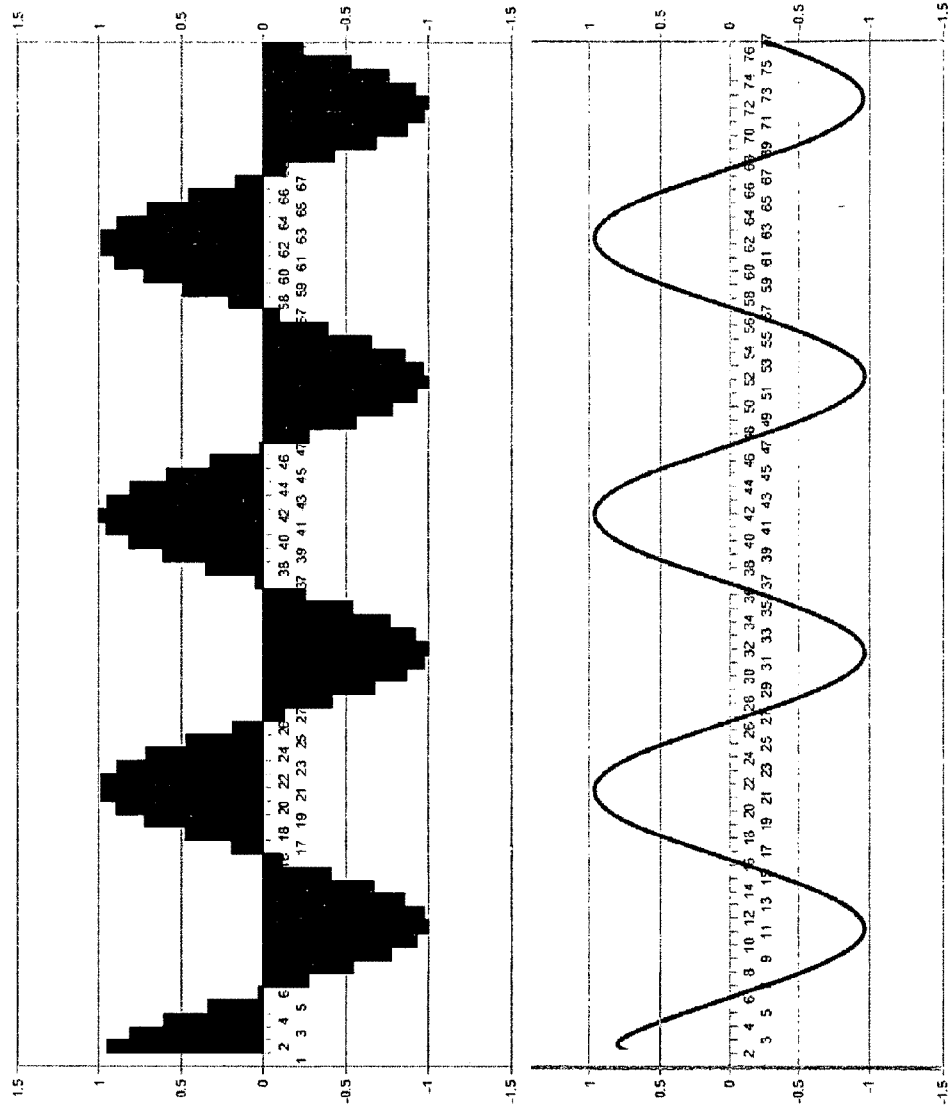


FIG. 21



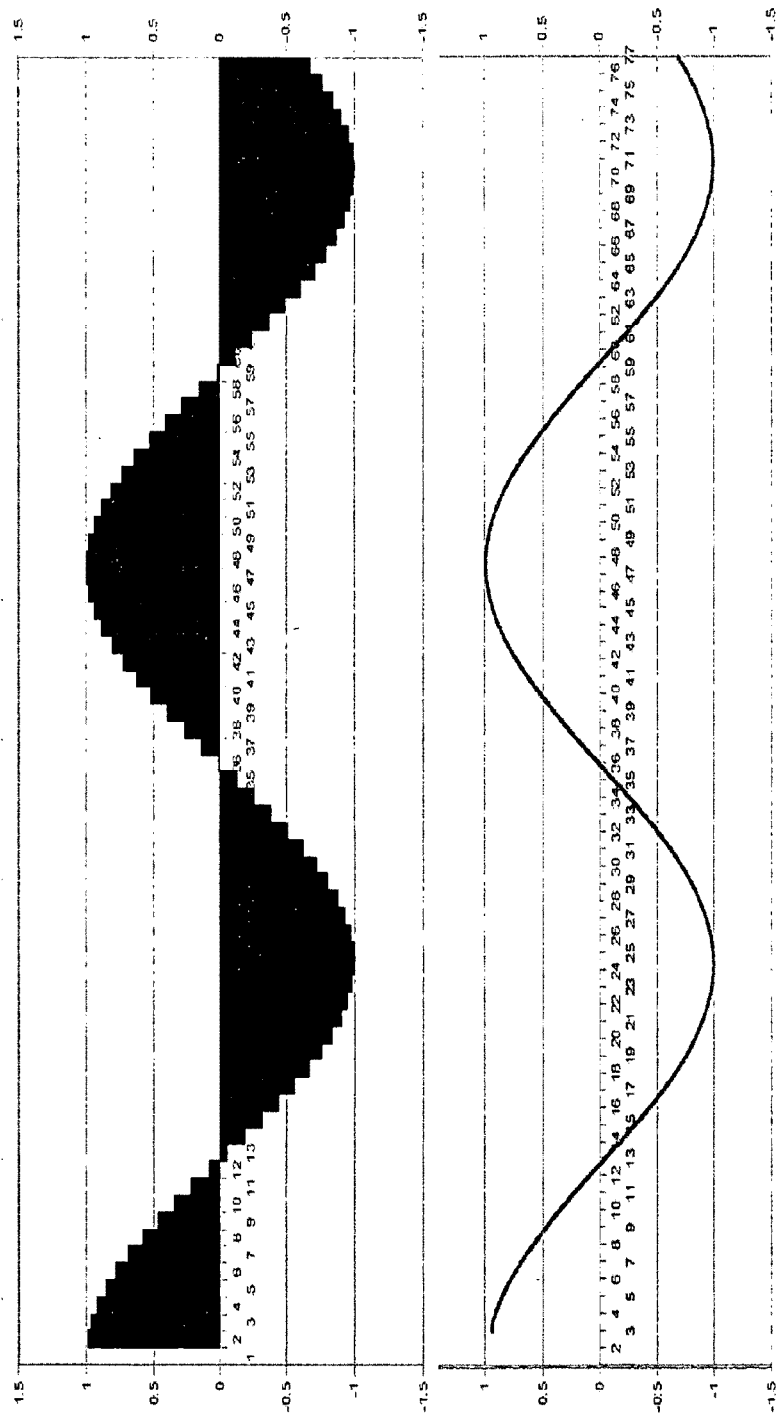
2200

FIG. 22



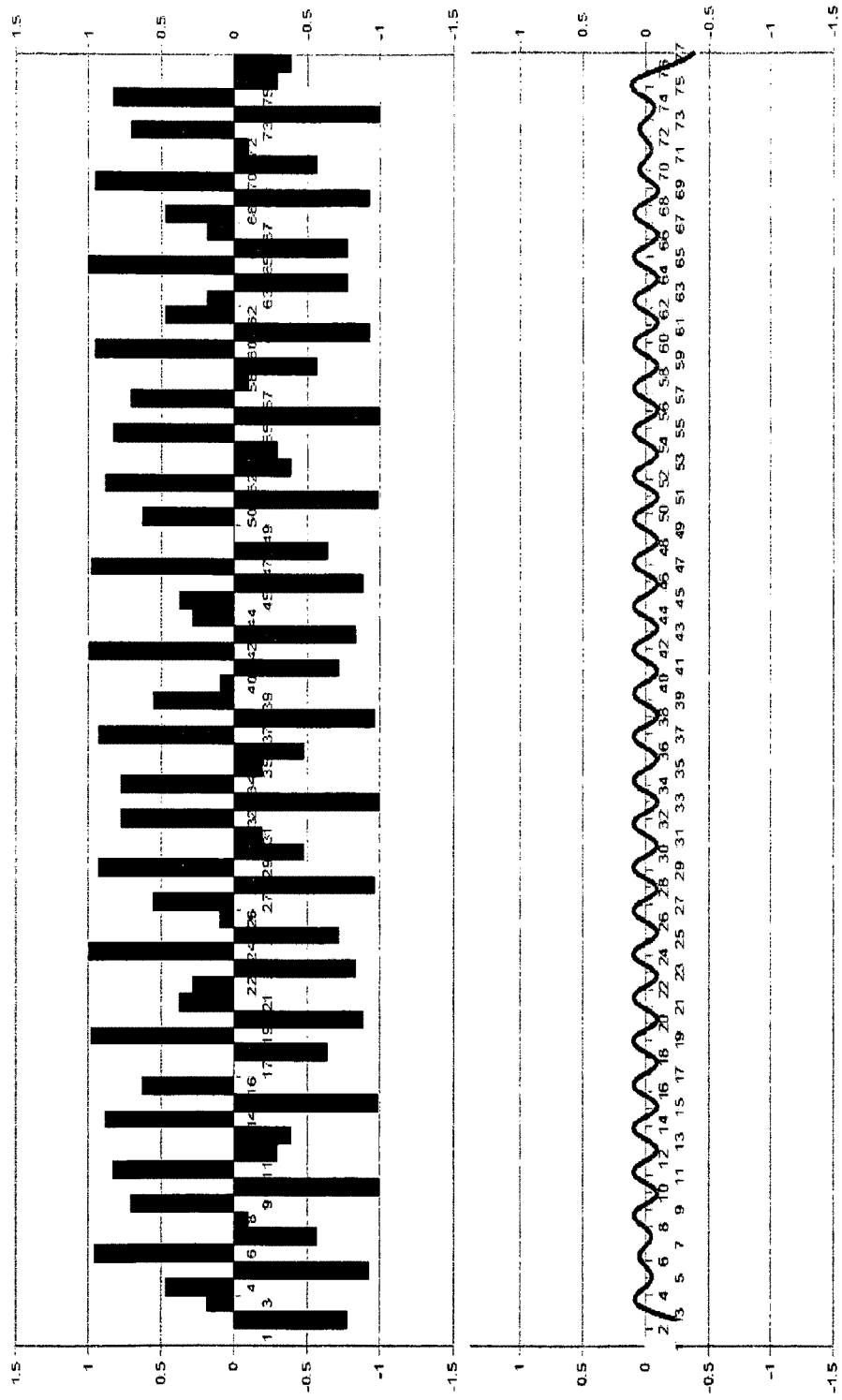
2300

FIG. 23



2400

FIG. 24



2500

FIG. 25

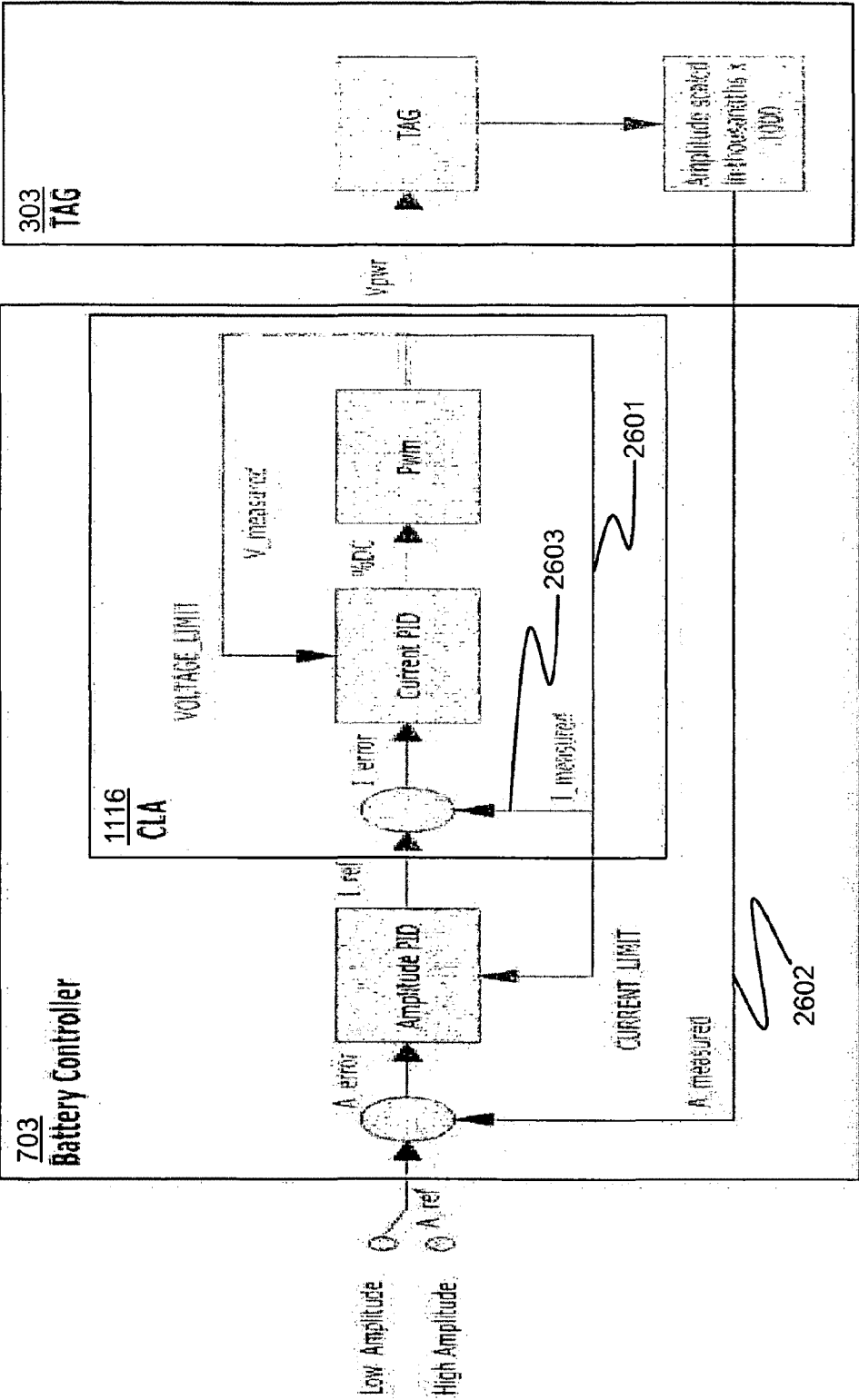


FIG. 26

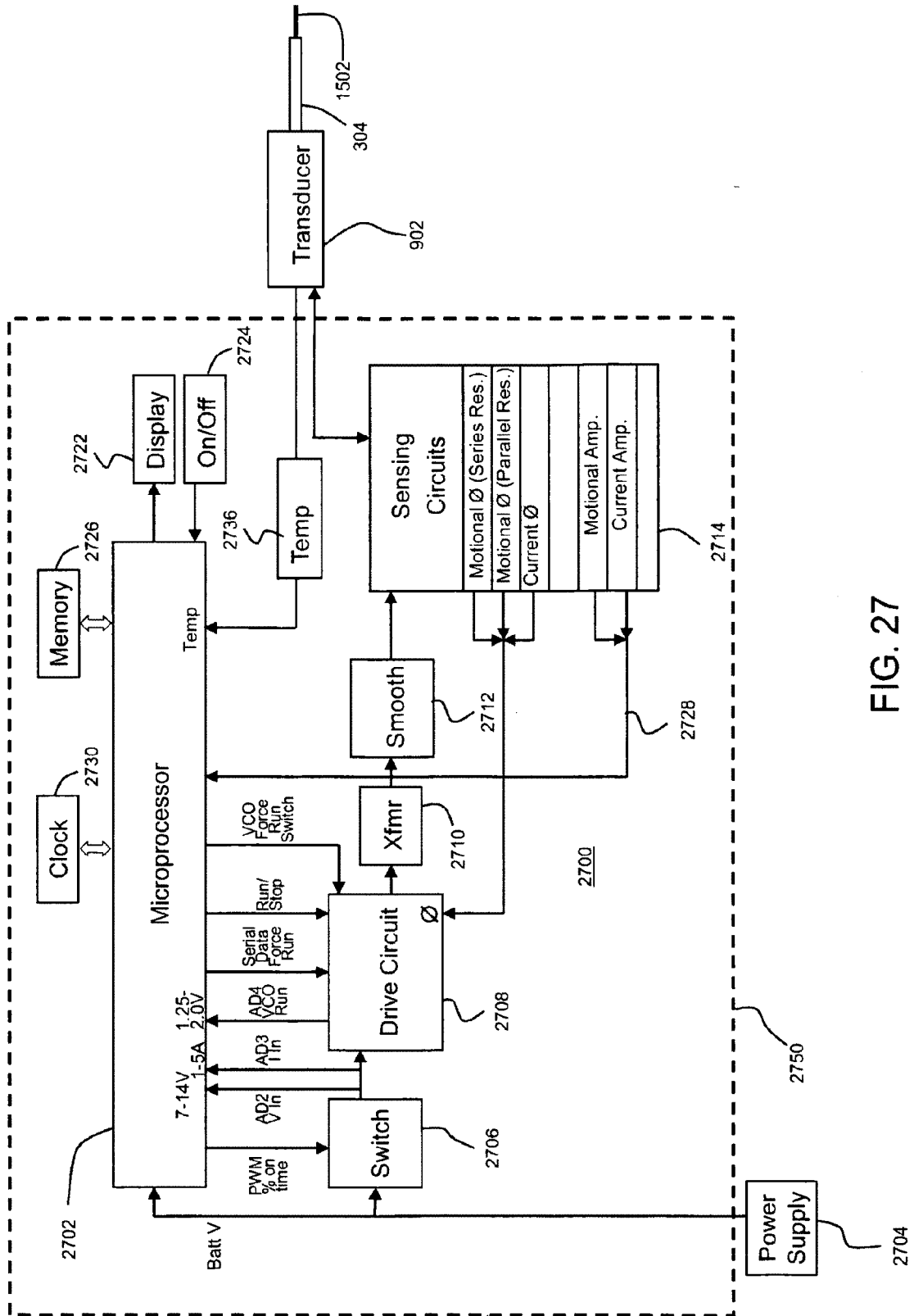


FIG. 27

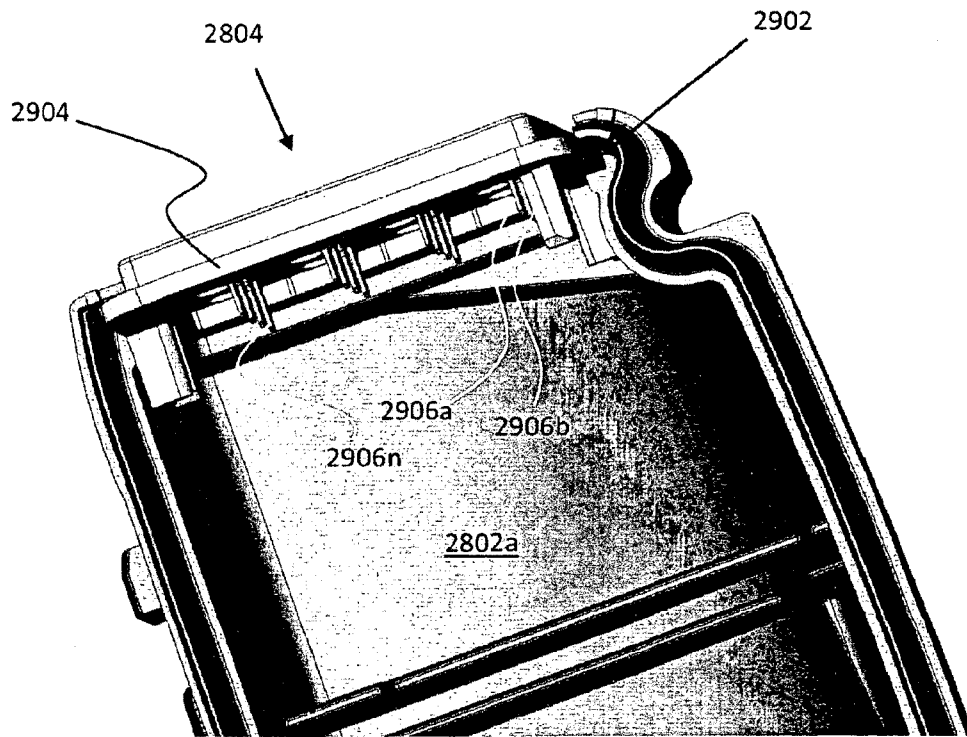


FIG. 29

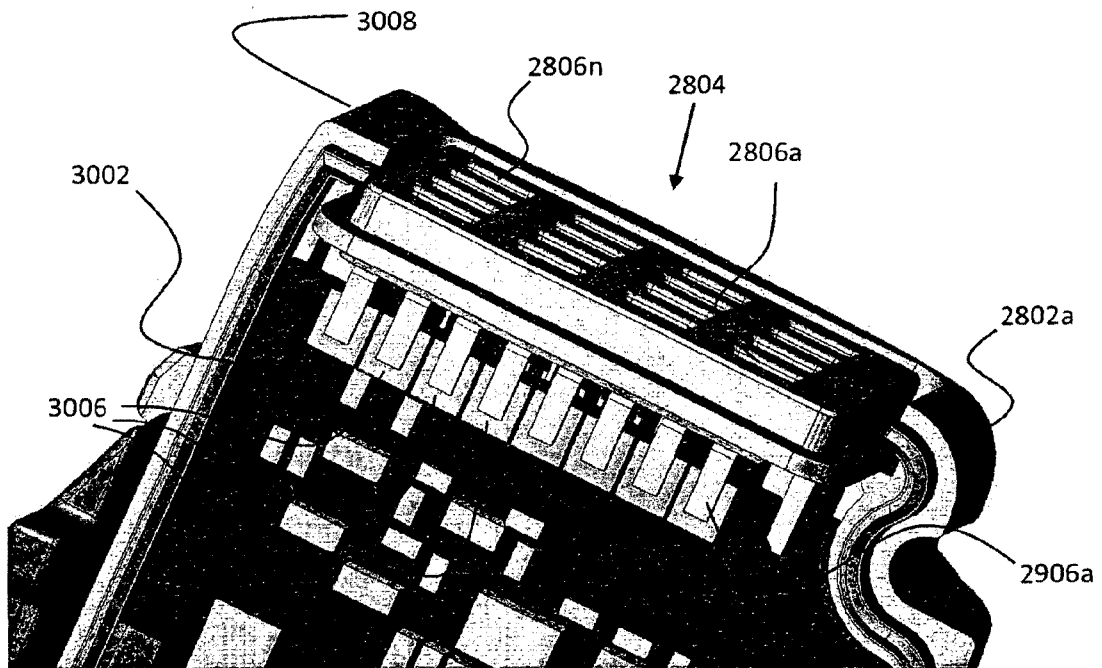


FIG. 30

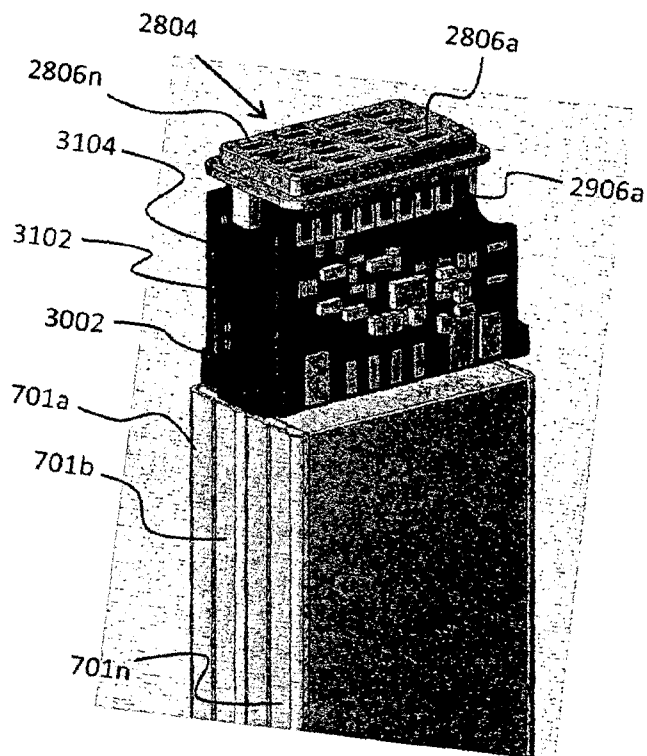


FIG. 31

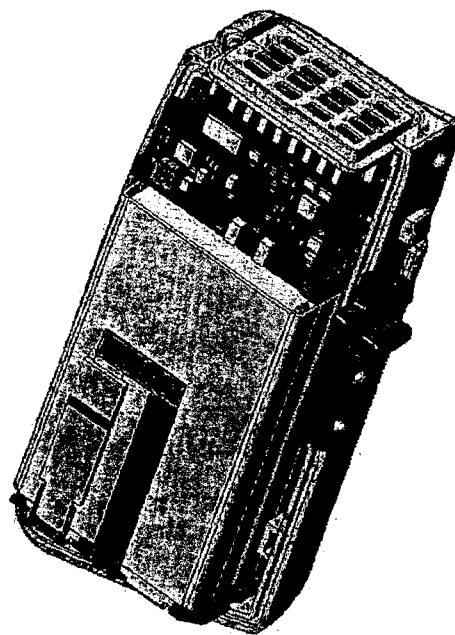


FIG. 32

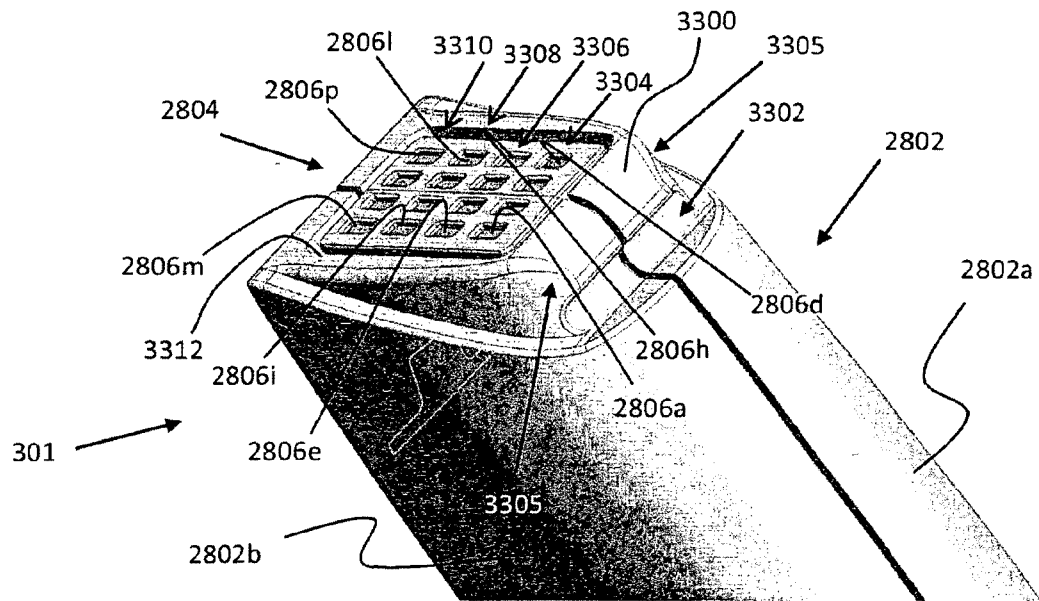


FIG. 33

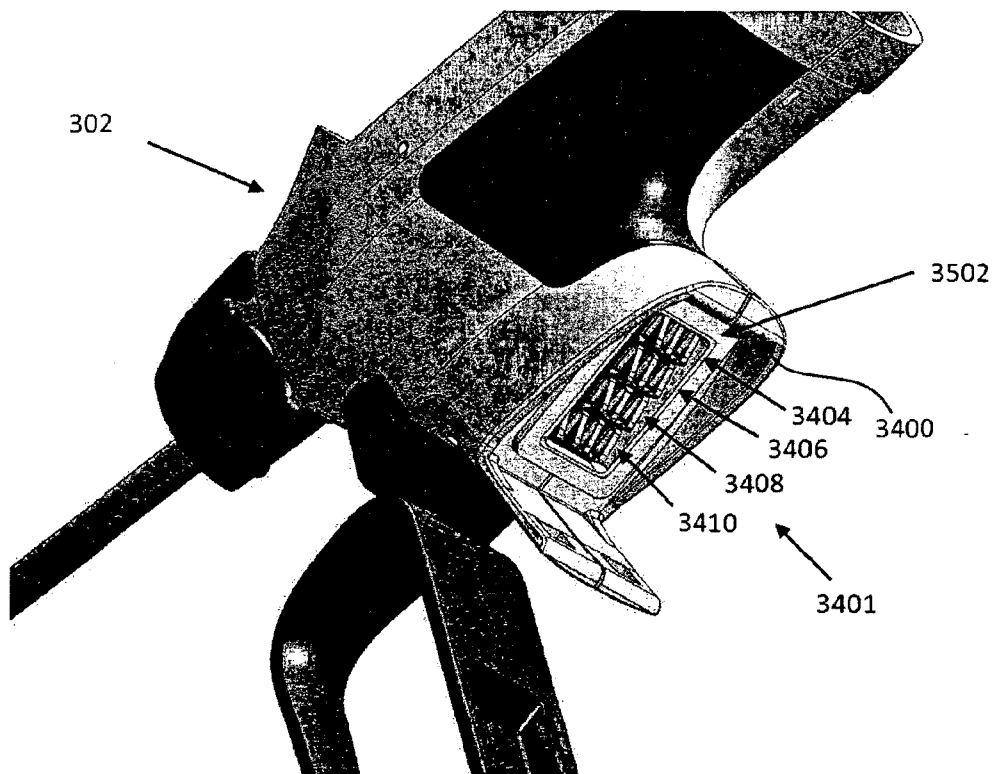


FIG. 34

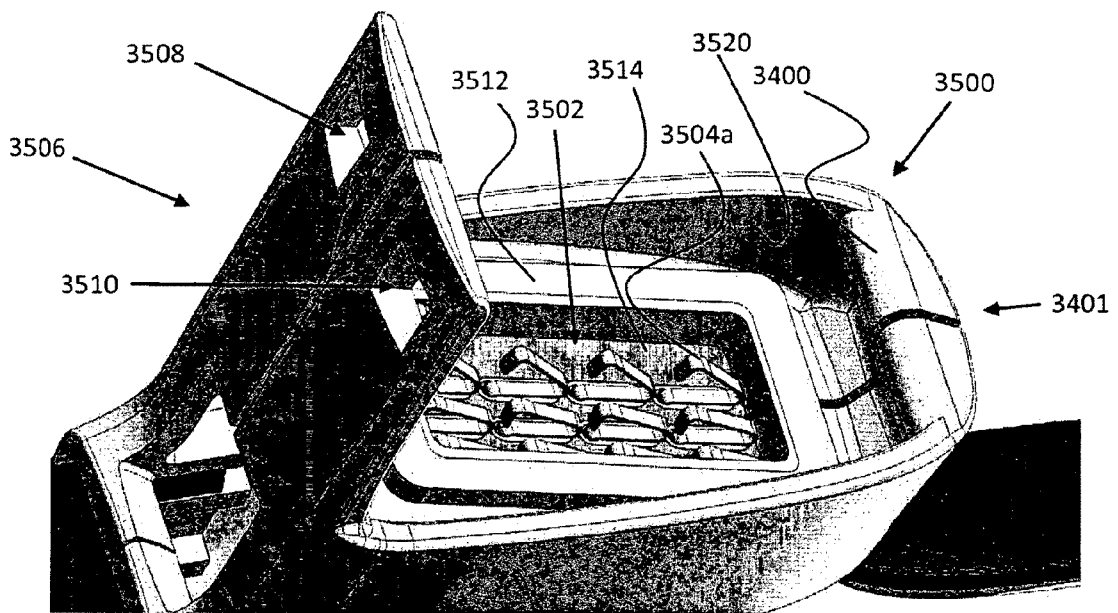


FIG. 35

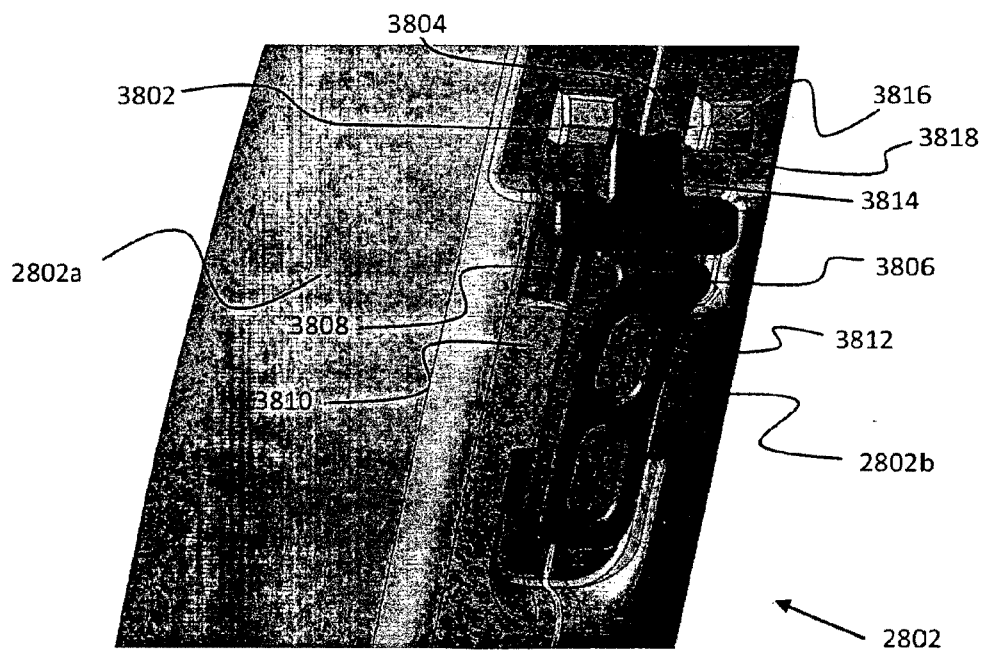


FIG. 38

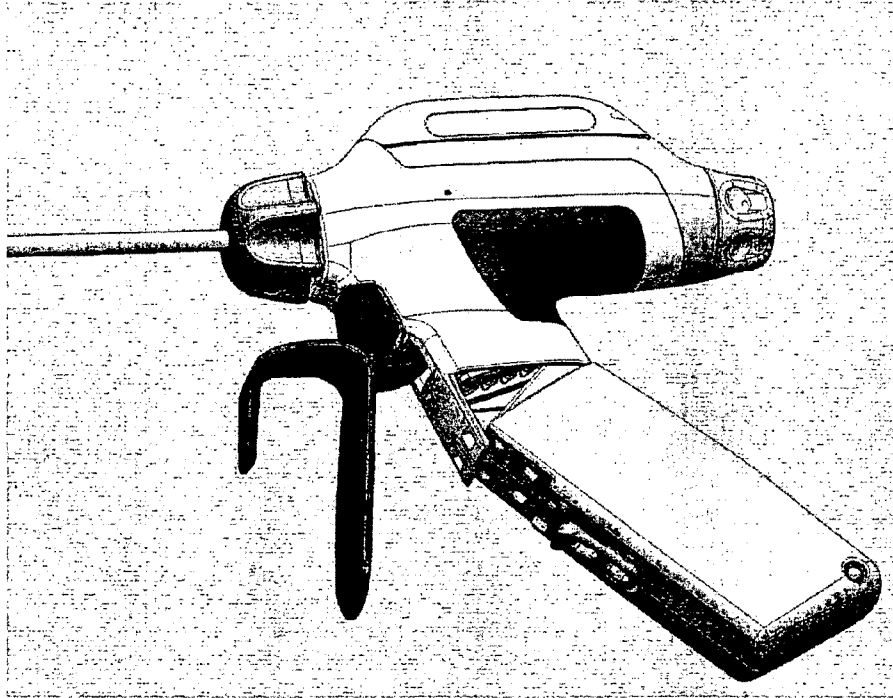


FIG. 36

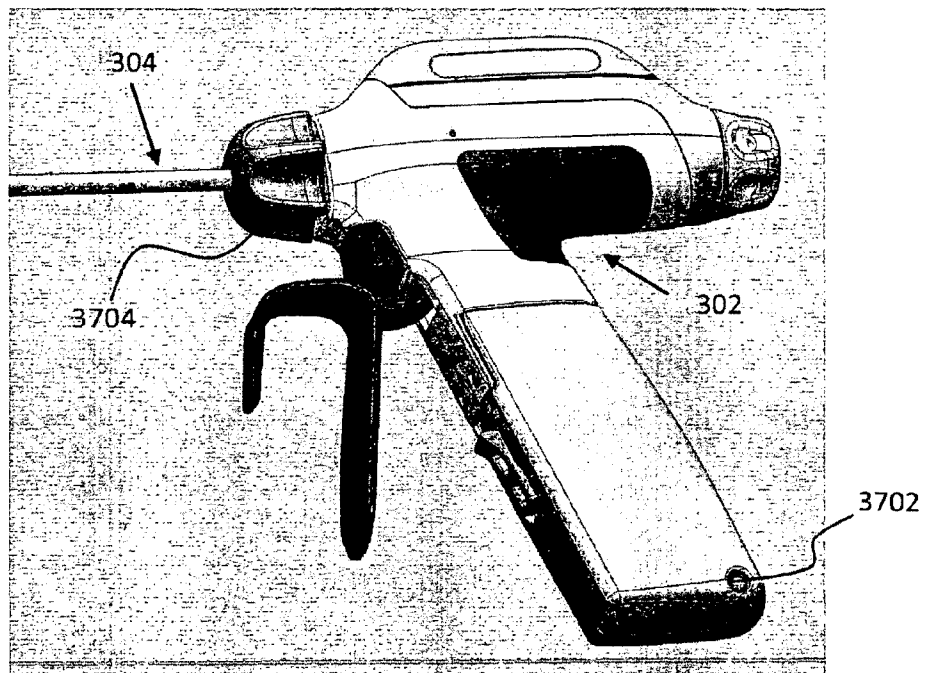


FIG. 37

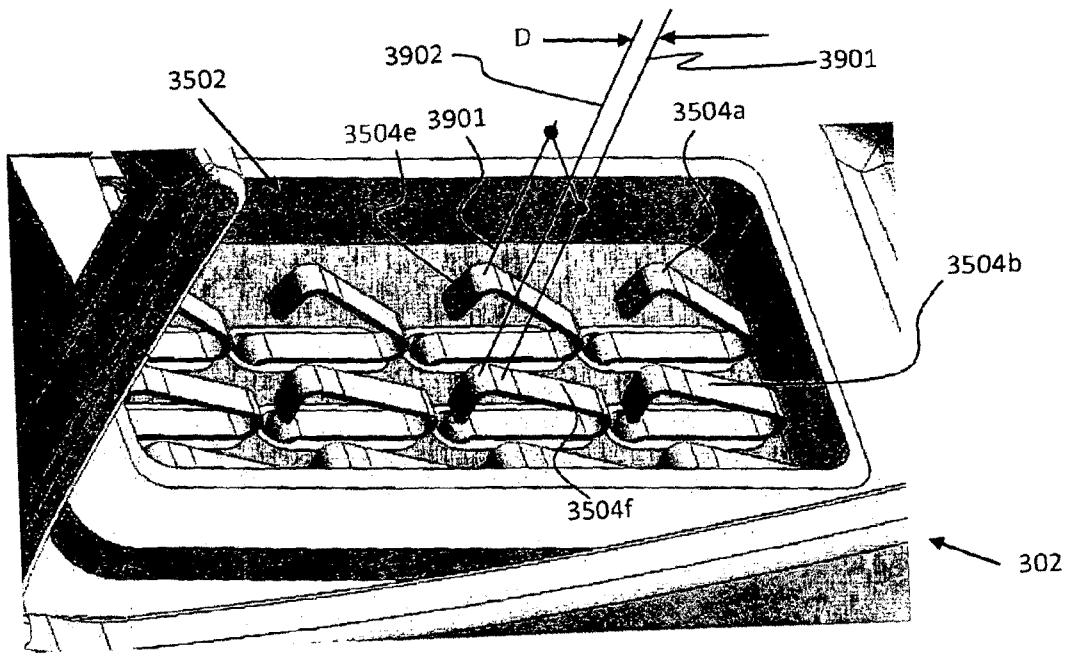


FIG. 39

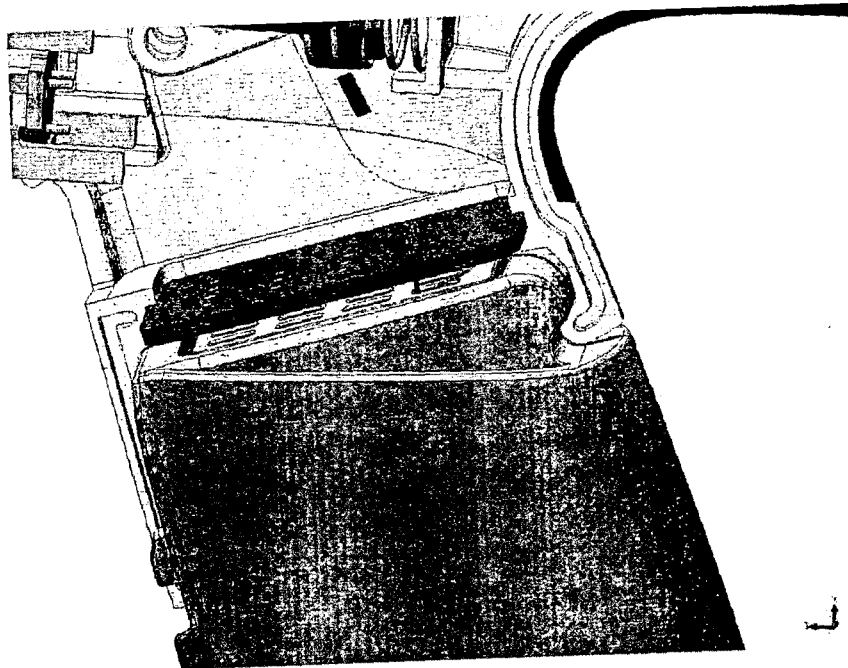
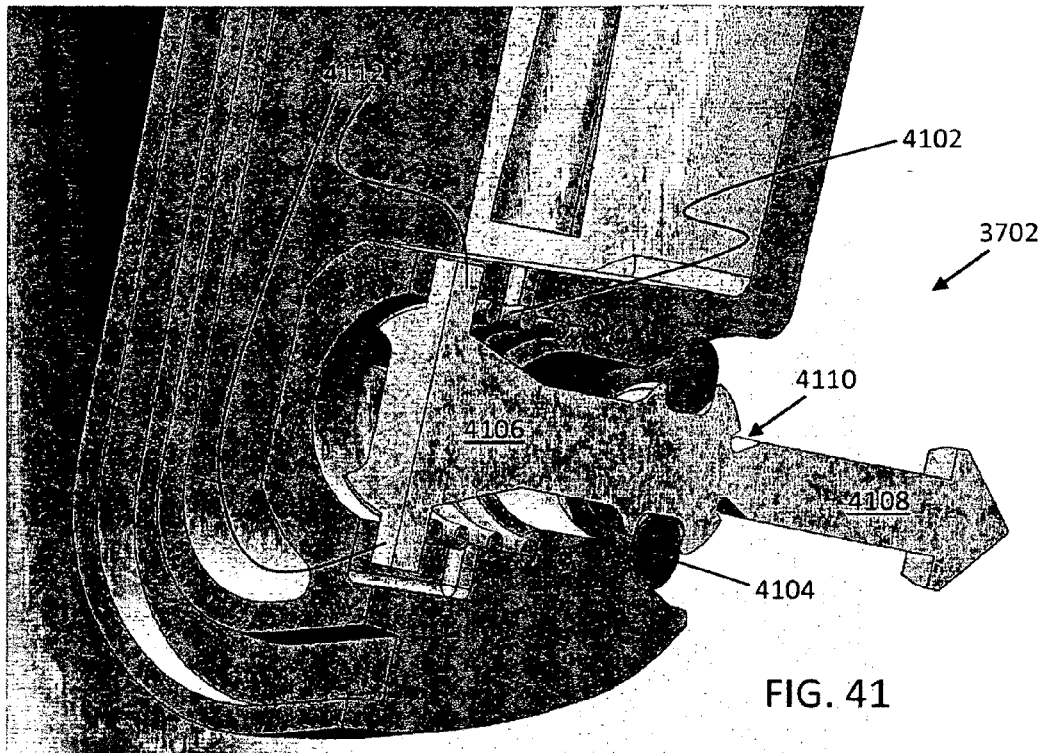
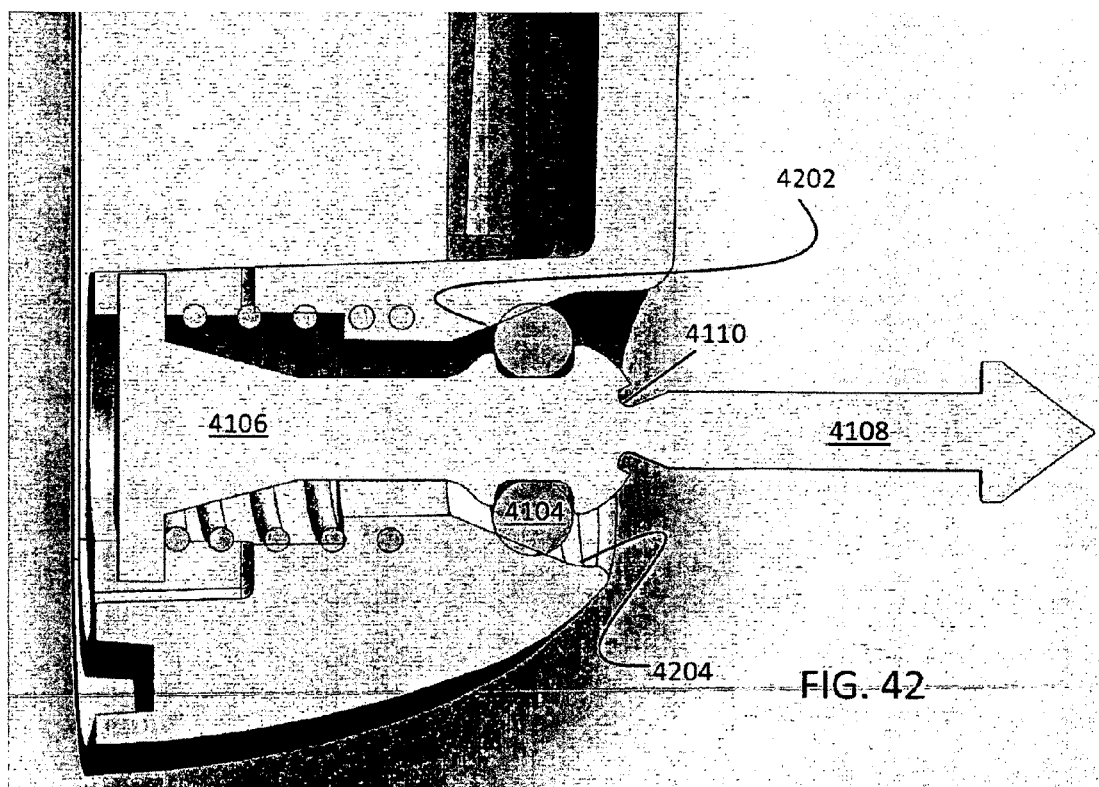


FIG. 40



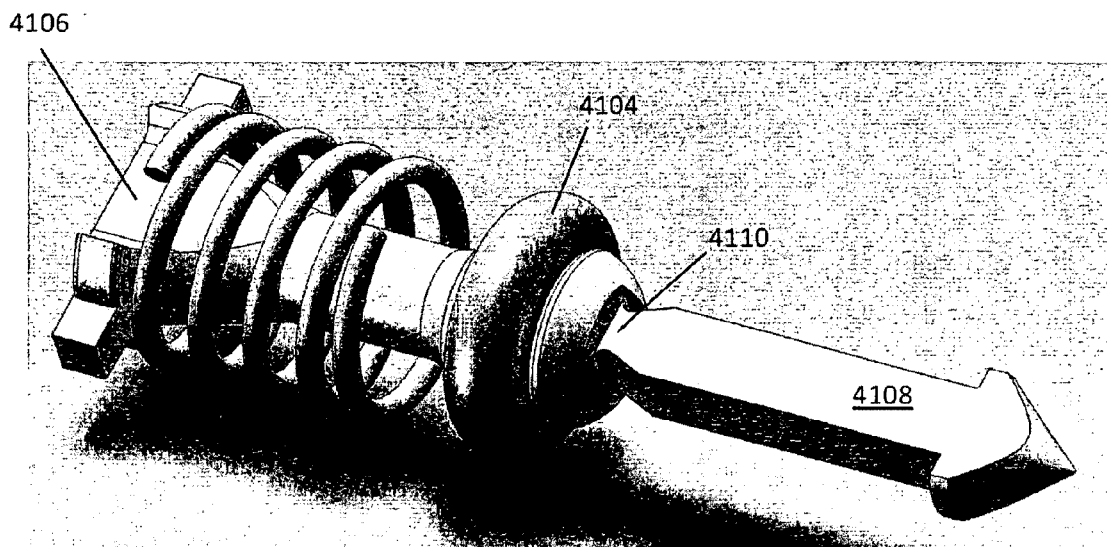


FIG. 43

Chart showing check valve opening event stages
X-axis is pressure
Y-axis is Flow

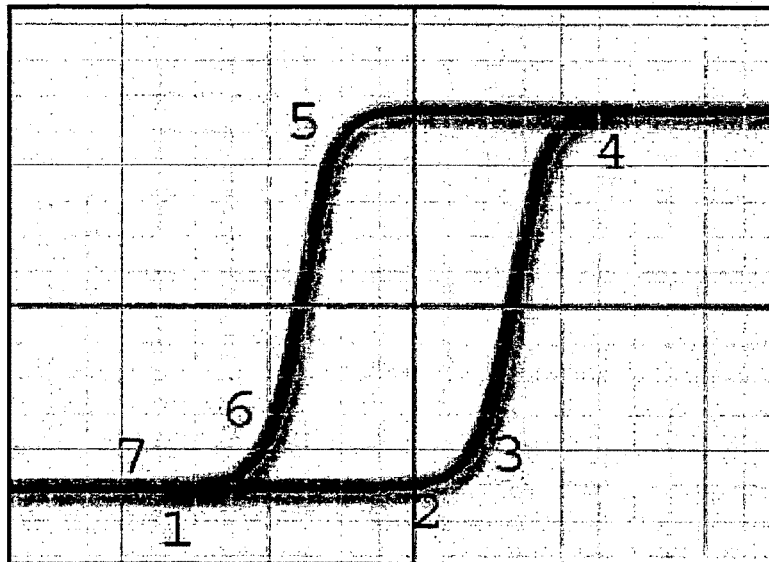


FIG. 44

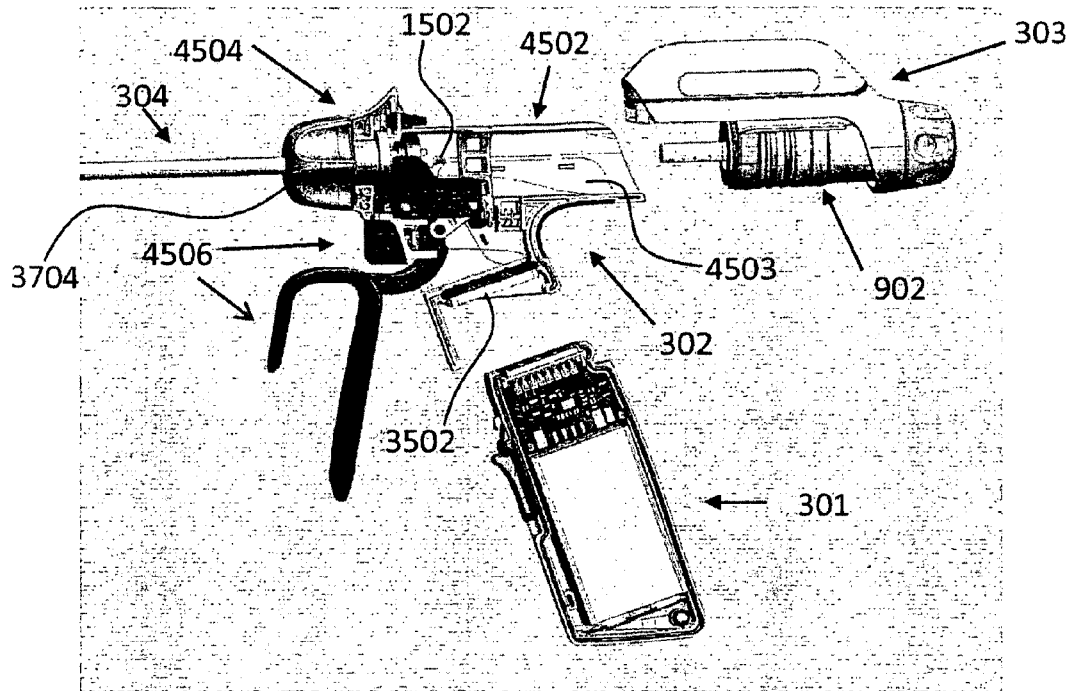


FIG. 45

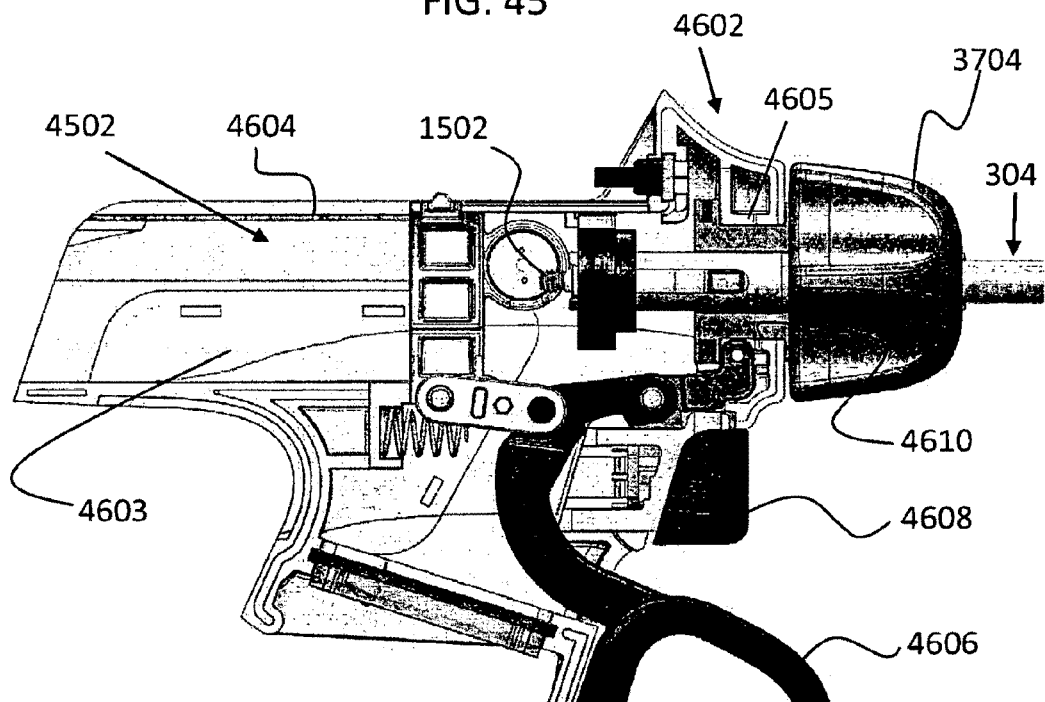
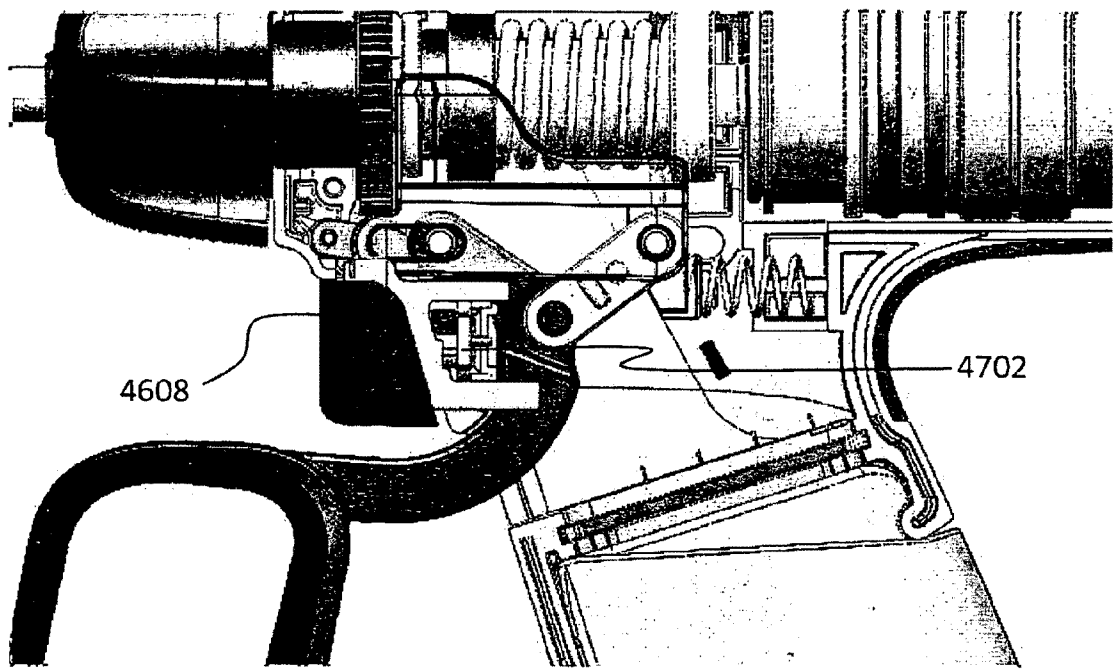
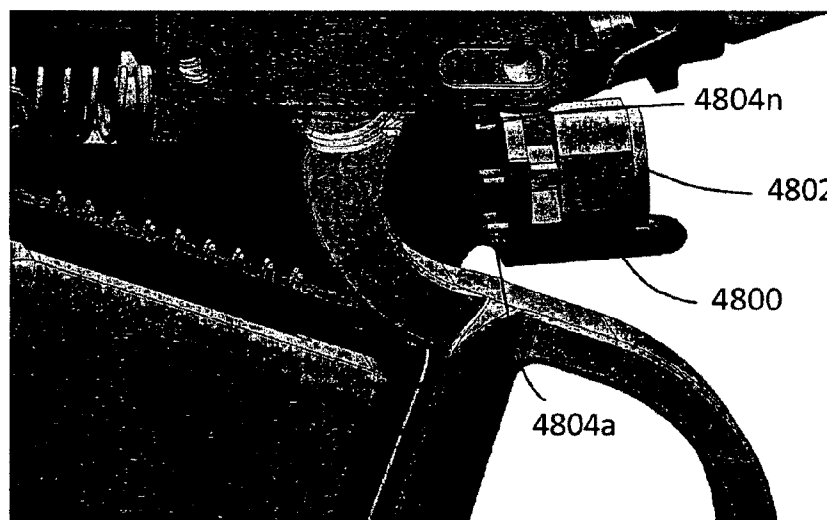


FIG. 46



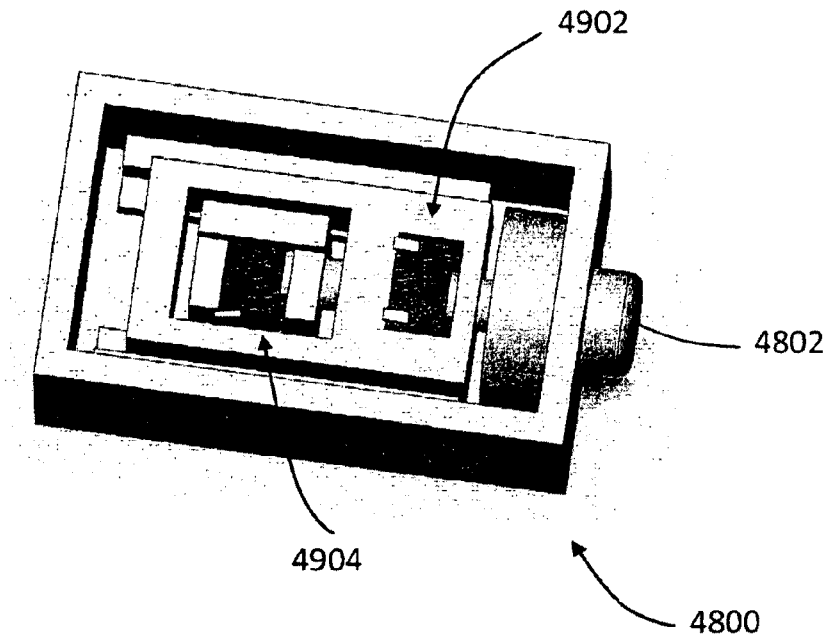


FIG. 49

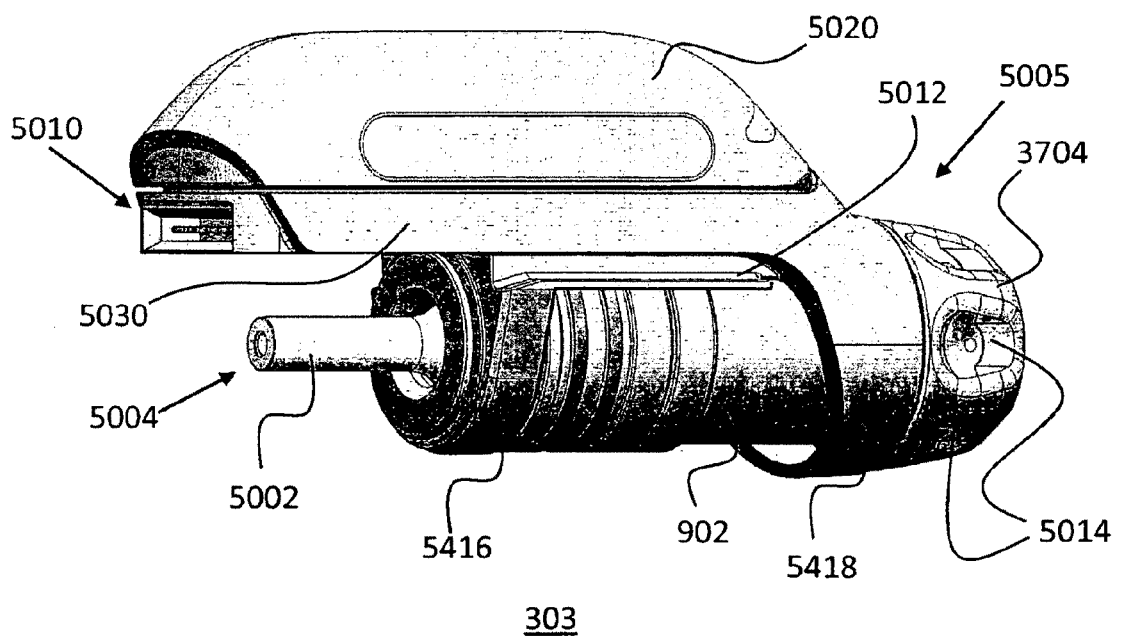
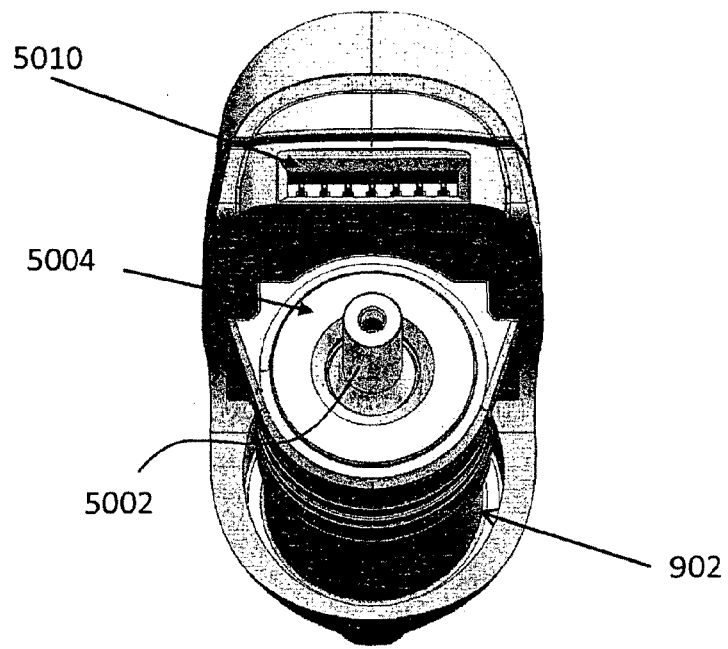
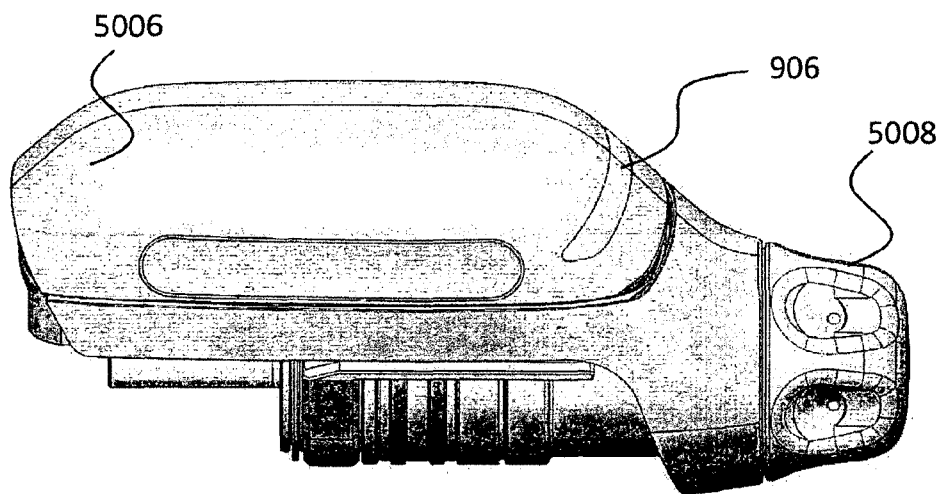


FIG. 50



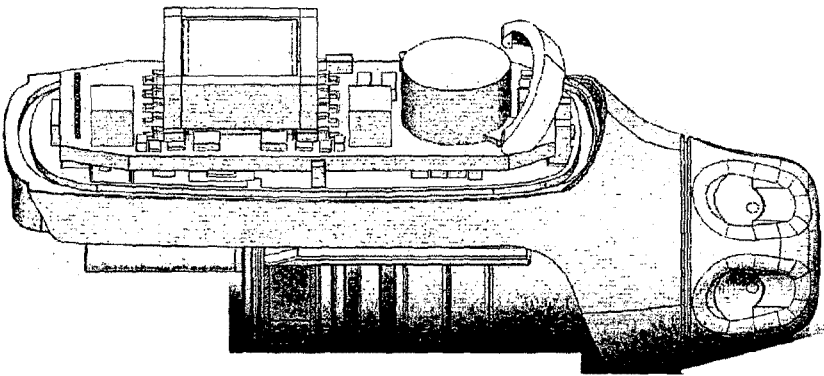
303

FIG. 51



303

FIG. 52



303

FIG. 53

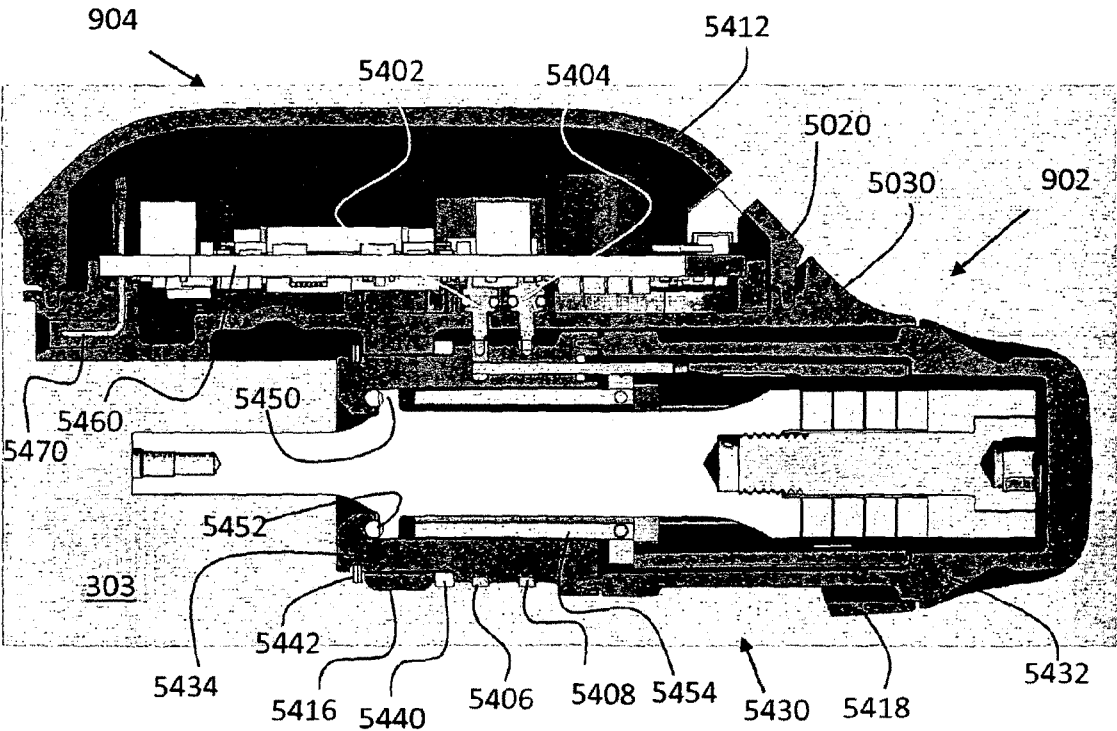
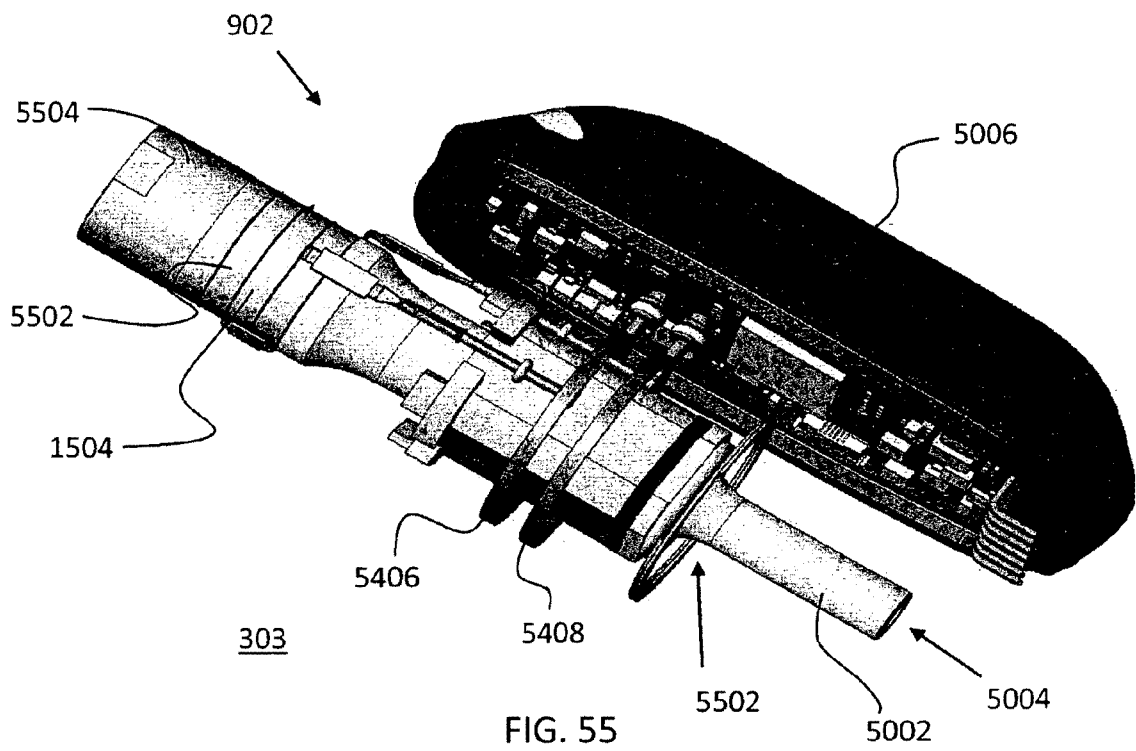
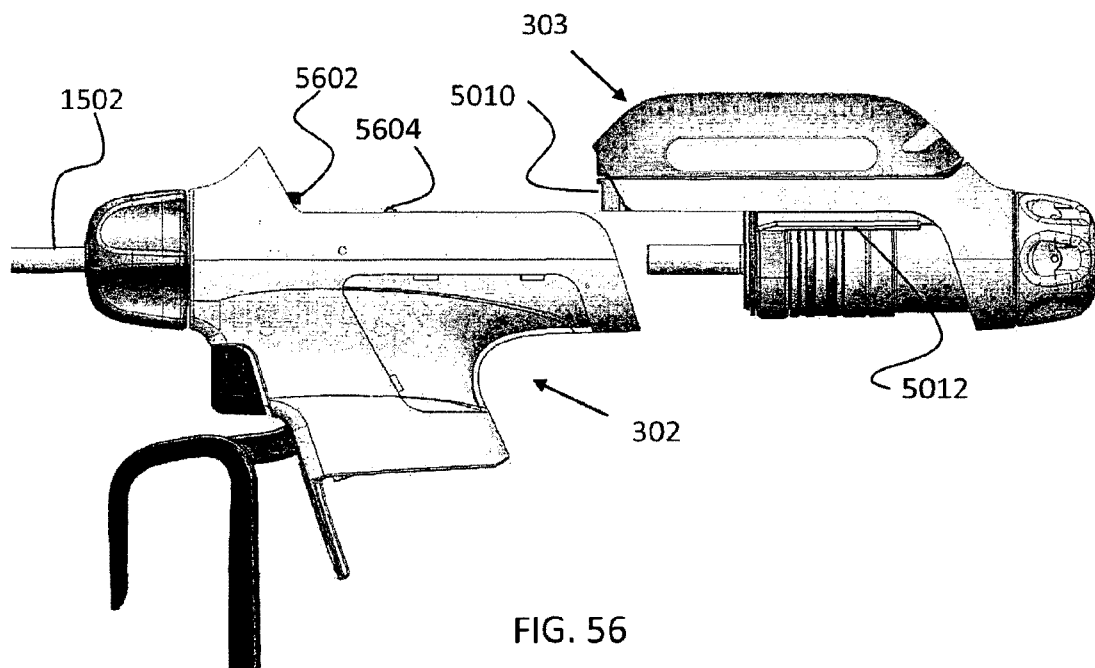
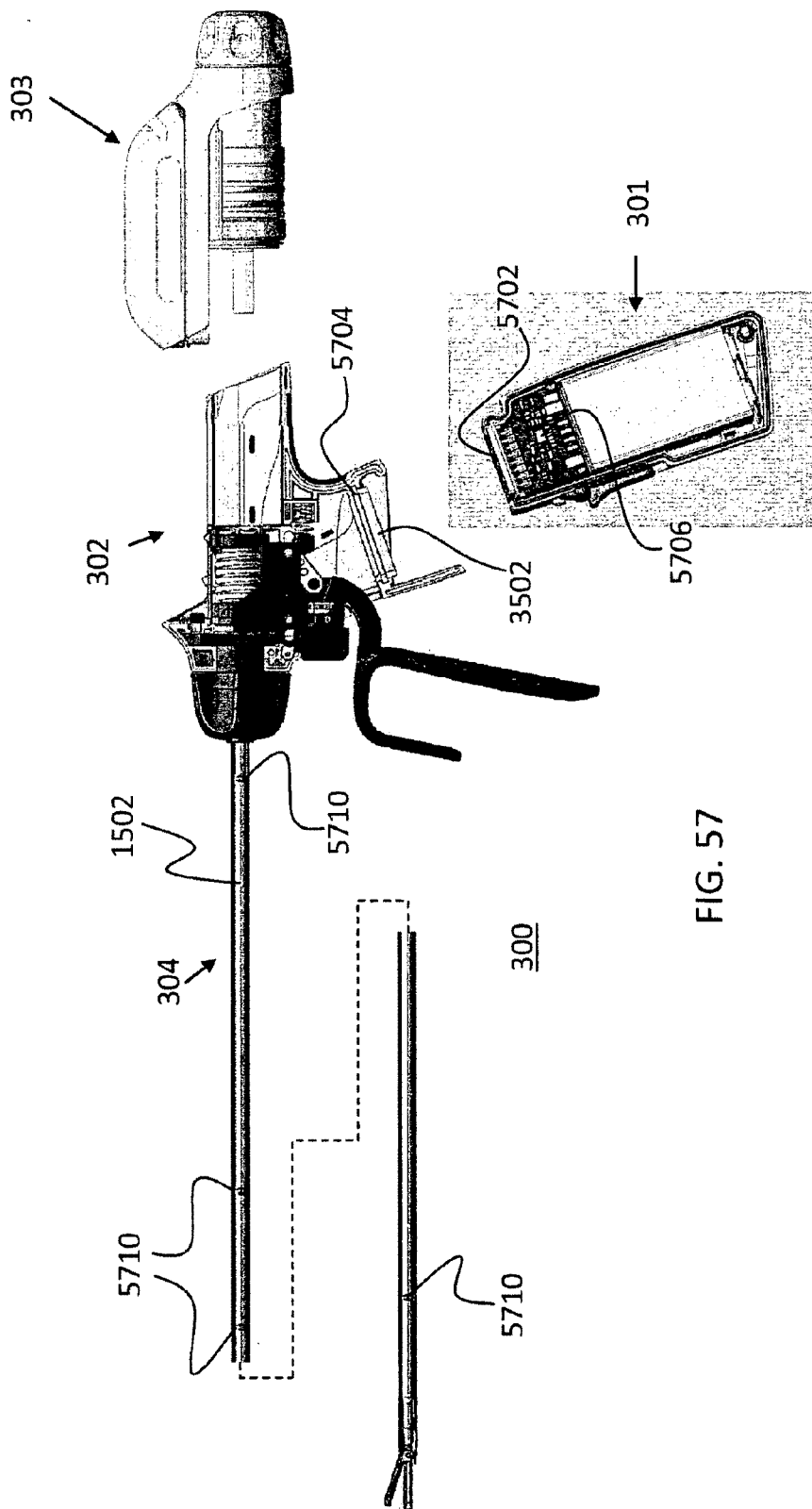
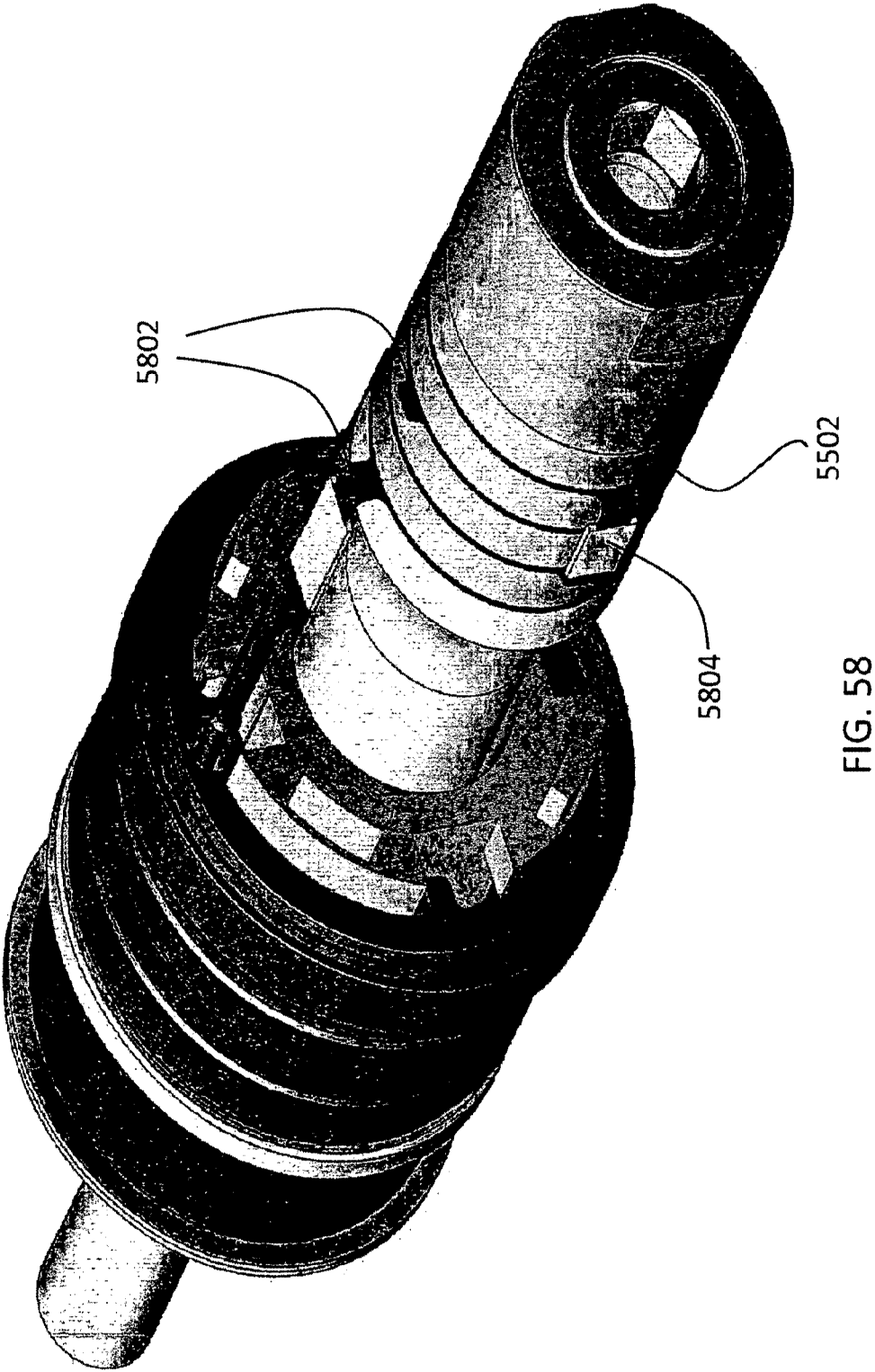


FIG. 54







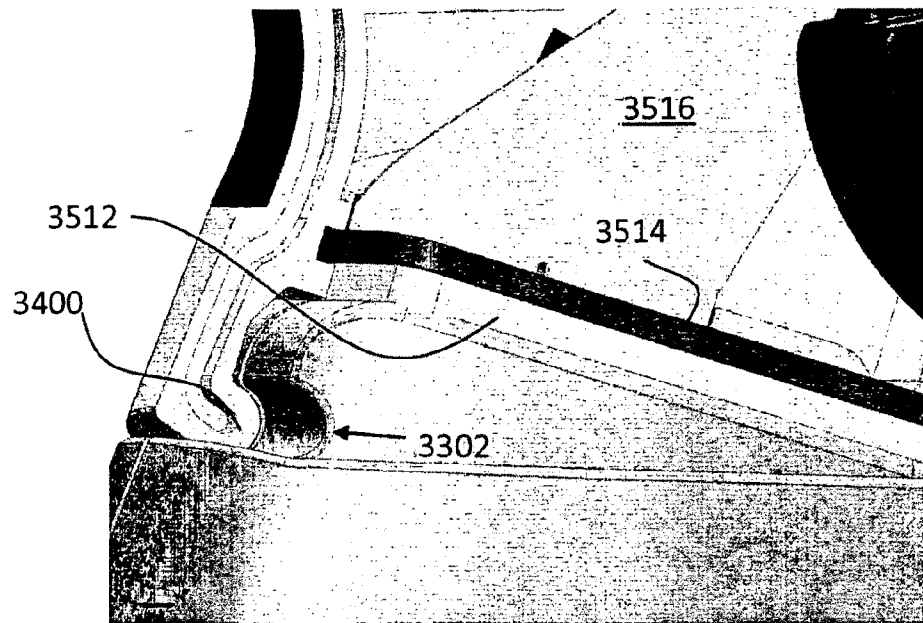


FIG. 59

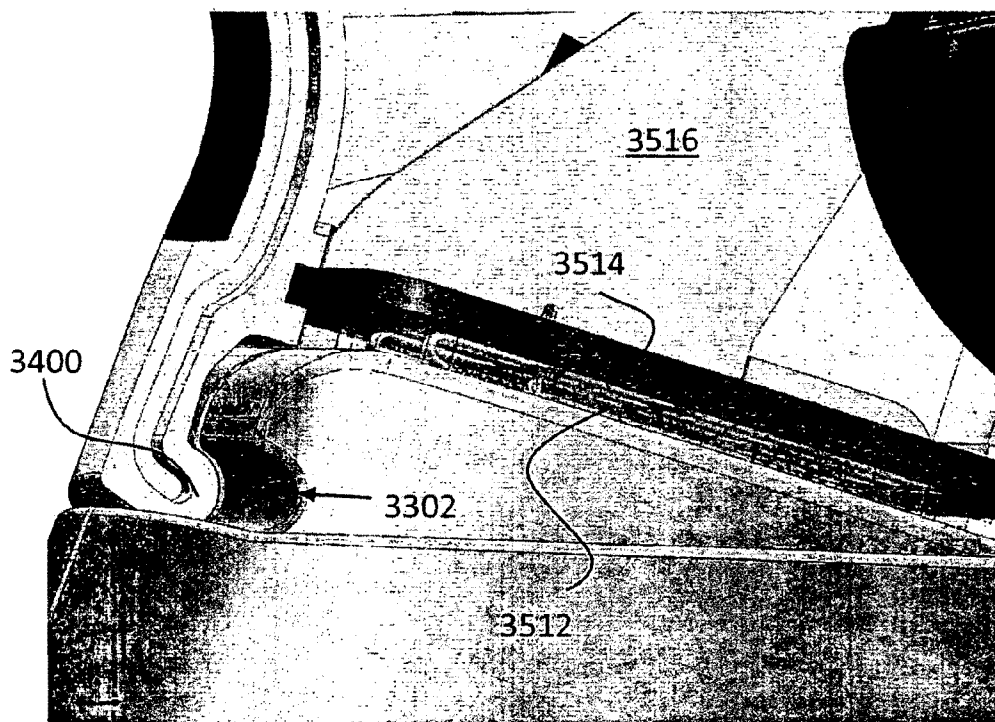


FIG. 60

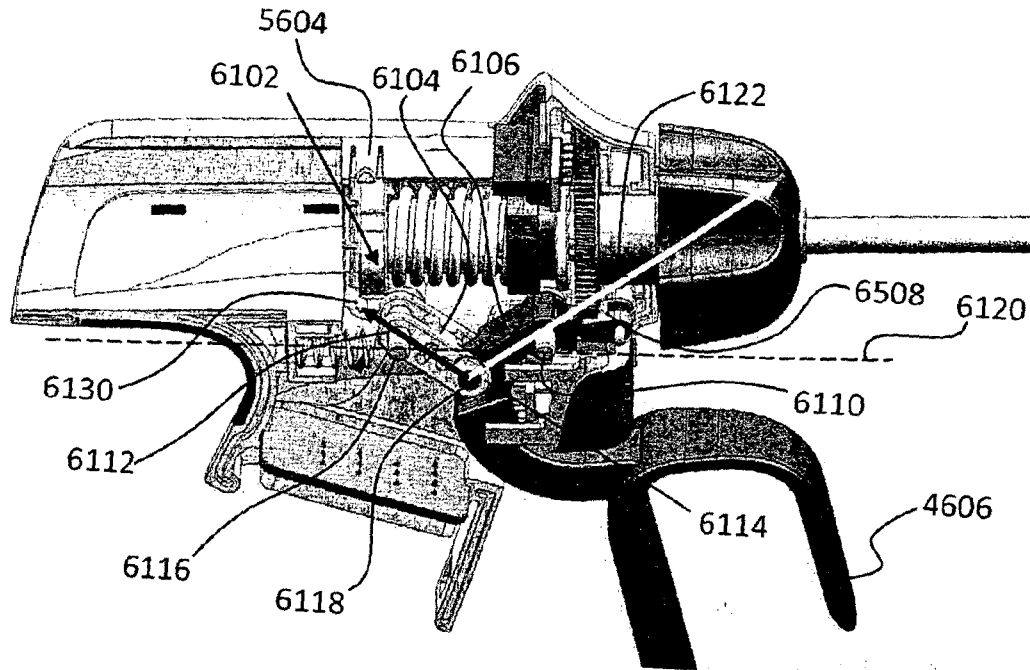


FIG. 61

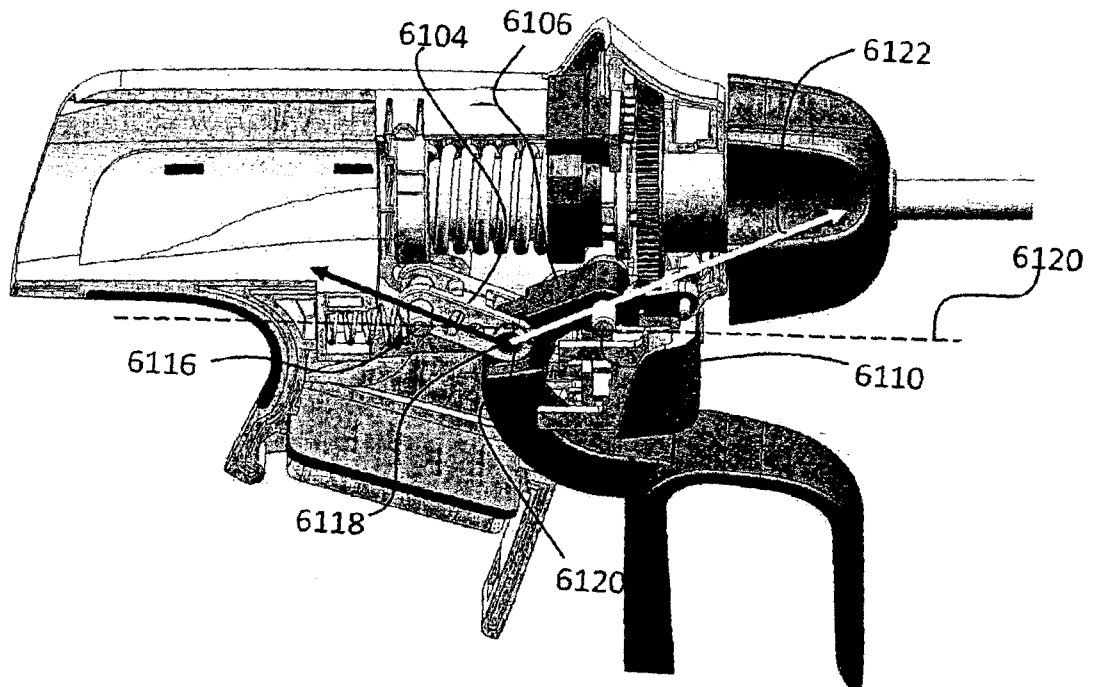


FIG. 62

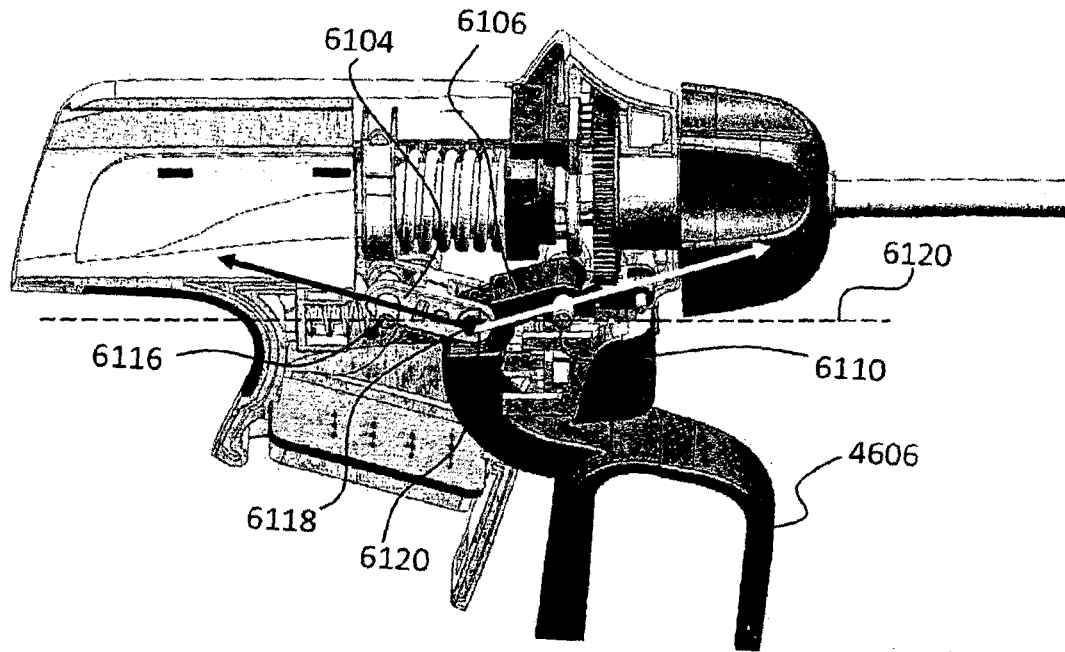


FIG. 63

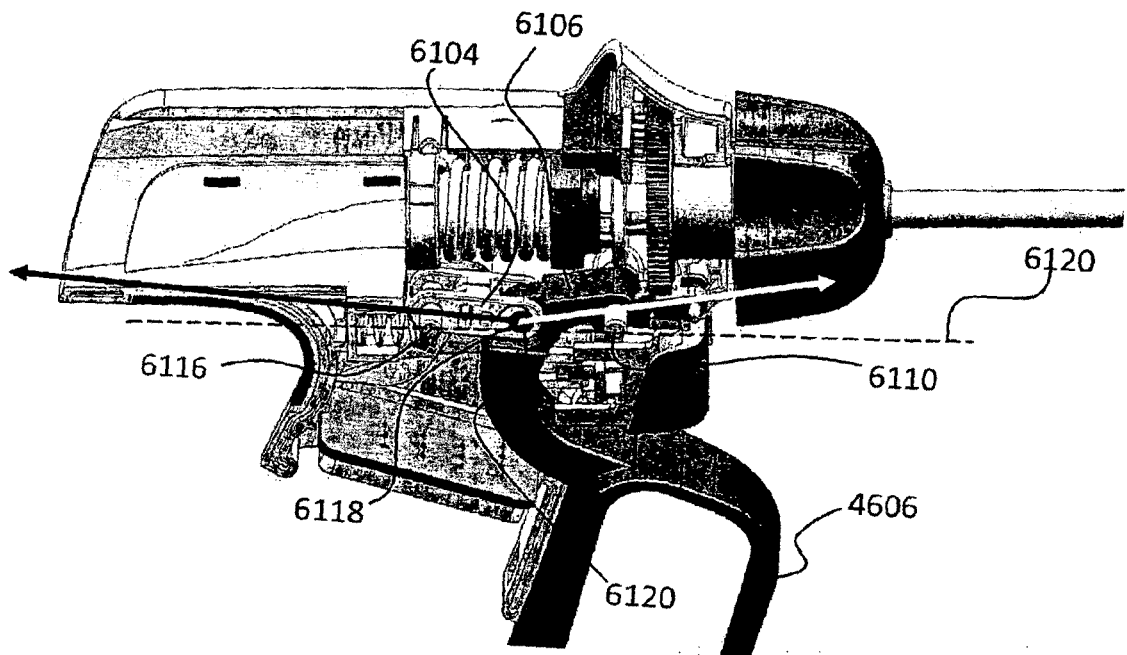


FIG. 64

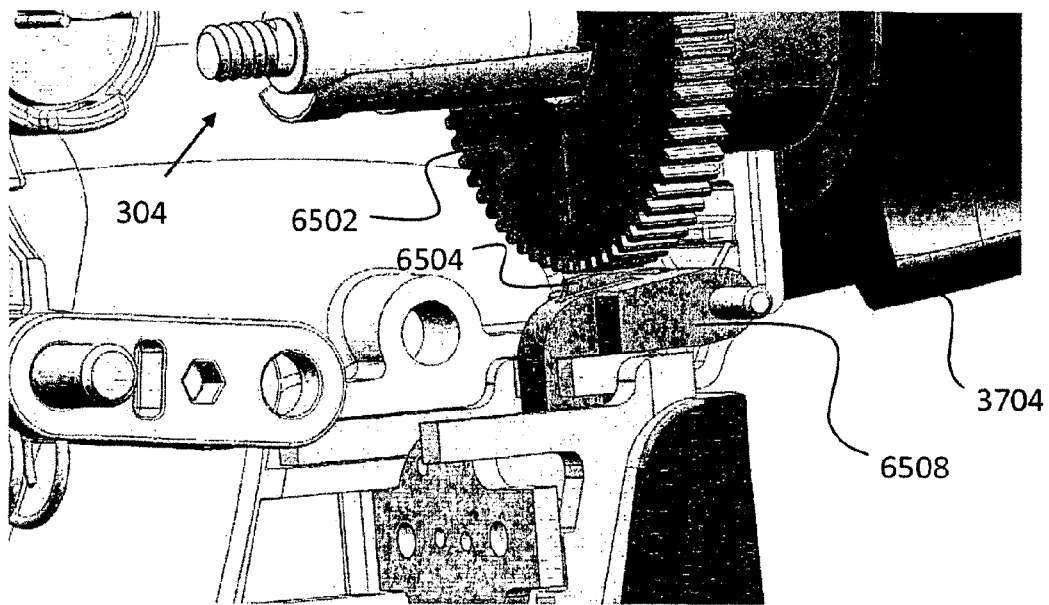


FIG. 65

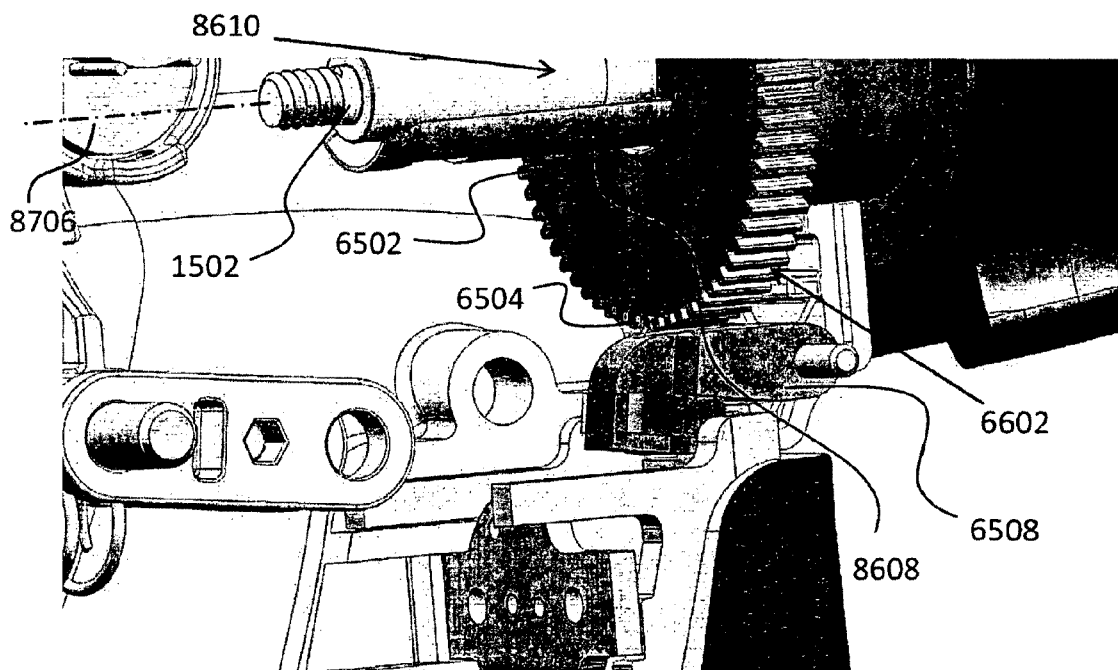


FIG. 66

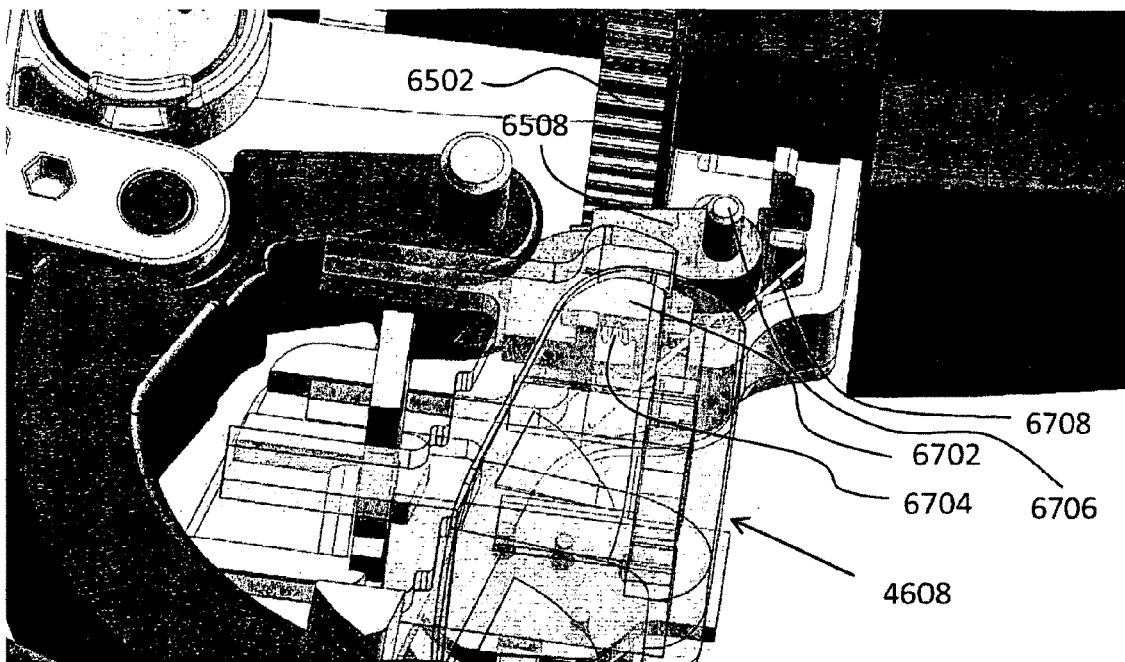


FIG. 67

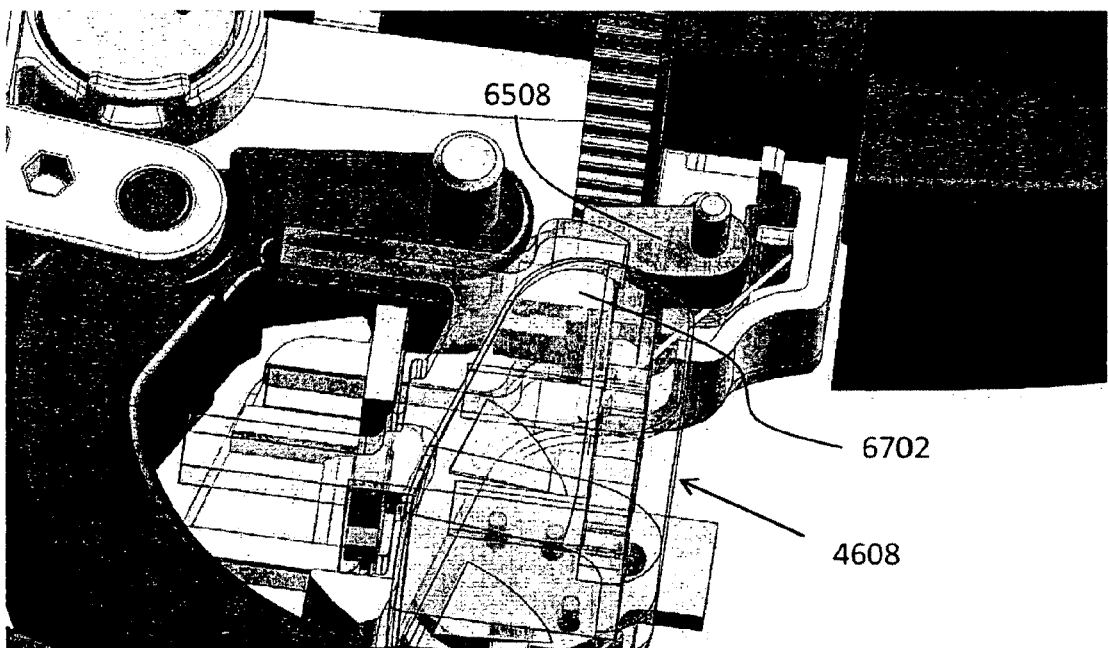


FIG. 68

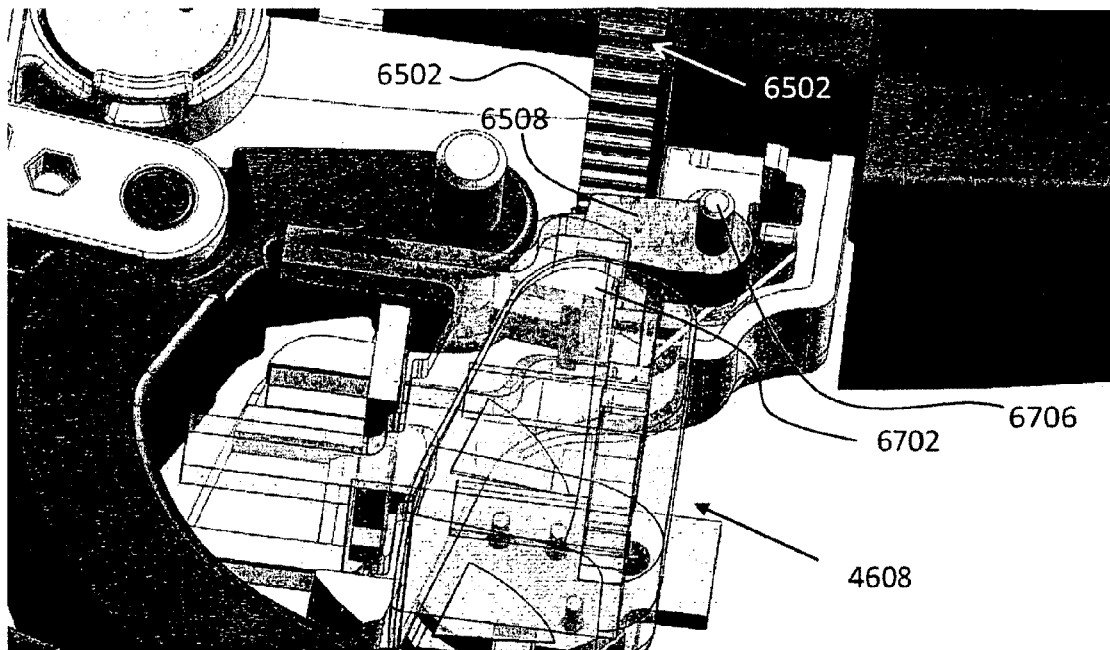


FIG. 69

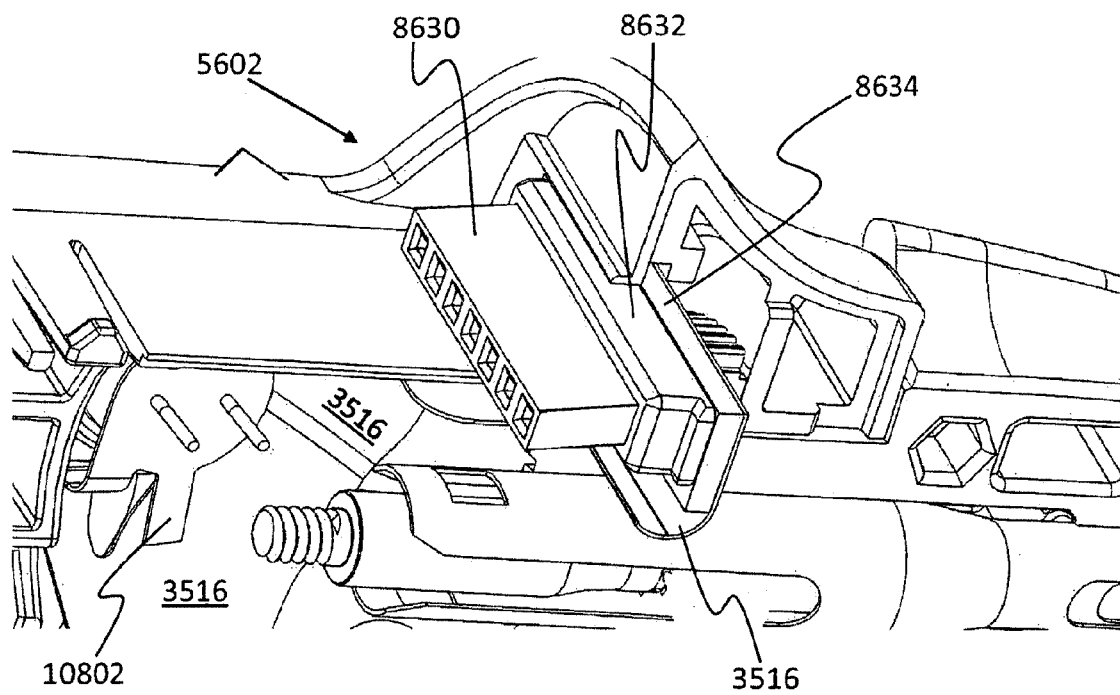


FIG. 108

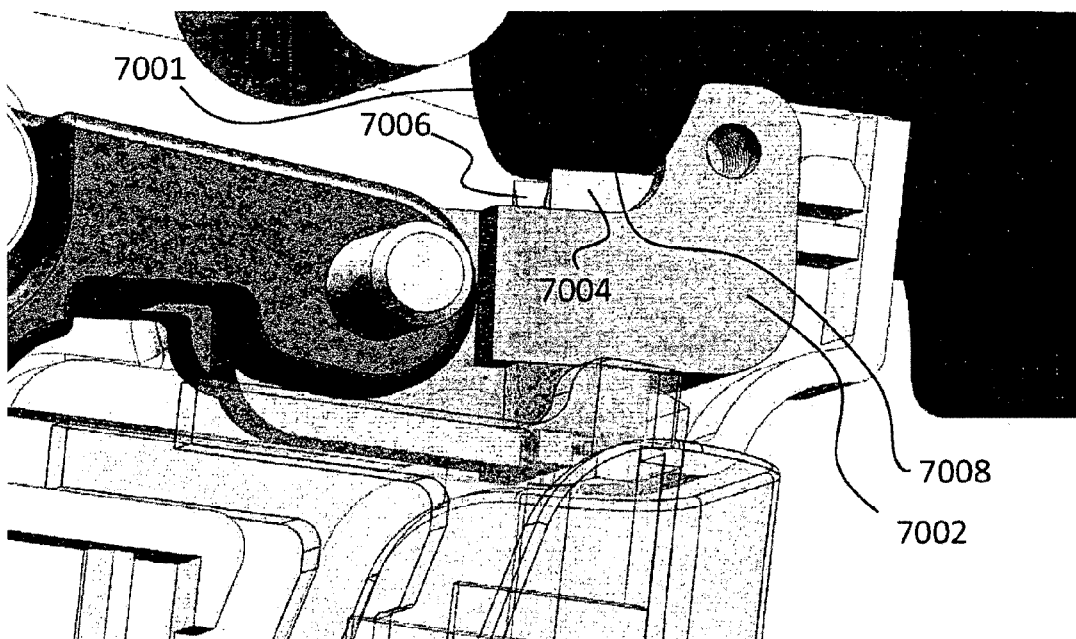


FIG. 70

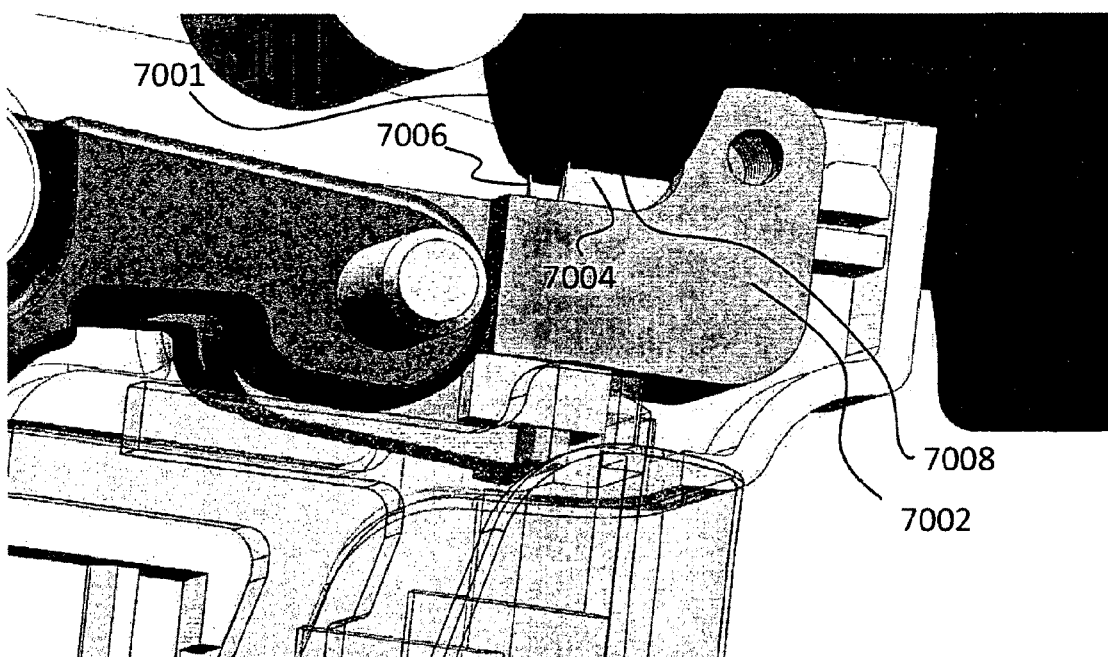
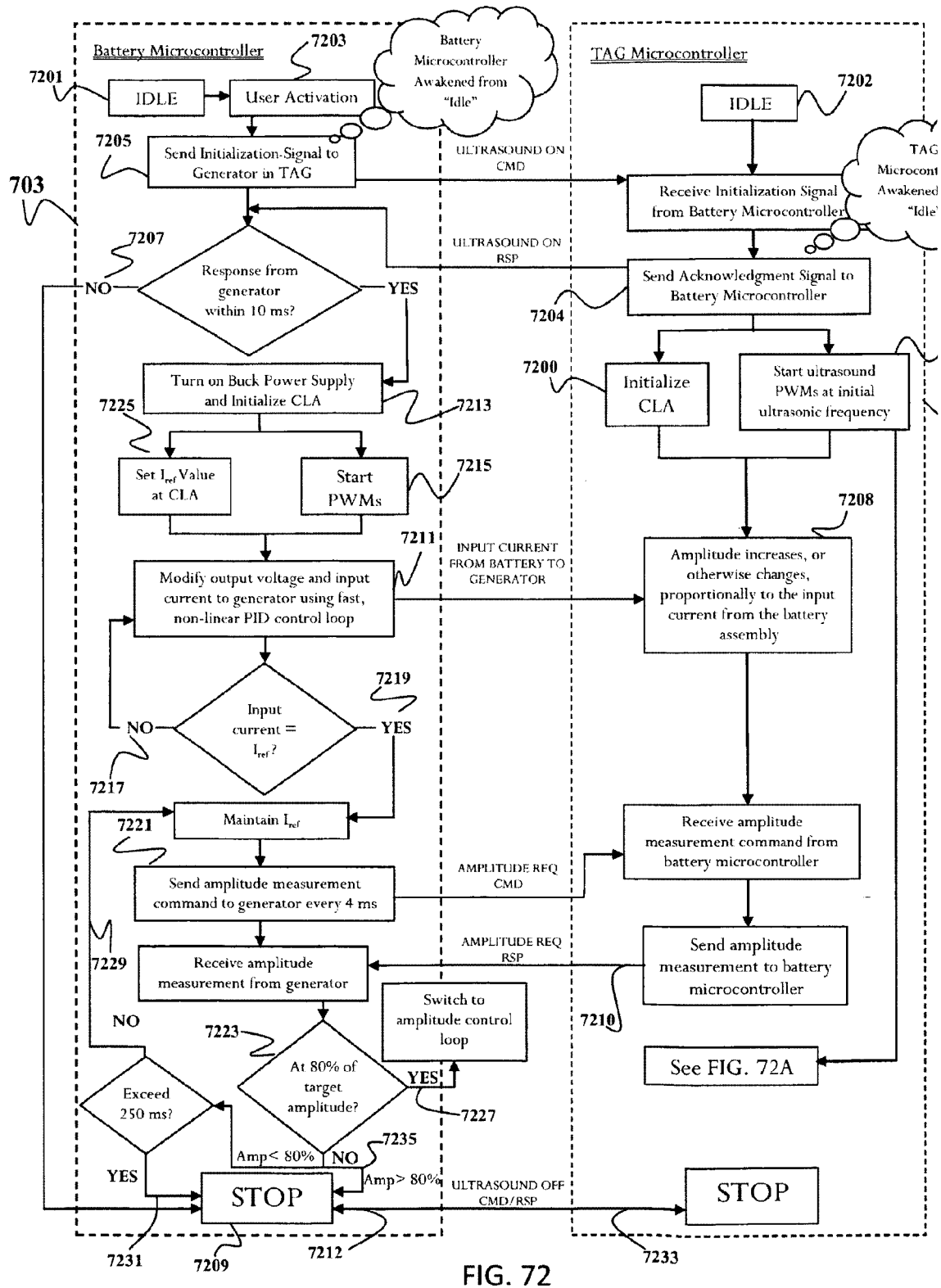
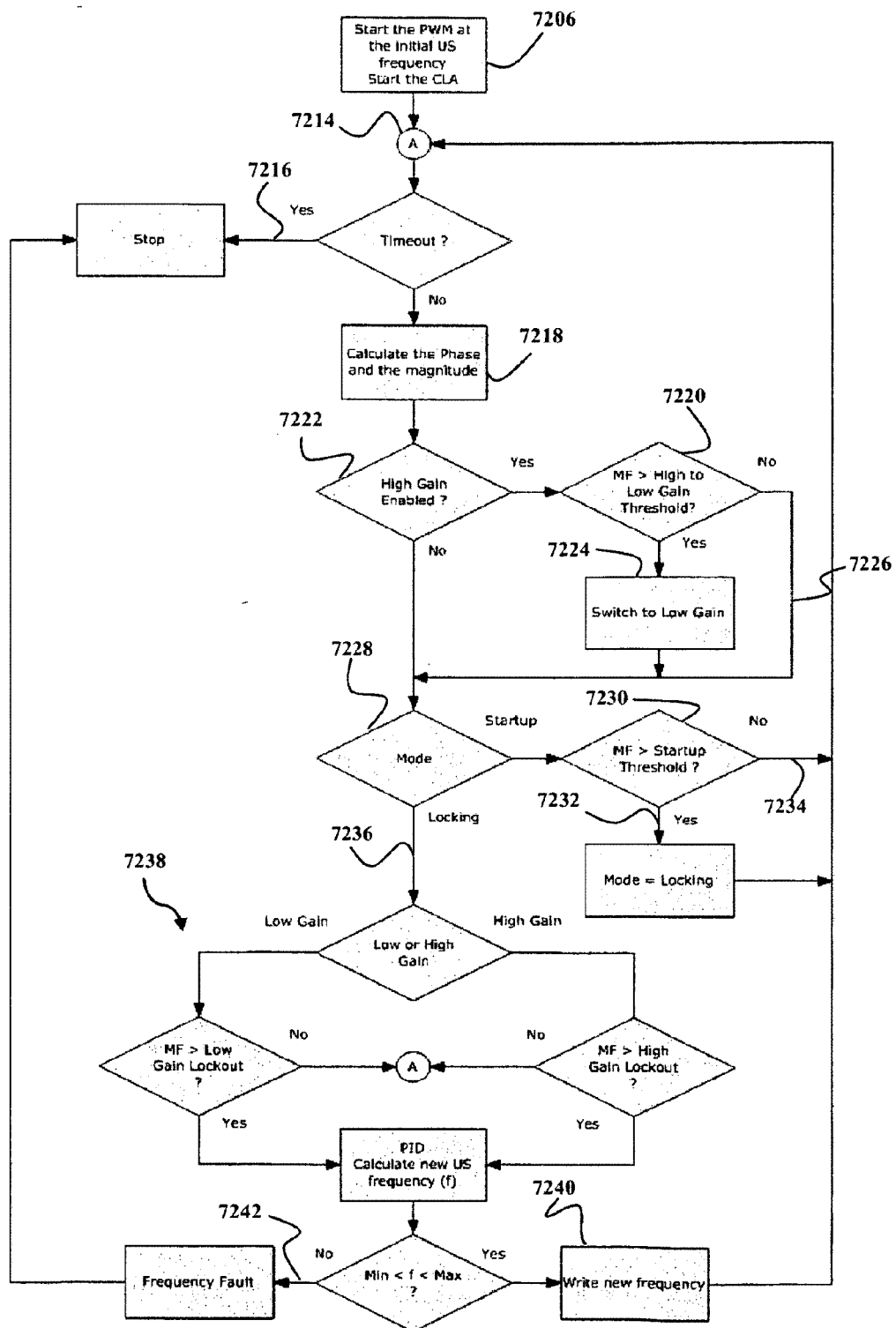


FIG. 71





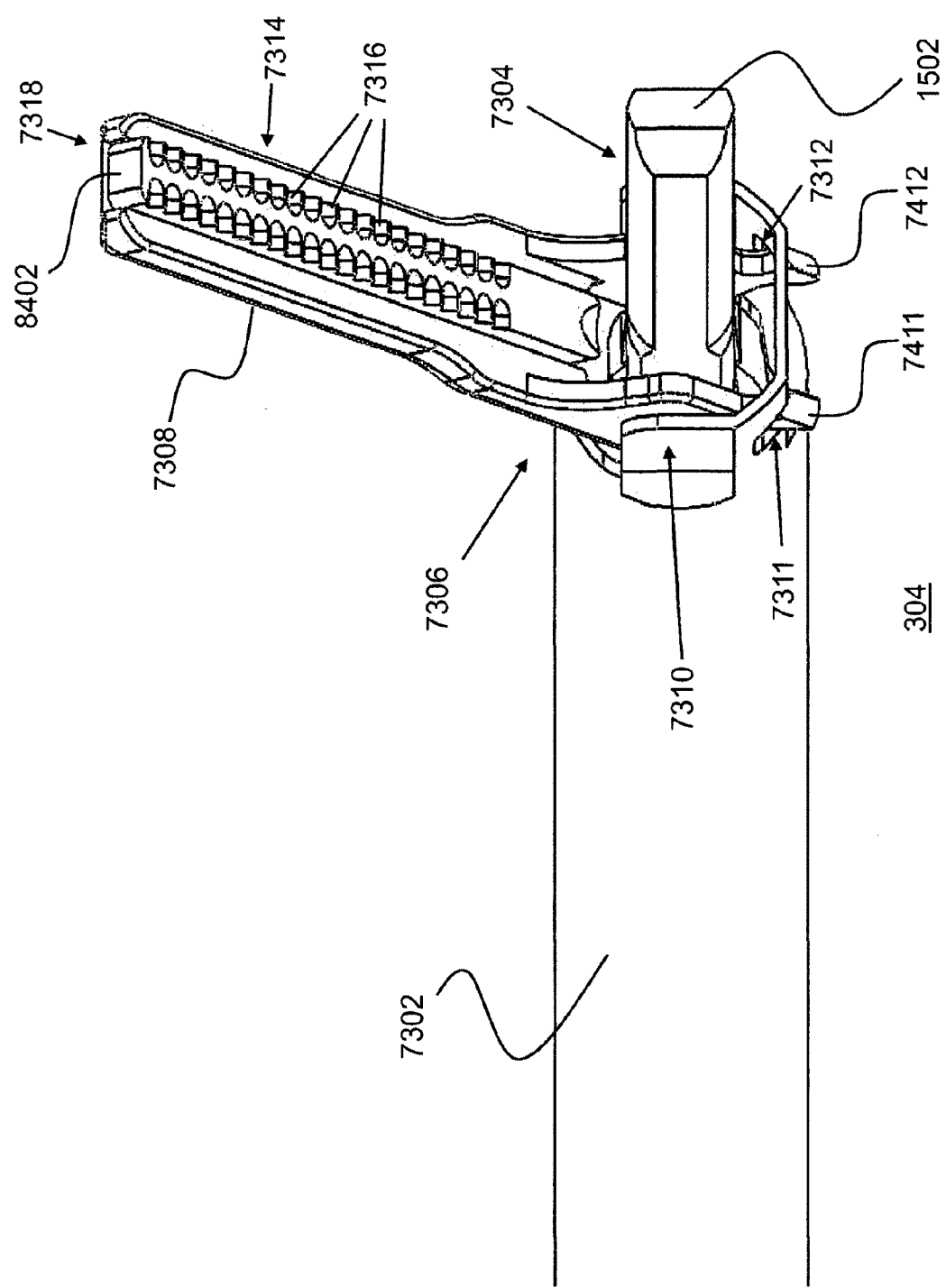


FIG. 73

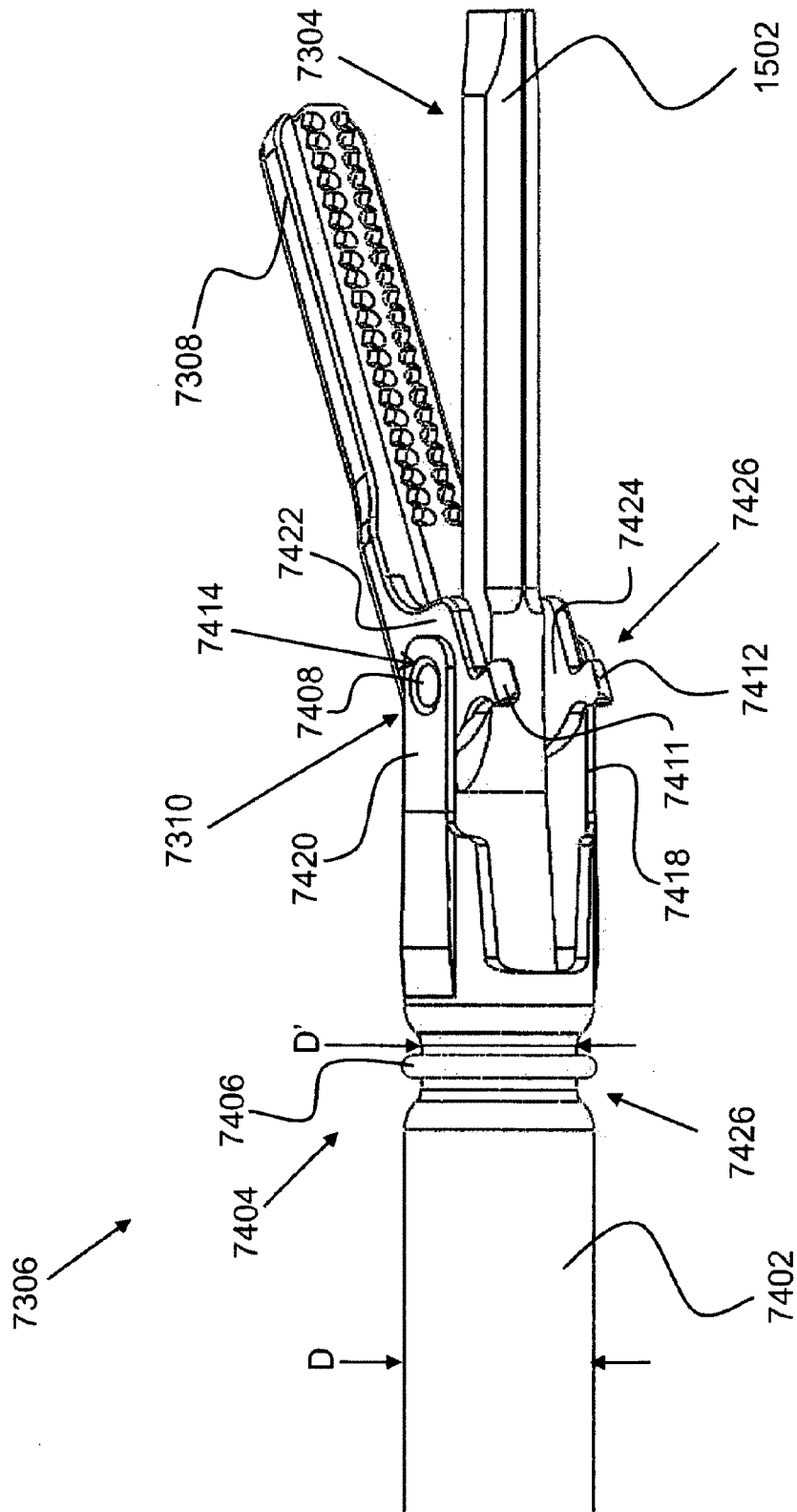


FIG. 74

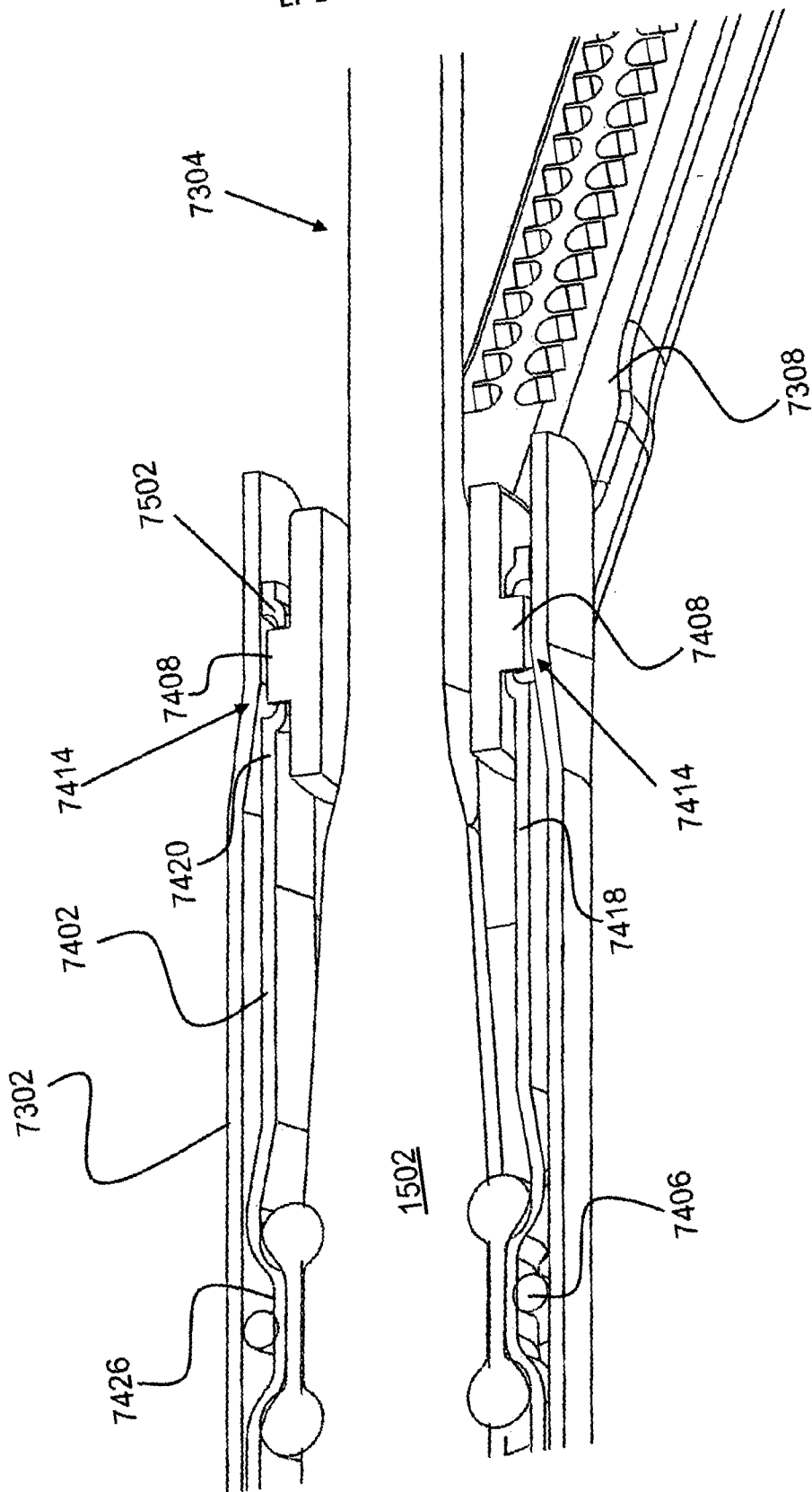


FIG. 75

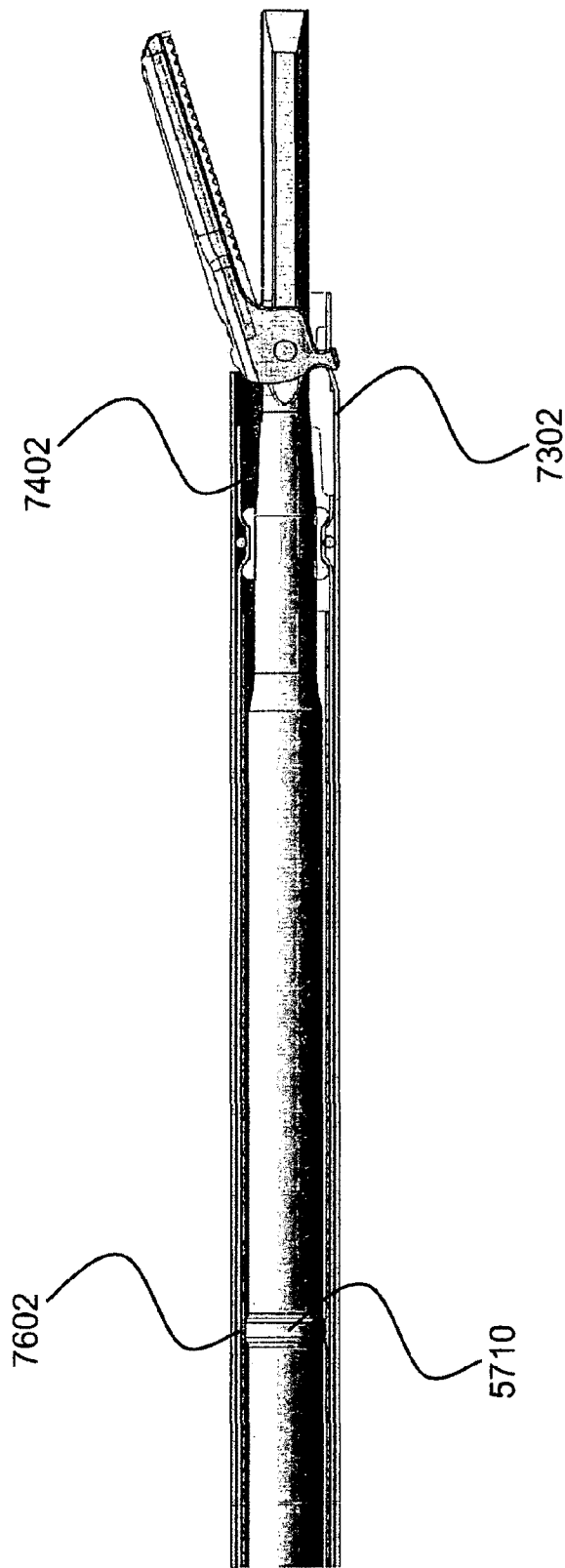


FIG. 76

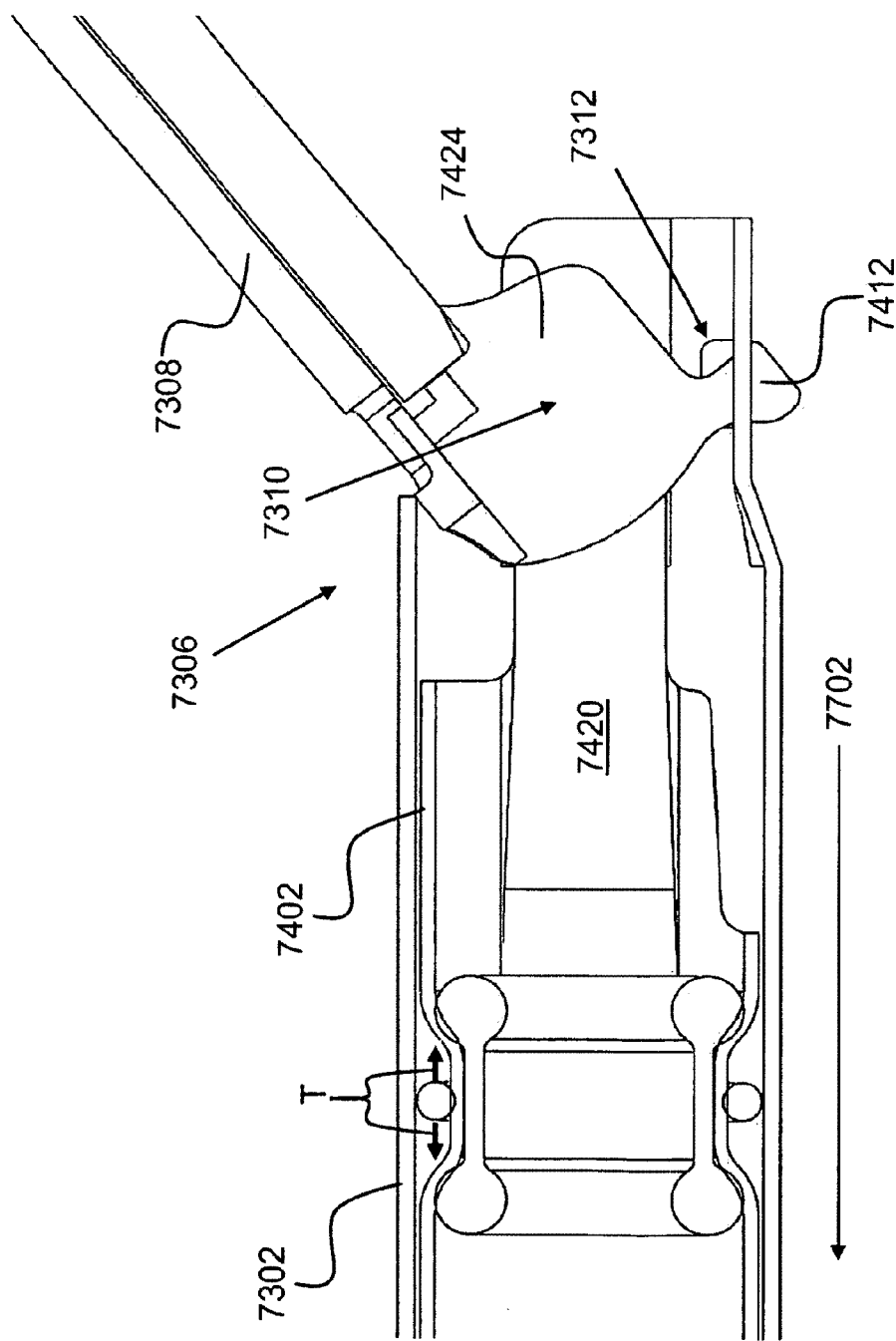


FIG. 77

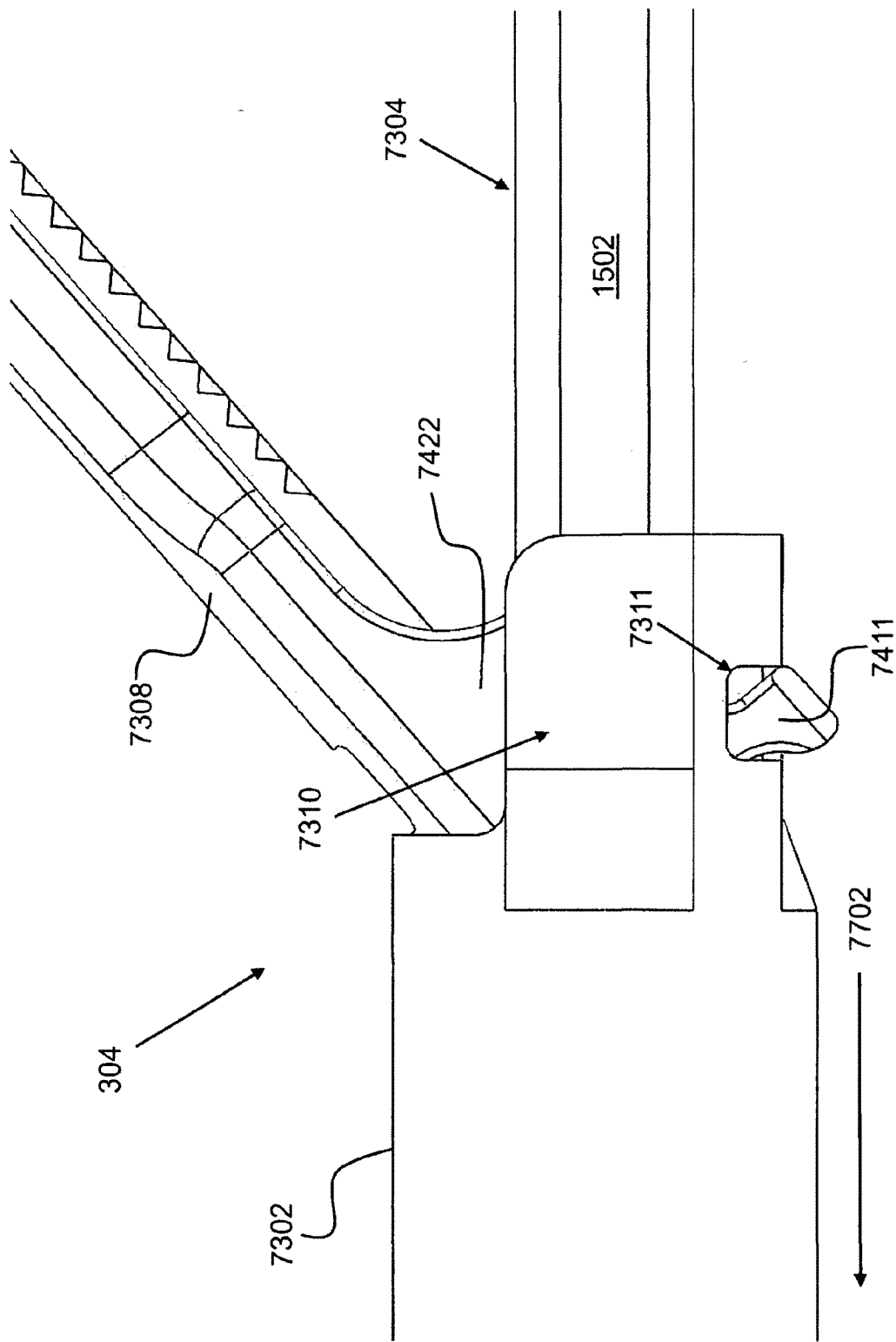


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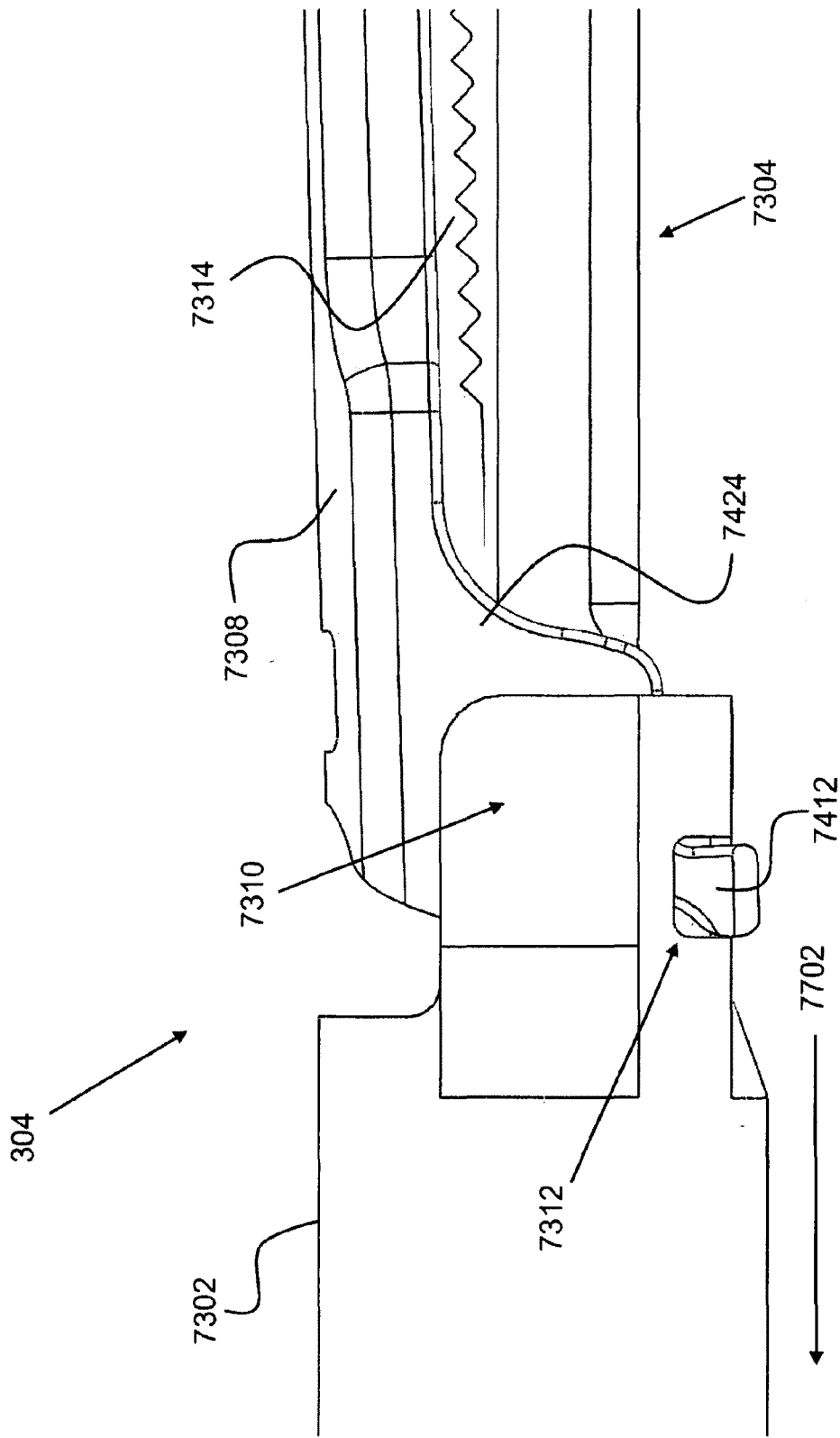


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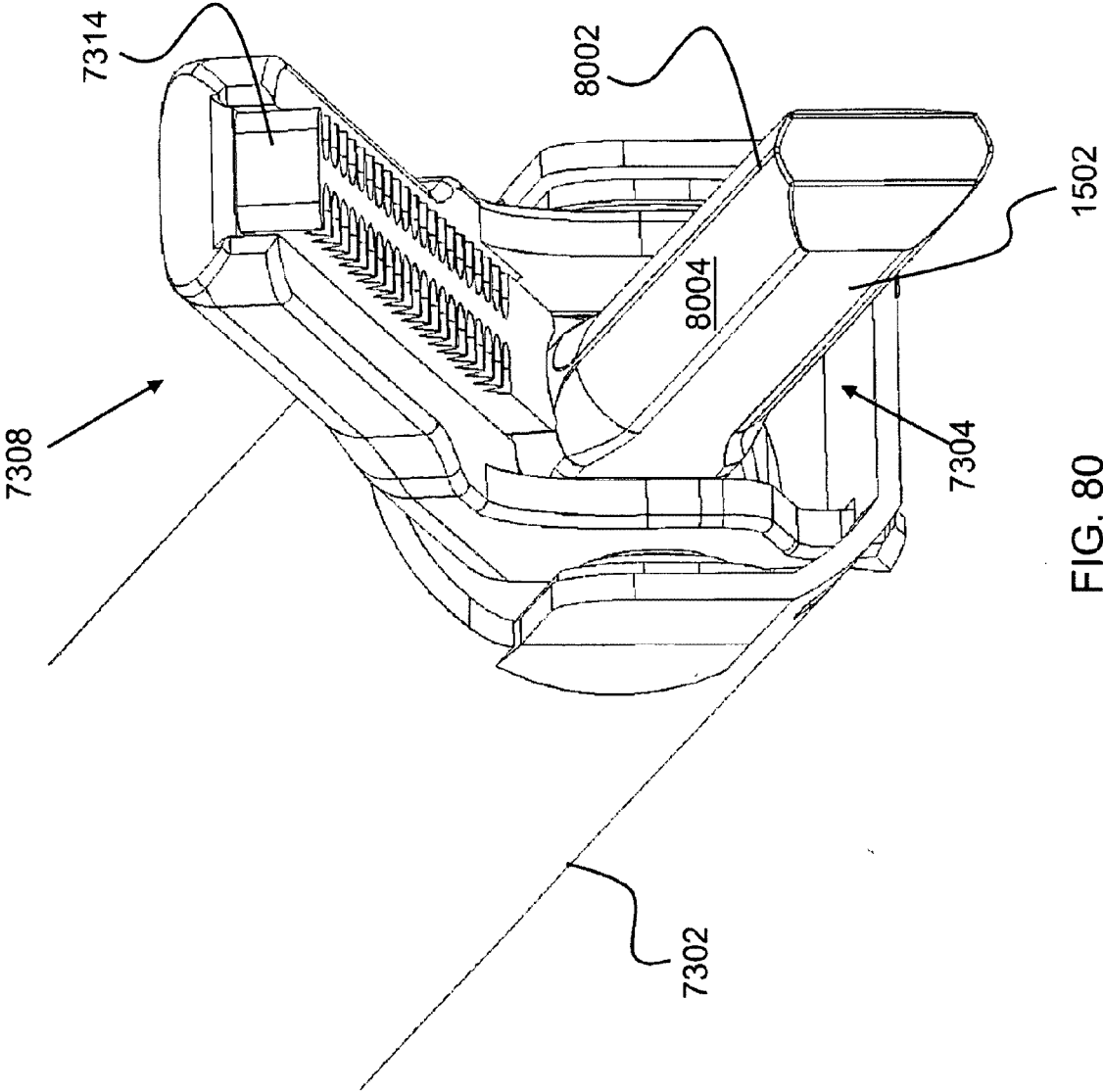


FIG. 80

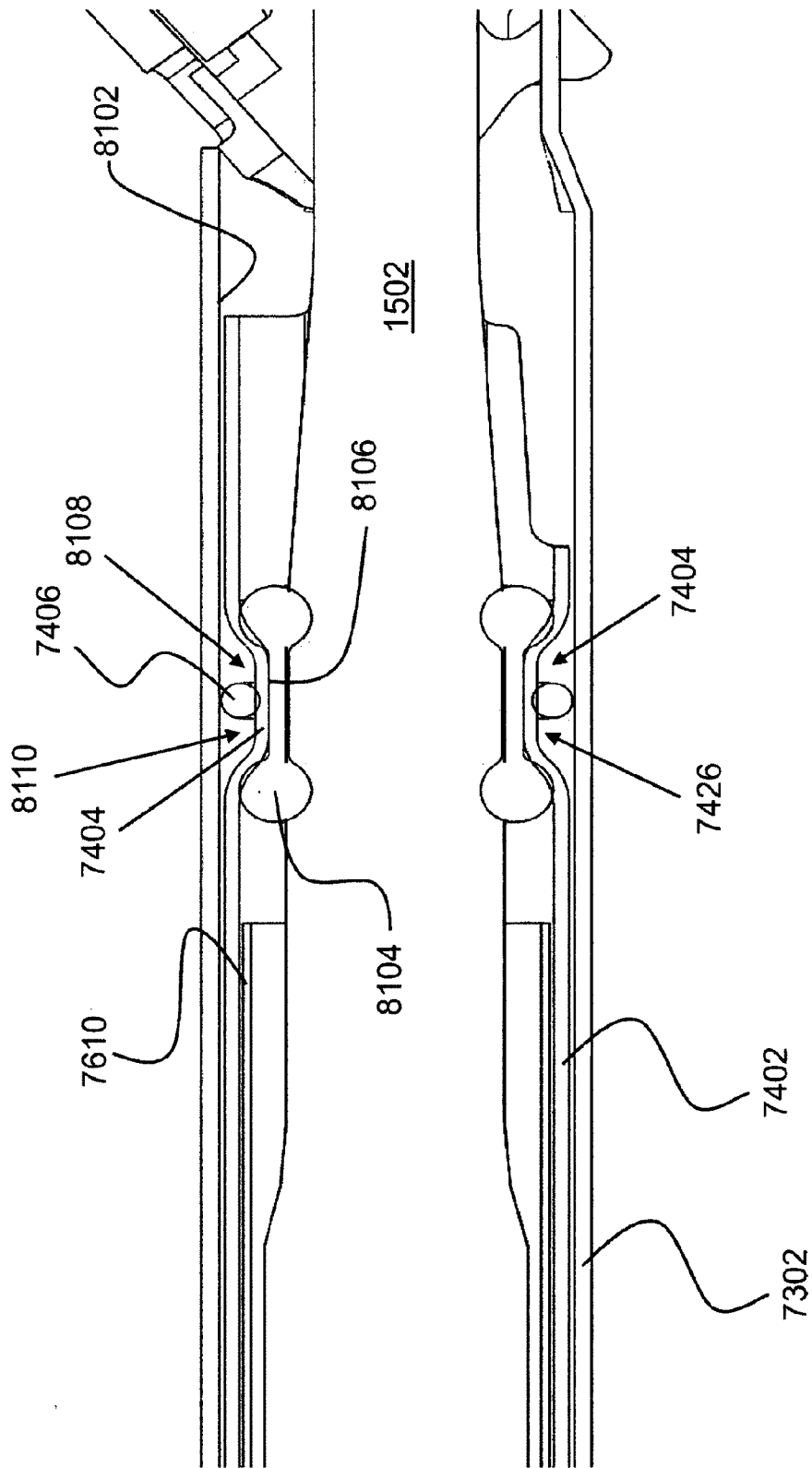


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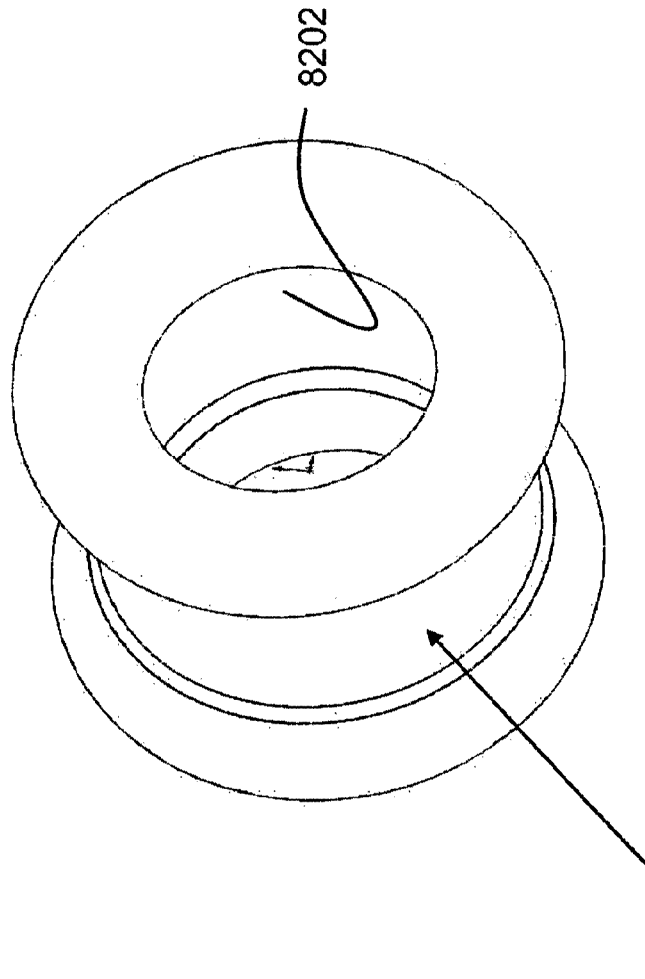


FIG. 82

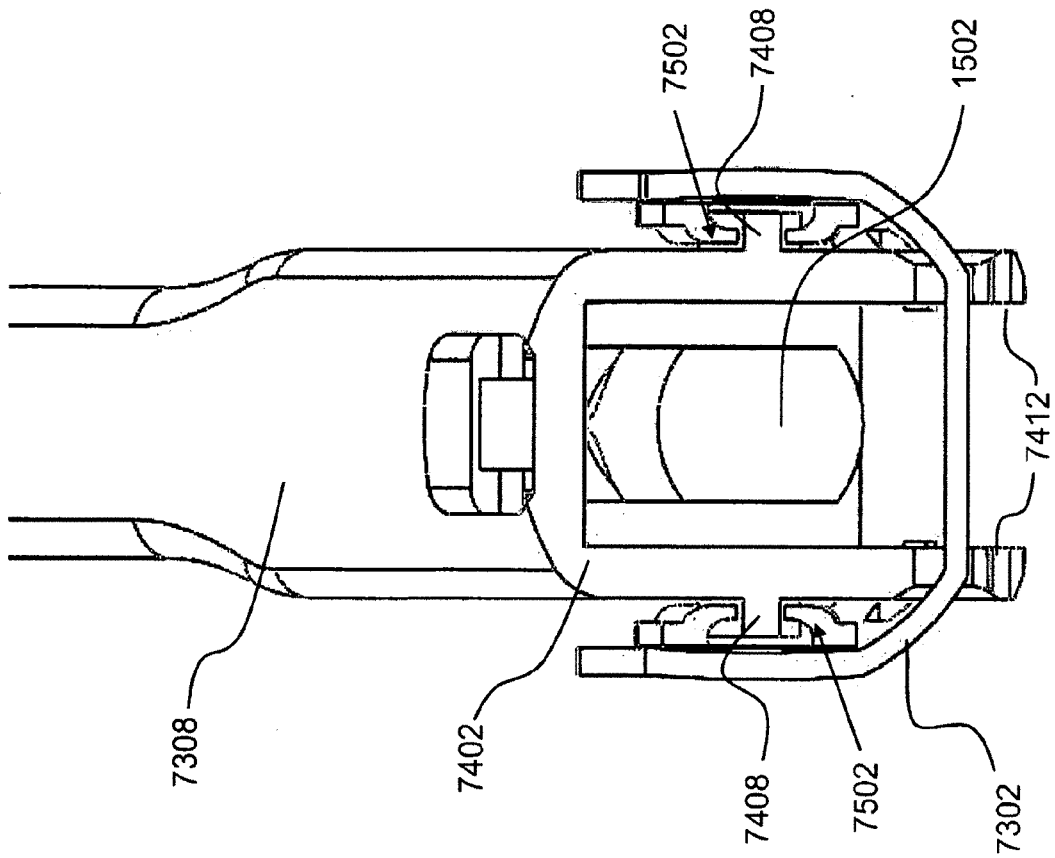


FIG. 83

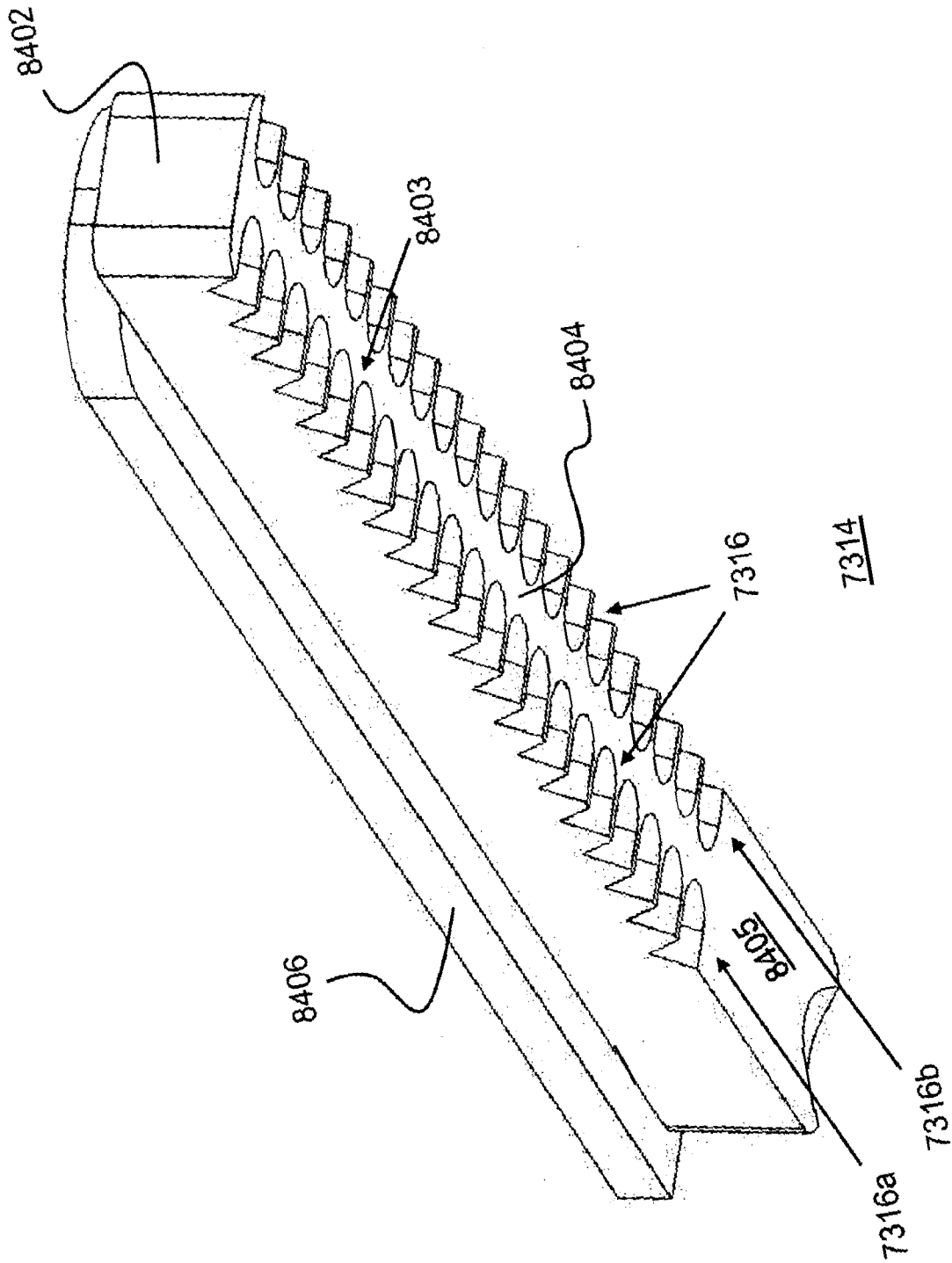


FIG. 84

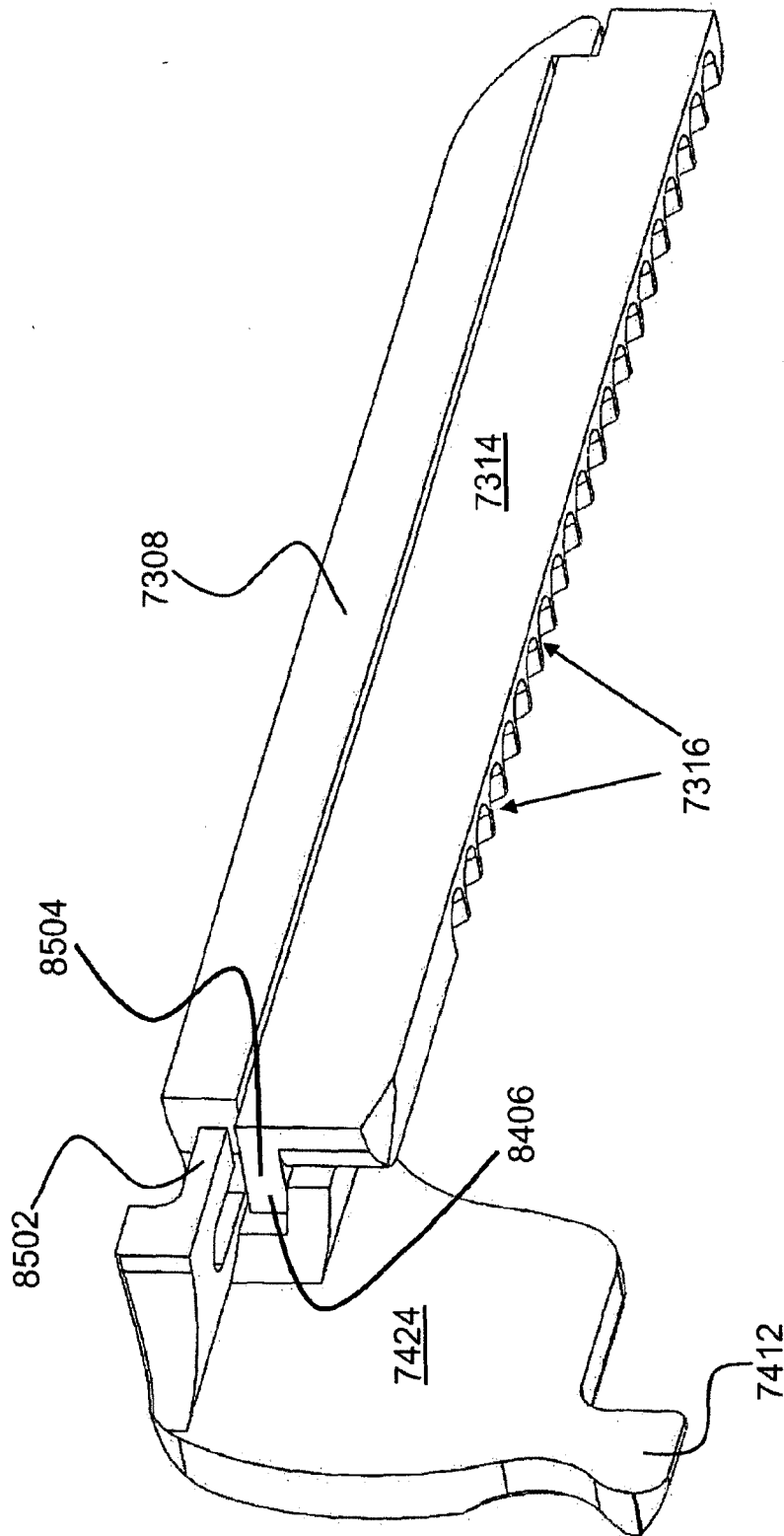


FIG. 85

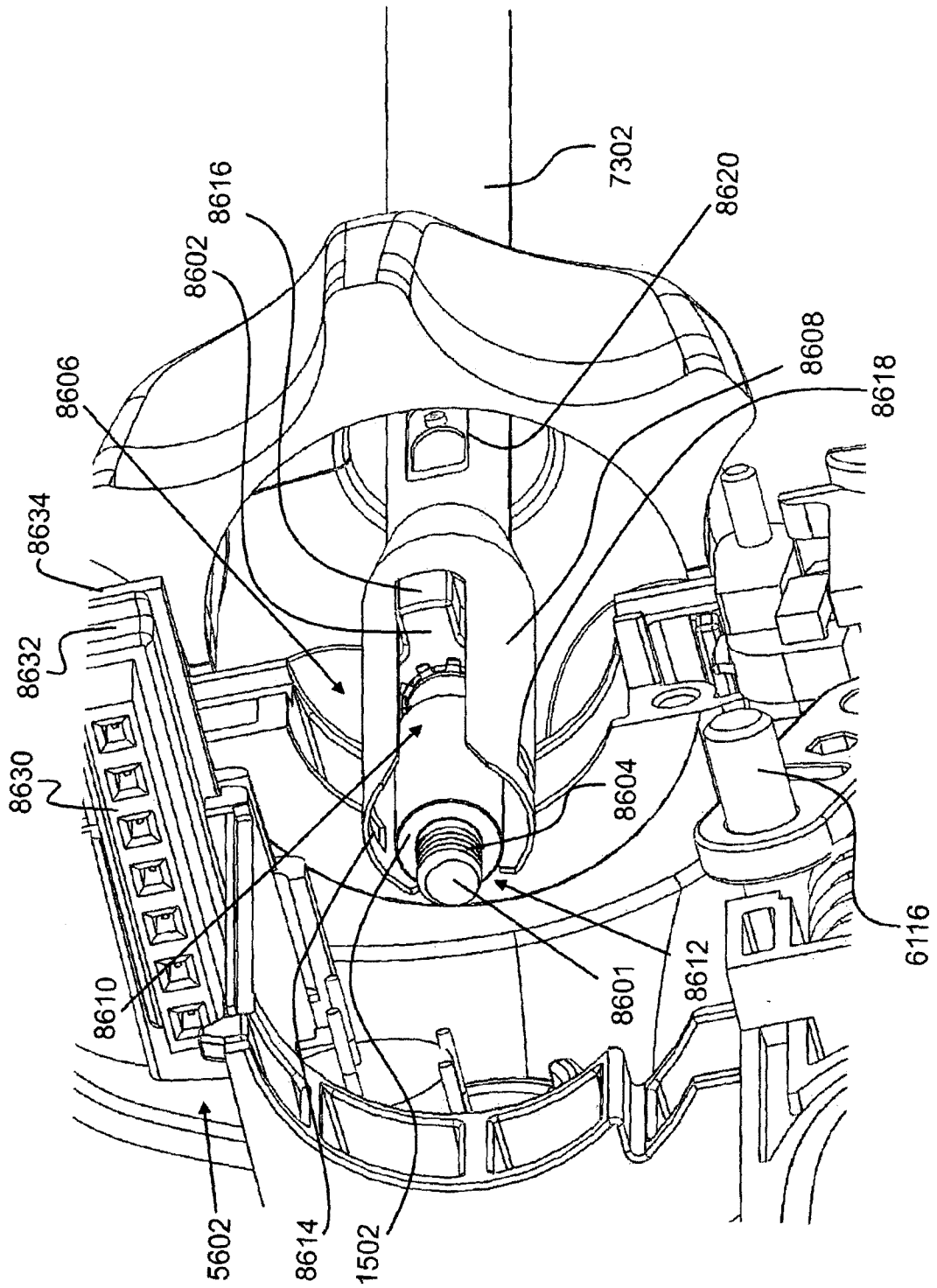


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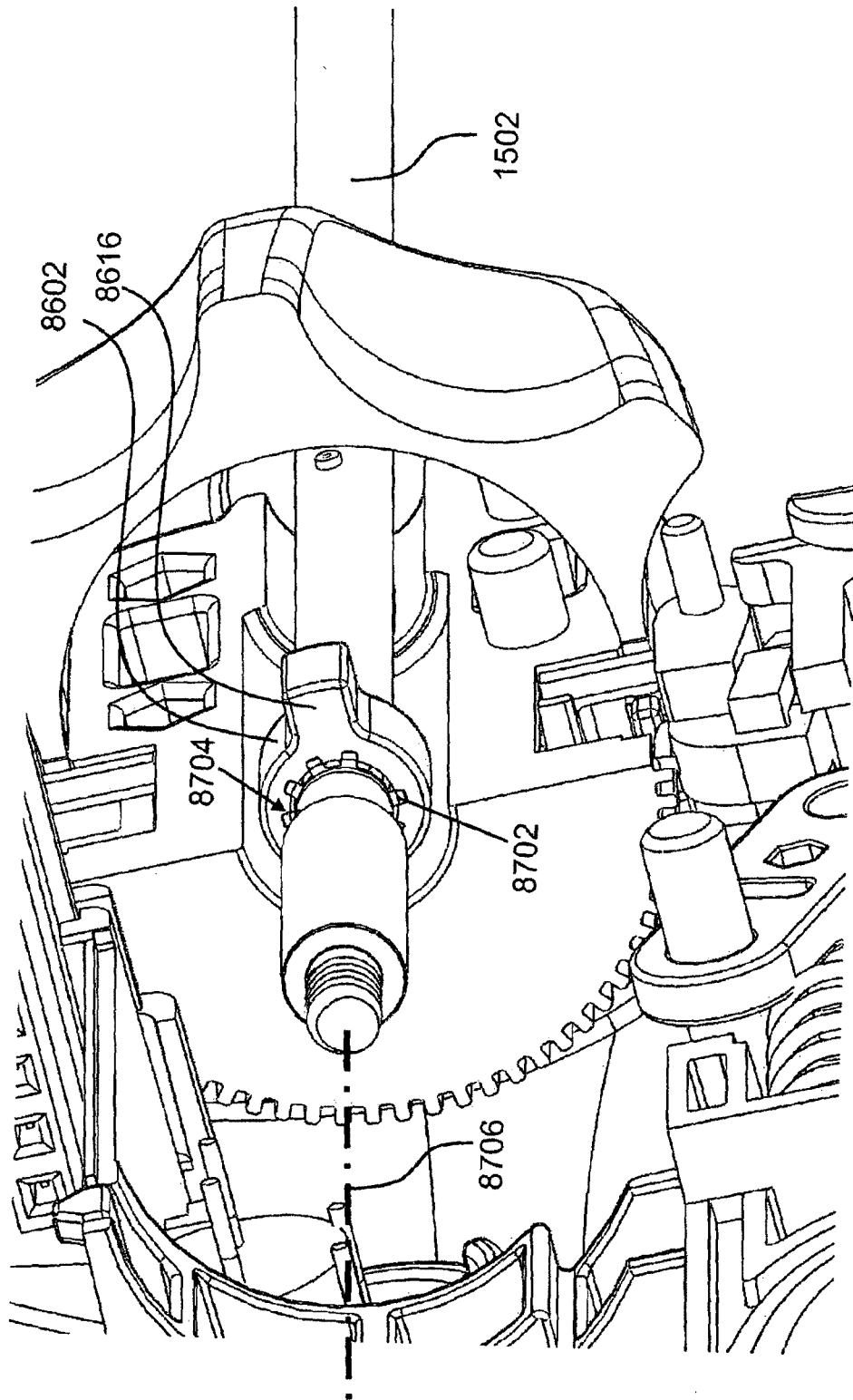


FIG. 87

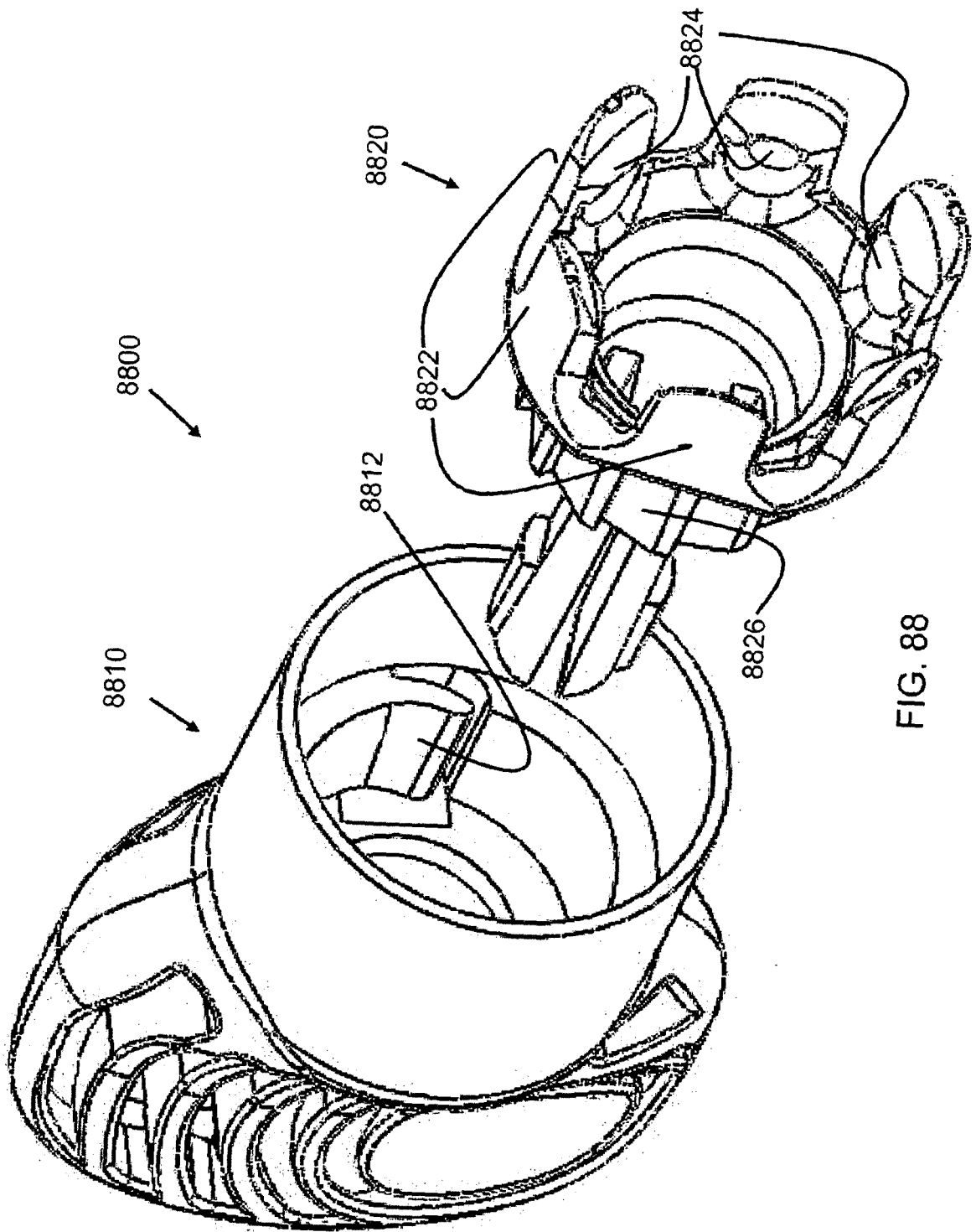


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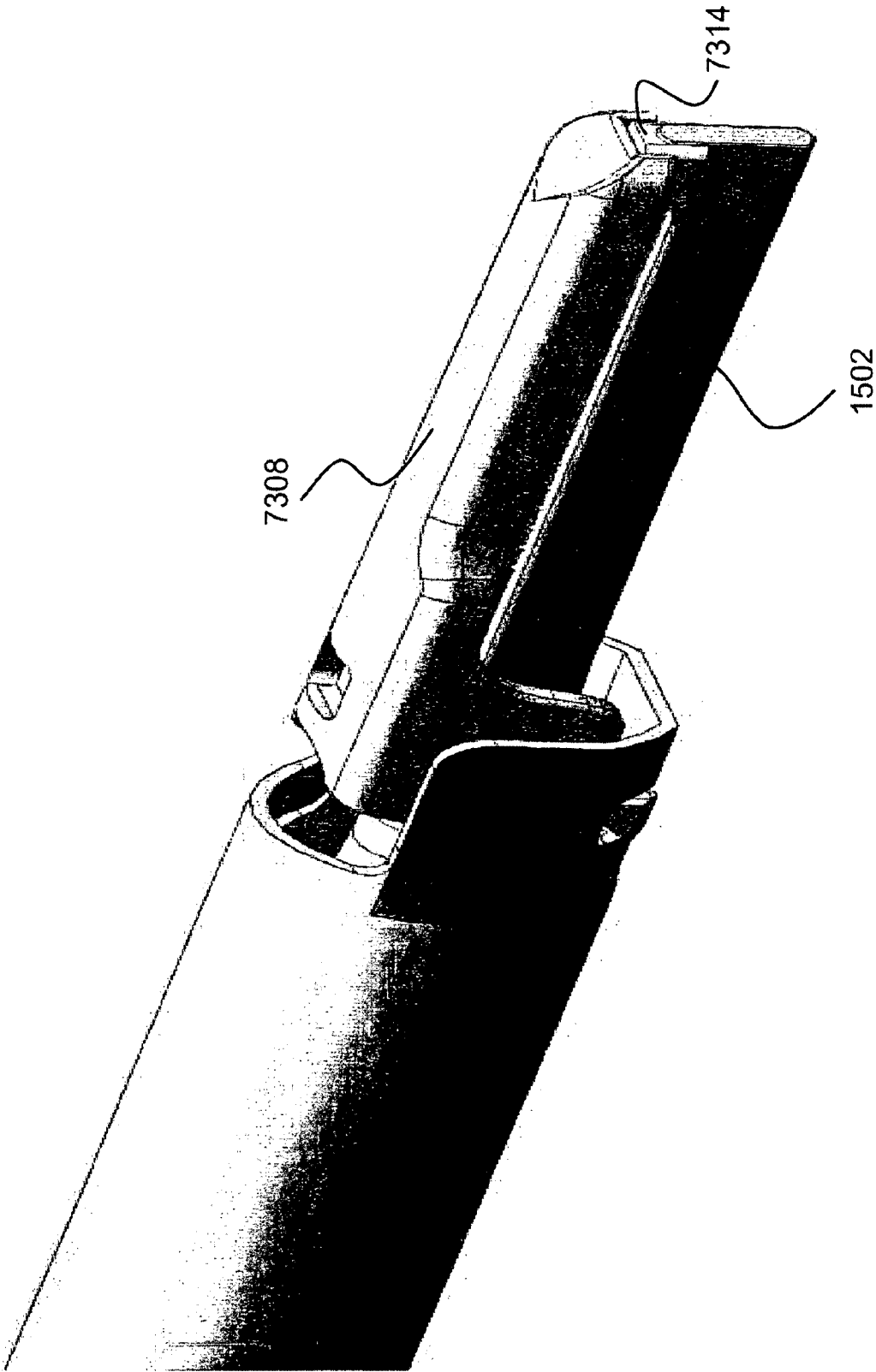


FIG. 89

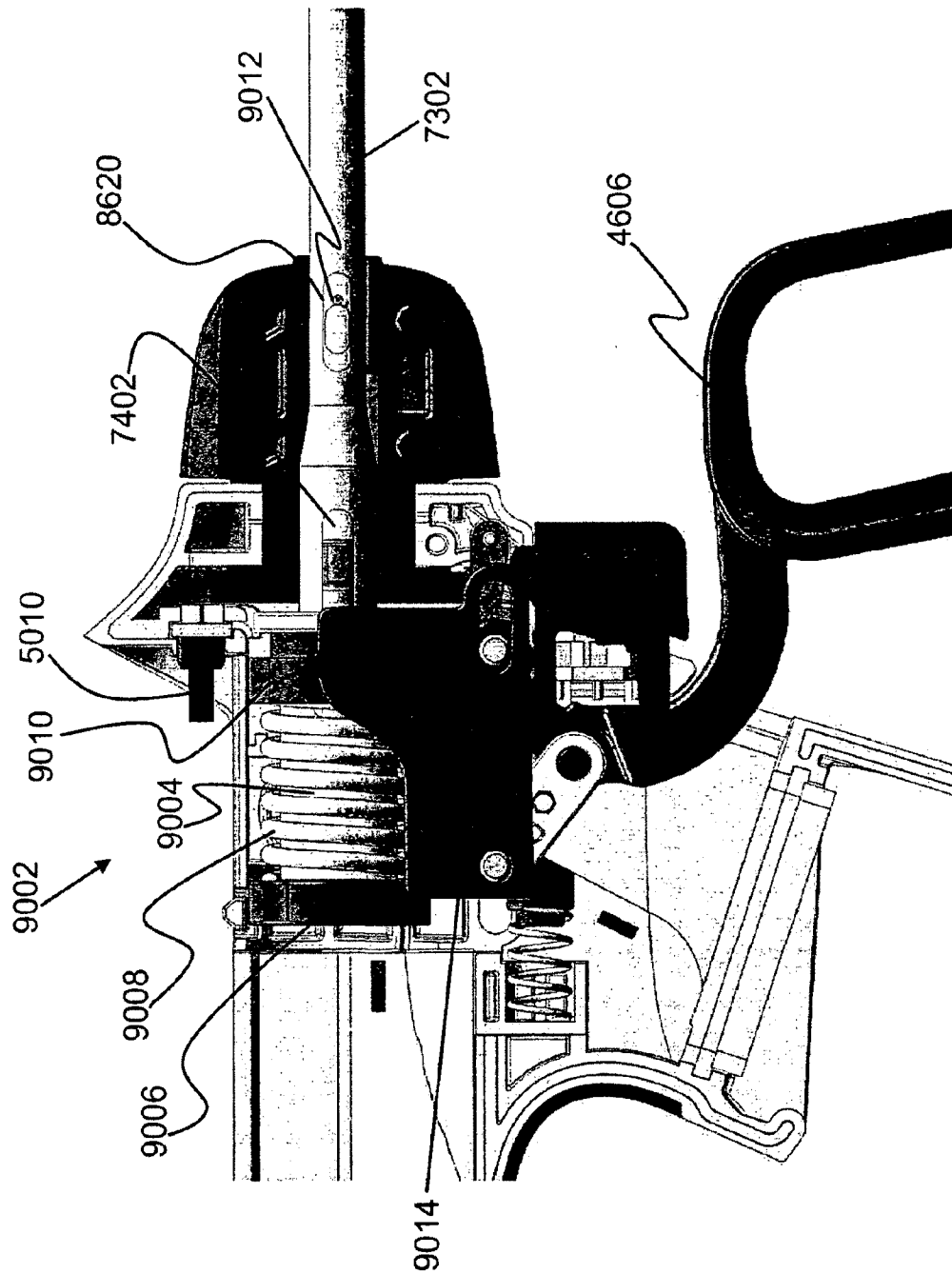


FIG. 90

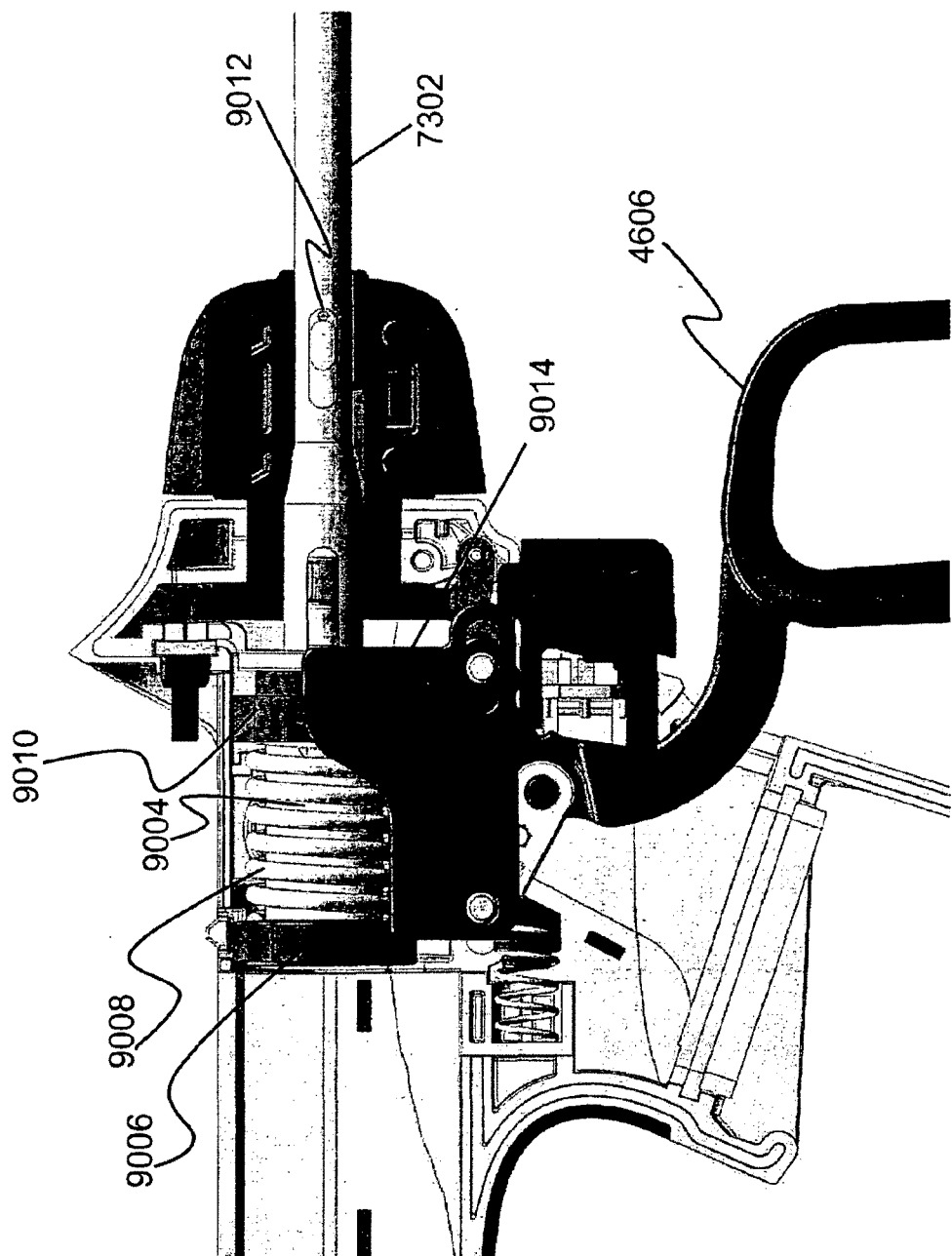


FIG. 91

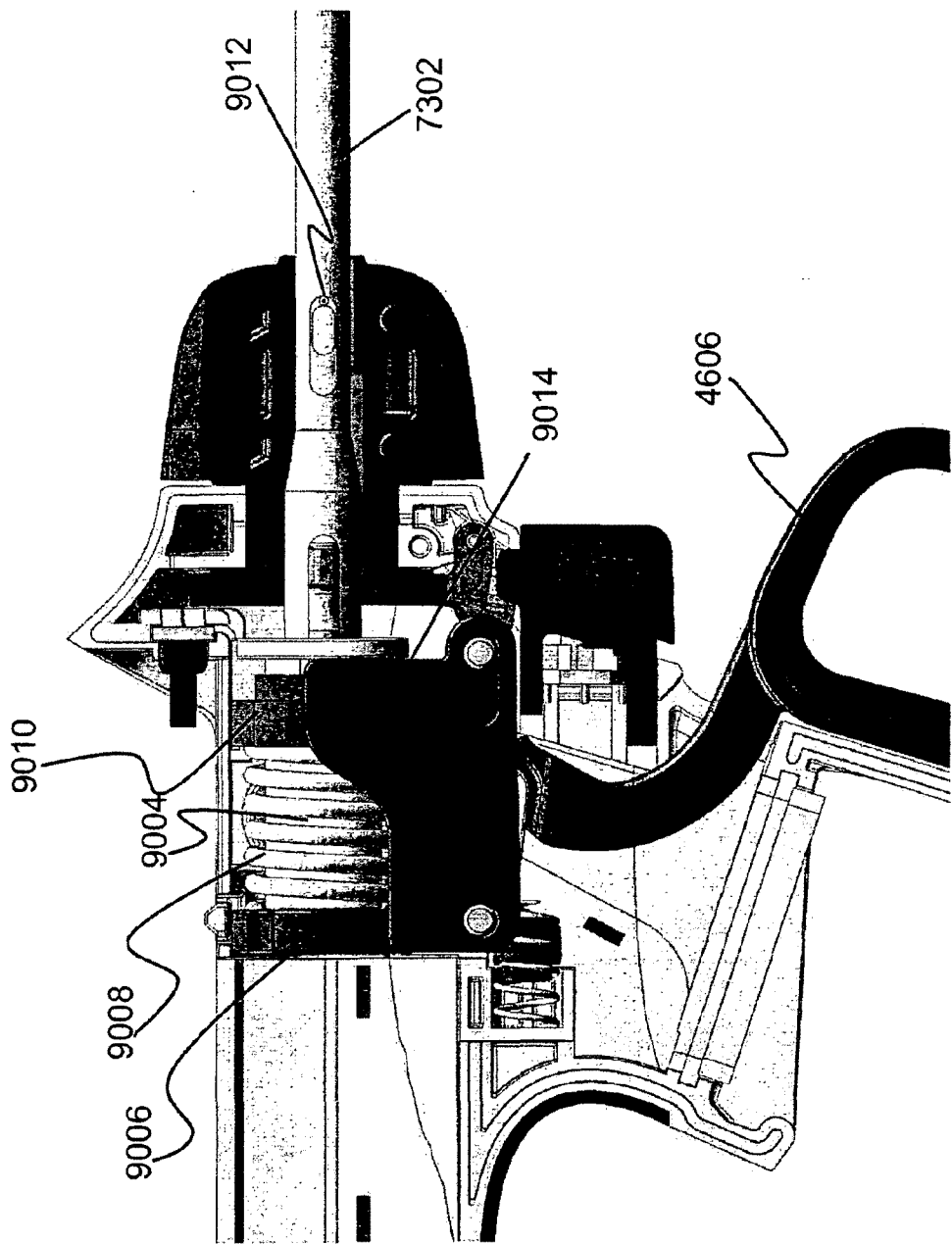


FIG. 92

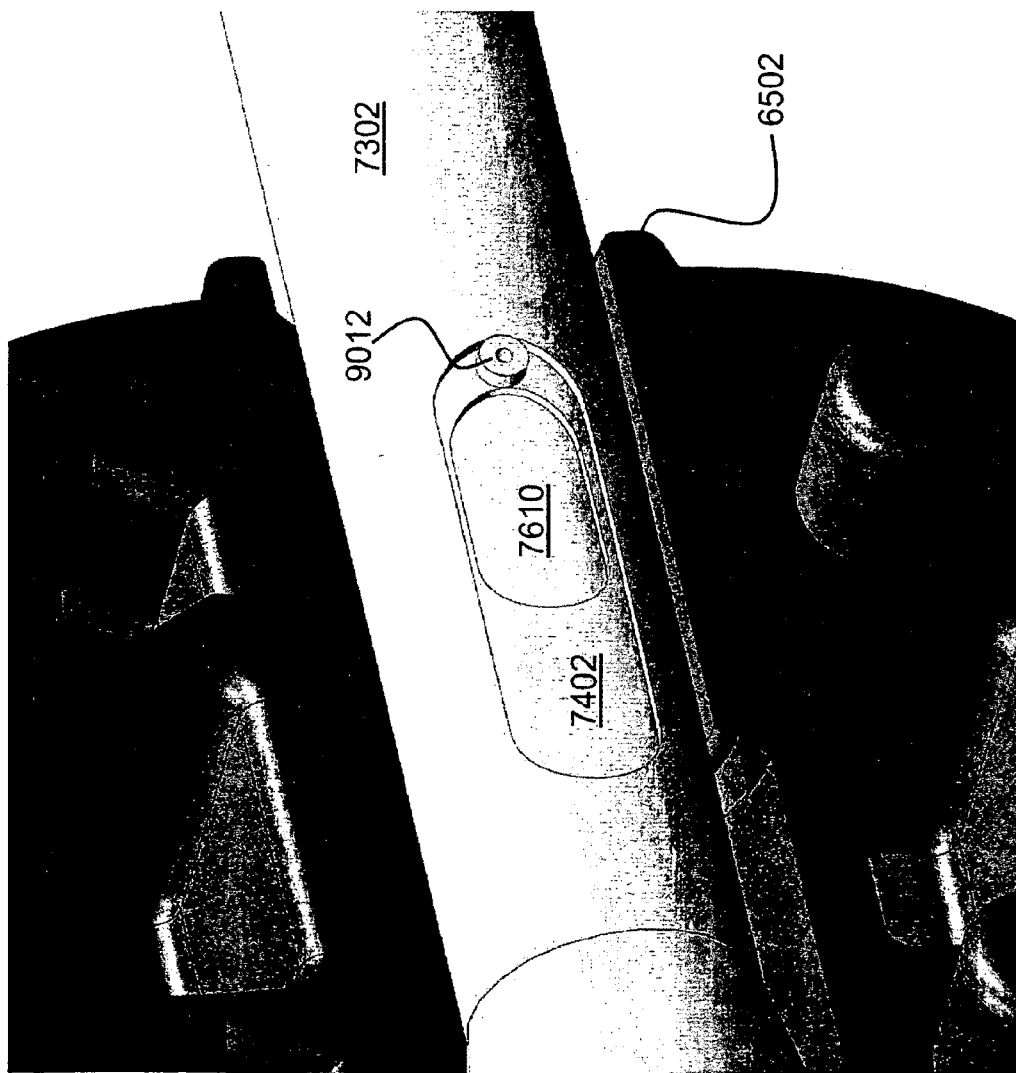


FIG. 93

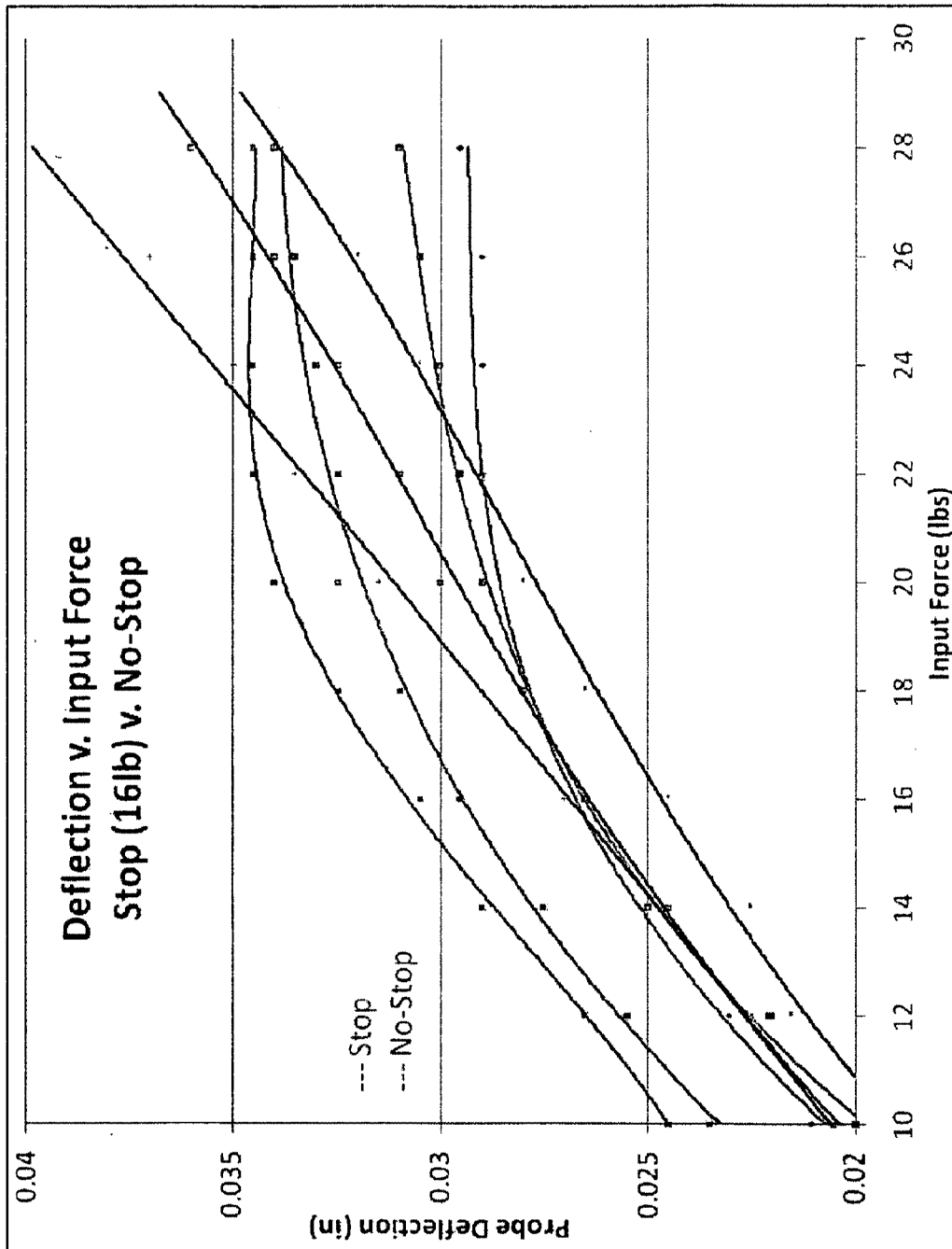


FIG. 94

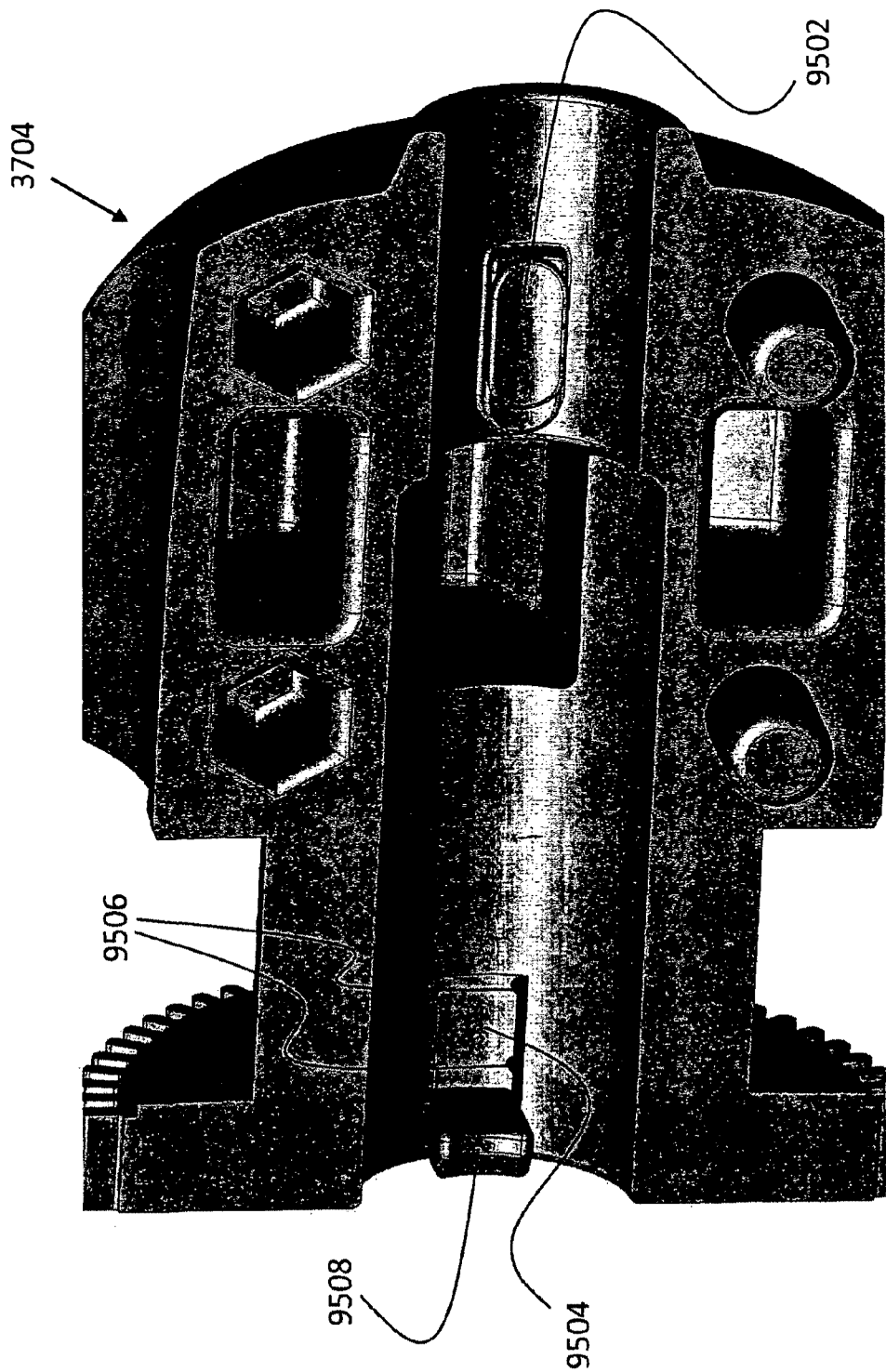
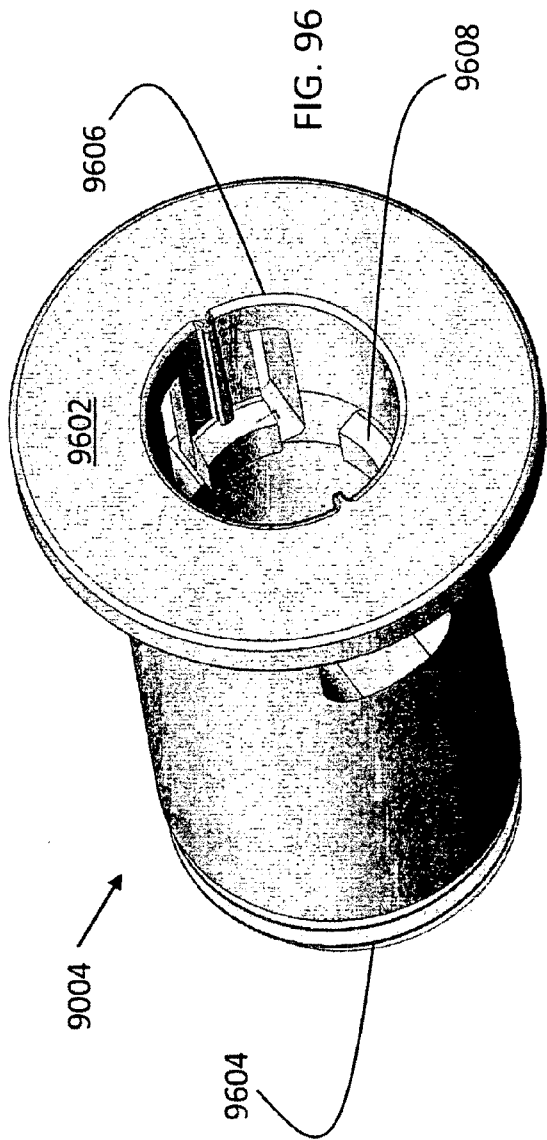
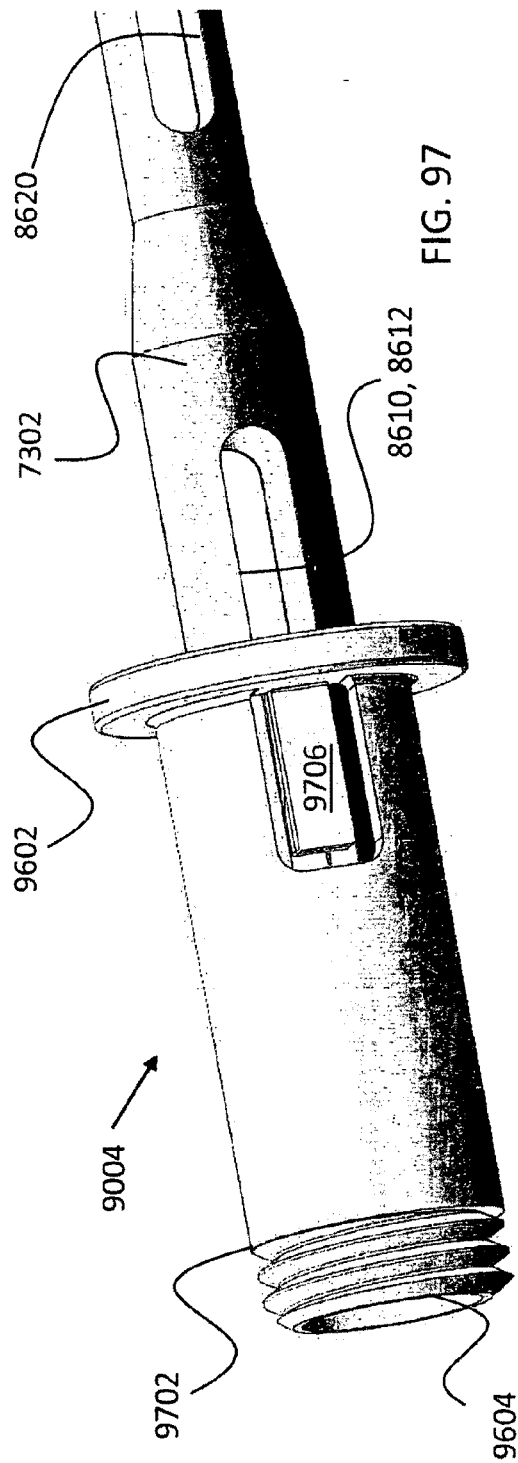
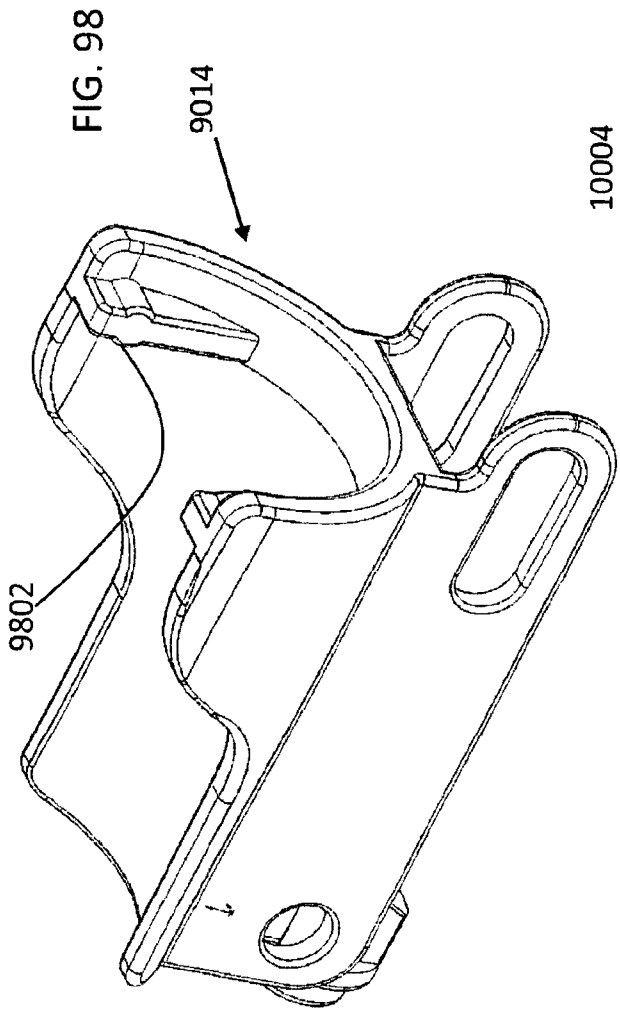
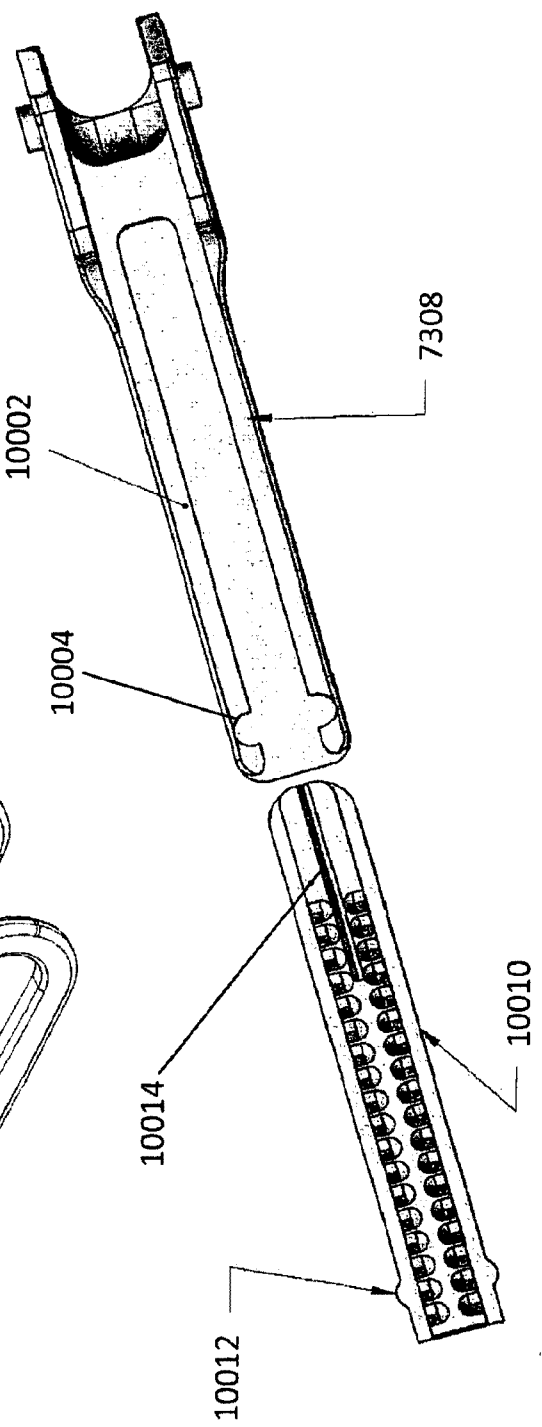


FIG. 95





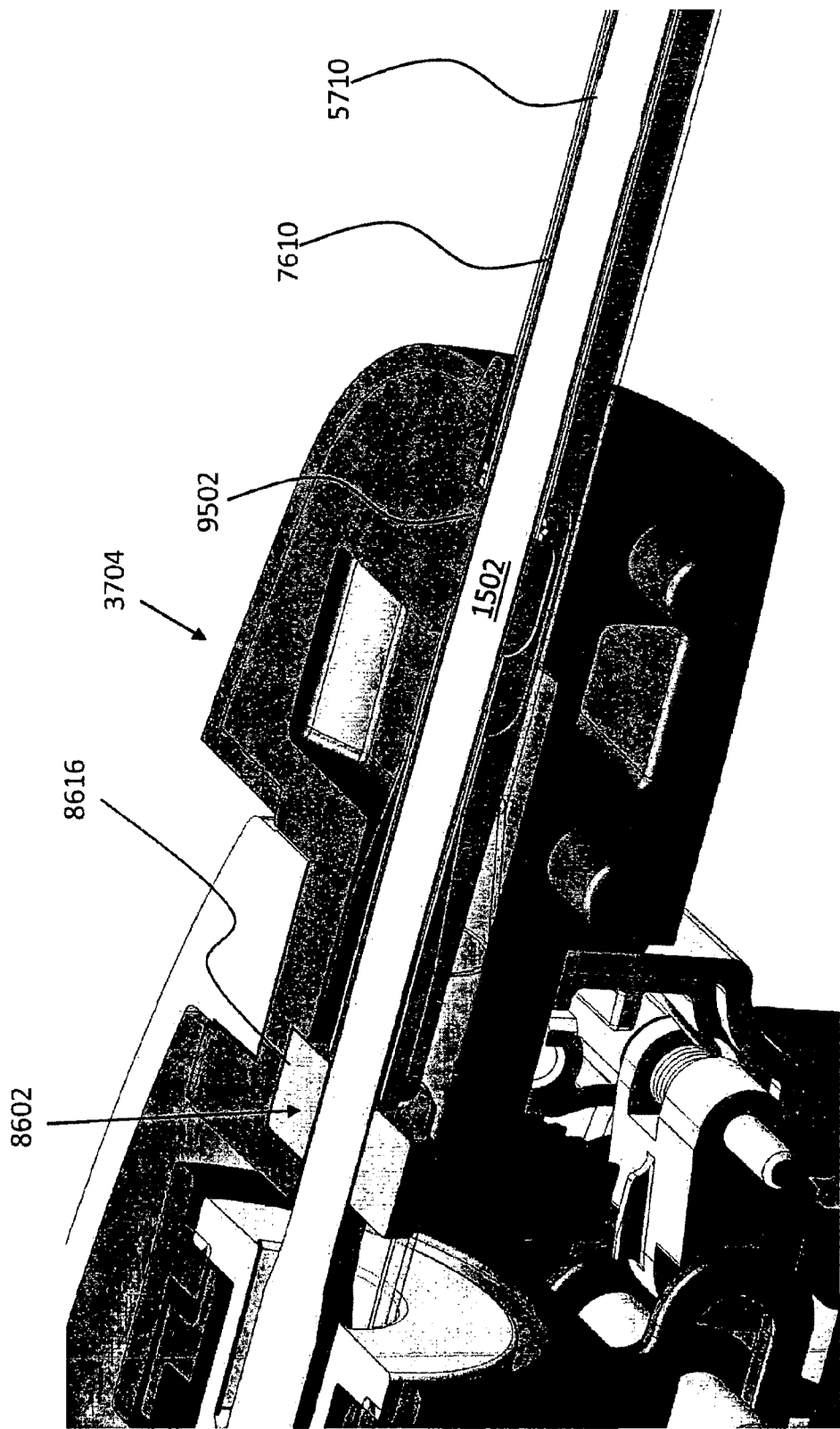
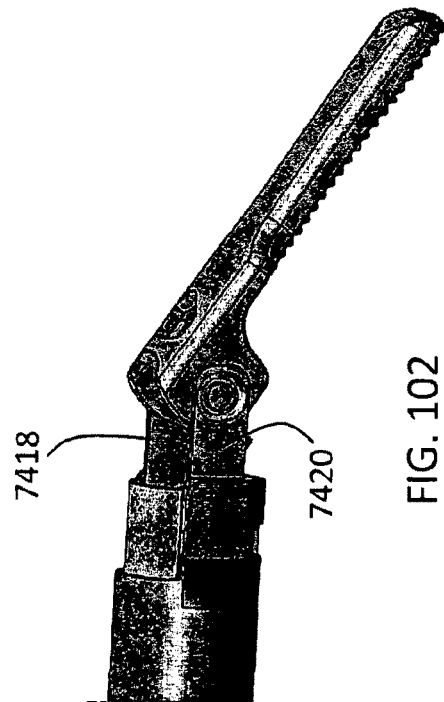
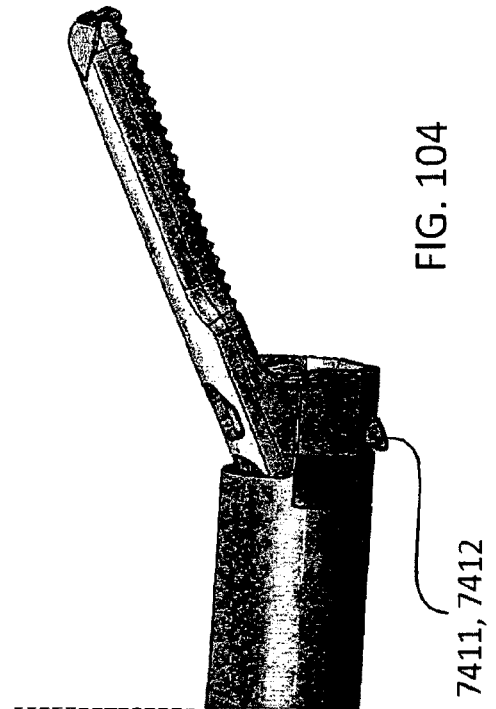
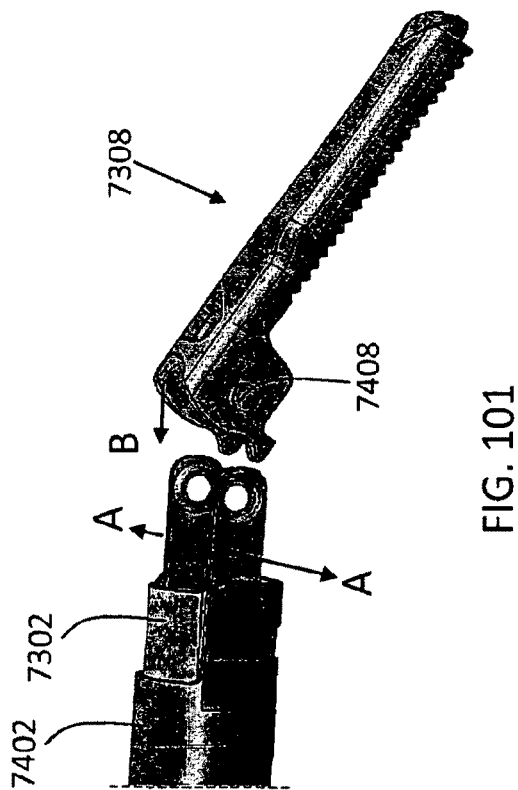
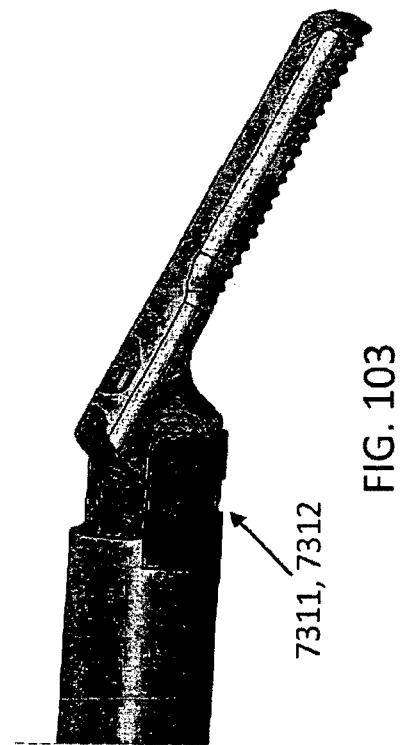


FIG. 99



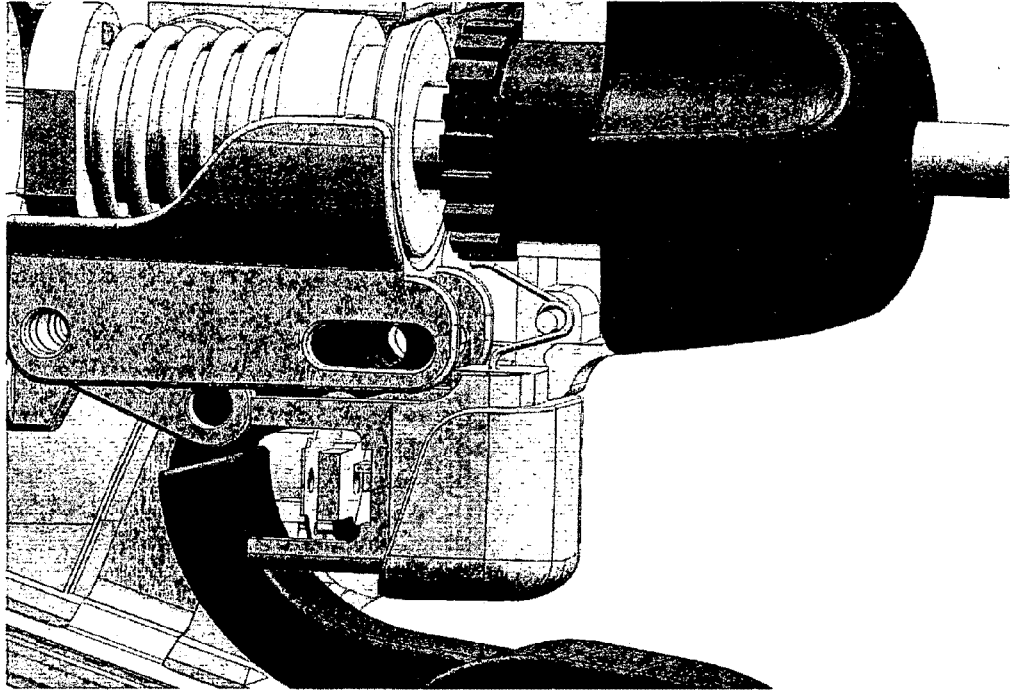


FIG. 105

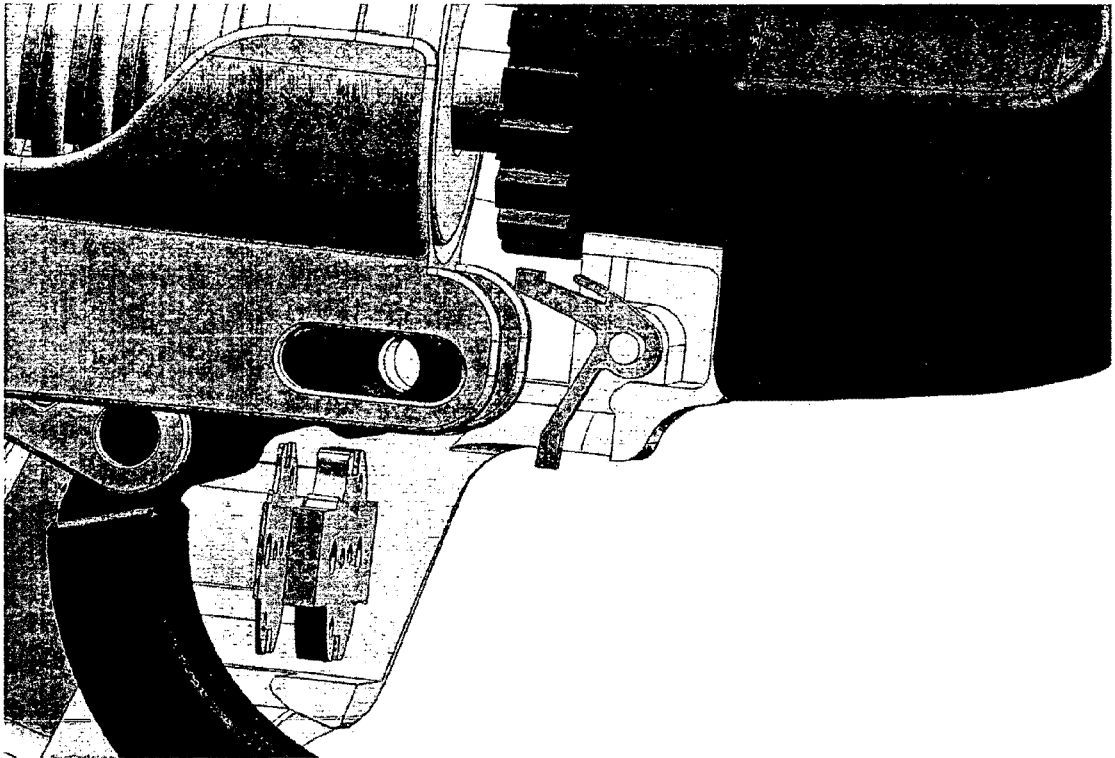


FIG. 106

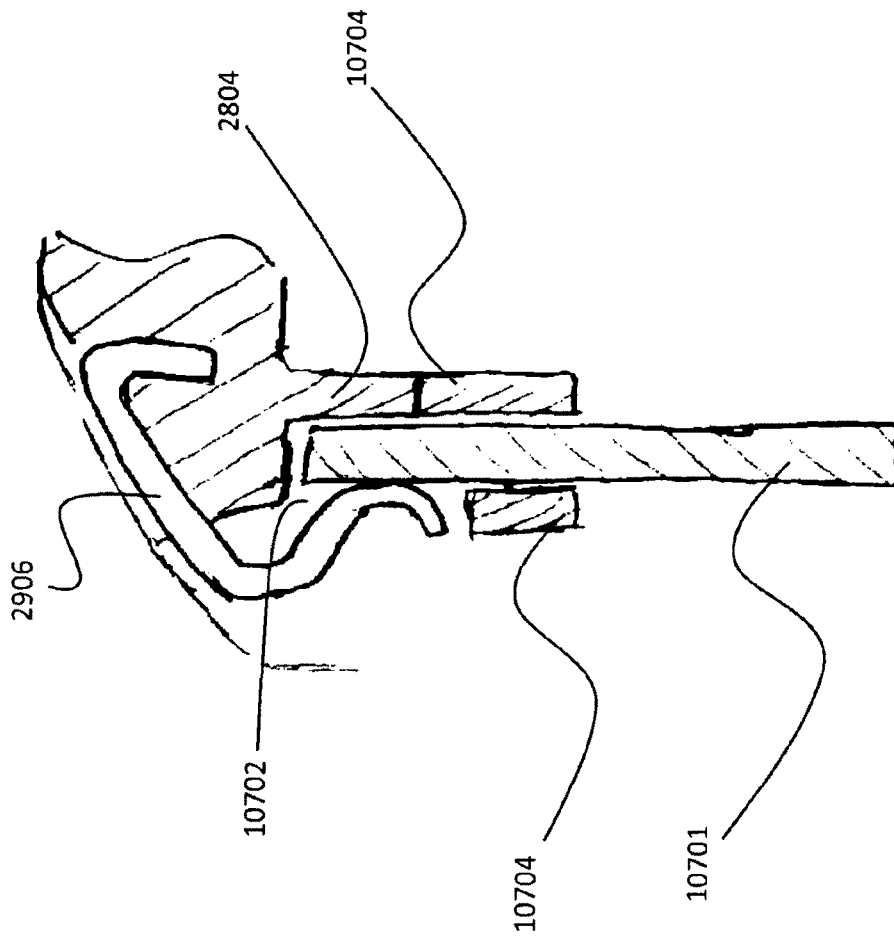


FIG. 107

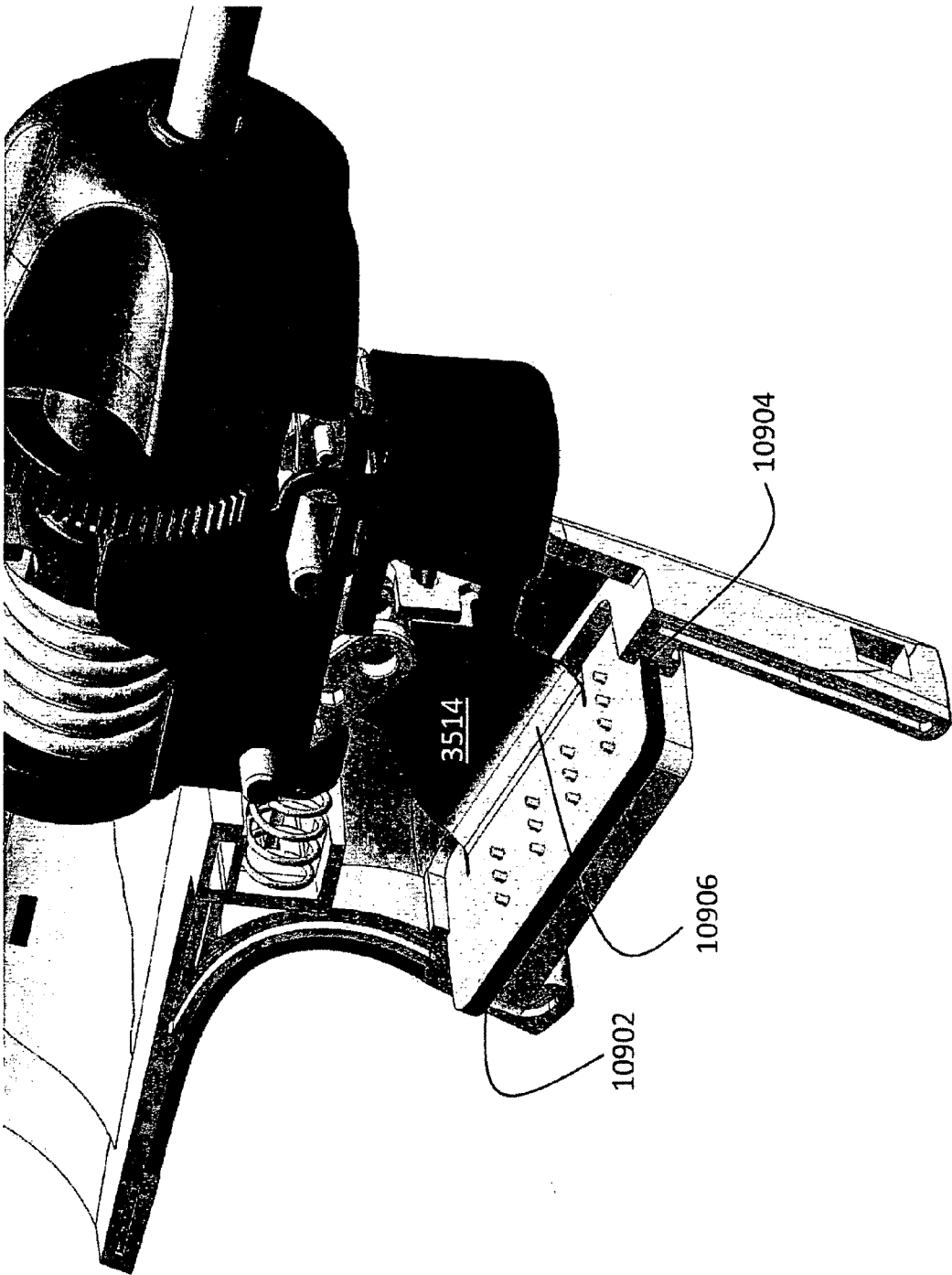


FIG. 109

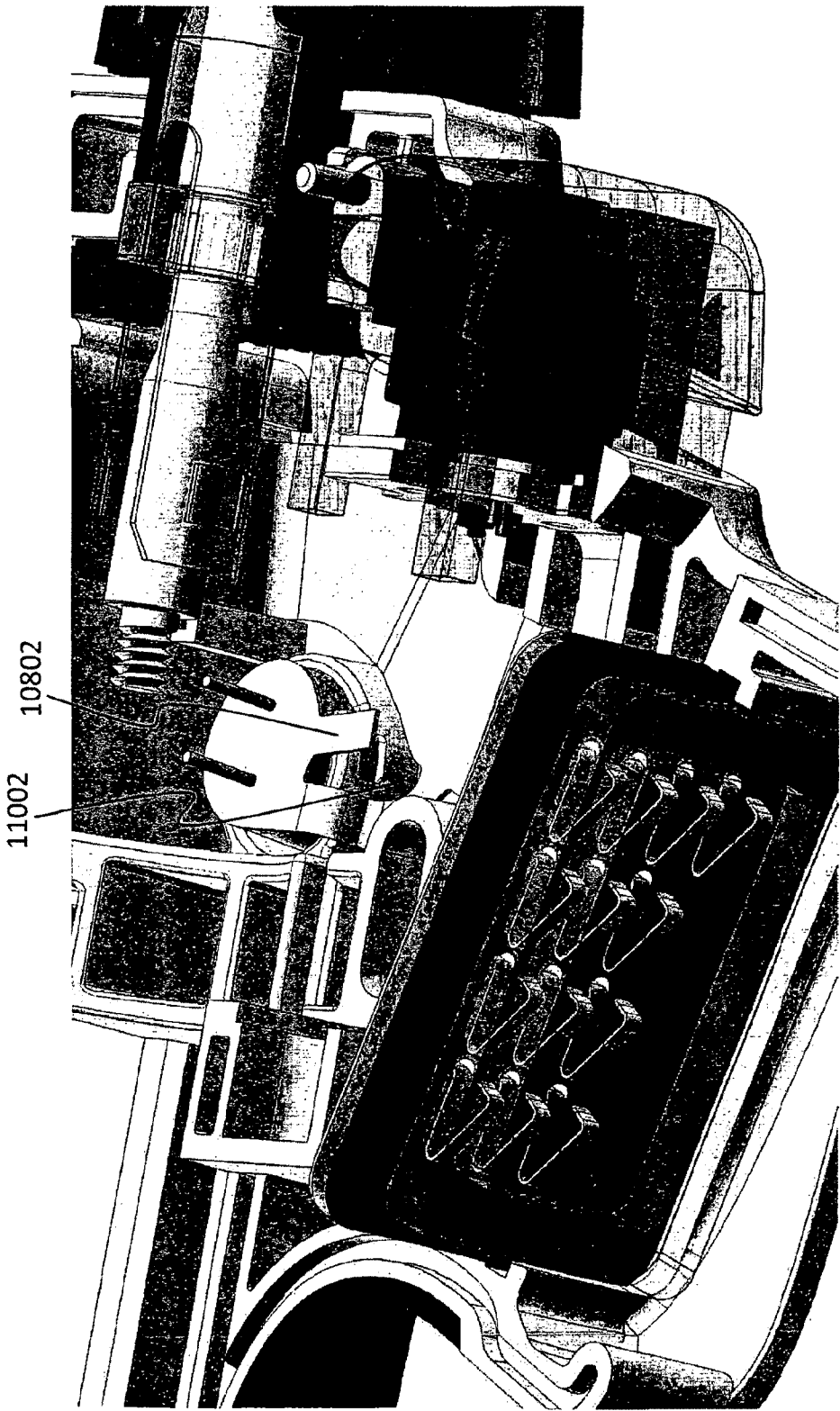


FIG. 110

REFERENCES CITED IN THE DESCRIPTION

This list of references cited by the applicant is for the reader's convenience only. It does not form part of the European patent document. Even though great care has been taken in compiling the references, errors or omissions cannot be excluded and the EPO disclaims all liability in this regard.

Patent documents cited in the description

- EP 1594209 A [0012]

Beating massage device

Abstract

The utility model relates to a beating massage device, which belongs to the field of medical appliances. The utility model is mainly composed of a power supply, a casing, a motor, a worm and gear mechanism, a roller, a cam, a rocker arm, a spring and a vibrator. The cam on a worm wheel causes the vibrator to continuously and alternately beat and massage a human body through the roller. The utility model can promote the blood circulation of the human body, activate blood circulation to dissipate blood stasis, eliminate pain, and relieve fatigue, with safe utilization. The utility model is an indispensable medical care appliance for a modern family.

Other languages: Chinese

Inventor: 林介昌, 姜丽凤

Worldwide applications

1995 [CN](#)

Application CN 95205097 events

1995-03-20 Application filed by 林介昌, 姜丽凤

1995-03-20 Priority to CN 95205097

1995-09-20 Application granted

1995-09-20 Publication of CN2207816Y

Info: Cited by (2), Legal events, Similar documents, Priority and Related Applications

External links: Espacenet, Global Dossier, Discuss

Claims (5)

Hide Dependent 

1, a kind of formula masseur of beating, form by power supply, housing, motor and oscillator, it is characterized in that: an end of motor shaft inserts in the groove of worm screw 11 ends, bearing 13 is housed on the housing medial wall, the joint 6 at worm gear two ends cooperates with bearing, worm gear 12 and worm engaging respectively have a size identical on the worm gear both ends of the surface, and the opposite cam 5 of direction; Also be equipped with a crossbeam 24 in the housing, an end of extension spring 23 hangs on this beam, and the other end is contained on the rocking arm 17, and masseur has two rocking arms, lays respectively at the worm gear both sides, and rocker arm shaft 22 passes the hole on the rocking arm, and rocking arm can be rotated around axle 22 jointly; The rear end of two rocking arms is equipped with roller 18, and lining 16 is housed in its centre bore, respectively with little axle 15 linings 16 that pass on the roller of rocking arm rear end, and the hole that reuse latch 14 inserts on the little axle head head, two rollers rotate on little axle.

2, masseur according to claim 1 is characterized in that: the front end of two rocking arms 17 all has spring 21, is connected with oscillator 20 by spring.

3, masseur according to claim 2 is characterized in that: oscillator is inlaid with metal derby 19.

4, masseur according to claim 1, it is characterized in that: housing is made up of two parts, i.e. and left-half 10 and right half part 25 are connected as a single entity two parts with screw 7, packing ring 8 and nut 9.

5, masseur according to claim 1 is characterized in that: housing is provided with external electric supply socket 1 and on and off switch 3; An end is equipped with battery holder in the housing.

Description

This utility model is a kind of formula masseur of beating, and it belongs to medical instruments field.

In daily life, during people's health a part pain, hands oneself commonly used or helped to beat massage by other people then can make pain alleviate or disappears; Owing to need exert oneself when beating massage, thereby both arms fatigue can not be lasting.

The purpose of this utility model is to overcome above-mentioned shortcoming, provides a kind of and automatically can beat the utensil of massage continuously lastingly, and its power of beating can steplessly be adjusted, and its effect is beaten massage as the human hands.

In order to achieve the above object, this utility model now is illustrated by the following technical solutions in conjunction with the accompanying drawings.

MassagerPriorArt0000023

Fig. 1 is this utility model master cut-away view.

Fig. 2 is the A-A cut-away view.

As shown in FIG.: the housing of massager is made up of two parts, be left-half 10 and right half part 25, with screw 7, packing ring 8 and nut 9 two parts are connected as a single entity, housing is provided with external electric supply socket 1 and power switch 3, an end is equipped with battery tray in the housing, for laying battery 2, one end of motor 4 at any time can with power connection, the axle of its other end inserts in the groove of worm screw 11 ends, bearing 13 is housed on the housing radial wall, joint 6 and the bearing fit at worm gear two ends, this two bearings is supporting worm gear; Worm gear 12 and worm engaging, on the worm gear both ends of the surface each There is a size identical, and the cam 5 of opposite direction, they and worm gear are one; Also be equipped with a crossbeam 24 in the housing, an end of extension spring 23 hangs on this beam, and the other end is contained on the rocking arm 17, and massager has two rocking arms, is located at respectively the worm gear both sides, and rocker arm shaft 22 passes the hole on the rocking arm, and they can be rotated around axle 22 jointly; The front end of two rocking arms all is equipped with spring 21, be connected with oscillator 20 by spring, oscillator is inlaid with metal derby 19, the rear end of two rocking arms is equipped with roller 18, lining 16 is housed in its centre bore, each passes lining 16 on the rear end roller of rocking arm with a little axle 15, and two rollers in hole that insert on the little shaft end head with latch 14 again rotate at little axle, and distinguish and can contact with separately corresponding cam.

During use, starting switch 3, plugged drive motor rotate, and whole worm-and-wheel gear is thereupon running also, two cams that are integrated with worm gear and roller contact; When cam peak and roller contact, the oscillator on this rocking arm is lifted to the extreme higher position, and when roller broke away from the cam peak, because of the effect of rocking arm upper pulling force spring, oscillator plunked down, knocking pain position; Oscillator on another rocking arm moves up to peak just at this moment, and along with the motor continuous operation, two oscillators are also alternately beaten continuously. When using massager, the garden arc part of housing front portion and Body contact are held at the housing rear portion as fulcrum, when subordinate presses, and the inertia force increasing of beating; When hand lifted, the inertia force of beating reduced; So can stepless adjustment beat power to the degree of User Satisfaction.

This utility model is safe and reliable, can promote the blood circulation of human body, and blood circulation promoting and blood stasis dispelling, elimination pain, relieving fatigue are the health doctors of Modern Family.

Cited By (2)

Publication number	Priority date	Publication date	Assignee	Title
CN102080713A *	2009-11-26	2011-06-01	赵广胜	Double-arm traction-type speed reducer
CN107252388A *	2017-05-03	2017-10-17	郑州飞龙医疗设备有限公司	Muscle arthrosis vibration therapeutic instrument

Family To Family Citations

* Cited by examiner, † Cited by third party, ‡ Family to family citation

Similar Documents

Publication	Publication Date	Title
DK1824440T3	2016-05-17	Electro-mechanical sexual stimulation devices
US5067480A	1991-11-26	Stimulator
CN106667716B	2019-04-05	Deformable multifunctional massage chair
US5460597A	1995-10-24	Portable hand-held vibratory feminine stimulator
FR2527437A1	1983-12-02	Massage apparatus
US20110009693A1	2011-01-13	Method and device for inducing erotic stimulation while asleep
AU2007289159A1	2008-03-06	Therapeutic devices for the treatment of various conditions of a female individual
CN105748192A	2016-07-13	Eye nursing apparatus
US6053881A	2000-04-25	Ankle massaging device
WO2016169448A1	2016-10-27	Lumbocruural pain massager
KR100922278B1	2009-10-15	Automatic hand massage machine
KR20030026805A	2003-04-03	Electro-motor for scalp massage
CN2870819Y	2007-02-21	Electric manual massaging device
US20040102822A1	2004-05-27	Pain relieving and healing device

MassagerPriorArt0000024

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CN105147510A	2015-12-16	Cervical vertebra massaging apparatus
US5065743A	1991-11-19	Kneader
CN106473911A	2017-03-08	A kind of Orthopaedic nursing massage recovering apparatus
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JP2010017489A	2010-01-28	Multifunctional massaging machine for exclusive use for arms
US20070225621A1	2007-09-27	Message apparatus
CN108309726A	2018-07-24	A kind of linkage mechanism for device for massaging feet
US5097822A	1992-03-24	Vibrating belt massager
CN203564490U	2014-04-30	Omnibearing skinscraping device applied to leg or foot bottom massager
CN106137709B	2019-07-16	Massage care device

Priority And Related Applications

Priority Applications (1)

Application	Priority date	Filing date	Title
CN 95205097	1995-03-20	1995-03-20	Beating massage device

Applications Claiming Priority (1)

Application	Filing date	Title
CN 95205097	1995-03-20	Beating massage device

Legal Events

Date	Code	Title	Description
1995-09-20	C14	Grant of patent or utility model	
1995-09-20	GR01	Patent grant	
2002-05-01	C19	Lapse of patent right due to non-payment of the annual fee	
2002-05-01	CF01	Termination of patent right due to non-payment of annual fee	

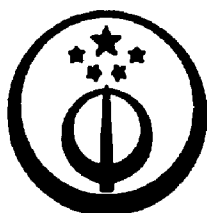
Concepts

machine-extracted

[Download](#) [Filter table](#)

Name	Image	Sections	Count	Query match
metal		claims,description	2	0.000

Show all concepts from the description section



[12] 实用新型专利说明书

[21] ZL 专利号 95205097.8

[51]Int.Cl⁶

A61H 23/00

[45]授权公告日 1995年9月20日

[22]申请日 95.3.20 [24]颁证日 95.8.27

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福春二小区西一委

共同专利权人 姜丽凤

[72]设计人 林介昌 姜丽凤

[21]申请号 95205097.8

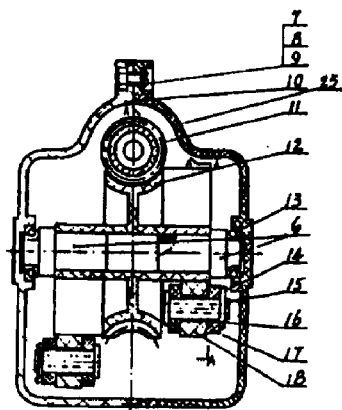
说明书页数:

附图页数:

[54]实用新型名称 捶打式按摩器

[57]摘要

本实用新型是一种捶打式按摩器,它属于医疗器械领域。主要由电源、壳体、电机、蜗轮蜗杆机构、滚轮、凸轮、摇臂、弹簧和振子组成。蜗轮上的凸轮通过滚轮使振子连续交替捶打按摩。使用该产品安全可靠、可大大促进人体的血液循环、活血化瘀、消除痛疼、解除疲劳,是现代家庭中必不可少的医疗保健用具。



(BJ)第 1452 号

权 利 要 求 书

1、一种捶打式按摩器，由电源、壳体、电机和振子组成，其特征在于：电机轴的一端插入蜗杆11端部的槽内，壳体内侧壁上装有轴承13，蜗轮两端的接头6与轴承配合，蜗轮12与蜗杆啮合，蜗轮两端面上各有一个大小相同，而方向相反的凸轮5；壳体内还安有一横梁24，拉伸弹簧23的一端挂在此梁上，另一端装在摇臂17上，按摩器共有两个摇臂，分别位于蜗轮两侧，摇臂轴22穿过摇臂上的孔，使摇臂可共同绕轴22转动；两摇臂的后端安有滚轮18，其中心孔内装有衬套16，各用一小轴15穿过摇臂后端滚轮上的衬套16，再用插销14插入小轴端头上的孔，两个滚轮在小轴上转动。

2、根据权利要求1所述的按摩器，其特征在于：两摇臂17的前端均有弹簧21，通过弹簧与振子20连接。

3、根据权利要求2所述的按摩器，其特征在于：振子镶嵌有金属块19。

4、根据权利要求1所述的按摩器，其特征在于：壳体由两部分组成，即左半部分10和右半部分25，用螺钉7、垫圈8和螺母9将两部分连为一体。

5、根据权利要求1所述的按摩器，其特征在于：壳体上设有外接电源插座1和电源开关3；壳体内一端安有电池座。

捶打式按摩器

本实用新型是一种捶打式按摩器，它属于医疗器械领域。

在日常生活中，人的身体某部位痛疼时，常用手自我或由他人帮助捶打按摩，则会使痛疼减轻或消失；由于捶打按摩时需要用力，因而双臂疲劳不能持久。

本实用新型的目的是克服上述缺点，提供一种全自动可连续持久捶打按摩的器具，它的捶力可以无级调整，其效果如同人用手捶打按摩一样。

为了达到上述目的，本实用新型采用以下技术方案，现结合附图加以说明。

图1是本实用新型主剖示图。

图2是A—A剖示图。

如图中所示：按摩器的壳体由两部分组成，即左半部分10和右半部分25，用螺钉7、垫圈8和螺母9将两部分连为一体，壳体上设有外接电源插座1和电源开关3，壳体内一端安有电池座，以供安放电池2，电机4的一端随时可与电源接通，其另一端的轴插入蜗杆11端部的槽内，壳体内侧壁上装有轴承13，蜗轮两端的接头6与轴承配合，此两轴承支承着蜗轮；蜗轮12与蜗杆啮合，蜗轮两端面上各

有一个大小相同，而方向相反的凸轮5，它们与蜗轮是一体；壳体
内还安有一横梁24，拉伸弹簧23的一端挂在此梁上，另一端装在摇
臂17上，按摩器共有两个摇臂，分别设在蜗轮两侧，摇臂轴22穿过
摇臂上的孔，使它们可共同围绕轴22转动；两摇臂的前端均装有弹
簧21，通过弹簧与振子20连接，振子镶嵌有金属块19，两摇臂的后
端安有滚轮18，其中心孔内装有衬套16，各用一小轴15穿过摇臂的
后端滚轮上的衬套16，再用插销4插入小轴端头上的孔两个滚轮在
小轴上转动，并分别能与各自相对应的凸轮接触。

使用时，启动开关3，接通电源带动电机转动，整个蜗轮蜗杆
机构也随之运转，与蜗轮为一体的两个凸轮与滚轮接触；当凸
轮最高点与滚轮接触时，此摇臂上的振子抬至最高位置，当滚轮脱
离凸轮最高点时，因摇臂上拉力弹簧的作用，振子突然落下，捶击
痛疼部位；此时另一个摇臂上的振子恰好向上运动至最高点，随着
电机连续运转，两个振子也连续交替捶打。在使用按摩器时，壳体
前部的园弧部分与身体接触作为支点，手握在壳体后部，当手下压
时，捶打的惯性力加大；手抬起时，捶打的惯性力减小；所以可无
级调整捶打力到使用者满意的程度。

本实用新型安全可靠，可促进人体的血液循环，活血化瘀、消
除痛疼、解除疲劳，是现代家庭的保健医生。

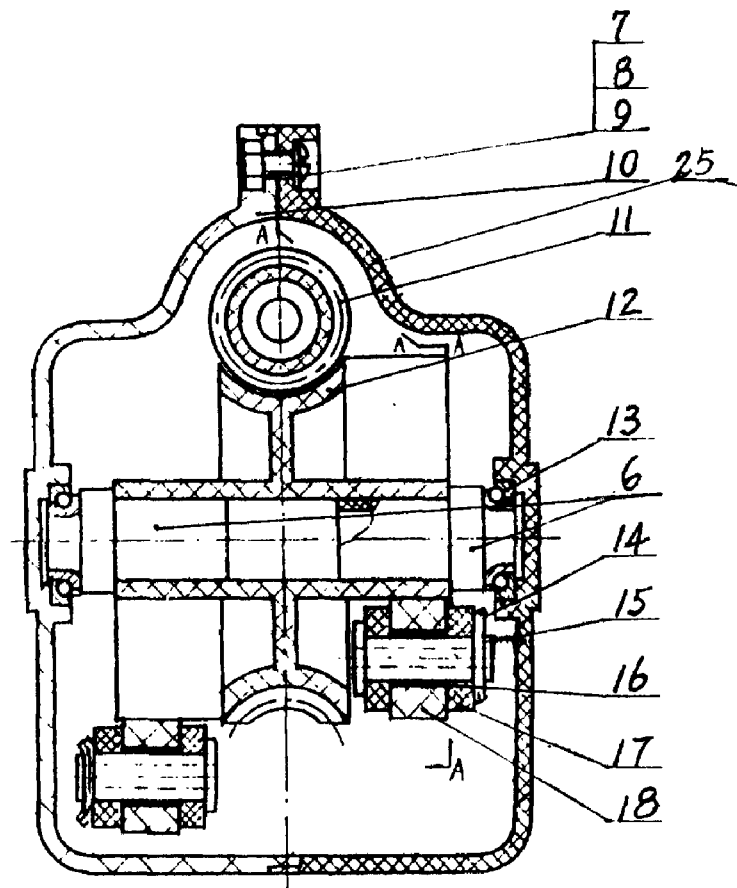


图 1

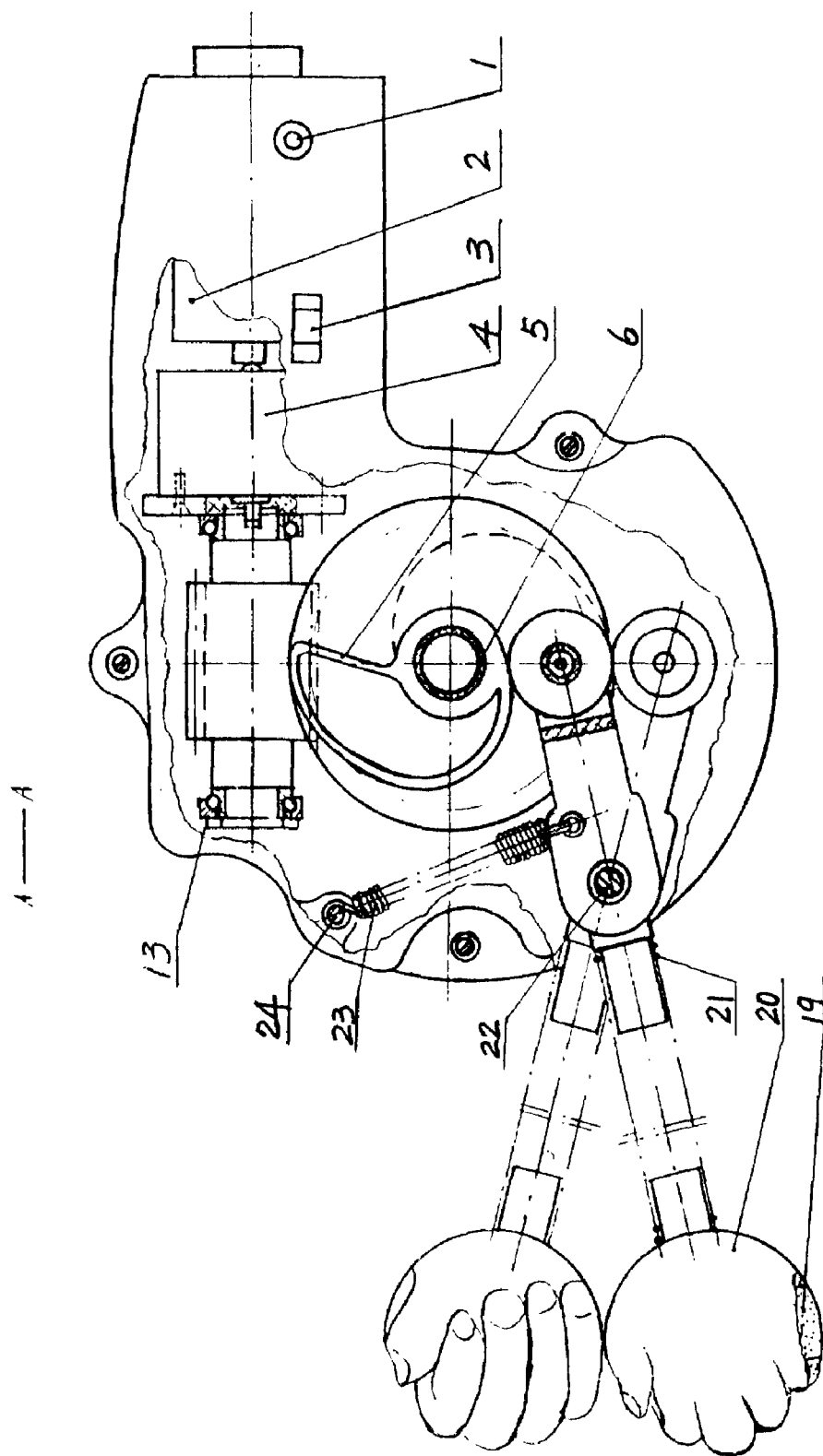


图 2

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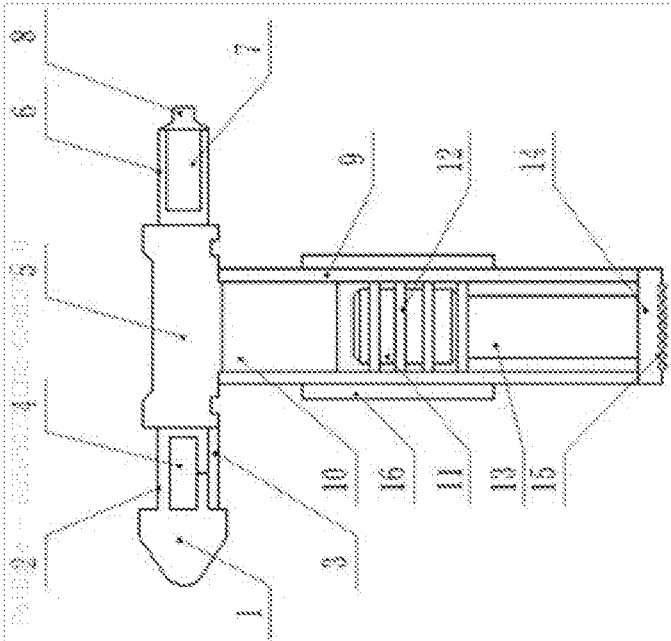
Pub. No. CN206381373 U

Pub. No. CN206381373 U

Title: ACUPOINT MASSAGER

Abstract:

Source: CN206381373 U The utility model provides an acupoint massager, belongs to acupuncture point massage technical field, and the technical problem that solve is the acupuncture point massage dress that provides a portable, can press specific acupoint, need not puncture skin and have the infrared irradiation function, the technical scheme who adopts: the connecting sleeve level sets up to connecting sleeve one end and massage muffjoint, middle part and vertical muffjoint, be provided with the massage head on the massage sleeve, embed the first battery that has with far infrared generating device power end electric connection, far infrared generating device sets up in massage sleeve below, at inside fixed frame, second battery that is used for installing the motor and the vertical shaft who is connected with motor output shaft of being equipped with of vertical sleeve, be equipped with the carousel in the pivot bottom, the carousel upper surface contacts with vertical sleeve bottom, and carousel lower surface edge circumference is equipped with a plurality of balls, the utility model is used for the massage of human acupuncture point.



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Published in: (family)

Country	Publication number	Publication date	Application number	Application date
CHINA	CN206381373 U	Aug 8, 2017	CN201621115878U	Oct 12, 2016

Priority: CN201621115878U 20161012

International class: A61H39/04 A61M37/00 A61N5/06 (Core/Invention)

PUBL. UTILITY MODEL APPLICATION



(12)实用新型专利

(10)授权公告号 CN 206381373 U

(45)授权公告日 2017.08.08

(21)申请号 201621115878.0

(22)申请日 2016.10.12

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(51)Int.Cl.

A61H 39/04(2006.01)

A61N 5/06(2006.01)

A61M 37/00(2006.01)

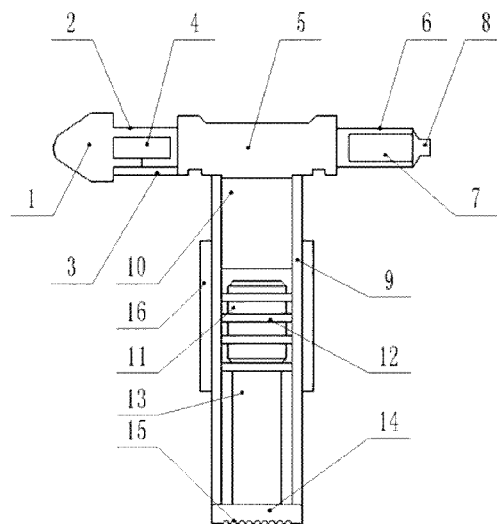
权利要求书1页 说明书2页 附图1页

(54)实用新型名称

一种穴位按摩器

(57)摘要

一种穴位按摩器,属于穴位按摩装置技术领域,所要解决的技术问题是提供一种便于携带、可按压特定穴位、不需要刺破皮肤且具有红外线照射功能的穴位按摩装,所采用的技术方案:连接套筒水平设置,并且连接套筒一端与按摩套筒连接、中部与竖直套筒连接;按摩套筒上设置有按摩头、内置有与远红外发生装置电源端电性连接的第一蓄电池,所述远红外发生装置设置在按摩套筒下方;在竖直套筒内部设有用于安装电机的固定框、第二蓄电池以及与电机输出轴连接的竖直转轴,在转轴底部设有转盘,转盘上表面与竖直套筒底端相接触,转盘下表面沿周向设有多个滚珠,本实用新型用于人体穴位按摩。



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MassagerPriorArt0000481

1. 一种穴位按摩器, 其特征在于: 包括按摩头(1)、按摩套筒(2)、远红外发生装置(3)、第一蓄电池(4)、连接套筒(5)、竖直套筒(9)、第二蓄电池(10)、电机(11)、转轴(13)、转盘(14)和滚珠(15), 所述连接套筒(5)水平设置, 并且连接套筒(5)的一端与按摩套筒(2)连接, 连接套筒(5)的中部与竖直套筒(9)连接;

在所述按摩套筒(2)上设置有按摩头(1), 所述按摩头(1)内置有与远红外发生装置(3)电源端电性连接的第一蓄电池(4), 所述远红外发生装置(3)设置在按摩套筒(2)下方;

在所述竖直套筒(9)内部设有第二蓄电池(10)、固定框(12)以及竖直转轴(13), 所述固定框(12)用于安装电机(11), 所述第二蓄电池(10)为电机(11)供电, 并且电机(11)的输出轴与转轴(13)连接, 在所述转轴(13)底部设有转盘(14), 所述转盘(14)的上表面同时与竖直套筒(9)的底端相接触, 转盘(14)的下表面沿周向设有多个滚珠(15)。

2. 根据权利要求1所述的一种穴位按摩器, 其特征在于: 在所述连接套筒(5)的另一端连接有储液筒(6), 所述储液筒(6)的内置空腔(7)装有红花油或按摩药油, 并且在储液筒(6)内置空腔(7)的一端设置带有密封装置的出液口(8)。

3. 根据权利要求1或2所述的一种穴位按摩器, 其特征在于: 在所述竖直套筒(9)外部包裹有防滑套(16)。

4. 根据权利要求1或2所述的一种穴位按摩器, 其特征在于: 所述按摩头(1)为圆弧形按摩头(1)。

5. 根据权利要求1或2所述的一种穴位按摩器, 其特征在于: 所述按摩头(1)为圆弧形按摩头(1)。

一种穴位按摩器

技术领域

[0001] 一种穴位按摩器,属于穴位按摩装置技术领域。

背景技术

[0002] 针灸输穴是中医医学中一个重要的组成部分,通过对穴位的针灸及其按压可以起到治病、缓解病痛以及保健养生的作用;穴位的保健及治疗作用,是根据不同的疾病及症状常选用几个比较重要的穴位来进行针灸或按压;针灸的治疗保健作用也比较不错,但是需要刺破皮肤,会产生一定的疼痛及不舒服的感觉;

[0003] 现有的按摩器具只能进行大面积的无针对性的按摩治疗,不能有针对性的按摩或按压特定的穴位,由于体积比较大,使用携带也较为不便且也不具有红外线照射的功能,将红外线用于治疗上即称为“光疗法”,使用时不会有疼痛感;热疗的基本原理在使体温升高或刺激穴位,用于治疗或保健。

实用新型内容

[0004] 本实用新型所要解决的技术问题是提供一种便于携带、可按压特定穴位、不需要刺破皮肤且具有红外线照射功能的穴位按摩装置。

[0005] 为解决上述技术问题,本实用新型所采用的技术方案:一种穴位按摩器,包括按摩头、按摩套筒、远红外发生装置、第一蓄电池、连接套筒、竖直套筒、第二蓄电池、电机、转轴、转盘和滚珠,所述连接套筒水平设置,并且连接套筒的一端与按摩套筒连接,连接套筒的中部与竖直套筒连接;

[0006] 在所述按摩套筒上设置有按摩头,所述按摩头内置有与远红外发生装置电源端电性连接的第一蓄电池,所述远红外发生装置设置在按摩套筒下方;

[0007] 在所述竖直套筒内部设有第二蓄电池、固定框以及竖直转轴,所述固定框用于安装电机,所述第二蓄电池为电机供电,并且电机的输出轴与转轴连接,在所述转轴底部设有转盘,所述转盘的上表面同时与竖直套筒的底端相接触,转盘的下表面沿周向设有多个滚珠。

[0008] 在所述连接套筒的另一端连接有储液筒,所述储液筒的内置空腔装有红花油或按摩药油,并且在储液筒内置空腔的一端设置带有密封装置的出液口。

[0009] 在所述竖直套筒外部包裹有防滑套。

[0010] 在所述按摩头外部包裹设有多个凸起的橡胶层。

[0011] 所述按摩头为圆弧形按摩头。

[0012] 本实用新型和现有技术相比具有以下有益效果。

[0013] 一、本实用新型通过按摩头可以对人体特定穴位进行按压按摩,并且通过远红外发生装置与按摩头配合使用,能更好的增强按摩效果,同时按摩头设为圆弧形、还包裹带有多个凸起的橡胶套,也使得按摩效果更好、更舒适。

[0014] 二、本实用新型通过储液筒放着红花油或按摩药油,在按摩之前在穴位处涂抹红

花油或按摩药油,按摩效果会更好。

[0015] 三、本实用新型通过开启电机带动转轴、转盘一起旋转,转盘底部的滚珠与人体待按摩部位接触后进行转动式按摩,不仅操作简单、省时省力,而且按摩效果好,每个人也能独立进行按摩。

[0016] 四、本实用新型通过在竖直套筒外部设防滑套,能够保证人们在使用过程中,手掌握住竖直套筒不会打滑、使用过程更加稳定。

[0017] 五、本实用新型结构小巧,便于携带,方便人们随时进行按摩。

附图说明

[0018] 图1为本实用新型的结构示意图。

[0019] 图中,1为按摩头,2为按摩套筒,3为远红外发生装置,4为第一蓄电池,5为连接套筒,6为储液筒,7为内置空腔,8为出液口,9为竖直套筒,10为第二蓄电池,11为电机,12为固定框,13为转轴,14为转盘,15为滚珠,16为防滑套。

具体实施方式

[0020] 如图1所示,一种穴位按摩器,包括按摩头1、按摩套筒2、远红外发生装置3、第一蓄电池4、连接套筒5、竖直套筒9、第二蓄电池10、电机11、转轴13、转盘14和滚珠15,所述连接套筒5水平设置,并且连接套筒5的一端与按摩套筒2连接,连接套筒5的中部与竖直套筒9连接;

[0021] 在所述按摩套筒2上设置有按摩头1,所述按摩头1内置有与远红外发生装置3电源端电性连接的第一蓄电池4,所述远红外发生装置3设置在按摩套筒2下方;

[0022] 在所述竖直套筒9内部设有第二蓄电池10、固定框12以及竖直转轴13,所述固定框12用于安装电机11,所述第二蓄电池10为电机11供电,并且电机11的输出轴与转轴13连接,在所述转轴13底部设有转盘14,所述转盘14的上表面同时与竖直套筒9的底端相接触,转盘14的下表面沿周向设有多个滚珠15。

[0023] 在所述连接套筒5的另一端连接有储液筒6,所述储液筒6的内置空腔7装有红花油或按摩药油,并且在储液筒6内置空腔7的一端设置带有密封装置的出液口8。

[0024] 在所述竖直套筒9外部包裹有防滑套16。

[0025] 在所述按摩头1外部包裹设有多个凸起的橡胶层。

[0026] 所述按摩头1为圆弧形按摩头1。

[0027] 上述实施例是对本实用新型结构的解释而非限制,在不脱离本实用新型原理前提下所作的变形也在本实用新型的保护范围之内。

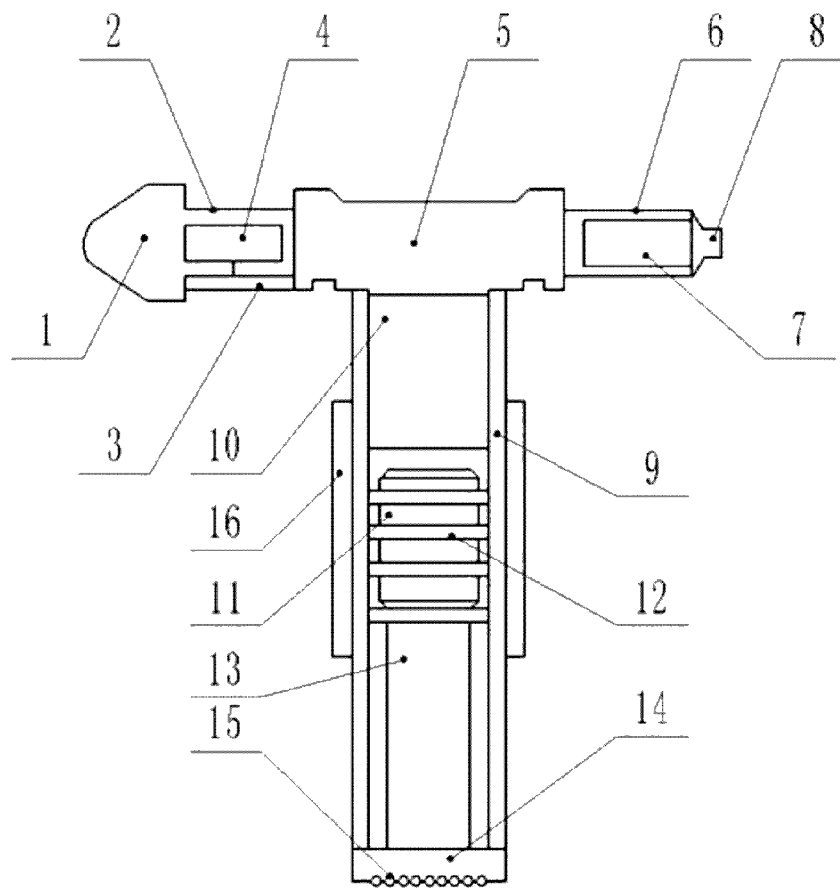


图1

List of publications

Application number 2013D.
DE202013012621 U1 ...

Publication date
2018-01-25

**Abstract**

Stimulation (1) device for sexual Stimulation of the clitoris (12), comprising: a pressure field generating device (2), having an opening for (42) placement over the clitoris and equipped with a drive unit (6), wherein the opening (42) is the only opening of the pressure field generating device (2) to its exterior is, and wherein the pressure field generating device (2) is arranged in such a manner, that the latter generates a pressure field at the opening (42), the chronologically alternating sub - and positive pressures, which are modulated on the atmospheric pressure, having; a control (7) device, which can control the drive (6) unit, and which has a Stimulation pattern; at least one operating element (71), the setting of the Stimulation pattern of the pressure field serves; a housing (8), the control (7) device, the the drive (6) unit and includes an internal (76) battery, wherein the Stimulation (1) device is configured as a portable hand-held device; wherein the Stimulation (1) device has no valves; wherein the control (7) means is arranged such, that by means of the at least one operating element (71) a Stimulation pattern from the Stimulation patterns of the control (7) device is adjustable, wherein the drive (6) unit is controlled in accordance with the set Stimulation pattern.

English Abstract (Native or MT)

Stimulation (1) device for sexual Stimulation of the clitoris (12), comprising: a pressure field generating device (2), having an opening for (42) placement over the clitoris and equipped with a drive unit (6), wherein the opening (42) is the only opening of the pressure field generating device (2) to its exterior is, and wherein the pressure field generating device (2) is arranged in such a manner, that the latter generates a pressure field at the opening (42), the chronologically alternating sub - and positive pressures, which are modulated on the atmospheric pressure, having; a control (7) device, which can control the drive (6) unit, and which has a Stimulation pattern; at least one operating element (71), the setting of the Stimulation pattern of the pressure field serves; a housing (8), the control (7) device, the the drive (6) unit and includes an internal (76) battery, wherein the Stimulation (1) device is configured as a portable hand-held device; wherein the Stimulation (1) device has no valves; wherein the control (7) means is arranged such, that by means of the at least one operating element (71) a Stimulation pattern from the Stimulation patterns of the control (7) device is adjustable, wherein the drive (6) unit is controlled in accordance with the set Stimulation pattern.

Abstract - German

Stimulationsvorrichtung (1) zur sexuellen Stimulation der Klitoris (12), aufweisend: eine Druckfelderzeugungseinrichtung (2), die eine Öffnung (42) zum Aufsetzen über die Klitoris und eine Antriebseinheit (6) aufweist, wobei die Öffnung (42) die einzige Öffnung der Druckfelderzeugungseinrichtung (2) zu deren Äußeren ist, und wobei die Druckfelderzeugungseinrichtung (2) derart eingerichtet ist, dass diese ein Druckfeld an der Öffnung (42) erzeugt, das sich zeitlich abwechselnde Unter- und Überdrücke, welche auf den Normaldruck aufmoduliert sind, aufweist; eine Steuereinrichtung (7), welche die Antriebseinheit (6) ansteuern kann, und welche Stimulationsmuster aufweist; zumindest ein Bedienelement (71), das der Einstellung des Stimulationsmusters des Druckfeldes dient; ein Gehäuse (8), das die Steuereinrichtung (7), die Antriebseinheit (6) und eine interne Batterie (76) umfasst, wobei die Stimulationsvorrichtung (1) als ein tragbares Handgerät ausgebildet ist; wobei die Stimulationsvorrichtung (1) keine Ventile aufweist; wobei die Steuereinrichtung (7) derart eingerichtet ist, dass mittels des zumindest einen Bedienelements (71) ein Stimulationsmuster aus den Stimulationsmustern der Steuereinrichtung (7) einstellbar ist, wobei die Antriebseinheit (6) entsprechend dem eingestellten Stimulationsmuster angesteuert wird.

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Re-assignment	2018 - NOVOLUTO Present Original
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Application Numbers & Dates	DE202013012621U 2013-09-23 [2013DE-20012621]

Priority Numbers & Dates DE202013012621U 2013-09-23 [2013DE-20012621]

Technology domain Medical technology

IPC codes A61H-019/00* A61H-009/00

CPC codes A61H-019/34* A61H-009/00/57 A61H-2201/0153A61H-2201/0188 A61H-2201/1207A61H-2201/1215 A61H-2201/1246A61H-2201/5035 A61H-2201/5038

Notes Number of Claims: 10

Cited Applicant citations

Patents -WO2006058291 (A2) [WO200658291] DRYSDALE JOANNE; -US6099463 (A) [US6099463] HOCKHALTER ROBERT; -US6464653 (B1) [US6464653] HOVLAND CL

Claims

1. Stimulation device (1) for sexual Stimulation of the clitoris (12), comprising: a pressure field generating device (2), an opening (42) for placement over the clitoris and a drive unit (6) has, wherein the opening (42) the only opening of the pressure field generating device (2) to the exterior thereof is, and wherein the pressure field generating device (2) is arranged such, that a pressure field at the opening (42) is generated, the chronologically alternating sub - and over-pressures, which are modulated on the atmospheric pressure, comprising; a control device (7), which the drive unit (6) can drive, and which has a Stimulation pattern; at least one operating element (71), the setting of the Stimulation pattern of the pressure field acts; a housing (8), the control device (7), the drive unit (6) and an internal battery (76) comprises, wherein the Stimulation device (1) is designed as a portable hand-held device; wherein the Stimulation device (1) has no valves; wherein the control device (7) is configured in such a way, that by means of the at least one operating element (71) a Stimulation pattern of the Stimulation patterns of the control device (7) is adjustable, wherein the drive unit (6) corresponding to the adjusted Stimulation pattern is controlled.

2. Stimulation device (1) according to claim 1, wherein the pressure field generating device (2) further comprising: a chamber (3) with a flexible wall (31); wherein the drive unit (6) is arranged such, that a deflection of the wall (31) in opposite directions to change in volume of the chamber (3) causes, in order to generate the pressure field.

3. Stimulation device (1) for sexual Stimulation of the clitoris (12), comprising: a pressure field generating device (2), a cavity (3, 4, 5) with an opening (42) for placement over the clitoris (12) and a drive unit (6) has, wherein the opening (42) of the single hole of the pressure field generating device (2) thereof is exterior, and wherein the compressed field generating device (2) is arranged such, that a pressure field at the opening (42) is generated, the chronologically alternating sub - and over-pressures, which are modulated on the atmospheric pressure, comprising; a control device (7), which the drive unit (6) and which can control; wherein the cavity (3, 4, 5) by a one-piece wall made of silicone or rubber is formed; a housing (8), the control device (7), the drive unit (6) and an internal battery (76) comprises, wherein the Stimulation device (1) a portable handheld device is formed; wherein the Stimulation device (1) has no valves.

4. Stimulation device (1) according to any one of the preceding claims, wherein the stimulation device (1) with water as a medium of the pressure field is usable.

5. Stimulation device (1) according to any one of the preceding claims, wherein the components of the pressure field generating device (2) and the drive unit (6) are so dimensioned, that the maximum producible sub - and super-atmospheric pressure is constrained, to a risk of injury to the clitoris (12) to minimize or eliminate.

6. Stimulation device (1) according to any one of the preceding claims, wherein the pressure field generating device (2) is arranged such, that, when the opening (42) over the clitoris (12) is placed, in the printing field generating device (2) an at least substantially closed flow system is formed, and in the flow system fluid flows, the temporally alternately to the clitoris (12) toward and away from the clitoris (12) are directed away from, can be generated, and the at least a substantially closed flow system a removal of bodily fluid from the pressure field generating device (2) are substantially avoided.

7. Stimulation device (1) according to claim 2, wherein the drive unit (6) an electric motor having an axis (61) and an eccentric (62) is, wherein the flexible wall (31) in accordance with the rotation axis (61) is deflected.

8. Stimulation device (1) according to any one of the preceding claims, wherein the stimulation pattern of pulses having a predetermined clock are.

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9. Stimulation device (1) according to any one of the preceding claims, wherein the opening (42) of the pressure field generating device (2) is of oval design.

10. System with a stimulation device (1) according to any one of claims 1 to 9, comprising: a to the stimulation device (1) separately located remote control device, wherein the control device (7) of the stimulation device (1) from the remote control device is remotely controllable.

Original Claims

1. Stimulationsvorrichtung (1) zur sexuellen Stimulation der Klitoris (12), aufweisend:

eine Druckfelderzeugungseinrichtung (2), die eine Öffnung (42) zum Aufsetzen über die Klitoris und eine Antriebseinheit (6) aufweist, wobei die Öffnung (42) die einzige Öffnung der Druckfelderzeugungseinrichtung (2) zu deren Äußeren ist, und wobei die Druckfelderzeugungseinrichtung (2) derart eingerichtet ist, dass diese ein Druckfeld an der Öffnung (42) erzeugt, das sich zeitlich abwechselnde Unter- und Überdrücke, welche auf den Normaldruck aufmoduliert sind, aufweist;

eine Steuereinrichtung (7), welche die Antriebseinheit (6) ansteuern kann, und welche Stimulationsmuster aufweist;

zumindest ein Bedienelement (71), das der Einstellung des Stimulationsmusters des Druckfeldes dient;

ein Gehäuse (8), das die Steuereinrichtung (7), die Antriebseinheit (6) und eine interne Batterie (76) umfasst, wobei die Stimulationsvorrichtung (1) als ein tragbares Handgerät ausgebildet ist;

wobei die Stimulationsvorrichtung (1) keine Ventile aufweist;

wobei die Steuereinrichtung (7) derart eingerichtet ist, dass mittels des zumindest einen Bedienelements (71) ein Stimulationsmuster aus den Stimulationsmustern der Steuereinrichtung (7) einstellbar ist, wobei die Antriebseinheit (6) entsprechend dem eingestellten Stimulationsmuster angesteuert wird.

2. Stimulationsvorrichtung (1) gemäß Anspruch 1, wobei die Druckfelderzeugungseinrichtung (2) weiter aufweist:

eine Kammer (3) mit einer flexiblen Wand (31);

wobei die Antriebseinheit (6) derart eingerichtet ist, dass diese eine Auslenkung der Wand (31) in einander entgegengesetzten Richtungen zur Volumenänderung der Kammer (3) bewirkt, um das Druckfeld zu erzeugen.

3. Stimulationsvorrichtung (1) zur sexuellen Stimulation der Klitoris (12), aufweisend:

eine Druckfelderzeugungseinrichtung (2), die einen Hohlraum (3, 4, 5) mit einer Öffnung (42) zum Aufsetzen über die Klitoris (12) und eine Antriebseinheit (6) aufweist, wobei die Öffnung (42) die einzige Öffnung der Druckfelderzeugungseinrichtung (2) zu deren Äußeren ist, und wobei die Druckfelderzeugungseinrichtung (2) derart eingerichtet ist, dass diese ein Druckfeld an der Öffnung (42) erzeugt, das sich zeitlich abwechselnde Unter- und Überdrücke, welche auf den Normaldruck aufmoduliert sind, aufweist;

eine Steuereinrichtung (7), welche die Antriebseinheit (6) ansteuern kann;

wobei der Hohlraum (3, 4, 5) durch eine einstückige Wand aus Silikon oder Gummi ausgebildet ist;

ein Gehäuse (8), das die Steuereinrichtung (7), die Antriebseinheit (6) und eine interne Batterie (76) umfasst, wobei die Stimulationsvorrichtung (1) als ein tragbares Handgerät ausgebildet ist;

wobei die Stimulationsvorrichtung (1) keine Ventile aufweist.

4. Stimulationsvorrichtung (1) gemäß einem der vorausgehenden Ansprüche, wobei die Stimulationsvorrichtung (1) mit Wasser als ein Medium des Druckfelds verwendbar ist.

5. Stimulationsvorrichtung (1) gemäß einem der vorausgehenden Ansprüche, wobei die Komponenten der Druckfelderzeugungseinrichtung (2) und die Antriebseinheit (6) so dimensioniert sind, dass der maximal erzeugbare Unter- und Überdruck derart beschränkt ist, um eine Verletzungsgefahr für die Klitoris (12) zu minimieren oder auszuschließen.

6. Stimulationsvorrichtung (1) gemäß einem der vorausgehenden Ansprüche, wobei

die Druckfelderzeugungseinrichtung (2) derart eingerichtet ist, dass,

wenn die Öffnung (42) über die Klitoris (12) aufgesetzt ist,

in der Druckfelderzeugungseinrichtung (2) ein zumindest weitgehend abgeschlossenes Strömungssystem ausgebildet wird, und

in dem Strömungssystem Medienströmungen, die zeitlich abwechselnd auf die Klitoris (12) hin gerichtet und von der Klitoris (12) weg gerichtet sind,

erzeugt werden, und das zumindest weitgehend abgeschlossene Strömungssystem einen Abtransport von Körperflüssigkeit aus der Druckfelderzeugungseinrichtung (2) weitgehend vermeidet.

7. Stimulationsvorrichtung (1) gemäß Anspruch 2, wobei die Antriebseinheit (6) ein Elektromotor mit einer Achse (61) und einem Exzenter (62) ist, wobei die flexible Wand (31) entsprechend der Drehung der Achse (61) ausgelenkt wird.

8. Stimulationsvorrichtung (1) gemäß einem der vorausgehenden Ansprüche, wobei die Stimulationsmuster aus Impulsen mit einem vorgegebenen Takt bestehen.

9. Stimulationsvorrichtung (1) gemäß einem der vorausgehenden Ansprüche, wobei die Öffnung (42) der Druckfelderzeugungseinrichtung (2) oval ausgebildet ist.

10. System mit einer Stimulationsvorrichtung (1) gemäß einem der Ansprüche 1 bis 9, aufweisend:

eine zu der Stimulationsvorrichtung (1) getrennt angeordnete Fernsteuervorrichtung,

wobei die Steuereinrichtung (7) der Stimulationsvorrichtung (1) von der Fernsteuereinrichtung fernsteuerbar ist.

Description

[0001] The present invention relates to a stimulation device for erogenous zones, in particular for the clitoris and a system with a stimulation device.

[0002] The erogenous zones of the human body can be stimulated with a variety of means. Such vibrators are used for example, by direct contact to apply a stimulus to a particular area of skin. This form of Stimulation can lead to irritation or skin irritations however. Also may be a direct contact of the genital zone with such aids for individual reasons, for example due to personal Hygiene or provisos, not be desired.

[0003] In particular the direct Stimulation of clitoris, for example with a Auflagevibrator, is problematic. In the female clitoris is the most sensitive erogenous zone usually. The entire clitoris is highly equipped with nerve endings, whereby this touch-sensitive and susceptible to sexual stimuli is particularly. Here in particular the clitoris glans, in which the nerve strands of the two legs meet, highlight. In the event of frequent application of a Auflagevibrators So there is direct Stimulation on the one hand for habituation effects or for conditioning the erogenous zone stimulated, while on the other hand the initial applications of such a device require a certain amount of practice and familiarization.

[0004] Further the female clitoris medical studies carried out in the year 2006 have relevant starting point of the female Klimax determined and for the first time as a different sensation qualities of klitoralem (and vaginal) orgasm neurologically detected. Recent medical research is considered according to the clitoral Stimulation, and not of the Vagina, as a starting point of the woman's sexual arousal "sexual pleasure" and thus as a key for female.

[0005] Is the sensitivity of the human erogenous zones further in this case, for example the clitoris, the inner and outer Labia or of the nipple, vary greatly between individuals. The Person may be so sensitive, that a direct stimulation only after prolonged as a prelude, and then only very tender, or even cannot be considered. The sensitivity of the corresponding zone of situation may further situation or even during a sexual act to change greatly.

[0006] For the above reasons are various forms as an alternative to direct Stimulation current practice for indirect Stimulation.

[0007] For indirect Stimulation of erogenous zones and in particular the clitoris are conventional vacuum devices are used, the erogenous zones of the Person in question to without directly touching the main portion to be stimulated to stimulate. Vacuum pumps for the female primary or secondary are for example known sex organs, which usually have a suction cup for placing and a hand pump. With this type of device creates a negative pressure applied to the clitoris for example in the clitoris itself under pressure, which usually is lower than the systolic blood pressure. This pressure differential results in a widening of the clitoris and/or stimulates the blood flow in the affected area. Clitoral vascular engorgement and air delivery through this serves both to increase the sensitivity as well as the optical and haptic Manipulation. Also leads to a better blood perfusion to an increased leakage of vaginal moisture, the more comfortable the Stimulation. But the manual operation of the hand pump is often inconvenient or troublesome. It can also

be in this category of devices by the longer term or continuous application of negative pressure to habituation effects occur, the efficacy of the device limit on duration. Increase of blood flow in the clitoris is sufficient also often not from pure, in order to get to Klimax; vacuum pumps are often used only as a prelude thus, in order to direct a subsequent Klimax (pressure -) Massage of the erogenous zone to achieve.

[0008] Instead of the manually operated vacuum pump also be propagated electrically driven vacuum pumps used. As an example of the disclosed WHERE 2006/05 82 91 A2 a device for sexual therapy, wherein the assembly of a tubular suction chamber for the clitoris, an electric vacuum source (vacuum pump) and a plurality of air flow openings. By the operation of the vacuum pump is a continuous air flow or air exchange in the chamber in the region of the clitoris is generated. In this case is more frequently occurring vaginal moisture sucked by the negative pressure is disadvantageously, for which reason a drying effect of the stimulated areas of the skin occurs. To contamination of the humid air sucked also results in terms of subsequent vacuum assembly, for example of the vacuum pump. Thus such arrangements may be problematic in their Hygiene with vacuum pumps, vacuum pump and associated valves and air since technical components and/or dead spaces or dead angle often are difficult to clean. Further the therapy of the blood vessels of the clitoris the device is used, and not the Stimulation to the sexual climax.

[0009] The US 6 099 463 A discloses a device for Stimulation of the clitoris with a tubular suction chamber, a vacuum source or a vacuum pump and a plurality of valves, with which the size of the vacuum is regulated. The vacuum can also be applied in a cyclic form, in order to provide a stimulation effect, wherein the application of a continuous vacuum also in this apparatus due to habituation effects are to be expected. Here as well the above-described disadvantages of the Hygiene and the drying of the skin to be stimulated. The printing arrangement having a plurality of valves is likewise, vacuum pump, etc. relatively complex.

[0010] The US 6 464 653 B1 discloses therapeutic devices and methods, a clitoral engorgement which with the aid of a vacuum produced by generating a vacuum pump, to the treatment of disorders of the clitoris, for example from incontinence, to support. With the aid of a control valve or modulator, can be covered with the finger in accordance with, the height of the vacuum in the suction chamber is manually adjusted or varied. This requires the attention of the user and can sometimes be annoying or distracting. Also has this relatively complex device with the above-explained drawbacks of the Hygiene and the further valves drying-out, wherein the device and not the short-term sexual Stimulation for purposes of long-term therapy also is used.

[0011] The WHERE 2008/02 80 76 A2 discloses a therapeutic device for women, primarily the treatment of sexual disorders which is used. In this case the device includes a combination of indirect Stimulation with the aid of a vacuum chamber and direct Stimulation with the aid of mechanical vibrators and oscillators.

[0012] In this therapeutic device is used the negative pressure of the blood flow in the clitoris increase, while the actual Stimulation or Massage of the skin area by means of direct mechanical vibrations/oscillations takes place. Such a suction cup which is placed on the skin area to be stimulated is internally connected to a motor via a mechanical connection. The suction cup is extended by the motor upon activation of the device, wherein the volume of the suction cup increases. The resulting volume of the suction cup and thus the intensity of the vacuum can be adjusted with the aid of control elements on the device. Through the intake air is displaced through a tube in the apparatus operation to the outside again. In this device has a supporting function only the vacuum, while the actual Stimulation in direct manner, which also entails the above-explained disadvantages of direct Stimulation.

[0013] The 2013/001 276 9 A1 US discloses an apparatus, wherein a pulsating positive pressure as the air-pressure massage is used for Stimulation. A pump or a compressor generates a pulsating positive pressure, with the aid of a nozzle onto the erogenous zone to be stimulated is directed. In this apparatus dries the affected skin part disadvantageously decreases greatly or from. There is also usually a temperature difference between the temperature of the supplied air and the temperature of the skin to be stimulated, which under certain circumstances may be troublesome. There are also in this device the above-explained problems of Hygiene, in which

case any pathogens or microbes or other contaminants situated in the device directly to the genital area of the user additionally be transported.

[0014] The devices of the prior art have the disadvantage in common, that the complexity of the negative pressure or positive pressure-generating devices and this device can have high hygienic problems.

[0015] Further the devices have the further disadvantage of the prior art have in common the fact, longer-lasting or continuous or frequently recurring in that in applications of suppressing habituation effects occur.

[0016] A further disadvantage in some of the above-described vacuum devices is, that first the negative pressure via a control valve or a vacuum pump must be limited, and secondly by means of a manual opening of a release valve of the negative pressure should be reduced, before the suction cup is peeled back from the skin. Should one of the valves and/or the user a technical defect have the device operate incorrectly, so there may be risk of injury.

[0017] In view of the above described problems it is object of the invention, to provide a stimulation device, which has a simple structure and is easy and secure in use.

[0018] A further object of the present invention is, with an effective Stimulation elicitor effect to provide a Stimulation device, which for the Stimulation of an erogenous zone, in particular of the female clitoris, is suitable.

[0019] There are also sub-tasks of the invention, to provide a device, a drying out of the erogenous zones to be stimulated which avoids, is hygienic and avoids habituation effects.

[0020] The aim of the invention is defined by the stimulation device according to claim 1 dissolved. Advantageous further developments and embodiments are subject matter of the further independent and dependent claims.

[0021] According to the Stimulation of erogonen zones, in particular the clitoris, provided, which comprises the steps of: forming a pressure field which is directed to a body part; and modulating of the pressure field with a pattern of sub - and over-pressures, with respect to a reference pressure, preferably atmospheric pressure.

[0022] In this case the stimulation effect by the modulation of the pressure field by means of an operating element be individually influenced. In addition the modulation pulse-shaped.

[0023] In one embodiment of the invention has a pressure field generating device the at least one first chamber and at least one second chamber stimulation device with at least one opening to be fitted onto a body part or on the erogenous zone and at least one connecting element, which connects the first chamber with the second chamber, on.

[0024] This configuration according to at least one connecting element communicating chambers may be created by over fluidically changing the volume of the first chamber in a simple manner a pressure field in the second chamber can be generated, temporarily to the skin area to be stimulated is directed to.

[0025] For the purposes of the invention is a pressure field is time-varying field of media pressures, which has temporarily via pressures and temporarily under pressures, while a partial vacuum is a pressure of the medium, under the reference pressure is, and a positive pressure is a pressure of the medium, the reference pressure is over.

[0026] The medium usually is a gas, preferably air, but may for example alternatively or in addition a liquid medium, for example water or commercially available lubricants, be. Example the lubricant may be filled before use of the stimulation device according to the invention in the chambers. In this way the Stimulation of the corresponding skin area instead of with air also connected to a suitable skin-friendly liquid may occur, depending on the individual user's preference may be desired which. As another example the stimulation device may also be used as the medium with water under water (for example in the bathtub).

[0027] The reference pressure is typically the in each case at the start of the application (i.e. before the mounting of the skin area to be stimulated on the stimulation device) with respect to the ambient pressure prevailing stimulation device. In the preferred application of the stimulation device with air is the

reference pressure of the currently prevailing air pressure or the atmospheric pressure.

[0028] According to the invention is the area of skin to be stimulated by the pressure field on the one hand in its blood circulation, during this on the other hand indirectly massaged is. Two advantageous effects are combined. Due to the increased blood flow through the erogenous zone of the Person in question is sensitive, while a massage effect is generated in addition, the Stimulation of the erogenous zone of, for example to sexual arousal Klimax, is used. The massage effect is due to the kinetic energy of the flowing medium from the first chamber through the connecting element against the surface of the skin area to be stimulated is generated. In this manner the massaging effect indirectly, i.e. without direct contact of the skin to be stimulated by a solid body, for example by means of a Vibrator, is generated, which has the consequence, that the initially explained disadvantages of the direct Stimulation can be avoided.

[0029] According to the invention by the exemplary application of the time-varying pressure field to the clitoris is mimicked by the pressure field irritation, which usually takes place during intercourse. It is also an alternating stimulus to the clitoris by the Kohabitationsbewegung generated. So is an Imitation of the natural Kohabitationsaktes near life, medical statements confirm being, that the application of the inventive pressure field neither habituation effects still to addiction generation leads. This is particularly in the alternating application of sub - and over-pressures (and also in the non-continuous application of only one type of pressure) because.

[0030] The invention further relates to the maximum applicable pressure regularly by the maximum load capacity of the skin area to be stimulated is limited. Introduces too great a partial vacuum in the erogenous zones for example risk of painful injury particularly. With only suppressing operating stimulation devices are commonly limited in their operation this maximum. In contrast according to the invention by the combination of over - and suppressing an expanded operating range of the stimulation from releasing pressure field or effect is created, since the working range of the pressure in both positive and negative range to now to the maximum can be utilized.

[0031] By the orientation of the at least one connecting element on the skin area to be stimulated can act directly the pressure field, wherein the pressure field to a considerable extent by the configuration of the at least one connecting element and the at least one opening of the connecting element into the second chamber is influenced, and thus can be adjusted depending on the application of the stimulation device. The at least one opening of the connecting element can be the body part to be stimulated, preferably directly, lie opposite one another. For example the connecting element in the case of a stimulation device, which is determined for the clitoris, a single through-opening with nozzle effect on the glans clitoris between the first and the second chamber. Alternatively the at least one connecting element from a plurality of, for example four, through openings between the chambers, when a larger downshell area of skin to be stimulated.

[0032] Further is formed on one side after placing the second chamber to the skin area to be stimulated or partially open a self-contained system of the media - or air flow in the pressure field generating device. So the medium is the air between the chambers or significantly moved back and forth -, during an exchange with media or with air from outside of the system is at least largely avoided. Preference is given to the first chamber over or through the connecting element is connected exclusively to the second chamber. So there are no other compounds than those of the first chamber to the second chamber; for example there is no direct connection of the first chamber with the environment of the device via a pressure valve or via an air discharge passage.

[0033] For example the temperature of the air in the present invention is flow system to quickly adapt to the skin temperature, while the interfering supplying new (for example cold) air from outside of the system is prevented, as in the prior art and others. with the use of vacuum pumps may be the case. In addition Abtrocknungseffekte avoided, since in a closed system-no or hardly any removal of stimulation-promoting liquid, for example body fluid, takes place.

[0034] Further according to the invention comprises pressure field generating device due to the simple construction has the advantage of increased Hygiene and an improved cleaning ability. The present invention avoids valves or pumps/compressors in this case with potential dead spaces

and not places to be cleaned. So according to the invention is pressure field generating device easy to clean. Can be cleaned in the stimulation device in a simple manner by for example filling a cleaning liquid into the first chamber and activating the pressure field occur. Alternatively the second chamber may be arranged to be exchangeable, which also facilitates the cleaning of the two chambers. And the connecting element of the pressure chambers of the invention can be further field generating device be produced in one piece, for example from a single plastic molded part being (e.g. rubber) exist.

[0035] In addition the inventive structure to prevent fluidic elements results in more complex, such as e.g. valves, leading to facilitation of manufacturing.

[0036] Further has the Stimulation device according to a drive unit, which changes the volume of the first chamber in such a way, that through the interconnecting member in the second chamber is a pressure field is generated, the erogenous zone to which the Stimulation is used, and a controller, which controls the drive unit.

[0037] The medium is transported between the chambers in its volume in principle on the maximum volume of the first chamber is limited. The transported volume by the maximum possible change in volume can also be, which is caused by the drive unit, are further structurally limited.

[0038] This has the consequence, that the maximum over - or under pressure, the stimulation device in the second chamber can build up, because of the dimensioning of the components of the pressure field generating device and the drive is limited. In particular the maximum negative pressure to a level over - or can be restricted, a risk of injury to the skin minimizes or eliminates areas to be stimulated. For example in the prior art is unnecessary so that a conventional safety valve or a manual intervention by the user into the stimulation operation, for example an opening of a release valve.

[0039] Further the temporal change in the pressure field is the modulation of the pressure field or by the control device substantially automatically controlled. The modulation of the pressure field in the control device may, for example intensity, time profile or sequence, may be pre-stored. Preferably the temporal change of the pressure field can regularly recurring (- stimulation) pattern, for example with a predetermined clock pulses or alternating pulse trains on a regular basis. In this way can the user's interaction with the on - and off of the stimulation device according to the invention and the choice of the stimulation pattern limit, while the stimulation device automatically performs the preferred stimulation pattern. Thus the application complexity of the stimulation device according to the invention is compared with the conventional straight (medical) vacuum-stimulating devices low. Alternatively or in addition the user during or prior to the stimulation pattern of the stimulation device configure individually in operation.

[0040] According to a further aspect of the invention is a system with the inventive stimulation device is proposed, comprising a separately located remote control device to the stimulation device has, wherein the control device of the stimulation device is remote from the remote control device. May be a conventional wireless So (for example via radio) or wired remote control be used, the modulation of the stimulation device or its activation by a different user to remotely control.

[0041] According to a further aspect of the invention is a method for Stimulation of body parts, in particular the clitoris, according to the invention. The associated advantageous effects and effects are explained in more detail above with respect to the pressure field. In this aspect of the invention is a method for Stimulation of erogenous zones, in particular the clitoris, provided, the method comprising the steps of: forming a pressure field which is directed to a body part; and modulating of the pressure field with a pattern of sub - and over-pressures, with respect to a reference pressure, preferably the normal pressure.

[0042] A further aspect of the invention is a method for Stimulation of erogenous zones according to the previously mentioned method, wherein the Stimulation effect by the modulation of the pressure field by means of a control element is individually influenced.

[0043] A further aspect of the invention is a method for Stimulation of erogenous zones according to one of the two above-described method, wherein the modulation pulse-shaped.

[0044] A further aspect of the invention is a method for Stimulation of erogenous zones, preferably of the clitoris, with the Stimulation apparatus according to any one of the appended claims with respect to the Stimulation

device, comprising the steps of: placing the second chamber over the body part, preferably over the clitoris; forming a pressure field directed to the body part; modulating of the pressure field with a pattern of sub - and over-pressures, with respect to a reference pressure, preferably the normal pressure; settling of the second chamber from the body part.

[0045] According to a further aspect of the invention is the use of the inventive Stimulation device as a sex toy to stimulate the female clitoris proposed. As explained above the female clitoris erogenous zone of a particularly sensitive is woman, which is why the inventive use of an indirect Massage - in combination with a vacuum for this body part for the Stimulation to reach orgasm Stimulation appears to be particularly advantageous.

[0046] The above-described features and functions of the present invention and realize additional aspects and features are described below with reference to a detailed description of preferred embodiments with reference to the accompanying figures further described.

BRIEF DESCRIPTION OF THE DRAWINGS

[0047] In the drawing/show:

[0048] 1 a front view of a first embodiment of the inventive stimulation device;

[0049] 2 a perspective side view of the first embodiment of the inventive stimulation device;

[0050] 3 a cross-section through the inventive stimulation device of the first embodiment;

[0051] 4 a cross section through a pressure field generating device of a first aspect of the present invention in the first state;

[0052] 5 a cross-section through a pressure field generating device of the present invention a first aspect in the second state;

[0053] 6 a cross section through a pressure field generating device of a first aspect of the present invention in the third state;

[0054] 7 a cross section through a pressure field generating device of a second aspect of the present invention;

[0055] 8 a cross section through a pressure field generating device of a third aspect of the present invention;

[0056] 9 a cross-section through a pressure field generating device of the present invention a fourth aspect;

[0057] 10a) , b) and c) cross-sections through a pressure-field generation means of a fifth aspect of the present invention;

[0058] 11 a partial cross-section through a second embodiment of the inventive stimulation device;

[0059] 12a) to f) various sub - and side views of further aspects of a second chamber of the present invention;

[0060] 13 a block diagram of an embodiment of the present invention;

[0061] 14a) to c) diagrams of different patterns of pressure modulations of the present invention

DESCRIPTION OF PREFERRED EMBODIMENTS

[0062] Referring to1 is a front view of a first embodiment of the inventive stimulation device 1 explained, wherein in2 a perspective view and in3 a cross-section of the inventive stimulation device 1 of the first embodiment.

[0063] The first embodiment of the stimulation device 1 is a, preferably hand-held, electro - or small appliance, comprising a housing 8, a pressure field generating device 2, controls 71, a display 72, An on - / off-switch 74, a bushing 75, An optional battery 76 and An optional illumination 9 has.

[0064] The housing 8is preferably such an ergonomic design, that it can hold it comfortably with one hand from sharp edges and no has. The housing may further 8made of a plastic, such as a polycarbonate (PC) or acrylonitrile-butadiene-styrene (ABS), exist. In addition the handle sections or also the entire housing may be configured with a haptically advantageous silicone or supplemented. The housing 8is preferably at least water-repelling or splash-water-tightly configured, for example protection class IP 24.

[0065] The operating elements 71serve for setting the operating mode of the device, i.e. the adjustment of the modulation pattern of the pressure field. The operating elements 71may be used as at least a push-button, as at least one rotary switch, or be embodied as at least one touch-sensitive switch. Further

the control elements can 71an optical feedback for actuating, for example by means of the switch integrated light-emitting diodes (LED), emit.

[0066] An optional display 72serves to inform the user about the device state and/or the set state. The display 72can be formed from a plurality of light emitting diodes or be configured as an LCD display. The displayed information can include for example the state of charge of a battery or the current setting of the modulation pattern may be optional.

[0067] The on - / off-switch 74serves to activate and deactivate the stimulation device 1. this on - / off-switch 74may for example be a push button, which the stimulation device 1 during prolonged pressures - or off, or a snap-in slide switch should be.

[0068] A bushing 75serves for external power supply of the stimulation device 1 via an external plug 73, which is connected to an external network adapter for example. The spray water strength of the stimulation device 1 ensure, may preferably in place of the bushing a magneto-inductive transducer may be provided, which power transmission in the stimulation device 1 without an electrical conductive contact permits. Preferably the stimulation device 1 also a battery, a nickel-Metalhydrit battery for example (nimh), for a wireless operation. Alternatively a (longer) power supply cable can be led out from the stimulation device.

[0069] The pressure field generating device 2a first embodiment comprises a first chamber 3 in the interior of the stimulation device 1, a second chamber 4 for placing on an to stimulating body part 11, and a connecting element 5 on, the first chamber 3 with the second chamber 4 connects.

[0070] A drive unit 6, for example an electric motor, drives via an axle 61 and by means of an eccentric 62 (or alternatively by means of a connecting rod) the first chamber 3 in such a way, that the volume of the first chamber 3 in accordance with rotation of the axle 61 of the drive unit 6is changed. For this purpose is noted, that in the stimulation device 1 in principle all types of drive can be used, a deflection of the wall 31 the first chamber 3 to cause change in volume. This may for example hydraulically, pneumatically, piezoelectrically, mechanically or electromagnetically take place. For this purpose are explained in more detail below by way of example.

[0071] A control device 7 controls the drive unit 6, the operating elements 71and display 72on. Here the control device is 7 and the drive unit 6from the internal battery 76 and/or the external power supply 73powered.

[0072] An optional illumination 9 is on or in the housing 8provided. The illumination serves 9 preferably the illumination of the interior of the second chamber 4. the illumination 9 may be either by the user upon activation of the stimulation device may be switched on or 1 be automatically activated. Further the illumination 9 from energy-saving light-emitting diodes may be formed. The illumination can for example be as an orientation aid for the user of the Stimulation device 1 in the dark or serve as an additional visual Stimulation.

[0073] Referring to the 4,5 and6 will be described below the structure and function of a first aspect of the pressure field generating device 2of the stimulation device 1 explained in more detail.

[0074] 4 shows the pressure field generating device 2in a first state, wherein the second chamber 4 area of skin or the body part to be stimulated on the 11is placed. The first state of the pressure field generating device 2is replaced by a neutral deflection of the first chamber 3 characterized, i.e., it is not subjected to external force, for example from the drive unit, on the first chamber 3. in this respect it is the volume V1 of the first chamber the standard volume of this chamber 3.

[0075] The body part to be stimulated 11is a skin area of the body, wherein here by way of example a particularly sensitive erogenous zone, the clitoris 12, is shown. Thus the application of the present invention is not limited to the female clitoris however 11limited, but the stimulation device 1 erogenous zones can be applied to all or parts of the body (for example the inside of the thighs, the lumbar, neck, nipples, etc.) can be applied, by means of massage and/or vacuum - or air media may be stimulated.

[0076] The second chamber 4 forms by the placement on the stimulated body part 11a to the exterior of the pressure field generating device 2largely or completely closed chamber, which only via the connecting element 5 with the second chamber is in communication, wherein the edges of the chamber 4 ideally sealed to the surface of the body part 11terminate. In this way gives rise to two communicating chambers 3 and 4, wherein the event of a change

of one of the chambers 3 or 4 a corresponding pressure equalization between the chambers 3 and 4 via connector 5 takes place.

[0077] A wall 31 the first chamber 3 is by means of a holder 32 fixed. The holder 32 is in turn attached to the housing 8 attached. On the holder 32 is further the wall 41 the second chamber. Two mutually aligned openings in the wall 41 the second chamber and the support 32 together form the connecting element 5, which the first chamber 3 and the second chamber 5 connects. In this case the wall 31, the holder 32 and wall 41 preferably bonded to each other - and airtight media. Alternatively they also may each other (for example with the aid of sealing areas between the housing 8 and the respective part) press-fitted or screwed to each other. And the bracket 32 may be connected to the housing 8 for example glued or screwed to each other.

[0078] The wall 31 the first chamber 3 preferably consists of a flexible, air-impermeable material or media -, for example rubber. The holder 32 is preferably made of a rigid plastic, which also is impermeable to air - or media. The wall 41 of the second chamber is preferably made of a flexible, skin-friendly material, for example silicone or rubber.

[0079] 5 shows the pressure field generating device 2 of 4 in a second state, wherein in turn the second chamber 4 on the body part to be stimulated 11 is placed. The second state is characterized in, that on the first chamber 3 force an expansion of the chamber A 3 causes. In detail in this embodiment the force A pulls the wall 31 the first chamber 3 in one direction, from the second chamber 4 is directed away.

[0080] This increases the volume of the chamber V_2 3, i.e., $V_2 > V_1$. To the resulting pressure difference between the chambers 3 and 4 balance, now flows to the medium or the air from the second chamber 4 into the first chamber 3.

[0081] Under the assumption, that in the first state in the compartments 3 and 4 currently prevailing the pressure present, external reference pressure (for example the air pressure) corresponds to, is now the total pressure in the second state can be lower present, than the outer reference pressure. This vacuum is designed in such a way, that preferably is less, than the usual systolic blood pressure in the blood vessels of the body part 11. This increases the blood flow in this region and the clitoris 12 is in the second state being better supplied with blood.

[0082] 6 shows the pressure field generating device 2 in a third state, wherein in turn the second chamber 4 on the body part to be stimulated 11 is placed. The third state is characterized in, that on the first chamber 3 acting force B a volume reduction or compression of the chamber 3 causes. In detail B in its direction of the direction of the force A deforms the wall and opposite force 31 the first chamber in such a way, that the resulting volume of the chamber V_3 is smaller, than the volume V_1 . The compression of the chamber 3 causes an overpressure in the chamber 3, by a media - or air flow through the connecting element 5 in the direction of the second chamber 4 is compensated for.

[0083] These media flow is now formed by the alignment of the opening 51 and/or the connecting member 5 preferably on the stimulated body part 11, in particular to the glans of the clitoris 12, directed. The inventive indirect (pressure -) Massage is performed by the on the body part 11 flowing medium. In this case is the size of the opening 51 dimensioned in such a way, that these in relation to the in the first chamber 3 displaced volume is sufficiently small, the medium for a noticeable sufficiently to accelerate massaging effect.

[0084] Further the nature of the flow not only by the size and orientation of the opening 51 are advantageously influenced, but also by the internal configuration of the connecting element. Helical grooves in the connecting element may for example 5 cause a swirl flow of the present invention, wherein the flow profile of the "softer" or more turbulent effect on the flow a body part to be stimulated is deployed. Alternatively in the second chamber the 4 resulting pressure field with the aid of several openings 51 be adjusted according to the application.

[0085] In the case of the 4 to 6 arrangement shown is advantageous, that this hygienically without problems (for example due to the prevention of dead spaces) and in the manufacture is easy. There are no valves or other openings in or on for example the first chamber 3 required.

[0086] 7 shows a second aspect of the present invention with an alternative construction of the pressure-generating device 2. So the walls 31 and 41 the first and second chambers 3 and 4 So engage one another, that these as well

as in the first aspect of the design of the pressure-generating device 2two communicating chambers with a connecting element 5 form. There is no need for a separate holder, while the second chamber 4 is replaceable. In addition the connecting element 5 integral or unitary with wall 41 the second chamber 4 be configured. A replaceable chamber 4 has the advantage, that in this way different, on the respective body part shapes adjusted to the chamber 4 can be used (a more detailed explanation in this regard can be found later), in order to remove the entire stimulation device 1 to replace. Alternatively the second chamber 4 also on the housing 8be attached to the plug (not shown). The wall 31 the first chamber 3 may be connected to the housing 8glued or screwed to each other.

[0087] Also, as in7 by the dashed line and the double-headed arrow C shown in more detail, the expansion and compression of the first chamber 3 by exerting a force take place, the perpendicular to the axial direction of the connecting element 5 lies. By the drive unit can in principle 5 directly or indirectly on the first chamber 3 from any direction by a force exerted. It is decisive here only, that the volume first chamber 3 by the drive unit 6can be increased and reduced.

[0088] 8 shows a third aspect of the invention with a one-piece or one-piece construction of the pressure field generating device 2. There can be used as material of the chambers 3 and 4 an elastic material, for example silicone or rubber, can be used. It is advantageous here, that any column can be avoided and the manufacturing cost is lower hygienically objectionable. Also in this case the pressure field generating device 2with the housing 8glued or screwed to each other. A change in the volume of the first chamber 3 here takes place in an analogous manner, as illustrated in connection with7 described.

[0089] 9 shows a fourth aspect of the invention with an alternative construction of the pressure field generating device 2. Wherein the second chamber 4, a plurality of connecting elements 5, as well as partial sections of the wall 31 the first chamber 3 integrally formed. Alternatively the pressure field generating device 2while maintaining the geometric idol the9 in a similar manner as in4 or7 shown in one or more pieces may be constructed from individual parts - also two.

[0090] The change in volume of first chamber 3 takes place here in a similar manner to the piston pump, but lacks any existing valves here. Such a piston 63 by the drive unit, for example an electric motor or an electromagnet, in the directions of the double arrow D - towards the back and forth. This type of drive has the advantage, that the volume of the first chamber 3 in a simple manner to zero or near zero can be reduced, and thus the first chamber 3 can be emptied almost completely.

[0091] The configuration of the connecting element 5 having a plurality of channels 52 and openings 51 results in a distribution of the pressure field on a plurality of concentration points. While the configuration of the connecting element 5 with only one channel, as illustrated in connection with6 described, to form a highly concentrated media - or air stream onto a target portion performs. may be used in the in9 shown configuration of the connecting element 5 the media - or air flow to a plurality of target areas are distributed. Thus for example the clitoris 11not only at its glans are blown, but uniformly from several sides. This distribution of the concentration of the air flow to a plurality of regions depending on the application aid, to avoid over-stimulation, and/or help, to increase the area of stimulation.

[0092] The 10a to 10c show a fifth aspect of the invention with (part -) cross-sections of a structure of the pressure field generating device 2with a bending element 64 as a drive for the change in volume of first chamber 3. the bending element 64 may for example be a conventional piezoelectric bending element, which deforms or bends after applying a voltage. In this aspect of the invention is the wall 31 the first chamber 3 rigid construction, while the bending element 64 in a suitable manner to the sides of the first chamber 3 is fitted. In this case the transitions between the bending element 64 and the wall 31 sealed (for example elastically bonded). In this structure is the drive for the pressure field generating device 2already integrated into it and there is no need for an external drive. For example an electric motor with an eccentric is eliminated. This makes it possible inter alia. any interfering natural oscillations due to the eccentric movement of the stimulation device can be reduced.

[0093] Shows in detail 10a the pressure field generating device 2with the flexural element 64 in the neutral position. Thus the volume of the first

chamber 3 with the flexural element 64 in the neutral position the standard volume. 10b further shows the first chamber 3 with an energized and in sequence outwardly curved bending element, and therefore the volume of the first chamber 3 is increased; and as a result prevails in the pressure field generating device 2a negative pressure. 10c shows a in comparison to 10b oppositely excited bending element of the first chamber 3, for which reason the volume of the first chamber 3 is reduced; and as a result prevails in the pressure field generating device 2a overpressure.

[0094] 11 shows a second embodiment of the invention with a spatially separated arrangement of the chambers 3 and 4 the pressure field generating device 2. In this case the chambers are 3 and 4 over an extended connector 5 connected, which is a longer flexible hose or a rigid tube may be also. For example the length of the link 5 be 0.5m. It is thus possible, the housing 8 in one hand to hold, while the other hand the second chamber 4 on the stimulated body part 11 holds; or the housing can be 8 simply to the side place, while the user is only the second chamber 4 holds in hands. In this embodiment may also be configured as a tabletop unit the stimulation device.

[0095] The 12a) to 12f) show various sub - and side views of further aspects of the second chamber 4 of the present invention. Shows in detail 12a) a bottom view of a circular second chamber 4 with a centrally disposed opening 51; 12b) a bottom view of a triangular-shaped second chamber 4 with a centrally disposed opening 51; 12c) a bottom view of an oval second chamber 4 with a centrally disposed opening 51; and 12d) a bottom view of an approximately eight-shaped second chamber 4 with two center staggered openings 51. 12e) further shows a side cross-section of an inventive second chamber 4, wherein the second chamber 4 in addition an extended contact surface 43 to the skin or a supporting part 43 has, around the (Ab -) function of sealing the second chamber 4 to improve on the skin. The extended tab 43 may also have grooves or protrusions, the sealing function can be improved further. 12f) shows a side cross-section of a second chamber 4 with a plurality of discrete connection elements 5 and an extended contact surface due to the support member 43.

[0096] Thus the shape of the second chamber 4 in principle be adapted to the anatomy of the erogenous zone to be stimulated. In this case is the shape of the chamber 4 of 12a) for example to the round shape of the breast is adjusted, while the shape of the chamber 4 the 12c) better to the shape of the female Vulva is adapted. Further determines the shape of the second chamber 4 also the embodiment of the inventive pressure field. So determines the size of the second chamber 4 in relation to that of the first chamber 3 displaced volume the level of the achievable under - or overpressure. Further the proximity of the opening can 51 of the connecting element 5 to the skin to be stimulated according to the intensity of the massage effect on these can be determined. With a plurality of openings 51, cf. 12d) , the massage effect can also be distributed to a plurality of regions. Thus for example the clitoris are stimulated directly on the very sensitive glans clitoris less (cf. 12e)), but enhances the glans clitoris to the surrounding areas, in order to avoid irritation of the clitoris over.

[0097] 13 shows a block diagram of An example of the functional structure of An embodiment of the present invention with a control device 7, a drive unit 6, An illumination 9, An on - / off-switch 74, controls 71, a battery 76 and An external power supply 73.

[0098] The controller 7, which for example has a microcontroller or is hard-wired, controls firstly the power supply for all consumers of the stimulation device 1, as well as optionally a charging and discharging of the battery - 76 and/or a battery management. In particular the control device controls 7 the energization of the drive unit 6, for example the size of the deflection, the frequency, modulation, etc.

[0099] The controller may further 7 have a memory, in the at least one modulation - or stimulation pattern (these are described in connection with 14a) to c) described in more detail) is stored. The drive unit 6 can now the option of the user of the stimulation device 1 via the operating elements 71 according to this pre-stored stimulation pattern in its excitation can be controlled. The stimulation pattern of the pressure field can optionally also by the user via the operating elements to be created and stored individually.

[0100] 14a) shows the time course of a total pressure p in the pressure field generating device (2) using this for Stimulation. The dashed line indicates the reference pressure, for example the currently prevailing atmospheric pressure, at, outside the pressure field generating device (2) is present. The

second chamber is 4 now on the stimulated body part 11 placed, is initially ambient pressure in the pressure field generating device (2) about maintained. Now it is assumed, that the second chamber 4 is mounted tightly on the body part to be stimulated substantially. After activation of the stimulation device is the drive unit 6 by the control device 7 actuated or energized according to a pre-stored stimulation pattern. Corresponding to the volume of the first chamber are 3 and keep the total pressure in the pressure field generating device 2 change, wherein the pressure changes on the reference pressure can be modulated. In 14a) shown by way of a pulsed pattern is developed or pressure - stimulation, regular pressure field. In phases of the increase in pressure is blown to the stimulating erogenous zone or massaged, while in the times, in which a sub-atmospheric pressure, the perfusion of the body part 11, for example the clitoris, is promoted. Thus there are time periods in accordance with the invention (in 14a) with I) characterized), in which a negative pressure prevails, while the clitoris at the same time is indirectly massaged.

[0101] 14b) shows three alternative stimulation patterns by way of example. Is in the with II) the range identified by a pulsed high amplitude stimulation pattern shown. In the with III) marked region is a low amplitude pulsed stimulation pattern shown. Further is in the with IV) the range identified by a in the chronological sequence in the amplitude and irregular or asymmetric stimulation pattern shown. Depending on the patterns can be varied according to individual preferences and physical activity/application.

[0102] 14c) shows another example of an alternative stimulation pattern. So the strength of the pressure increase with time, in order to adapt the excitation state of the user.

[0103] The invention can be in addition to the illustrated embodiments to further design principles. Thus different arrangements or configurations of the first chamber 3 in any desired manner with various embodiments of the second chamber 5 or the connecting element 5 be combined. For example the first chamber 3 with the drive of 10 with the second chamber of the 12f) be combined.

[0104] Although only a first chamber in all embodiments 3 shown, may also be two or more first chambers 3 be present, which are then simultaneously or sequentially driven in accordance with such, that these your change in volume, in order to build up a pressure field of the invention.

[0105] Although in all embodiments an opening from the first chamber only 3 to the connecting element 5 is shown, it is also possible for a plurality of openings for a connecting element 5 or else a plurality of openings for a plurality of connecting elements 5 in the first chamber 3 be present.

[0106] A stimulation device 1 may include a plurality of pressure field generating device 2 have. Thus for example two pressure field generating devices may be present, in order to stimulate erogenous zones simultaneously to two.

[0107] The inventive stimulation patterns may be defined in the 14a) , b) and c) other than the pattern shown, as long as a temporal sequence of sub - and over-pressures have. For example at the beginning or after activation of the device initially a relatively long-lasting negative pressure may be established (for example 3 minutes), the blood supply to the zone to be stimulated in order to effectively increase, which then slowly increasing in amplitude pulses of sub - and over-pressures follow.

List of reference signs

- 1 Stimulation device
- 2 Pressure field generating device
- 3 first chamber
- 4 second chamber
- 5 Connecting element
- 6 Drive unit
- 7 Control device
- 8 Housing
- 9 Illumination
- 11 Body portion
- 12 Clitoris
- 31 Wall of the first chamber
- 32 Holder
- 41 Wall of the second chamber
- 42 Opening of the second chamber

43 Contact surface
51 Opening of the connecting member to the second chamber
61 Drive shaft
62 Eccentric
63 Piston
64 Bending element
71 Operating element
72 Display
73 Power supply
74 - On/off switch
75 Bushing
76 Battery
77 Control board

CITATIONS INCLUDED IN THE TARGET DESCRIPTION

[0108] This list of the documents cited by applicant was exclusively for better information of the reader in an automated manner is generated and is recorded. The list is not intended to be exhaustive or - utility model application. Reference should be had to the appended claims.

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(10) **DE 20 2013 012 621 U1** 2018.01.25

(12)

Gebrauchsmusterschrift

(21) Aktenzeichen: **20 2013 012 621.3**
(22) Anmeldetag: **23.09.2013**
(67) aus Patentanmeldung: **10 2013 022 393.8**
(47) Eintragungstag: **19.12.2017**
(45) Bekanntmachungstag im Patentblatt: **25.01.2018**

(51) Int Cl.: **A61H 19/00 (2006.01)**
A61H 9/00 (2006.01)

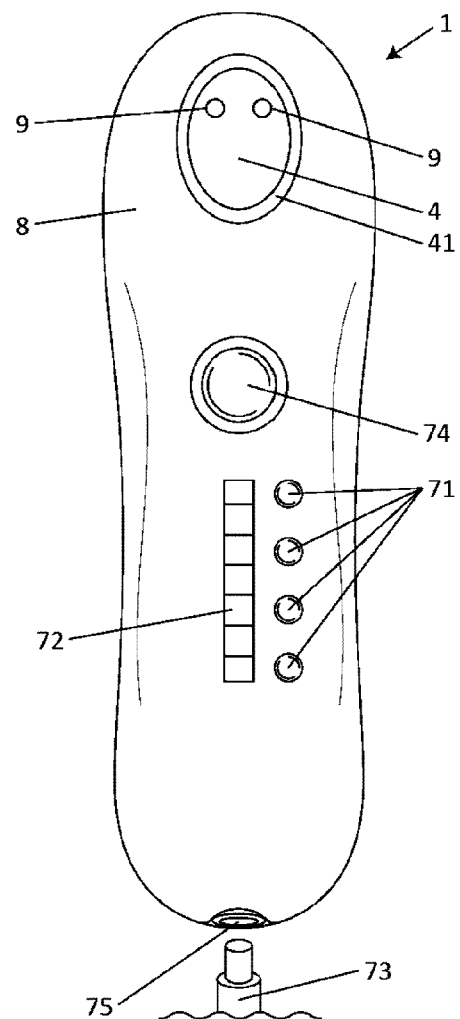
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Die folgenden Angaben sind den vom Anmelder eingereichten Unterlagen entnommen.

(54) Bezeichnung: **Stimulationsvorrichtung**

(57) Hauptanspruch: Stimulationsvorrichtung (1) zur sexuellen Stimulation der Klitoris (12), aufweisend:
eine Druckfelderzeugungseinrichtung (2), die eine Öffnung (42) zum Aufsetzen über die Klitoris und eine Antriebseinheit (6) aufweist, wobei die Öffnung (42) die einzige Öffnung der Druckfelderzeugungseinrichtung (2) zu deren Äußeren ist, und wobei die Druckfelderzeugungseinrichtung (2) derart eingerichtet ist, dass diese ein Druckfeld an der Öffnung (42) erzeugt, das sich zeitlich abwechselnde Unter- und Überdrücke, welche auf den Normaldruck aufmoduliert sind, aufweist;
eine Steuereinrichtung (7), welche die Antriebseinheit (6) ansteuern kann, und welche Stimulationsmuster aufweist;
zumindest ein Bedienelement (71), das der Einstellung des Stimulationsmusters des Druckfeldes dient;
ein Gehäuse (8), das die Steuereinrichtung (7), die Antriebseinheit (6) und eine interne Batterie (76) umfasst, wobei die Stimulationsvorrichtung (1) als ein tragbares Handgerät ausgebildet ist;
wobei die Stimulationsvorrichtung (1) keine Ventile aufweist;
wobei die Steuereinrichtung (7) derart eingerichtet ist, dass mittels des zumindest einen Bedienelements (71) ein Stimulationsmuster aus den Stimulationsmustern der Steuereinrichtung (7) einstellbar ist, wobei die Antriebseinheit (6) entsprechend dem eingestellten Stimulationsmuster angesteuert wird.



MassagerPriorArt0000536

Beschreibung

[0001] Die vorliegende Erfindung betrifft eine Stimulationsvorrichtung für erogene Zonen, insbesondere für die Klitoris und ein System mit einer Stimulationsvorrichtung.

[0002] Die erogenen Zonen des menschlichen Körpers können mit einer Vielzahl von Hilfsmitteln stimuliert werden. So werden beispielsweise Vibratoren verwendet, um mittels direkter Berührung einen Reiz auf einen bestimmten Hautbereich auszuüben. Diese Form der Stimulation kann jedoch zu Irritationen oder Hautreizungen führen. Auch kann ein direkter Kontakt der Intimzone mit derartigen Hilfsmitteln aus individuellen Gründen, beispielsweise der Hygiene oder wegen persönlichen Vorbehalten, nicht gewünscht sein.

[0003] Insbesondere die direkte Stimulation der Klitoris, beispielsweise mit einem Auflegevibrator, ist problembehaftet. So ist bei der Frau die Klitoris üblicherweise die empfindlichste erogene Zone. Die gesamte Klitoris ist stark mit Nervenendungen ausgestattet, womit diese besonders berührungsempfindlich und empfänglich für sexuelle Reize ist. Hier ist insbesondere die Klitoriseichel, in der sich die Nervenstränge der beiden Schenkel treffen, hervorzuheben. So kommt es einerseits bei häufiger Anwendung eines Auflegevibrators zur direkten Stimulation zu Gewöhnungseffekten bzw. zur Konditionierung der stimulierten erogenen Zone, während andererseits die erstmaligen Anwendungen eines derartigen Gerätes eine gewisse Einübung bzw. Eingewöhnung erfordern.

[0004] Weiter haben im Jahre 2006 durchgeführte medizinische Studien die weibliche Klitoris als maßgeblichen Ausgangspunkt des weiblichen Klimax bestimmt und erstmals die unterschiedlichen Empfindungsqualitäten von klitoralem (und vaginalem) Orgasmus neurologisch nachgewiesen. So gilt nach der jüngeren medizinischen Forschung die Stimulation der Klitoris, und nicht der Vagina, als Ausgangspunkt der sexuellen Erregung der Frau und damit als Schlüssel zum weiblichen "sexuellen Vergnügen".

[0005] Dabei ist weiter die Empfindlichkeit der menschlichen erogenen Zonen, beispielsweise der Klitoris, der inneren und äußeren Labia oder der Brustwarzen, individuell sehr unterschiedlich. Die Person kann so empfindlich sein, dass eine direkte Stimulierung erst nach längerem Vorspiel, und auch dann nur sehr zart, oder gar nicht in Betracht kommt. Weiter kann sich die Empfindlichkeit der entsprechenden Zone von Situation zu Situation oder sogar während eines Sexualakts stark verändern.

[0006] Aus vorgenannten Gründen sind verschiedene indirekte Stimulationsformen als Alternative zur direkten Stimulation gängige Praxis.

[0007] Zur indirekten Stimulation von erogenen Zonen und insbesondere der Klitoris werden herkömmliche Vakuumvorrichtungen verwendet, um die erogenen Zonen der betreffenden Person ohne direkte Berührung des zu stimulierenden Hauptbereichs zu reizen. So sind beispielsweise Vakuumpumpen für die weiblichen primären oder sekundären Geschlechtsorgane bekannt, welche üblicherweise eine Saugglocke zum Aufsetzen und eine Handpumpe aufweisen. Der mit dieser Art von Vorrichtung beispielsweise auf die Klitoris ausgeübte Unterdruck erzeugt einen negativen Druck in der Klitoris selbst, welcher üblicherweise niedriger ist als der systolische Blutdruck. Dieser Druckunterschied führt zu einer Erweiterung der Klitoris und/oder stimuliert den Blutfluss in dem betroffenen Bereich. Diese klitorale vaskuläre Blutwallung dient sowohl der Lustförderung durch Steigerung der Empfindlichkeit als auch der optischen und haptischen Manipulation. Auch führt die bessere Durchblutung zu einem erhöhten Austreten von Scheidenfeuchtigkeit, die die Stimulation angenehmer gestaltet. Jedoch ist die manuelle Betätigung der Handpumpe oft lästig oder störend. Zudem kann es auch bei dieser Gerätekategorie durch die langfristige bzw. ununterbrochene Anwendung von Unterdruck zu Gewöhnungseffekten kommen, die die Wirksamkeit der Vorrichtung auf Dauer einschränken. Zudem reicht eine reine Erhöhung des Blutflusses in der Klitoris oftmals nicht aus, um zum Klimax zu gelangen; somit werden Vakuumpumpen oftmals nur als Vorspiel eingesetzt, um den Klimax mit einer nachfolgenden direkten (Druck-)Massage der erogenen Zone zu erreichen.

[0008] Anstelle der manuell betriebenen Vakuumpumpe werden vermehrt auch elektrisch angetriebene Vakuumpumpen verwendet. Als Beispiel hierfür offenbart die WO 2006/05 82 91 A2 eine Vorrichtung zur sexuellen Therapie, wobei die Anordnung aus einer röhrenförmigen Saugkammer für die Klitoris, einer elektrischen Vakuumquelle (Vakuumpumpe) und mehreren Luftflussöffnungen besteht. Durch den Betrieb der Vakuumpumpe wird in der Kammer ein andauernder Luftfluss bzw. Luftaustausch im Bereich der Klitoris erzeugt. Dabei wird nachteilhaft die durch den Unterdruck verstärkt auftretende Scheidenfeuchtigkeit abgesaugt, weshalb ein Trocknungseffekt der stimulierten Hautpartien eintritt. Ebenso führt die abgesaugte feuchte Luft zu einer Verschmutzung der strömungstechnisch nachfolgenden Vakuumanordnung, beispielsweise der Vakuumpumpe. So können derartige Anordnungen mit Vakuumpumpen in ihrer Hygiene problematisch sein, da Vakuumpumpe und die zugehörigen Ventile bzw. lufttechnischen Bauteile oftmals Toträume bzw. tote Winkel aufweisen und/oder schwer zu reinigen sind. Weiter dient die Vor-

richtung der Therapie der Blutgefäße der Klitoris, und nicht der Stimulation bis zum sexuellen Höhepunkt.

[0009] Die US 6 099 463 A offenbart eine Vorrichtung zur Stimulation der Klitoris mit einer röhrenförmigen Saugkammer, einer Vakuumquelle bzw. einer Vakuumpumpe und mehreren Ventilen, mit denen die Größe des Vakuums geregelt wird. Das Vakuum kann hierbei auch in zyklischer Form angewandt werden, um eine Stimulationswirkung zu erzielen, wobei auch bei dieser Vorrichtung aufgrund der Anwendung eines andauernden Vakuums Gewöhnungseffekte zu erwarten sind. Auch hier bestehen die vorstehend erläuterten Nachteile der Hygiene und der Austrocknung der zu stimulierenden Hautpartie. Ebenso ist die drucktechnische Anordnung mit mehreren Ventilen, Vakuumpumpe, etc. relativ komplex.

[0010] Die US 6 464 653 B1 offenbart therapeutische Vorrichtungen und Verfahren, welche eine kitorale Blutwallerung mit Hilfe eines mit einer Vakuumpumpe erzeugten Vakuums erzeugen, um die Behandlung von Störungen der Klitoris, beispielsweise von Inkontinenz, zu unterstützen. Mit Hilfe eines Steuerventils bzw. Modulators, das mit dem Finger entsprechend abgedeckt werden kann, wird die Höhe des Vakuums in der Saugkammer manuell eingestellt oder variiert. Dies erfordert die Aufmerksamkeit des Benutzers und kann unter Umständen störend oder ablenkend sein. Auch weist diese relativ komplexe Vorrichtung mit weiteren Ventilen die vorstehend erläuterten Nachteile der Hygiene und der Austrocknung auf, wobei die Vorrichtung zudem langfristigen Therapie zwecken und nicht der kurzfristigen sexuellen Stimulation dient.

[0011] Die WO 2008/02 80 76 A2 offenbart eine therapeutische Vorrichtung für Frauen, welche vornehmlich der Behandlung sexueller Störungen dient. Dabei beinhaltet die Vorrichtung eine Kombination aus indirekter Stimulation mit Hilfe einer Vakuumkammer und direkter Stimulation mit Hilfe mechanischer Vibratoren und Oszillatoren.

[0012] Bei dieser therapeutischen Vorrichtung dient der Unterdruck der Erhöhung des Blutflusses in der Klitoris, während die eigentliche Stimulation bzw. Massage des Hautbereichs mit Hilfe direkter mechanischer Vibrationen/Oszillationen erfolgt. So ist eine Saugglocke zum Aufsetzen auf den zu stimulierenden Hautbereich intern über eine mechanische Verbindung mit einem Motor verbunden. Die Saugglocke wird durch den Motor nach Aktivierung der Vorrichtung erweitert, wobei sich das Volumen der Saugglocke vergrößert. Das resultierende Volumen der Saugglocke und damit die Stärke des Vakuums kann mit Hilfe von Steuerungselementen an der Vorrichtung eingestellt werden. Die durch den Ansaugvorgang in der Vorrichtung verdrängte Luft wird über ein Rohr wieder nach außen abgegeben. Bei

dieser Vorrichtung hat das Vakuum nur eine unterstützende Funktion, während die eigentliche Stimulation in direkter Weise erfolgt, was auch die vorstehend erläuterten Nachteile einer direkten Stimulation nach sich zieht.

[0013] Die US 2013/001 276 9 A1 offenbart eine Vorrichtung, bei der ein pulsierender Überdruck zur Stimulation als Luftdruckmassage verwendet wird. So erzeugt eine Pumpe bzw. ein Kompressor einen pulsierenden Überdruck, welcher mit Hilfe einer Düse auf die zu stimulierende erogene Zone gerichtet wird. Bei dieser Vorrichtung trocknet die betroffene Hautpartie nachteilhaft stark ab bzw. aus. Ebenso besteht üblicherweise ein Temperaturunterschied zwischen der Temperatur der zugeführten Luft und der Temperatur der zu stimulierenden Hautpartie, was unter Umständen als störend empfunden werden kann. Auch treten bei dieser Vorrichtung die vorstehend erläuterten Probleme der Hygiene auf, wobei in diesem Falle eventuell in der Vorrichtung befindliche Erreger oder Keime oder sonstige Verschmutzungen zudem noch direkt zu dem Intimbereich des Benutzers transportiert werden.

[0014] So haben die Vorrichtungen des Stands der Technik den Nachteil gemein, dass die Komplexität der Unterdruck bzw. Überdruck erzeugenden Anordnungen hoch und diese Vorrichtung hygienische Probleme aufweisen können.

[0015] Weiter haben die Vorrichtungen des Stands der Technik den weiteren Nachteil gemein, dass bei länger andauernden bzw. bei kontinuierlichen oder häufig wiederkehrenden Anwendungen von Unterdrücken Gewöhnungseffekte auftreten.

[0016] Ein weiterer Nachteil bei einigen der vorstehend beschriebenen Vakuumvorrichtungen besteht darin, dass erstens der Unterdruck mittels eines Regelventils oder einer Vakuumpumpe begrenzt sein muss, und zweitens der Unterdruck mittels einer manuellen Öffnung eines Freigabeventils abgebaut werden sollte, bevor die Saugglocke von der Haut abgelöst wird. Sollte eines der Ventile einen technischen Defekt aufweisen und/oder der Benutzer das Gerät falsch bedienen, so besteht unter Umständen Verletzungsgefahr.

[0017] So ist es in Anbetracht der vorstehend erläuterten Probleme die der Erfindung zugrunde liegende Aufgabe, eine Stimulationsvorrichtung anzugeben, welche einen einfachen Aufbau aufweist und in der Verwendung einfach und sicher ist.

[0018] Eine weitere Aufgabe der vorliegenden Erfindung besteht darin, eine Stimulationsvorrichtung mit einem effektiven stimulationsauslösenden Effekt anzugeben, welcher für der Stimulation einer erogenen

Zone, insbesondere der weiblichen Klitoris, geeignet ist.

[0019] Zudem bestehen Teilaufgaben der Erfindung darin, eine Vorrichtung vorzusehen, welche ein Austrocknen der zu stimulierenden erogenen Zonen vermeidet, hygienisch ist und Gewöhnungseffekte vermeidet.

[0020] Die der Erfindung zugrunde liegende Aufgabe wird durch die Stimulationsvorrichtung gemäß Anspruch 1 gelöst. Vorteilhafte Weiterentwicklungen und Ausführungsformen sind Gegenstand der weiteren nebengeordneten und abhängigen Ansprüche.

[0021] Erfindungsgemäß ist eine Stimulation von erogenen Zonen, insbesondere der Klitoris, vorgesehen, welche die folgende Schritte aufweist: Ausbilden eines auf ein Körperteil gerichteten Druckfeldes; und Modulieren des Druckfeldes mit einem Muster von Unter- und Überdrücken, bezüglich eines Referenzdrucks, vorzugsweise dem Normaldruck.

[0022] Dabei kann die Stimulationswirkung durch die Modulation des Druckfeldes mittels eines Bedienelements individuell beeinflusst werden. Zudem kann die Modulation pulsformig sein.

[0023] Bei einer erfindungsgemäßen Ausführungsform weist eine Druckfelderzeugungseinrichtung der Stimulationsvorrichtung zumindest eine erste Kammer und zumindest eine zweite Kammer mit zumindest einer Öffnung zum Aufsetzen auf ein Körperteil bzw. auf die erogene Zone und zumindest ein Verbindungselement, welches die erste Kammer mit der zweiten Kammer verbindet, auf.

[0024] Durch diese erfindungsgemäße Ausbildung von strömungstechnisch über zumindest ein Verbindungselement kommunizierenden Kammern kann durch Änderung des Volumens der ersten Kammer in einfacher Weise ein Druckfeld in der zweiten Kammer erzeugt werden, dass zeitweise auf den zu stimulierenden Hautbereich gerichtet ist.

[0025] Ein Druckfeld im Sinne der Erfindung ist ein sich zeitlich veränderliches Feld von Mediendrücken, welches zeitweise Überdrücke und zeitweise Unterdrücke aufweist, wobei ein Unterdruck ein Mediendruck ist, der unter dem Referenzdruck liegt, und ein Überdruck ein Mediendruck ist, der über dem Referenzdruck liegt.

[0026] Das Medium ist üblicherweise gasförmig, vorzugsweise Luft, kann jedoch beispielsweise alternativ oder additiv ein flüssiges Medium, beispielsweise Wasser oder handelsübliches Gleitmittel, sein. Beispielsweise kann das Gleitmittel vor Benutzung der Stimulationsvorrichtung in die erfindungsgemäßen Kammern eingefüllt werden. Auf diese Weise

kann die Stimulation des entsprechenden Hautbereichs anstelle mit Luft auch mit einer geeigneten hautfreundlichen Flüssigkeit erfolgen, was je nach individueller Präferenz des Anwenders gewünscht sein kann. Als weiteres Beispiel kann die Stimulationsvorrichtung auch unter Wasser mit Wasser als Medium verwendet werden (beispielsweise in der Badewanne).

[0027] Der Referenzdruck ist üblicherweise der jeweils bei Beginn der Anwendung (d.h. vor dem Aufsetzen der Stimulationsvorrichtung auf den zu stimulierenden Hautbereich) vorliegende Umgebungsdruck in Bezug auf die Stimulationsvorrichtung. Bei der vorzugsweisen Anwendung der Stimulationsvorrichtung mit Luft ist der Referenzdruck der aktuell vorliegende Luftdruck bzw. der Normaldruck.

[0028] Durch das erfindungsgemäße Druckfeld wird der zu stimulierende Hautbereich einerseits in seiner Durchblutung angeregt, während dieser andererseits indirekt massiert wird. So werden zwei vorteilhafte Effekte kombiniert. Aufgrund der erhöhten Durchblutung ist die erogene Zone der betreffenden Person empfindlicher, während zudem ein Massageeffekt erzeugt wird, der der Stimulation der erogenen Zone, beispielsweise der sexuellen Erregung bis zum Klimax, dient. Der Massageeffekt wird durch die kinetische Energie des aus der ersten Kammer durch das Verbindungselement strömenden Mediums gegen die Oberfläche des zu stimulierenden Hautbereichs erzeugt. Auf diese Weise wird der Massageeffekt indirekt, also ohne direkte Berührung der zu stimulierenden Hautpartie durch einen festen Körper, beispielsweise durch einen Vibrator, erzeugt, was zur Folge hat, dass die eingangs erläuterten Nachteile der direkten Stimulation vermieden werden.

[0029] Durch die beispielhafte Anwendung des sich erfindungsgemäß zeitlich verändernden Druckfeldes auf die Klitoris wird durch das Druckfeld eine Reizung nachgeahmt, welche beim Sexualverkehr üblicherweise stattfindet. Dabei wird durch die Kohabitationsbewegung ebenfalls ein wechselnder Reiz an der Klitoris erzeugt. So handelt es sich um eine lebensnahe Imitation des natürlichen Kohabitationsaktes, wobei ärztliche Aussagen bestätigen, dass die Anwendung des erfindungsgemäßen Druckfeldes weder zu Gewöhnungseffekten noch zur Suchterzeugung führt. Dies ist insbesondere in der abwechselnden Anwendung von Unter- und Überdrücken (bzw. auch in der nicht kontinuierlichen Anwendung nur einer Art eines Drucks) begründet.

[0030] Weiter ist der maximal anwendbare Druck regelmäßig durch die maximale Belastbarkeit des zu stimulierenden Hautbereichs beschränkt. So birgt beispielsweise ein zu hoher Unterdruck besonders in erogenen Zonen das Risiko von schmerzhaften Verletzungen. Ausschließlich mit Unterdrücken ar-

beitende Stimulationsvorrichtungen sind in ihrer Arbeitsweise üblicherweise auf dieses Maximum beschränkt. Im Gegensatz dazu wird erfindungsgemäß durch die Kombination von Über- und Unterdrücken ein erweiterter Arbeitsbereich des stimulationsauslösenden Druckfeldes bzw. Effektes geschaffen, da der Arbeitsbereich des Drucks nunmehr sowohl im positiven als auch im negativen Bereich bis zum Maximum ausgenutzt werden kann.

[0031] Durch die Ausrichtung des zumindest einen Verbindungselements auf den zu stimulierenden Hautbereich kann das Druckfeld unmittelbar wirken, wobei das Druckfeld maßgeblich durch die Konfiguration des zumindest einen Verbindungselements und der zumindest einen Öffnung von dem Verbindungselement in die zweite Kammer beeinflusst wird, und so je nach Anwendung der Stimulationsvorrichtung einstellbar ist. So kann die zumindest eine Öffnung des Verbindungselements dem zu stimulierenden Körperteil, vorzugsweise direkt, gegenüber liegen. Beispielsweise kann das Verbindungselement bei einer Stimulationsvorrichtung, welche für die Klitoris bestimmt ist, eine einzelne Durchgangsöffnung mit Düsenwirkung auf die Klitoriseichel zwischen der ersten und der zweiten Kammer aufweisen. Alternativ kann das zumindest eine Verbindungselement aus mehreren, beispielsweise vier, Durchgangsöffnungen zwischen den Kammern bestehen, wenn ein großflächigerer Hautbereich stimuliert werden soll.

[0032] Weiter entsteht nach dem Aufsetzen der halbseitig bzw. teilweise geöffneten zweiten Kammer auf den zu stimulierenden Hautbereich ein in sich abgeschlossenes System der Medien- bzw. Luftströmung in der Druckfelderzeugungseinrichtung. So wird das Medium bzw. die Luft maßgeblich zwischen den Kammern hin- und herbewegt, während ein Austausch mit Medien bzw. mit Luft von außerhalb des Systems zumindest weitgehend vermieden wird. So ist vorzugsweise die erste Kammer über bzw. durch das Verbindungselement ausschließlich mit der zweiten Kammer verbunden. So bestehen keine anderen Verbindungen der ersten Kammer als diejenigen zur zweiten Kammer; beispielsweise besteht keine direkte Verbindung der ersten Kammer mit der Umgebung des Gerätes über ein Druckventil oder über einen Luftabführkanal.

[0033] Beispielsweise wird sich die Temperatur der Luft in dem erfindungsgemäßen Strömungssystem schnell an die Hauttemperatur anpassen, während das störende Zuführen von neuer (beispielsweise kalter) Luft von außerhalb des Systems vermieden wird, so wie dies beim Stand der Technik u.A. bei der Verwendung von Vakuumpumpen der Fall sein kann. Zudem werden Abtrocknungseffekte vermieden, da in einem geschlossenen System kein oder kaum Abtransport von stimulationsfördernder Flüssigkeit, beispielsweise Körperflüssigkeit, stattfindet.

[0034] Weiter weist die erfindungsgemäße Druckfelderzeugungseinrichtung aufgrund des einfachen Aufbaus den Vorteil einer erhöhten Hygiene und einer verbesserten Reinigungsfähigkeit auf. Dabei vermeidet die vorliegende Erfindung Ventile oder Pumpen/Kompressoren mit potentiellen Toträumen und nicht zu reinigenden Stellen. So ist die erfindungsgemäße Druckfelderzeugungseinrichtung einfach zu reinigen. Beispielsweise kann eine Reinigung der Stimulationsvorrichtung in einfacher Weise durch Einfüllen einer Reinigungsflüssigkeit in die erste Kammer und aktivieren des Druckfeldes erfolgen. Alternativ kann die zweite Kammer austauschbar angeordnet sein, was die Reinigung beider Kammern ebenfalls erleichtert. Weiter können die erfindungsgemäßen Kammern und das Verbindungselement der Druckfelderzeugungseinrichtung einstückig hergestellt sein, wobei diese beispielsweise aus einem einzelnen Plastikformteil (z.B. Gummi) bestehen.

[0035] Zudem führt der erfindungsgemäße Aufbau zur Vermeidung komplexer strömungstechnischer Elemente, wie z.B. Ventile, was zu einer Vereinfachung der Herstellung führt.

[0036] Weiter weist die erfindungsgemäße Stimulationsvorrichtung eine Antriebseinheit, welche das Volumen der ersten Kammer derart verändert, dass über das Verbindungselement in der zweiten Kammer ein Druckfeld erzeugt wird, welches der Stimulation der erogenen Zone dient, und eine Steuereinrichtung auf, welche die Antriebseinheit ansteuert.

[0037] Das zwischen den Kammern transportierte Medium ist in seinem Volumen prinzipbedingt auf das maximale Volumen der ersten Kammer begrenzt. Zudem kann das transportierte Volumen durch die maximal mögliche Volumenänderung, welche durch die Antriebseinheit bewirkt wird, weiter konstruktiv beschränkt werden.

[0038] Dies hat zur Folge, dass der maximale Über- bzw. Unterdruck, den die Stimulationsvorrichtung in der zweiten Kammer aufbauen kann, aufgrund der Dimensionierung der Komponenten der Druckfelderzeugungseinrichtung und des Antriebs beschränkt ist. Insbesondere kann der maximale Über- bzw. Unterdruck auf ein Maß beschränkt werden, der eine Verletzungsgefahr für die zu stimulierenden Hautbereiche minimiert oder ausschließt. Beispielsweise erübrigt sich damit ein im Stand der Technik übliches Sicherheitsventil oder ein manuelles Eingreifen des Benutzers in den Stimulationsvorgang, beispielsweise ein Öffnen eines Freigabeventils.

[0039] Weiter wird die zeitliche Veränderung des Druckfeldes bzw. die Modulation des Druckfeldes durch die Steuereinrichtung weitgehend automatisch gesteuert. So kann in der Steuereinrichtung die Modulation des Druckfeldes, beispielsweise Intensität,

zeitlicher Verlauf oder Abfolge, vorgespeichert sein. Vorzugsweise kann die zeitliche Veränderung des Druckfeldes regelmäßige bzw. wiederkehrende (Stimulations-)Muster aufweisen, beispielsweise Impulse mit einem vorgegebenen Takt oder sich regelmäßig abwechselnde Impulsfolgen. Auf diese Weise kann sich die Interaktion des Benutzers mit der Stimulationsvorrichtung erfindungsgemäß auf das An- und das Ausschalten und die Wahl des Stimulationsmusters beschränken, während die Stimulationsvorrichtung das bevorzugte Stimulationsmuster automatisch ausführt. Somit ist erfindungsgemäß die Anwendungskomplexität der Stimulationsvorrichtung gerade im Vergleich zu den herkömmlichen (medizinischen) Vakuum-Stimulationsvorrichtungen niedrig. Alternativ oder zusätzlich kann der Benutzer die Stimulationsmuster der Stimulationsvorrichtung während oder vor dem Betrieb individuell konfigurieren.

[0040] Gemäß einem weiteren Aspekt der Erfindung wird ein System mit der erfindungsgemäßen Stimulationsvorrichtung vorgeschlagen, welches eine zu der Stimulationsvorrichtung getrennt angeordnete Fernsteuervorrichtung aufweist, wobei die Steuereinrichtung der Stimulationsvorrichtung von der Fernsteuereinrichtung ferngesteuert wird. So kann eine übliche kabellose (beispielsweise über Funk) oder kabelgebundene Fernsteuerung eingesetzt werden, um die Modulation der Stimulationsvorrichtung oder deren Aktivierung von einem weiteren Benutzer fernzusteuern zu lassen.

[0041] Gemäß einem weiteren Aspekt der Erfindung wird ein Verfahren zur Stimulation von Körperteilen, insbesondere der Klitoris, vorgeschlagen. Die zugehörigen vorteilhaften Effekte und Wirkungen sind vorstehend in Bezug auf das Druckfeld näher erläutert. Bei diesem Aspekt der Erfindung ist ein Verfahren zur Stimulation von erogenen Zonen, insbesondere der Klitoris, vorgesehen, das Verfahren aufweisend folgende Schritte: Ausbilden eines auf ein Körperteil gerichteten Druckfeldes; und Modulieren des Druckfeldes mit einem Muster von Unter- und Überdrücken, bezüglich eines Referenzdrucks, vorzugsweise dem Normaldruck.

[0042] Ein weiterer Aspekt der Erfindung ist ein Verfahren zur Stimulation von erogenen Zonen gemäß dem vorherig aufgeführten Verfahren, wobei die Stimulationswirkung durch die Modulation des Druckfeldes mittels eines Bedienelements individuell beeinflusst wird.

[0043] Ein weiterer Aspekt der Erfindung ist ein Verfahren zur Stimulation von erogenen Zonen gemäß einer der beiden vorausstehend beschriebenen Verfahren, wobei die Modulation pulsförmig ist.

[0044] Ein weiterer Aspekt der Erfindung ist ein Verfahren zur Stimulation von erogenen Zonen, vor-

zugsweise der Klitoris, mit der Stimulationsvorrichtung gemäß einem der beiliegenden Ansprüche bezüglich der Stimulationsvorrichtung, aufweisend folgende Schritte: Aufsetzen der zweiten Kammer über das Körperteil, vorzugsweise über der Klitoris; Ausbilden eines auf das Körperteil gerichteten Druckfeldes; Modulieren des Druckfeldes mit einem Muster von Unter- und Überdrücken, bezüglich eines Referenzdrucks, vorzugsweise dem Normaldruck; Absetzen der zweiten Kammer von dem Körperteil.

[0045] Gemäß einem weiteren Aspekt der Erfindung wird die Verwendung der erfindungsgemäßen Stimulationsvorrichtung als Sexspielzeug zur Stimulation der weiblichen Klitoris vorgeschlagen. Wie eingangs erläutert ist die weibliche Klitoris eine besonders empfindliche erogene Zone der Frau, weshalb die erfindungsgemäße Verwendung einer indirekten Massage- in Kombination mit einer Unterdruckstimulation für dieses Körperteil zur Stimulation bis zum Orgasmus besonders vorteilhaft erscheint.

[0046] Die vorstehend beschriebenen Merkmale und Funktionen der vorliegenden Erfindung sowie weitere Aspekte und Merkmale werden nachfolgend anhand einer detaillierten Beschreibung von bevorzugten Ausführungsformen unter Bezugnahme auf die beigefügten Figuren weiter beschrieben.

KURZE BESCHREIBUNG DER ZEICHNUNGEN

[0047] Hierbei zeigt/zeigen:

[0048] Fig. 1 eine Vorderansicht einer ersten Ausführungsform der erfindungsgemäßen Stimulationsvorrichtung;

[0049] Fig. 2 eine perspektivische Seitenansicht der ersten Ausführungsform der erfindungsgemäßen Stimulationsvorrichtung;

[0050] Fig. 3 einen Querschnitt durch die erfindungsgemäßen Stimulationsvorrichtung der ersten Ausführungsform;

[0051] Fig. 4 einen Querschnitt durch eine Druckfelderzeugungseinrichtung eines ersten Aspekts der vorliegenden Erfindung im ersten Zustand;

[0052] Fig. 5 einen Querschnitt durch eine Druckfelderzeugungseinrichtung eines ersten Aspekts der vorliegenden Erfindung im zweiten Zustand;

[0053] Fig. 6 einen Querschnitt durch eine Druckfelderzeugungseinrichtung eines ersten Aspekts der vorliegenden Erfindung im dritten Zustand;

[0054] Fig. 7 einen Querschnitt durch eine Druckfelderzeugungseinrichtung eines zweiten Aspekts der vorliegenden Erfindung;

[0055] Fig. 8 einen Querschnitt durch eine Druckfelderzeugungseinrichtung eines dritten Aspekts der vorliegenden Erfindung;

[0056] Fig. 9 einen Querschnitt durch eine Druckfelderzeugungseinrichtung eines vierten Aspekts der vorliegenden Erfindung;

[0057] Fig. 10a), b) und c) Querschnitte durch eine Druckfelderzeugungseinrichtung eines fünften Aspekts der vorliegenden Erfindung;

[0058] Fig. 11 einen teilweisen Querschnitt durch eine zweite Ausführungsform der erfindungsgemäßen Stimulationsvorrichtung;

[0059] Fig. 12a) bis f) verschiedene Unter- und Seitenansichten weiterer Aspekte einer zweiten Kammer der vorliegenden Erfindung;

[0060] Fig. 13 ein Blockdiagramm einer Ausführungsform der vorliegenden Erfindung;

[0061] Fig. 14a) bis c) Diagramme von verschiedenen Mustern der Druckmodulationen der vorliegenden Erfindung

BESCHREIBUNG BEVORZUGTER AUSFÜHRUNGSFORMEN

[0062] Bezugnehmend auf Fig. 1 wird eine Vorderansicht einer ersten Ausführungsform der erfindungsgemäßen Stimulationsvorrichtung 1 erläutert, wobei in Fig. 2 eine perspektivische Ansicht und in Fig. 3 ein Querschnitt der erfindungsgemäßen Stimulationsvorrichtung 1 der ersten Ausführungsform gezeigt ist.

[0063] Die erste Ausführungsform der Stimulationsvorrichtung 1 ist ein, vorzugsweise tragbares, Elektro- oder Kleingerät, welches ein Gehäuse 8, eine Druckfelderzeugungseinrichtung 2, Bedienelemente 71, eine Anzeige 72, einen An-/Aus-Schalter 74, eine Buchse 75, eine optionale Batterie 76 und eine optionale Beleuchtung 9 aufweist.

[0064] Das Gehäuse 8 ist vorzugsweise derart ergonomisch ausgeführt, dass man es mit einer Hand bequem halten kann und es keine scharfen bzw. spitzen Kanten aufweist. Weiter kann das Gehäuse 8 aus einem Kunststoff, beispielsweise Polycarbonat (PC) oder Acrylnitril-Butadien-Styrol (ABS), bestehen. Zudem können die Griffbereiche oder auch das gesamte Gehäuse mit einem haptisch vorteilhaften Silikon ergänzt bzw. ausgestaltet sein. Das Gehäuse 8 ist vorzugsweise zumindest wasserabweisend oder spritzwasserfest ausgestaltet, beispielsweise Schutzklasse IP 24.

[0065] Die Bedienelemente 71 dienen der Einstellung der Betriebsart des Gerätes, d.h. der Einstel-

lung des Modulationsmusters des Druckfeldes. Die Bedienelemente 71 können beispielsweise als zumindest ein Drucktaster, als zumindest ein Drehschalter, oder als zumindest ein berührungsempfindlicher Schalter ausgeführt sein. Weiter können die Bedienelemente 71 ein optisches Feedback zur Betätigung, beispielsweise mittels in den Schalter integrierter Leuchtdioden (LED), abgeben.

[0066] Eine optionale Anzeige 72 dient der Information des Benutzers über den Gerätezustand und/oder den Einstellzustand. Die Anzeige 72 kann beispielsweise aus einer Mehrzahl von Leuchtdioden oder als LCD-Anzeige ausgestaltet sein. Die angezeigten Informationen können beispielsweise der Ladezustand einer optionalen Batterie oder die aktuelle Einstellung des Modulationsmusters sein.

[0067] Der An-/Aus-Schalter 74 dient der Aktivierung und Deaktivierung der Stimulationsvorrichtung 1. Dieser An-/Aus-Schalter 74 kann beispielsweise ein Drucktaster, welcher die Stimulationsvorrichtung 1 bei längerem Drücken ein- bzw. ausschaltet, oder ein einrastender Schiebeschalter sei.

[0068] Eine Buchse 75 dient der externen Stromversorgung der Stimulationsvorrichtung 1 über einen externen Stecker 73, welcher beispielsweise an einen externen Netzadapter angeschlossen ist. Um die Spritzwasserfestigkeit der Stimulationsvorrichtung 1 sicherzustellen, kann vorzugsweise anstelle der Buchse ein magnetisch-induktiver Übertrager vorgesehen sein, welcher eine Leistungsübertragung in die Stimulationsvorrichtung 1 ohne einen elektrischen leitenden Kontakt ermöglicht. Vorzugsweise weist die Stimulationsvorrichtung 1 zudem eine Batterie, beispielsweise einen Nickel-Metalhydrit-Akku (NiMH), für einen kabellosen Betrieb auf. Alternativ kann auch ein (längeres) Stromversorgungskabel aus der Stimulationsvorrichtung herausgeführt sein.

[0069] Die Druckfelderzeugungseinrichtung 2 einer ersten Ausführungsform weist eine erste Kammer 3 im Inneren der Stimulationsvorrichtung 1, eine zweite Kammer 4 zum Aufsetzen auf ein zu stimulierendes Körperteil 11, und ein Verbindungselement 5 auf, welche die erste Kammer 3 mit der zweiten Kammer 4 verbindet.

[0070] Eine Antriebseinheit 6, beispielsweise ein Elektromotor, treibt über eine Achse 61 und mittels eines Exzenters 62 (oder alternativ mittels einer Pleuelstange) die erste Kammer 3 derart an, dass das Volumen der ersten Kammer 3 entsprechend Drehung der Achse 61 der Antriebseinheit 6 verändert wird. Hierzu wird angemerkt, dass in der Stimulationsvorrichtung 1 grundsätzlich alle Antriebsarten einsetzbar sind, welche eine Auslenkung der Wand 31 der ersten Kammer 3 zur Volumenänderung bewirken. So kann dies beispielsweise hydraulisch, pneumatisch,

piezoelektrisch, mechanisch oder elektromagnetisch geschehen. Beispiele hierfür werden später noch näher erläutert.

[0071] Eine Steuereinrichtung 7 steuert die Antriebseinheit 6, die Bedienelemente 71 und die Anzeige 72 an. Dabei wird die Steuereinrichtung 7 und die Antriebseinheit 6 von der internen Batterie 76 und/oder der externen Leistungsversorgung 73 mit Leistung versorgt.

[0072] Eine optionale Beleuchtung 9 ist an oder in dem Gehäuse 8 vorgesehen. Dabei dient die Beleuchtung 9 vorzugsweise der Beleuchtung des Inneren der zweiten Kammer 4. Die Beleuchtung 9 kann entweder durch den Benutzer zuschaltbar sein oder bei Aktivierung der Stimulationsvorrichtung 1 automatisch aktiviert sein. Weiter kann die Beleuchtung 9 aus energiesparenden Leuchtdioden ausgebildet sein. Die Beleuchtung kann beispielsweise als Orientierungshilfe für den Benutzer der Stimulationsvorrichtung 1 im Dunkeln oder als zusätzliche optische Stimulation dienen.

[0073] Bezugnehmend auf die Fig. 4, Fig. 5 und Fig. 6 wird nachstehend der Aufbau und die Funktion eines ersten Aspekts der Druckfelderzeugungseinrichtung 2 der Stimulationsvorrichtung 1 näher erläutert.

[0074] Fig. 4 zeigt die Druckfelderzeugungseinrichtung 2 in einem ersten Zustand, wobei die zweite Kammer 4 auf den zu stimulierenden Hautbereich bzw. das Körperteil 11 aufgesetzt ist. Der erste Zustand der Druckfelderzeugungseinrichtung 2 ist durch eine neutrale Auslenkung der ersten Kammer 3 gekennzeichnet, d.h., es wirkt keine externe Kraft, beispielsweise von der Antriebseinheit, auf die erste Kammer 3. Hierbei ist das Volumen V_1 der ersten Kammer das Standardvolumen dieser Kammer 3.

[0075] Das zu stimulierende Körperteil 11 ist ein Hautbereich des Körpers, wobei hier beispielhaft eine besonders empfindliche erogene Zone, die Klitoris 12, dargestellt ist. Somit ist die Anwendung der vorliegenden Erfindung ist jedoch nicht auf die weibliche Klitoris 11 beschränkt, sondern die Stimulationsvorrichtung 1 kann auf alle Körperteile bzw. erogenen Zonen (beispielsweise die Innenseite der Oberschenkel, die Lenden, Nacken, Brustwarzen, etc.) angewandt werden, welche mittels Medien- bzw. Luftdruckmassage und/oder Unterdruck stimuliert werden können.

[0076] Die zweite Kammer 4 bildet durch das Aufsetzen auf das zu stimulierende Körperteil 11 eine zum Äußeren der Druckfelderzeugungseinrichtung 2 weitgehend oder vollständig abgeschlossene Kammer, welche nur noch über das Verbindungselement 5 mit der zweiten Kammer in Verbindung steht, wobei die

Ränder der Kammer 4 im Idealfall dicht mit der Oberfläche des Körperteils 11 abschließen. Auf diese Weise entstehen zwei kommunizierende Kammern 3 und 4, wobei bei Volumenänderung einer der Kammern 3 oder 4 ein entsprechender Druckausgleich zwischen den Kammern 3 und 4 über das Verbindungselement 5 erfolgt.

[0077] Eine Wand 31 der ersten Kammer 3 ist mittels einer Halterung 32 fixiert. Die Halterung 32 ist wiederum an dem Gehäuse 8 befestigt. An der Halterung 32 ist weiter die Wand 41 der zweiten Kammer angebracht. Zwei zueinander ausgerichtete Öffnungen in der Wand 41 der zweiten Kammer und der Halterung 32 bilden gemeinsam das Verbindungselement 5, welches die erste Kammer 3 und die zweite Kammer 5 verbindet. Dabei sind die Wand 31, die Halterung 32 und die Wand 41 vorzugsweise miteinander medien- bzw. luftdicht verklebt. Alternativ können diese auch miteinander (beispielsweise mit Hilfe von dichtenden Bereichen zwischen dem Gehäuse 8 und dem jeweiligen Teil) press-gepasst oder verschraubt sein. Auch die Halterung 32 kann mit dem Gehäuse 8 beispielsweise verklebt oder verschraubt sein.

[0078] Die Wand 31 der ersten Kammer 3 besteht vorzugsweise aus einem flexiblen, medien- bzw. luftundurchlässigen Material, beispielsweise Gummi. Die Halterung 32 besteht vorzugsweise aus einem starren Kunststoff, welcher ebenso medien- bzw. luftundurchlässig ist. Die Wand 41 der zweiten Kammer ist vorzugsweise aus einem flexiblen, hautfreundlichen Material hergestellt, beispielsweise Silikon oder Gummi.

[0079] Fig. 5 zeigt die Druckfelderzeugungseinrichtung 2 von Fig. 4 in einem zweiten Zustand, wobei wiederum die zweite Kammer 4 auf das zu stimulierende Körperteil 11 aufgesetzt ist. Der zweite Zustand ist dadurch gekennzeichnet, dass eine auf die erste Kammer 3 wirkende Kraft A eine Expansion der Kammer 3 bewirkt. Im Detail zieht bei diesem Ausführungsbeispiel die Kraft A die Wand 31 der ersten Kammer 3 in eine Richtung, die von der zweiten Kammer 4 weggerichtet ist.

[0080] Dadurch vergrößert sich das Volumen V_2 der Kammer 3, d.h., $V_2 > V_1$. Um den entstandenen Druckunterschied zwischen den Kammern 3 und 4 auszugleichen, strömt nunmehr das Medium bzw. die Luft von der zweiten Kammer 4 in die erste Kammer 3.

[0081] Unter der Annahme, dass in dem ersten Zustand der in den Kammern 3 und 4 vorliegende Druck dem aktuell herrschendem, äußerem Referenzdruck (beispielsweise dem Luftdruck) entspricht, wird nun der vorliegende Gesamtdruck in dem zweiten Zustand geringer sein, als der äußere Referenzdruck. Dieser Unterdruck ist derart ausgelegt, dass dieser

vorzugsweise geringer ist, als der übliche systolische Blutdruck in den Blutgefäßen des Körperteils **11**. Damit erhöht sich die Durchblutung in diesem Bereich und die Klitoris **12** wird in dem zweiten Zustand besser durchblutet.

[0082] Fig. 6 zeigt die Druckfelderzeugungseinrichtung **2** in einem dritten Zustand, wobei wiederum die zweite Kammer **4** auf das zu stimulierende Körperteil **11** aufgesetzt ist. Der dritte Zustand ist dadurch gekennzeichnet, dass eine auf die erste Kammer **3** wirkende Kraft **B** eine Volumenverkleinerung bzw. Kompression der Kammer **3** bewirkt. Im Detail ist die Kraft **B** in seiner Richtung der Richtung der Kraft **A** entgegengesetzt und verformt die Wand **31** der ersten Kammer derart, dass das resultierende Volumen V_3 der Kammer kleiner ist, als das Volumen V_1 . Die Kompression der Kammer **3** bewirkt einen Überdruck in der Kammer **3**, welcher durch eine Medien- bzw. Luftströmung durch das Verbindungselement **5** in Richtung der zweiten Kammer **4** ausgeglichen wird.

[0083] Diese Medienströmung ist nun durch die Ausrichtung der Öffnung **51** und/oder des Verbindungselements **5** vorzugsweise auf das zu stimulierende Körperteil **11**, insbesondere auf die Eichel der Klitoris **12**, gerichtet. Die erfindungsgemäße indirekte (Druck-)Massage erfolgt durch das auf das Körperteil **11** strömende Medium. Dabei ist die Größe der Öffnung **51** derart dimensioniert, dass diese im Verhältnis zu dem in der ersten Kammer **3** verdrängten Volumen klein genug ist, um das Medium für eine spürbare Massagewirkung ausreichend zu beschleunigen.

[0084] Weiter kann die Art der Strömung nicht nur durch die Größe und die Ausrichtung der Öffnung **51** vorteilhaft beeinflusst werden, sondern auch durch die innere Konfiguration des Verbindungselements. Beispielsweise können helixförmige Rillen in dem Verbindungselement **5** einen Drall der erfindungsgemäßen Strömung verursachen, wobei das Strömungsprofil der Strömung eine „weichere“ bzw. turbulentere Wirkung auf das zu stimulierende Körperteil entfaltet. Alternativ kann das sich in der zweiten Kammer **4** ergebende Druckfeld mit Hilfe mehrerer Öffnungen **51** entsprechend der Anwendung angepasst werden.

[0085] Bei der in den Fig. 4 bis Fig. 6 gezeigten Anordnung ist vorteilhaft, dass diese hygienisch unproblematisch (beispielsweise aufgrund der Vermeidung von Toträumen) und in der Herstellung einfach ist. Beispielsweise sind keine Ventile oder weitere Öffnungen in oder an der ersten Kammer **3** erforderlich.

[0086] Fig. 7 zeigt einen zweiten Aspekt der vorliegenden Erfindung mit einem alternativen Aufbau der Druckerzeugungseinrichtung **2**. So können die Wände **31** und **41** der ersten und zweiten Kammer **3** und **4**

derart ineinander eingreifen, dass diese ebenso wie bei dem ersten Aspekt des Aufbaus der Druckerzeugungseinrichtung **2** zwei kommunizierende Kammern mit einem Verbindungselement **5** ausbilden. So entfällt eine gesonderte Halterung, während die zweite Kammer **4** austauschbar ist. Zudem kann das Verbindungselement **5** integral oder einstückig mit der Wand **41** der zweiten Kammer **4** ausgestaltet sein. Eine austauschbare Kammer **4** hat den Vorteil, dass auf diese Weise verschiedene, auf das jeweilige Körperteil angepasste Formgebungen der Kammer **4** zum Einsatz kommen können (eine nähere Erläuterung hierzu findet sich später), ohne dazu die gesamte Stimulationsvorrichtung **1** auszutauschen zu müssen. Alternativ kann die zweite Kammer **4** auch an dem Gehäuse **8** steckbar befestigt werden (nicht näher dargestellt). Die Wand **31** der ersten Kammer **3** kann beispielsweise mit dem Gehäuse **8** verklebt oder verschraubt sein.

[0087] Auch kann, wie in Fig. 7 durch die gestrichelte Linie und den Doppelpfeil **C** näher dargestellt, die Expansion und die Kompression der ersten Kammer **3** durch eine Kraftwirkung erfolgen, die senkrecht zur der Achsrichtung des Verbindungselements **5** liegt. Grundsätzlich kann die durch die Antriebseinheit **5** mittelbar oder unmittelbar auf die erste Kammer **3** ausgeübte Kraft aus einer beliebigen Richtung erfolgen. Entscheidend ist hier bei nur, dass das Volumen ersten Kammer **3** durch die Antriebseinheit **6** vergrößert und verkleinert werden kann.

[0088] Fig. 8 zeigt einen dritten Aspekt der Erfindung mit einem einstückigen bzw. einteiligen Aufbau der Druckfelderzeugungseinrichtung **2**. Dabei kann als Material der Kammern **3** und **4** ein elastisches Material, beispielsweise Silikon oder Gummi, zum Einsatz kommen. Vorteilhaft ist hierbei, dass evtl. hygienisch bedenkliche Spalte vermieden werden und der Herstellungsaufwand niedriger ist. Auch in diesem Falle kann die Druckfelderzeugungseinrichtung **2** mit dem Gehäuse **8** verklebt oder verschraubt sein. Eine Änderung des Volumens der ersten Kammer **3** erfolgt hier in analoger Weise, wie in Zusammenhang mit Fig. 7 beschrieben.

[0089] Fig. 9 zeigt einen vierten Aspekt der Erfindung mit einem alternativen Aufbau der Druckfelderzeugungseinrichtung **2**. Dabei sind die zweite Kammer **4**, mehrere Verbindungselemente **5**, sowie Teilabschnitte der Wand **31** der ersten Kammer **3** einstückig ausgebildet. Alternativ kann die Druckfelderzeugungseinrichtung **2** unter Wahrung des geometrischen Vorbilds der Fig. 9 in ähnlicher Weise wie in Fig. 4 oder Fig. 7 dargestellt auch zwei- oder mehrstückig aus Einzelteilen aufgebaut sein.

[0090] Die Volumenänderung der ersten Kammer **3** erfolgt hier in einer zur Kolbenpumpe ähnlichen Weise, jedoch fehlen hier etwaig vorhandene Ventile. So

wird ein Kolben **63** durch die Antriebseinheit, beispielsweise ein Elektromotor oder ein Elektromagnet, in den Richtungen des Doppelpfeils D hin- und herbewegt. Diese Art des Antriebs hat den Vorteil, dass das Volumen der ersten Kammer **3** in einfacher Weise auf Null bzw. auf annähernd Null verringert werden kann, und so die erste Kammer **3** fast vollständig entleert werden kann.

[0091] Die Ausgestaltung des Verbindungselements **5** mit mehreren Kanälen **52** und Öffnungen **51** führt zu einer Verteilung des Druckfeldes auf mehrere Konzentrationspunkte. Während die Ausgestaltung des Verbindungselements **5** mit nur einem Kanal, wie in Zusammenhang mit **Fig. 6** beschrieben, zur Ausbildung eines stark konzentrierten Medien- bzw. Luftstroms auf einen Zielbereich hin führt, kann bei der in **Fig. 9** gezeigten Ausgestaltung des Verbindungselements **5** der Medien- bzw. Luftstrom auf mehrere Zielbereiche verteilt werden. So kann beispielsweise die Klitoris **11** nicht nur an seiner Eichel angeblasen werden, sondern gleichmäßig von mehreren Seiten. Diese Verteilung der Konzentration der Luftströmung auf mehrere Bereiche kann je nach Anwendung helfen, eine Überstimulation zu vermeiden, und/oder helfen, den Stimulationsbereich zu vergrößern.

[0092] Die **Fig. 10a** bis **Fig. 10c** zeigen einen fünften Aspekt der Erfindung mit (Teil-)Querschnitten eines Aufbaus der Druckfelderzeugungseinrichtung **2** mit einem Biegeelement **64** als Antrieb zur Volumenänderung der ersten Kammer **3**. Das Biegeelement **64** kann beispielsweise ein herkömmliches piezoelektrisches Biegeelement sein, welches sich nach Anlegen einer Spannung verformt bzw. biegt. Bei diesem Aspekt der Erfindung ist die Wand **31** der ersten Kammer **3** starr bzw. steif aufgebaut, während das Biegeelement **64** in geeigneter Weise an den Seiten der ersten Kammer **3** eingepasst ist. Dabei sind die Übergangsstellen zwischen dem Biegeelement **64** und der Wand **31** abgedichtet (beispielsweise elastisch verklebt). Bei diesem Aufbau ist der Antrieb für die Druckfelderzeugungseinrichtung **2** schon in diese integriert und es entfällt ein externer Antrieb. Beispielsweise entfällt ein Elektromotor mit einem Exzenter. Dadurch können u.A. evtl. störende Eigenschwingungen aufgrund der Exzenterbewegung der Stimulationsvorrichtung verringert werden.

[0093] Im Detail zeigt **Fig. 10a** die Druckfelderzeugungseinrichtung **2** mit dem Biegeelement **64** in Neutralstellung. Somit ist das Volumen der ersten Kammer **3** mit dem Biegeelement **64** in Neutralstellung das Standardvolumen. **Fig. 10b** zeigt weiter die erste Kammer **3** mit einem erregten und in Folge nach Außen gebogenen Biegeelement, weshalb das Volumen der ersten Kammer **3** vergrößert ist; und in Folge herrscht in der Druckfelderzeugungseinrichtung **2** ein Unterdruck. **Fig. 10c** zeigt ein in Vergleich zu **Fig. 10b** entgegengesetzt erregtes Biegeelement der ersten

Kammer **3**, weshalb das Volumen der ersten Kammer **3** verkleinert ist; und in Folge herrscht in der Druckfelderzeugungseinrichtung **2** ein Überdruck.

[0094] **Fig. 11** zeigt eine zweite Ausführungsform der Erfindung mit einer örtlich getrennten Anordnung der Kammern **3** und **4** der Druckfelderzeugungseinrichtung **2**. Dabei sind die Kammern **3** und **4** über ein ausgedehntes Verbindungselement **5** verbunden, welches ein längerer flexibler Schlauch oder ein auch starres Rohr sein kann. Beispielsweise kann die Länge des Verbindungselements **5** 0,5m betragen. Damit ist es möglich, das Gehäuse **8** in einer Hand zu halten, während die andere Hand die zweite Kammer **4** auf das zu stimulierende Körperteil **11** hält; oder aber kann man das Gehäuse **8** einfach zur Seite legen, während der Benutzer nur die zweite Kammer **4** in Händen hält. Bei dieser Ausführungsform kann die Stimulationsvorrichtung auch als Tischgerät ausgestaltet sein.

[0095] Die **Fig. 12a)** bis **Fig. 12f)** zeigen verschiedene Unter- und Seitenansichten weiterer Aspekte der zweiten Kammer **4** der vorliegenden Erfindung. Im Detail zeigt **Fig. 12a)** eine Unteransicht einer kreisförmigen zweiten Kammer **4** mit einer mittig angeordneten Öffnung **51**; **Fig. 12b)** eine Unteransicht einer dreiecksförmigen zweiten Kammer **4** mit einer mittig angeordneten Öffnung **51**; **Fig. 12c)** eine Unteransicht einer ovalen zweiten Kammer **4** mit einer mittig angeordneten Öffnung **51**; und **Fig. 12d)** eine Unteransicht einer annähernd acht-förmigen zweiten Kammer **4** mit zwei zur Mitte versetzt angeordneten Öffnungen **51**. **Fig. 12e)** zeigt weiter einen Seitenquerschnitt einer erfindungsgemäßen zweiten Kammer **4**, wobei die zweite Kammer **4** zusätzlich eine erweiterte Kontaktfläche **43** zur Haut bzw. ein Auflageteil **43** aufweist, um die (Ab-)Dichtfunktion der zweiten Kammer **4** an der Haut zu verbessern. Die erweiterte Kontaktfläche **43** kann zudem Rillen oder Vorsprünge aufweisen, die die Dichtfunktion noch weiter verbessern. **Fig. 12f)** zeigt einen Seitenquerschnitt einer zweiten Kammer **4** mit mehreren getrennten Verbindungselementen **5** und einer erweiterten Kontaktfläche aufgrund des Auflageteils **43**.

[0096] So kann die Form der zweiten Kammer **4** grundsätzlich an die Anatomie der zu stimulierenden erogenen Zone angepasst sein. Dabei ist die Form der Kammer **4** von **Fig. 12a)** beispielsweise an die runde Form der Brust angepasst, während die Form der Kammer **4** der **Fig. 12c)** besser an die Form der weiblichen Vulva angepasst ist. Weiter bestimmt die Form der zweiten Kammer **4** zudem auch die Ausprägung des erfindungsgemäßen Druckfeldes. So bestimmt die Größe der zweiten Kammer **4** im Verhältnis zu dem von der ersten Kammer **3** verdrängten Volumen die Höhe des erreichbaren Unter- bzw. Überdrucks. Weiter kann über die Nähe der Öffnung **51** des Verbindungselements **5** zu dem zu stimulieren-

den Hautbereich die Intensität der erfindungsgemäßen Massagewirkung auf diese bestimmt werden. Mit mehreren Öffnungen **51**, vgl. **Fig. 12d**), kann die Massagewirkung auch auf mehrere Bereiche verteilt werden. So kann beispielsweise die Klitoris weniger direkt an der sehr empfindlichen Klitoriseichel stimuliert werden (vgl. **Fig. 12e**)), sondern verstärkt an den die Klitoriseichel umgebenden Bereichen, um eine Überreizung der Klitoris zu vermeiden.

[0097] **Fig. 13** zeigt ein Blockdiagramm eines Beispiels des funktionellen Aufbaus einer Ausführungsform der vorliegenden Erfindung mit einer Steuereinrichtung **7**, einer Antriebseinheit **6**, einer Beleuchtung **9**, einem An-/Aus-Schalter **74**, Bedienelementen **71**, einer Batterie **76** und einer externen Stromversorgung **73**.

[0098] Die Steuereinrichtung **7**, welche beispielsweise einen Mikrocontroller aufweist oder festverdrahtet ist, steuert zunächst die Stromversorgung aller Verbraucher der Stimulationsvorrichtung **1**, sowie optional einen Lade- und Entladevorgang der Batterie **76** und/oder ein Batteriemanagement. Insbesondere steuert die Steuereinrichtung **7** die Erregung der Antriebseinheit **6**, beispielsweise die Größe der Auslenkung, die Frequenz, die Modulation, etc.

[0099] Weiter kann die Steuereinrichtung **7** einen Speicher aufweisen, in dem zumindest ein Modulations- bzw. Stimulationsmuster (diese werden in Zusammenhang mit **Fig. 14a**) bis c) näher erläutert) abgespeichert ist. Die Antriebseinheit **6** kann nun nach Wahl des Benutzers der Stimulationsvorrichtung **1** über die Bedienelemente **71** entsprechend dieser vorgespeicherten Stimulationsmuster in seiner Erregung angesteuert werden. Die Stimulationsmuster des Druckfeldes können optional auch durch den Benutzer über die Bedienelemente individuell erstellt und abgespeichert werden.

[0100] **Fig. 14a**) zeigt den zeitlichen Verlauf eines Gesamtdrucks p in der Druckfelderzeugungseinrichtung (**2**) bei Anwendung dieser zur Stimulation. Die gestrichelte Linie gibt den Referenzdruck, beispielsweise den aktuell herrschende atmosphärischen Druck, an, welcher außerhalb der Druckfelderzeugungseinrichtung (**2**) vorhanden ist. Wird die zweite Kammer **4** nun auf das zu stimulierende Körperteil **11** aufgesetzt, wird der anfangs herrschende Umgebungsdruck der in Druckfelderzeugungseinrichtung (**2**) etwa beibehalten. Nunmehr wird angenommen, dass die zweite Kammer **4** auf das zu stimulierende Körperteil weitgehend dicht aufgesetzt ist. Nach Aktivierung der Stimulationsvorrichtung wird die Antriebseinheit **6** von der Steuereinrichtung **7** gemäß einem vorgespeicherten Stimulationsmuster angesteuert bzw. erregt. Entsprechend werden sich das Volumen der ersten Kammer **3** und damit der Gesamtdruck in der Druckfelderzeugungseinrichtung

2 ändern, wobei die Druckänderungen auf den Referenzdruck aufmoduliert werden. Das in **Fig. 14a**) beispielhaft gezeigte Druck- bzw. Stimulationsmuster entwickelt ein gepulstes, regelmäßiges Druckfeld. In Phasen der Erhöhung des Drucks wird die zu stimulierende erogene Zone angeblasen bzw. massiert, während in den Zeiten, in denen ein Unterdruck herrscht, die Durchblutung des Körperteils **11**, beispielsweise der Klitoris, gefördert wird. So existieren erfindungsgemäß Zeiträume (In **Fig. 14a**) mit I) gekennzeichnet), in denen ein Unterdruck herrscht, während die Klitoris gleichzeitig indirekt massiert wird.

[0101] **Fig. 14b)** zeigt drei Beispiele von alternativen Stimulationsmustern. So ist in dem mit II) gekennzeichneten Bereich ein gepulstes Stimulationsmuster mit hoher Amplitude dargestellt. In dem mit III) gekennzeichneten Bereich ist ein gepulstes Stimulationsmuster mit niedriger Amplitude dargestellt. Weiter ist in dem mit IV) gekennzeichneten Bereich ein in der zeitlichen Abfolge und in der Amplitude unregelmäßiges bzw. asymmetrisches Stimulationsmuster abgebildet. Die Muster können je nach körperlicher Wirkung/Anwendung und nach individuellen Wünschen variiert werden.

[0102] **Fig. 14c)** zeigt ein weiteres Beispiel eines alternativen Stimulationsmusters. So kann die Stärke des Drucks mit der Zeit zunehmen, um sich an den Erregungszustand des Benutzers anzupassen.

[0103] Die Erfindung lässt neben den erläuterten Ausführungsformen weitere Gestaltungsgrundsätze zu. So können verschiedene Anordnungen bzw. Aufbauten der ersten Kammer **3** beliebig mit verschiedenen Ausführungen der zweiten Kammer **5** oder dem Verbindungselement **5** kombiniert werden. Beispielsweise kann die erste Kammer **3** mit dem Antrieb der **Fig. 10** mit der zweiten Kammer der **Fig. 12f**) kombiniert werden.

[0104] Obschon bei allen Ausführungsformen nur eine erste Kammer **3** dargestellt ist, können auch zwei oder mehr erste Kammern **3** vorhanden sein, welche dann entsprechend simultan oder zeitversetzt derart angetrieben werden, dass diese ihr Volumen ändern, um ein erfindungsgemäßes Druckfeld aufzubauen.

[0105] Obschon bei allen Ausführungsformen nur eine Öffnung aus der ersten Kammer **3** zu dem Verbindungselement **5** dargestellt ist, so können auch mehrere Öffnungen für ein Verbindungselement **5** oder auch mehrere Öffnungen für mehrere Verbindungselemente **5** in der ersten Kammer **3** vorhanden sein.

[0106] Eine Stimulationsvorrichtung **1** kann mehrere Druckfelderzeugungseinrichtung **2** aufweisen. So können beispielsweise zwei Druckfelderzeugungs-

einrichtungen vorhanden sein, um zwei erogene Zonen gleichzeitig zu stimulieren.

[0107] Die erfindungsgemäßen Stimulationsmuster können von dem in den **Fig. 14a)**, **b)** und **c)** gezeigten Mustern abweichen, solange diese eine zeitliche Abfolge von Unter- und Überdrücken aufweisen. Beispielsweise kann zu Beginn bzw. nach Aktivierung der Vorrichtung zunächst ein relativ lang anhaltender Unterdruck aufgebaut sein (beispielsweise 3 Minuten), um die Durchblutung der zu stimulierenden Zone effektiv zu erhöhen, worauf dann langsam in der Amplitude größer werdende Pulse von Unter- und Überdrücken folgen.

Bezugszeichenliste

1	Stimulationsvorrichtung
2	Druckfelderzeugungseinrichtung
3	erste Kammer
4	zweite Kammer
5	Verbindungselement
6	Antriebseinheit
7	Steuereinrichtung
8	Gehäuse
9	Beleuchtung
11	Körperteil
12	Klitoris
31	Wand der ersten Kammer
32	Halterung
41	Wand der zweiten Kammer
42	Öffnung der zweiten Kammer
43	Kontaktfläche
51	Öffnung des Verbindungselements zur zweiten Kammer
61	Antriebswelle
62	Exzenter
63	Kolben
64	Biegeelement
71	Bedienelement
72	Anzeige
73	Stromversorgung
74	An-/Aus-Schalter
75	Buchse
76	Batterie
77	Steuerplatine

ZITATE ENTHALTEN IN DER BESCHREIBUNG

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Zitierte Patentliteratur

- WO 2006/058291 A2 [0008]
- US 6099463 A [0009]
- US 6464653 B1 [0010]
- WO 2008/028076 A2 [0011]
- US 2013/0012769 A1 [0013]

Schutzansprüche

1. Stimulationsvorrichtung (1) zur sexuellen Stimulation der Klitoris (12), aufweisend:
 eine Druckfelderzeugungseinrichtung (2), die eine Öffnung (42) zum Aufsetzen über die Klitoris und eine Antriebseinheit (6) aufweist, wobei die Öffnung (42) die einzige Öffnung der Druckfelderzeugungseinrichtung (2) zu deren Äußeren ist, und wobei die Druckfelderzeugungseinrichtung (2) derart eingerichtet ist, dass diese ein Druckfeld an der Öffnung (42) erzeugt, das sich zeitlich abwechselnde Unter- und Überdrücke, welche auf den Normaldruck aufmoduliert sind, aufweist;
 eine Steuereinrichtung (7), welche die Antriebseinheit (6) ansteuern kann, und welche Stimulationsmuster aufweist;
 zumindest ein Bedienelement (71), das der Einstellung des Stimulationsmusters des Druckfeldes dient;
 ein Gehäuse (8), das die Steuereinrichtung (7), die Antriebseinheit (6) und eine interne Batterie (76) umfasst, wobei die Stimulationsvorrichtung (1) als ein tragbares Handgerät ausgebildet ist;
 wobei die Stimulationsvorrichtung (1) keine Ventile aufweist;
 wobei die Steuereinrichtung (7) derart eingerichtet ist, dass mittels des zumindest einen Bedienelements (71) ein Stimulationsmuster aus den Stimulationsmustern der Steuereinrichtung (7) einstellbar ist, wobei die Antriebseinheit (6) entsprechend dem eingestellten Stimulationsmuster angesteuert wird.

2. Stimulationsvorrichtung (1) gemäß Anspruch 1, wobei die Druckfelderzeugungseinrichtung (2) weiter aufweist:
 eine Kammer (3) mit einer flexiblen Wand (31);
 wobei die Antriebseinheit (6) derart eingerichtet ist, dass diese eine Auslenkung der Wand (31) in einander entgegengesetzten Richtungen zur Volumenänderung der Kammer (3) bewirkt, um das Druckfeld zu erzeugen.

3. Stimulationsvorrichtung (1) zur sexuellen Stimulation der Klitoris (12), aufweisend:
 eine Druckfelderzeugungseinrichtung (2), die einen Hohlraum (3, 4, 5) mit einer Öffnung (42) zum Aufsetzen über die Klitoris (12) und eine Antriebseinheit (6) aufweist, wobei die Öffnung (42) die einzige Öffnung der Druckfelderzeugungseinrichtung (2) zu deren Äußeren ist, und wobei die Druckfelderzeugungseinrichtung (2) derart eingerichtet ist, dass diese ein Druckfeld an der Öffnung (42) erzeugt, das sich zeitlich abwechselnde Unter- und Überdrücke, welche auf den Normaldruck aufmoduliert sind, aufweist;
 eine Steuereinrichtung (7), welche die Antriebseinheit (6) ansteuern kann;
 wobei der Hohlraum (3, 4, 5) durch eine einstückige Wand aus Silikon oder Gummi ausgebildet ist;
 ein Gehäuse (8), das die Steuereinrichtung (7), die Antriebseinheit (6) und eine interne Batterie (76) um-

fasst, wobei die Stimulationsvorrichtung (1) als ein tragbares Handgerät ausgebildet ist;
 wobei die Stimulationsvorrichtung (1) keine Ventile aufweist.

4. Stimulationsvorrichtung (1) gemäß einem der vorausgehenden Ansprüche, wobei die Stimulationsvorrichtung (1) mit Wasser als ein Medium des Druckfeldes verwendbar ist.

5. Stimulationsvorrichtung (1) gemäß einem der vorausgehenden Ansprüche, wobei die Komponenten der Druckfelderzeugungseinrichtung (2) und die Antriebseinheit (6) so dimensioniert sind, dass der maximal erzeugbare Unter- und Überdruck derart beschränkt ist, um eine Verletzungsgefahr für die Klitoris (12) zu minimieren oder auszuschließen.

6. Stimulationsvorrichtung (1) gemäß einem der vorausgehenden Ansprüche, wobei die Druckfelderzeugungseinrichtung (2) derart eingerichtet ist, dass, wenn die Öffnung (42) über die Klitoris (12) aufgesetzt ist, in der Druckfelderzeugungseinrichtung (2) ein zumindest weitgehend abgeschlossenes Strömungssystem ausgebildet wird, und in dem Strömungssystem Medienströmungen, die zeitlich abwechselnd auf die Klitoris (12) hin gerichtet und von der Klitoris (12) weg gerichtet sind, erzeugt werden, und das zumindest weitgehend abgeschlossene Strömungssystem einen Abtransport von Körperflüssigkeit aus der Druckfelderzeugungseinrichtung (2) weitgehend vermeidet.

7. Stimulationsvorrichtung (1) gemäß Anspruch 2, wobei die Antriebseinheit (6) ein Elektromotor mit einer Achse (61) und einem Exzenter (62) ist, wobei die flexible Wand (31) entsprechend der Drehung der Achse (61) ausgelenkt wird.

8. Stimulationsvorrichtung (1) gemäß einem der vorausgehenden Ansprüche, wobei die Stimulationsmuster aus Impulsen mit einem vorgegebenen Takt bestehen.

9. Stimulationsvorrichtung (1) gemäß einem der vorausgehenden Ansprüche, wobei die Öffnung (42) der Druckfelderzeugungseinrichtung (2) oval ausgebildet ist.

10. System mit einer Stimulationsvorrichtung (1) gemäß einem der Ansprüche 1 bis 9, aufweisend:
 eine zu der Stimulationsvorrichtung (1) getrennt angeordnete Fernsteuervorrichtung,

wobei die Steuereinrichtung (7) der Stimulationsvorrichtung (1) von der Fernsteuereinrichtung fernsteuerbar ist.

Es folgen 7 Seiten Zeichnungen

Fig. 1

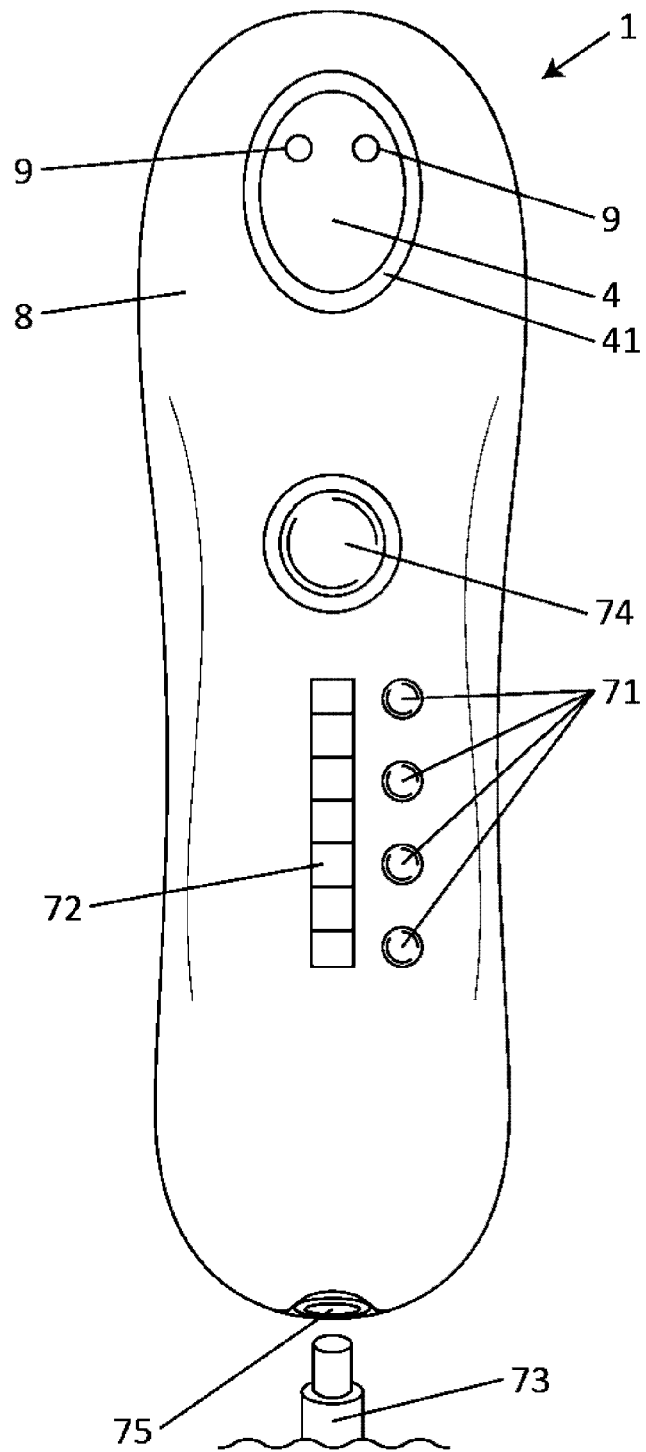


Fig. 2

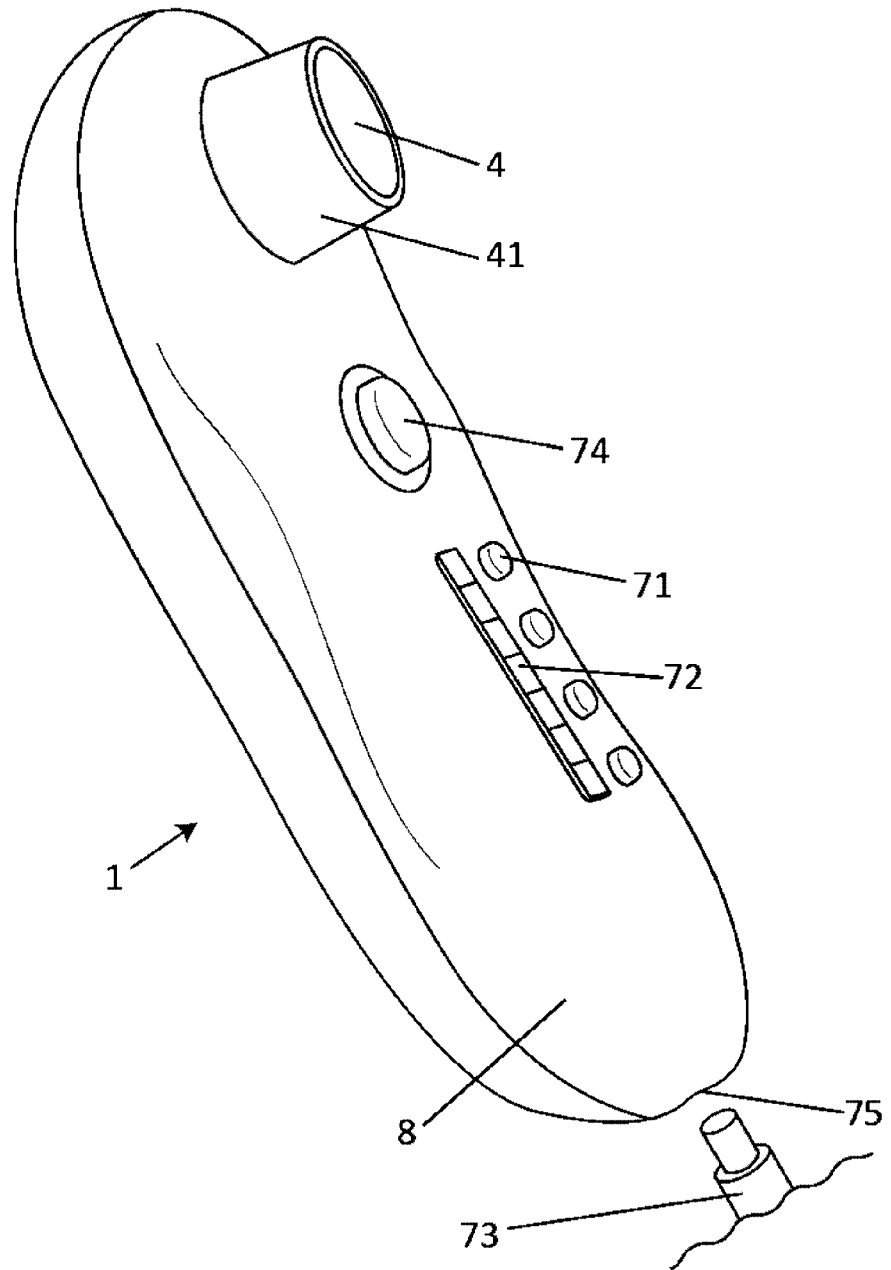


Fig. 3

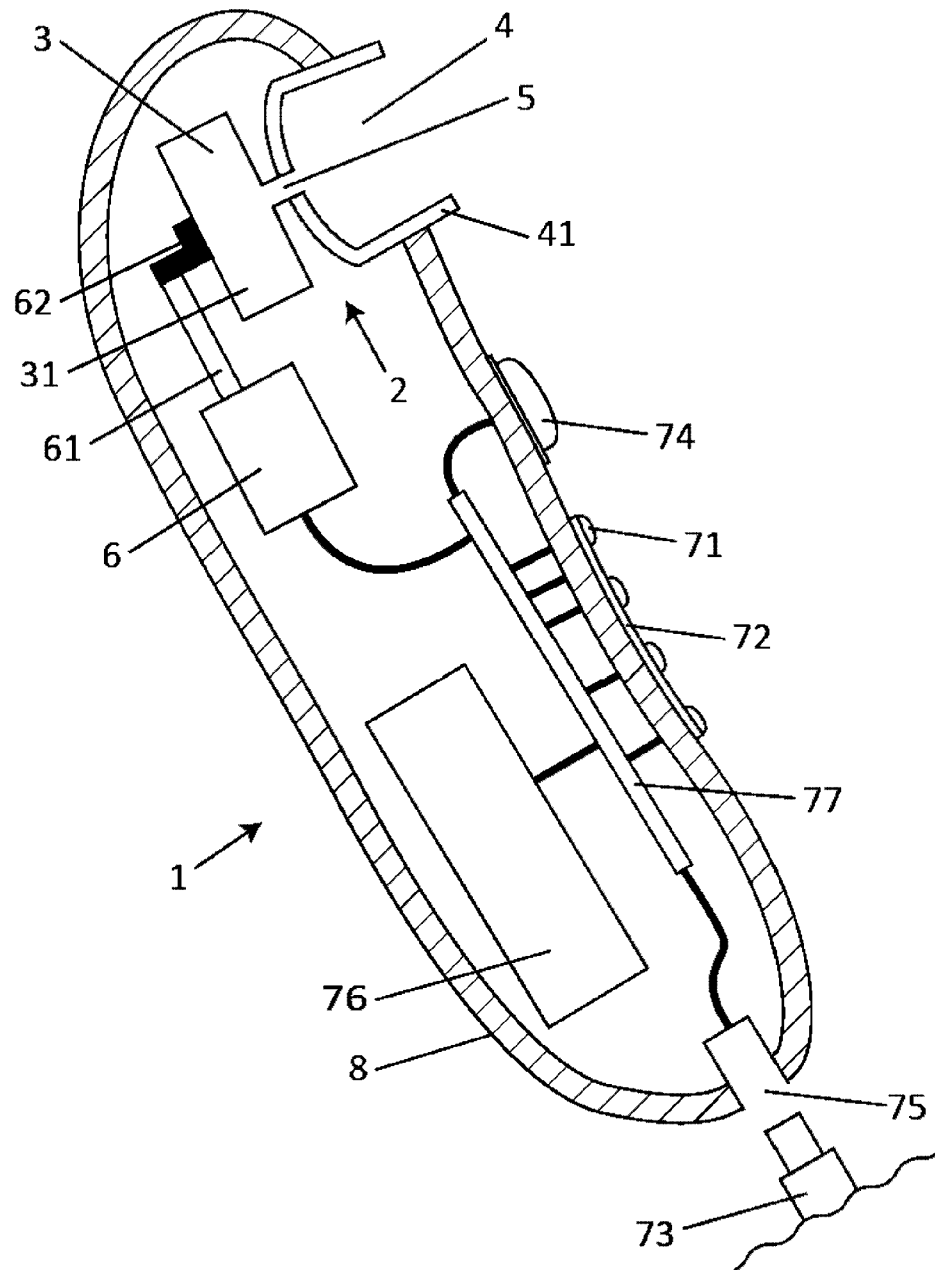


Fig. 4

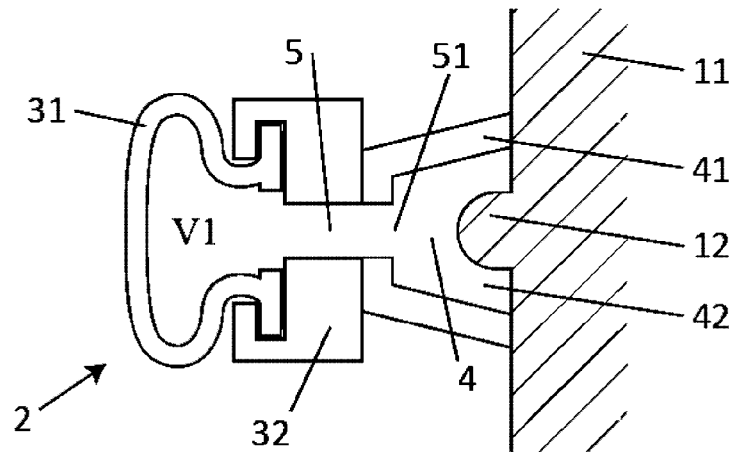


Fig. 5

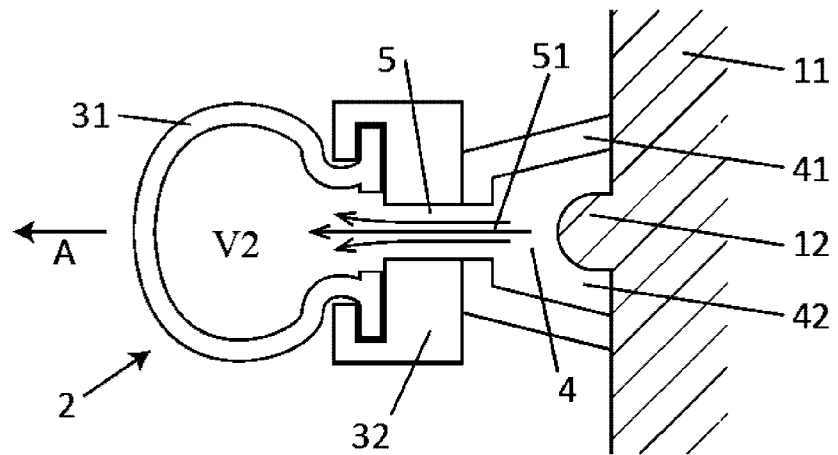


Fig. 6

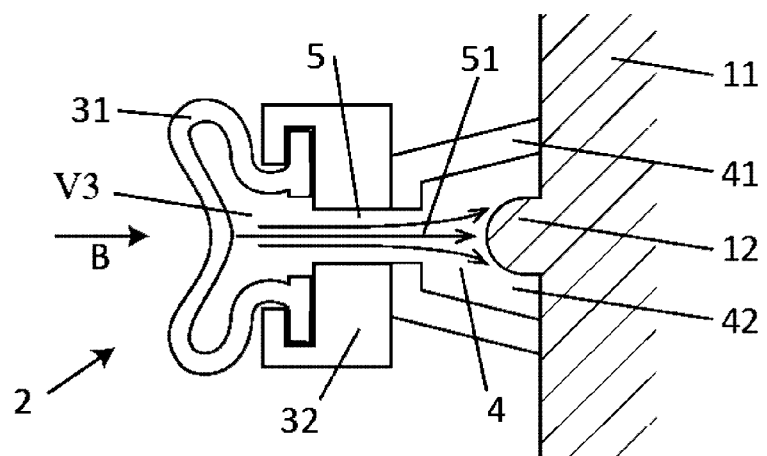


Fig. 7

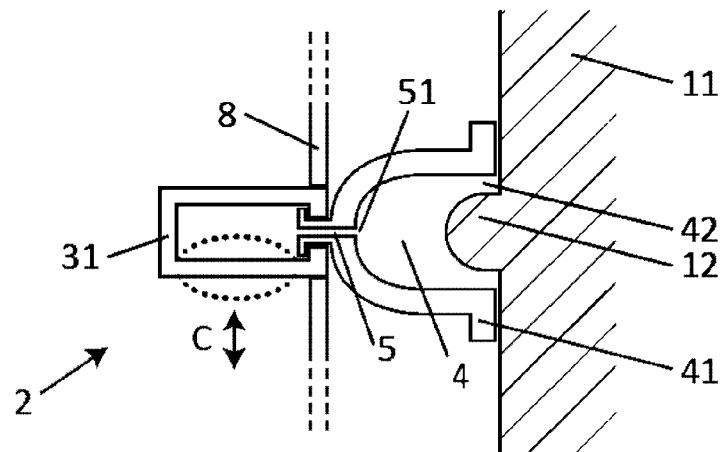


Fig. 8

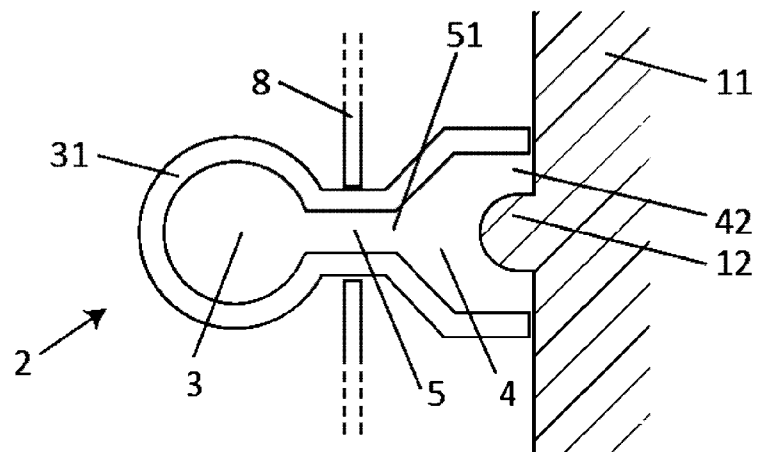


Fig. 9

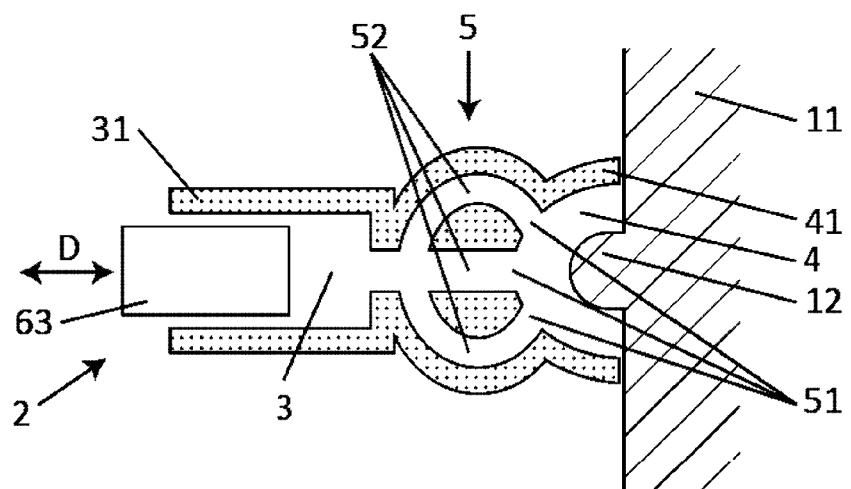


Fig. 10a

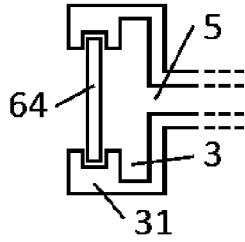


Fig. 10b

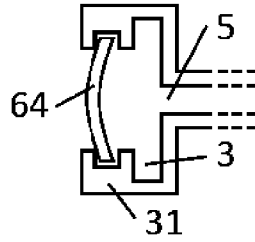


Fig. 10c

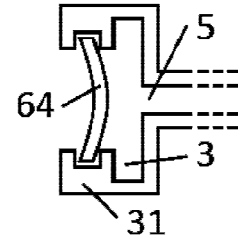


Fig. 11

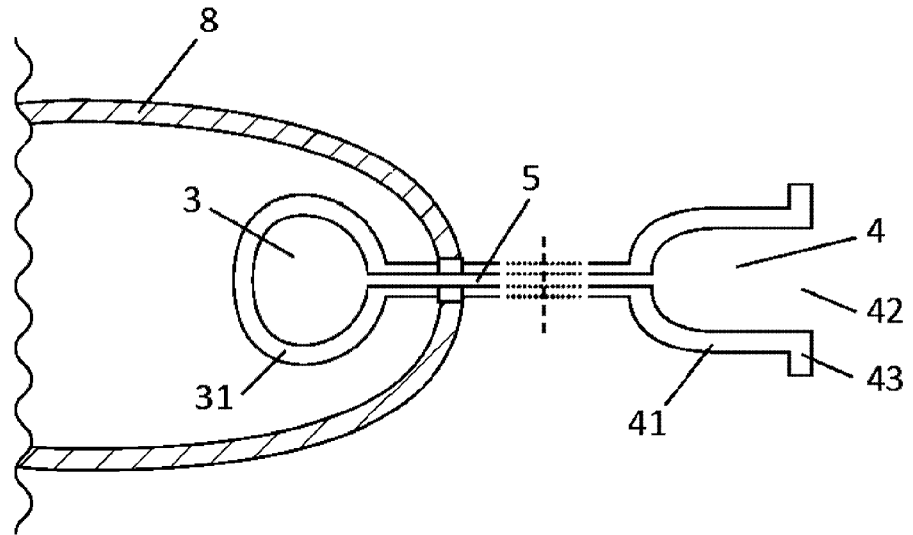


Fig. 12a

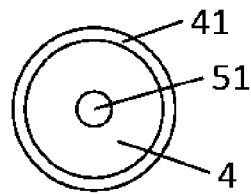


Fig. 12b

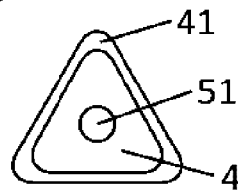


Fig. 12c

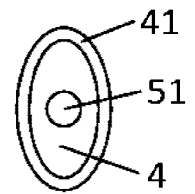


Fig. 12d

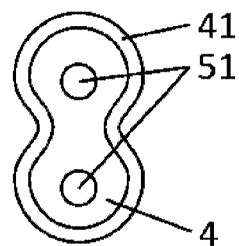


Fig. 12e

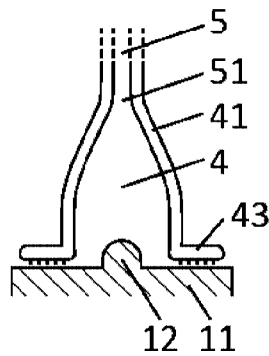


Fig. 12f

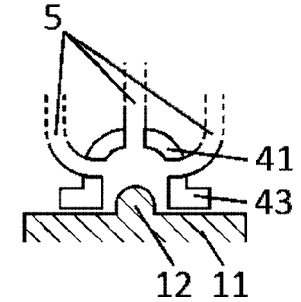


Fig. 13

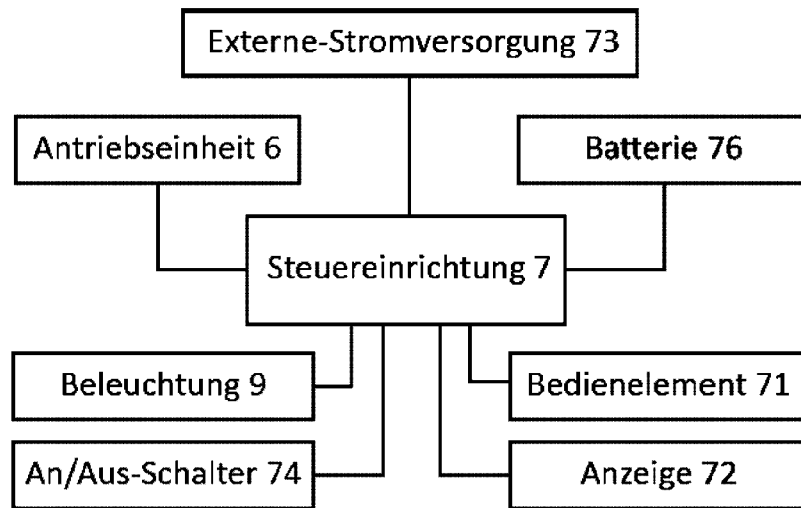


Fig. 14a

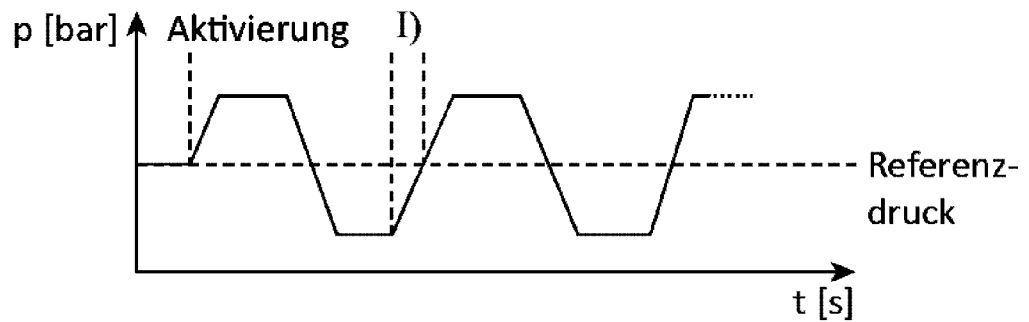


Fig. 14b

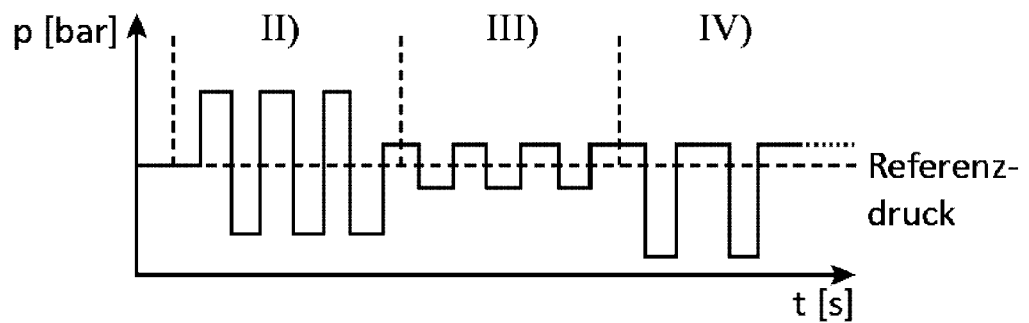
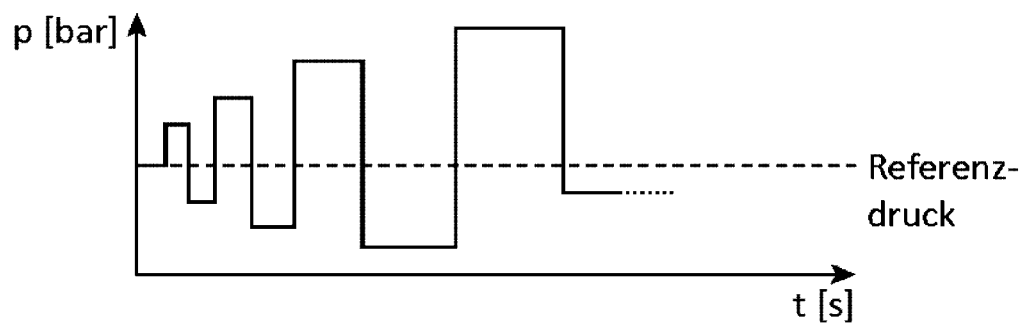


Fig. 14c



List of publications



Application number 2016K...
KR101649522 B1 Pat...

Publication date
2016-08-19



Abstract

The present invention relates to a multi-function cosmetic device using the light of a light-emitting diode having various colors (R,G,B) instead of an electric heater and, more specifically, to a multi-function cosmetic device comprising: a main body; a rechargeable battery; a main printed circuit board; a motor for generating vibration; a head; a light-transmissive cap; a printed circuit board; and a plurality of functional caps.

English Abstract (Native or MT)

The present invention relates to a multi-function cosmetic device using the light of a light-emitting diode having various colors (R,G,B) instead of an electric heater and, more specifically, to a multi-function cosmetic device comprising: a main body; a rechargeable battery; a main printed circuit board; a motor for generating vibration; a head; a light-transmissive cap; a printed circuit board; and a plurality of functional caps.

Other Abstracts

본 발명은 다기능 미용기기에 관한 것으로, 특히 타원형의 속이 빈 통체 형상을 갖는 본체와; 메인 인쇄회로기판을 포함하여 진동 발생용 모터 및 각종 발광다이오드의 구동에 필요한 전압을 공급시켜 주는 충전식 배터리와; 전원스위치가 "온"되면 각종 기능 제어키의 조작에 대응하여 정해진 프로그램에 맞춰 진동 발생용 모터 및 각종 발광다이오드의 구동을 포함하여 스피커의 구동을 제어하는 메인 인쇄회로기판과; 헤드가 진동 작동하도록 하는 진동 발생용 모터와; 상기 본체의 헤드 설치부에 착탈 가능하게 결합되는 원뿔 형상의 헤드와; 반투명의 합성수지로 형성된 형태를 갖는 원판형의 투광캡과; 각종 컬러의 빛을 포함한 적외선(IR)을 상기 투광캡을 통해 외부로 발생시켜 주는 발광다이오드 설치용 인쇄회로기판과; 사용자가 마사지하고자 인체의 각 부위에 대응하여 서로 다른 형상을 갖는 복수의 기능성 캡;으로 구성된 것을 특징으로 한다. 따라서, 각 가정이나 사무실 등에서 간편하게 사용이 가능하면서 휴대가 용이하고 장소와 시간에 구애받지 않으며 자유롭게 사용할 수 있고, 또 전열히터를 전혀 사용하지 않고 각종 컬러(R, G, B)의 발광다이오드의 빛을 이용하여 인체의 각 부위의 피부를 가열하여 온열과 원적외선을 동시에 제공할 수 있는 한편, 적외선(IR) 발광다이오드에서 발생하는 근적외선을 인체의 피부 깊숙이(약 40mm)까지 침투시켜 표피층은 물론 진피층까지 온도를 상승시켜 미세혈관의 확장과 혈액순환을 촉진하여 혈액량과 산소량을 충분히 공급시켜 줄 수 있음은 물론, 안면 등과 같이 민감한 피부에도 안전하게 적용할 수 있으며, 또한 다양한 주파수의 진동을 통해 피부질 개선은 물론 근육 마사지 효과를 증대시킬 수 있는 효과가 있다.

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Application Numbers & Dates	KR20160002162 2016-01-07 [2016KR-0002162]
Priority Numbers & Dates	KR20160002162 2016-01-07 [2016KR-0002162]
Technology domain	Electrical machinery, apparatus, energy Audio-visual technology Medical technology
IPC codes	A61H-023/02* A61H-039/04 A61N-005/06H01M-002/10 H04R-001/02
CPC codes	A61H-023/02/54* A61H-039/04 A61N-005/06/25H01M-002/10/22 H04R-001/02/8 A61H-2201/5023A61H-2201/5043 A61H-2201/5082A61N-2005/0659 A61N-2005/066
Notes	Number of Claims: 4
Cited Patents	Examiner citations -KR101504885 (B1) [KR101504885]; -KR101522730 (B1) [KR101522730]; -KR101470281 (B1) [KR101470281]; -KR100809633 (B1) [KR100809633]; Search Report [Examiner] -KR101504885 (B1) [KR101504885] JO SUNG CHAN, et al; -KR101522730 (B1) [KR101522730] DOTECH; -KR101470281 (B1) [KR101470281] CHOI JAE YOUNG; Applicant citations -KR101504885 (B1) [KR101504885] JO SUNG CHAN, et al; -KR200462094 (Y1) [KR200462094U]; -KR20140059471 (A) [KR20140059471] SEO HYUN SEUNG; -KF
Claims	

1. A hollow cylindrical shape of an elliptical shape and has, in the inside of the battery and the main printed circuit board, a motor for generating vibration and a speaker housed, in the center of the front power switch of the control key as well as various functions installed in a front upper portion and the bottom head mounting portion is formed in the battery charger provided for coupling the connector body; connector for coupling the battery charger in the connected state installed in the inside of the main body including a printed circuit board and various light emitting diode for generating the vibration motor needed to drive the supply voltage of the rechargeable battery and to; installed in the main body when the power switch is one of the control key various functions corresponding to an operation in accordance with a predetermined program and various driving motor for generating vibration of the light emitting diode including a main speaker to control the operation of a printed circuit board; eccentric weights on the axis and within the body into proximity with the head provided at the main printed circuit board and corresponding to an output signal of the operating head so as to operate the vibration motor for generating vibration and; head mounting portions of the body and detachably connected with the head of a cone shape; translucent formed of a synthetic resin lens having a front face of the head opening and removably coupled in various light emitting diode comprises a light transmitting cap to evenly zoom functionality as well as the binding function of a cylindrical shape of the light to perform cap; R, G, the color of the light in the infrared B (IR) various light emitting diodes generating mounted thereon wherein the head has been installed into the main printed circuit board corresponding to the output signal of the infrared radiation includes light of various color (IR) coupled to the head to the outside through the transparent cap has generates light emitting diode printed circuit board for installation; massage to the user corresponding to their respective sites of the human body to a different molded with the shape of the head cap coupled to the plurality of transmitting and detachably connected with the functionality of the cap; power supply comprises a light emitting diode display to a user by operating the operation state of the control key corresponding to the function selected for each operating state of the skin care mode display period of the main body to a front center part installed at the bottom with a plurality of light emitting diode for a display mode of operation; are composed, the main printed circuit board, a power switch for function control key input to the input signal and a control program itself corresponding to the overall control function beautification equipment carried out with a microcomputer; under control of the microcomputer and controlling the charging of rechargeable batteries and battery charge and discharge control unit; is selected by a user in the operating state of the skin care mode including various synat guidance control of the microcomputer or the like are output through a speaker signal corresponding to a negative control unit; signal corresponding to the control of the microcomputer to control driving of a motor for generating vibration motor control unit; corresponding to a control signal from the microcomputer to control the drive of the various types of light emission diode emitting diode controller; is provided, installed within the head and include a temperature sensor, wherein the main printed circuit board via a temperature sensor to the microcomputer in the detected temperature rises above a predetermined temperature of the head when the power supply voltage supplied to the various types of light emission diode blocks rise above a temperature at a predetermined temperature at the head of that block and so as to be performed, the functional cap is cap and cap and lifting scalp massage comprises massaging the sore cap multifunctional beautification equipment.

2. Method according to claim 1, wherein the lifting cap is functional in the cap, the shape of a heart dimension of said head having a bottom surface outside the cap surrounding the light transmitting elastically resilient coupling and which are combined into a plate, a plurality of protrusions and recesses in the upper side crossed V shaped to form the subsequent stages, wherein the plurality of shaped projections V from inside to outside of the end portion is tapered from top to bottom height and also gradually increases in size is formed to a multifunctional device characterized in that the cosmetic.

3. Method according to claim 1, wherein the cap is in functional scalp massage cap, having an elliptical shape dimension of the head outside the cap bottom surface surrounding the light transmitting elastically resilient coupling and which are combined into a plate, a plurality of scalp massaging rod on an upper surface forming a radially protruding, the height of the plurality of scalp massaging from outside to inside the rod gradually lowered by making the, a plurality of massaging the scalp of the human body shape

rod end portion in a direction opposite to the head so that the concavely formed round the multifunctional beautification equipment.

4. Method according to claim 1, wherein the cap is in functional muscle massage cap, having a rounded shape of a disk is the entire top surface of the head dimension outside the cap bottom surface surrounding the light transmitting elastically resilient coupling and which are combined into a plate, a plurality of semicircular protrusions for pressing an upper surface of the skin a predetermined interval so as to be arranged in a radial form a multifunctional device characterized in that the cosmetic.

5. AMEND STATUS: Delete

6. AMEND STATUS: delete

7. AMEND STATUS: delete



(19) 대한민국특허청(KR)

(12) 등록특허공보(B1)

(45) 공고일자 2016년08월19일

(11) 등록번호 10-1649522

(24) 등록일자 2016년08월12일

(51) 국제특허분류(Int. Cl.)

A61H 23/02 (2006.01) A61H 39/04 (2006.01)

A61N 5/06 (2006.01) H01M 2/10 (2006.01)

H04R 1/02 (2006.01)

(52) CPC특허분류

A61H 23/0254 (2013.01)

A61H 39/04 (2013.01)

(21) 출원번호 10-2016-0002162

(22) 출원일자 2016년01월07일

심사청구일자 2016년01월07일

(56) 선행기술조사문헌

KR101504885 B1*

KR101522730 B1

KR101470281 B1

KR100809633 B1

*는 심사관에 의하여 인용된 문헌

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심사관 : 한재균

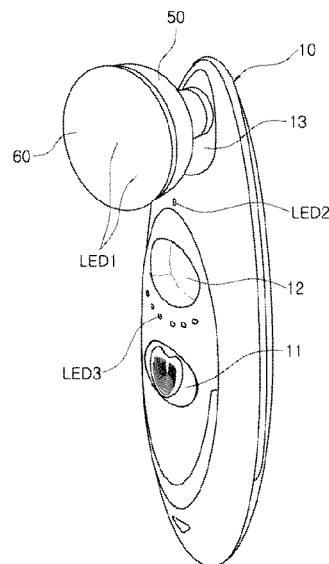
(54) 발명의 명칭 다기능 미용기기

(57) 요약

본 발명은 다기능 미용기기에 관한 것으로, 특히 타원형의 축이 빈 통체 형상을 갖는 본체와; 메인 인쇄회로기판을 포함하여 진동 발생용 모터 및 각종 발광다이오드의 구동에 필요한 전압을 공급시켜 주는 충전식 배터리와; 전원스위치가 "온"되면 각종 기능 제이키의 조작에 대응하여 정해진 프로그램에 맞춰 진동 발생용 모터 및 각종

(뒷면에 계속)

대표도 - 도1



발광다이오드의 구동을 포함하여 스피커의 구동을 제어하는 메인 인쇄회로기판과; 헤드가 진동 작동하도록 하는 진동 발생용 모터와; 상기 본체의 헤드 설치부에 착탈 가능하게 결합되는 원뿔 형상의 헤드와; 반투명의 합성수지로 형성된 형태를 갖는 원판형의 투광캡과; 각종 컬러의 빛을 포함한 적외선(IR)을 상기 투광캡을 통해 외부로 발생시켜 주는 발광다이오드 설치용 인쇄회로기판과; 사용자가 마사지하고자 인체의 각 부위에 대응하여 서로 다른 형상을 갖는 복수의 기능성 캡;으로 구성된 것을 특징으로 한다.

따라서, 각 가정이나 사무실 등에서 간편하게 사용이 가능하면서 휴대가 용이하고 장소와 시간에 구애받지 않으며 자유롭게 사용할 수 있고, 또 전열히터를 전혀 사용하지 않고 각종 컬러(R, G, B)의 발광다이오드의 빛을 이용하여 인체의 각 부위의 피부를 가열하여 온열과 원적외선을 동시에 제공할 수 있는 한편, 적외선(IR) 발광다이오드에서 발생하는 근적외선을 인체의 피부 깊숙이(약 40mm)까지 침투시켜 표피층은 물론 진피층까지 온도를 상승시켜 미세혈관의 확장과 혈액순환을 촉진하여 혈액량과 산소량을 충분히 공급시켜 줄 수 있음은 물론, 안면 등과 같이 민감한 피부에도 안전하게 적용할 수 있으며, 또한 다양한 주파수의 진동을 통해 피부질 개선은 물론 근육 마사지 효과를 증대시킬 수 있는 효과가 있다.

(52) CPC특허분류

A61N 5/0625 (2013.01)

H01M 2/1022 (2013.01)

H04R 1/028 (2013.01)

A61H 2201/5023 (2013.01)

A61H 2201/5043 (2013.01)

A61H 2201/5082 (2013.01)

A61N 2005/0659 (2013.01)

A61N 2005/066 (2013.01)

명세서

청구범위

청구항 1

타원형의 속이 빈 통체 형상을 갖고, 내부에는 배터리와 메인 인쇄회로기판, 진동 발생용 모터 및 스피커가 내장되며, 전면 중앙에는 전원스위치를 포함한 각종 기능 제어키가 설치된 물론 전면 상부에는 헤드 설치부가 형성되고 저부에는 배터리 충전기 결합용 콘넥터가 설치된 본체와;

상기 배터리 충전기 결합용 콘넥터와 연결된 상태에서 본체의 내부에 설치되어 메인 인쇄회로기판을 포함하여 진동 발생용 모터 및 각종 발광다이오드의 구동에 필요한 전압을 공급시켜 주는 충전식 배터리와;

상기 본체 내에 설치되어 전원스위치가 "온"되면 각종 기능 제어키의 조작에 대응하여 정해진 프로그램에 맞춰 진동 발생용 모터 및 각종 발광다이오드의 구동을 포함하여 스피커의 구동을 제어하는 메인 인쇄회로기판과;

측 상에 편심형 중량추를 구비하고 상기 본체 내에서 헤드에 근접되게 설치되어 상기 메인 인쇄회로기판의 출력 신호에 대응하여 작동하며 헤드가 진동 작동하도록 하는 진동 발생용 모터와;

상기 본체의 헤드 설치부에 착탈 가능하게 결합되는 원뿔 형상의 헤드와;

반투명의 합성수지로 형성된 형태를 갖고 상기 헤드의 전면 개구부에 착탈 가능하게 결합되어 각종 발광다이오드에서 발생하는 빛을 고르게 투광시켜 줌은 물론 기능성 캡의 결합기능을 수행하는 원판형의 투광캡과;

R, G, B 컬러의 빛을 포함하여 적외선(IR)을 발생하는 각종 발광다이오드들을 실장한 상태에서 상기 헤드 내에 설치되어 메인 인쇄회로기판의 출력신호에 대응하는 각종 컬러의 빛을 포함한 적외선(IR)을 상기 헤드에 결합된 투광캡을 통해 외부로 발생시켜 주는 발광다이오드 설치용 인쇄회로기판과;

사용자가 마사지하고자 인체의 각 부위에 대응하여 서로 다른 형상을 갖게 성형되어 상기 헤드에 결합되는 투광캡에 착탈 가능하게 결합되는 복수의 기능성 캡과;

전원 공급 표시용 발광다이오드를 포함하여 사용자가 조작한 기능 제어키의 조작상태에 대응하여 선택되는 각 피부관리 모드에 대한 작동 상태를 표시해 주기 위해 상기 본체의 전면 중앙부와 저부에 설치되는 복수의 작동 모드 표시용 발광다이오드;로 구성하되,

상기 메인 인쇄회로기판에는,

전원스위치를 포함하여 기능 제어키의 입력신호 및 자체에 입력되어 있는 제어프로그램에 대응하여 미용기기의 전반적인 제어기능을 수행하는 마이컴과;

상기 마이컴의 제어를 받아 충전식 배터리의 충방전을 제어하는 배터리 충방전 제어부와;

사용자가 선택한 피부관리 모드에서의 각종 작동 상태 멘트를 포함하여 안내 멘트 등을 상기 마이컴의 제어신호에 대응하여 스피커를 통해 출력해 주는 음성 제어부와;

상기 마이컴의 제어신호에 대응하여 진동 발생용 모터의 구동을 제어하는 모터 제어부와;

상기 마이컴의 제어신호에 대응하여 각종 발광다이오드의 구동을 제어하는 발광다이오드 제어부;를 구비하고,

상기 헤드 내에는 온도센서를 설치하고, 상기 메인 인쇄회로기판 내 마이컴으로 하여금 상기 온도센서를 통해 검출되는 헤드의 온도가 정해진 온도이상 상승할 경우 각종 발광다이오드에 공급되는 전원전압을 차단하여 헤드의 온도가 정해진 온도이상으로 상승하는 것을 차단할 수 있도록 하며,

상기 기능성 캡은 리프팅 캡과 두피 마사지 캡 및 근육통 마사지 캡을 포함하는 것을 특징으로 하는 다기능 미용기기.

청구항 2

청구항 1에 있어서,

상기 기능성 캡 중 리프팅 캡은,

하트 형상을 갖는 판체의 저면에 상기 헤드의 투광캡 외부에 탄력적으로 감싸는 형태로 결합되는 탄성 결합판을 구비하고, 상면에는 복수의 "V"자형 돌기와 홈을 교차되게 다단으로 연이어 형성하되, 상기 복수의 "V"자형 돌기의 끝단부는 내측에서 외측으로 또한 상부에서 하부로 갈수록 높이와 크기가 점차 커지도록 형성한 것을 특징으로 하는 다기능 미용기기.

청구항 3

청구항 1에 있어서,

상기 기능성 캡 중 두피 마사지 캡은,

타원 형상을 갖는 판체의 저면에 상기 헤드의 투광캡 외부에 탄력적으로 감싸는 형태로 결합되는 탄성 결합판을 구비하고, 상면에는 복수의 두피 마사지를 위한 방사형으로 돌출 형성하되, 상기 복수의 두피 마사지를 위한 높이는 외측에서 내측으로 갈수록 점차 낮아지게 형성하여, 복수의 두피 마사지를 위한 끝단부가 인체의 머리 형상과 반대방향으로 오목하게 라운드지도록 형성한 것을 특징으로 하는 다기능 미용기기.

청구항 4

청구항 1에 있어서,

상기 기능성 캡 중 근육통 마사지 캡은,

상면 전체가 라운드진 원판 형상을 갖는 판체의 저면에 상기 헤드의 투광캡 외부에 탄력적으로 감싸는 형태로 결합되는 탄성 결합판을 구비하고, 상면에는 복수의 피부 압박용 반원형 돌기가 정해진 각도를 두고 방사형으로 배치되도록 형성한 것을 특징으로 하는 다기능 미용기기.

청구항 5

삭제

청구항 6

삭제

청구항 7

삭제

발명의 설명

기술 분야

[0001] 본 발명은 다기능 미용기기에 관한 것으로 보다 구체적으로는 각 가정이나 사무실 등에서 간편하게 사용이 가능하면서 휴대가 용이하여 장소와 시간에 구애받지 않고 자유롭게 사용할 수 있고, 각종 컬러(R, G, B)의 발광다이오드(LED; Light-Emitting-Diode)의 빛을 이용하여 인체의 각 부위의 피부를 가열하여 온열과 원적외선을 동시에 제공하는 한편, 적외선(IR; Infra-red) 발광다이오드에서 발생하는 근적외선을 인체의 피부 깊숙이(약 40mm)까지 침투시켜 표피층은 물론 진피층까지 온도를 상승시켜 미세혈관의 확장과 혈액순환을 촉진하여 혈액량과 산소량을 충분히 공급시켜 줄 수 있도록 하고, 또 진동을 통해 피부질 개선은 물론 근육 마사지 효과를 증대시킬 수 있으며, 또한 서로 다른 형상을 갖는 각종 기능성 캡(예를 들어 리프팅 캡, 두피 마사지 캡, 근육통 마사지 캡 등)을 각종 발광다이오드가 설치되어 있는 헤드에 선택적으로 장착시켜 안면 등의 피부 마사지 및 미용 효과와, 두피에 대한 긴장 증진 및 탈모 예방 효과는 물론 무릎 등과 같은 각 부위의 근육 마사지를 대폭 증대시킬 수 있도록 발명한 다기능 미용기기에 관한 것이다.

배경 기술

- [0002] 일반적으로 아름다운 피부를 추구하기 위해서는 체계적인 피부관리가 무엇보다 중요하다.
- [0003] 전통적인 피부관리는 주로 손을 사용하여 혈액이나 림프의 순환을 촉진하는 마사지(massage)가 주류를 이루었으나, 근래 들어서는 각 가정 등에서 개인이 손쉽게 피부를 관리할 수 있도록 다양한 피부 미용기기들이 개발되어 사용되고 있다.
- [0004] 이와 같은 피부 미용기기로는 롤러를 이용한 가압방식, 진동모터를 이용한 진동방식, 초음파를 이용한 방식, 황토, 숯, 옥 등으로 이루어진 원적외선 방사체를 이용한 방식 등이 주로 사용되고 있으나, 이러한 방식들은 피부 미용 효과를 극대화하는데 한계가 있다.
- [0005] 특히 원적외선 방사체를 이용한 방식은 진열히터를 이용하여 원적외선 방사체를 가열하여 원적외선을 방출하는 것으로 화상 위험 때문에 안전 피부에는 적용하지 못하고, 침대, 매트, 방석 또는 국부적 치료기에만 한정적으로 적용되고 있는 실정이다.
- [0006] 또한, 원적외선 방사체를 이용한 방식에서는 진열히터를 사용함에 따라 진열히터에서 발생하는 전자파로 인한 인체 부작용이 발생하기 때문에 그 효능에도 불구하고 실질적으로 원적외선 방사체를 피부 미용기기에 적용하는데에는 여전히 한계가 있었다.
- [0007] 한편, 피부를 구성하는 기본적인 구조는 표피층, 진피층, 피하조직 등 3층으로 구성되는데, 표피층은 피부의 상층부에 있는 부분이고, 진피층은 표피층의 안쪽에 있으며 단백질의 일종인 콜라겐과 엘라스틴으로 구성되어 있다.
- [0008] 피하조직은 곡선미를 형성하고 외부의 충격으로부터 보호와 체온을 유지하는 기능을 하게 된다.
- [0009] 표피층은 피부의 제일 상층부에 위치하여 외부의 자극으로부터 피부를 보호하는 역할을 하며 각화 및 각질 현상이 나타난다.
- [0010] 진피층은 표피층의 아래층에 있으며, 표피층보다 약 7배 이상 두껍고, 단백질의 일종인 교원섬유(콜라겐/Collagen)와 탄력섬유(엘라스틴/Elastin)를 보유하고 있다.
- [0011] 그리고, 진피층은 피부의 영양 보급, 분비, 감각 등의 중요한 기능을 담당한다.
- [0012] 이러한 표피층과 진피층을 자극하여 피부 미용 효과를 가지도록 하기 위해 일반적으로 초음파와 진동을 이용한 미용 기구를 이용하게 되는데, 초음파는 실질적으로 많은 진동을 하게 되지만 사용자는 이를 느끼지 못함으로 인하여 진동이 주는 시원함과 상쾌함을 직접 느낄 수 없으며, 제대로 작동되고 있는지도 알 수 없다.
- [0013] 이로 인해 사용자는 감성적으로 초음파 미용 기구에 대한 만족감을 느끼지 못하는 문제점이 있다.
- [0014] 그리고, 사용자가 작동상태를 느끼기 위해 전력을 높게 하면, 따끔거림과 함께 불필요한 부분까지 초음파가 침투하여 오히려 피부를 손상시키는 문제점이 발생한다.
- [0015] 따라서, 최근에는 발광다이오드 및 진동을 이용한 미용기기들이 제시되고 있는 실정인데, 이와 같은 미용기기에서는 단순히 발광다이오드에서 발생하는 빛과 편심 모터의 진동을 이용하여 피부 미용 효과를 얻고 있으므로 그 효과를 기대할 수 없는데, 특히 이와 같은 구성을 갖는 미용기기는 평면적인 렌즈만 사용하고 있어서 피부에 대한 미용 효과 및 근육 운동에 따른 마사지 효과가 저하되는 문제점이 있다.

선행기술문헌

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발명의 내용

해결하려는 과제

- [0017] 본 발명은 이와 같은 종래의 제반 문제점을 해결하기 위해 안출한 것으로서, 각 가정이나 사무실 등에서 간편하게 사용이 가능하면서 휴대가 용이하여 장소와 시간에 구애받지 않고 자유롭게 사용할 수 있고, 또 전열히터를 전혀 사용하지 않고 각종 컬러(R, G, B)의 발광다이오드의 빛을 이용하여 인체의 각 부위의 피부를 가열하여 온열과 원적외선을 동시에 제공하는 한편, 적외선(IR) 발광다이오드에서 발생하는 근적외선을 인체의 피부 깊숙이(약 40mm)까지 침투시켜 표피층은 물론 진피층까지 온도를 상승시켜 미세혈관의 확장과 혈액순환을 촉진하여 혈액량과 산소량을 충분히 공급시켜 줄 수 있을 뿐만 아니라 안면 등과 같이 민감한 피부에도 안전하게 적용할 수 있으며, 또한 다양한 주파수의 진동을 통해 피부질 개선은 물론 근육 마사지 효과를 증대시킬 수 있는 다기능 미용기기를 제공하는데 그 목적이 있다.
- [0018] 본 발명의 다른 목적은, 리프팅 캡과 두피 마사지 캡 및 근육통 마사지 캡 등과 같이 서로 다른 형상을 갖는 각종 기능성 캡을 각종 발광다이오드가 설치되어 있는 헤드에 선택적으로 장착하여 사용할 수 있도록 하는 방식을 통해 안면 등의 피부 마사지 및 미용 효과의 극대화를 포함하여 두피에 대한 건강 증진과 탈모 예방 효과 및 무릎 등과 같은 각 부위에 대한 근육 마사지 효과를 대폭 증대시킬 수 있는 다기능 미용기기를 제공하는데 있다.

과제의 해결 수단

- [0019] 상기한 목적을 달성하기 위한 본 발명은, 타원형의 속이 빈 통체 형상을 갖고, 내부에는 배터리와 메인 인쇄회로기판(PCB), 진동 발생용 모터 및 스피커가 내장되며, 전면 중앙에는 전원스위치를 포함한 각종 기능 제어키가 설치됨은 물론 전면 상부에는 헤드 설치부가 형성되고 저부에는 배터리 충전기 결합용 콘택터가 설치된 본체와; 상기 배터리 충전기 결합용 콘택터와 연결된 상태에서 본체의 내부에 설치되어 메인 인쇄회로기판을 포함하여 진동 발생용 모터 및 각종 발광다이오드의 구동에 필요한 전압을 공급시켜 주는 충전식 배터리와; 상기 본체 내에 설치되어 전원스위치가 "온"되면 각종 기능 제어키의 조작에 대응하여 정해진 프로그램에 맞춰 진동 발생용 모터 및 각종 발광다이오드의 구동을 포함하여 스피커의 구동을 제어하는 메인 인쇄회로기판과; 측 상에 편심형 중량추를 구비하고 상기 본체 내에서 헤드에 근접되게 설치되어 상기 메인 인쇄회로기판의 출력신호에 대응하여 작동하며 헤드가 진동 작동하도록 하는 진동 발생용 모터와; 상기 본체의 헤드 설치부에 착탈 가능하게 결합되는 원뿔 형상의 헤드와; 반투명의 합성수지로 형성된 형태를 갖고 상기 헤드의 전면 개구부에 착탈 가능하게 결합되어 각종 발광다이오드에서 발생하는 빛을 고르게 투광시켜 줌은 물론 기능성 캡의 결합기능을 수행하는 원판형의 투광캡과; R, G, B 컬러의 빛을 포함하여 적외선(IR)을 발생하는 각종 발광다이오드들을 실장한 상태에서 상기 헤드 내에 설치되어 메인 인쇄회로기판의 출력신호에 대응하는 각종 컬러의 빛을 포함한 적외선(IR)을 상기 헤드에 결합된 투광캡을 통해 외부로 발생시켜 주는 발광다이오드 설치용 인쇄회로기판과; 사용자가 마사지고자 인체의 각 부위에 대응하여 서로 다른 형상을 갖게 형성되어 상기 헤드에 결합되는 투광캡에 착탈 가능하게 결합되는 복수의 기능성 캡;으로 구성한 것을 특징으로 한다.
- [0020] 이때, 상기 기능성 캡의 일 실시 예는, 하트 형상을 갖는 판체의 저면에 상기 헤드의 투광캡 외부에 탄력적으로 감싸는 형태로 결합되는 탄성 결합판을 구비하고, 상면에는 복수의 "V"자형 돌기와 홈을 교차되게 다단으로 연이어 형성되되, 상기 복수의 "V"자형 돌기의 끝단부는 턱신과 볼 및 광대뼈 부위에 맞게 내측에서 외측으로 또한 상부에서 하부로 갈수록 높이와 크기가 점차 커지도록 형성한 리프팅 캡을 포함하는 것을 특징으로 한다.
- [0021] 또, 상기 기능성 캡의 다른 실시 예는, 타원 형상을 갖는 판체의 저면에 상기 헤드의 투광캡 외부에 탄력적으로 감싸는 형태로 결합되는 탄성 결합판을 구비하고, 상면에는 복수의 두피 마사지를 위한 방사형으로 돌출 형성되되, 상기 복수의 두피 마사지를 위한 돌기의 높이는 외측에서 내측으로 갈수록 점차 낮아지게 형성하여, 복수의 두피 마사지를 위한 끝단부가 인체의 머리 형상과 반대방향으로 라운드지게 형성되도록 한 두피 마사지 캡을 포함하는 것을 특징으로 한다.
- [0022] 또한, 상기 기능성 캡의 또 다른 실시 예는, 상면 전체가 라운드진 원판 형상을 갖는 판체의 저면에 상기 헤드의 투광캡 외부에 탄력적으로 감싸는 형태로 결합되는 탄성 결합판을 구비하고, 상면에는 복수의 피부 압박용 반원형 돌기가 방사형으로 배치되도록 형성한 근육통 마사지 캡을 포함하는 것을 특징으로 한다.
- [0023] 또, 상기 본체의 전면 중앙부와 저부에는 전원 공급 표시용 발광다이오드를 포함하여 사용자가 조작한 기능 제어키의 조작상태에 대응하여 선택되는 각 피부관리 모드에 대한 작동 상태를 표시해 주는 복수의 작동모드 표시용 발광다이오드를 더 설치한 것을 특징으로 한다.

[0024] 또한, 상기 메인 인쇄회로기판에는 전원스위치를 포함하여 기능 제어키의 입력신호 및 자체에 입력되어 있는 제어프로그램에 대응하여 미용기기의 전반적인 제어기능을 수행하는 마이컴과; 상기 마이컴의 제어를 받아 충전식 배터리의 충방전을 제어하는 배터리 충방전 제어부와; 사용자가 선택한 피부관리 모드에서의 각종 작동 상태 멘트를 포함하여 안내 멘트 등을 상기 마이컴의 제어신호에 대응하여 스피커를 통해 출력해 주는 음성 제어부와; 상기 마이컴의 제어신호에 대응하여 진동 발생용 모터의 구동을 제어하는 모터 제어부와; 상기 마이컴의 제어신호에 대응하여 각종 발광다이오드의 구동을 제어하는 발광다이오드 제어부;를 구비시킨 것을 특징으로 한다.

[0025] 또, 상기 헤드 내에는 온도센서를 더 설치하고, 상기 마이컴에는 상기 온도센서를 통해 검출되는 헤드의 온도가 정해진 온도이상 상승할 경우 각종 발광다이오드에 공급되는 전원전압을 차단하여 헤드의 온도가 정해진 온도이상으로 상승하는 것을 차단할 수 있도록 한 것을 특징으로 한다.

발명의 효과

[0026] 이상에서 설명한 바와 같이 본 발명의 다기능 미용기기에 의하면, 각 가정이나 사무실 등에서 간편하게 사용이 가능하면서 휴대가 용이하고 장소와 시간에 구애받지 않으며 자유롭게 사용할 수 있고, 또 전열히터를 전혀 사용하지 않고 각종 컬러(R, G, B)의 발광다이오드의 빛을 이용하여 인체의 각 부위의 피부를 가열하여 온열과 원적외선을 동시에 제공할 수 있는 한편, 적외선(IR) 발광다이오드에서 발생하는 근적외선을 인체의 피부 깊숙이(약 40mm)까지 침투시켜 표피층은 물론 진피층까지 온도를 상승시켜 미세혈관의 확장과 혈액순환을 촉진하여 혈액량과 산소량을 충분히 공급시켜 줄 수 있음은 물론, 안면 등과 같이 민감한 피부에도 안전하게 적용할 수 있으며, 또한 다양한 주파수의 진동을 통해 피부질 개선은 물론 근육 마사지 효과를 증대시킬 수 있는 효과가 있다.

[0027] 또, 본 발명에 의하면 리프팅 캡과 두피 마사지 캡 및 근육통 마사지 캡 등과 같이 서로 다른 형상을 갖는 각종 기능성 캡을 각종 발광다이오드가 설치되어 있는 헤드에 선택적으로 장착하여 사용할 수 있도록 함으로써 안면 등의 피부 마사지 및 미용 효과의 극대화를 포함하여 두피에 대한 건강 증진과 탈모 예방 효과 및 무릎 등과 같은 각 부위에 대한 근육 마사지 효과를 대폭 증대시킬 수 있다.

[0028] 뿐만 아니라, 본 발명에 의하면 헤드 내에 온도센서를 설치하여 헤드의 온도가 정해진 온도이상으로 상승할 경우 각종 발광다이오드에 공급되는 전원전압을 차단할 수 있도록 함으로써 마사지 중 피부의 일부에 화상을 입히게 되거나 피부가 손상되는 것을 미연에 방지할 수 있어 제품 자체의 신뢰도는 물론 안전성을 대폭 확보할 수 있는 등 매우 유용한 발명인 것이다.

도면의 간단한 설명

[0029] 도 1은 본 발명이 적용된 미용기기의 사시도.

도 2는 본 발명이 적용된 미용기기의 개략적인 측 단면도.

도 3의 (a)~(c)는 본 발명에서 적용한 기능형 캡 중 리프팅 캡의 정면과 배면 사시도 및 측 단면도.

도 4는 본 발명이 적용된 미용기기의 헤드에 기능형 캡 중 리프팅 캡을 설치한 상태의 사시도.

도 5의 (a)~(c)는 본 발명에서 적용한 기능형 캡 중 두피 마사지 캡의 정면과 배면 사시도 및 측 단면도.

도 6은 본 발명이 적용된 미용기기의 헤드에 기능형 캡 중 두피 마사지 캡을 설치한 상태의 사시도.

도 7의 (a)(b)는 본 발명에서 적용한 기능형 캡 중 근육통 마사지 캡의 정면 및 배면 사시도.

도 8은 본 발명이 적용된 미용기기의 헤드에 기능형 캡 중 근육통 마사지 캡을 설치한 상태의 사시도.

도 9는 본 발명이 적용된 미용기기 내 메인 인쇄회로기판에 설치된 회로에 대한 블록 구성도.

발명을 실시하기 위한 구체적인 내용

[0030] 이하, 첨부된 도면을 참조하여 본 발명에 따른 바람직한 실시 예 및 작동상태를 상세히 설명하면 다음과 같다.

[0031] 본 발명을 설명함에 있어서, 관련된 공지기능 혹은 구성에 대한 구체적인 설명이 본 발명의 요지를 불필요하게 흐릴 수 있다고 판단되는 경우 그 상세한 설명은 생략한다.

[0032] 도 1은 본 발명이 적용된 미용기기의 사시도를 나타낸 것이고, 도 2는 본 발명이 적용된 미용기기의 개략적인

측 단면도를 나타낸 것이다.

- [0033] 또, 도 3의 (a)~(c)는 본 발명에서 적용한 기능형 캡 중 리프팅 캡의 정면과 배면 사시도 및 측 단면도를 나타낸 것이고, 도 4는 본 발명이 적용된 미용기기의 헤드에 기능형 캡 중 리프팅 캡을 설치한 상태의 사시도를 나타낸 것이다.
- [0034] 또한, 도 5의 (a)~(c)는 본 발명에서 적용한 기능형 캡 중 두피 마사지 캡의 정면과 배면 사시도 및 측 단면도를 나타낸 것이고 도 6은 본 발명이 적용된 미용기기의 헤드에 기능형 캡 중 두피 마사지 캡을 설치한 상태의 사시도를 나타낸 것이다.
- [0035] 또, 도 7의 (a)(b)는 본 발명에서 적용한 기능형 캡 중 근육통 마사지 캡의 정면 및 배면 사시도를 나타낸 것이고, 도 8은 본 발명이 적용된 미용기기의 헤드에 기능형 캡 중 근육통 마사지 캡을 설치한 상태의 사시도를 나타낸 것이며, 도 9는 본 발명이 적용된 미용기기 내 메인 인쇄회로기판에 설치된 회로에 대한 블록 구성도를 나타낸 것이다.
- [0036] 이에 따르면 본 발명은,
- [0037] 타원형의 속이 빈 통체 형상을 갖고, 내부에는 `배터리(20)와 메인 인쇄회로기판(30), 진동 발생용 모터(40) 및 스피커(15)가 내장되며, 전면 중앙에는 전원스위치(11)를 포함한 각종 기능 제어키(12)가 설치됨은 물론 전면 상부에는 헤드 설치부(13)가 형성되고 저부에는 배터리 충전기 결합용 콘넥터(14)가 설치된 본체(10)와;
- [0038] 상기 배터리 충전기 결합용 콘넥터(14)와 연결된 상태에서 본체(10)의 내부에 설치되어 메인 인쇄회로기판(30)을 포함하여 진동 발생용 모터(40) 및 각종 발광다이오드(LED1)의 구동에 필요한 전압을 공급시켜 주는 충전식 `배터리(20)와;
- [0039] 상기 본체(10) 내에 설치되어 전원스위치(11)가 "온"되면 각종 기능 제어키(12)의 조작에 대응하여 정해진 프로그램에 맞춰 상기 진동 발생용 모터(40) 및 각종 발광다이오드(LED1)의 구동을 포함하여 스피커(15) 등의 구동을 제어하는 메인 인쇄회로기판(30)과;
- [0040] 측 상에 편심형 증광주를 구비하고 상기 본체(10) 내에서 헤드(50)에 근접되게 설치되어 상기 메인 인쇄회로기판(30)의 출력신호에 대응하여 작동하며 헤드(50)가 진동 작동하도록 하는 진동 발생용 모터(40)와;
- [0041] 상기 본체(10)의 헤드 설치부(13)에 착탈 가능하게 결합되는 원뿔 형상의 헤드(50)와;
- [0042] 반투명의 합성수지로 형성된 형태를 갖고 상기 헤드(50)의 전면 개구부에 착탈 가능하게 결합되어 각종 발광다이오드(LED1)에서 발생하는 빛을 고르게 투광시켜 줌은 물론 기능성 캡(80)의 결합기능을 수행하는 원관형의 투광캡(60)과;
- [0043] R, G, B 컬러의 빛을 포함하여 적외선(IR)을 발생하는 등 각종 발광다이오드(LED1)들을 실장한 상태에서 상기 헤드(50) 내에 설치되어 메인 인쇄회로기판(30)의 출력신호에 대응하는 각종 컬러의 빛을 포함한 적외선(IR)을 상기 헤드(50)에 결합된 투광캡(60)을 통해 외부로 발생시켜 주는 발광다이오드 설치용 인쇄회로기판(70)과;
- [0044] 사용자가 마사지고자 인체의 각 부위에 대응하여 서로 다른 형상을 갖게 성형되어 상기 헤드(50)에 결합되는 투광캡(60)에 착탈 가능하게 결합되는 복수의 기능성 캡(80);으로 구성된 것을 특징으로 한다.
- [0045] 이때, 상기 기능성 캡(80)의 일 실시 예는,
- [0046] 하트 형상을 갖는 관체(811)의 저면에 상기 헤드(50)의 투광캡(60) 외부에 탄력적으로 감싸는 형태로 결합되는 탄성 결합관(812)을 구비하고, 상면에는 복수의 "V"자형 돌기(813)와 홈(814)을 교차되게 다단으로 연이어 형성하되, 상기 복수의 "V"자형 돌기(813)의 끝단부는 턱선과 볼 및 광대뼈 부위에 맞게 내측에서 외측으로 또한 상부에서 하부로 갈수록 높이가 크기가 점차 커지도록 형성하여, 안면에 접촉시켜 밀어주는 형태로 마사지를 실시할 때 피부가 복수의 "V"자형 돌기(813)와 홈(814) 사이로 밀려들어 갔다 나오는 형태가 반복 작동되며 피부에 탄력을 줄 수 있도록 함과 동시에 진동 발생용 모터(40)에서 발생하는 진동에 의해 피부 리프팅 효과를 얻을 수 있는 리프팅 캡(81)을 포함하는 것을 특징으로 한다.
- [0047] 또, 상기 기능성 캡(80)의 다른 실시 예는,
- [0048] 타원 형상을 갖는 관체(821)의 저면에 상기 헤드(50)의 투광캡(60) 외부에 탄력적으로 감싸는 형태로 결합되는 탄성 결합관(822)을 구비하고, 상면에는 복수의 두피 마사지에용 봉(823)을 방사형으로 돌출 형성하되, 상기 복수의 두피 마사지에용 봉(823)의 높이는 외측에서 내측으로 갈수록 점차 낮아지게 형성하여, 복수의 두피 마사지에용

봉(823) 끝단부가 인체의 머리 형상과 반대방향으로 라운드지게 형성되도록 한 두피 마사지 캡(82)을 포함하는 것을 특징으로 한다.

- [0049] 또한, 상기 기능성 캡(80)의 또 다른 실시 예는,
- [0050] 상면 전체가 라운드진 원판 형상을 갖는 판체(831)의 저면에 상기 헤드(50)의 투광캡(60) 외부에 탄력적으로 감싸는 형태로 결합되는 탄성 결합판(832)을 구비하고, 상면에는 복수의 피부 압박용 반원형 돌기(833)가 방사형으로 배치되도록 형성한 근육통 마사지 캡(83)을 포함하는 것을 특징으로 한다.
- [0051] 또, 상기 본체(10)의 전면 중앙부와 저부에는 전원 공급 표시용 발광다이오드(LED2)를 포함하여 사용자가 조작한 기능 제어키(12)의 조작상태에 대응하여 선택되는 각 피부관리 모드에 대한 작동 상태를 표시해 주는 복수의 작동모드 표시용 발광다이오드(LED3)를 더 설치한 것을 특징으로 한다.
- [0052] 또한, 상기 메인 인쇄회로기판(30)에는 전원스위치(11)를 포함하여 기능 제어키(12)의 입력신호 및 자체에 입력되어 있는 제어프로그램에 대응하여 미용기기의 전반적인 제어기능을 수행하는 마이컴(31)과;
- [0053] 상기 마이컴(31)의 제어를 받아 충전식 `배터리(20)의 충방전을 제어하는 배터리 충방전 제어부(32)와;
- [0054] 사용자가 선택한 피부관리 모드에서의 각종 작동 상태 멘트를 포함하여 안내 멘트 등을 상기 마이컴(31)의 제어신호에 대응하여 스피커(15)를 통해 출력해 주는 음성 제어부(33)와;
- [0055] 상기 마이컴(31)의 제어신호에 대응하여 진동 발생용 모터(40)의 구동을 제어하는 모터 제어부(34)와;
- [0056] 상기 마이컴(31)의 제어신호에 대응하여 각종 발광다이오드(LED1)의 구동을 제어하는 발광다이오드 제어부(35);를 구비시킨 것을 특징으로 한다.
- [0057] 또, 상기 헤드(50) 내에는 온도센서(90)를 더 설치하고, 상기 마이컴(31)에는 상기 온도센서(90)를 통해 검출되는 헤드(50)의 온도가 정해진 온도이상 상승할 경우 각종 발광다이오드(LED1)에 공급되는 전원전압을 차단하여 헤드(50)의 온도가 정해진 온도이상으로 상승하는 것을 차단할 수 있도록 한 것을 특징으로 한다.
- [0058] 이와 같이 구성된 본 발명의 다기능 미용기기에 대한 작용효과를 설명하면 다음과 같다.
- [0059] 먼저, 본 발명의 다기능 미용기기는 도 1 내지 도 9에 도시한 바와 같이, 본체(10)와 충전식 `배터리(20), 메인 인쇄회로기판(30), 진동 발생용 모터(40), 원뿔 형상의 헤드(50), 원판형의 투광캡(60), 발광다이오드 설치용 인쇄회로기판(70) 및 복수의 기능성 캡(80)으로 형성시켜 휴대가 용이하고 장소와 시간에 구애받지 않으며 각 가정이나 사무실 등에서 간편하면서도 자유롭게 사용하여 인체의 각 부위를 자유롭게 마사지할 수 있도록 한 것을 주요기술 구성요소로 한다.
- [0060] 이때, 상기 본체(10)는 도 1 및 도 2에 도시한 바와 같이, 사용자가 손으로 쉽게 잡고 사용할 수 있도록 타원형으로 된 속이 빈 통체 형상으로 성형한 것으로, 내부에는 `배터리(20)와 메인 인쇄회로기판(30), 진동 발생용 모터(40) 및 스피커(15) 등이 내장되고, 전면 중앙에는 전원스위치(11)를 포함한 각종 기능 제어키(12)가 설치된 물론 전면 상부 및 저부에는 헤드 설치부(13) 및 배터리 충전기 결합용 콘넥터(14)가 형성 및 설치된 형태를 갖는다.
- [0061] 뿐만 아니라, 상기 본체(10)의 전면 중앙부와 저부에는 전원 공급 표시용 발광다이오드(LED2)를 포함하여 사용자가 조작한 기능 제어키(12)의 조작상태에 대응하여 선택되는 각 피부관리 모드에 대한 작동 상태를 표시해 주는 복수의 작동모드 표시용 발광다이오드(LED3)를 더 구비한 형태를 갖는다.
- [0062] 또, 상기 `배터리(20)는 충전식으로 상기 배터리 충전기 결합용 콘넥터(14)와 연결된 상태에서 상기 본체(10)의 내부에 설치된 상태에서, 후술하는 메인 인쇄회로기판(30)을 포함하여 진동 발생용 모터(40) 및 각종 발광다이오드(LED1)의 구동에 필요한 전압을 배터리 충방전 제어부(32)를 통해 공급시켜 주는 기능을 수행한다.
- [0063] 또한, 상기 메인 인쇄회로기판(30)은 도 9에 도시한 바와 같이, 마이컴(31)과 배터리 충방전 제어부(32), 음성 제어부(33), 모터 제어부(34) 및 발광다이오드 제어부(35) 등을 구비하고, 상기 본체(10) 내에 설치되어 사용자에게 의해 전원스위치(11)가 "온"되면 각종 기능 제어키(12)의 조작에 대응하여 정해진 프로그램에 맞춰 진동 발생용 모터(40) 및 각종 발광다이오드(LED1)의 구동을 포함하여 스피커(15) 등의 구동을 제어하는 기능을 수행한다.
- [0064] 이때, 상기 메인 인쇄회로기판(30)에 구비된 구성요소 중 상기 마이컴(31)은 전원스위치(11)를 포함하여 기능 제어키(12)의 입력신호 및 자체에 입력되어 있는 제어프로그램에 대응하여 미용기기의 각 구성요소에 대한 전반

적인 제어기능을 수행하게 된다.

- [0065] 또, 상기 배터리 충방전 제어부(32)는 상기 마이컴(31)의 제어를 받아 상기 배터리 충전기 결합용 콘넥터(14)와 연결된 상태에서 상기 본체(10)의 내부에 설치된 충전식 배터리(20)의 충전 및 방전에 대한 제어기능을 수행한다.
- [0066] 또한, 상기 음성 제어부(33)는 사용자가 기능 제어키(12)를 통해 선택한 각종 피부관리 모드에서의 각종 작동 상태 멘트(예를 들어 "동안 피부 관리모드입니다" 또는 "V 라인 관리모드입니다" 또는 피부 관리모드입니다" 등)를 포함하여 주위사항 멘트(예를 들어 발광다이오드 빛을 눈에 오래 비추지 마십시오" 등) 및 안내 멘트(예를 들어 "기능 제어를 어떻게 또는 몇 번 조작하라는 등의 메시지 등) 등을 상기 마이컴(31)의 제어신호에 대응하여 스피커(15)를 통해 출력시켜 주는 기능을 수행한다.
- [0067] 또, 상기 모터 제어부(34)는 상기 마이컴(31)의 제어신호에 대응하여 진동 발생용 모터(40)의 구동을 제어하는 기능을 수행하고, 상기 발광다이오드 제어부(35)는 상기 마이컴(31)의 제어신호에 대응하여 각종 발광다이오드(LED1)의 구동을 포함하여 전원 공급 표시용 발광다이오드(LED2) 및 복수의 작동모드 표시용 발광다이오드(LED3)의 구동을 제어하는 기능을 수행한다.
- [0068] 한편, 상기 진동 발생용 모터(40)는 축 상에 편심형 중량추를 구비한 형태를 갖고 상기 본체(10) 내에서 헤드(50)에 근접되게 설치된 상태에서 상기 메인 인쇄회로기판(30)의 마이컴(31) 제어를 받는 상기 모터 제어부(34)의 출력신호에 대응하여 작동하며 헤드(50)가 각 부위를 마사지하는데 필요한 진동력을 발생시키도록 작동하는 기능을 수행한다.
- [0069] 또, 상기 헤드(50)는 합성수지를 이용하여 원뿔 형상으로 제작된 것으로, 상기 본체(10)의 헤드 설치부(13)에 착탈 가능하게 결합되어 각종 발광다이오드(LED1)와 투광캡(60) 등이 설치될 수 있도록 함은 물론 상기 진동 발생용 모터(40)에서 발생하는 진동을 투광캡(60) 등을 통해 인체의 각 부위 피부에 전달시켜 주는 기능을 수행한다.
- [0070] 또한, 상기 투광캡(60)은 반투명의 합성수지를 이용하여 원판형으로 성형된 것으로, 상기 헤드(50)의 전면 개구부에 착탈 가능하게 결합된 상태에서 각종 발광다이오드(LED1)에서 발생하는 빛을 고르게 투광시켜 주는 물론 기능성 캡(80)의 결합기능과 상기 진동 발생용 모터(40)에서 발생하는 진동을 인체의 각 부위 피부에 직접 또는 각종 기능성 캡(80)을 통해 전달시켜 주는 기능을 수행한다.
- [0071] 또, 상기 발광다이오드 설치용 인쇄회로기판(70)은 R, G, B 컬러 빛을 포함하여 적외선(IR) 발생시켜 주는 각종 발광다이오드(LED1)를 실장한 상태에서, 상기 헤드(50) 내에 착탈 가능하게 설치되어, 메인 인쇄회로기판(30)의 출력신호에 대응하는 각종 컬러의 빛을 포함한 적외선(IR)이 마이컴(31) 내 제어프로그램에 맞춰 출력될 수 있도록 하는 기능을 수행한다.
- [0072] 이때, 상기 발광다이오드 설치용 인쇄회로기판(70)에 실장되어 있는 복수의 R, G, B 발광다이오드들을 포함한 적외선(IR)을 발생하는 각종 발광다이오드들은 사용자가 기능 제어키(12)를 통해 선택한 각 피부관리 모드에 대응하여 마이컴(31)에 별도로 각각 기 입력시켜 놓은 시간 간격을 두고 점등과 소등 및 점멸 작동이 이루어지게 된다.
- [0073] 또한, 상기 복수의 기능성 캡(80)은 내화хар성이 강하고 인체에 무해한 합성수지 재질을 이용하여 사용자가 마사지하고자 인체의 각종 부위에 특성에 맞게 서로 다른 형상을 갖도록 각각 사출 성형된 상태에서 상기 헤드(50)에 결합되는 투광캡(60)의 외부를 감싸는 형태로 착탈 가능하게 결합되어 사용된다.
- [0074] 이때, 상기 기능성 캡(80)으로는 리프팅 캡(81)과 두피 마사지 캡(82) 및 근육통 마사지 캡(83)을 포함하게 된다.
- [0075] 상기한 복수의 기능성 캡(80) 중 상기 리프팅 캡(81)은 도 3의 (a)~(c)에 도시한 바와 같이, 평면이 내략 하트 형상을 갖는 판체(811)의 저면에 상기 헤드(50)의 투광캡(60) 외부에 탄력적으로 감싸는 형태로 결합되는 탄성 결합편(812)을 구비시켜 주고, 또한 상기 판체(811)의 상면에는 복수의 "V"자형 돌기(813)와 홈(814)을 교차되게 다단으로 연이어 형성되되, 피부 운동 마사지의 극대화를 위해 상기 복수의 "V"자형 돌기(813)의 끝단부는 턱선과 볼 및 광대뼈 부위에 맞게 내측에서 외측으로 또한 상부에서 하부로 갈수록 높이와 크기가 점차 커지도록 형성(예를 들어 최소 높이 1mm, 최대 높이 2mm가 되도록 하되, 내측에서 외측으로 또한 상부에서 하부로 갈수록 0.1~0.2mm씩 점차 커지도록 형성)한 형태를 갖는다.
- [0076] 이와 같은 형태를 갖는 리프팅 캡(81)을 도 4와 같이 헤드(50)의 투광캡(60)에 결합한 상태에서 안면의 소정부

위(예를 들어 턱, 볼, 광대 등)에 접촉시켜 밀어주는 형태로 마사지를 실시하게 되면, 각종 발광다이오드(LED 1)에서 발생하는 빛들이 안면의 피부에 조사됨은 물론 안면 피부의 일부가 복수의 "V"자형 돌기(813)와 홈(814) 사이로 밀려들어 갔다 나오는 형태가 반복 작동되므로 피부에 탄력을 줄 수 있을 뿐만 아니라 진동 발생용 모터(40)에서 발생하는 진동(예를 들어 10,000번의 진동)에 의해 피부를 자극시켜 줄 수 있으므로 안면 피부에 대한 리프팅 효과까지 얻을 수 있다.

[0077] 또, 상기한 기능성 캡(80) 중 두피 마사지 캡(82)은 도 5의 (a)~(c)에 도시한 바와 같이, 평면이 타원 형상을 갖는 판체(821)의 저면에 상기 헤드(50)의 투광캡(60) 외부에 탄력적으로 감싸는 형태로 결합되는 탄성 결합판(822)을 구비시켜 주고, 또 상면에는 복수의 두피 마사지를 위한 돌출 형상(823)을 방사형으로 돌출 형성하되, 상기 복수의 두피 마사지를 위한 돌출 형상(823)의 높이는 외측에서 내측으로 갈수록 점차 낮아지게 형성한 형태 즉, 복수의 두피 마사지를 위한 돌출 형상(823) 끝단부가 인체의 머리 형상과 반대방향으로 오목하게 라운드진 형태를 갖는다.

[0078] 이와 같은 형태를 갖는 두피 마사지 캡(82)을 도 6에 도시한 바와 같이 헤드(50)의 투광캡(60)에 결합시킨 상태에서 본 발명이 적용된 미용기기를 작동시키며 상기 두피 마사지 캡(82)을 머리에 대어 이동시켜 주게 되면 각종 발광다이오드(LED1)에서 발생하는 빛들이 인체의 두피에 조사됨은 물론 상기 두피 마사지 캡(82)의 상면에 돌출 형성된 복수의 두피 마사지를 위한 돌출 형상(823) 끝단부가 인체의 두피 및 모공을 자극하게 되므로 탈모예방은 물론 두피건강에 큰 도움을 줄 수 있다.

[0079] 또한, 상기한 기능성 캡(80) 중 근육통 마사지 캡(83)은 도 7의 (a)(b)에 도시한 바와 같이, 상면 전체가 라운드진 원판 형상을 갖도록 사출 성형되는 판체(831)의 저면에 상기 헤드(50)의 투광캡(60) 외부에 탄력적으로 감싸는 형태로 결합되는 탄성 결합판(832)을 구비시켜 주고, 또 상면에는 복수의 피부 압박용 반원형 돌기(833)가 방사형으로 정해진 간격을 두고 돌출 형성한 형태를 갖는다.

[0080] 이와 같은 형태를 갖는 근육통 마사지 캡(83)을 도 8에 도시한 바와 같이 헤드(50)의 투광캡(60)에 결합시킨 상태에서 본 발명이 적용된 미용기기를 작동시키며 상기 근육통 마사지 캡(83)을 근육이 많은 부위의 피부나 근육통이 있는 피부에 대어 이동시켜 주게 되면, 각종 발광다이오드(LED1)에서 발생하는 빛들이 해당 부위에 조사됨은 물론 상기 근육통 마사지 캡(83)의 상면에 돌출 형성된 복수의 피부 압박용 반원형 돌기(833)가 해당 부위를 강하게 자극하게 되므로 마사지 효과의 극대화를 통한 근육통을 대폭 완화시켜 줄 수 있다.

[0081] 상기와 같은 근육통 마사지 캡(83)을 헤드(50)에 결합시켜 근육이 많은 부위나 근육통이 있는 부위를 마사지하고자 할 때에는, 해당 부위의 피부에 근육통 개선 크림 등을 바르고 마사지를 실행하는 것이 바람직하다.

[0082] 물론, 본 발명이 적용된 미용기기를 이용하여 마사지를 실시함에 있어서, 상기한 기능성 캡(80)들을 결합하지 않고, 상기 헤드(50)에 결합되어 있는 투광캡(60)의 외면을 안면의 각 부위(예를 들어 턱, 볼, 광대 등)에 직접 접촉시킨 상태에서 마사지를 실시해도 각종 발광다이오드(LED1)에서 발생하는 빛들이 안면의 피부에 조사됨은 물론 진동 발생용 모터(40)에서 발생하는 진동(예를 들어 10,000번의 진동)에 의해 피부를 자극시켜 줄 수 있으므로 안면 피부에 대한 마사지 효과를 얻을 수 있다.

[0083] 한편, 본 발명에서는 상기 헤드(50) 내에 도 2와 같이 온도센서(90)를 더 설치하고, 미용기기를 통해 특정 부위에 대한 마사지를 실시할 때 상기 마이컨(31)으로 하여금 상기 온도센서(90)를 통해 실시간으로 검출되는 헤드(50)의 온도가 정해진 온도이상 상승할 경우 각종 발광다이오드(LED1)에 공급되는 전압전압을 차단하도록 함으로써 헤드(50)의 온도가 정해진 온도이상으로 상승하게 되므로 인한 화상 등과 같은 안전사고의 발생을 미연에 방지할 수 있어 제품 자체의 안전성과 작동에 따른 신뢰도를 대폭 향상시킬 수 있다.

[0084] 상술한 실시 예는 본 발명의 가장 바람직한 예에 대하여 설명한 것이지만, 상기한 실시 예 및 특허청구범위에 기재된 내용만으로 한정하는 것은 아니며, 본 발명의 기술사상을 벗어나지 않는 범위 내에서 다양한 변형이 가능하다는 것은 당업자에게 있어서 명백한 것이다.

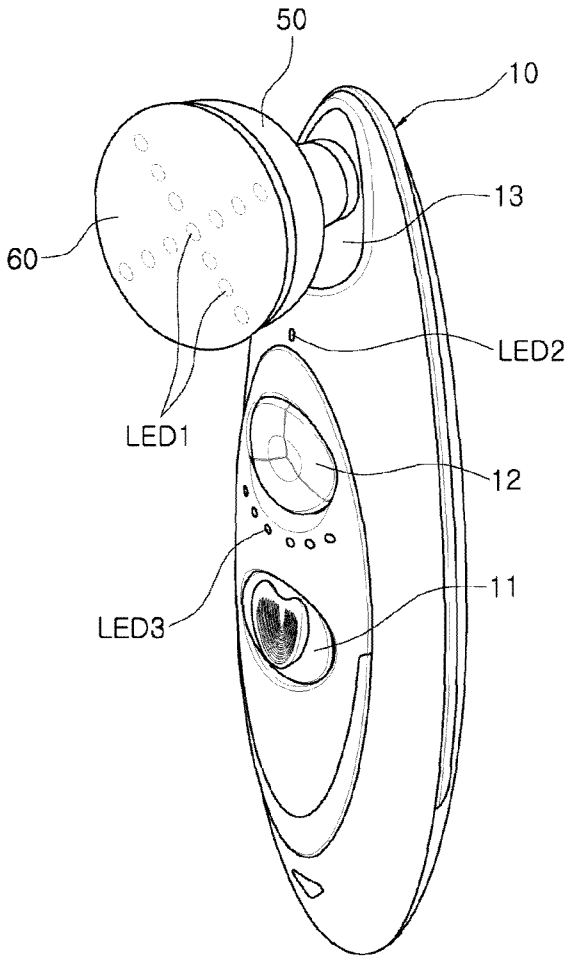
부호의 설명

[0085] 10 : 본체
11 : 전원스위치
12 : 기능 제어키
13 : 헤드 설치부
14 : 배터리 충전기 결합용 콘넥터
15 : 스피커
20 : 충전식 배터리

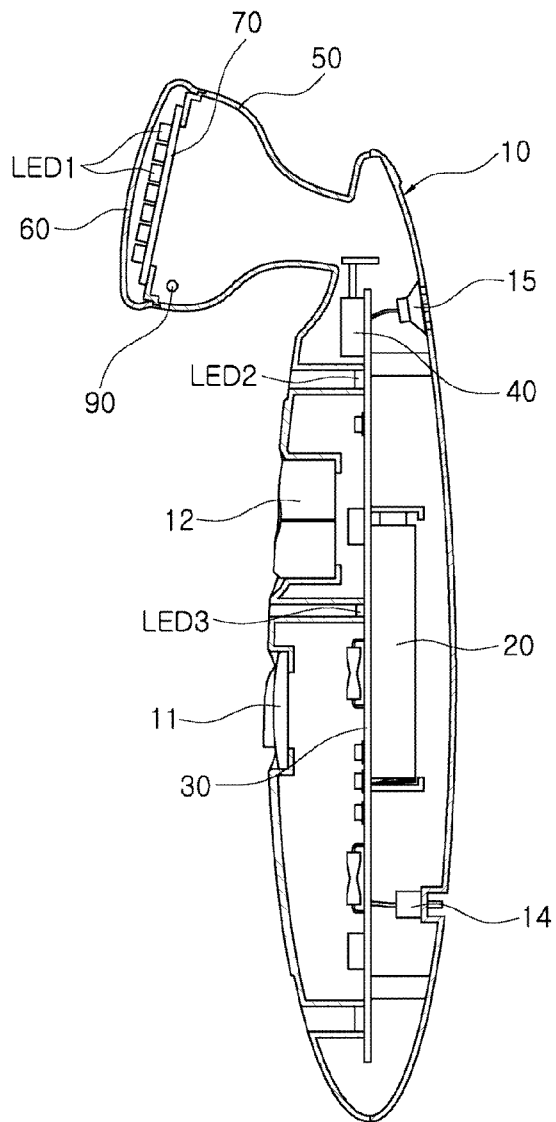
30 : 메인 인쇄회로기판	31 : 마이크
32 : 배터리 충방전 제어부	33 : 음성 제어부
34 : 모터 제어부	35 : 발광다이오드 제어부
40 : 진동 발생용 모터	
50 : 헤드	
60 : 투광캡	
70 : 발광다이오드 설치용 인쇄회로기판	
80 : 기능성 캡	
81 : 리프팅 캡	811 : 판체
812 : 탄성 결합판	813 : "V"자형 돌기(813)
814 : "V"자형 홈	
82 : 두피 마사지 캡	821 : 판체
822 : 탄성 결합판	823 : 두피 마사지용 봉
83 : 근육통 마사지 캡	831 : 판체
832 : 탄성 결합판	833 : 피부 압박용 반원형 돌기
90 : 온도센서	
LED1 : R, G, B 컬러의 빛 및 적외선(IR) 발생용 발광다이오드	
LED2 : 전원 공급 표시용 발광다이오드	
LED3 : 작동모드 표시용 발광다이오드	

도면

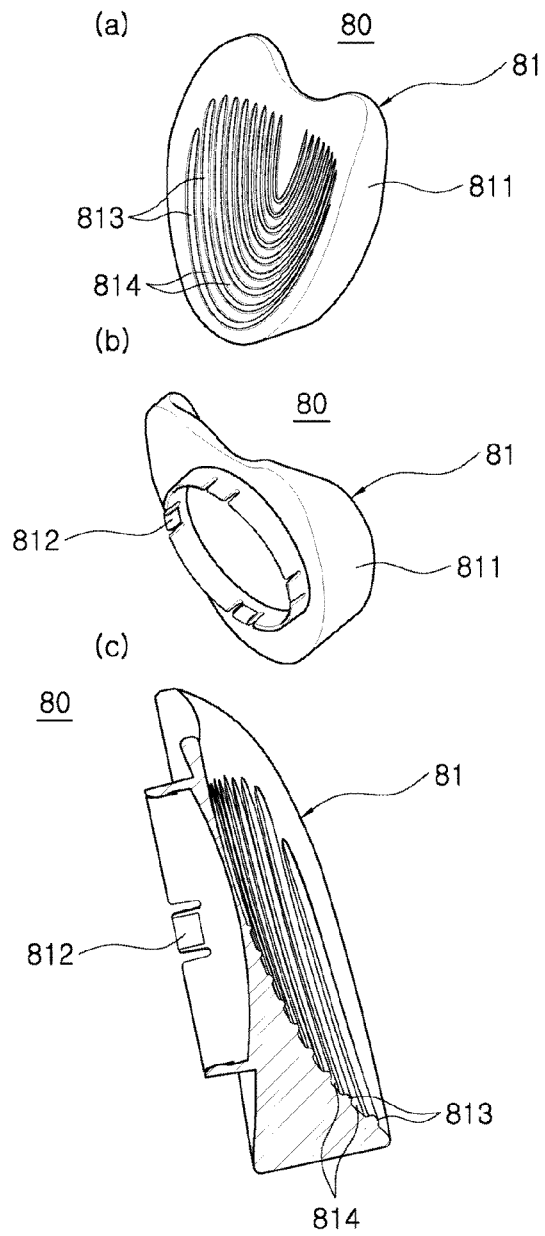
도면1



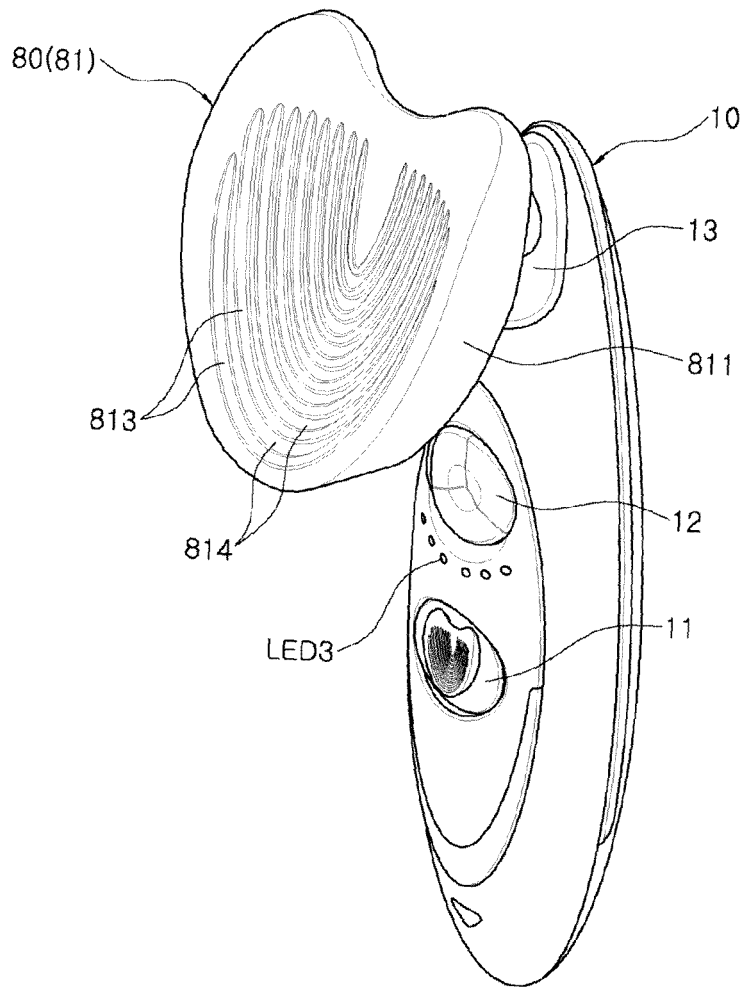
도면2



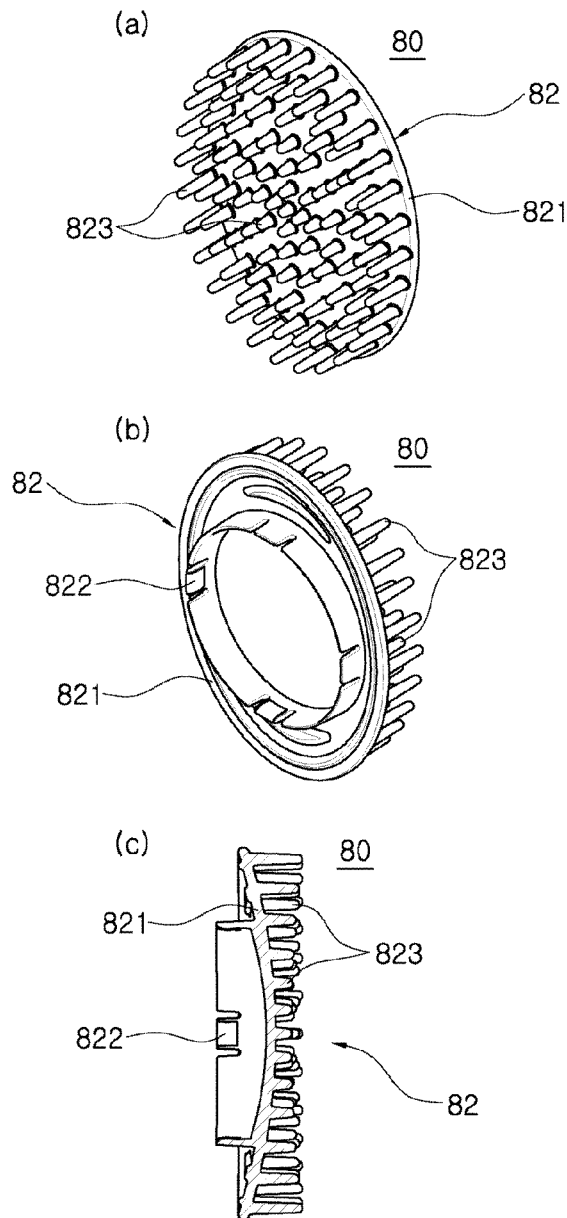
도면3



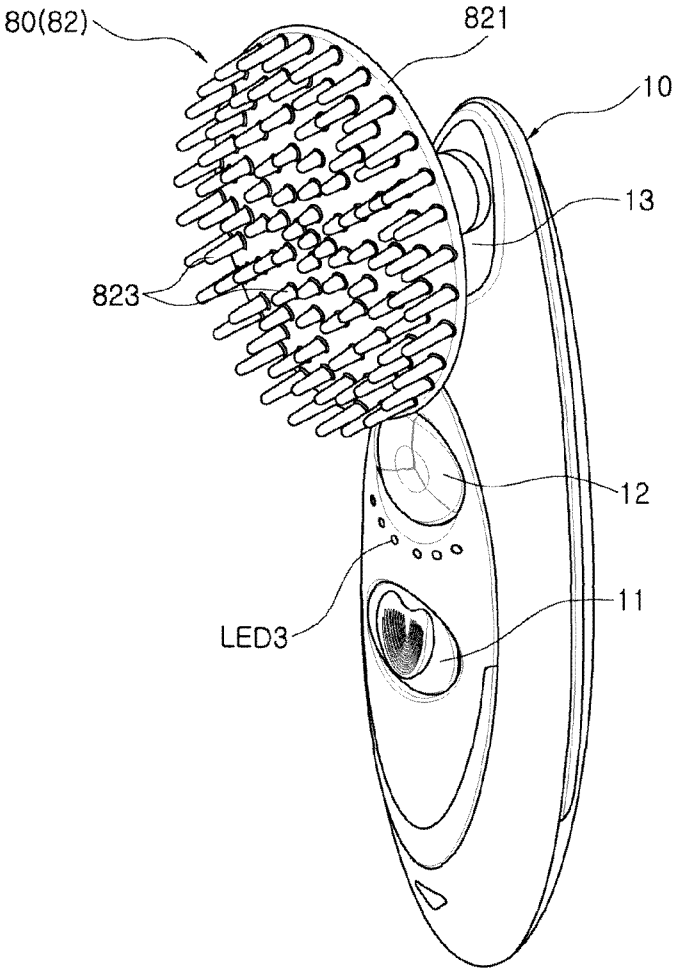
도면4



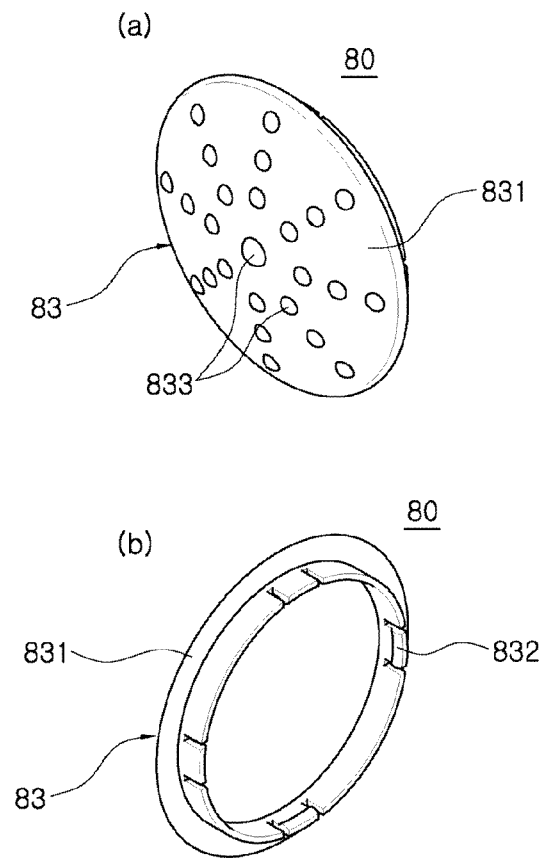
도면5



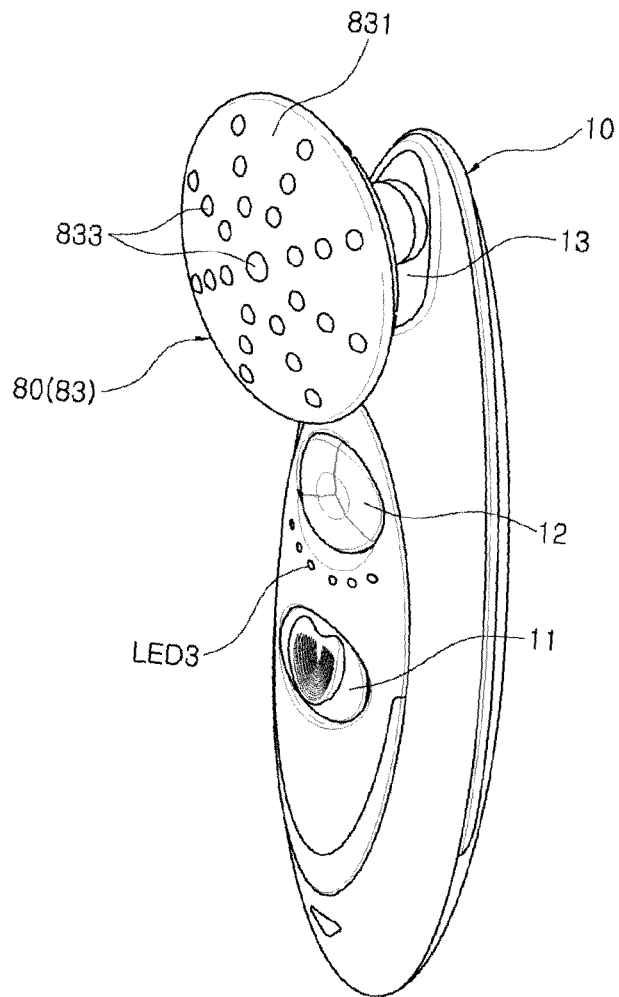
도면6



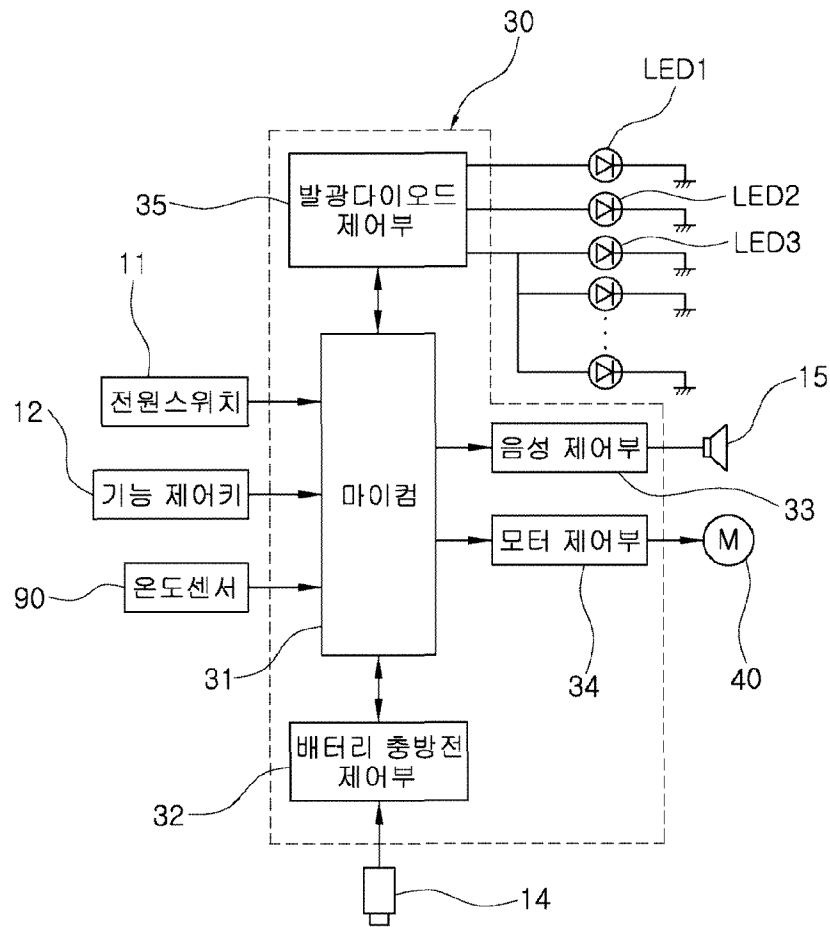
도면7



도면8



도면9



PATENT SPECIFICATION

(11) 1 293 876

1 293 876

DRAWINGS ATTACHED

- (21) Application No. 23495/70 (22) Filed 14 May 1970
(31) Convention Application No. 824449 (32) Filed 14 May 1969 in
(33) United States of America (US)
(45) Complete Specification published 25 Oct. 1972
(51) International Classification A61H 7/00
(52) Index at acceptance
A5R 81
A4K 14
H2H 8E1 8F



(54) POWER DRIVEN SKIN TREATING APPLIANCES

- (71) We, SUNBEAM CORPORATION, a corporation organized and existing under the laws of the State of Delaware, United States of America, of 5400 West Roosevelt Road, Chicago, Illinois 60650, United States of America, do hereby declare the invention for which we pray that a patent may be granted to us and the method by which it is to be performed, to be particularly described in and by the following statement:—
- This invention relates to power driven skin treating appliances.
- In our present affluent society, vast amount of money is spent on cosmetics and means for maintaining or preserving the beauty and the condition of a person's complexion. Although expensive creams and lotions have long been available for skin treatment, there have been no appliances which have been specifically developed for the skin or complexion care. Various types of pads and cloths have been used by women to apply soaps and lotions to their skin by hand. Because of the absence of any suitable equipment, many women simply apply soaps and lotions to their face and body using their hands or fingertips. Such an approach represents an unsatisfactory solution to the skin care problem since it is difficult for women of ordinary dexterity to apply soaps and lotions evenly and uniformly using the fingertips or some sort of pad or cloth.
- With the development of small, efficient, permanent magnet motors, it has been possible to produce compact, portable appliances suitable for many purposes. Through the utilization of the recently developed nickel cadmium rechargeable batteries, it has been possible to provide such small appliances which may be used safely for personal grooming and under conditions in which they may be subjected to water or other liquids. An outstanding example of one such appliance is the rechargeable battery operated electrical toothbrush which is in widespread use at the present time. Even as the toothbrush permits the user to perform a quicker and better cleaning job on the teeth, so a similar appliance is required to enable women to perform a better and more complete cleaning and treatment of their skin.
- According to one aspect of the invention there is provided a power driven skin treating appliance comprising an elongated housing which is tapered towards an implement mounting end, a skin treating implement adapted to be detachably supported with respect to said housing and having a shank arranged to overlap the implement mounting end of said housing, a motor mounted within said housing at the end remote from said implement mounting end, a drive lever pivotally mounted intermediate its ends within said housing with one end engageable with said implement within said shank and the other end drivingly connected to said motor, said lever being completely surrounded by said housing and said implement shank when the implement is engaged with said lever, and a power supply battery for said motor mounted in said housing between said motor and the pivotal mounting for said lever.
- According to another aspect of the invention there is provided a power driven skin treating appliance comprising a housing, a skin treating implement adapted to be detachably supported with respect to said housing and having a shank arranged to overlap one end of said housing, a motor mounted within said housing, a drive lever pivotally mounted about a transverse axis intermediate its ends within said housing with one end engageable with said implement within said shank and the other end drivingly connected to said motor, said lever being completely surrounded by said housing and said implement shank when engaged with said lever, and means for mounting a power supply battery for said motor in said housing.
- In one embodiment of the invention the switch for operating the motor may be arranged to be actuated when a lateral pressure is applied to the implement supporting lever. This actuation may be accomplished by means of supporting the lever bearing in a spring biased carrier which may be moved between a switch open and a switch closing

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position when the aforementioned lateral force is applied to the end of the implement supporting shaft.

5 As a means of avoiding actuation of the switch when skin treating implements are applied to or removed from the shaft, a simple button having a shaft restraining portion may be provided in the housing. This button permits the shaft to be restrained
10 against displacement during the time in which brushes or massage heads are applied to the appliance. This button may be such that it may be displaced to the inoperative position simply by applying a substantial force to
15 the skin treating implement or by moving the button by hand to a non-restraining position.

20 An object of the present invention is to provide an improved power operated skin treating appliance.

For a better understanding of the present invention reference may be made to the accompanying drawings in which:—

25 Figure 1 is a perspective view of a new and improved electrically operated skin treating appliance embodying the principles of the present invention;

30 Figure 2 is a vertical sectional view taken substantially through the vertical axis of the power handle of the appliance shown in Figure 1;

Figure 3 is an exploded perspective view of the internal mechanism of the appliance shown in Figures 1 and 2;

35 Figure 4 is an enlarged fragmentary sectional view of the drive mechanism which is also shown in Figure 2;

Figure 5 is a sectional view taken substantially on line 5-5 of Figure 4;

40 Figure 6 is an enlarged sectional view taken on line 6-6 of Figure 4;

Figure 7 is a fragmentary sectional view taken on line 7-7 of Figure 6;

45 Figure 8 is a fragmentary sectional view taken on line 8-8 of Figure 6;

Figure 9 is a fragmentary sectional view taken on line 9-9 of Figure 6;

50 Figure 10 is an enlarged sectional view taken substantially along line 10-10 of Figure 1;

Figure 11 is a sectional view similar to Figure 10 but with the control button shown in the off position;

55 Figure 12 is a fragmentary sectional view taken on line 12-12 of Figure 11;

60 Figure 13 is a fragmentary vertical elevational view of the appliance shown in Figure 1 with portions of the charging stand and the power handle shown in section for the purposes of illustration;

Figure 14 is a schematic diagram of the electrical circuit in the power handle and the charging stand;

65 Figure 15 is an enlarged fragmentary view taken on line 15-15 of Figure 3; and

Figure 16 is a sectional view of an alternative embodiment of the face and skin treating implement.

70 There is shown in Figure 1 of the drawings an electrically operated skin treating appliance designated generally by reference numeral 20. The appliance 20 includes a power handle 22, a charging stand 24, and at least one detachable skin treating implement
75 26. The skin treating implement 26 is provided with a brush back or bristle supporting head 28 from which a plurality of tufts or bristles 30 extend. The brush or implement 26 is designed to be moved in one plane in a substantially elliptical orbit by means of the mechanism to be described below which is
80 included in the power handle 22. The bristles 30 are made of soft, synthetic fibres so that they may be safely used in connection with skin treating without the danger of any irritation. The brush 26 is made in a configuration having an elliptical outline with the long dimension being about twice the shorter dimension. It has been found that such a brush configuration provides the
85 maximum convenience for cleaning the various areas and contours of the face, neck, etc. The brush is caused to move in an elliptical orbit in which the dimension of the orbit parallel to the long dimension of the brush is approximately $\frac{3}{16}$ of an inch while the size of the orbit parallel to the short dimension of the brush is approximately $\frac{1}{8}$ of an inch. Thus, the orbit through which the brush is moved is substantially similar to the elliptical shape of the brush itself. For the purpose of illustration, a dotted line showing of the shape of the orbit is included in Figure 1.

100 In order to provide a satisfactory power handle for producing the orbital motion of the treating implement 26, it is necessary to arrange the drive to the implement so that the power handle 22 will not be caused to oscillate rather than the implement 26. This requires a particular design to the power transmitting shaft and arrangement of the driving elements as will be more specifically described below.

115 The power handle 22 as best shown in Figure 2 includes an elongated housing 32 which is formed by a tapered member 34 having a substantially circular cross-section and a cup-shaped cap member 36. The housing member 34 is provided with a stepped flange 34a which cooperates with a flange 36a on the cap member 36 at their abutting edges to form an overlapping connection. A suitable cement or adhesive is applied in this area to seal the members 34 and 36 together in this area.

120 Within the sealed portion of the housing 32 is a rechargeable battery 38 and a low voltage direct current operated motor 40 which is adapted to operate from the battery 38. In
130

order to visualize the manner in which the motor 40 and the battery 38 are interrelated, reference should be made to Figures 3, 4 and 5 of the drawings. The motor 40 includes a cup-shaped housing 42 which is closed by means of a gear supporting frame 44. Joined to the gear supporting frame 44 and extending outwardly therefrom is a channel-shaped battery support 46 which at its outer end is joined to a forward bearing support 48. Battery support 46 is generally semicylindrical in shape and partially encloses the battery 38 as is shown in Figures 3, 4 and 5. The portion of the support 46 extending from the battery enclosing area to the supporting frame 44 includes three legs or struts 46a, 46b and 46c. The outer legs 46a and 46b are notched at 46d and 46e so that they may be hooked into engagement with projections 44a provided on the frame 44. A third projection 44b shown best in Figure 4 engages an opening in the center strut 46c to provide a rigid connection between the battery support 46 and the gear supporting frame 44. The projections 44a and 44c are staked or deformed over the adjacent portions of battery support 46 to increase the rigidity of the assembly.

The gear supporting frame 44 is a die-cast member which is substantially U-shaped having a pair of upwardly extending legs 44c and 44d which support a transversely extending shaft 50. The purposes of the shaft 50 is to support for rotation thereon a gear member 52. The gear member 52 is provided to drivingly connect the output of the motor 40 with an elongated power transmission lever or shaft 54. The motor 40 includes an output shaft 56 on which a spur gear 58 is secured. The gear member 52 is formed with a face gear 52a which is driven by the spur gear 58.

Positioned axially from the face gear 52a on the gear member 52, there are provided two separate cylindrical cams 52b and 52c. These cams 52b and 52c determine the orbit through which the skin treating implement 26 will move when it is connected to the outer end of the power shaft 54.

In order to relate the power shaft 54 with the gear member 52, the end of the lever 54 is provided with a double cam follower 60 which is best shown in Figures 3, 4 and 5. The interior of the cam follower 60 is provided with a recess within which the cams 52b and 52c extend. Cam follower surfaces 60a and 60b, as best shown in Figure 15, are rounded, rectangular openings which control the movement of the follower 60 during the rotation of the gear member 52. The interengaging cam and follower portions 52b and 60a control the movement of the lever 54 lengthwise thereof, whereas the cam 52c and follower surface 60b control the lateral movement of the follower 60.

The outermost end of the follower 60 is formed with a guide portion 60c which slides between the projection 44d and a guide wall 44e. The guide 60c in its sliding engagement with the frame 44 assures adequate support for the inner end of the lever 54 as force or pressure is applied to the skin treating implement 26. The gear member 52 and the co-operating follower 60 are made of a suitable plastics material which will have the necessary bearing qualities for such an application. In one constructed embodiment of the invention, an impregnated, nylon material was used.

The follower 60 is molded into the outer end of the shaft 54 with a clearance opening 60d being provided for the gear shaft 50 to extend therethrough.

The power transmitting lever or shaft 54 is made up of a forwardly extending rod portion 54a and a formed U-shaped portion 54b. The U-shaped portion 54b extends alongside of the battery 38 and serves to drivingly interconnect the gear member 52 with the rod portion 54a which is axially disposed within the power handle 22. The rod portion 54a is received in a bearing 62 which is positioned on the bearing support 48. In order to retain the bearing support 48 in assembled relationship with the battery support 46, the bearing support 48 is formed with integrally molded flanges 48a and 48b which snugly receive the forward end of the battery support 46 which is the end remote from the motor 40. A third projection 48c on the bearing support 48 engages the interior of the semicylindrical battery support 46 to insure a rigid connection between the parts. The inward projections 48d on the flanges 48a and 48b snap behind projections 46g on the battery support to restrain the bearing support 48 against axial movement with respect to the battery support 46. The manner in which the projections 48a, 48b and 48c interlock with the battery support 46 is best shown in Figures 3, 5 and 6. This provides a simple and inexpensive means of assembling the supports 46 and 48 relying simply on the resilience of the battery support 46 to retain the parts against disassembly.

The above described bearing 62 for the lever 54 is mounted on the bearing support 48 in such a way that it may slide a limited distance along a line generally parallel to the pivotal axis of the lever 54. This mounting is accomplished by means of a bearing carrier 64 which is provided with a plurality of resilient fingers 64a which snap into retaining engagement with the spherical bearing 62, as is best shown in Figure 7. The carrier 64 on the side thereof away from the bearing 62 is formed with a pair of T-shaped extensions 65 and 66. These T-shaped extensions 65 and 66 extend through slots 67 and 68 in the bearing support 48. While the slots 67

and 68 are shown in Figures 6 and 7, the sectional view of Figure 8 illustrates in detail the manner in which one of the T-shaped extensions, namely 66, is received and guided in the slot 68. In order to insert the ends of the T-shaped extensions 65 and 66 through the bearing support 48 so that the enlarged ends are on the opposite side of the support from the bearing 62, clearance openings 70 and 71 are provided. In assembling the carrier 64 to the bearing support 48, the T-shaped extensions 65 and 66 are inserted through the clearance openings 70 and 71, and the carrier 64 is then displaced laterally so that the extensions 65 and 66 are positioned within the slots 67 and 68 with the enlarged portions positioned behind the bearing support 48, as best shown in Figure 8.

So as to limit displacement of the carrier 64 in its sliding movement with respect to bearing support 48, a stop member 72 is assembled into obstructing relationship with respect to the lower clearance opening 71. Figures 6, 7 and 9 show clearly the manner in which the stop member 72 is positioned within the clearance opening 71. The hook-shaped resilient legs 72a and 72b on the stop member 72 are forced into retaining engagement with the edges of the clearance opening 71 as best shown in Figure 9. With the stop member 72 assembled to the bearing support 48, the carrier 64 is mounted for a small amount of sliding movement in a direction parallel to the slots 67 and 68.

The purpose of this limited movement is to actuate a switch 74 which is mounted on the inner face of the bearing support 48, as is clearly shown in Figures 6 and 7. The switch 74 consists of two L-shaped contact members 75 and 76 which are mounted on the bearing support 48 by means of rivets 77 with the free ends of the contact members 75 and 76 extending into an overlapping relationship, as is shown in Figure 6.

Under normal conditions, when the carrier 64 is in its disengaged position with respect to switch 74, the contact members 75 and 76 are formed and mounted so that their overlapping ends are spaced apart, as shown in Figure 4. The carrier 64 is biased to this disengaged position by means of a coil spring 78 which is positioned in the slot 67 and supported on axially extending protuberances formed on the bearing support 48 and the carrier 64. As shown in Figures 4, 6 and 7, the spring 78 biases the carrier 64 downwardly into engagement with the stop member 72. In this position, the contact members 75 and 76 are spaced apart, and the switch 74 is, therefore, in its open position even though the carrier 64 is engaged with the contact member 75. When a force is applied upwardly against the outer or exposed end of the lever 54, as shown in Figure 7 by an

arrow, the carrier 64 is urged upwardly in the slots 67 and 68 overcoming the biasing force of the spring 78.

An actuating projection 79 on the T-shaped extension 66 of the carrier 64 is in continuous engagement with the contact member 75, and when the carrier 64 is urged upwardly, the projection 79 forces contact member 75 upwardly into engagement with the contact member 76. Although not shown in the drawings, suitable leads are provided to interconnect motor 40, battery 38, and switch 74. As shown in the schematic drawing of Figure 14, the closing of the switch 74 connects the motor 40 in series with the battery 38 causing the motor 40 to operate. It should be evident that the purpose of the switch 74 and the movable carrier 64 is to provide a means whereby the appliance 20 may be actuated by merely placing the skin treating implement 26 against the face or skin of the user thereby deflecting the shaft 54 as the carrier 64 moves in opposition to the biasing spring 78. The motor 40 will then continue to operate until such time as the appliance 20 is moved away from the skin and there is no longer any force applied to the implement 26. At this point, the biasing spring 78 will again return the carrier 64 to a position in which the contact members 75 and 76 are spaced apart thereby opening the circuit between the battery 38 and the motor 40.

In view of the fact that the appliance 20 is used in applying soaps, creams, and other liquids to the skin, it is important that the internal parts including the battery 38 and the motor 40 be sealed against the entrance of moisture. As was indicated above, the cap member 36 is sealed to the tapered cylindrical housing member 34 by a suitable adhesive or cement. The front or upper end of the housing 32 is formed with a clearance opening 80 which is sufficiently large to provide clearance for the oscillatory movement of the shaft 54 as well as the deflection permitted by the movement of carrier 64. Because of the amount of movement of the shaft 54 in the area of the opening 80, it would be difficult to provide a tight seal on the shaft 54 at that point. Accordingly, the interior mechanism of the appliance 20 is sealed against the entrance of moisture at a point close to the pivot point of lever 54 by a gasket 82 which is clamped between the bearing support 48 and an annular shoulder 83 formed on the interior of the tapered housing member 34.

The gasket is a molded rubber part having a thick outer rim 82a which is gripped between the bearing support 48 and the housing member 34 at shoulder 83, an intermediate thin-walled connecting portion 82b, and an axially elongated hub portion 82c which engages the shaft 54a and is received within a

5 reduced diameter portion 84, as best shown in Figure 4. The gasket 82 is sufficiently resilient in the area of the intermediate connecting portion 82b to permit limited axial and pivotal movement of the shaft 54 in the bearing 62. The gasket 82 thus forms with the lower two thirds of the cylindrical housing member 34 and the cap member 36 an enclosure for a sealed chamber 85 within which the motor 40 and the battery 38 are positioned.

10 The upper portion of the housing member 34 extending from the gasket 82 to the end opening 80 forms a protective shroud or covering for the otherwise exposed end of the shaft 54. In addition, the outermost end of the housing member 34 is formed with an upstanding flange 86 which extends into an opening 87 formed in supporting shank 88 of the skin treating implement 26. As is evident from the showings in Figures 2 and 12 of the drawings, the overlapping relationship between the shank 88 and the flange 86 provide an arrangement in which liquid is essentially prevented from entering into the opening 80 because of the tortuous path it must follow to accomplish such entry. Any liquid soap or cream which runs down the shank 88 of the implement 26 tends to run off the bottom of the shank onto the power handle 22 and has no tendency to move inwardly over the flange 86 and into the interior of the housing member 34. This provides a type of baffling which maintains the forward third of the housing 32 reasonably free of liquids thereby placing little demand on the sealing functions provided by the gasket 82.

40 The outer end of the shaft 54 is formed with a flattened portion 90 and circumferential groove 91. The flattened portion 90 cooperates with a correspondingly shaped opening or recess in the implement 26 to key the implement to a selected position when it is assembled to the power handle 22 whereby the bristles 30 face in a particular radial direction with respect to shaft 54. The circumferential groove 91 cooperates with deflectable nibs 92 formed on the implement 26 to detachably retain the implement 26 assembled to the shaft 54. This provides an arrangement where the implement 26 may be readily assembled to or disassembled from the shaft 54 and whereby it will always be assembled so that the bristles 30 will be facing in a proper direction so that forces on the shaft 54 will actuate the switch 74.

55 For the purpose of restraining the shaft 54 during the mounting or dismounting of implements 26, a shaft restraining member 95 is provided in the forward end of the housing 32. The tapered housing member 34 is formed with an opening 96 which is aligned with a larger opening 97 formed at the opposite walls thereof. The openings 96 and

97 are designed to receive and support the shaft restraining member 95, as is best shown in Figures 10 and 11. The member 95 is formed with an enlarged actuating button 98 which is exposed at the front of the handle 22 and a smaller holding button 99 exposed at the back of the handle 22. The central portion of the restraining member 95 is formed with a large clearance opening 100 through which the shaft 54 extends. In addition, there are detent projections 101 on the member 95 which cooperate with the walls of the housing member 34 to hold the button in either of the two positions shown in Figures 10 and 11.

80 When it is desired to apply or remove an implement 26 from the power handle 22, the holding button 99 is depressed forcing the restraining member 95 to the position shown in Figure 11. In this position, the shaft 54 abuts against the side of the clearance opening 100 and is restrained from moving in a direction which would close the switch 74 and energize the motor 40. Thus, implements may be applied to and removed from the shaft 54 without actuating the switch 74 as long as the restraining member 95 is in the position shown in Figure 11. When it is desired to use the appliance 20 in treating the skin, the actuating button 98 is pushed rearwardly displacing the member 95 to the position shown in Figure 10. In this position, the hole 100 provides sufficient clearance for the shaft 54 to be deflected to a position in which the switch 74 is closed thereby energizing the motor 40. In addition, the hole 100 provides sufficient lateral clearance so that the shaft portion 54a may move in a plane perpendicular to the direction of movement of the member 95 so as to cause the implement 26 to move in its orbital path. It should also be noted that the member may be displaced from its holding position as shown in Figure 11 to the operating position as shown in Figure 10 by merely applying sufficient force on shaft 54 to overcome the action of detent projections 101. In some instances, this approach may be more convenient than displacing member 95 by pushing actuating button 98.

115 It should be readily appreciated that as the lever 54 moves axially and pivots about the bearing 62, the forward portion 54a of the lever 54 pivots sufficiently to produce the three sixteenths lateral movement discussed above in connection with the orbit of the implement 26. The motor speed and reduction produced in the gear member 52 is such that the shaft 54 in one constructed embodiment oscillates or defines the orbital movement of the implement 26 at the rate of 1800 times per minute. Because of the speed and extent of this oscillation, it is desirable to have the forward portion 54a of the lever 54 enclosed within the housing member 34 so

that it will not be in a position to strike or bruise sensitive areas of the face and head when the bristles 30 of the implement 26 are being applied to the face, neck, etc. In addition, by having the housing 22 made in an elongated form and extending all the way to the shank portion 88 of the implement 26, the user is given more latitude and freedom in the manner in which the power handle 22 is gripped when applying the implement 26 to the skin of the body. This advantage is, of course, extremely important since there are some instances when reaching a remote portion of the back that one may desire to hold the power handle 22 adjacent the cap member 36 while when delicately cleaning a portion of the face, between the nose and eyes for instance, the handle 22 may be held closely adjacent the implement mounting end of the power handle 22 so as to more accurately direct and control the location of the bristles 30.

In Figure 16, there is shown an alternative embodiment of the skin treating or conditioning implement 26 designated as a massage implement 105. The implement 105 is similar to the implement 26 in that it has an elliptical back 106 and a shank 107 which is provided with means identical to those on implement 26 for receiving the end of shaft 54 and connecting the implement 105 thereto. The face of the implement 105 is formed with a recess 108 which occupies essentially the same area as the tufts or bristles 30 in the implement 26. Within the recess 108, there is mounted a hollow blow-molded polyethylene plastics container 109 which is filled with water or any other freezable liquid which would be liquid at room temperature and easily frozen in a household freezer. In enclosing relationship with the container 109 is a drawn aluminium cup 110 which is adhesively secured at its edges 111 to the walls of the recess 108. The other surface of the cup 110 is smooth and polished so that it may be applied to the face and skin without causing any scratching or irritation.

The implement 105 is intended to be placed in a freezing compartment prior to use so that the water enclosed in the polyethylene container 109 is completely frozen. Then, upon removing the implement 105 from the freezer and applying it to the face while driven by the power handle 22, the implement 105 provides a stimulating facial treatment by virtue of the heat transfer which occurs from the face through the aluminium cup 110 to the container 109 with its frozen contents. This type of treatment is recommended to close the skin pores during various types of beauty treatment. The elliptical, orbital movement of the massage implement 105 increases the effectiveness of the cold treatment or conditioning of the skin. For simple massaging without heat or cold treat-

ment, a third implement has been provided having the same shape as implement 105 but having a rubber cup rather than aluminium cup 110.

To permit the power handle 22 to be completely sealed against the entrance of moisture, charging means for recharging the battery 85 have been employed which avoid the necessity for having any contacts or conductors extending through the walls of the power handle 22. These charging means involve the use of an induction coupling between an external charging circuit 113 enclosed in the charging stand 24 and an internal charging circuit 115 sealed within the power handle 22. The internal charging circuit 115 includes a secondary coil 116 of a charging transformer. The charging transformer also includes a primary coil 118 which is positioned in the charging stand 24. As is best shown in Figures 2 and 13, the secondary coil 116 is made up of a bobbin or core 119 of permeable material having its axis coextensive with the axis of the power handle 22 and having windings 120 positioned thereon. The core or bobbin 119 comprises a cup-shaped upper member 119a which is formed of a magnetically permeable material and is secured to a lower circular wall 119b of the bobbin by a magnetically permeable hub 119c. The cup-shaped member 119a is formed with side walls 119d which are snugly received against the inside walls of the cap member 36. The upper edges of the side walls 119d engage a plastic spider 122 which in turn engages a retainer 121 and the motor 40. Both the spider 122 and retainer 121, which are best shown in Figures 2 and 3, position the motor against lateral displacement and also retain the parts in their relative axial positions. The retainer 121 includes three upwardly projecting legs 121a which are formed with barbs 121b. These barbs 121b dig into the side walls of housing member 34 and retain the motor and battery assembly therein during assembly of cap member 36. Between the spider member 122 and the upper wall 119a of the bobbin 119, there is located a rectifier 123 which is connected in circuit with the secondary coil 116 in the manner shown in the schematic drawing of Figure 14.

The external charging circuit 113 consists of a power cord 124 and the above mentioned primary coil 118 to which the cord is connected. The coil 118 is completely encapsulated in plastic to minimize shock hazards in connection with the use of the appliance 20. The encapsulated primary coil 118 is completely enclosed within a magnetic flux conducting enclosure 125 which is formed by two interfitting cup-shaped members 126 and 127 made of a magnetically permeable material, such as cold rolled steel. The lowermost of these two cup-shaped

members, designated as by reference numeral 127, has a flat bottom wall 127a and a narrow upstanding peripheral side wall 127b. Received within the side walls 127b in overlapping relationship are the downwardly extending side walls 126a of the cup-shaped member 126. The member 126 is formed with a large opening 126b at the centre thereof defined by upstanding flange 126c. The flange 126c is positioned to closely receive the cap member 36 on the power handle 22 as the power handle is rested in the charging stand 24. The primary coil 118 also has a central opening 118a which receives the cap member 36, as is best shown in Figure 13.

When the power handle 22 is in the charging position in the stand 24, as shown in Figure 13, the cap member 36 rests within the enclosure 125 with the bottom thereof against the centre portion of the cup-shaped member 127. This places the primary coil 118 and the second coil 116 in a nested relationship to provide the maximum coupling of magnetic flux between the two coils of the transformer. The cap member 36 is made of minimum wall thickness in the area between the lower wall 119b of the core 119 and the cup-shaped member 127 which makes up part of the enclosure for the primary coil 118. In addition, the wall thickness of the cap member 36 is at a minimum in the area of the upstanding wall 119d of the core 119 and the adjacent wall 126c on the upper cup-shaped member 126 of the coil enclosure 125. This arrangement minimizes the reluctance in the gaps between the metallic flux conducting members associated with the primary and secondary coils of the transformer 117. As a consequence, there is good coupling between the primary coil 118 and secondary coil 116. Thus, the charging of the battery 38 is accomplished by merely inserting the power handle 22 into the charging stand 24 where the primary and secondary coils 118 and 116 of the transformer will be inductively coupled to supply a charging current in the internal charging circuit 115. The rectifier 123 provides a half wave charging current to the battery 38.

The housing portion of the charging stand 24 consists merely of two plastics molded parts, an upper housing member 24a, and a lower housing member 24b which are suitably secured together by assembly screws. In the assembled position, the upper housing member 24a has a downwardly directed wall 24c which engages the coil enclosure 125 and clamps it against the lower housing member 24b. This provides a structurally simple and attractive charging stand which supports and cradles the power handle 22 and positions it so that the internal charging circuit 115 is inductively coupled to the external charging circuit 113 in order that the battery 38 may be charged.

WHAT WE CLAIM IS:—

1. A power driven skin treating appliance comprising an elongated housing which is tapered toward an implement mounting end, a skin treating implement adapted to be detachably supported with respect to said housing and having a shank arranged to overlap the implement mounting end of said housing, a motor mounted within said housing at the end remote from said implement mounting end, a drive lever pivotally mounted intermediate its ends within said housing with one end engageable with said implement within said shank and the other end drivingly connected to said motor, said lever being completely surrounded by said housing and said implement shank when the implement is engaged with said lever, and a power supply battery for said motor mounted in said housing between said motor and the pivotal mounting for said lever.

2. An appliance according to claim 1 wherein said motor is arranged to drive said lever through a gear and cams which reciprocate said lever along its axis and oscillate said lever about the pivotal mounting thereof, said reciprocation and oscillation of said lever causing said implement, when engaged with said lever, to move through an elliptical orbit.

3. An appliance according to claim 1 or 2 wherein said implement includes a skin treating head carried on a short shank so that, when said implement is engaged with said lever, said head is supported closely adjacent the tapered end of said housing, said housing having a reduced diameter flange at the opening from which said lever extends out of said housing, said shank having a flange which when said implement is engaged with said lever, overlaps said housing flange but is spaced radially therefrom to permit said implement to move through an elliptical orbit.

4. An appliance according to claim 1, 2 or 3 including a sealing gasket embracing said lever adjacent its pivotal mounting and clamped at its periphery into sealing engagement with the interior of the housing, the end of said housing remote from said implement mounting end being sealed to provide a sealed enclosure for said battery and said motor.

5. An appliance according to any one of the preceding claims wherein said lever includes a rod portion which is axially disposed within said housing and extends through the pivotal mounting for connection with said implement, said lever also including a connecting portion which extends from said rod portion into driving connection with said motor, said connecting portion being U-shaped and straddling said battery.

6. An appliance according to any one of the preceding claims wherein said battery is a rechargeable battery.

5 7. An appliance according to claim 6 including induction charging means for said battery, said charging means including a primary coil mounted within a charging stand and having a centre opening for receiving the end of said housing remote from the
10 the implement mounting end, a magnetically permeable enclosure surrounding said primary coil and having an opening surrounded by a flux coupling flange, said enclosure opening being coextensive with said coil opening, a secondary coil in said housing at said remote end remote from the implement mounting end connected in circuit with said
15 battery, said secondary coil having a permeable core with a cup-shaped upper wall having side walls which are in closely spaced relationship with said enclosure flange when said housing is disposed in said charging stand.

25 8. An appliance according to anyone of the preceding claims wherein the lever is pivotally mounted within a bearing.

30 9. An appliance according to claim 8 wherein said motor is controlled by a switch positioned within said housing, a movable carrier supporting said bearing, said switch being positioned to be actuated by said carrier, a spring biasing said carrier to a position in which said switch is open, said carrier being movable to a switch closing position by the application of force to said implement, when engaged with said lever, so as to overcome said spring biasing force.

40 10. An appliance according to claim 9 wherein said carrier is arranged for limited rectilinear movement in a direction perpendicular to the plane of oscillation of said lever.

45 11. An appliance according to claim 9 or 10 including immobilizing means for holding said lever against deflecting said carrier to a switch closing position during the assembly and disassembly of said implement to and from said lever.

50 12. An appliance according to claim 11 wherein said immobilizing means comprises a member extending through said housing and providing exposed portions which may be utilized to push the member to either of two positions, said lever in one of said
55 positions being unrestrained while in the other position said lever is restrained against deflecting said carrier to a switch closing position.

60 13. An appliance according to claim 12 wherein said member is provided with a detent to retain said member in either one or

the other of said positions, said lever being operable to move said member from said other position to said one position when sufficient force is applied to said implement to overcome the resistance of said detent.

14. An appliance according to any one of claims 8 to 13 wherein said motor and said battery are both of cylindrical shape supported within said housing, and including a semicylindrical channel-shaped frame extending lengthwise in said housing and connected to said motor at one end and to a lever bearing support at the other end, said battery being received within said frame between said motor and said bearing support.

15. An appliance according to claim 14 together with claim 2 wherein said motor is provided with an integral support for said gear and cams, said frame being secured at one end to said integral support, and a guide on said integral support receiving one end of said lever and supporting it for movement in an elliptical orbit.

16. An appliance according to any one of the preceding claims wherein said implement comprises a brush having bristles the free ends of which lie when said implement is engaged with said lever, in a plane parallel to the axis of said lever and which define an orbital area similar in peripheral configuration to the path through which said brush is driven by said lever.

17. An appliance according to any one of claims 1 to 15 wherein the implement comprises a rigid molded plastics supporting head having a shank extending therefrom to couple the implement to said lever, said head having a recess therein defined by a flat bottom and side walls extending perpendicular to said bottom, a blow-molded polyethylene sealed container which is filled with a freezable liquid, said container being snugly received in said recess with a smooth rounded portion extending outwardly from said head, a drawn aluminium cup-shaped member fitting snugly around said container with its peripheral side walls received in said recess and cemented to side walls of said recess.

18. A power driven skin treating appliance comprising a housing, a skin treating implement adapted to be detachably supported with respect to said housing and having a shank arranged to overlap one end of said housing, a motor mounted within said housing, a drive lever pivotally mounted about a transverse axis intermediate its ends within said housing with one end engageable with said implement within said shank and the other end drivingly connected to said motor, said lever being completely surrounded by said housing and said implement shank when engaged with said lever, and means for

mounting a power supply battery for said motor in said housing.

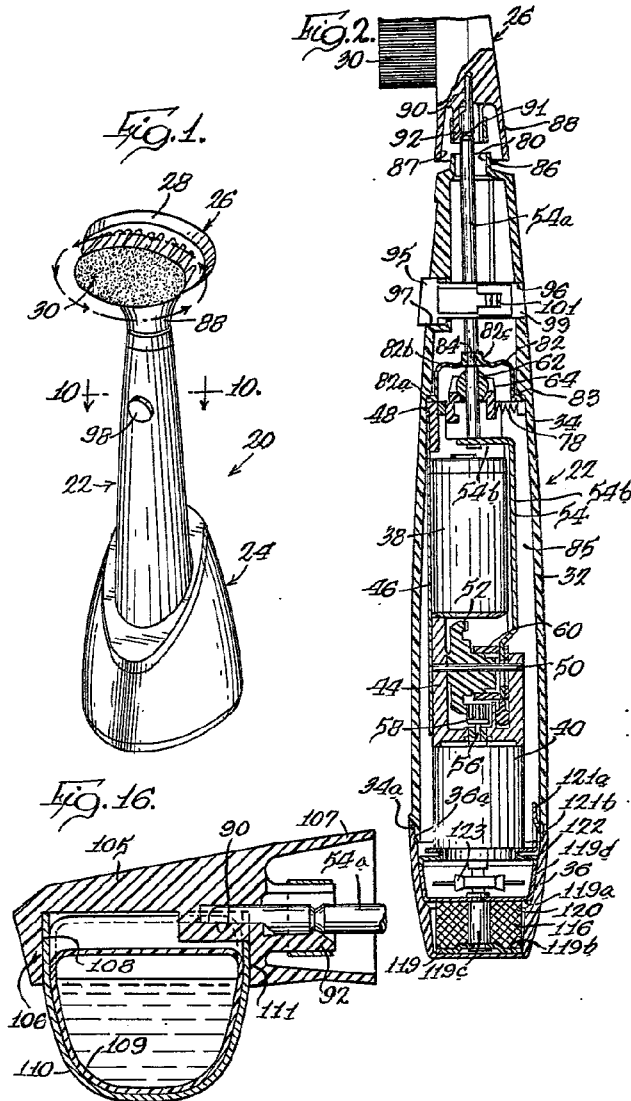
- 5 19. A power driven skin treating appliance substantially as shown in and as hereinbefore described in relation to the accompanying drawings.

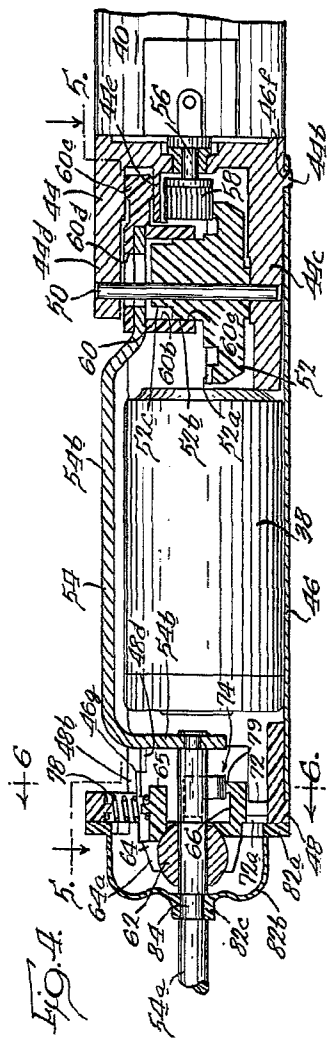
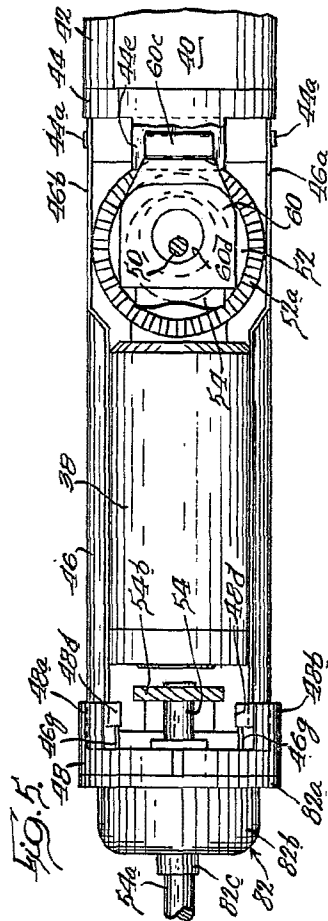
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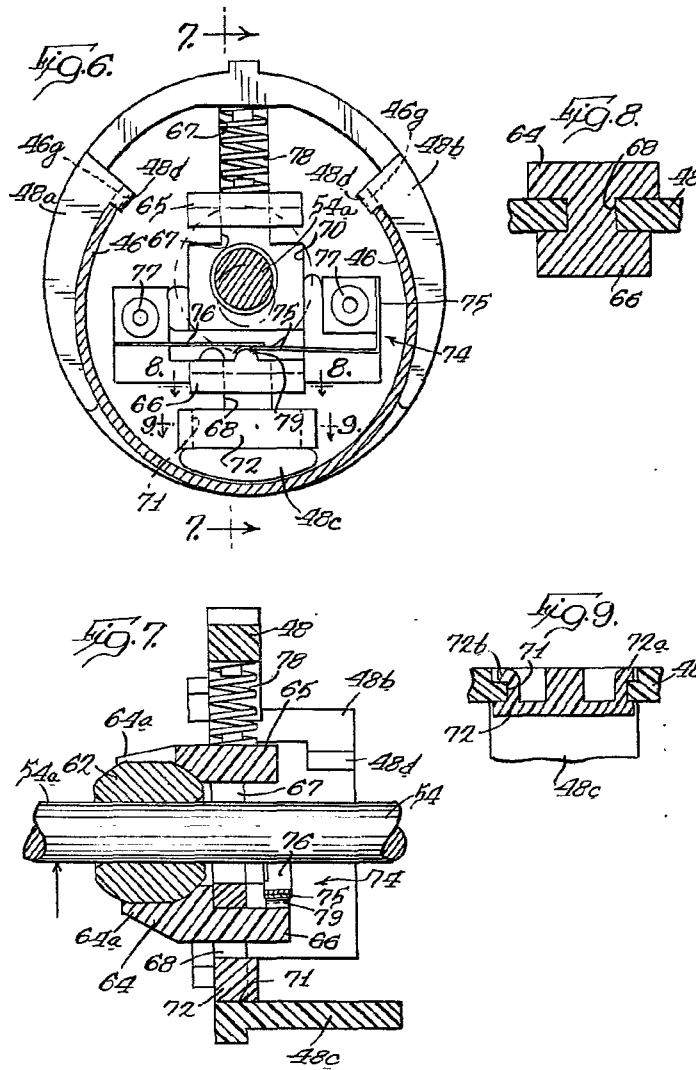
(9598)

Printed in Scotland by Her Majesty's Stationery Office
at HMSO Press, Edinburgh, 1972.

Published by The Patent Office, 25 Southampton Buildings, London, WC2A 1AY,
from which copies may be obtained.









(12) **EUROPEAN PATENT APPLICATION**

(43) Date of publication:
31.08.2016 Bulletin 2016/35

(21) Application number: **16157574.1**

(22) Date of filing: **26.02.2016**

(51) Int Cl.:

H01M 10/6554 ^(2014.01)	H01M 10/6551 ^(2014.01)
H01M 10/658 ^(2014.01)	H01M 10/613 ^(2014.01)
H01M 10/6235 ^(2014.01)	H01M 2/10 ^(2006.01)
A61B 17/072 ^(2006.01)	A61B 17/16 ^(2006.01)
B25F 3/00 ^(2006.01)	B25F 5/00 ^(2006.01)

(84) Designated Contracting States:
AL AT BE BG CH CY CZ DE DK EE ES FI FR GB GR HR HU IE IS IT LI LT LU LV MC MK MT NL NO PL PT RO RS SE SI SK SM TR
Designated Extension States:
BA ME
Designated Validation States:
MA MD

(30) Priority: **27.02.2015 US 201514633542**

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(54) **REINFORCED BATTERY FOR A SURGICAL INSTRUMENT**

(57) A battery assembly is disclosed which includes a housing and one or more battery cells position in the housing. The battery assembly further comprises features configured to absorb an impact force and protect

the battery cells. The battery assembly further comprises features configured to accommodate the thermal expansion of the battery cells.

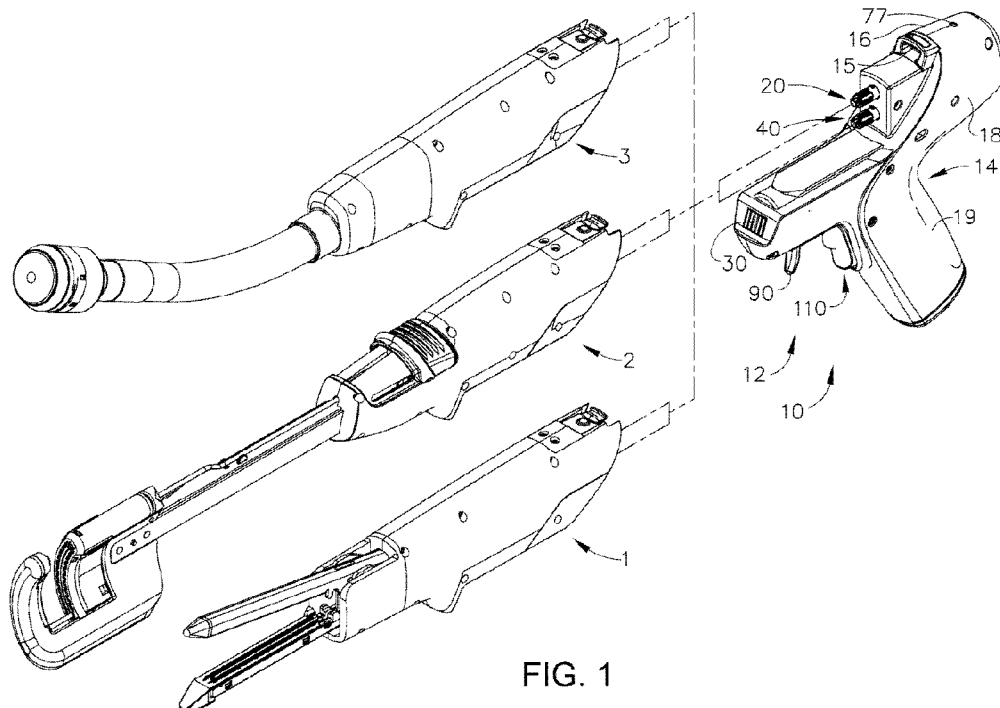


FIG. 1

Description**BACKGROUND**

- 5 [0001] The present invention relates to surgical instruments and, in particular, to surgical stapling and cutting instruments and staple cartridges for use therewith.
- [0002] A stapling instrument can include a pair of cooperating elongate jaw members, wherein each jaw member can be adapted to be inserted into a patient and positioned relative to tissue that is to be stapled and/or incised. One of the jaw members can support a staple cartridge with at least two laterally spaced rows of staples contained therein, and the other jaw member can support an anvil with staple-forming pockets aligned with the rows of staples in the staple cartridge. Generally, the stapling instrument can further include a pusher bar and a knife blade which are slidable relative to the jaw members to sequentially eject the staples from the staple cartridge via camming surfaces on the pusher bar and/or camming surfaces on a wedge sled that is pushed by the pusher bar. The camming surfaces can be configured to activate a plurality of staple drivers carried by the cartridge and associated with the staples in order to push the staples against the anvil and form laterally spaced rows of deformed staples in the tissue gripped between the jaw members. The knife blade can trail the camming surfaces and cut the tissue along a line between the staple rows. Examples of such stapling instruments are disclosed in U.S. Patent No. 7,794,475, entitled SURGICAL STAPLES HAVING COMPRESSIBLE OR CRUSHABLE MEMBERS FOR SECURING TISSUE THEREIN AND STAPLING INSTRUMENTS FOR DEPLOYING THE SAME, the entire disclosure of which is hereby incorporated by reference herein.
- 10 [0003] The foregoing discussion is intended only to illustrate various aspects of the related art in the field of the invention at the time, and should not be taken as a disavowal of claim scope.

BRIEF DESCRIPTION OF THE DRAWINGS

- 25 [0004] Various features described herein, together with advantages thereof, may be understood in accordance with the following description taken in conjunction with the accompanying drawings as follows:
- FIG. 1 is a perspective view of a modular surgical system including a motor-driven handle module and three interchangeable detachable shaft modules;
- 30 FIG. 2 is a side perspective view of the handle module of FIG. 1 with a portion of the handle housing removed for clarity;
- FIG. 3 is a partial exploded assembly view of the handle module of FIG. 1;
- 35 FIG. 4 is another partial exploded assembly view of the handle module of FIG. 1;
- FIG. 5 is a side elevational view of the handle module of FIG. 1 with a portion of the handle housing removed;
- FIG. 6 is an exploded assembly view of a mechanical coupling system for operably coupling the rotary drive systems of the handle module of FIG. 1 to the drive systems of a detachable shaft module;
- 40 FIG. 7 is a block diagram depicting electrical components of the handle module of FIG. 1 and the detachable shaft module;
- 45 FIG. 8 is a diagram of a process flow executed by a handle processor of the handle module of FIG. 1 to determine when the handle module reaches its end of life;
- FIG. 9 is another diagram of a process flow executed by the handle processor of the handle module of FIG. 1 to determine when the handle module reaches its end of life;
- 50 FIG. 10A is a chart showing differences between the expected firing and retraction forces to be applied by the handle module of FIG. 1 and the actual firing and retraction forces applied by the handle module as a function of the stroke of the shaft module;
- 55 FIG. 10B is a diagram of a process flow executed by the handle processor of the handle module of FIG. 1 to determine when the handle module reaches its end of life based on the differences between the expected firing and retraction forces to be applied by the handle module of FIG. 1 and the actual firing and retraction forces applied by the handle module;

FIG. 10C is a diagram of a process flow executed by the handle processor of the handle module of FIG. 1 to determine when the handle module reaches its end of life based on the energy expended by the handle module during use, in aggregate, and the energy expended by the handle module during each use;

5 FIG. 10D is a chart showing an example of the energy expended by the handle module over a number of device activations, in aggregate;

FIG. 10E is a chart showing an example of the power expended during each activation of the handle module of FIG. 1;

10 FIGS. 11A and 11B illustrate a sterilization tray in which a handle module may be inserted for sterilization;

FIGS. 11C and 11D illustrate a sterilization tray in which a handle module and a detachable shaft module may be inserted for sterilization;

15 FIG. 11E illustrates another sterilization tray in which a handle module may be inserted for sterilization;

FIGS. 11F, 11G, 11H, and 11I illustrate aspects of the sterilization tray of FIG. 11E interfacing with a handle module;

20 FIGS. 12A, 12B and 12E illustrate an inspection station for inspecting a handle module before, during, and/or following a surgical procedure;

FIG. 12C is a block diagram of the inspection station and the handle module;

25 FIG. 12D is a diagram of a process flow executed by the handle processor of the handle module to determine when the handle module reaches its end of life based on a number of times the handle module is placed on the inspection station;

30 FIG. 13A is a block diagram illustrating aspects of a handle module and a removable battery pack, where the battery pack includes an identification emitter so that the handle module can identify the battery pack;

FIG. 13B illustrates a process flow executed by the handle processor of the handle module of FIG. 13A to determine when the handle module reaches its end of life based on a number of times a battery pack has been installed in the handle module;

35 FIGS. 14A, 14B, and 14C illustrate aspects of a handle module that detects the attachment of a detachable shaft module thereto;

FIG. 14D illustrates a handle module and a detachable shaft module, where the handle module detects attachment of the detachable shaft module thereto;

40 FIG. 14E illustrates the handle module of FIG. 14D, where the handle module also detects attachment of a removable battery pack;

45 FIGS. 14F and 14G illustrate a sensor for the handle module of FIG. 14D to detect the insertion of a removable battery pack therein;

FIGS. 15A and 15B illustrate another sensor for the handle module to detect the insertion of a removable battery pack therein;

50 FIG. 16 illustrates a handle module with multiple power packs;

FIGS. 17A and 17B illustrate additional process flows executed by the handle processor of a handle module to determine when the handle module reaches its end of life;

55 FIGS. 18A, 18B and 18C illustrate a handle module with a mechanism that prevents the insertion of a battery pack in certain circumstances;

FIGS. 18D and 18E illustrate a mechanism of the handle module of FIG. 18A that prevents removal of the battery

pack from the handle module in certain circumstances;

FIGS. 19A, 19B and 19C illustrate a charging station and a handle module, where the charging station is for charging a battery pack of the handle module;

FIGS. 20A and 20B illustrate a handle module with sterilization covers for covering components of the handle module during the sterilization thereof;

FIG. 20C illustrates a sterilization cover for a battery cavity of the handle module of FIG. 20A;

FIG. 20D illustrates a removable battery pack for the handle module of FIG. 20A;

FIGS. 21A, 21B, 21C and 21D illustrate display configurations for a surgical instrument comprising a handle module and a detachable shaft module;

FIG. 22 illustrates a removable battery pack with an internal circuit board;

FIG. 23A illustrates a handle module with a projecting device that, when projected, prevents insertion of the handle module into a sterilization tray;

FIG. 23B illustrates the handle module of FIG. 23A and a sterilization tray;

FIGS. 24A and 24B illustrate a handle module inspection station for applying vacuum pressure to a handle module;

FIGS. 25A, 25B, 25C and 25D illustrate a handle module inspection station with one or more fans for drying the handle module;

FIG. 25E illustrates an inspection station with a vacuum port to dry a handle module;

FIGS. 26A, 26B and 26C illustrate an inspection station, a handle module, and a load simulation adapter for applying a simulated load to the handle module when the handle module is connected to the inspection station;

FIG. 26D is a cross-sectional view of the load simulation adapter of FIGS. 26A-26C;

FIG. 26E is a chart illustrating a sample model of gear backlash for a handle module as a function of use;

FIGS. 27A and 27B illustrate an inspection station that can accommodate both a handle module and a detachable shaft module;

FIG. 28A illustrates a process flow executed by an inspection station processor to make service recommendations for a handle module;

FIG. 28B illustrates a process flow executed by a handle module processor to make service recommendations for a handle module;

FIG. 29A illustrates a charging station for charging one or more removable battery packs that can be used in a handle module;

FIGS. 29B and 29C illustrate a mechanism of the charging station for securing a battery pack to the charging station;

FIG. 29D is a block diagram of the charging station and a battery pack;

FIG. 29E illustrates a process flow executed by a handle module charging station;

FIGS. 30A and 30B illustrate process flows executed by a handle module charging station;

FIGS. 31 and 32 are electrical schematic diagrams of a charging station;

FIG. 33A is a top view of a battery pack;

FIG. 33B is a top view of a charging station showing its contact configuration for the battery pack of FIG. 33A;

5 FIG. 34A is a top view of a battery pack;

FIG. 34B is a top view of a charging station showing its contact configuration for the battery pack of FIG. 34A;

10 FIG. 35 is a flow chart of a process using an inspection station;

FIGS. 36 and 37 are process flow charts illustrating exemplary steps for sterilizing a handle module and tracking the number of times it is sterilized;

15 FIG. 38 is a perspective view of a battery assembly for use with a surgical instrument, wherein the battery assembly comprises a plurality of shock absorbing elements;

FIG. 38A is a detail cross-sectional view of one of the shock absorbing elements of the battery assembly of FIG. 38;

20 FIG. 39 is a partial cross-sectional view of the battery assembly of FIG. 38;

FIG. 40 is a perspective view of a battery assembly for use with a surgical instrument comprising a battery housing configured to protect one or more battery cells of the battery assembly;

25 FIG. 40A is a detail cross-sectional view of the battery assembly of FIG. 40;

FIG. 41 illustrates a handle of a surgical instrument system including a power adapter extending from the handle to a power source;

30 FIG. 42 illustrates the handle of FIG. 41 which is selectively usable with the power adapter of FIG. 41 or a power adapter system including a removable battery and a detachable power cord;

FIG. 43 is a schematic representation of a power adapter;

35 FIG. 44 is a schematic representation of a power adapter;

FIG. 45 is a perspective view of a handle of a surgical instrument system including a battery;

FIG. 46 is a perspective view of a second battery attached to the handle of FIG. 45; and

40 FIG. 47 is a cross-sectional view of the handle and the battery of FIG. 45 and the second battery of FIG. 46.

[0005] Corresponding reference characters indicate corresponding parts throughout the several views.

DETAILED DESCRIPTION

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[0006] Numerous specific details are set forth to provide a thorough understanding of the overall structure, function, manufacture, and use of the devices described in the specification and illustrated in the accompanying drawings. Well-known operations, components, and elements have not been described in detail so as not to obscure the description. The reader will understand that the examples described and illustrated herein are non-limiting, and thus it can be appreciated that the specific structural and functional details disclosed herein may be representative and illustrative. Variations and changes thereto may be made without departing from the scope of the claims.

50

[0007] The terms "comprise" (and any form of comprise, such as "comprises" and "comprising"), "have" (and any form of have, such as "has" and "having"), "include" (and any form of include, such as "includes" and "including") and "contain" (and any form of contain, such as "contains" and "containing") are openended linking verbs. As a result, a surgical system, device, or apparatus that "comprises," "has," "includes" or "contains" one or more elements possesses those one or more elements, but is not limited to possessing only those one or more elements. Likewise, an element of a system, device, or apparatus that "comprises," "has," "includes" or "contains" one or more features possesses those one or more features, but is not limited to possessing only those one or more features.

55

[0008] The terms "proximal" and "distal" are used herein with reference to a clinician manipulating the handle portion of the surgical instrument. The term "proximal" referring to the portion closest to the clinician and the term "distal" referring to the portion located away from the clinician. It will be further appreciated that, for convenience and clarity, spatial terms such as "vertical", "horizontal", "up", and "down" may be used herein with respect to the drawings. However, surgical instruments are used in many orientations and positions, and these terms are not intended to be limiting and/or absolute.

[0009] Various exemplary devices and methods are provided for performing laparoscopic and minimally invasive surgical procedures. However, the reader will readily appreciate that the various methods and devices disclosed herein can be used in numerous surgical procedures and applications including in connection with open surgical procedures. As the present Detailed Description proceeds, the reader will further appreciate that the various instruments disclosed herein can be inserted into a body in any way, such as through a natural orifice, through an incision or puncture hole formed in tissue, etc. The working portions or end effector portions of the instruments can be inserted directly into a patient's body or can be inserted through an access device that has a working channel through which the end effector and elongated shaft of a surgical instrument can be advanced.

[0010] A surgical stapling system can comprise a shaft and an end effector extending from the shaft. The end effector comprises a first jaw and a second jaw. The first jaw comprises a staple cartridge. The staple cartridge is insertable into and removable from the first jaw; however, alternatives are envisioned in which a staple cartridge is not removable from, or at least readily replaceable from, the first jaw. The second jaw comprises an anvil configured to deform staples ejected from the staple cartridge. The second jaw is pivotable relative to the first jaw about a closure axis; however, alternatives are envisioned in which first jaw is pivotable relative to the second jaw. The surgical stapling system further comprises an articulation joint configured to permit the end effector to be rotated, or articulated, relative to the shaft. The end effector is rotatable about an articulation axis extending through the articulation joint. Alternatives are envisioned which do not include an articulation joint.

[0011] The staple cartridge comprises a cartridge body. The cartridge body includes a proximal end, a distal end, and a deck extending between the proximal end and the distal end. In use, the staple cartridge is positioned on a first side of the tissue to be stapled and the anvil is positioned on a second side of the tissue. The anvil is moved toward the staple cartridge to compress and clamp the tissue against the deck. Thereafter, staples removably stored in the cartridge body can be deployed into the tissue. The cartridge body includes staple cavities defined therein wherein staples are removably stored in the staple cavities. The staple cavities are arranged in six longitudinal rows. Three rows of staple cavities are positioned on a first side of a longitudinal slot and three rows of staple cavities are positioned on a second side of the longitudinal slot. Other arrangements of staple cavities and staples are possible.

[0012] The staples are supported by staple drivers in the cartridge body. The drivers are movable between a first, or unfired position, and a second, or fired, position to eject the staples from the staple cavities. The drivers are retained in the cartridge body by a retainer which extends around the bottom of the cartridge body and includes resilient members configured to grip the cartridge body and hold the retainer to the cartridge body. The drivers are movable between their unfired positions and their fired positions by a sled. The sled is movable between a proximal position adjacent the proximal end and a distal position adjacent the distal end. The sled comprises a plurality of ramped surfaces configured to slide under the drivers and lift the drivers, and the staples supported thereon, toward the anvil.

[0013] Further to the above, the sled is moved distally by a firing member. The firing member is configured to contact the sled and push the sled toward the distal end. The longitudinal slot defined in the cartridge body is configured to receive the firing member. The anvil also includes a slot configured to receive the firing member. The firing member further comprises a first cam which engages the first jaw and a second cam which engages the second jaw. As the firing member is advanced distally, the first cam and the second cam can control the distance, or tissue gap, between the deck of the staple cartridge and the anvil. The firing member also comprises a knife configured to incise the tissue captured intermediate the staple cartridge and the anvil. It is desirable for the knife to be positioned at least partially proximal to the ramped surfaces such that the staples are ejected ahead of the knife.

[0014] An end effector can be configured to articulate relative to the handle and/or shaft of a surgical instrument. For example, the end effector can be pivotably and/or rotatably coupled to the shaft of the surgical instrument such that the end effector is configured to pivot relative to the shaft and the handle. The end effector can be configured to articulate at an articulation joint located intermediate the end effector and the shaft. Alternatively, the shaft can include a proximal portion, a distal portion, and an articulation joint, which can be located intermediate the proximal portion and the distal portion of the shaft.

[0015] FIGS. 1-5 illustrate aspects of a modular surgical cutting and fastening instrument that includes a motor-driven, reusable handle module 10 that may be used, and reused, in connection with one or a variety of different detachable (and typically reusable) shaft modules (DSM)s. As described in more detail below, the handle module 10 includes a housing 12 with one or more motor-driven rotary drive systems that generate and apply various control motions to corresponding drive shaft portions of a particular DSM coupled thereto. Two such rotary drive systems 20, 40 are shown in the handle module 10 of FIGS. 1 and 5. The first rotary drive system 20 is employed to apply "closure" motions to a corresponding closure drive shaft assembly that is operably supported in the DSM and the second rotary drive system

40 is employed to apply "firing" motions to a corresponding firing drive shaft assembly in the DSM that is coupled thereto. The various DSMs may be releasably and interchangeably connected to the housing 12. Three exemplary DSMs that could be connected to the handle module 10 in various arrangements are depicted in FIG. 1. The depicted exemplary DSMs include an open linear stapler DSM 1, a curved cutter stapler DSM 2, and a circular surgical stapler DSM 3. Other DSM types that are adapted for the drive systems 20, 40 of the handle module 10 could also be used, including an endocutter DSM, which is described in more detail in U.S. Patent Application Serial No. _____, entitled MODULAR STAPLING ASSEMBLY, Attorney Docket No. END7544USNP/140469, which was filed on even date herewith and is incorporated by reference in its entirety. More details about an exemplary dual-drive surgical cutting and fastening instrument are provided in U.S. Patent Application Serial No. 14/248,590, entitled MOTOR DRIVEN SURGICAL INSTRUMENTS WITH LOCKABLE DUAL DRIVE SHAFTS, filed April 9, 2014, hereinafter "the '590 application," which is incorporated herein by reference in its entirety.

[0016] As shown in FIGS. 1-5, the housing 12 comprises a handle 14 that is configured to be grasped, manipulated and actuated by a clinician. The handle 14 comprises a pair of handle housing segments 16 and 18 that may be interconnected by screws, snap features, adhesive, etc. In the illustrated arrangement, the handle housing segments 16, 18 cooperate to form a pistol grip portion 19 that can be gripped and manipulated by the clinician. The handle 14 operably supports the two rotary drive systems 20, 40.

[0017] The first and second rotary drive systems 20, 40 may be powered by a motor 80 through a "shiftable" transmission assembly 60 that essentially shifts power/motion between two power trains. The first rotary drive system 20 includes a first rotary drive shaft 22 that is rotatably supported in the housing 12 of the handle 14 and defines a first drive shaft axis "FDA-FDA." A first drive gear 24 is keyed onto or otherwise non-rotatably affixed to the first rotary drive shaft 22 for rotation therewith about the first drive shaft axis FDA-FDA. Similarly, the second rotary drive system 40 includes a second rotary drive shaft 42 that is rotatably supported in the housing 12 of the handle 14 and defines a second drive shaft axis "SDA-SDA." In at least one arrangement, the second drive shaft axis SDA-SDA is offset from and parallel or substantially parallel to the first drive shaft axis FDA-FDA. As used in this context, the term "offset" means that the first and second drive shaft axes are not coaxial. The second rotary drive shaft 42 has a second drive gear 44 keyed onto or otherwise non-rotatably affixed to the second drive shaft 42 for rotation therewith about the second drive shaft axis SDA-SDA. In addition, the second drive shaft 42 has an intermediate drive gear 46 rotatably journaled thereon such that the intermediate drive gear 46 is freely rotatable on the second rotary drive shaft 42 about the second drive shaft axis SDA-SDA.

[0018] The motor 80 includes a motor output shaft that has a motor drive gear 82 attached thereto. The motor drive gear 82 is configured for intermeshing "operable" engagement with the transmission assembly 60. The transmission assembly 60 includes a transmission carriage 62 that is supported for axial travel between the drive gear 82 and gears 44 and 46 on the second rotary drive shaft 42. For example, the transmission carriage 62 may be slidably journaled on a support shaft 63 that is mounted within the housing 12 on a shaft mount 61 such that the line of action of the transmission carriage is perpendicular to the gear trains of the rotary drive systems. The shaft mount 61 is configured to be rigidly supported within slots or other features within the handle module 10. The transmission carriage 62 includes a carriage gear 64 that is rotatably supported on the support shaft 63 and is configured for selective meshing engagement with gears 44 and 46 while in driving engagement with drive gear 82. In the arrangement depicted in FIGS. 1-5, the transmission carriage 62 is attached operably to a shifter or a "means for shifting" 70 that is configured to shift axially the transmission carriage 62 between a "first drive position" and a "second drive position." For example, the means for shifting 70 includes a shifter solenoid 71 that is supported within the housing 12 of the handle 14. The shifter solenoid 71 comprises a bi-stable solenoid or comprises a dual position, spring loaded solenoid. The illustrated arrangement includes a spring 72 that biases the transmission carriage 62 in the distal direction "DD" to the first drive position wherein the carriage gear 64 is in meshing engagement with the intermediate drive gear 46 while also in meshing engagement with the drive gear 82. When in that first drive position, activation of the motor 80 will result in rotation of gears 82, 46 and 24, which will ultimately result in rotation of the first drive shaft 22.

[0019] The shifter solenoid 71 may be actuated by a firing trigger 90 that is pivotally supported on the housing 12 of handle 14 as shown in FIGS. 1-5. As illustrated, the firing trigger 90 is pivotally supported on a firing trigger shaft 92 mounted in the handle 14. The firing trigger 90 is normally biased in an unactuated position by a firing trigger spring 94, as shown in FIG. 3. The firing trigger 90 is mounted for operable actuation of a firing switch 96 that is operably supported on a control circuit board assembly 100 housed in the housing 12 of the handle module 10. In the illustrated arrangement, actuation of the firing trigger 90 results in the actuation of the shifter solenoid 71. Actuation of the firing trigger 90 results in the shifter solenoid 71 pulling the transmission carriage 62 in the proximal direction "PD" to thereby move the carriage gear 64 into meshing engagement with the second drive gear 44. Actuation of motor 80 when the carriage gear 64 is in meshing engagement with the drive gear 82 and the second drive gear 44 will result in the rotation of the second drive shaft 42 about the second drive shaft axis "SDA." The shiftable transmission assembly 60 also includes an indicator system 74 that includes a pair of switches 75 and 76 that are operably coupled to the control board 100 as well as a transmission indicator light 77. The switches 75, 76 serve to detect the position of the transmission carriage 62, which results in the control system actuating the indicator light 77 depending upon the position of the transmission carriage

62. For example, the indicator light 77 may be energized when the transmission carriage 62 is in the first drive position. This provides the clinician with an indication that actuation of the motor 80 will result in the actuation of the first drive system 20.

[0020] The motor 80 may be a DC brushed driving motor having a maximum rotation of, approximately, 25,000 RPM.

In other arrangements, the motor includes a brushless motor, a cordless motor, a synchronous motor, a stepper motor, or any other suitable electric motor, including autoclavable motors. The motor 80 may be powered by a power source 84 that comprises a power pack 86 that is removably stored in the pistol grip portion 19 of the handle 14. To access the power pack 86, the clinician removes a removable cap 17 that is attached at the bottom of the pistol grip portion 19. The power pack 86 may operably support a plurality of battery cells (not shown) therein. The battery cells may each comprise a Lithium Ion ("Li") or other suitable battery type. The power pack 86 is configured for removable operable attachment to the control circuit board assembly 100 of the handle module 10, which is also operably coupled to the motor 80 and mounted within the handle 14. The power pack 86 comprises a number of battery cells connected in series that may serve as the power source for the surgical instrument. In addition, the power source 84 may be replaceable and/or rechargeable and can include CR123 batteries.

[0021] The motor 80 may be actuated by a "rocker-trigger" 110 that is pivotally mounted to the pistol grip portion 19 of the handle 14. The rocker trigger 110 is configured to actuate a first motor switch 112 that is operably coupled to the control board 100. The first motor switch 112 comprises a pressure switch that is actuated by pivoting the rocker trigger 110 into contact therewith. Actuation of the first motor switch 112 will result in actuation of the motor 80 such that the drive gear 82 rotates in a first rotary direction. A second motor switch 114 is also attached to the circuit board 100 and mounted for selective contact by the rocker trigger 110. Actuation of the second motor switch 114 will result in actuation of the motor 80 such that the drive gear 82 is rotated in a second direction. For example, a voltage polarity provided by the power source 84 can operate the electric motor 80 in a clockwise direction wherein the voltage polarity applied to the electric motor by the battery can be reversed in order to operate the electric motor 80 in a counter-clockwise direction. The handle 14 can also include a sensor that is configured to detect the directions in which the drive systems are being moved.

[0022] The housing 12 also comprises a surgical instrument contact board 30 mounted thereto. Correspondingly, the various DSMs (e.g., DSMs 1, 2, 3) includes a mating DSM contact board (see FIGS. 34-60 of the '590 application). The DSM contact board may be positioned in the DSM such that when the DSM is operably coupled to the handle module 10, the end effector contact board is electrically coupled to a handle module contact board 30 mounted in the handle module 10. In such a manner, data and/or electric power can be transferred between the handle module 10 and the DSM via the mating contact boards.

[0023] FIG. 6 illustrates a mechanical coupling system 50 that is employed to facilitate the simultaneous removable and operable coupling of the two drive systems 20, 40 in the handle module 10 to the corresponding "driven" shafts in the DSMs. The coupling system 50 comprises male couplers that may be attached to the drive shafts in the handle module 10 and corresponding female socket couplers that are attached to the driven shafts in the surgical DSM. Each of the male couplers 51 are configured to be drivingly received within corresponding female socket couplers 57 that may also be attached to the driven shafts within the DSM.

[0024] Arrangements for driving the drive systems 20, 40 are disclosed in the '590 application, including that the handle module 10 includes multiple motors.

[0025] FIG. 7 is a block diagram of a modular motor driven surgical instrument 2100 comprising a handle module 2102 and a DSM 2104. The handle and DSMs 2102, 2104 comprise respective electrical subsystems 2106, 2108 electrically coupled by a communications and power interface 2110. The components of the electrical subsystem 2106 of the handle portion 2102 are supported by, and can be connected to, the previously described control board 100. The communications and power interface 2110 is configured such that electrical signals and/or power can be readily exchanged between the handle portion 2102 and the shaft portion 2104.

[0026] In the illustrated example, the electrical subsystem 2106 of the handle module 2102 is coupled electrically to various electrical elements 2112 and a display 2114. The display 2114 is an organic light emitting diode (OLED) display, although the display 2114 should not be limited in this context, and other display technologies could be used. The electrical subsystem 2108 of the DSM 2104 is electrically coupled to various electrical elements 2116 of the DSM 2104.

[0027] The electrical subsystem 2106 of the handle module 2102 comprises a solenoid driver 2118, an accelerometer system 2120, a motor controller/driver 2122, a handle processor 2124, a voltage regulator 2126, and is configured to receive inputs from a plurality of sensor switches 2128 that may be located either in the DSM and/or the handle. The handle processor 2124 may be a general-purpose microcontroller suitable for medical and surgical instrument applications. The handle processor 2124 may be a TM4C123BH6ZRB microcontroller from Texas Instruments that comprises a 32-bit ARM® Cortex™-M4 80-MHz processor and on-chip memory, such as 256 KB Flash, 32 KB SRAM, internal ROM for C Series software, and 2 KB EEPROM. The electrical subsystem 2106 could also comprise one or more separate, external memory chips/circuits (not shown) connected to the handle processor 2124 via a data bus. As used herein, a "processor" or "processor circuit," such as the handle processor 2124, may be implemented as a microcontroller, mi-

croprocessor, a field programmable gate array (FPGA), or an application specific integrated circuit (ASIC), that executes program code, such as firmware and/or software, stored in associated memory to perform the various functions programmed by the program code.

the electrical subsystem 2106 of the handle module 2102 receives signals from the various electrical components 2112, including a solenoid 2132, a clamp position switch 2134, a fire position switch 2136, a motor 2138, a battery pack 2140, an OLED interface board 2142 (which drives the display 2114), and various switches, such as an open switch 2144 (which indicates whether the closure trigger is open), a close switch 2146 (which indicates whether the closure trigger is closed), and a fire switch 2148 (which indicated whether the fire switch is activated or not). The motor 2138 may represent motor 80 in FIGS. 2-5.

[0028] The electrical subsystem 2108 of the DSM 2104 comprises a shaft processor 2130. The electrical subsystem 2108 of the DSM is configured to receive signals from various switches and sensors 2116 located in the DSM that are indicative of the status of the clamp jaws and cutting element in the DSM. In particular, the electrical subsystem 2108 of the DSM may receive signals from a clamp opened status switch 2150 (which indicates whether the end effector clamp is open), a clamp closed status switch 2152 (which indicates whether the end effector clamp is closed), a fire begin status switch 2154 (which indicates whether the end effector commenced firing), and a fire end status switch 2156 (which indicates whether the end effector ended firing), so that the various switches indicate the states of the clamp and cutting element.

[0029] The accelerometer system 2120 includes a MEMS motion sensor that senses 3-axis motion of the handle module 10, such as a LIS331DLM accelerometer from STMicroelectronics. The motor controller/driver 2122 comprises a three phase brushless DC (BLDC) controller and MOSFET driver, such as the A3930 motor controller/driver provided by Allegro. The modular motor driven surgical instrument 2100 is equipped with a brushless DC electric motor 2138 (BLDC motor, BL motor), also known as an electronically commutated motor (ECM, EC motor). One such motor is the BLDC Motor B0610H4314 provided by Portescap. The sensor switches 2128 includes one or more unipolar integrated circuit type Hall Effect sensors. The voltage regulator 2126 regulates the power supplied to the various electrical components of the handle module 2102 and DSM 2104 from a power source (e.g., battery 2140). The battery 2140, which can represent battery pack 86 in FIGS. 1-5, may be a lithium-ion polymer (LiPo) battery, polymer lithium ion, and/or lithium polymer batteries which (abbreviated Li-poly, Li-Pol, LiPo, LIP, PLi or LiP) are rechargeable (secondary cell) batteries. The LIPO battery 2140 comprises several (e.g., four or six) identical secondary cells in parallel (a "pack"). The OLED interface 2142 is an interface to the OLED display 2114, which comprises organic light-emitting diodes.

[0030] The DSM processor 2130 of the electrical subsystem 2108 of the DSM 2104 may be implemented as an ultra-low power 16-bit mixed signal MCU, such as the MSP430FR5738 Ultra-low Power MCU from Texas Instruments. It comprises, among other things, internal RAM nonvolatile memory, a CPU, an A/D converter, a 16-channel comparator, and three enhanced serial channels capable of I2C, SPI, or UART protocols. The subsystem 2108 could also comprise one or more separate, external memory chips/circuits connected to the DSM processor 2130 via a data bus.

[0031] More details about exemplary electrical subsystem for the handle and DSMs 2102, 2104 may be found in the '590 application. In operation, the electrical subsystem 2106 of the handle module 2102 receives signals from the open switch 2144, close switch 2146, and fire switch 2148 supported on a housing of the handle module portion 2102 (e.g., housing 12). When a signal is received from the close switch 2146 the handle processor 2124 operates the motor 2138 to initiate closing the clamp arm. Once the clamp is closed, the clamp closed status switch 2152 in the end effector sends a signal to the shaft processor 2130, which communicates the status of the clamp arm to the handle processor 2124 through the communications and power interface 2110.

[0032] Once the target tissue has been clamped, the fire switch 2148 may be actuated to generate a signal, which is received by the handle processor 2124. In response, the handle processor 2124 actuates the transmission carriage to its second drive position such that actuation of the motor 2138 will result in the rotation of a second drive shaft. Once the cutting member is positioned, the fire begin status switch 2154 located in the end effector sends a signal indicative of the position of the cutting member to the DSM processor 2130, which communicates the position back to the handle processor 2124 through the communications and power interface 2110.

[0033] Actuating the first switch 2148 once again sends a signal to the handle processor 2138, which in response actuates the second drive system and the firing system in the DSM to drive the tissue cutting member and wedge sled assembly distally through the surgical staple cartridge. Once the tissue cutting member and wedge sled assembly have been driven to their distal-most positions in the surgical staple cartridge, the fire end switch 2156 sends a signal to the DSM processor 2130 which communicates the position back to the handle processor 2124 through the interface 2110. Now the fire switch 2148 may be activated to send a signal to the handle processor 2124, which operates the motor 2138 in reverse rotation to return the firing system to its starting position.

[0034] Actuating the open switch 2144 once again sends a signal to the handle processor 2124, which operates the motor 2138 to open the clamp. Once open, the clamp opened status switch 2150 located in the end effector sends a signal to the shaft processor 2130, which communicates the position of the clamp to the handle processor 2124. The clamp position switch 2134 and the fire position switch 2136 provide signals to the handle processor 2124 that indicate

the respective positions of the clamp arm and the cutting member.

[0035] FIG. 8 is a diagram of a process flow that may be executed by the handle processor 2124 by executing software and/or firmware instructions for the handle processor 2124 stored in the internal memory of the processor and/or in an external memory chip/circuit connected to the handle processor 2124. At step 202, the handle processor 2124 monitors input signals from sensors of the instrument 2100 for so-called "life events." The life events are events or actions involving the handle module 2102 and/or the DSM 2104 wherein the handle module 2102 should be retired (i.e., no longer used) once the threshold number of life events is reached. The life events could be the clamping of the end effector, the firing of the end effector, combinations of these events, and/or other events or actions involving the handle module 2102 and/or DSM 2104 that can be and are sensed by the instrument 2100. For example, the open switch 2144, the close switch 2146, and the fire switch 2148 of the handle module 2102 may be coupled to the handle processor 2124. In addition to or in lieu of the above, the clamp opened status switch 2150, the clamp closed status switch 2152, the fire begin status switch 2154, and the fire end status switch 2156 in the DSM 2104 may be coupled to the handle processor 2124 (via the interface 2110). A life event may occur and may be counted when some or all these respective switches are activated, and/or activated in a particular sequence detected by the handle processor 2124, depending on the design and application of the handle module 2102 and instrument 2100. For example, each detected clamp closure and each detected firing may count as a life event. Stated another way, a detected clamp closure can comprise a first life event and a detected firing can comprise a second, or different, life event. In other cases, a sequence of a clamp closure followed by firing may count as one life event. Also, as described above, the handle processor 2124 can use inputs from the handle sensors 2144, 2146, 2148 and/or the DSM sensors 2150, 2152, 2154, 2156 to detect life events.

[0036] The handle processor 2124 keeps a count of the life events. When a life event is detected, the handle processor 2124 increments the present value of the life event counter in either its internal or external memory at step 204. The counter may be a count-up counter, where the count is increased by one count (increment by +1) when a life event occurs until a pre-established threshold is met; or the counter may be a count-down counter, where the count is decreased by one count (incremented by -1) when a life event occurs until a specific end count (e.g., zero) is reached after starting at value that is different from the end count by the pre-established threshold. The pre-established life event count threshold could be set at any value desired by the manufacturer of the handle module 2102 in view of the particular sensor events that count as life events.

[0037] If the life event counter reaches the pre-established life event threshold at step 206, the handle processor 2124 may initiate one or more end-of-life actions at step 208, such as causing the display 2114 of the handle module 2102 or some other display (e.g., a mechanical counter visible to the user) in communication with the handle processor 2124 to indicate that the handle module 2102 is spent (at end-of-life) and should be retired. Any suitable visual, tactile, and/or audible indication may be used. For example, the display 2114 includes an icon and/or text indicating that the end-of-life for the handle module has been reached. The display 2114 could also indicate the life event count on an on-going basis, such as by a numerical display or volume indicator (full, close to empty, etc.) so that the user can monitor whether the handle module is nearing the end of its life cycle. In addition or in lieu of a constant display of the life event count, the display 2114 may have an icon and/or use text to show that the handle module is nearing the end of its life (e.g., "N uses left"). The handle processor 2124 may also initiate conditions that prevent further use of the handle module 2102 when the end-of-life count is reached, as described further below. If the end-of-life count has not been reached, the handle processor 2124 continues to monitor the switches and sensors for life count events until the end-of-life threshold is reached.

[0038] Sensors can be used to detect certain life events. For example, the DSM that is used (e.g., DSM 1, 2 or 3) includes two drive shafts - one for driving the closure system and one for driving the firing system (each driven by one of the drive systems 20, 40 respectively). Each such drive shaft may drive a carriage forward during a clamping or firing event, respectively. The closure and/or firing systems include switches that are triggered when the closure or firing carriage, as the case may be, contacts them. The switch(es) may be coupled to the handle processor 2124, and the handle processor 2124 may register a life event count when it receives a signal from the switch(es) that it has been triggered. The switches may be automatically-resettable push button switches that reset each time they are contacted - and triggered - by the carriage driven by the drive shaft.

[0039] Further to the above, the '590 application describes that the DSMs 1-3 includes a pair of lead screws for driving the closure and firing systems of various different types of DSMs. Examples of such lead screw pairs are shown in the '590 application at FIGS. 34-37 thereof for an open linear stapler, FIGS. 38-41 thereof for a curved cutter stapler, and FIGS. 42-45 thereof for a circular surgical stapler. Other DSM types that are adapted for the handle module could also be used, such as endocutters and/or right-angle staplers. Since different DSMs could be used with the handle module, the handle module (e.g., the handle processor 2124) could use more sophisticated algorithms for tracking handle module usage and remaining life that depend on the number of times the various types of DSMs are used and fired. For example, the handle processor 2124 could compute a progressively accumulating life event score that weighs the use by different DSMs differently (depending on how stressful they are on the handle module, for example) and compares the score to a predetermined threshold value. When the handle module's score reaches the threshold value, the handle module is

retired (e.g., one or more end-of-life actions are taken). For example, the handle processor 2124 may compute the life event score based on the following relationship:

$$\text{Life Event Score} = \sum_{i=1}^N W_i \sum_{j=1}^S F_{i,j}$$

where $i = 1, \dots, N$ represents the different DSM types that could be used with the handle module (e.g., endocutter, liner open, circular, curved, right-angle stapler, etc.), W_i is a weighting factor for DSM type i , and $F_{i,j}$ is the number of firings for DSM type i over the $j = 1, \dots, S$ procedures involving DSM type i . DSM types that impart less stress in general on the handle module could have a lower weight W than then DSM types that impart greater stress in general on the handle module. That way, in various arrangements, a handle module that is used only for high stress procedures would expire prior to a handle module that is used only for less stressful procedures, all other things being equal.

[0040] FIG. 9 illustrates an exemplary process flow that the handle processor 2124 may execute to compute a life event score and/or compare the life event score to a threshold score. The handle processor 2124 can execute firmware and/or software stored in internal and/or external memory. Assuming that the threshold score of the handle module has not yet been reached, the process starts at block 250 where the handle processor 2124 receives inputs for the upcoming procedure. At least one such input can include an identification of the type of DSM that is attached to the handle module, which the handle processor can receive from the DSM processor 2130 when the DSM is connected to the handle module and/or when the handle processor 2124 and the DSM processor 2130 establish a data connection therebetween. In the process of recognizing and/or authenticating the DSM, the DSM processor 2130 sends an identifier to the handle processor 2124 that identifies the type of DSM (e.g., endocutter, circular, etc.) that is attached to the handle module. Next at step 252, the handle processor 2124 tracks how many times the handle module is fired during the surgical procedure. The handle processor 2124 may track how many times the handle module has been fired by tracking the number of times the firing trigger has been activated and/or by tracking feedback from the DSM, such as indications that the end effector cartridge has been replaced.

[0041] Following the procedure and/or at any other suitable time, referring now to step 254, the handle processor 2124 may update the handle processor's life event score by adding the score for the just-completed procedure to the prior score. The score for the just-completed procedure may be based on multiplying the weighting for the DSM type used in the procedure W_i and the number of firings in the procedure S . The handle processor 2124 may determine the weighting for the DSM type W_i by looking up the weighting in a look-up table (stored in internal and/or external memory) based on the type identifier received from the DSM at step 250. At step 256, the handle processor compares the updated life event score for the handle module to the pre-established threshold score to determine if the handle module is at the end of its life. If the threshold has been reached, the process advances to step 258 where one or more end-of-life actions for the handle module are taken such as one or more of the end-of-life actions described herein. On the other hand, if the threshold has not yet been reached, the process can advance to step 260 so that the handle module can be used in at least one more procedure, whereupon the process of FIG. 9 is repeated.

[0042] The loading conditions experienced by the instrument can be used to track the usage of both the handle module and the DSM to assess whether one or both of the handle module and the DSM should be retired. One such case can involve comparing the force actually exerted by the instrument to drive the firing member of the end effector to the force that the instrument was expected to experience. Similarly, the force actually exerted to retract the firing member can be compared to the force that the instrument was expected to experience in order to assess whether the handle module and/or the DSM should be retired. The handle module can be rated to a threshold number of firings based on the force levels that the handle module is expected to experience. Similarly, the DSM can be rated to a threshold number of firings based on the force levels that the DSM is expected to experience. The handle module threshold number and the DSM threshold number can be the same or different. If the actual forces experienced by the handle module and/or the DSM meaningfully exceed the expected force levels, the handle processor and/or the DSM processor, as the case may be, can determine that the handle module and/or the DSM should be retired before reaching its expected number of firings.

[0043] The force exerted by a handle module and/or DSM may be constant throughout a firing stroke of the firing member; however, it is quite common for the force exerted by the handle module and/or DSM to change throughout the firing stroke. In either event, the force exerted by the handle module and/or the force expected to be exerted by the handle module can be a function of the firing member position. Similarly, the force exerted by the DSM and/or the force expected to be exerted by the DSM can be a function of the firing member position. A particular type of DSM can have an expected firing force which is correlated to the firing stroke of the DSM throughout the entire length thereof, i.e., the distance between the initial starting position of the firing member and its end-of-stroke position. The DSM can also have an expected retraction force which is correlated to the retraction stroke of the DSM throughout the entire length thereof, i.e., the distance between the end-of-stroke position of the firing member and its starting position. FIG. 10A shows an example of expected forces for one type of DSM. The upper curve 270 shows the expected firing forces as the firing

member traverses the end effector from its starting position to its end-of-stroke position, and the lower curve 272 shows the expected retraction forces as the firing member is retracted back to its starting position. In this particular example, the expected firing forces are greater than the expected retraction forces.

[0044] For each firing, further to the above, the handle module and/or DSM processors can track the force exerted per unit distance increment (e.g., 1 millimeter) of stroke length. Moreover, the handle module and/or DSM processors can track the force exerted for each distance increment of stroke length and then compare the actual forces to the expected forces to see if the actual forces exerted exceeded the expected forces or not. One way to measure the force exerted by the instrument during firing and retraction is to measure the torque output of the motor(s) during the firing and retraction strokes. The torque output of a motor can be determined based on the current drawn by the motor and the motor speed. As an example, the voltage applied to the motor is constant. The current can be measured with a current sensor; the motor speed can be measured with an encoder. FIG. 10A shows exemplary force measurements as departures from the expected firing stroke forces and the expected retraction stroke forces. In this diagram, for the sake of simplicity in the illustration, all of the measured forces exceeded the expected force, and only the difference between the measured force and the expected force is shown by the line segments 274 for the firing stroke and the by the dotted line segments 276 for the retraction stroke. The reader should appreciate that one or more measured forces could be less than their respective expected force.

[0045] FIG. 10B is a diagram of an exemplary process flow executed by the handle module processor and/or the DSM processor by executing firmware and/or software stored in the memory of the handle module and/or DSM, as the case may be. Referring now to step 280, the processor can aggregate, i.e., accumulate, the difference between the measured force and the expected force at each unit length increment (denoted ΔL below) along the firing stroke and/or the retraction stroke of the instrument. For example, the accumulated force difference for a firing stroke and a subsequent retraction stroke could be computed based on the following relationship:

$$\text{Accumulated Force Difference} = \sum_{\Delta L=0}^{EOS} (F_{m,f,\Delta L} - F_{e,f,\Delta L}) + \sum_{\Delta L=EOS}^0 (F_{m,r,\Delta L} - F_{e,r,\Delta L})$$

where EOS represents end-of-stroke location; $F_{m,f,\Delta L}$ and $F_{e,f,\Delta L}$ represent the measured and expected firing forces, respectively, at position ΔL ; and $F_{m,r,\Delta L}$ and $F_{e,r,\Delta L}$ represent the measured and expected retraction forces respectively at position ΔL . At step 282, the processor can then accumulate the force differences by summing the accumulated force differences per firing for each of the firings that the handle module and/or DSM has experienced.

[0046] For example, the processor can calculate the accumulated force differences in real-time. The processor can calculate the force differences after each firing and retraction cycle. The processor can calculate the force differences after each surgical procedure, which includes more than one firing and retraction cycle. For example, if there were seven (7) firings in a particular procedure, then the processor would sum the result from step 280 for each of the seven firings. Next, at step 284, the handle can update the total accumulated force differences for the handle module and/or the DSM, as the case may be, by adding the accumulated force differences for the recently-completed procedure to the total prior to the recently-completed procedure (or zero in the case of the module's first procedure). At step 286, the processor can then compare the updated accumulated force difference total to a threshold. If the threshold has been reached or otherwise satisfied, the process advances to step 288 where an end-of-life action for the handle module or DSM, as the case may be, is taken. Conversely, if at step 286 the processor determines that the threshold has not yet been reached, the handle module and/or DSM, as the case may be, can be used once again.

[0047] Even if the accumulated force difference threshold has not yet been reached, the handle module and/or the DSM, as the case may be, may have reached the end of its life according to a different threshold. For instance, the processor of FIG. 10B can advance to step 289 after step 286 where the processor compares the total number of procedures involving the handle module and/or the DSM, as the case may be, to a procedure count threshold. A handle module can have a procedure count threshold of 20 procedures and a DSM can have a procedure count threshold of 10 procedures. In another example, a handle module and a DSM can have the same procedure count threshold. If the procedure count threshold has been reached, the end-of-life action for the handle module and/or DSM, as the case may be, is initiated at step 288. Conversely, if the procedure count threshold has not yet been reached, the process advances to step 290 where the handle module and/or the DSM is prepared for another procedure. Any of the techniques described herein for tracking procedure counts may be used to detect the end of a procedure.

[0048] The handle processor could perform the calculations for both the handle module and the DSM and then communicate the results for the DSM to the DSM processor so that the DSM processor can initiate the end-of-life actions, if required. Similarly, the DSM processor could perform the calculations for both the handle module and the DSM and then communicate the results for the handle module to the handle processor so that the handle processor can initiate the end-of-life actions, if required. In another arrangement, all of the measured forces for a procedure can be downloaded following a procedure to a remote processor, such as a processor in an inspection station or another remote computer-

or-processor-based system that is connected to the handle module following a procedure for post-procedure processing. Such an inspection station is disclosed and described in connection with FIGS. 12A-B.

[0049] FIG. 10C illustrates, in conjunction with FIGS. 10D and 10E, another exemplary process flow that the handle processor could employ to monitor whether the handle module has reached its end of life. The process illustrated in FIG. 10C determines whether the handle module has reached its end of life based on the energy used by the handle module over its life, an exemplary graph of which is shown in FIG. 10D. FIG.

[0050] 10D depicts the aggregate, or accumulated, energy spent by a handle module as a function of the uses, or firings, of the handle module. In addition to or in lieu of the above, the process illustrated in FIG. 10C can determine whether the handle module has reached its end of life based on the power used during each firing of the handle module, an exemplary graph of which is shown in FIG. 10E. FIG. 10E depicts the power consumed for each individual firing of the handle module. The processor, in implementing the exemplary process of FIG. 10C, monitors whether the energy expended by the handle module, in the aggregate, exceeds various thresholds (see FIG. 10D) and, concomitantly, whether the handle module has had a certain number of firings above a threshold power level (see FIG. 10E). When both of these conditions have been met the handle processor can conclude that the handle module is at its end of life. The handle processor could utilize any number of multiple-factor tests, with thresholds for each test, to determine if a handle module is at its end of life. The handle processor can determine that it has reached its end of life if any test threshold has been met or exceeded.

[0051] Following a procedure, the handle processor can execute the process of FIG. 10C by executing firmware and/or software stored in internal and/or external memory to determine whether the handle module is at its end of life. At step 290, the handle processor can compare the accumulated energy of the handle module over its life to a first threshold energy level, i.e., Energy Level 1 in FIG. 10D. Energy Level 1 can be 40kJ. The handle module includes a micro watt or power meter connected to the motor(s) of the handle module to measure and record the electrical parameters of the motor(s) so that the energy and power outputs of the motor(s) can be determined. If the first threshold energy level has been reached or exceeded, i.e., Energy Level 1, the handle processor can determine at step 291 that the handle module is at its end of life and initiate an end-of-life action, such as one or more of the end-of-life actions described herein.

[0052] If the handle processor determines that first threshold energy level, i.e., Energy Level 1, has not been met at step 290, the process advances to step 292 where the handle module determines if a second, (e.g., lower) energy threshold has been met, i.e., Energy Level 2 in FIG. 10D. Energy Level 2 can be 30kJ. If the second threshold energy level has been reached or exceeded (without reaching or exceeding the first threshold energy level), the process advances to step 293 where the handle processor determines if the handle module has undergone a certain number of firings over its life that have exceeded a first power level threshold, e.g., two firings greater than 55 Watts (see FIG. 10E). If the second energy level threshold has been met or exceeded and the power level threshold has been met or exceeded the predetermined number of times, the handle processor can determine that the handle module is at its end of life. If, however, the power level threshold has not been met or exceeded the predetermined number of times, the handle processor can determine that the handle module has not yet reached its end of life even though the second energy level threshold has been met or exceeded. The dual factors of steps 292 and 293 can be another test on the handle module's life, and if the handle module fails both tests (i.e., both thresholds or conditions have been satisfied), the handle module can be determined to be at its end of life.

[0053] The handle processor can execute any number of such dual-factor tests. The example of FIG. 10C shows one additional such dual-factor test. If the dual factors of steps 292 and 293 are not both satisfied, the process can advance to step 294 where the handle module determines if a third (e.g., still lower) energy threshold, i.e., Energy Level 3, has been met. Energy Level 3 can be 25kJ. If the third threshold energy level has been reached or exceeded (without reaching or exceeding the third threshold energy level), the process advances to step 295 where the handle processor determines if the handle module has had a certain number of firings over its life (preferably greater than the number of such firings checked for at step 293) that exceeded a second power level threshold (which could be the same or different from the power level threshold at step 293), e.g., four firings greater than 55 Watts. The dual factors of steps 294 and 295 can be another test on the handle module's life, and if the handle module fails both tests (i.e., the thresholds or conditions have been satisfied), the handle module can be determined to be at its end of life. Otherwise, the handle processor can determine that the handle module is not at its end of life and can be used in a subsequent procedure.

[0054] It should be apparent that the steps of FIG. 10C can be performed in various orders while still achieving the same result. For example, steps 294 and 295 can be performed before step 290, and so on.

[0055] According to current best practices, a handle module should be sterilized before it is used to perform a surgical procedure. The handle module is placed in a sterilization tray which is then placed in a sterilization chamber. In addition to or in lieu of the above described manners for tracking the end of life of the handle module, the number of times that the handle module is placed in a sterilization tray for sterilization could be used to track the end of life for the handle module. Stated another way, the number of times that a handle module is sterilized can serve as a proxy for the number of times that the handle module has been used. Each handle module has its own sterilization tray that keeps the sterilization count for that particular handle module. In such an arrangement, the sterilization tray includes a counter that

is incremented each time the associated handle module is placed in the tray. The counter can have visual readout display that can show the number of times the handle module has been sterilized if a count-up counter is used or the number of sterilizations remaining, or permitted, when a count-down counter is used. That way the user can know when the sterilization limit is reached and, as a result, the user can retire the handle module and/or take other appropriate end-of-life measures. In order for the placement of the handle module in a sterilization tray to be used as a proxy for the number of times the handle module is sterilized and, thus, a proxy for the number of times the handle module has been used, the handle module should be sterilized in one and only one sterilization tray. That way, the counter does not count placements in the tray of other handle modules. Accordingly, the handle module and sterilization tray could be provided together, as a kit for example, and they include identifiers (e.g., numbers or icons) which show that they are to be used together. The handle module and DSM could be sterilized separately or together.

[0056] FIG. 11A depicts an exemplary sterilization tray 300 and a handle module 302 which is positionable in the sterilization tray 300. The sterilization tray 300 defines an opening, or recess, 304 whose shape matches the shape of handle module 302 to be placed therein. The recess 304 is configured to closely receive the handle module 302 such that there is little, if any, relative movement possible therebetween. The sterilization tray 300 includes a stroke counter 306 that has a lever arm 308 that extends into the opening 304. The stroke counter 306 further includes a counter visual readout 310. When the user places the handle module 302 in the opening 304, the lever arm end 308 is depressed, toggled, or stroked, which registers as a count, thereby incrementing the stroke counter 306 by one for a count-up counter (or -1 for a count-down counter) which is displayed on the readout 310. To reduce false toggles or strokes of the lever arm 306, in various arrangements, the lever arm end 308 includes a protrusion 312 configured to fit into a corresponding opening 314 defined in the handle module 302. FIG. 11B shows the handle module 302 after it is placed in the sterilization tray 300. The lever end arm 308 is not visible in FIG. 11B because it is underneath the handle module 302. The counter readout 310 remains visible to the user when the handle module 302 is positioned in the opening 304.

[0057] FIGS. 11C and 11D depict a variation where a handle module 302 can be placed in sterilization tray 300 with a DSM 312. Handle module 302 is similar to handle module 10 in many respects and DSM 312 represents an exemplary DSM. In such an arrangement, the sterilization tray 300 includes a handle module opening 318 for receiving the handle module 302, a handle module lever counter 314, and a handle module counter readout 316. The tray 300 also includes a DSM opening 324 for receiving the DSM 312, a DSM lever counter 320, and a DSM counter readout 322. In such an arrangement, the handle module 302 and the DSM 312 should only be sterilized in a particular sterilization tray 300 so that their respective sterilizations can be accurately tracked. The handle module counter 312 shows the number of times the handle module 302 has been sterilized in the sterilization tray 300, and/or the number of sterilizations remaining. The DSM counter 324 shows the number of times the DSM 312 has been sterilized in the sterilization tray 300, and/or the number of sterilizations remaining. The handle module 302 could be sterilized without the DSM 312, and vice versa, in which case their respective counts may not be equal.

[0058] FIGS. 11E to 11I illustrate other arrangements for using a sterilization tray 300 to track uses of a handle module. In FIG. 11E, the sterilization tray 300 includes a protrusion 340 extending upwardly from the bottom of the opening 304 in the sterilization tray. The protrusion 340 is positioned to extend into a corresponding opening 342 defined in the handle module 302 when the handle module 302 is seated in the opening 304. As shown in FIG. 11F, the handle module 302 comprises a two-position mechanical toggle switch 344 having a portion extending into the opening 342 defined by the handle 302 when the switch 344 is in a first position. When the handle module 302 is placed in the sterilization tray 300, the opening 342 is aligned with the protrusion 340 such that the protrusion 340 pushes the switch 344 to a second position, as shown in FIG. 11G. The switch 344 may be in communication with the handle processor and the handle processor may update an internal sterilization count (stored in internal and/or external processor memory of the handle module) when the switch 344 is moved from the first position (FIG. 11F) to the second position (FIG. 11G). In such an case, the handle module 302 comprises a power source as described herein to power the handle processor and to update the sterilization count during sterilization. Such a power source can comprise a secondary battery which is not removed from the handle module even if a primary battery is removed from the handle module 302. The handle processor may compare the sterilization count to a predetermined threshold (e.g., 20 sterilizations) and when the sterilization count reaches the predetermined threshold, the handle processor may implement one or more of the various end-of-life actions described herein. The switch 344 may stay in the "triggered" or "activated" state until it is reset at a later time, such as after the sterilization process (see FIG. 36). The switch 344 can be biased by a spring to revert back to its open position once the handle module 302 is removed from the tray 300 and the protrusion 340 is removed from the opening 342. The handle module processor could also set an internal flag to indicate that the handle module 302 was placed in the sterilization tray 300 and this flag can later be reset after the sterilization process (see FIG. 37). FIGS. 11H and 11I illustrate a similar example with a contact switch 348. When the handle module 302 is placed in the sterilization tray 300, the opening 342 is aligned with the protrusion 340 such that the protrusion 340 closes the contact switch 348, as shown in FIG. 11G, when the handle module 302 is seated in the opening 304. The contact switch 348 is in communication with the handle processor to update the sterilization count of the handle module. The contact switch 348 may be biased to revert to its open position (FIG. 11H) by a spring when the handle 302 is removed from the tray 300 and pressure

being applied to the contact switch 348 by the inserted protrusion 340 is removed.

[0059] In addition to or in lieu of the above described manners for tracking the end of life of a handle module, the end of the life of a handle module could be tracked through the use of an inspection station to which the handle module can be connected. The inspection station could be used at any suitable time to evaluate whether the handle module can be used to perform a surgical procedure and/or a subsequent step in a surgical procedure. For instance, an inspection station could be used before, during, and/or after the sterilization process of a handle module and/or while preparing the handle module for reuse. The handle module could be connected to the inspection station after (i) the post-op cleanup for reusable components of the handle module following a procedure (usually involving a manual wipe down of the component or instrument); (ii) decontamination (e.g., by auto-washer) of the component or instrument; and/or (iii) cleaning and/or room drying of the component or instrument. Placement of the handle module on the inspection station can be a proxy for the number of times the handle module was used, sterilized, and/or otherwise processed for reuse. A display on the inspection station (or elsewhere) may indicate to a user when a threshold number of placements of the handle module on the inspection station has been reached or is about to be reached, at which point the user can take appropriate action with respect to the handle module, such as retire it. Also, the inspection station could upload data to the handle processor that prevents further usage of the handle module (e.g., disables the handle module) when the handle module has reached the end of its life.

[0060] Further to the above, FIGS. 12A and 12B illustrate an exemplary inspection station 400 and handle module 402. The handle module 402 is similar to the handle module 10 in many respects. FIG. 12A shows the handle module 402 before being placed on the inspection station 400 and FIG. 12B shows the handle module 402 after being placed into position on the inspection station 400. The handle module 402 comprises a battery cavity 403 defined therein which is configured to receive a battery pack therein. See battery pack 86 in FIGS. 2-5. As also disclosed elsewhere herein, the battery pack is readily insertable into and removable from the battery cavity 403. FIG. 12A also shows that the battery pack is removed from the handle module 402 thereby exposing the battery cavity 403 prior to the handle module 402 being placed on the inspection system 400. The inspection station 400 comprises an insert, or data/power adapter, 404 extending therefrom that is sized and configured to fit within the battery cavity 403 of the handle module 402. The data/power adapter 404 is placed in communication with the processor of the handle module via the power contacts configured to engage the power terminals of the battery pack and/or via one or more signal contacts positioned in the battery cavity 403, as described in greater detail further below. The handle module 402 may be positioned on the inspection station 400 by sliding the opening 403 over the data/power adapter 404.

[0061] FIG. 12C is a block diagram illustrating certain components of the inspection station 400 and the handle module 402. The data/power adapter 404 includes power terminals 430 that provide voltage there-across to a voltage regulator 432 of the handle module 402 in the same or similar manner in which the battery pack provides voltage to the voltage regulator 432 when the battery pack is positioned in the opening 403. For instance, if a battery pack is configured to supply 6V DC to the voltage regulator 432, the insert 404 can be configured to supply 6V DC to the voltage regulator 432. The voltage regulator 432 provides electrical power to the control board 100 (see FIGS. 1-6) of the handle module 402 to power the components of the control board 100, including a handle processor 434 and the associated internal and/or external memory 436. The inspection station 400 may itself be powered by an AC power source through a power cord 437 utilizing appropriate AC-DC converters. The inspection station 400 includes data ports 438 which come into contact with data ports 440 of the handle module 402 when the handle module 402 is engaged with the inspection station 400 so that the handle processor 434 can be in communication with the inspection station processor 442. As the reader will appreciate, the inspection station 400 can further include internal and/or external memory 444 associated with the inspection station processor 442.

[0062] FIG. 12D is a diagram of a process flow that may be performed by the handle processor 434 and/or the inspection station processor 442 when executing software and/or firmware in the handle memory 436 and/or the inspection station memory 444 to track and respond to the number of times the handle module 402 is placed on the inspection station 400. In various arrangements, whenever the handle module 402 is installed on the inspection device 400 such that the insert 404 makes data and/or power connections to the control board 100 of the handle module 402, the handle processor 434 may increment an inspection counter. The inspection counter may be a count-up counter from zero to a pre-established threshold number of inspections or a count-down counter from the pre-established threshold number of inspections to zero. The handle module 402 includes an inspection station insertions switch 446 (FIG. 12C) that is triggered when the data/power adapter 404 is fully and properly inserted into the opening 403. This switch 446 may be in communication with the handle processor 434 via the control board 100 and, when the switch 446 is triggered at step 420 of FIG. 12D, the handle processor 434 may increment (by +1 or -1 as the case may be, depending on the type of counter) the inspection counter at step 422. At step 424, the handle processor 434 may compare the inspection count to the predetermined threshold. If the threshold has not yet been reached, the handle processor 434 may then output at step 426 the value of the inspection counter to the inspection station processor 442 while in data communication with the inspection station 400 via the insert 404.

[0063] Referring to FIG. 12E, the inspection station 400 includes a visual display 448 that displays visual information

related to the inspection counter, such as the number of times the handle module 402 has been placed on the inspection station 400 and/or the number (or approximate number) of times remaining that the handle module 402 should be placed on the inspection station 400 for inspection before the handle module 402 has reached its end-of-life. However, if the inspection count threshold has been reached, the process may advance to step 428 where appropriate end-of-life action(s) may be taken. One such end-of-life action is that the display 448 of the inspection station 400 may visually display to the user that the handle module 402 should not be used any further. Another end-of-life action that could be employed in addition to or in lieu of the visual display is that the inspection station processor 442 sends an instruction string to the handle processor 434 that causes the handle processor 434 to disable further use of the handle module 402. For example, the instruction string could instruct the handle processor 434 to never thereafter actuate the motor of the handle module 402 or some other disabling action. For example, the instruction string may instruct the handle processor to set a flag that, when set, prevents the handle processor 434 from actuating the motor.

[0064] The inspection station insertion switch 446 may be a pressure switch that is actuated when the data/power adapter 404 is fully inserted into the opening 403 and reset when the data/power adapter 404 is removed, or at least partially removed, from the opening 403. there could be a timer associated with the inspection station insertion switch 446 so that the inspection station counter is incremented (step 422 of FIG. 12D) only if the switch 446 is activated for at least a threshold period of time (e.g., 30 seconds, etc.). Such a timer could reduce the number of false positives, i.e., short placements of the handle module 402 on the inspection station 400 that are likely not associated with post-procedure inspection or sterilization of the handle module 402.

[0065] In another variation, the inspection station 400 includes a pressure switch with a counter whose readout is displayed to a user. The inspection station pressure switch is activated by placement of the handle module 402 on the inspection station 400. For example, the inspection station pressure switch could be at the base of the insert 404 of the inspection station 400 such that when the handle module 402 is fully slid onto the insert 404, the inspection station pressure switch is activated. Each time the inspection station pressure switch is activated, the counter could be updated (e.g., incremented by one) so that the readout shows the number of times that the handle module 402 has been installed on the inspection system 400. Such a counter could be a mechanical counter and/or an electronic counter. If the limit, or threshold, is displayed on the inspection station 400, displayed on the handle module 402, and/or otherwise publicized to the user, the user can know if the limit has been reached or is being approached. The limit could be printed on the inspection station 400 and/or the handle module 402.

[0066] The display 448 of the inspection station 400 could also display other information obtained by the inspection station 400 and/or communicated to the inspection station 400 from the handle module 402 via the data connection therebetween. For example, the handle processor memory may store a device type identifier for the handle module (e.g., a serial number) and that device type identifier may be downloaded to the inspection station processor 442 for display on the display 448. In addition to or in lieu of the above, the display 448 may indicate a state of the handle module, such as how close the handle module is to its end-of-life and/or whether or not the handle module has been locked out based on status data received from the handle processor 434. As described herein, the display 448 could indicate the number of remaining uses (e.g., procedures) for the handle module and/or the number of procedures in which the handle module has been used. As disclosed herein, the inspection station 400 could also be used to perform post-procedure testing of the handle module 402 to ensure that the handle module 402 can be used in a subsequent procedure. This testing can include moisture testing, seal integrity testing, and/or simulated load testing. The display could indicate the results of those tests (e.g., passed, failed, in progress).

[0067] In addition to or in lieu of the above, the display 448 of the inspection station 400 may indicate the status of the inspection station itself, such as whether the inspection station is (i) downloading data from the handle module, (ii) uploading data and/or software upgrades to the handle module, (iii) processing data, and/or (iv) performing testing. The display 448 may indicate results from the testing and data processing, such as whether the handle module is ready to use in another procedure, whether the handle module needs servicing, whether the warranty of the handle module has expired because the handle module has reached its threshold number of uses and/or other warnings. The display 448 of the inspection station 400 may be a LED-backlit LCD display that is controlled by the inspection station processor 442. The inspection station 400 also includes control buttons 410, as shown in FIG. 12E, where a user could input data and/or configuration settings that are stored and used by the inspection station processor 442. The display 448 could also be a touch-screen where users could enter data and/or configuration settings via the touch-screen. The inspection station 400 includes an external data port 412, such as a USB, micro or mini USB for connection to a data cable 414 so that data can be uploaded from or downloaded to the inspection station 400. For example, procedure data from the handle module 402 could be downloaded to the inspection station 400 and then downloaded to a remote computer device via the data port 412. Software and/or firmware upgrades could be downloaded from a remote computer device via the data port 412 to the inspection station 400 and then uploaded to the handle module 402.

[0068] FIGS. 13A and 13B depict an arrangement for tracking the use of a handle module by tracking the installation of power packs in the handle module. FIG. 13A is a block diagram of a handle module 500. The handle module 500 is similar to the handle module 10 in many respects. The handle module 500 includes a removable power pack 502, such

as a battery and a handle processor 504. FIG. 13B illustrates a process flow that may be executed by the handle processor 504. The process can be executed from firmware and/or software in memory 506 which is associated with the processor 504. As illustrated in FIG. 13A, the power pack 502 includes an identification emitter 508, such as a RFID tag that can communicate with an identification receiver 510, such as a RFID reader in the handle module 500. The identification emitter 508 is a wireless signal emitter; however, any suitable identification emitter could be used. The identification receiver 510 is a wireless signal receiver that is in communication with the handle processor 504; however, any suitable identification receiver could be used. The identification emitter 508 transmits a unique ID for the power pack 502 which can be received by the identification receiver 510. The strength of the signal emitted by the identification emitter 508 can be controlled or limited such that the identification receiver 510 can only detect the signal emitted from the identification emitter 508 when the power pack 502 is very close to the identification receiver 510 (e.g., within 10 cm). the identification receiver 510 can be mounted on the control board 100 (FIGS. 2-4) such that the identification receiver 510 can only detect the identification emitter 508 when the power pack 502 has been inserted in the handle module 500. Short range RFID tags and readers could be used such that the identification receiver 510 is less likely to falsely detect power packs 502 that are not installed in the handle module 500.

[0069] Referring to the process flow depicted in FIG. 13B, the identification reader 510 detects an identification emitter at step 520. At step 522, the handle processor 504 determines whether the power pack 502 is a new power pack based on its ID received by the identification receiver 510. The term "new" in this context means that a particular power pack 502 has not been used with a particular handle module 500. The handle processor 504 may perform this step by comparing the ID for the newly detected power pack 502 to a stored list of power pack IDs that were previously detected by the identification receiver 510. Such a list of previously-used power pack IDs are stored in a non-volatile memory of the handle module 500. If the power pack 502 is not new, i.e., its ID is on the stored list of previously used power packs, the process advances to step 524, where appropriate and pre-established action(s) is taken. For example, the handle processor 504 can disable use of the handle module 500 until a new, i.e., previously-unrecognized, power pack is installed in the handle module 500. As an example, the handle module 500 can disable the motor 80. In addition to or in lieu of the above, the display of the handle module 500 can display to the user that the power pack is not new and request installation of a different power pack, which returns the process to step 520.

[0070] If the power pack 502 is determined to be new by the processor 504, i.e., the ID of the power pack 502 is not on the stored list of previously-used power packs, the process advances to step 526 where the handle processor 504 increments the use count for the handle module 500. As before, a count-up counter and/or a count-down counter could be used. At step 528, the handle processor 504 compares the use count to a pre-established threshold value that represents the number of times that the handle module 500 should be used with a different, unique power pack. Such a use count can serve as a proxy for the number of times the handle module 500 has been used in patient procedures. If the use count threshold has been reached at step 528, a pre-established end-of-life action(s) can be taken at step 529. For example, the handle processor 504 may disable the motor, the handle module display may display to the user that the handle module 500 has no remaining uses, and/or activate an alarm alerting the user that there are no remaining uses. If the use count threshold has not been reached, the handle processor 504 adds the ID of the new power pack 502 to the stored list of previously-used power packs at step 530 so that the new power pack 502 cannot be used after its current use. In other variations, the steps illustrated in FIG. 13B could be performed in different orders. For example, the new power pack ID could be added to the stored list prior to incrementing the use count. Other techniques for tracking installation of power packs in the handle module are described below in connection with FIGS. 14E and 15A-B.

[0071] The arrangement described above in connection with FIGS. 13A and 13B can be used with rechargeable and/or non-rechargeable battery packs. That said, battery packs which are used with a handle module 500, recharged, and then reused with the same handle module 500 may cause the handle module 500 to go into a lockout mode. In this case, recharged battery packs would have to be reused with a different handle module. Along these lines, an alternative handle module 500 is envisioned in which a recharged battery pack can be reused with the same handle module 500.

[0072] The processor 504 can employ logic which prevents a battery pack 502 from being counted two or more times for the same use. The processor 504 may not count a battery pack 502 a second time unless it has been dis-engaged from and re-engaged with the handle module 500. Even then, the processor 504 may require an elapsed time between the first engagement and the subsequent engagement before counting the subsequent engagement as a second use. Such an elapsed time could be the time that it takes to recharge the battery pack.

[0073] In addition to or in lieu of the above, a handle module can track the number of times that a DSM is connected to and/or disconnected from the handle module as a proxy for the number of times that the handle module has been used. The handle module can display the updated number of uses remaining for the handle module, the estimated number of uses remaining for the handle module, such as with a volume indicator that indicates the percentage of life remaining and/or the number of times that the handle module has been used. When the use threshold limit has been reached, the handle module, via the handle processor, can take one or more end-of-life actions, such as displaying that the handle module is spent, disabling further use of the handle module by disabling the motor and/or sounding an audible alarm. FIGS. 14A-G represent different arrangements for tracking the connection or disconnection of a DSM to a handle

module, as discussed in greater detail further below.

[0074] Turning now to FIG. 14A, a handle module 600, which is similar to the handle module 10 in many respects, comprises two rotary drive systems 602, 604. A DSM having two drive systems, discussed above, can be operably coupled to the rotary drive systems 602, 604. The DSM can have grooves that are configured to receive and slide onto bilateral edges 605A, 605B of a tongue defined in a connection area 608 on the upper portion of the handle module 600. In such an arrangement, the handle module 600 includes a depressible switch 612 on the tongue, as shown in FIG. 14A, and/or elsewhere in the connection area 608 such that, when a DSM, such as DSM 634 (FIGS. 14B and 14C) is connected to the handle module 600, the depressible switch 612 is depressed. The DSM may not depress the switch 612 until the DSM has been fully seated onto the handle module 600. The switch 612 may be connected to the handle processor wherein the handle processor may count the number of times the depressible switch 612 is depressed as a proxy for the number of times that a DSM has been connected to the handle module 600 and/or as a proxy for the number of times that the handle module 600 has been used. Also, the handle processor could require that the depressible switch 612 be depressed continuously for at least a certain period of time (e.g., 30 seconds) before incrementing the count to reduce instances of false positives. When a pre-established threshold number of uses, or activations of switch 612, has been reached, an end-of-life action(s) may be performed, as described herein.

[0075] FIGS. 14B and 14C illustrate one arrangement for an electro-mechanical depressible switch 612. As shown, the depressible switch 612 includes a head 620 that extends into an opening 622 defined in the tongue and/or any other suitable DSM-mating surface of the handle module 600. The head 620 may be at the end of a spring arm 624 configured to bias the position of the head 620 upwardly into the opening 622. The spring arm 624 also includes a shoulder 626 positioned behind an extension, or edge, 628 defined in the handle module 600 that limits the upward movement of the head 620 in the opening 622 to a desired position. The depressible switch 612 also includes a contact 630. When the switch 612 is in an unactuated, or open, condition, as illustrated in FIG. 14B, the spring arm 624 is not in engaged with the contact 630; when the DSM 634 is attached to the handle module 600 and pushes the head 620 downwardly, as illustrated in FIG. 14C, the shoulder 626 of the spring arm 624 engages the contact 630 and closes the switch 612. The DSM 634 includes a projection 632 extending therefrom which is configured to contact the head 620. The switch arm 624 and the contact 630 can be comprised of electrically conductive materials which can complete a circuit in communication with the handle processor when the head 620 is depressed downwardly by the DSM 634, as discussed above.

[0076] Referring now to FIG. 14D, a handle module 700 includes an electrical contact board 702 that interfaces/mates with and makes electrical connections to a corresponding electrical contact board 704 on a DSM 706. The processor of the handle module 700 may count the number of times that a DSM, such as the DSM 706 is assembled to the handle module 700. The processor can increase the DSM-connection count when the contacts 704 of the DSM 706 engage the contacts 702 of the handle module 700 and make a working data connection therebetween. The mating of the contact boards 702, 704 can serve as a proxy for the number of times that a DSM has been connected to the handle module 700 and as a proxy for the number of times that the handle module 700 has been used. Similar to the above, the handle processor could require that there be a data connection between the contact boards 702, 704 continuously for at least a certain period of time (e.g., 30 seconds) before incrementing the count to reduce the instances of false positives. In another variation, the handle processor and the DSM processor may exchange data when the DSM 706 is connected to the handle module 700. In this exchange, the handle processor can receive identification information for the DSM 706 so that the handle processor can identify the DSM 706 connected to the handle module 700 (e.g., the model type for the DSM). In such an arrangement, the handle processor may increment the DSM-connection count each time that the handle processor receives identification information from a DSM that is attached thereto. In any of these variations, the handle processor compares the DSM connection count to a pre-established threshold, and if the threshold is reached, the handle processor takes an end-of-life action(s).

[0077] An alternative arrangement for detecting the connection of a DSM to a handle module is shown in FIGS. 14E-14G. The illustrated arrangement uses a Hall Effect sensor to detect the connection of the DSM 706 to the handle module 700. As shown in FIG. 14E, the handle module 700 includes a Hall Effector sensor 710 positioned relative to an upper surface 712 of the handle module 700 to which the DSM 706 is to be attached. Correspondingly, the DSM 706 includes a magnet 714, such as a permanent magnet that is in close proximity to the Hall Effect sensor 710 when the DSM 706 is fully and properly connected to the handle module 700, as shown in FIG. 14G. The Hall Effector sensor 710 may be in communication with the handle processor via a lead wire 716. The Hall Effect sensor 710 can sense the approaching magnet 714 of the DSM 706 as the DSM 706 is installed on the handle module 700. The magnetic field generated by the magnet 714 may be constant and the handle processor can have access to data regarding the magnetic field such that the distance between the magnet 714 and the Hall Effect sensor 710 can be determined based on the output of the Hall Effect sensor 710. Once the distance between the magnet 714 and the Hall Effect sensor 710 stabilizes to a distance corresponding to the DSM 706 being fully and properly installed on the handle module 700, the handle processor can infer that the DSM 706 is fully and properly installed on the handle module 700 and update the DSM-connection count.

[0078] Similarly, referring again to FIG. 14E, the handle module 700 includes a battery cavity 724 configured to receive a battery pack 722 therein. The handle module 700 further includes a Hall Effect sensor 720 configured to detect the

insertion of the removable battery pack 722 into the battery cavity 724. The battery-pack Hall Effect sensor 720 can be positioned at an upper interior surface 723 in the battery cavity 724 in the handle module 700 for the battery pack 722. As the reader will appreciate, the battery pack 722 is configured to supply power to the handle module 700 via electrical terminals 726 and it may be desirable to position the Hall Effect sensor 720 as far away as possible from the electrical terminals 726 such that any magnetic fields generated by the current flowing through the terminals 726 do not substantially disturb the ability of the Hall Effect sensor 720 to properly detect the insertion of the battery pack 722 into the handle module 700. The battery pack 722 includes a magnet 730, such as a permanent magnet that the Hall Effect sensor 720 senses as the battery pack 722 is inserted into the battery cavity 724. Similar to the DSM Hall Effect sensor 710, the battery pack Hall Effect sensor 720 is in communication with the handle processor via a lead wire 732. The Hall Effect sensor 720 can sense the approaching battery pack magnet 730 as the battery pack 722 is installed into the battery cavity 724. The magnetic field generated by the magnet 730 may be constant and the handle processor can have access to data regarding the magnetic field such that the distance between the magnet 730 and the Hall Effect sensor 720 can be determined based on the output of the Hall Effect sensor 720. Once the distance between the magnet 730 and the Hall Effect sensor 720 stabilizes to a distance corresponding to the battery pack 722 being fully and properly installed in the handle module 700, the handle processor can infer that the battery pack 722 is fully and properly installed in the handle module 700 and update the battery-pack-connection count.

[0079] A handle module can track the number of times that a DSM and/or a battery pack is connected to and/or disconnected from the handle module as a proxy for the number of times that the handle module has been used. The handle module can display the updated number of uses remaining for the handle module, the estimated number of uses remaining for the handle module, such as with a volume indicator that indicates the percentage of life remaining and/or the number of times that the handle module has been used. When the use threshold limit has been reached, the handle module, via the handle processor, can take one or more end-of-life actions, such as displaying that the handle module is spent, disabling further use of the handle module by disabling the motor and/or sounding an audible alarm.

[0080] Turning now to FIGS. 15A and 15B, a handle module 800 can track the installation of power packs thereto utilizing a pressure switch that is depressed when a power pack 806 is completely and properly attached to the handle module 800. The handle module 800 is similar to the handle module 10 in many respects. The handle 800 includes an electrically conductive contact pad 802 that the power pack 806 connects to in order to supply voltage to the electrical components of the handle module 800. In the illustrated arrangement, a pressure switch 804 is adjacent to the conductive contact pad 802 and it is in communication with the handle processor. When the power pack 806 is assembled to the handle module 800, referring to FIG. 15B, the housing of the power pack 806 depresses and actuates the pressure switch 804. Each time the pressure switch 804 is actuated, the handle processor can increment the power-pack-connection count until a threshold is reached, at which point an end of life action(s) can be undertaken. Similar to the above, the handle processor may require that the pressure switch 804 be actuated continuously for a period of time (e.g., 30 seconds) before incrementing the power-pack-connection count to reduce instances of false positives. In other arrangements, an electro-mechanical switch could be used.

[0081] A processor of a handle module can increment the use count each time that the handle processor is powered on. The processor of a handle module can automatically power down when a battery pack is disengaged from the handle module. Similarly, the processor can automatically power up when a battery pack is engaged with the handle module. The battery pack may be the sole power source for the handle module and the disconnection of the battery pack from the handle module may immediately de-power the processor and the connection of a battery pack to the handle module may immediately re-power the processor. The handle module can include one or more capacitive elements which can store power from a battery pack when the battery pack is engaged with the handle module. When the battery pack is disconnected from the handle module, the capacitive elements can provide power to the processor for a period of time and, as a result, the processor may not power down during a battery pack change. In such cases, the processor can count a life, or use, event if a battery installation is detected by a sensor, as described above, and/or if the processor is powered on after being de-powered.

[0082] The handle processor of the handle module 800 can track how often it receives electrical power via the conductive contact pad 802 that is used to couple the battery power pack 806 to the internal electrical components of the handle module 800. For example, the handle module 800 comprises a microvoltage and/or current sensor (not shown) connected to the conductive contact pad 802. The voltage and/or current sensor may be in communication with the handle processor. When a threshold input voltage and/or current from the power pack 806 is detected at the contact pad 802, the handle processor can increment the battery-pack-connection count. This arrangement may be useful where the handle processor is powered at times by power sources other than the power pack, such as by supercapacitors or other sources.

[0083] Turning now to FIG. 16, a handle module 900 comprises a plurality of power sources, including a removable battery power pack 902 and a secondary power source 904. The removable battery power pack 902 is similar to the removable battery power packs described herein in many respects. The battery power pack 902 contains multiple Li ion and/or LiPo battery cells. The secondary power source 904 provides a source of power to the handle module 900 even when the removable battery power pack 902 has been removed or otherwise disconnected from the handle module 900.

In this case, the secondary power source 904 is used for low-power operations of the handle module 900, such as powering the electronic components on the control board 910 when the removable battery power pack 902 is removed from the handle module 900 - and not for high-power operations, such as powering the motor(s) 905 of the handle module 900. In various arrangements, the secondary power source 904 comprises rechargeable battery cells and/or supercapacitors (a/k/a ultracapacitors) that are charged by the removable battery power pack 902 when it is installed. The secondary power source 904 can power the electronic components on the control board 910 in the absence of the primary power source 902 for as long as the secondary power source 904 possesses a sufficient charge.

[0084] The secondary power source 904 may permit the handle module 900 to track use events and/or take end-of-life actions even when the power pack 902 is not installed in the handle module 900. FIG. 17A is a flow chart of a process executable by the processor of the control board 910, such as handle processor 2124. The process can be executed from software and/or firmware stored in the memory of the handle module. Prior to performing a surgical procedure, the power pack 902 is installed in the handle module 900. At step 920 of the process, the handle processor may record a time stamp for when a DSM is properly connected to the handle module 900. Once the surgical procedure begins, at step 922, the handle processor may record time stamps for each firing of the handle module 900 that occur during the surgical procedure. In addition, the handle processor can track the time which elapses between the firings. The secondary power source 904 can continue to supply power to the handle processor to track the time following a firing event even if the removable power pack 902 is removed from the handle module 900. At step 924, the handle processor can determine whether the elapsed time since the last firing is greater than a threshold time period. The threshold time period may be on the order of the time required to substantially process and sterilize the handle module following a procedure. If the time period between firings is not greater than the threshold, it can be assumed that the procedure is ongoing and the process may return to step 922 to record the time stamp for the next firing. On the other hand, if the time period between firings is greater than the threshold, it can be assumed that the procedure has concluded, at which point, at step 926, the handle processor can increment the use count of the handle module 900. At step 928, the handle processor compares the use count to the pre-programmed threshold use count for the handle module 900. If the use count is less than the threshold, the handle module 900 can be used in another procedure and the process can return to step 920 to await connection of a DSM for the next procedure. On the other hand, if the use count threshold has been reached, the process advances to step 930, where the end-of-life action(s) for the handle module 900 can be initiated. As described above, the end-of-life action(s) can include disabling the handle module such that the handle module cannot be used in subsequent surgical procedures. The motor of the handle module can be physically and/or electronically disabled. The end-of-life action(s) include visually indicating the end of life for the handle module on a display of the handle module and/or sounding an audible alarm.

[0085] FIG. 17B is a flow chart of another exemplary process that can be executed by the handle processor and powered at times by the secondary power source 904 to track uses of the handle module. At step 950, the handle processor can detect the connection of the removable battery power pack 902 to the handle module 900. Various techniques for detecting the insertion of the battery power pack 902 are described elsewhere herein. The insertion of the power pack 902 indicates to the handle processor that a surgical procedure involving the handle module 900 is about to commence. As a result, the handle processor can set a process flag to ON at step 952 when the handle processor detects the insertion of the power pack 902 into the handle module 900. At step 954, the handle processor can detect the complete and proper connection of a DSM to the handle module for the procedure. Various techniques for detecting the attachment of a DSM are described elsewhere herein. Once the DSM and the battery pack 902 have been properly attached, the surgical instrument can be used to complete a surgical procedure. In the event that the battery pack 902 is removed from the handle module 900, the handle processor can detect removal of the battery power pack 902 at step 956. Various techniques for detecting the removal of a power pack are disclosed elsewhere herein. Removal of the power pack is indicative of the conclusion of a surgical procedure and, as a result, the handle processor, now powered by the secondary power source 904, can increment the use count for the handle module 900 at step 958. Even if the removal of the power pack does not constitute the end of a surgical procedure, the insertion of a new battery pack and/or the re-insertion of a re-charged battery pack can be viewed as another use. Such reuse of the handle module 900 may be conditioned on a test administered at step 960 to assess whether the handle module 900 has reached the end of its useful life. If the end of the handle module's life has been reached, the handle processor can initiate an appropriate end-of-life action(s) at step 962. Various end-of-life actions are disclosed elsewhere herein. It should be appreciated that, with regard to any of the devices disclosed herein, an end-of-life action can be overridden by the user of the handle module. This can typically arise when the use threshold count has been reached in the middle of a surgical procedure.

[0086] FIGS. 18A-18E show end-of-life actions that could be taken by a handle module that uses a removably battery power pack to prevent further use of the handle module. FIG. 18A illustrates a handle module 1000 which includes an internal spring-activated lock-out 1002. The lock-out 1002, when released by the handle module 1000, prevents the complete and proper installation of a battery power pack 1004, and/or any other suitable battery pack, into the handle module 1000. The lock-out 1002 can be configured to completely prevent the power pack 1004 from entering the handle module 1000. Alternatively, the lock-out 1002 can prevent the power pack 1004 from being inserted to a depth in which

the battery contacts make electrical contact with the handle contacts, as illustrated in FIG. 18A and described in greater detail further below. Owing to the activation of the lock-out 1002, the power pack 1004 sticks out of the handle module 1000 by a distance D, as also illustrated in FIG. 18A. But for the lock-out 1002, the battery pack 1004 could be seated to a depth in which an end cap 1006 of the battery pack 1004 is flush, or at least substantially flush, with the housing of the handle module 1000.

[0087] As discussed above, the lock-out 1002 can selectively prevent the power pack 1004 from supplying power to the handle module 1000. In the non-locked-out state of the handle module 1000 illustrated in FIG. 18B, an electrical contact pad 1016 of the handle module 1000 can be in contact with a contact pad 1018 of the battery pack 1004 so that the internal electrical components of the handle module 1000 can be powered by the battery power pack 1004. In the locked-out state of the handle module 1000 illustrated in FIG. 18C, the lock-out 1002 prevents the contact pad 1018 of the battery pack 1004 from contacting the contact pad 1016 of the handle module 1000. Where the handle module 1000 does not include a secondary power source and/or a means for storing power, the handle module 1000 will be unusable in its locked-out condition. Where the handle module 1000 includes a secondary power source and/or a means for storing power, the handle module 1000 can utilize the power from these other sources to run the operating system of the handle module 1000, but not the drive systems and/or electric motors of the handle module 1000.

[0088] FIG. 18B illustrates the lock-out 1002 in a normal, operational state where it is not locking out the battery pack 1004 and FIG. 18C illustrates the lock-out 1002 in the locked-out state where it is locking out the battery pack 1004. The lock-out 1002 is biased to rotate from its unlocked position (FIG. 18B) to its locked-out position (FIG. 18C) by a torsion spring 1010 that is connected to the lock-out 1002. The torsion spring 1010 has a first end biased against an internal surface 1013 of the handle module 1000 and a second end mounted to the lock-out 1002. The handle module 1000 further includes a latch 1012 configured to releasably hold the lock-out 1002 in its unlocked position. The lock-out 1002 includes a lock shoulder 1014 that abuts the latch 1012 when the latch 1012 is in an extended position and, thus, holds the lock-out 1002 in its unlocked position. When the latch 1012 is retracted, as illustrated in FIG. 18C, the shoulder 1014 of the lock-out 1002 is no longer engaged with the latch 1012 and the torsion spring 1010 can bias the lock-out 1002 into its locked-out position.

[0089] When an end-of-life condition of the handle module 1000 has not yet been reached, a latch actuator of the handle module 1000 can hold the latch 1012 in the position illustrated in FIG. 18B. When an end-of-life condition is reached, however, the latch actuator may move the latch 1012 in the direction indicated by arrow A to move the latch 1012 away from the lock shoulder 1014 thereby allowing the lock-out 1002 to rotate counter-clockwise, as indicated by the arrow B in FIG. 18C, due to the bias of the spring 1010. In the locked-out state, the lock-out 1002 protrudes into the battery compartment of the handle module such that, when a battery pack 1004 is inserted in the handle module 1000, the electrical contact pad 1016 of the handle module 1000 does not contact the contact pad 1018 of the battery pack 1004, as discussed above. The latch actuator can comprise any suitable actuator, such as a solenoid.

[0090] In addition to or in lieu of the above, FIGS. 18D and 18E illustrate the case where, at the determined end-of-life for the handle module, a battery pack positioned in the handle module cannot be removed from the handle module, thereby preventing the insertion of a new (or recharged) battery pack in the handle module for a subsequent procedure. FIG. 18D illustrates a battery pack 1004 in a normal, operational state where it can be removed from the handle module following a procedure and FIG. 18E illustrates a latch 1040 locking the battery pack 1004 in the handle module such that the battery pack 1004 cannot be removed from the handle module. As shown in FIGS. 18D and 18E, the battery pack 1004 may define an opening 1042 in which a latch head 1044 of the latch 1040 can be inserted to lock the battery pack 1004 in position. The latch 1040 is biased downwardly by a compression spring 1046 mounted on an upper shaft 1048 of the latch 1040. The latch 1040 also includes an upper shoulder 1050 that, in the normal operating state of the handle module, shown in FIG. 18D, abuts a second latch 1052 that is positioned to keep the spring 1046 in a compressed state and prevent the downward movement of the latch 1040. As also shown in FIGS. 18D and 18E, the latch head 1044 includes a shoulder 1054 that, when the latch 1044 is in its actuated position as shown in FIG. 18E, locks behind a mating shoulder 1056 defined by the battery pack 1004.

[0091] In operation, when the handle processor determines that the handle module has reached the end of its life (by any of the means described herein), the handle processor may actuate the second latch 1052 causing the second latch 1052 to move out of the way of the latch 1044. The second latch 1052 may be actuated by any suitable actuator, such as a solenoid. As illustrated, the second latch 1052 moves left to right away from the shoulder 1050 of the latch 1040 as indicated by the arrow A when the latch 1052 is actuated. The removal of the second latch 1052 away from the shoulder 1050 allows the spring 1046 to decompress and urge the latch 1044 downward, as indicated by the arrow B, through an opening 1060 defined in the housing 1013 of the handle module. As the latch 1040 is moved downwardly by the spring 1046, the latch head 1044 extends into the opening 1042 defined in the battery pack 1004. The latch shoulder 1054 of the latch head 1044 can slide through the opening 1042 and lock in behind the mating shoulder 1056 of the battery pack 1004. The downward movement of the latch head 1044 is limited by the handle module housing 1013 when the upper shoulder 1050 of the latch 1040 contacts the handle module housing 1013. As a result, the battery pack 1004 cannot be removed from the handle module, thereby preventing insertion of a new (or recharged) battery pack

into the handle module for a subsequent procedure.

[0092] Referring now to FIGS. 19A-19C, a handle module 1100 comprises a rechargeable battery pack 1102 (with one or more rechargeable battery cells 1104) that can be recharged when the handle module 1100 is docked to a charging station 1106. The handle module 1100 further includes a slidable door 1108 that slides, generally up and down in a channel 1110 defined in the handle module 1100, between an open position (FIG. 19C) and a closed position (FIG. 19B). A compression spring 1112 is positioned in the channel 1110 which is configured to bias the slidable door 1108 downwardly into its closed position. When the door 1108 is in its closed position, the door 1108 can shield the battery charging terminals 1114, as depicted in FIG. 19B, from being damaged and/or accidentally coming into contact with a conductive surface in the surrounding environment. To recharge the battery cells 1104, the handle module 1100 is placed in a receiving area 1120 defined by the charging station 1106 that includes charging terminals 1122 that mate and contact with the charging terminals 1114 of the handle module 1100 when the handle module 1100 is inserted fully and properly in the receiving area 1120, as shown in FIG. 19C. As the handle module 1100 is placed in the received area 1120, the slidable door 1108 engages a shoulder 1124 of the charging station 1106 which urges the slidable door 1108 upward, as indicated by the arrow A, compressing the spring 1112, and unshielding (or revealing) the battery pack charging terminals 1114. At such point, the charging terminals 1114 can connect to and contact the receiving station charging terminals 1122 to thereby recharge the battery cells 1104 of the battery pack 1102.

[0093] The charging station 1106 may be powered by an AC power supply via a power cord 1130. The charging station 1106 also includes a visual display 1132 that displays information about the handle module 1100. For example, the charging station 1106 includes a processor (not shown) that communicates with the handle processor when the handle module 1100 is installed in the charging station 1106. For example, the charging terminals 1114, 1122 also includes data terminals that provide a data path between the processors. The charging station processor can receive information/data from the handle processor that can be displayed on the display 1132. The displayed information can include the charge status of the battery pack 1102 (e.g., X% charged) and/or any information tracked by the handle processor, such as the life count or remaining uses of the handle module and/or the number of lifetime firings.

[0094] FIGS. 20A-20B show covers 1201, 1202, 1203 that can be used with a handle module 1200 during a sterilization process to protect the internal components of the handle module 1200. The handle module 1200 includes an attachment portion configured to have a DSM attached thereto. An end effector connection area cover 1201 can connect to (e.g., snap-fit) and cover where the DSM connects to the handle module 1200. The handle module 1200 also includes a removable trigger assembly which is used to actuate the drive systems of the handle module 1200. In addition to or in lieu of the above, a trigger cover 1202 can connect to (e.g., snap-fit) and cover the opening that is created when the firing trigger assembly is removed from the handle module 1200. The handle module 1200 further comprises a battery cavity configured to receive a removable power pack therein. Also in addition to or in lieu of the above, a battery pack cover 1203 can connect to and cover where the battery pack is inserted in a pistol grip portion 1206 of the handle module 1200. These covers 1201, 1202, 1203 are preferably made of a material that is resistant to the chemicals used to sterilize the handle module, such as plastic. Further, the covers 1201, 1202, 1203 can cover electrical contacts of the handle module 1200 including an end effector contact board 1210, drive systems 1212, and/or the internal contacts for the battery pack (not shown).

[0095] The attachment of the covers 1201, 1202, and/or 1203 to the handle module 1200 can aid in tracking the number of times that the handle module 1200 has been used and/or sterilized. Similarly, the detachment of the covers 1201, 1202, and/or 1203 from the handle module 1200 can aid in tracking the number of times that the handle 1200 has been used and/or sterilized. At least one of the covers 1201, 1202, 1203 can include means to trigger a switch on the handle module 1200 indicating that the cover has been installed. When such a switch is triggered, the handle processor can assume that a sterilization procedure is imminent and enter a sterilization operation mode which is optimized to endure a sterilization procedure. When the handle processor is in a sterilization operation mode, the handle processor can prevent the motor(s) of the handle module 1200 from being operated, de-power certain contacts and/or sensors, power-up certain contacts and/or sensors, record any data stored in transient memory to a memory chip, copy the memory of the handle module to a back-up memory, and/or create a copy the current version of the operating system software for the handle module. The handle processor can also increase the use count of the handle module 1200 when one or more of the covers 1201, 1202, 1203 are attached to or detached from the handle module 1200. In the illustrated arrangement, the DSM connection area cover 1201 includes a protrusion 1220 that contacts and actuates a corresponding switch 1222 on the handle module 1200 (e.g., a depressible switch, or a contact switch, etc.) when the cover 1201 is placed on the handle module 1200. The switch 1222 may be in communication with the handle processor and, the handle processor may update its sterilization count when actuation of the switch 1222 is detected. In other arrangements, the trigger 1220 could be on other cover pieces 1202, 1203 and/or placed in different position on the DSM connection area cover 1201. In any event, since the battery pack is ordinarily removed during sterilization, the covers 1201, 1202, 1203 are preferably used in a handle module with a secondary power source that powers the handle processor even when the battery pack is removed, as described herein. As described in other arrangements herein, the handle processor may implement one or more of the end-of-life actions described herein when the sterilization count reaches the threshold level.

[0096] FIGS. 20C shows a variation of the battery pack cover 1203 and FIG. 20D shows a battery pack 1240 that is interchangeable with the battery pack cover 1203 in FIG. 20C. Because the battery pack cover 1203 and the battery pack 1240 are both designed to fit into the battery pack opening in the pistol grip portion 1206 of the handle module 1200 in lieu of one another, the battery pack cover 1203 of FIG. 20C has a shape and configuration that is very similar to the battery pack 1240 of FIG. 20D. For example, the battery pack cover 1203 and the battery pack 1240 both include a clip 1244 for locking to the handle module 1200. Also, the battery pack cover 1203 and the battery pack 1240 both include one or more tubular vessels 1242. The battery cells 1246 may be inside the vessels 1242 in the battery pack 1240 but not for the cover 1203. The cover 1203, however, also includes a feature(s) that readily distinguishes it from the battery pack 1240. In the illustrated arrangement, the cover 1203 includes a relatively thin, long, easily-graspable tab 1248 at the bottom of the cover 1203 that can include markings indicating that it is for use in sterilization, as shown in FIG. 20C.

[0097] As also shown in FIGS. 20C and 20D, each of the cover 1203 and the battery pack 1240 includes a respective tab 1250, 1252 that are located in different relative locations. In the illustrated arrangement, the tab 1250 of the cover 1203 is on the right vessel 1242 and the tab 1252 on the battery pack 1240 is on the left vessel 1242 thereof. When inserted into the handle module 1200, the tabs 1250, 1252 may contact and actuate corresponding and respective switches in the handle module 1200 to identify the insertion of the cover 1203 or battery pack 1240, as the case may be. The switches (not shown) may be in communication with the handle processor, and the handle processor can use the actuation of the respective switches to update its use, sterilization, and/or battery-pack-connection counts, as the case may be. The actuation of the sterilization switch can place the handle module 1200 in a sterilization operation mode and the actuation of the battery switch can place the handle module in a surgical operation mode. The tabs 1250, 1252 are preferably in two different locations such that the handle module 1200 includes two different switches: a battery switch which is only actuated by the battery pack 1240 and a sterilization switch which is only actuated by the sterilization cover 1203. In various arrangements, the tabs 1250, 1252 could be located at mirror opposite positions on the vessels 1242. Both the cover 1203 and battery pack 1240 can include feature(s) so that they can only be inserted in one orientation, to thereby prevent the battery pack tab 1252 from actuating the sterilization cover switch and vice versa. In the illustrated arrangement, the battery pack cover 1203 and the battery pack 1240 both include a tongue 1254 on only one side thereof that can fit into a corresponding groove defined in only one side of the handle module 1200.

[0098] FIGS. 21A-21C show exemplary displays for a handle module 1300 and/or a DSM 1302 that may provide visual information to a user about the status of the handle module 1300 and/or DSM 1302. As shown in FIG. 21A, the display includes a display portion 1304A on the handle module 1300 and a display portion 1304B on the DSM. The display portions 1304A and 1304B can be adjacent to one another or separated from one another. The display portions 1304A and 1304B can be utilized to display discrete, or non-overlapping, sets of information. The display portions 1304A and 1304B can be utilized to display coordinated information which may or may not be duplicative. Alternatively, the display 1304 could be wholly on the DSM 1302 as shown in FIG. 21B or, alternatively, the display 1304 could be wholly on the handle module 1300 as shown in FIG. 21C. The display 1304 comprises a flat panel display, such as a LED-backlit LCD flat panel display and/or any other suitable flat panel or non-flat panel display type. The display 1304 may be controlled by the handle processor and/or the DSM processor.

[0099] FIG. 21D shows an exemplary display configuration wherein the display comprises adjacent handle and end effector portions 1304A, 1304B. As shown in FIG. 21D, the handle portion 1304A indicators includes indicators related to the handle module, such as a battery status indicator 1310, an indicator 1312 that shows that the DSM connected to the handle module is recognized, and/or a general handle module error indicator 1314. The DSM display 1304B includes indicators related to the DSM, such as an indicator 1320 for whether the end effector jaws are closed, an indicator for whether the staples in the end effector have not yet been fired, an indicator 1322 for whether the staples have been properly fired, and/or an indicator 1324 for whether there is an error related to the staples or staple cartridge. Of course, in other variations, fewer, more, and/or different icons could be used to alert the user/clinician as to the status of various components of the handle module 1300 and/or DSM 1302. For example, the display 1304 may indicate the number of firings remaining for the battery pack and/or the number of remaining uses for the handle module. The display includes buttons and/or a touch screen interface where a user/clinician could input information to the handle module and/or DSM processors/memory.

[0100] A removable battery pack may be sterilized and recharged after a procedure so that it can be reused in a subsequent procedure in the same handle module and/or a different handle module. FIG. 22 is a diagram of a removable battery pack 1350 that can track the number of times it has been sterilized, which can be a proxy for the number of times that the battery pack 1350 has been used in surgical procedures. The battery pack 1350 includes a number of battery cells 1352 with output voltage terminals 1354. As shown in FIG. 22, the battery pack 1350 also includes a battery pack processor 1360 mounted to a battery pack circuit board 1362. The battery pack processor 1360 includes internal or external memory (such as external memory chip 1364 mounted to the circuit board 1362), and the battery pack processor 1360 can execute software/firmware stored in the memory. As such, the battery pack processor, 1360 can implement a battery management system (BMS) that manages the rechargeable battery. The BMS can protect the battery from being

operated outside its safe operating area, monitor the state of the battery, calculate secondary data, report that data, control its environment, authenticate the battery, and/or balance the cells of the battery.

[0101] In various arrangements, the battery pack 1350 also includes a micro moisture or humidity sensor 1366 for sensing when the battery pack 1350 is in a moist or humid environment consistent with undergoing a sterilization process.

The battery pack processor 1360 may be in communication with the moisture/humidity sensor 1366 such that, for each instance that the moisture/humidity sensor 1366 detects a threshold level of moisture or humidity for a threshold period of time which is consistent with a typical sterilization process, the battery processor 1360 may update its sterilization count as a proxy for the number of times the battery pack 1350 has been used. The battery processor 1360 can be configured to not count aberrational events that might yield false positives. In any event, once the threshold sterilization count has been reached, the battery pack processor 1360 may disable use of the battery pack 1350. For example, as shown in FIG. 22, the battery pack 1350 includes a data terminal 1368 that can provide a connection to the handle processor of the handle module. When the battery pack 1350 is spent (e.g., reached the sterilization count threshold), the battery pack processor 1360 may send a signal to the handle processor that the battery pack 1350 should not be used. The handle processor may then indicate through its display that there is a problem with the battery pack 1350.

[0102] The battery pack processor 1360 may update its use count based on data connections to a handle module. Every time the battery pack processor 1360 detects a data connection to a handle module, the battery pack processor can update its use count.

[0103] The battery pack 1350 includes a secondary power source (not shown) that is charged by the battery cells 1352 when the battery cells 1352 are charged and/or supply power to a handle module during a surgical procedure. In such an case, the low-power battery pack electronic components can remain powered even when the battery pack 1350 is not installed in a handle module. Also, as shown in FIG. 22, the battery pack 1350 includes an end cap 1370 and a latch 1372 for facilitating the connection of the battery pack 1350 to the handle module.

[0104] FIGS. 23A and 23B illustrate another possible end-of-life action for a handle module. In the illustrated arrangement, a handle module 1400 includes a projecting portion 1402 that is movable between a retracted position and an extended position. Prior to the end-of-life of the handle module 1400, the projecting portion 1402 is held in its retracted position. In such a position, the projecting portion 1402 does not interfere with the handle module 1400 being positioned in the corresponding opening in its sterilization tray 1404. Once the handle processor determines that the handle module 1400 has reached its end-of-life, according to any suitable algorithm, the projecting portion 1402 is moved into its extended position. In such a position, the projecting portion 1402 interferes with the proper placement of the handle module 1400 in its corresponding opening in the sterilization tray 1404. In the illustrated arrangement, the projecting portion 1402 is at the distal end 1406 of the handle module 1400, but it could be placed anywhere that is convenient and that, when projected, inhibits placing the handle module 1400 in the corresponding opening of the sterilization tray 1404. As mentioned before in connection with FIG. 11A, the sterilization tray includes an opening whose shape corresponds to the shape of the handle module so that the handle module is closely received in the opening. In the arrangement of FIGS. 23A and 23B, the handle module 1400 fits into the opening in the sterilization tray 1404 when the projection portion 1402 is retracted (not projected), but does not fit into the opening when the projecting portion 1402 is projected outwardly from the handle module 1400 as shown in FIGS. 23A and 23B. The projecting portion 1402 may be solenoid-driven. When the handle processor has determined that the end-of-life for the handle module 1400 has been reached, the coil of the solenoid is energized so that the solenoid armature is extended outwardly thereby causing the projecting portion 1402 to extend outwardly from the handle module 1400. The handle module 1400 also includes a stopper, such as a spring-loaded detent that prevents the retraction of the solenoid armature and the projecting portion 1402 once they have been actuated.

[0105] As described in connection with FIGS. 12A-E, a handle module could be connected to an inspection station before, during, and/or following a procedure. The inspection station can be used to perform tests on the handle module to determine if the handle module is in a condition suitable for another surgical procedure, or whether the handle module needs to be conditioned or repaired before it is suitable for another surgical procedure. As shown in FIGS. 24A and 24B, an inspection station 1500 includes an extension 1504 configured to be inserted into the empty battery cavity of a handle module such that the extension 1504 can be placed in communication with the handle module. A handle module 1501 depicted in FIG. 24B comprises such a handle module. The inspection station includes a vacuum coupling 1502 at the upper portion of the extension 1504 which can mate to a corresponding vacuum coupling 1506 in the internal portion of the handle module 1501. The inspection station 1500 may be connected to a vacuum pump via a vacuum port 1508, which is connected to the vacuum coupling 1502 of the inspection station 1500 via a tube 1510. When the vacuum pump is turned on, it may draw air from the internal portion of the handle module 1501 to dry the internal portions of the handle module 1501. The inspection station 1500 includes pressure gauges and/or air flow sensors in communication with the tube 1510 that measure how well the handle module 1501 holds the vacuum pressure. Such a vacuum test can evaluate the integrity of various seals throughout the handle module 1501, such as seals engaged with the rotary drive outputs 1512, 1514, seals engaged with the firing trigger areas 1516, and/or seals engaged with the electrical contact board 1518 that connects to the DSM. If the various handle module seals are not satisfactory, and the handle module does

not adequately maintain the vacuum as detected by the vacuum sensors, the inspection station 1500 can issue a warning via its display indicating that the handle module 1501 needs to be repaired.

[0106] In addition to or in lieu of the above, an inspection station could be adapted to dry a handle module following a surgical procedure and/or sterilization procedure as part of preparing the handle module for a subsequent procedure.

FIG. 25A illustrates an inspection station 1600 that could be used to dry a handle module 1602. Similar to the above, the inspection station 1600 includes a base portion 1610 and, in addition, an extension 1606 extending from the base portion 1610 that is positionable in the empty battery cavity of the handle module 1602 in order to place the handle module 1602 in communication with the inspection station 1600. The inspection station 1600 includes two fans - a first fan 1604 located at the upper end of the extension 1606 - and a second fan 1608 located at the front of the base portion 1610. The fans 1604 and 1608 are electrically powered, such as by an AC power source via a power adapter 1612. The first fan 1604 can be aimed at the internal components of the handle module 1602 through an opening in the battery pack cavity. The upper surface of the extension 1606 can include vent openings through which the air blown by the first fan 1604 can circulate to the handle module 1602. The second fan 1608 can be aimed at a trigger area 1614 of the handle module 1602 to dry the trigger area 1614 and the surrounding areas of the handle module 1602. The top, front surface of the base portion 1610 of the inspection station 1600 can include vent openings 1616 for the second fan 1608 so that air blown from the second fan 1608 can be circulated to the trigger area 1614. The base portion 1610 also includes an air intake for the fans 1604 and 1608, such as an air intake 1618 in the base portion 1610. The inspection station 1600 also includes exhaust vents, such as bilateral exhaust vents 1620 at the bottom of the extension 1606, to allow exhaust to escape from the inspection station 1600. The inspection station 1600 could include as many fans, air intakes, and/or air exhausts as deemed necessary.

[0107] FIGS. 25B, 25C, and 25D illustrate another exemplary inspection station 1600. The base portion 1610 in FIGS. 25B, 25C, and 25D is longer front-to-back than the base station in FIG. 25A, and the lower front fan 1608 in FIGS. 25B, 25C, and 25D is raised above the base portion 1610 and angled at the trigger area 1614. The arrangement shown in FIGS. 25B, 25C, and 25D also includes a cover (or lid) 1630 that attaches to the base portion 1610 of the inspection station 1600 and that covers and envelops the handle module 1602. The cover 1630 may be made of hard, translucent plastic, such as polycarbonate. The fan 1608 may be powered by the adapter 1612 for the inspection station 1600, as shown in FIG. 25C. Alternatively, the fan 1608 may have its own power adapter 1632, separate from the power adapter 1612 for the inspection station 1600, as shown in FIG. 25D. The upper surface of the cover/lid 1630 includes one or more air exhaust vents 1634, and the cover/lid 1630 also includes air intake vents 1636 near the fan 1608.

[0108] FIG. 25E illustrates another arrangement for the inspection station 1600 that uses vacuum flow to dry the handle module 1602. In such an arrangement, the cover/lid 1630 may define one or more air intakes 1640 (two of which are illustrated in FIG. 25E) and have a vacuum port 1642 configured to be placed in communication with a vacuum pump. To dry the handle module 1602, the vacuum pump is turned on to draw air from the air intakes 1640, across the handle module 1602, and into the vacuum port 1642. Preferably, the vacuum port 1642 is spaced away from the air intakes 1640 to increase the air flow across the handle module 1602. In the example of FIG. 25E, the air intakes 1640 are at the bottom of the cover/lid 1630 and the vacuum port 1642 is at the top of the cover/lid 1630; however, any suitable arrangement could be utilized.

[0109] A handle module, such as handle module 1602 could also be tested by a simulated load adapter. The handle module 1602 can be tested by a load adapter 1650 when the handle module 1602 is connected to the inspection station 1600, as shown in the examples of FIGS. 26A-26D. Alternatively, a simulated load adapter can be configured to test a handle module without a complementing inspection station. In any event, the simulated load adapter 1650 includes a housing 1651 and opposing load motors 1652, 1654 positioned in the housing 1651. As described in greater detail further below, the first load motor 1652 is configured to apply a first test load to a first drive motor of the handle module 1602 and the second load motor 1654 is configured to apply a second test load to a second drive motor of the handle module 1602. The first load motor 1652 is configured to drive a first mating nut 1660 which is operably engageable with a coupler 1656 driven by the first drive motor of the handle module 1602. The second load motor 1654 is configured to drive a second mating nut 1662 which is operably engageable with a coupler 1658 driven by the second drive motor of the handle module 1602.

[0110] The simulated load adapter 1650 comprises a motor control circuit on a circuit board with at least a processor, memory and a motor controller for controlling the load motors 1652, 1654. The motor control circuit may be embodied as one integrated circuit (e.g., a SOC) or a number of discrete integrated circuits or other circuitry. The motor control circuit may control the motors 1652, 1654 to apply an opposing force, under varying load conditions, to the rotary drive systems of the handle module 1602. The power drawn by the rotary drive systems of the handle module 1602 to resist and/or overcome the opposing forces can be monitored by the inspection station 1600 to determine whether the handle module motor(s) and rotary drive systems are functioning properly. The first motor 1652 of the simulated load adapter 1650 can be driven in one direction and the drive motor of the handle module 1602 can drive the first coupler 1656 in an opposite direction. If the drive motor of the handle module 1602 is unable to resist or overcome the simulated load applied by the first motor 1652 of the simulated load adapter 1650, then the simulated load adapter 1650 can instruct

the handle module 1602 that the handle module 1602 cannot perform as required. The second motor 1654 of the simulated load adapter 1650 can be driven in one direction and the drive motor of the handle module 1602 can drive the second coupler 1658 in an opposite direction. If the drive motor of the handle module 1602 is unable to resist or overcome the simulated load applied by the second motor 1654 of the simulated load adapter 1650, then the simulated load adapter 1650 can instruct the handle module 1602 that the handle module 1602 cannot perform as required. Such an assessment can constitute one facet of the overall assessment of whether the handle module 1602 is suitable for another procedure.

[0111] further to the above, the simulated load adapter motor control circuit can vary the load imparted by the simulated load adapter motors 1652, 1654 on the rotary drive systems of the handle module 1600 from (relatively) low to (relatively) high in a way that simulates the load that the handle module rotary drive systems are expected to experience during a surgical procedure. The motor control circuit can be programmed so that it can vary the load profiles of the motors 1652, 1654 based on the type of DSM to be used in an upcoming procedure. For example, using the user interface 1672 (e.g., the buttons 1670 and/or a touch screen of the interface 1672), the user could specify the desired simulated load conditions, such as selecting a pre-programmed simulated load condition corresponding to the different available DSMs. The simulated load adapter 1650 may have a data contact terminal 1674 that mates with the data connection terminal of the handle module 1602. In such a manner, the user's load profile selection can be uploaded from the inspection station processor, to the handle module processor, and to the motor control circuit of the load simulator 1650. In real-time and/or after the simulation, the motor control circuit can download to the handle module processor and/or the inspection station processor time-stamped power readings for the power (e.g., volt-amps) supplied to the load simulator motors 1652, 1654 during the simulation. The inspection station processor and/or the handle module processor can correlate these readings to time-stamped readings for the power drawn by the handle module motor(s) to evaluate the efficacy of the handle module motor(s) and rotary drive systems.

[0112] The simulated load adapter 1650 may be powered by the inspection station 1600. As shown in the example of FIG. 26B, electrical power from the inspection station 1600 could be supplied to the simulated load adapter 1650 via the handle module 1602 and the electrical contact board 1674. In the example of FIG. 26C, a separate power cord 1680 extending from the inspection station 1600 to the simulated load adapter 1650 can supply electrical power directly to the load simulator adapter 1650, bypassing the handle module 1602. In another arrangement, the load simulation adapter 1650 could have its own connection to an AC power source and/or its own battery power supply. The cord 1680 can also place the load simulator 1650 in direct signal communication with the inspection station 1600.

[0113] The simulated load adapter 1650 could also be used to monitor backlash in the handle module gears that are part of the rotary drive systems. When the simulated load adapter 1650 is in a backlash detection mode, the simulated load adapter motor control circuit can cause one or both of the simulated load motors 1652, 1654 to rotate, and the processors of either the inspection system 1600 and/or the handle module 1602 can track the rotations by the corresponding rotary drive systems of the handle module 1602. The difference in rotation between the simulated load adapter motors 1652, 1654 and the rotary drive systems of the handle module 1602 is an indication of the backlash in the respective rotary drive systems of the handle module 1602, which can diminish the life of the handle module. In other words, an increase in backlash can decrease the number of uses remaining for the handle module 1602. Accordingly, at each inspection of a handle module 1602, the inspection station 1600 and the load simulator 1650 can check the handle module's backlash and write the result to the handle module's memory. The handle module memory can store and time-stamp the backlash readings. The handle processor and/or the inspection station processor can determine a revised end-of-life threshold for the handle module, in terms of firings based on a model for the effect of backlash on the number of remaining uses. A sample model is depicted in FIG. 26E. Dashed line 1690 shows a threshold limit for backlash as a function of the number of firings of a handle module. Line 1691 depicts the expected backlash for the handle module as a function of use (e.g., firings). In this example, the backlash threshold is reached (lines 1690 and 1691 intersect) at about 500 firings. Since the backlash measurements can be tracked over time (and hence over the number of firings), the handle processor and/or the inspection processor can compare the backlash measurements, indicated by the diamonds FIG. 26E, to determine that the handle module backlash is trending to reach the threshold at less than 500 firings, in this example about 370 firings. This revised, updated firing threshold could be used in assessing the remaining life of the handle module. For example, if the handle module has been fired 220 times, and its revised end-of-life is 370 firings because of backlash, the processor could determine that the handle module has 150 firings remaining; or if 7 firings per procedure are assumed, then the handle module has 21 procedures remaining. The backlash can be tested for each rotary drive system of the handle module in this manner and the one with the least remaining life can dictate the overall remaining life of the handle module.

[0114] The above being said, if less backlash than expected is measured, then the firings needed to reach the end-of-life threshold of the handle module can be revised upwardly, or increased. In fact, the end-of-life threshold of a handle module can be increased if any parameter and/or a combination of parameters indicates that the handle module is experiencing less wear than expected. Correspondingly, the end-of-life threshold of a handle module can be decreased if any parameter and/or a combination of parameters indicates that the handle module is experiencing more wear than

expected. Moreover, the various parameter thresholds disclosed herein can be fixed or adaptable. A threshold parameter can be adapted based on intrinsic and/or extrinsic information. For instance, the control system of a handle module can evaluate patterns or trends in parameter data and adapt a parameter threshold relative to the pattern or trend. The control system can establish a baseline from sensed parameter data and establish a parameter threshold relative to that baseline. The control system of a handle module can evaluate patterns or trends in the data obtained for a first parameter and adjust the threshold of a second parameter based on the evaluation of the first parameter data. The control system can establish a baseline from sensed data of a first parameter and establish a threshold for a second parameter relative to that baseline. Moreover, many thresholds are described herein as comprising two ranges, i.e., a first range below the threshold and a second range above the threshold. The threshold itself may be part of the first range or the second range, depending on the circumstances. That said, a threshold, as used herein, comprises three ranges, i.e., a first range below a minimum value, a second range above a maximum value, and a third range between the minimum value and the maximum value. If the sensed data for a parameter is in the first range, the control system may take a first action and, if the sensed data for the parameter is in the second range, the control system may take a second action, which may or may not be the same as the first action. If the sensed data for the parameter is in the third range, the control system may take a third action, which could include no action at all. The minimum value could be part of the first range or the third range, depending on the circumstances, and the maximum value could be part of the third range or the second range, depending on the circumstances. If data is sensed in a first range, the control system may adapt a threshold in one direction and, if the data is sensed in a second range, the control system may adapt the threshold in the opposite direction while, if the data is sensed in a third range, the control system may not adapt the threshold.

[0115] As shown in FIGS. 27A and 27B, the inspection station 1600 could accommodate both a handle module 1602 and one or more DSMs 1680. FIG. 27A illustrates such an inspection station 1600 by itself; FIG. 27B shows the inspection station 1600 with both the handle module 1602 and a DSM 1680 connected thereto. The inspection station processor may be in communication with the handle module processor and/or the DSM processor in order to download and upload data and information. As shown in FIG. 27A, an inspection station 1600 that also supports DSMs includes rotary drives 1682, 1684, configured like the rotary drives 1656, 1658 of the handle module 1600. The inspection station 1600 may actuate the inspection station rotary drives 1682, 1684 to test the drive systems of the DSM 1680. In yet other arrangements, the DSM 1680 may have its own inspection station for performing the various tests and/or data transfers.

[0116] In view of the above, an inspection station 1600 could be used to perform a number of pre-procedure and/or post-procedure instrument processing tasks for a handle module and/or a DSM, such as:

- Determine and display a device ID (e.g., serial number) and/or model, and the state of the device (e.g., end-of-life, locked out, etc.);
- Read/download data from the memory of the handle module 1602, such as the number of firings/cycles, performance parameters, handle and/or DSM software versions;
- Based on the device identification, set and upload the operation instructions and criteria for the handle module and/or DSM, which the inspection station can retrieve from memory based on the device ID;
- Perform various electronic tests, such as modular connection integrity tests, memory version tests, system electronic checks, transfer rate (read/write) checks, scheduled maintenance checks, warranty expiration checks, end-of-life checks, system lockout checks, and/or internal battery life conditioning tests;
- Perform various physical tests, such as motor performance tests (with and/or without simulated loads as described above), seal integrity tests, etc.;
- Performance testing, such as comparing actual data from a procedure (downloaded from the handle module and/or DSM memory) to expected procedure data;
- Reset lockouts in the handle module where necessary;
- Dry the device;
- Inform users (e.g., via the display) that the device (handle module and/or DSM) is or is not suitable for continued use;
- Upgrade software of the handle module and/or DSM;
- Write test results to the handle module memory and/or DSM memory; and/or

- Transmit handle and/or DSM performance and usage data to a remote computer system, via a USB or wireless (e.g., WiFi) connection.

[0117] The inspection station memory may store software and/or firmware that the inspection station processor executes to perform these various functions.

[0118] The displays of the inspection station and/or the handle module may also make maintenance and servicing recommendations based on the various usage related data for the handle module. Based on usage data such as the number of procedures, the number of sterilizations, the number and/or intensity of firings, and/or the gear backlash the inspection station and/or handle module processors can determine whether various maintenance or servicing tasks should be undertaken or recommended with respect to the handle module and/or the DSM, and communicate those recommendations to a user via the displays of either the inspection station and/or the handle module. The maintenance and servicing recommendations could be performed and communicated to the user following a completed procedure, during a procedure, and/or at the beginning of a procedure.

[0119] FIGS. 28A-28B are exemplary process flows for making maintenance and/or service recommendations that could be performed by the handle module processor and/or the inspection station processor by executing firmware and/or software in the processors' associated memory. FIG. 28A illustrates an exemplary process flow for the inspection station processor 442. At step 1800, following a procedure, the handle module is connected to the inspection station (see FIG. 19A), whereupon usage and performance data from the handle module memory is downloaded to the inspection station. This data includes a count of the number of procedures for the handle module; various ways to count the number of procedures are described herein. The data also includes the number of firings by the handle module, the intensity (e.g., force) for each firing, the firing force differential between the expected firing force and the actual firing force, the (accumulated) energy spent by the handle module over the life of the handle module, and/or the gear backlash.

[0120] At step 1802, based on the data, the inspection station processor determines whether service of the handle module is needed. The inspection station processor may parse the usage and performance data multiple ways as programmed to determine if service is needed, and may make one or several service recommendations at step 1804 if it is determined that service is required. The service recommendations could be as extensive as suggesting that the handle module be rebuilt, or as minor as lubricating certain parts. Also one service check that the inspection station processor may perform at step 1802 is that for every N_1 procedures and/or every S_1 firings, or some combination of procedures and firings (e.g., N_2 procedures and S_2 firings), the handle module should be rebuilt. In such a case, if the inspection station processor determines that any of those thresholds has been met, at step 1804 the inspection station processor may control the inspection station display to show that the handle module should be rebuilt. Another service check that the inspection station processor may perform at step 1802 is that at every S_3 firings, the rotary drive systems' gears should be lubricated. Other service checks that the inspection station can perform and recommend if appropriate include: electrical integrity checks for electrical contacts of the handle module; testing of the communication system; extended diagnostics of electronics of the handle module (e.g., RAM and/or ROM integrity, processor operation, idle and operating current draw, operating temperatures of selected components, etc.); operation of indicators, displays and sensors; and/or battery issues, such as cycling, balancing and/or testing. Service checks can be performed on a battery to evaluate the condition of the battery. For instance, the inspection station can assess whether the battery is nearing the end of its life, if rechargeable, or nearing a threshold for less than one firing remaining for a disposable battery. Yet other services checks include firing the device (in a diagnostics mode or other mode that permits firing without a DSM or cartridge) to monitor abnormalities in a motor parameter (such as voltage or current, etc.). A damaged gear can cause a change in motor load, detectable through the monitored motor parameters, that can indicate an internal problem requiring replacement. Also, a generally higher motor load can indicate a need for cleaning or lubrication, or damage within the device.

[0121] At step 1806 the inspection station processor may determine whether any components of the handle module need to be checked. As before, the inspection station processor may parse the usage and performance data multiple ways as programmed to determine if the checking of various handle module components is needed, and may make one or several component check recommendations at step 1808 if it is determined that component checking is required. For example, if the inspection station processor determines that the gear backlash is beyond a pre-established threshold at step 1806, the inspection station processor may display a suggestion at step 1808 that the gears of the rotary drive systems should be checked. Also, if the inspection station processor determines that the accumulated energy spent by the handle module is beyond a pre-established threshold at step 1806, the inspection station processor may display a suggestion at step 1808 that the motor(s) and/or the gears of the rotary drive systems should be checked. Similarly, if the inspection station processor determines that a threshold number of firings (in the most-recently completed procedure and/or during the life of the handle module) exceed a pre-established intensity threshold (e.g., force or electric power) at step 1806, the inspection station processor may display a suggestion at step 1808 that the motor(s) and/or the gears of the rotary drive systems should be checked. The inspection station processor, via the display, could also recommend that the DSM be checked. For example, if the inspection station processor determines that a threshold number of firings

in the most-recently completed procedure exceed a pre-established intensity threshold at step 1806, the inspection station processor may display a suggestion at step 1808 that the sharpness of the cutting instrument in the end effector should be checked, since a dull cutting instrument may necessitate greater force to execute a cutting stroke.

[0122] The handle module processor may also make service and/or component checking determinations and recommendations. FIG. 28B illustrates an exemplary process flow for the handle module processor 2124. The process of FIG. 28B is similar to that of FIG. 28A, except that, at step 1801, the handle module processor stores usage and performance data from its procedures and post-procedure processing so that it can make the determinations at step 1802 and 1806 about whether service and/or component checking is required. The recommendations and suggestions displayed at steps 1804 and 1808 may be on the handle module's display and/or, in the case when the handle module is connected to the inspection station and there is a data connection therebetween, the handle module processor may communicate the recommendations to the inspection station processor so that the inspection station display can display the recommendations, in lieu of or in addition to displaying them on the handle module display.

[0123] As shown in FIGS. 27A and 27B, a DSM 1680 could also be connected to an inspection station 1600. In such an arrangement, the DSM processor and/or the inspection station processor may make service and component checking determinations and recommendations based on usage and performance data stored in the DSM memory.

[0124] To that end, FIG. 35 is a flowchart illustrating steps that can be performed with the inspection stations described herein. At step 2200, a clinician performs a surgical procedure with the surgical instrument comprising the handle module and one of the DSMs. As described herein, the handle module memory can store usage and procedure data from throughout the procedure, such as motor energy and power levels, motor torque, and/or time stamps for actuation of various triggers. Following the procedure, at step 2202, the clinician can disconnect the DSM from the handle module and remove the removable battery pack so that the handle module can be prepared for use in a subsequent procedure by, at step 2204, connecting the handle module to the inspection station as shown herein. At step 2206, the inspection station can download (or read) the procedure and usage data from the memory of the handle module. The inspection station can also download the identification data for the handle module, which the inspection station processor can use to determine the handle module type and/or configuration at step 2208, which the inspection station can display on its display.

[0125] At step 2210, the inspection station can set the inspection programs and inspection criteria for the handle module based on its type and configuration. For example, the inspection station memory may store the inspection programs that should be performed for each handle module type and configuration, as well as the criteria for the inspections. Based on the handle module type and configuration resolved by the inspection station at step 2208, the inspection station can call and/or set the appropriate inspection programs and inspection criteria to be used for the handle module. For example, at step 2212, the inspection module can dry components of the handle module, such as described herein in conjunction with FIGS. 25A-25E. Also, at step 2214 the seal integrity tests can be performed, such as described herein in conjunction with FIGS. 24A-24B. At step 2216, electronic integrity tests for the handle module can be performed. These tests can include testing that electrical connections exist between the appropriate components, and for data processing components of the handle module, that the protocols and connections for transmitting data are functioning. At step 2218, functional and/or physical tests of the handle module can be performed. For example, the motor(s) and/or the rotary drive systems can be tested (e.g., driven) to make sure that they are functioning properly. At step 2220, the handle module lockouts that need to be reset following a procedure can be reset. At step 2222, further necessary conditioning for the handle module can be performed. This conditioning can include any other conditioning necessary to prepare the handle module for a subsequent surgical procedure, and/or performance of any service recommendations identified by the inspection station. At step 2224, the handle module can be released from the inspection station, whereupon it can be used in a subsequent surgical procedure (or sterilized before using in a subsequent procedure). The inspection station may "release" the handle module by indicating on the display of the inspection station that it can be removed.

[0126] As shown in FIGS. 27A and 27B, a DSM could also be connected to such an inspection station following its use in a surgical procedure in order to inspect the DSM. A similar process to that illustrated in FIG. 35 can be used for the DSM connected to the inspection station to prepare the DSM for a subsequent procedure.

[0127] Various steps illustrated in FIG. 35 can be performed in different orders or simultaneously and the steps illustrated in FIG. 35 do not necessarily need to be performed in the order illustrated in FIG. 35, although they could be. For example, the electronic integrity tests (step 2216) could be performed before the seal integrity test (step 2214), etc.

[0128] FIGS. 36 and 37 are flow charts illustrating exemplary steps involved in sterilizing a handle module and tracking the number of times it is used/sterilized. In FIG. 36, the process starts at step 2300 where the handle module (and a DSM) are used in a surgical procedure. After the procedure, at step 2302, a post-op clean-up of the handle module can be performed, which can entail a manual wipe down of the handle module. Thereafter, at step 2304, the handle module can be decontaminated, such as with an auto-washer. At step 2306, the handle module can be dried in a clean room, using heat and/or air. At step 2308, the handle module can be connected to an inspection station, such as the inspection stations described herein in connection with FIGS. 12A-12C, 19A, 25A-25E, 26A-26C, and/or 27A-27B.

[0129] At step 2310, the inspection station can query or interrogate the handle module to determine if the sterilization switch (e.g., switch 344, see FIGS. 11E-11I) was activated or otherwise in the state that indicates its prior placement in a sterilization tray, such as shown above in FIGS. 11E-11I. If the sterilization tray switch is in the triggered or actuated state, at step 2311 the sterilization count is increased and the switch state reset. Then, at step 2312, the inspection station can determine whether the threshold sterilization count for the handle module has been reached, as described herein. If the sterilization count has been reached, at step 2314, any of the herein-described end-of-life actions for the handle module can be taken.

[0130] Conversely, if the threshold has not yet been reached, the process can advance to step 2316 where the handle module is prepared for sterilization, such as by placing the handle module in its corresponding sterilization tray (see FIGS. 11E-11I, for example) and/or placing the sterilization covers on it (see FIGS. 20A-20D, for example), which in either case can activate the sterilization trigger at step 2318. The handle module can be sterilized at step 2320, whereupon it can be stored and subsequently transported to an operating room at step 2322 for use in a subsequent procedure at step 2300.

[0131] Returning to step 2310, if the sterilization trigger is not activated or its status changed, the handle module may have to be physically inspected at step 2324.

[0132] The exemplary process flow of FIG. 37 is similar to that of FIG. 36, except that following the procedure at step 2300, the handle module can be powered back on to determine if its sterilization state flag (set by handle module processor when the switch 344 is activated, see FIGS. 11E-11I) is set at step 2310. If so, at step 2311 the sterilization count can be updated and the sterilization state reset.

[0133] As mentioned above, the handle module battery pack may be removed from the handle module following a surgical procedure so that it can be used in the same or another, similarly-configured handle module in a subsequent procedure, typically after recharging. FIGS. 29A-D illustrate a charging station 1700 for recharging battery packs 1702. The battery packs 1702 are inserted into receptacles 1704 defined in the charging station 1700, shown in the side-views of FIGS. 29B and 29C, such that, when the battery packs 1702 are inserted, their respective power terminals 1706 contact corresponding charge terminals 1708 at the bottom of the receptacles 1704 to charge the respective battery packs 1702. The illustrated charging station 1700 can simultaneously charge two battery packs, although in other arrangements a charging station could have receptacles for storing and charging more or fewer battery packs.

[0134] The charging station 1700 includes a display 1709 that displays the status of the battery packs 1702 in terms of the charging process, such as currently charging or charged/ready to use. For battery packs currently charging, the display may show how far along the charging process is and/or how far there is to go. Text and/or graphics may be used to indicate the charging status, such as a volume and/or other type of fractional indicator that indicates how charged the battery pack is (e.g., 40% charged, 50% charged, etc.).

[0135] As shown in FIGS. 29B and 29C, the receptacle 1704 may be sized so that the end portion of the battery pack 1702 that is inserted into the receptacle fits in easily (e.g., a zero insertion force connection). The charging station 1700 includes means for detecting when the battery pack 1702 is inserted into the receptacle. For example, as shown in the block diagram of FIG. 29D, the charging station 1700 includes a pressure switch 1720, in communication with the charging station processor 1722, at the bottom of the receptacle 1704 that is actuated when the battery pack 1702 is inserted. Additionally or alternatively, the charging station processor 1722 may detect the insertion of a battery pack 1702 when a charging station data terminal 1712 makes a data connection with the battery pack data terminal 1710. In any case, when the battery pack 1702 is inserted into the receptacle 1704 of the charging station 1700 for charging, the charging station 1700 may temporarily secure the battery pack 1702 to the charging station 1700 so that the battery pack 1702 cannot be removed prematurely (e.g., prior to charging and/or a complete charging). In one arrangement, as shown in FIGS. 29B and 29C, this is accomplished by a screw 1724 at the bottom of the receptacle 1704 of the charging station 1700 that automatically screws into a corresponding opening 1726 in the bottom of the battery pack 1702 that is sized and threaded for receiving the screw 1724.

[0136] FIG. 29D is a simplified block diagram of the charging station 1700 and a battery pack 1702 according to various arrangements. Assuming the charging station 1700 is powered by an AC power source, the charging station 1700 includes an AC/DC converter 1730 to convert the AC voltage into DC voltage and a voltage regulator 1732 for converting the DC voltage to the desired charging voltage and/or current for charging the battery cells 1734 of the battery pack 1702. The charging station 1700 includes a charging controller circuit 1736 for controlling the voltage regulator 1732 based on sensed parameters of the charging operation, such as current, voltage and/or temperature, which can be sensed by the sensing circuit 1738 of the charging station 1700. For example, when charging a battery pack 1702 under normal charging conditions, the charging controller circuit 1736 may control the voltage regulator 1732 to charge at a constant current until the Li-ion or LiPo battery cells 1734 reach a specified voltage per cell (V_{pc}). Then the charging controller circuit 1736 can hold the cells at that V_{pc} until the charge current drops to X% of the initial charge rate (e.g., 10%), at which point the charging process can terminate. Other charging regimens, appropriate to the battery technology, can be performed.

[0137] The pressure switch 1720 may detect the insertion of the battery pack 1702 into the receptacle 1704 of the

charging station 1700 and, when activated, send a signal to the charging station processor 1722. The charging station processor 1722 may send in response a control signal to a connection actuator 1740, such as a linear actuator, that drives the screw 1724 into the battery pack screw opening 1726. The connection actuator 1740 may be powered by a second voltage regulator 1742 that can power, in addition to the connection actuator 1740, the other electronic components of the charging station 1700.

[0138] Further to the above, the battery pack 1702 includes a data terminal 1710 that, when the battery pack 1702 is inserted into the receptacle 1704, mates with a corresponding data terminal 1712 of the charging station 1700. The charging station processor 1722 may have internal or external memory 1744 that stores firmware and/or software to be executed by the charging station processor 1722. By executing the firmware and/or software, the charging station processor 1722 can (i) control the display 1709, (ii) control aspects of the battery cell charging process by communicating with the charging controller 1736, and/or (iii) exchange data with the battery pack processor 1750 via the data terminals 1710, 1712. As described herein, the battery pack electronics also includes memory 1752 that stores firmware and/or software to be executed by the battery pack processor 1750, such as a battery management system (BMS). The battery pack 1702 also comprises sensors 1754 for sensing conditions related to the battery pack 1702, such as moisture and/or humidity as described above. The data terminal 1712 of the charging station 1700 may also supply low-level power to the battery pack processor 1750. The charging station 1700 also includes a wireless module 1755 in communication with the processor 1722 that can communicate with remote devices via wireless communication links (e.g., Wi-Fi, Bluetooth, LTE, etc.). As such, the charging station 1700 could communicate wirelessly to remote computing systems (e.g., servers, desktops, tablet computer, laptops, smartphones, etc.) the charge status and other data regarding the battery packs 1702 installed in the charging station 1700 (e.g., impending end-of-life, temperature). The charging station could also include a port for a wired connection (e.g., USB-type port) so that charge status and other data regarding the battery packs 1702 can be downloaded from the charging station 1700 to the connected device. That way, the surgical staff and/or the battery pack supplier can receive such information.

[0139] To extend battery run time as well as battery life the battery cells comprising the battery pack 1702 may be rebalanced from time to time during the life of the battery pack 1702. FIG. 29E is a diagram of a process flow that can be performed by the charging station processor 1722 (by executing firmware/software stored in the memory 1744) to rebalance the battery cells. At step 1760, the charging station processor 1722 can detect the insertion of a battery pack 1702 into the inspection station 1700 for charging based on the signal from the pressure switch 1720 in the receptacle 1704 and/or by some other suitable means. At step 1762, the charging station processor 1722 can actuate the connection actuator 1740 to temporarily secure the battery pack 1702 to the charging station 1700 during the charging (and/or discharging) session. At step 1764, the charging station processor 1722 can exchange data with the battery pack processor 1750. Among other things, the battery pack processor 1750 can exchange a log of the times the battery pack 1702 has been charged and the times that its cells were balanced. At step 1765, the charging station 1700 can quickly top-off the charge of the battery cells in case the battery pack is needed before a complete charging or discharging cycle can be performed. The top-off charge at step 1765 could be to merely charge the battery cells at a constant current to bring them to the specified Vpc level or a fraction thereof. At step 1766, the charging station processor 1722 can determine whether the battery cells should be balanced again. The cells may be balanced every N times they are charged, where N is an integer greater than or equal to one, and preferably greater than one. If it is not time to rebalance the cells, the process advances to step 1768 where the battery cells are recharged and at step 1770 released for use, such as by de-actuating the connection actuator 1740 so that the battery pack 1702 can be removed from the receptacle. On the other hand, at step 1766, if it is determined that the battery cells need to be rebalanced, the process can advance to step 1772 where the cells are discharged before being charged at step 1768. The cells may be discharged at step 1772 to a suitable (low) voltage level.

[0140] As shown in FIG. 29A, the charging station 1700 includes an emergency release button 1780 for each battery pack charging receptacle, or just one emergency release button 1780 that releases only the battery pack 1702 that presently has the most charge (and thus most suitable for emergency use). The charging station processor 1722 may initiate one or many actions when the emergency release button 1780 is depressed for a particular battery pack 1702 when charging of that battery pack is in process. For example, the charging station processor 1722 can signal the connection actuator 1740 to unscrew the battery pack 1702 so that it can be removed. Also, before such mechanical release of the battery pack 1702, the charging station processor 1722 can instruct the charging controller to take action to expedite rapid charging of the battery pack 1702. For example, the charging station processor 1722 can instruct the charging controller 1736 to use a charging profile that more rapidly charges the battery cells 1734 for a brief time period, even though such rapid, short-term charging may not fully charge the battery cells to their capacity or promote longevity of the battery cells. Common charge profile stages for charging Li-ion battery cells include (i) trickle charge, (ii) constant current charge, and (iii) constant voltage charge. The charging controller circuit 1736 can switch to one of these profiles (e.g., constant current charge) in the short duration to provide the battery pack 1702 with as much additional charge as possible in the short time period. Also, the charging station processor 1722 can coordinate increasing the charging voltage available for charging the battery cells by making other power sources available for charging, such as from other

receptacles and/or charge storing devices (e.g., supercapacitors or battery cells) in the charging station 1700. Data about such charging procedures can also be logged in the battery pack memory.

[0141] FIG. 30A illustrates another exemplary charging/discharging determination process that the charging station processor 1722 may undertake, in addition to or in lieu of the process shown in FIG. 29E. The process of FIG. 30A recognizes that discharging of surgical instrument battery packs often is beneficial to their longevity, but that the battery packs should not be discharged if there is insufficient time to discharge them before they will be needed in a surgical procedure. The process of FIG. 30A starts at step 1780 where a "first" rechargeable battery pack is inserted into one of the charging receptacles 1704 of the charging station 1700. At step 1782, battery pack usage data from the first battery pack is downloaded to the charging station memory, which includes the current remaining battery capacity. Although not shown in FIG. 30A, the first battery pack could also be secured to the charging station when it is inserted (see FIGS. 29B-29C). At step 1784, the charging station 1700 may immediately charge the first battery pack in case it might be needed in a currently ongoing or imminent procedure. At step 1786, data about the charging of the first battery pack at step 1784 is written to the memory of the first battery pack. This data can include time stamps for the beginning and ending of the charging step, as well as the starting and ending battery capacity.

[0142] At step 1788, the charging station processor checks the charging/discharging log for the first battery pack and, if the first battery pack was fully discharged since the last procedure, the process advances to step 1790 where the first battery pack is ready for use in a procedure. At this step, the charging station display may indicate that the first battery pack is ready for use. On the other hand, if at step 1788 it is determined that the first battery pack has not been fully discharged since its last procedure, the process may advance to step 1792 where the charging station processor can determine if there is at least one other fully charged battery pack in its charging receptacles. If so, at step 1794 the first battery pack can be fully discharged to prolong its longevity and because there is another fully charged battery pack ready for use if needed. Once the discharge of the first battery pack is complete, at step 1796 the discharging data (e.g., beginning and ending time-stamps, beginning and end capacities) can be written to the first battery pack memory so that the evaluation at step 1788 can be performed. Thereafter, the process can advance to step 1784 where the battery cells of the first battery pack are recharged, and the process repeats. If the first battery pack was discharged at step 1794 since the last procedure, from step 1788 the process will advance to step 1790 because another discharge of the battery cells is not required.

[0143] Modifications to the process of FIG. 30A can be made. For example, the initial charging step 1784 could be eliminated and/or moved between steps 1788 and 1790 and/or between steps 1792 and 1790.

[0144] FIG. 30B illustrates another exemplary charging/discharging determination process that the charging station processor 1722 may undertake. The process of FIG. 30B is similar to that of FIG. 30A, except that at step 1783, following step 1782, the charging station 1700 can perform a quick charge top-off of the battery pack (e.g., short charge to less than full capacity) and record data about the top-off charging in the battery pack memory. Then at step 1788, as in FIG. 30A, the charging station processor can determine if the battery pack was discharged fully since the last procedure and, if so, at step 1789, then perform a full charging of the battery pack, at which point the battery pack is ready for use (block 1790). On the other hand, at step 1788, if the charging station processor determines that the battery pack was not fully discharged since the last procedure, the process can advance to step 1792 where the charging station determines if another battery pack is currently inserted in one of its receptacles 1704 is ready for use (e.g., adequately or fully charged). If not, the first battery pack can be fully charged at step 1789. However, if another battery pack is adequately or fully charged and ready for use, at step 1794 the first battery pack can be discharged (with data about the discharge being stored in the battery pack memory). After full discharge, the process can advance to step 1789 so that the first battery pack can then be charged.

[0145] The charging station processor 1722 can monitor and store the times at which the various battery cells are inserted into it, as indications of when procedures are being performed by the hospital or surgical unit in which the charging station is located. The charging station processor 1722 can be programmed to determine times of the day when the hospital or surgical unit is typically performing procedures involving instruments that utilize such battery packs and when it is not. In particular, the charging station processor 1722 can determine a statistical likelihood that the hospital or surgical unit is performing a procedure involving instruments that utilize such battery packs for non-overlapping time increments that span a 24-hour period, such as one-hour increments. Thus, for the full charging of the battery packs (e.g., at step 1789 of FIG. 30B), the charging station can commence such full charging steps at times when there is a low likelihood of an ongoing procedure, especially in instances where there is an already another fully charged battery pack ready for use. That is in FIG. 30B, the full charging at step 1789 following discharging at step 1792 need not immediately follow the discharging at step 1792 but could instead be scheduled for a time that there is a low likelihood of an ongoing procedure, as determined and scheduled by the charging station processor 1722. Further, the personnel at the hospital or surgical unit can input to the charging station 1700, via the user interface 1709 data about when procedures are to be performed and/or the types of procedures (or the amount of charge needed for the procedures) that are to be performed. This data can be stored in the charging station memory 1744 and used by the charging station processor 1722 to determine when to charge the battery packs.

[0146] In a system that charges and discharges batteries, there can be a significant amount of energy wasted in dumping the power from the cell(s) under maintenance in the form of heat because typically the charge on a battery cell to be discharged is drained through a resistive load. Accordingly, the charging station includes fans and/or heat sinks to help dissipate heat. Alternatively, the charging station may use the charge on a cell to be discharged to charge another cell in the charging station or store it in another charge storing device. FIG. 31 is a simplified diagram of a circuit 1900 for discharging battery cells in such a manner. When charging the "first" battery cell 1902, the power source/voltage regulator 1904 is connected to the first battery cell 1902 by closing switch S1, with all other switches (S2, S3, S4 and S5) being open. To discharge the first battery cell 1902 through the resistor 1906, switches S2 and S3 are closed and switches S1, S4 and S5 are open. The diode 1903 controls the direction in which current flows from the first battery cell 1902. To discharge the first battery cell 1902 to the energy storage device 1908 (e.g., supercapacitor or another battery cell internal to the charging station and not ordinarily for use in a surgical instrument), switch S2 is closed and the rest of the switches S1, S3, S4 and S5 are open. The diode 1903 controls the direction in which current flows to the energy storage device 1908. To charge the first battery cell 1902 with the charge on the energy storage device 1908, switch S5 is closed and the rest of the switches S1, S2, S3, and S4 are open. The diode 1905 controls the direction in which current flows to the first battery cell 1902. To charge another battery cell 1910 with the first battery cell 1902, switches S2 and S4 are closed and switches S1, S3 and S5 are open. The switches S1, S2, S3, S4 and S5 can be controlled by the charging station processor 1722 and/or the charging controller 1736.

[0147] FIG. 32 shows a circuit for charging and discharging the first battery pack 1902 that is similar to that of FIG. 31, except that the configuration of FIG. 32 includes a set of battery cells 1920 that can be used to charge the first battery cell 1902. In the illustrated arrangement, the set 1920 includes three battery cells 1922, 1924, 1926, although in other arrangements the set 1920 includes more or less battery cells. The battery cells 1922, 1924, and 1926 in the set 1920 may be internal battery cells of the charging station and/or other battery packs inserted into the charging station. The cells 1922, 1924, 1926 in the set 1920 may be used to rapidly charge the first battery pack 1902, such as in a situation where a replacement battery pack is needed in an ongoing procedure. In the illustrated arrangement, the cells 1922, 1924, 1926 in the set 1920 may be connected in series or in parallel to provide increased voltage (when connected in series) or increased current (when connected in parallel). To connect the cells 1922, 1924, 1926 in series, the switches S7 are closed and the switches S6 are open. To connect the cells 1922, 1924, 1926 in parallel, the switches S6 are closed and the switches S7 are open. Each cell may have an associated resistor R1, R2, R3 respectively to provide a current source when connected in parallel.

[0148] Referring back to FIG. 29A, if a clinician is in the midst of a procedure and needs a new battery pack to complete the procedure, the clinician (or his/her assistant) can select and remove from the charging station 1700 one of the battery packs that is fully charged and ready for use, which may be indicated on the display 1709 of the charging station 1700. If none of the battery packs 1702 is indicated as ready for use, the clinician can press the emergency release button 1780 which may release the battery pack 1702 currently in the charging station 1700 that has the most charge at the moment, as determined by the charging controller 1736 and/or the charging station processor 1722, so that the partially-charged battery pack can be inserted into the handle module currently being used in the procedure. The charging station 1700 also includes visual indicators to indicate which battery pack 1702 is being released in the emergency so that it is clear which battery pack should be removed from the charging station for insertion into the surgical instrument. For charging stations 1700 that include means for securing the battery pack 1702 to the charging station 1700 during charging, such as the screw 1724 in the arrangement of FIGS. 29A-29C, activation of the emergency release button 1780 can cause the connection means to disconnect (or unsecure) the appropriate battery pack 1702, as described herein. At about the same time, the charging station 1722 can take steps to rapidly charge the selected battery pack 1702 for a short time period, preferably to give it at least enough charge to complete one or a couple of firings. As described herein, the charging station processor 1722 may, in conjunction with the charging controller circuit 1736, change the charging profile (e.g., constant current or constant voltage charge), charge the battery pack with a supercapacitor(s) 1908, and/or charge the battery pack with one or more other battery cells (which could be connected in series or in parallel, as described herein). In various arrangements, the battery pack 1702 is not released (e.g., by disconnecting the screw 1724) until the short-term charging charges the battery pack 1702 to a charge level to a threshold charge that is sufficient to complete one or a couple of firings.

[0149] The charging station may also be configured to ease the proper placement of the battery packs into the charging station for charging and/or to enhance the engagement between the electrical contacts between the battery pack and the charge terminals of the charging station to thereby increase the efficiency of the charging process. For example, the wells (or receptacles) in the charging station can have multiple sets of terminals so that no matter which way the battery pack is inserted into the well/receptacle, the battery pack's charging terminals contact one set of charging terminals of the charging station. FIGS. 33A and 33B illustrate top views of a battery pack 2000 and a charging station 2002, respectively, wherein the battery pack 2000 has a square cross-sectional shape and the wells/receptacles 2004 of the charging station 2002 are sized to receive such a square-cross-sectional battery pack 2000. The illustrated charging station 2002 has two wells/receptacles 2004, but in other arrangements the charging station 2002 can have one well/re-

ceptacle or more than two wells/receptacles. As shown in FIG. 33A, the battery pack 2000 has a positive terminal 2006 and a negative terminal 2008 that the charging station terminals contact in order to charge the battery packs. In the illustrated arrangement, the terminals 2006, 2008 are not centered on the top of the battery pack 2000. Because such a battery pack 2000 could be inserted into one of square-shaped wells/receptacles 2004 in one of four configurations (each 90 degree turn, and assuming the side of the battery pack 2000 with the terminals 2006-2008 is always face-down), each well/receptacle can have four pairs of charging terminals 2010 positioned in it so that, no matter which way the battery pack 2000 is turned when it is inserted into the well/receptacle 2004, the off-center battery pack terminals 2006-2008 will make contact with one of the charging station terminal pairs 2010. Each charging station terminal pair 2010 is connected to the charging circuitry of the charging station, but only the one pair 2010 that contacts the battery pack terminals 2006-2008 will have a completed circuit so that charging current can flow to the battery pack 2000. In another arrangement, as shown in FIGS. 34A and 34B, one of the battery pack terminals could be in the center of the battery pack 2000. In the illustrated case, the negative terminal 2008 is in the center with the positive terminal 2006 to one side; however, the opposite arrangement could be utilized in an alternative. The wells/receptacle of the charging station could correspondingly have one terminal 2014 in the center for contacting the negative terminal 2008 of the battery pack 2000, and four terminals 2016 on each side of the center terminal 2014 for contacting the positive terminal 2006 no matter which way the battery pack 2000 is inserted into the well/receptacle. For battery packs that have other geometries, there may need to be a fewer or greater number of terminal pairs in the well/receptacles (such as two pairs for a rectangular battery pack).

[0150] As discussed above, a surgical instrument can include a battery assembly capable of being attached to and/or detached from the surgical instrument. Such handling of the battery assembly can increase the chances of damaging the battery assembly. For example, the battery assembly may be inadvertently dropped while assembling the battery assembly to the surgical instrument and/or transporting the battery assembly to a charging station. Discussed in greater detail further below, the battery assembly can be configured to protect the housing, battery cells, and/or power supply circuit of the battery assembly in the event that the battery assembly is inadvertently dropped.

[0151] Referring now to FIG. 38, a battery assembly, such as battery assembly 5000 can comprise a battery housing 5010 and a plurality of internal components 5030 including at least one battery cell 5031 and/or a power supply circuit positioned within the battery housing 5010. The at least one battery cell 5031 comprises a lithium-ion battery. The battery assembly 5000 also comprises one or more electrical contacts 5011 configured to transmit electrical energy provided by the at least one battery cell 5031 to the surgical instrument. The battery assembly 5000 further comprises one or more alignment features 5012 configured to assist a user in properly assembling the battery assembly 5000 to the surgical instrument. The alignment features 5012 comprise slots which are alignable with projections extending from the surgical instrument. The alignment features 5012 are symmetrically arranged around the perimeter of the battery housing 5010. Although not illustrated, alternatives are envisioned in which the alignment features 5012 comprise a non-symmetrical configuration permitting the battery assembly 5000 to be attached to the surgical instrument in only one orientation. The battery assembly 5000 further comprises a lock mechanism 5040 configured to secure the battery assembly 5000 to the surgical instrument during use. When the battery assembly 5000 is attached to the surgical instrument, the battery assembly 5000 can transmit electrical energy to electrical receiving contacts of the surgical instrument.

[0152] The battery housing 5010 can act as a container configured to house the internal components 5030 and/or act as a support structure configured to support various components thereon. Functioning as a container and/or a support structure, the battery housing 5010 may be rigid in order to support the internal components 5030 positioned therein. The battery housing 5010 may be comprised of a plastic material. The inner housing 5010 is comprised of an elastomeric material. Referring again to FIG. 38, the battery housing 5010 comprises a top face, a bottom face 5016, a plurality of lateral faces 5015, and a plurality of corners 5014. The bottom face 5016 can be associated with the electrical contacts 5011. The lateral faces 5015 and the corners 5014 are configured to surround the internal components 5030.

[0153] Various parts of the discussion herein relate to the protection of a battery assembly for use with a surgical instrument. Referring again to FIG. 38, the battery assembly 5000 comprises a radial and/or vertical reinforcement configured to protect the battery housing 5010, the internal components 5030, and/or the electrical contacts 5011. The radial and/or vertical reinforcement comprises a shock absorbing layer. The shock absorbing layer may surround the battery housing 5010 in order to absorb an impact force that is applied to a lateral face 5015, the bottom face 5016, and/or a corner 5014 of the battery housing 5010. In addition to or in lieu of the above, a shock absorbing layer is housed within the battery housing 5010. Also, in addition to or in lieu of the above, the battery assembly 5000 may further comprise an outer housing for added protection. The outer housing can be configured to house the battery housing 5010 and the shock absorbing layer.

[0154] One means for protecting the battery assembly 5000 is illustrated in detail in FIG. 38A comprising a battery housing, or inner housing 5010, and a shock absorbing layer 5020. As discussed above, the housing 5010 may be comprised of a rigid material which can support the internal components 5030 of the battery assembly 5000. The shock absorbing layer 5020 may contain a lattice structure 5022 comprising a plurality of cells 5024. The cells 5024 can lower the density of the shock absorbing layer 5020. The cells 5024 can have an open cellular structure and/or a closed cellular

structure. Moreover, the lattice structure 5022 can comprise one or more lattice layers. For instance, the lattice structure 5022 can include a first, or inner, lattice layer and a second, or outer, lattice layer.

[0155] The lattice structure 5022 further comprises a plurality of struts 5025 designed to deflect and/or buckle under pressure. If the battery assembly 5000 is dropped, an impact force is absorbed through the compression of the cells 5024 and the buckling and/or deflection of the struts 5025. Therefore, the shock absorbing layer 5020 can absorb shock and/or vibrational energy rather than relying on the battery housing 5010 to absorb the energy which could, in some circumstances, result in the damaging of the internal components 5030 of the battery assembly 5000. The shock absorbing layer 5020 comprises a foam-like structure and/or an elastomeric material.

[0156] Referring again to FIG. 38, the cells 5024 are arranged in rows having an inner row of cells 5026, an intermediate row of cells 5027, and an outer row of cells 5028. Each cell of the inner row of cells 5026 can comprise a planar wall 5026a. The cells 5026 are oriented such that the planar walls 5026a of the cells 5026 are at least substantially parallel with a lateral face 5015 of the battery housing 5010. Each cell of the outer row of cells 5028 can comprise a planar wall 5028a. The cells 5028 are oriented such that planar walls 5028a of the cells 5028 are at least substantially parallel with an outer surface 5029 of the shock absorbing layer 5020. Orienting the planar walls 5026a, 5028a of each cell of the inner row 5026 and the outer row 5028 in such a manner can create a more shock resistant shock absorbing layer 5020. The shock absorbing layer 5020 comprises corner portions positioned near the corners 5014 of the battery housing 5010 that can absorb an impact force directed to a corner 5014 of the battery housing 5010. The corner portions 5020 are not connected to one another; however, the alternative is envisioned in which the corner portions 5020 could be connected to one another.

[0157] The battery assembly 5000 comprises a plurality of shock absorbing elements 5020. The shock absorbing elements 5020 are positioned to protect the corners 5014 of the battery assembly 5000. An impact force may be more concentrated at the corners 5014 which can increase the risk of damaging the battery housing 5010 and/or the internal components 5030. The shock absorbing elements 5020 comprise end portions 5021 which extend beyond a bottom face 5016 of the battery housing 5010 in order to prevent damage to the electrical contacts 5011 and to further protect the battery assembly 5000. If the battery assembly 5000 is dropped in an orientation such that the bottom face 5016 is at least substantially parallel with the ground, one or more of the end portions 5021 can absorb the impact force and dissipate the impact energy.

[0158] It may be preferred that a battery assembly be useable after experiencing an impact force, such as when the battery assembly 5000 is inadvertently dropped. In such cases, the shock absorbing elements 5020 are configured to allow the battery assembly 5000 to retain the ability to be properly fitted into the battery receiving portion of the surgical instrument and still transmit electrical energy to the electrical receiving contacts of the surgical instrument even though the battery assembly 5000 has been dropped. The shock absorbing elements 5020 comprises crumple zones configured to deform when an impact force is applied. A crumple zone may not permanently deform, or at least substantially permanently deform, if the impact force is below a crumple force threshold. In such cases, the crumple zone may permanently deform only if the impact force meets or exceeds the crumple force threshold. The crumple zones may limit the direction of the deformation of the shock absorbing elements 5020 toward the center of the battery assembly 5000. This inward deformation can preserve the ability of the battery assembly 5000 to fit into the battery receiving portion of the surgical instrument by preventing outward deformation that would cause the battery assembly 5000 to acquire a shape that would not fit into the battery receiving portion of the surgical instrument.

[0159] The shock absorbing elements 5020 may experience an excessive amount of deformation requiring replacement of the shock absorbing elements 5020. In the event that the shock absorbing elements 5020 need to be replaced, the battery assembly 5000 can be configured so that the user of the surgical instrument can remove the damaged shock absorbing elements from the battery assembly 5000 and then attach useable shock absorbing elements thereto. Discussed in greater detail below, it may be preferred that the shock absorbing elements 5020 can be replaced in a timely fashion. Minimizing the amount of time required to replace the shock absorbing elements 5020 can be important when introducing another task to a surgical operation.

[0160] Assembling the shock absorbing elements 5020 to the battery assembly 5000 may be necessary when the shock absorbing elements 5020 need to be replaced. The shock absorbing elements 5020 comprise one or more protrusions 5023 configured to slide and/or wedge into corresponding slots 5013 in the battery housing 5010. The slots 5013 are configured to receive the protrusions 5023 of new and/or useable shock absorbing elements in the event that the shock absorbing elements 5020 need to be replaced. The protrusions 5023 and the slots 5013 can comprise a press-fit therebetween which can permit the protrusions 5023 to be slid within the slots 5013 along the corners of the housing 5010. The protrusions 5023 and the slots 5013 can comprise a wedge-fit therebetween. The shock absorbing elements 5020 may be attached to the battery housing 5010 in a snap-fit fashion. The battery housing 5010 comprises apertures configured to receive the protrusions 5023 in a snap fit-fashion. The protrusions 5023 can enter into the slots 5013 radially in a snap-fit manner. In addition to or in lieu of the above, the shock absorbing elements 5020 may be attached to the housing 5010 utilizing an adhesive.

[0161] The battery assembly 5000 further comprises a shock absorbing cap 5050. The shock absorbing cap 5050 is

positioned at an outer end 5002 of the battery assembly 5000. The shock absorbing cap comprises a shoulder 5051 configured to contact the surgical instrument when the battery assembly 5000 is fully seated in the surgical instrument. The shoulder 5051 can act as a stop and can define the fully seated position of the battery assembly 5000. The shoulder 5051 is configured to abut the shock absorbing elements 5020. If the battery assembly 5000 is attached to the surgical instrument, the shock absorbing cap 5050 can protect the battery assembly 5000 and/or the surgical instrument if the surgical instrument is dropped in an orientation such that the top face is at least substantially parallel with ground upon impact. On the other hand, if the battery assembly 5000 is not attached to the surgical instrument the shock absorbing cap 5050 can still protect the battery assembly 5000 if the battery assembly 5000 is dropped in an orientation such that the top face is at least substantially parallel to the ground.

[0162] A partial, cross-sectional view of the battery assembly 5000 is illustrated in FIG. 39. The shock absorbing cap 5050 comprises a lattice structure, or cellular structure, comprising a plurality of cells 5052. The shock absorbing cap 5050 can comprise a material similar to that of the shock absorbing layer 5020. A denser lattice arrangement 5055 is used near outer edges 5054 of the battery assembly 5000 which can dissipate a more concentrated impact force. The shock absorbing cap 5050 comprises a center portion 5053 comprising a columnar lattice arrangement 5056 configured to absorb an impact energy generated by an impact force applied to the center portion 5053. The column lattice arrangement 5056 is configured to dissipate a broadly-applied impact force.

[0163] The shock absorbing cap 5050 comprises crumple zones configured to deform when an impact force is applied. The shock absorbing cap 5050 can be designed to use the crumple zones to prevent the battery assembly 5000 from bouncing on the floor in the event the battery assembly 5000 is dropped.

[0164] The shock absorbing cap 5050 may be readily replaceable. In the event that the shock absorbing cap 5050 experiences an excessive amount of deformation requiring replacement of the shock absorbing cap 5050, the battery assembly 5000 can be configured so that the user of the surgical instrument can remove the damaged shock absorbing cap from the battery assembly 5000 and attach a useable shock absorbing cap.

[0165] The shock absorbing elements 5020 can be tethered by intermediate portions. The intermediate portions can be configured to protect the lateral faces 5015 and/or the alignment features 5012 of the battery housing 5010. It can be appreciated that if an impact force is applied over the surface area of a lateral face 5015 of the battery housing 5010, the stress generated by the impact force would be less than that if the same impact force were to be applied to a corner 5014 of the battery housing 5010 which has a smaller surface area. Stated another way, the more surface area over which an impact force is distributed, the lower the stress and the stress concentration will be. Therefore, it may not be necessary that the intermediate portions between the shock absorbing elements 5020 be comprised of a composition which is as substantial as the shock absorbing elements 5020. As a result, the intermediate portions comprise a thinner composition than the shock absorbing elements 5020; however, alternatives are envisioned in which the intermediate portions comprise the same and/or a thicker composition than the shock absorbing elements 5020.

[0166] Each of the shock absorbing elements 5020 of the battery assembly 5000 comprise a similar construction; however, alternatives are envisioned in which one or more of the shock absorbing elements 5020 may be different than the others. As an example, at least one of the shock absorbing elements 5020 can comprise an additional weight, such as a metal weight positioned therein which can cause the battery assembly 5000 to fall and land in a specific orientation. Such an effect could also be achieved by placing one or more weights in the battery housing 5010.

[0167] A battery assembly 5100, which is similar to the battery assembly 5000 in many respects, is depicted in FIG. 40. The battery assembly 5100 can comprise means for protecting the internal components 5030 of the battery assembly 5100 from damage as a result of impact shock and/or heat. Various means for protecting the battery assembly 5100 from impact shock are discussed above. Heat, which is represented by Q in FIG. 40A, can pass through the battery housing 5110 and can be absorbed by the battery cells 5031 positioned in the battery housing 5110.

[0168] It should be appreciated that heat flows from a higher temperature environment to a lower temperature environment. Under typical sterilization conditions, the battery assembly 5100 is exposed to a high temperature and, as a result, heat flows from a sterilization chamber into the battery assembly 5100. In some circumstances, however, the battery assembly 5100 may be improperly sterilized and may be exposed to an excessive temperature. If at least one of the battery cells 5031 absorbs and/or retains a damaging amount of heat Q, the battery cells 5031 may experience a thermal runaway event and fail.

[0169] Referring now to FIG. 40A, the battery housing 5110 comprises a heat reflective shell, or shield, 5111, a shock absorbing layer 5112, and a heat sink layer 5113. The reflective shell 5111 is configured to reflect and/or block the transfer of heat Q generated by improper sterilization. The reflective shell 5111 may be comprised of a material with a low thermal conductivity, such as a polymer and/or ceramic material. A material having a low thermal conductivity usually has a low thermal expansion rate. A material having a low thermal conductivity can also perform well as an insulating layer. In any event, the reflective shell 5111 can comprise a reflective outer surface which can reflect heat away from the battery assembly 5100. The reflective outer surface can be comprised of a polished metal, such as a polished aluminum.

[0170] Further to the above, the heat sink layer 5113 is configured to absorb heat that passes through the reflective shell 5111. The heat sink layer 5113 can also be configured to absorb heat generated by the battery cells 5031 when

the battery cells 5031 are being re-charged. The battery cells 5031 may generate an atypical amount of heat due to the overcharging and/or overuse thereof. The heat sink layer 5113 can be comprised of a material having a high thermal conductivity such as a metal. Any suitable material having a high thermal conductivity can be used to absorb heat generated by the at least one battery cell 5031. Moreover, a material having a high thermal conductivity often has a high thermal expansion rate.

[0171] Further to the above, the battery cells 5031 can expand as they are being charged. The expanding battery cells 5031 can push the heat sink layer 5113 outwardly. Moreover, the heat sink layer 5113 can rapidly expand outwardly due to its high thermal expansion rate. Such outward movement of the battery cells 5031 and the heat sink layer 5113 can push the shock absorbing layer 5112 toward the reflective shell 5111 and apply pressure to the reflective shell 5111.

Such pressure can generate stress within the reflective shell 5111, the heat sink layer 5113, and the battery cells 5031, especially where the reflective shell 5111 is comprised of a material which has a lower thermal expansion rate than the heat sink layer 5113. In such cases, the heat sink layer 5113 may expand more than the reflective shell 5111 thereby creating additional stress in the reflective shell 5111, the heat sink layer 5113, and the battery cells 5031.

[0172] The shock absorbing layer 5112 is configured to permit expansion of the battery cells 5031 while preventing damage to the battery housing 5110. Acting as a degree of freedom for the battery housing 5110, the shock absorbing layer 5112 may expand and/or contract in order to manage the expansion and/or contraction of the battery cells 5031 by allowing the heat sink layer 5113 and the at least one battery cell 5031 to expand and/or contract due to the transfer of heat while maintaining the supportive ability of the battery assembly 5100. The expansion and contraction of the shock absorbing layer 5112 can prevent damage to the battery housing 5110. The shock absorbing layer 5112 can absorb thermal shocks as well as impact shocks.

[0173] Turning now to FIGS. 41 and 42, a surgical instrument system 5300 includes a handle 5310 which is usable with a shaft assembly selected from a plurality of shaft assemblies. Further to the above, one or more of such shaft assemblies can include a staple cartridge. The handle 5310 comprises a housing 5312, a first rotatable drive output 5340, and a second rotatable drive output 5350. The handle 5310 further includes a first actuator 5314 for operating the first rotatable drive output 5340 and a second actuator 5315 for operating the second rotatable drive output 5350. The handle housing 5312 comprises a battery cavity 5311 configured to receive a battery therein. The battery can be any suitable battery, such as a lithium ion battery. The battery is insertable into and removable from the battery cavity 5311. Such a battery can provide power to the handle 5310 to operate the surgical instrument system 5300 without the complement of an additional and/or tethered power source. Such a design can be advantageous for many reasons. For instance, when the surgical instrument system 5300 is untethered to a power source, the entirety of the surgical instrument system 5300 can be present in a sterile field of the operating suite. Such batteries, however, can only supply a finite amount of power. In many circumstances, the finite amount of power that the battery can supply is sufficient to operate the surgical instrument system 5300. On the other hand, some circumstances can arise in which the battery cannot supply the surgical instrument system 5300 with the requisite power.

[0174] Referring again to FIG. 41, the battery positioned in the battery cavity 5311 of the handle 5310 can be removed and replaced with a power supply adapter 5360. The power supply adapter 5360 comprises a distal plug 5361 positionable in the battery cavity 5311. The distal plug 5361 comprises a plurality of electrical contacts 5366 which are engageable with corresponding electrical contacts 5316 in the handle 5310. The battery and the distal plug 5361 can engage the same electrical contacts 5316, depending on which one is positioned in the battery cavity 5311. In such cases, the handle 5310 can be supplied with power from one set of electrical contacts 5316 regardless of whether the battery or the power supply adapter 5360 is engaged with the handle 5310. Alternatively, the battery engages a first set of electrical contacts 5316 and the distal plug 5361 engages a different set of electrical contacts 5316. In such cases, a microprocessor of the handle 5310 can be configured to identify whether the battery or the power supply adapter 5360 is coupled to the handle 5310.

[0175] The distal plug 5361 of the power supply adapter 5360 can comprise any suitable shape so long as the distal plug 5361 is positionable in the battery cavity 5311. The distal plug 5361 can comprise the same geometry as the battery. The housing of the distal plug 5361 is analogous or sufficiently similar to the housing of the battery. In any event, the distal plug 5361 can be configured such that there is little, if any, relative movement between the distal plug 5361 and the battery cavity 5311 once the distal plug 5361 has been fully seated in the battery cavity 5311. The distal plug 5361 comprises a stop 5368 configured to contact a stop datum 5318 defined on the handle housing 5312. When the stop plug stop 5368 contacts the handle stop datum 5318, the plug 5361 may be fully seated in the battery cavity 5311. The handle 5310 and/or the plug 5361 can comprise a lock configured to hold the plug 5361 in its fully seated position. For instance, the plug 5361 comprises at least one lock 5362 configured to releasably engage the housing 5312.

[0176] The power supply adapter 5360 further comprises a cord 5363 extending from the plug 5361. The cord 5363 electrically couples the plug 5361 with a power source, such as power source 5370. The power source 5370 can comprise any suitable power source such as a signal generator that receives power from a 110V, 60 Hz power source and/or a battery. The cord 5363 comprises any suitable number of conductors and insulators to communicate electrical power from the power source 5370 to the plug 5361. The cord 5363 comprises a supply conductor, a return conductor, and a

ground conductor which are electrically insulated from one another by an insulator jacket. Each conductor of the cord 5363 can comprise a proximal terminal contained within a proximal plug 5369. The proximal plug 5369 can be releasably attached to the power source 5370. Alternatively, the proximal plug may not be readily detached from the power source 5370.

5 **[0177]** The power source 5370 can comprise a direct current (DC) power source. In such cases, the battery and the power supply adapter 5360 can both supply DC power to the handle 5310, depending on which one is electrically coupled to the handle 5310. The power supply adapter 5360 and the power source 5370 can cooperatively supply electrical power to the handle 5310 which is equal to and/or in excess of the electrical power that the battery can supply to the handle 5310. A surgeon using the handle 5310 as part of the surgical instrument system 5300 may determine that the
10 handle 5310 is underpowered, remove the battery from the handle 5310, and couple the power supply adapter 5360 to the handle 5310. The power source 5370 can then be operated to supply sufficient power to the handle 5310 via the power supply adaptor 5360 to operate the surgical instrument system in the desired manner. The power source 5370 can supply a larger voltage to the handle 5310.

[0178] The power source 5370 can comprise an alternating current (AC) power source. As an example, the power
15 supply adapter 5360 can include an alternating current to direct current (AC/DC) power converter configured to convert the AC power supplied by the power source 5370 to DC power. In such cases, the battery and the power supply adapter 5360 can both supply DC power to the handle 5310, depending on which one is electrically coupled to the handle 5310. The AC/DC power converter can include a transformer, a full-wave bridge rectifier, and/or a filter capacitor; however, any suitable AC/DC power converter could be utilized. The AC/DC power converter is positioned in the plug 5361;
20 however, the AC/DC power converter can be positioned within the power supply adapter 5360 in any suitable location, such as the cable 5363.

[0179] The handle 5310 includes an AC/DC power converter in addition to or in lieu of the AC/DC power converter of the power supply adapter 5360. This arrangement could implement the dual sets of battery contacts 5316 discussed above. A battery power supply circuit can comprise, one, a first circuit segment including the first set of contacts 5316
25 which are engaged by the battery and, two, a second circuit segment in parallel to the first circuit segment which includes the second set of contacts 5316 that are engaged by the power supply adapter 5360. The second circuit segment includes an AC/DC power converter configured to convert the AC power supplied by the power source 5370 to DC power while the first circuit segment does not include an AC/DC power converter as the battery is already configured to supply DC power.

[0180] Referring again to FIG. 41, the handle 5310 may be in a sterile operating field 5301 and the power supply 5370 may be in a non-sterile field 5302. In such cases, the power supply adapter 5360 can extend between the sterile field 5301 and the non-sterile field 5302. The sterile field 5301 and the non-sterile field are separated by a boundary 5303. The boundary 5303 comprises a physical boundary, such as a wall or a virtual boundary intermediate a sterile operating table and a non-sterile back table.

[0181] In order to use the power supply adapter 5360, the battery positioned in the battery cavity 5311 must be removed
35 in order to install the plug 5361 of the power supply adapter 5360 into the battery cavity 5311. Alternatives are envisioned in which the battery can remain in the battery cavity 5311 when a power supply adapter is operably coupled with the handle 5310. Turning now to FIG. 42, a battery 5461 is positionable in the battery cavity 5311. The battery 5461 is readily removable from the battery cavity 5311 when the lock 5362 is deactivated; however, alternatives are envisioned in which
40 the battery 5461 is not readily removable from the battery cavity 5311. Similar to the plug 5361, the battery 5461 can be sized and configured such that the battery 5461 is closely received in the battery cavity 5311 in order to limit relative movement between the battery 5461 and the battery cavity 5311 when the battery 5461 is fully seated in the battery cavity 5311. Also similar to the plug 5361, the battery 5461 comprises an end stop 5468 configured to contact the stop datum 5318 of the handle 5310.

[0182] The battery 5461 comprises one or more lithium ion battery cells positioned therein. Similar to the above, the battery 5461 can supply sufficient power to the handle 5310 to operate the surgical instrument system. In the event that the battery cells of the battery 5461 lack the necessary power to operate the surgical instrument system, a power supply
45 adapter 5460 can be coupled to the battery 5461. The power supply adapter 5460 is similar to the power supply adapter 5360 in many respects. Similar to the above, the power supply adapter 5460 comprises a cord 5463 including a proximal end 5369 which can be connected to a power source, such as power source 5370. The battery 5461 includes an electrical connector 5464 defined therein which is configured to receive a distal connector 5465 of the cord 5463 to electrically couple the power source 5370 to the battery 5461.

[0183] The power supply adapter 5460 can be placed in series with the cells of the battery 5461 when the adapter connector 5465 is inserted into the battery connector 5464. In such cases, the battery 5461 and the power source 5370
50 can both supply power to the handle 5310. FIG. 43 depicts such a case. As disclosed in FIG. 43, a battery 5461' comprises a power supply circuit including one or more battery cells 5470' which are configured to supply DC power to the handle 5310. When the power supply adapter 5460 is electrically coupled to the battery 5461', the power source 5370 can, one, re-charge the battery cells 5470' via recharging circuit 5471' and/or, two, supplement the power that the battery cells

5470' are supplying to the handle 5310. Where the power source 5370 comprises an AC power source, the battery 5461' can comprise an AC/DC transformer 5467' which is configured to convert the AC power supplied by the power source 5370 to DC power before the power is supplied to the charge circuit 5471' and/or the battery cells 5470'. The power supply circuit in the battery comprises the battery connector 5464, the AC/DC transformer 5467', the charge circuit 5471', the battery cells 5470', and the battery terminals 5366 which are in series with one another; however, any suitable arrangement for the power supply circuit can be utilized.

[0184] Alternatively, the insertion of the adapter connector 5465 into the battery connector 5464 can electrically couple the power source 5370 with the handle 5310 and, concurrently, electrically decouple the battery cells of the battery 5461' from the handle 5310. FIG. 44 depicts such a case. As disclosed in FIG. 44, a battery 5461" comprises a power supply circuit including one or more battery cells 5470" which are configured to supply DC power to the handle 5310. The battery cells 5470" are in electrical communication with the battery contacts 5366 via a first circuit segment 5472" and a battery switch 5474" when the adapter connector 5465 is not positioned in the battery connector 5464. In such cases, the battery switch 5474" is in a first switch state. The insertion of the adapter connector 5465 into the battery connector 5464 places the switch 5474" in a second switch state, as illustrated in FIG. 44, in which the battery cells 5470" are no longer able to supply electrical power to the contacts 5366. Additionally, the power supply adapter 5460 and the battery connector 5464 are in electrical communication with the battery contacts 5366 via a second circuit segment 5473" and the battery switch 5474" when the switch 5474" is in its second switch state. Where the power source 5370 comprises an AC power source, the second circuit segment 5473" of the battery 5461" can comprise an AC/DC transformer 5467" which is configured to convert the AC power supplied by the power source 5370 to DC power.

[0185] As discussed above, referring again to FIG. 44, the battery switch 5474" can be operated to selectively place the first parallel circuit segment 5472" including the battery cells 5470" in electrical communication with the battery contacts 5366 when the switch 5474" is in its first switch state and, alternatively, the second parallel circuit segment 5473" including the battery connector 5464 and the AC/DC transformer 5467" in electrical communication with the battery contacts 5366 when the switch 5474" is in its second switch state. The battery switch 5474" can comprise a mechanical switch, an electromechanical switch, and/or an electronic switch, as described in greater detail further below.

[0186] A mechanical battery switch 5474" can comprise a sliding busbar which is pushed between a first position associated with a first switch state of the switch 5474" and a second position associated with a second switch state of the switch 5474". In the first position of the sliding busbar, the busbar couples the first circuit segment 5472" with the battery contacts 5366 but does not couple the second circuit segment 5473" with the battery contacts 5366. In the second position of the sliding busbar, the busbar couples the second circuit segment 5473" with the battery contacts 5366 but does not couple the first circuit segment 5472" with the battery contacts 5366. The battery 5461 can further comprise a biasing member, such as a spring configured to bias the busbar into its first position and, thus, bias the battery switch 5474" into its first switch state. Further to the above, the adapter connector 5465 can contact the busbar of the switch 5474" when the adapter connector 5465 is inserted into the battery connector 5464 and push the busbar from its first position into its second position and place the switch 5474" into its second switch state. When the adapter connector 5465 is removed from the battery connector 5464, the biasing member can return the busbar to its first position and electrically re-couple the battery cells 5470" with the battery contacts 5366. Alternatively, the insertion of the adapter connector 5465 into the battery connector 5464 may permanently decouple the battery cells 5470" from the battery contacts 5466. The battery 5461" can comprise a lock configured to hold the busbar in its second position once the busbar is pushed into its second position by the adapter connector 5465. Such an example can provide a permanent lockout to prevent the battery 5461" from being used again to supply power from the battery cells 5470" as it may be undesirable and/or unreliable to reuse and/or recharge a battery that was unable to provide the handle 5310 with sufficient power.

[0187] An electromechanical switch 5474" can comprise a relay. The relay can be biased into a first relay state when the adapter connector 5465 is not positioned in the battery connector 5464. The relay can be switched into a second relay state when the adapter connector 5465 is electrically coupled to the battery connector 5464. The relay can comprise an electromagnet, which can include a wire coil and an armature that is activated when the contacts of the adapter connector 5465 interface with the battery connector 5464. The power supply adapter 5460 can comprise a relay control circuit in addition to the power circuits which can provide the coil of the relay with a sufficient voltage to move the armature of the relay between its first switch state and its second switch state. The switch 5474" can comprise a latching relay. The switch 5474" can comprise a contactor which can be electronically controlled by a microprocessor and a control circuit.

[0188] Certain electronic switches may not have any moving components, such as a solid-state relay. A solid-state relay can utilize a thyristor, TRIAC and/or any other solid-state switching device. A solid-state relay can be activated by a control signal from the power source 5370 to switch the load being supplied to the battery contacts 5366 from the battery cells 5470" to the power source 5370. The solid-state relay can comprise a contactor solid-state relay. An electronic switch can comprise a microprocessor and a sensor in signal communication with the microprocessor which detects whether power is being supplied to a contact of the battery connector 5464. The sensor can be configured to inductively detect a field that is generated when voltage is applied to the contacts of the battery connector 5464. The

microprocessor can be responsive to a control signal received from the power supply 5370 to switch a relay between a first relay state and a second relay state to control whether the first parallel circuit segment 5472" or the second parallel circuit segment 5473", respectively, is in electrical communication with the battery contacts 5366.

[0189] Further to the above, the power supply adapter 5460 can include an AC/DC power converter. The power supply adapter 5460 includes an AC/DC power transformer 5467 in the cord 5463; however, an AC/DC power transformer may be placed in any suitable location in the power supply adapter 5460.

[0190] A power adapter supply system can include a battery, such as the battery 5361, 5461, 5461', and/or 5461" and a power supply adapter, such as the power supply adapter 5360 and/or 5460.

[0191] Turning now to FIGS. 45-47, a handle 5510 of a surgical instrument system comprises a gripping portion, or pistol grip, 5511 and a housing 5512. The handle 5510 further comprises one or more battery cells, such as battery cells 5470 positioned in the gripping portion 5511. The battery cells 5470 can provide enough power to the handle 5510 to operate the surgical instrument system. Alternatively, the battery cells 5470 may not be able to provide enough power to the handle 5510. In such cases, as described in greater detail further below, a supplemental battery, such as supplemental battery 5560 can be attached to the handle 5510 to provide power to the handle 5510.

[0192] Further to the above, referring primarily to FIG. 47, the battery cells 5470 are arranged in series as part of a battery power supply circuit 5513. The battery power supply circuit 5513 is in electrical communication with an electrical connector 5516 defined in the housing 5512. The electrical connector 5516 can comprise any suitable number of electrical contacts. The electrical connector 5516 comprises two electrical contacts. The electrical connector 5516 is positioned at the end of the gripping portion 5511; however, the electrical connector 5516 can be positioned at any suitable location on the handle 5510.

[0193] The handle 5510 further comprises a connector cover 5517. The connector cover 5517 is movable between a first position in which it covers the electrical connector 5516 and a second position in which the electrical connector 5516 is exposed. The housing 5512 comprises a slot 5518 defined therein configured to slidably receive and support the connector cover 5517. The handle 5510 further comprises a biasing member, such as spring 5519 positioned in the slot 5518 intermediate the housing 5512 and the connector cover 5517. The spring 5519 is configured to bias the connector cover 5517 into its first position to cover the electrical connector 5516.

[0194] As discussed above, the supplemental battery 5560 is attachable to the handle 5510. The supplemental battery 5560 comprises a housing 5562 and one or more battery cells, such as battery cells 5570 positioned therein. The battery cells 5570 are arranged in series as part of a supplemental battery supply circuit 5563. The supplemental battery supply circuit 5563 is in electrical communication with an electrical connector 5566 defined in the battery housing 5562. The electrical connector 5566 comprises the same number of electrical contacts as the electrical connector 5516 and are configured to form mating pairs with the electrical contacts of the electrical connector 5516.

[0195] The housing 5562 of the supplemental battery 5560 further comprises a cavity, or receptacle, 5561 defined therein which is configured to receive the gripping portion 5511 of the handle 5510. The cavity 5561 is configured to closely receive the gripping portion 5511 such that there is little to no relative movement between the supplemental battery 5560 and the handle 5510 when the supplemental battery 5560 is fully assembled thereto. As the supplemental battery 5560 is being assembled to the handle 5510, the housing 5562 contacts the connector cover 5517 and pushes the connector cover 5517 into its second position to expose the electrical connector 5516. Once the contacts of the electrical connector 5516 have been at least partially exposed, the contacts of the electrical connector 5566 can engage the contacts of the electrical connector 5516. At such point, the supplemental battery supply circuit 5563 has been electrically coupled to the battery power supply circuit 5513.

[0196] The electrical connectors 5516 and 5566 can be positioned and arranged such that they do not engage one another until the supplemental battery 5560 has been fully seated onto the gripping portion 5511. Alternatively, the electrical connectors 5516 and 5566 can be positioned and arranged such that they engage one another prior to the supplemental battery 5560 being fully seated onto the gripping portion 5511. In either event, the housing 5512 of the handle 5510 and/or the housing 5562 of the supplemental battery 5560 can comprise a lock configured to hold the supplemental battery 5560 to the housing 5510. The lock is releasable to allow the supplemental battery 5560 to be readily removed from the handle 5510; however, alternatives are envisioned in which the lock does not permit the supplemental battery 5560 to be readily released from the handle 5510.

[0197] As discussed above, the supplemental battery supply circuit 5563 is electrically coupled to the battery power supply circuit 5513 when the supplemental battery 5560 is assembled to the handle 5510. The supplemental battery cells 5570 are placed in series with the handle battery cells 5470 and can increase the power available to the handle 5510. This can be useful when the handle battery cells 5470 have become drained from use. Alternatively, the supplemental battery cells 5570 of the supplemental battery 5560 are placed in parallel with the battery cells 5470 of the handle 5510. As an example, the handle battery cells 5470 can be electrically decoupled from the handle 5510 when the supplemental battery cells 5570 are electrically coupled with the handle 5510. This can be useful when a short has occurred in the handle battery cells 5470. The handle 5510 can include a switch which can allow the user to selectively place the supplemental battery cells 5570 in series with or in parallel with the handle battery cells 5470.

*Examples***[0198]**

5 Example 1 - A surgical apparatus comprising a handle module comprising an attachment portion, wherein a detachable shaft module is attachable to the attachment portion for collectively performing a surgical procedure, and wherein the handle module comprises a rotary drive system for driving the detachable shaft module, an electric motor coupled to the rotary drive system for powering the rotary drive system, and one or more sensors. The handle module further comprises a handle module processor circuit in communication with the one or more sensors and the electric motor, wherein the handle module processor circuit is programmed to control the electric motor, track an end-of-life parameter for the handle module based on input from the one or more sensors, and maintain a count of the end-of-life parameter.

15 Example 2 - The surgical apparatus of Example 1, further comprising means, in communication with the handle module processor circuit, for taking an end-of-life action when the handle module processor circuit determines that the count for the end-of-life parameter reaches a threshold value.

20 Example 3 - The surgical apparatus of Example 2, wherein the means for taking the end-of-life action comprises a display that displays to a user of the surgical apparatus information indicative of the end-of-life parameter reaching the threshold value.

Example 4 - The surgical apparatus of Example 3, wherein the display displays the count.

25 Example 5 - The surgical apparatus of Examples 3 or 4, wherein the display displays an indicator that indicates a remaining number of uses for the handle module before the threshold value is reached.

Example 6 - The surgical apparatus of Examples 2, 3, 4, or 5, wherein the means for taking the end-of-life action comprises means for disabling the handle module for a subsequent surgical procedure.

30 Example 7 - The surgical apparatus of Example 6, wherein the means for disabling the handle module comprises means for disabling the operation of the electric motor.

35 Example 8 - The surgical apparatus of Examples 6 or 7, wherein the means for disabling the handle module comprise means for preventing installation of a charged battery pack in the handle module.

40 Example 9 - The surgical apparatus of Examples 2, 3, 4, 5, 6, 7, or 8, wherein the end-of-life parameter is selected from the group consisting of a number of firings by the handle module, a number of surgical procedures involving the handle module, a number of attachments of a detachable shaft module to the handle module, a number of sterilizations of the handle module, and a number of attachments of removable battery packs to the handle module, wherein the removable battery packs are for supplying electric power to the handle module during a surgical procedure.

45 Example 10 - The surgical apparatus of Examples 2, 3, 4, 5, 6, 7, 8, or 9, wherein the end-of-life parameter is computed according to a function whose inputs include the number of firings by the handle module and the number of surgical procedures involving the handle module.

Example 11 - The surgical apparatus of Example 10, wherein the function computes the end-of-life parameter by using different weighting coefficients for different detachable shaft modules.

50 Example 12 - The surgical apparatus of Examples 2, 3, 4, 5, 6, 7, 8, 9, 10, or 11, wherein the detachable shaft module comprises an end effector with a firing member that, when fired, traverses a stroke length, and wherein the end-of-life parameter comprises a usage parameter for the handle module indicative of differences between the force that is expected to be exerted by the handle module and the force actually exerted by the handle module over the stroke length of the firing member.

55 Example 13 - The surgical apparatus of Examples 2, 3, 4, 5, 6, 7, 8, 9, 10, 11, or 12, wherein the end-of-life parameter comprises the number of times the handle module has been sterilized.

Example 14 - The surgical apparatus of Examples 2, 3, 4, 5, 6, 7, 8, 9, 10, 11, 12, or 13, wherein the handle module includes a sterilization sensor that is in communication with the handle module processor circuit that is actuated when a protective sterilization cover is attached to the handle module.

5 Example 15 - The surgical apparatus of Example 14, wherein the sterilization sensor comprises a switch that is actuated when the protective sterilization cover is attached to the handle module.

10 Example 16 - The surgical apparatus of Examples 2, 3, 4, 5, 6, 7, 8, 9, 10, 11, 12, 13, 14 or 15, further comprising an inspection station, wherein the handle module is connectable to the inspection station for inspection of the handle module following the surgical procedure, wherein the inspection station comprises an inspection station processor circuit that communicates with the handle module processor circuit via a data connection when the handle module is connected to the inspection station, and an inspection station display in communication with the inspection station processor circuit, wherein the inspection station display displays information about the handle module when the handle module is connected to the inspection station.

15 Example 17 - A surgical apparatus comprising a handle module that is attachable to a detachable shaft module for collectively performing a surgical procedure, wherein the handle module comprises a rotary drive system which is activatable to drive the detachable shaft module, an electric motor coupled to the rotary drive system for powering the rotary drive system, and means for tracking a count of an end-of-life parameter for the handle module based on the number of times in which the rotary drive system is activated.

20 Example 18 - The surgical apparatus of Example 17, wherein the means for tracking the count of the end-of-life parameter comprises a processor circuit and memory, wherein the memory stores program code that is executed by the processor to track the count of the end-of-life parameter for the handle module.

25 Example 19 - The surgical apparatus of Examples 17 or 18, wherein the handle module is powered by a removable battery pack, and wherein the means for tracking the count of the end-of-life parameter for the handle module is further based on a number of times a removable battery pack is connected to the handle module.

30 Example 20 - The surgical apparatus of Examples 17, 18, or 19, further comprising a sterilization tray for holding the handle module during a sterilization procedure, wherein the means for tracking the count of the end-of-life parameter for the handle module comprises a counter on the sterilization tray that increments the count when the handle module is placed in the sterilization tray.

35 Example 21 - An apparatus, comprising a handle module that is attachable to a detachable shaft module for collectively performing a surgical procedure, wherein the handle module comprises a rotary drive system for driving the detachable shaft module, an electric motor coupled to the rotary drive system for powering the rotary drive system, and a handle module processor circuit in communication with the electric motor. The apparatus further comprises an inspection station for connection to the handle module when the handle module is not being used in a surgical procedure, wherein the inspection station comprises an inspection station processor circuit that communicates with the handle module processor circuit via a data connection when the handle module is connected to the inspection station, and an inspection station display in communication with the inspection station processor circuit, wherein the inspection station display displays information about handle module connected to the inspection station.

40 Example 22 - The apparatus of Example 21, wherein the inspection station comprises an electric power source for supplying electric power to the handle module when the handle module is connected to the inspection station.

45 Example 23 - The apparatus of Examples 21 or 22, wherein the inspection station is configured to perform one or more tests on the handle module to determine the suitability of the handle module for use in a subsequent surgical procedure.

50 Example 24 - The apparatus of Example 23, wherein the one or more tests comprises a seal integrity test of the handle module.

55 Example 25 - The apparatus of Examples 23 or 24, wherein the one or more tests comprises a gear backlash test for the rotary drive system of the handle module.

Example 26 - The apparatus of Examples 21, 22, 23, 24, or 25, wherein the inspection station is configured to

perform a conditioning action to condition the handle module for use in a subsequent surgical procedure.

Example 27 - The apparatus of Example 26, wherein the conditioning action comprises drying components of the handle module.

Example 28 - The apparatus of Examples 21, 22, 23, 24, 25, 26, or 27, wherein the inspection station comprises one or more fans for blowing air on the components of the handle module.

Example 29 - The apparatus of Examples 21, 22, 23, 24, 25, 26, 27, or 28, wherein the inspection station comprises a vacuum port for drying the components of the handle module with vacuum pressure air flow.

Example 30 - The apparatus of Examples 21, 22, 23, 24, 25, 26, 27, 28, or 29, wherein the inspection station further comprises a load simulation adapter connectable to the rotary drive system of the handle module.

Example 31 - The apparatus of Example 30, wherein the load simulation adapter comprises a motor for supplying a simulated load to the rotary drive system of the handle module.

Example 32 - The apparatus of Examples 21, 22, 23, 24, 25, 26, 27, 28, 29, 30, or 31 wherein the inspection station is further connected to the detachable shaft module.

Example 33 - A surgical process comprising performing, by a clinician, a surgical procedure on a patient with a surgical instrument that comprises a handle module connected to a detachable shaft module, wherein the handle module includes a memory that stores data about the handle module and the surgical procedure, while the handle module is connected to the inspection station, downloading to a memory of the inspection station data about the surgical procedure stored in the memory of the handle module, and while the handle module is connected to the inspection station, visually displaying on a display of the inspection station information about the handle module.

Example 34 - The surgical process of Example 33, further comprising following the surgical procedure and prior to connecting the handle module to an inspection station, removing a removable battery pack from the handle module, wherein the removable battery pack powered the handle module during the surgical procedure, and while the handle module is connected to the inspection station, electrically powering the handle module with electric power from the inspection station.

Example 35 - The surgical process of Examples 33 or 34, while the handle module is connected to the inspection station, performing one or more tests on the handle module to determine the suitability of the handle module for use in a subsequent surgical procedure.

Example 36 - The surgical process of Example 35, wherein the one or more tests comprises a seal integrity test of the handle module.

Example 37 - The surgical process of Examples 35 or 36, wherein the one or more tests comprises a gear backlash test.

Example 38 - The surgical process of Examples 34, 35, 36, or 37, while the handle module is connected to the inspection station, performing a conditioning action to condition the handle module for use in a subsequent surgical procedure.

Example 39 - The surgical process of Example 38, wherein the conditioning action comprises drying components of the handle module.

Example 40 - A surgical apparatus comprising a handle module that is attachable to a detachable shaft module for collectively performing a surgical procedure, wherein the handle module comprises a rotary drive system for driving the detachable shaft module, an electric motor coupled to the rotary drive system for powering the rotary drive system, one or more sensors for sensing data about the electric motor, and a handle module processor circuit in communication with the one or more sensors, wherein the handle module processor circuit is programmed to monitor a performance parameter of the handle module based on input from the one or more sensors, and wherein the handle module processor circuit monitors the performance parameter of the handle module by monitoring whether the performance parameter is outside an acceptable performance band.

Example 41 - The surgical apparatus of Example 40, wherein the processor circuit monitors the performance parameter of the handle module by monitoring whether the performance parameter is below or above the acceptable performance band.

5 Example 42 - The surgical apparatus of Examples 40 or 41, wherein the handle module further comprises means for taking remedial action when the handle module processor circuit determines that the performance parameter is outside the acceptable performance band.

10 Example 43 - The surgical apparatus of Examples 40, 41, or 42, wherein the performance parameter comprises a performance parameter of the electric motor.

Example 44 - The surgical apparatus of Example 43, wherein the performance parameter of the electric motor comprises the energy consumed by the electric motor over the life of the handle module.

15 Example 45 - The surgical apparatus of Examples 43 or 44, wherein the performance parameter of the electric motor comprises the power consumed by the electric motor for each firing of the handle module.

20 Example 46 - The surgical apparatus of Examples 43, 44, or 45, wherein the performance parameter of the electric motor comprises the energy consumed by the electric motor over the life of the handle module and the power consumed by the electric motor for each firing of the handle module.

25 Example 47 - The surgical apparatus of Example 46, wherein the handle module processor circuit is programmed to determine that remedial action should be taken when at least one of the following conditions is met the energy consumed by the electric motor over the life of the handle module exceeds a first energy threshold value, and the energy consumed by the electric motor over the life of the handle module exceeds a second energy threshold value, which is lower than the first energy threshold value, and the handle module has had a threshold number of device firings above a threshold power level.

30 Example 48 - The surgical apparatus of Examples 43, 44, 45, 46, or 47 wherein the performance parameter comprises output torque of the electric motor.

Example 49 - The surgical apparatus of Examples 40, 41, 42, 43, 44, 45, 46, 47, or 48 wherein the performance parameter comprises a performance parameter of the rotary drive system.

35 Example 50 - The surgical apparatus of Example 49 wherein the performance parameter of the rotary drive system comprises gear backlash.

40 Example 51 - The surgical apparatus of Examples 42, 43, 44, 45, 46, 47, 48, 49 or 50, wherein the means for taking remedial action comprises a display for displaying a condition of the handle module.

Example 52 - The surgical apparatus of Examples 42, 43, 44, 45, 46, 47, 48, 49, 50, or 51 wherein the means for taking remedial action comprises means for disabling the handle module.

45 Example 53 - The surgical apparatus of Example 52, wherein the means for disabling the handle module comprises means for preventing the insertion of a charged, removable battery pack into the handle module to power the handle module during a surgical procedure.

50 Example 54 - The surgical apparatus of Example 53, wherein the means for preventing the insertion of a charged, removable battery pack comprises a spring-loaded mechanical lock-out.

Example 55 - The surgical apparatus of Examples 53 or 54, wherein the means for preventing the insertion of a charged, removable battery pack comprises a latch that, when actuated, prevents the removal of a discharged, removable battery pack from the handle module.

55 Example 56 - A surgical apparatus, comprising a detachable shaft module and a handle module connected to the detachable shaft module for collectively performing a surgical procedure, wherein the handle module comprises a rotary drive system for driving the detachable shaft module, an electric motor coupled to the rotary drive system for powering the rotary drive system, means for monitoring a performance parameter of at least one of the electric

motor and the rotary drive system, and means for taking a remedial action upon a determination that the performance parameter is outside an acceptable performance band.

Example 57 - The surgical apparatus of Example 56, wherein the performance parameter comprises the energy consumed by the electric motor over the life of the handle module.

Example 58 - The surgical apparatus of Examples 56 or 57, wherein the performance parameter comprises the power consumed by the electric motor for each firing of the handle module.

Example 59 - The surgical apparatus of Examples 56, 57, or 58, wherein the performance parameter comprises the output torque of the electric motor.

Example 60 - The surgical apparatus of Examples 56, 57, 58, or 59, wherein the means for taking remedial action comprises means for disabling the handle module.

Example 61 - The surgical apparatus of Example 60, wherein the means for disabling the handle module comprises means for disabling the electric motor.

Example 62 - The surgical apparatus of Examples 60 or 61, wherein the means for disabling the handle module comprises means for preventing the insertion of a charged, removable battery pack into the handle module to power the handle module during a surgical procedure.

Example 63 - A combination, comprising a handle module that is attachable to a detachable shaft module for collectively performing a surgical procedure, a removable, rechargeable battery pack connectable to the handle module for providing electric power to the handle module during a surgical procedure, wherein the battery pack comprises a memory for storing charging data and discharging data for the battery pack, and a charging station for at least one of charging and discharging the battery pack when the battery pack is removed from the handle module and inserted into the charging station, wherein the charging station is for at least one of charging and discharging the battery pack based on the charging data and discharging data stored in the memory of the battery pack.

Example 64 - The combination of Example 63, wherein the battery pack comprises a plurality of battery cells, the charging station comprises a charging station processor circuit that determines when the battery cells should be rebalanced based on the charging data and discharging data stored in the battery pack memory and based on rebalancing criteria, and the charging station rebalances the battery cells of the battery pack when the charging station processor circuit determines that the battery cells should be rebalanced.

Example 65 - The combination of Example 64, wherein the charging station processor circuit is programmed to determine that the battery cells should be rebalanced after N charges of the battery pack without rebalancing, where N is an integer greater than zero.

Example 66 - The combination of Examples 64 or 65, wherein prior to rebalancing the battery cells, the charging station is configured to top off a charge of the battery cells.

Example 67 - The combination of Examples 63, 64, 65, or 66, wherein the charging station comprises a charging station processor circuit that determines whether the battery pack should be discharged based on the charging and discharging data stored in the battery pack memory and based on discharging criteria, and wherein the charging station discharges the battery pack when the charging station processor circuit determines that the battery pack should be discharged.

Example 68 - The combination of Example 67, wherein the discharging criteria comprise whether a second battery pack installed in the charging station is fully charged and ready for use in the handle module.

Example 69 - The combination of Examples 63, 64, 65, 66, 67, or 68, wherein the charging station is programmed to charge the battery pack at a time of day based on surgical procedure schedule data for an organizational user of the charging station, and wherein the surgical procedure schedule data is stored in a memory of the charging station.

Example 70 - The combination of Example 69, wherein the surgical procedure schedule data comprises a statistical likelihood that the organizational user is performing a surgical procedure with the handle module at the time of day.

Example 71 - The combination of Examples 63, 64, 65, 66, 67, 68, 69, or 70, wherein the charging station comprises means for automatically securing the battery pack to the charging station when the battery pack is not ready for use in the handle module for a surgical procedure.

5 Example 72 - The combination of Example 71, wherein the means for automatically securing the battery pack to the charging station comprises a screw that, when actuated by insertion of the battery pack into the charging station, screws into the battery pack.

10 Example 73 - The combination of Examples 71 or 72, wherein the means for automatically securing the battery pack to the charging station further comprises a linear actuator for actuating the screw.

Example 74 - The combination of Examples 63, 64, 65, 66, 67, 68, 69, 70, 71, 72, or 73, wherein the charging station comprises a display for displaying charge status information about the battery pack.

15 Example 75 - The combination of Examples 63, 64, 65, 66, 67, 68, 69, 70, 71, 72, 73, or 74, wherein the charging station comprises means for rapidly charging the first battery pack when a rapid charge user input for the battery pack is received by the charging station.

20 Example 76 - The combination of Example 75, wherein the charging station comprises means for automatically securing the battery pack to the charging station when the battery pack is not ready for use in the handle module for a surgical procedure.

25 Example 77 - A surgical process comprising performing, by a clinician, a surgical procedure on a patient with a surgical instrument that comprises a handle module connected to a detachable shaft module, wherein the handle module is powered during the surgical procedure by a removable, rechargeable battery pack, and wherein the battery pack comprises a memory for storing charging data and discharging data for the battery pack, removing the battery pack from the handle module after it has been used during the surgical procedure, following the removing step, placing the battery pack in a charging station to recharge the battery pack, following the placement step, downloading by the charging station the charging and discharging data from the memory of the battery pack, and following the downloading step, at least one of charging and discharging, by the charging station, the battery pack based on the charging data and discharging data stored in the memory of the battery pack.

35 Example 78 - The surgical process of Example 77, wherein the battery pack comprises a plurality of battery cells, and wherein the process further comprises: following the downloading step, determining, by the charging station, whether the battery cells should be rebalanced based on the charging data and discharging data stored in the battery pack memory and based on rebalancing criteria, and upon determining that rebalancing of the battery cells of the battery pack should be performed, rebalancing the battery cells by the charging station.

40 Example 79 - The surgical process of Examples 77 or 78, following the downloading step, rapidly charging the battery pack in response to receipt of a rapid charge user input.

45 Example 80 - The surgical process of Examples 77, 78, or 79, following the placement step, automatically securing the battery pack to the charging station when the battery pack is not ready for use in the handle module for a surgical procedure.

50 Example 81 - A combination, comprising a handle module that is attachable to a detachable shaft module for collectively performing a surgical procedure, a removable, rechargeable battery pack connectable to the handle module for providing electric power to the handle module during a surgical procedure, and a charging station for charging the battery pack when the battery pack is removed from the handle module and inserted into the charging station, wherein the charging station comprises circuitry for rapidly charging the battery pack when a rapid charge user input for the battery pack is received by the charging station.

55 Example 82 - The combination of Example 81, wherein the charging station comprises a display for displaying the charge status of the battery pack.

Example 83 - The combination of Examples 81 or 82, wherein the charging station comprises a user interface through which a user inputs the rapid charge user input to the charging station.

Example 84 - The combination of Example 83, wherein the user interface comprises a button on the charging station which is actuatable to provide the charging station with the rapid charge user input.

Example 85 - The combination of Examples 81, 82, 83 or 84, wherein the circuitry for rapidly charging the battery pack comprises circuitry for changing a charging profile for the battery pack.

Example 86 - The combination of Examples 81, 82, 83, 84, or 85, wherein the circuitry for changing the charging profile for the battery pack comprises a voltage regulator connected to the battery pack, and a charging controller circuit connected to the voltage regulator.

Example 87 - The combination of Examples 81, 82, 83, 84, 85, or 86 wherein the circuitry for rapidly charging the battery pack comprises a charge-storing device of the charging station, and wherein charge stored on the charge-storing device is used to charge the battery pack.

Example 88 - The combination of Example 87, wherein the charge-storing device comprises a supercapacitor.

Example 89 - The combination of Example 88, wherein the charging station further comprises circuitry for discharging the first battery pack to the supercapacitor.

Example 90 - The combination of Examples 87, 88, or 89, wherein the charge-storing device comprises one or more battery cells internal to the charging station.

Example 91 - The combination of Examples 87, 88, or 89, wherein the charge-storing device comprises a plurality of battery cells internal to the charging station, and wherein the circuitry for rapidly charging the battery pack comprises circuitry for charging the battery pack with the plurality of battery cells.

Example 92 - The combination of Example 91, wherein the plurality of battery cells are connected in series.

Example 93 - The combination of Examples 91 or 92, wherein the plurality of battery cells are connected as parallel current sources.

Example 94 - The combination of Examples 81, 82, 83, 84, 85, 86, 87, 88, 89, 90, 91, 92, or 93, wherein the charging station further comprises circuitry for discharging the first battery pack to the internal plurality of battery cells.

Example 95 - The combination of Examples 81, 82, 83, 84, 85, 86, 87, 88, 89, 90, 91, 92, 93, or 94, wherein the battery pack comprises a first battery pack, wherein the charging station comprises a first charging receptacle for receiving the first battery pack to charge the first battery pack, and a second charging receptacle for receiving a second battery pack to charge the second battery pack, and wherein the circuitry for rapidly charging the first battery pack comprises circuitry for charging the first battery pack with charge stored on the second battery pack.

Example 96 - The combination of Example 95, wherein the charging station further comprises circuitry for discharging the first battery pack to the second battery pack.

Example 97 - The combination of Examples 95 or 96, wherein the charging station comprises a display for displaying the charge status of the first battery pack and the second battery pack.

Example 98 - The combination of Examples 81, 82, 83, 84, 85, 86, 87, 88, 89, 90, 91, 92, 93, 94, 95, 96, or 97, wherein the charging station comprises means for automatically securing the battery pack to the charging station when the battery pack is not ready for use in the handle module for a surgical procedure.

Example 99 - A surgical instrument system comprising a handle module for performing a surgical procedure, a removable, rechargeable battery pack connectable to the handle module for providing electric power to the handle module during the surgical procedure, and a charging station for charging the battery pack, wherein the charging station comprises circuitry for charging the handle module under two operating conditions: a first operating condition in which the battery pack is charged from a primary power source, and a second operating condition in which the battery pack is charged from the primary power source and a secondary power source in order to rapidly charge the battery pack in case the battery pack is urgently needed in the surgical procedure.

Example 100 - The surgical instrument system of Example 99, wherein the secondary power source comprises a second removable, rechargeable battery pack connectable to the handle module.

Example 101 - An apparatus comprising a handle module that is attachable to a detachable shaft module for collectively performing a surgical procedure, wherein the handle module comprises a handle module memory circuit for storing handle module usage data for the handle module, and an inspection station for connection to the handle module when the handle module is not being used in a surgical procedure, wherein the inspection station comprises an inspection station processor circuit for determining one or more service recommendations for the handle module based on the handle module usage data stored in the memory of the handle module and based on service recommendation criteria.

Example 102 - The apparatus of Example 101, wherein the inspection station further comprises a display that is in communication with the inspection station processor circuit, and wherein the display is for displaying information about the one or more service recommendations.

Example 103 - The apparatus of Examples 101 or 102, wherein the service recommendation criteria are stored in an inspection station memory of the inspection station, and wherein the inspection station processor circuit is in communication with the inspection station memory.

Example 104 - The apparatus of Examples 101, 102, or 103, wherein the handle module comprises a handle module processor circuit in communication with the handle module memory circuit, and wherein the handle module processor circuit is in communication with the inspection station processor circuit when the handle module is connected to the inspection station such that usage data from the handle module memory is downloadable to the inspection station.

Example 105 - The apparatus of Examples 101, 102, 103, or 104, wherein the handle module usage data comprises data selected from the group consisting of data regarding a number of surgical procedures involving the handle module, data regarding a number of device firings by the handle module, data regarding the power expended during the device firings of the handle module, data regarding the forces experienced during the device firings of the handle module, data regarding energy consumed by an electric motor of the handle module over the life of the handle module, and data regarding gear backlash for a rotary drive system of the handle module.

Example 106 - The apparatus of Examples 101, 102, 103, 104, or 105 wherein the one or more service recommendations comprise a recommendation that the handle module be rebuilt.

Example 107 - The apparatus of Examples 101, 102, 103, 104, 105, or 106, wherein the one or more service recommendations comprise a recommendation that one or more components of the handle module be lubricated.

Example 108 - The apparatus of Examples 101, 102, 103, 104, 105, 106, or 107 wherein the one or more service recommendations comprise a recommendation that one or more components of the handle module be inspected.

Example 109 - An apparatus comprising a handle module that is attachable to a detachable shaft module for collectively performing a surgical procedure, wherein the handle module comprises a handle module memory circuit for storing handle module usage data for the handle module, and a handle module processor circuit for determining one or more service recommendations for the handle module based on the handle module usage data stored in the memory of the handle module and based on service recommendation criteria. Example 110 - The apparatus of Example 109, wherein the handle module further comprises a display that is in communication with the handle module processor circuit, and wherein the display is for displaying information about the one or more service recommendations.

Example 111 - The apparatus of Examples 109 or 110, wherein the handle module usage data comprises data selected from the group consisting of data regarding a number of surgical procedures involving the handle module, data regarding a number of device firings by the handle module, data regarding the power expended during the device firings of the handle module, data regarding the forces experienced during the device firings of the handle module, data regarding energy consumed by an electric motor of the handle module over the life of the handle module, and data regarding gear backlash for a rotary drive system of the handle module.

Example 112 - The apparatus of Examples 109, 110, or 111, wherein the one or more service recommendations comprise a recommendation that the handle module be rebuilt.

Example 113 - The apparatus of Examples 109, 110, 111, or 112, wherein the one or more service recommendations comprise a recommendation that the handle module be rebuilt.

Example 114 - The apparatus of Examples 109, 110, 111, 112, or 113, wherein the one or more service recommendations comprise a recommendation that one or more components of the handle module be lubricated.

Example 115 - The apparatus of Examples 109, 110, 111, 112, 113, or 114, wherein the one or more service recommendations comprise a recommendation that one or more components of the handle module be inspected.

Example 116 - A surgical instrument system comprising a handle including a battery cavity and a direct current electrical motor, a battery removably positionable in the battery cavity, wherein the battery is configured to supply direct current electrical power to the direct current electrical motor, and a power adapter including a plug removably positionable in the battery cavity in lieu of the battery and a cord extending from the plug, wherein the cord is configured to transmit power to the plug from a power source. The surgical instrument system further comprises an alternating current to direct current power converter configured to convert alternating current electrical power supplied from the power source to direct current electrical power.

Example 117 - The surgical instrument system of Example 116, wherein the alternating current to direct current power converter is positioned in the plug.

Example 118 - The surgical instrument system of Examples 116 or 117, wherein the battery comprises a battery housing, wherein the plug comprises a plug housing, and wherein the battery housing is analogous to the plug housing.

Example 119 - The surgical instrument system of Examples 116, 117, or 118, wherein the handle comprises a set of handle electrical contacts in the battery cavity, wherein the battery comprises a set of battery electrical contacts configured to engage the handle electrical contacts when the battery is positioned in the battery cavity, and wherein the plug comprises a set of plug electrical contacts configured to engage the handle electrical contacts when the plug is positioned in the battery cavity.

Example 120 - The surgical instrument system of Examples 116, 117, 118, or 119, wherein the handle comprises a first set of handle electrical contacts and a second set of handle electrical contacts in the battery cavity, wherein the battery comprises a set of battery electrical contacts configured to engage the first set of handle electrical contacts when the battery is positioned in the battery cavity, and wherein the plug comprises a set of plug electrical contacts configured to engage the second set of handle electrical contacts when the plug is positioned in the battery cavity.

Example 121 - The surgical instrument system of Examples 116, 117, 118, 119, or 120, wherein the alternating current to direct current power converter is positioned in the handle and is in electrical communication with the second set of handle electrical contacts.

Example 122 - The surgical instrument system of Examples 116, 117, 118, 119, 120, or 121, further comprising a plurality of shaft assemblies, wherein each shaft assembly is selectively engageable with the handle.

Example 123 - The surgical instrument system of Example 122, wherein at least one of the shaft assemblies comprises a stapling cartridge.

Example 124 - A surgical instrument system comprising a handle including a battery cavity and a direct current electrical motor, a power adapter including a battery positioned in the battery cavity, wherein the battery comprises at least one battery cell, an electrical connector, and a cord engageable with the electrical connector, wherein the cord is configured to transmit power from a power source. The surgical instrument system further comprises an alternating current to direct current power converter configured to convert alternating current electrical power supplied from the power source to direct current electrical power and supply direct current electrical power to the direct current electrical motor.

Example 125 - The surgical instrument system of Example 124, further comprising a battery circuit, wherein the at least one battery cell, the alternating current to direct current power converter, and the electrical connector are arranged in series in the battery circuit such that the at least one battery cell and the power source can supply power to the direct current electric motor when the cord is engaged with the electrical connector.

Example 126 - The surgical instrument system of Example 124, further comprising a first battery circuit segment, wherein the first battery circuit segment includes the at least one battery cell, a second battery circuit segment, wherein the second battery circuit segment includes the alternating current to direct current power converter, and a switch positioned in the battery, wherein the switch is switchable between a first switch state in which the at least one battery cell can supply electrical power to the direct current electrical motor and the power supply cannot supply electrical power to the direct current electrical motor, and a second switch state in which the at least one battery cell cannot supply electrical power to the direct current electrical motor and the power supply can supply electrical power to the direct current electrical motor.

Example 127 - The surgical instrument system of Example 126, wherein the switch is biased into the first switch state.

Example 128 - The surgical instrument system of Examples 126 or 127, wherein the insertion of the cord into the battery electrical connector switches the switch from the first switch state into the second switch state.

Example 129 - The surgical instrument system of Example 128, further comprising a biasing member configured to return the switch into the first switch state.

Example 130 - The surgical instrument system of Examples 126, 127, or 128, wherein the switch is incapable of being returned to the first switch state after being placed in the second switch state.

Example 131 - The surgical instrument system of Examples 124, 125, 126, 127, 128, 129, or 130, further comprising a plurality of shaft assemblies, wherein each shaft assembly is selectively engageable with the handle.

Example 132 - The surgical instrument system of Example 131, wherein at least one of the shaft assemblies comprises a stapling cartridge.

Example 133 - A surgical instrument system comprising a handle including a handle housing, a handle battery cell positioned in the handle housing, a handle electrical circuit, wherein the handle battery cell is configured to supply power to the handle electrical circuit, and a handle electrical connector in communication with the handle electrical circuit. The surgical instrument system further comprises a supplemental battery selectively engageable with the handle, wherein the supplemental battery comprises a battery housing engageable with the handle housing, a battery electrical circuit, a supplemental battery cell positioned in the battery housing, wherein the supplemental battery cell is configured to supply power to the battery electrical circuit, and a battery electrical connector in communication with the battery electrical circuit, wherein the battery electrical connector is engageable with the handle electrical connector when the supplemental battery is engaged with the handle to place the battery electrical circuit in communication with the handle electrical circuit.

Example 134 - The surgical instrument system of Example 133, wherein the handle housing comprises a gripping portion, and wherein the battery housing comprises a receptacle configured to receive the gripping portion.

Example 135 - The surgical instrument system of Examples 133 or 134, wherein the handle further comprises a connector cover movable between a first position in which the connector cover inhibits accidental contact with the handle electrical connector and a second position in which the connector cover permits the battery electrical connector to engage the handle electrical connector.

Example 136 - The surgical instrument system of Example 135, wherein the battery housing is configured to move the connector cover between the first position and the second position when the supplemental battery is engaged with the handle.

Example 137 - The surgical instrument system of Examples 133, 134, 135, or 136, further comprising a plurality of shaft assemblies, wherein each shaft assembly is selectively engageable with the handle.

Example 138 - The surgical instrument system of Example 137, wherein at least one of the shaft assemblies comprises a stapling cartridge.

Example 139 - A surgical instrument comprising a housing, a motor, and a battery assembly attachable to the housing of the surgical instrument, the battery assembly comprising a battery cell configured to provide electrical energy to the motor and a battery housing comprising a support housing configured to support the battery cell, and

a shock absorbing element configured to absorb shock provided by an impact force, wherein the shock absorbing element is configured to crumple when an impact force is applied to the shock absorbing element.

Example 140 - The surgical instrument of Example 139, wherein the shock absorbing element is replaceable.

Example 141 - The surgical instrument of Examples 139 or 140, wherein the shock absorbing element comprises attachment means configured to permit the shock absorbing element to be attached to the battery assembly in a snap-fit fashion.

Example 142 - The surgical instrument of Example 141, wherein the attachment means comprises an adhesive.

Example 143 - The surgical instrument of Examples 141 or 142, wherein the battery housing further comprises an aperture, and wherein the attachment means comprises a protrusion configured to be received by the aperture in the battery housing in a wedge-fit fashion.

Example 144 - The surgical instrument of Examples 139, 140, 141, 142, or 143, wherein the shock absorbing element comprises a lattice structure.

Example 145 - The surgical instrument of Examples 139, 140, 141, 142, 143, or 144 wherein, when the shock absorbing element crumples, the shock absorbing element deforms in an inward direction which still permits the attachment of the battery assembly to the housing of the surgical instrument after the shock absorbing element has been impacted.

Example 146 - The surgical instrument of Examples 139, 140, 141, 142, 143, 144, or 145, wherein the shock absorbing element crumples when the impact force is greater than a threshold force.

Example 147 - The surgical instrument of Examples 139, 140, 141, 142, 143, 144, 145, or 146 wherein the battery assembly further comprises a plurality of corners, wherein the battery housing further comprises a plurality of the shock absorbing elements, and wherein the plurality of shock absorbing elements are positioned at each corner.

Example 148 - The surgical instrument of Example 147, wherein the battery housing comprises an electrical contact configured to transmit electrical energy from the battery cell to the motor and a bottom face associated with the electrical contact, wherein each shock absorbing element comprises an end portion extending beyond the bottom face of the battery housing to protect the electrical contact.

Example 149 - The surgical instrument of Examples 148 or 149, wherein each shock absorbing element comprises a bottom end and a top end, and wherein the battery assembly further comprises a shock absorbing cap positioned at the top ends of the shock absorbing elements.

Example 150 - A battery assembly for use with a surgical instrument, the battery assembly comprising a battery cell, an electrical contact configured to transmit electrical energy provided by the battery cell to the surgical instrument when the battery assembly is attached to the surgical instrument, a first housing configured to support the battery cell, a second housing configured to house the first housing, and a shock absorbing layer positioned between the first housing and the second housing, wherein the shock absorbing layer comprises a lattice structure.

Example 151 - The battery assembly of Example 150, wherein the shock absorbing layer comprises a foam-like material.

Example 152 - The battery assembly of Examples 150 or 151, wherein the lattice structure comprises a plurality of cells, the plurality of cells comprising an inner cell comprising an inner planar wall, wherein the inner planar wall is oriented at least substantially parallel the first housing and an outer cell comprising an outer planar wall, wherein the outer planar wall is oriented at least substantially parallel the second housing.

Example 153 - The battery assembly of Examples 150, 151, or 152, wherein the battery assembly further comprises a shock absorbing cap, the shock absorbing cap comprising an outer lattice and an inner lattice, wherein the outer lattice is more dense than the inner lattice.

Example 154 - The battery assembly of Examples 150, 151, 152, or 153, wherein the shock absorbing layer comprises

a plurality of dampening elements.

Example 155 - A battery assembly for use with a surgical instrument, the battery assembly comprising a battery cell configured to provide power to the surgical instrument and a housing comprising a heat reflecting shell, a heat sink layer, and a compressible layer positioned between the heat sink layer and the heat reflecting shell, wherein the compressible layer is configured to flex in response to expansion of the battery cell.

Example 156 - The battery assembly of Example 155, wherein the compressible layer is further configured to dissipate impact energy absorbed by the heat reflecting shell.

Example 157 - The battery assembly of Examples 155 or 156, wherein the compressible layer comprises a lattice structure.

Example 158 - The battery assembly of Example 157, wherein the lattice structure is a closed lattice structure defined by the heat reflecting shell and the heat sink layer.

Example 159 - The battery assembly of Examples 155, 156, 157, or 158, wherein the heat reflecting shell comprises a first thermal expansion coefficient, wherein the heat sink layer comprises a second thermal expansion coefficient, and wherein the first thermal expansion coefficient is less than the second thermal expansion coefficient.

[0199] Although the devices have been described herein in connection with certain specific examples, many modifications and variations may be implemented. Also, where materials are disclosed for certain components, other materials may be used. Furthermore, a single component may be replaced by multiple components, and multiple components may be replaced by a single component, to perform a given function or functions. The foregoing description and following claims are intended to cover all such modification and variations.

[0200] The devices disclosed herein can be designed to be disposed of after a single use, or they can be designed to be used multiple times. In either case, however, the device can be reconditioned for reuse after at least one use. Reconditioning can include any combination of the steps of disassembly of the device, followed by cleaning or replacement of particular pieces, and subsequent reassembly. In particular, the device can be disassembled, and any number of the particular pieces or parts of the device can be selectively replaced or removed in any combination. Upon cleaning and/or replacement of particular parts, the device can be reassembled for subsequent use either at a reconditioning facility, or by a surgical team immediately prior to a surgical procedure. Those skilled in the art will appreciate that reconditioning of a device can utilize a variety of techniques for disassembly, cleaning/replacement, and reassembly. Use of such techniques, and the resulting reconditioned device, are all within the scope of the present application.

[0201] Preferably, the invention described herein will be processed before surgery. First, a new or used instrument is obtained and if necessary cleaned. The instrument can then be sterilized. In one sterilization technique, the instrument is placed in a closed and sealed container, such as a plastic or TYVEK bag. The container and instrument are then placed in a field of radiation that can penetrate the container, such as gamma radiation, x-rays, or high-energy electrons. The radiation kills bacteria on the instrument and in the container. The sterilized instrument can then be stored in the sterile container. The sealed container keeps the instrument sterile until it is opened in the medical facility.

Claims

1. A surgical instrument, comprising:

a housing;
a motor; and

a battery assembly attachable to said housing of said surgical instrument, said battery assembly comprising:

a battery cell configured to provide electrical energy to said motor; and
a battery housing, comprising:

a support housing configured to support said battery cell; and
a shock absorbing element configured to absorb shock provided by an impact force, wherein said shock absorbing element is configured to crumple when an impact force is applied to said shock absorbing element.

2. The surgical instrument of Claim 1, wherein said shock absorbing element is replaceable.
3. The surgical instrument of Claim 2, wherein said shock absorbing element comprises attachment means configured to permit said shock absorbing element to be attached to said battery assembly in a snap-fit fashion.
- 5 4. The surgical instrument of Claim 3, wherein said attachment means comprises an adhesive.
5. The surgical instrument of Claim 3, wherein said battery housing further comprises an aperture, and wherein said attachment means comprises a protrusion configured to be received by said aperture in said battery housing in a wedge-fit fashion.
- 10 6. The surgical instrument of any preceding Claim, wherein said shock absorbing element comprises a lattice structure.
7. The surgical instrument of any preceding Claim, wherein, when said shock absorbing element crumples, said shock absorbing element deforms in an inward direction which still permits the attachment of said battery assembly to said housing of said surgical instrument after said shock absorbing element has been impacted.
- 15 8. The surgical instrument of any preceding Claim, wherein said shock absorbing element crumples when the impact force is greater than a threshold force.
- 20 9. The surgical instrument of any preceding Claim, wherein said battery assembly further comprises a plurality of corners, wherein said battery housing further comprises a plurality of said shock absorbing elements, and wherein each of said plurality of said shock absorbing elements is positioned at a respective corner.
- 25 10. The surgical instrument of Claim 9, wherein said battery housing comprises:

an electrical contact configured to transmit electrical energy from said battery cell to said motor; and
a bottom face associated with said electrical contact, wherein each said shock absorbing element comprises an end portion extending beyond said bottom face of said battery housing to protect said electrical contact.
- 30 11. The surgical instrument of Claim 9 or Claim 10, wherein each said shock absorbing element comprises a bottom end and a top end, and wherein said battery assembly further comprises a shock absorbing cap positioned at the top ends of said shock absorbing elements.
- 35 12. A battery assembly for use with a surgical instrument, said battery assembly comprising:

a battery cell;
an electrical contact configured to transmit electrical energy provided by said battery cell to the surgical instrument when said battery assembly is attached to the surgical instrument;
40 a first housing configured to support said battery cell;
a second housing configured to house said first housing; and
a shock absorbing layer positioned between said first housing and said second housing, wherein said shock absorbing layer comprises a lattice structure.
- 45 13. The battery assembly of Claim 12, wherein said shock absorbing layer comprises a foam-like material.
14. The battery assembly of Claim 12 or Claim 13, wherein said lattice structure comprises a plurality of cells, said plurality of cells comprising:

50 an inner cell comprising an inner planar wall, wherein said inner planar wall is oriented at least substantially parallel said first housing; and
an outer cell comprising an outer planar wall, wherein said outer planar wall is oriented at least substantially parallel said second housing.
- 55 15. The battery assembly of any one of Claims 12 - 14, wherein said battery assembly further comprises a shock absorbing cap, said shock absorbing cap comprising:

an outer lattice; and

an inner lattice, wherein said outer lattice is more dense than said inner lattice.

16. The battery assembly of any one of Claims 12 - 15, wherein said shock absorbing layer comprises a plurality of dampening elements.

17. A battery assembly for use with a surgical instrument, said battery assembly comprising:

a battery cell configured to provide power to the surgical instrument;
a housing, comprising:

a heat reflecting shell;

a heat sink layer; and

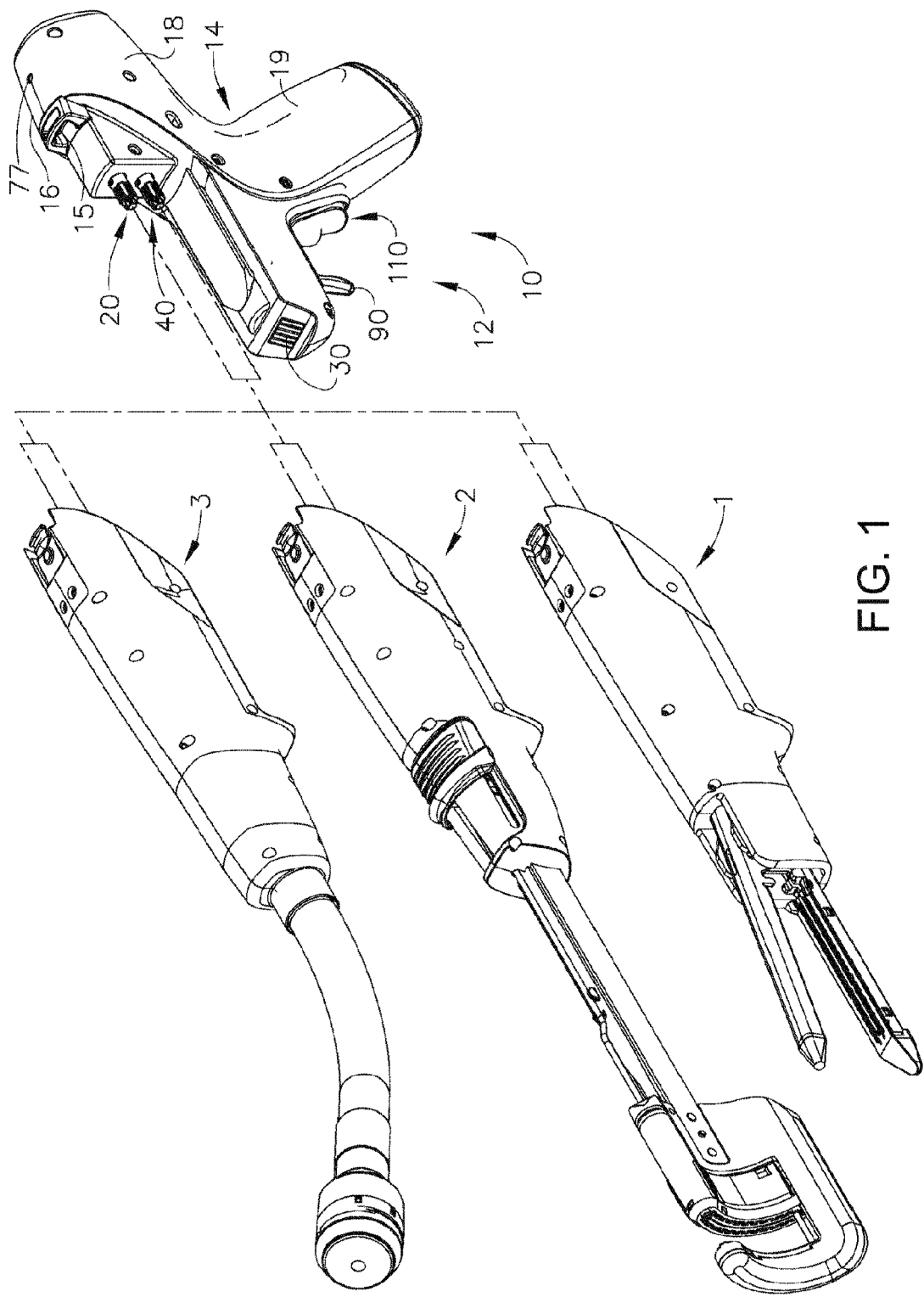
a compressible layer positioned between said heat sink layer and said heat reflecting shell, wherein said compressible layer is configured to flex in response to expansion of said battery cell.

18. The battery assembly of Claim 17, wherein said compressible layer is further configured to dissipate impact energy absorbed by said heat reflecting shell.

19. The battery assembly of Claim 17 or Claim 18, wherein said compressible layer comprises a lattice structure.

20. The battery assembly of Claim 19, wherein said lattice structure is a closed lattice structure defined by said heat reflecting shell and said heat sink layer.

21. The battery assembly of any one of Claims 17 - 20, wherein said heat reflecting shell comprises a first thermal expansion coefficient, wherein said heat sink layer comprises a second thermal expansion coefficient, and wherein said first thermal expansion coefficient is less than said second thermal expansion coefficient.



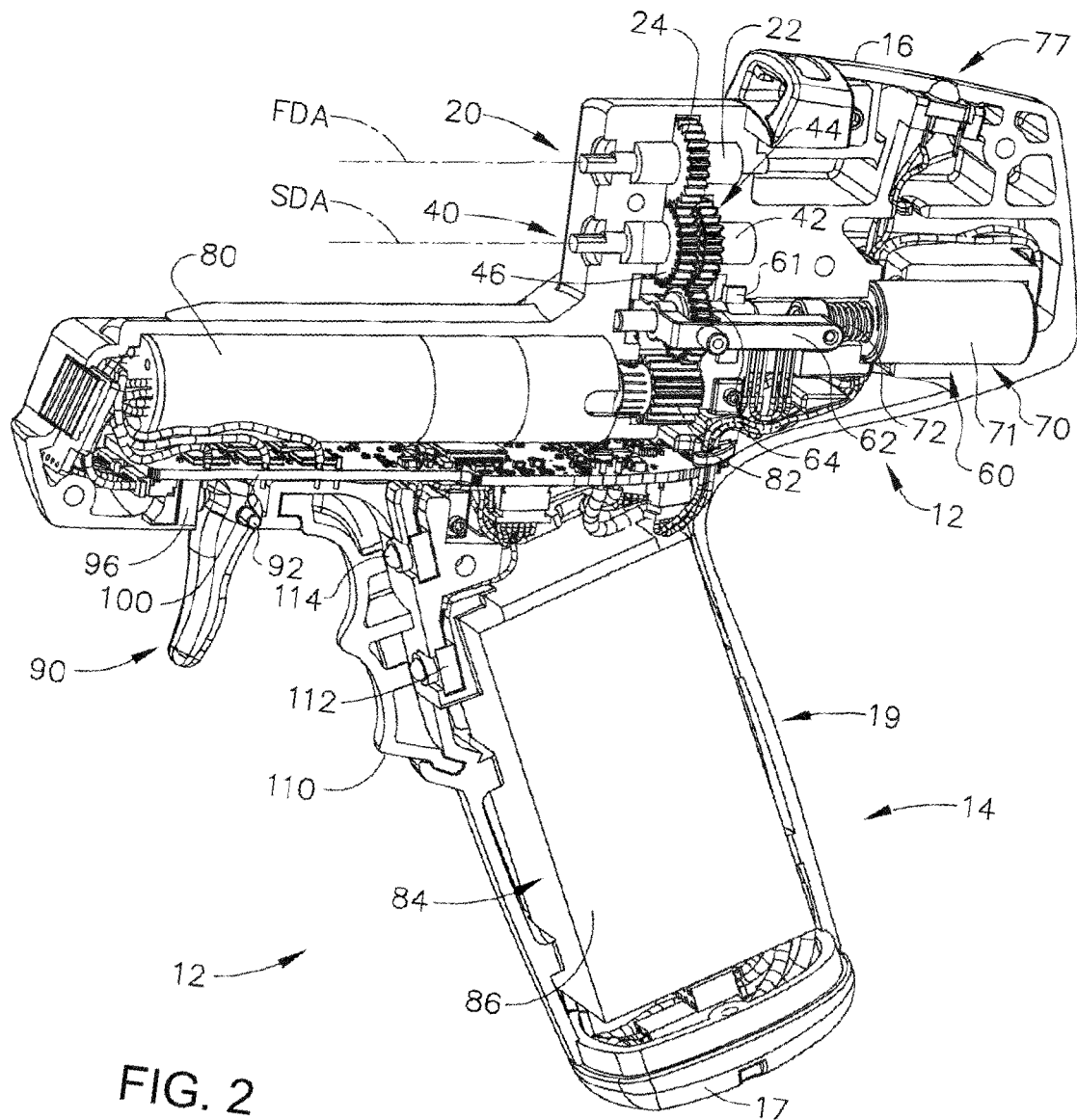


FIG. 2

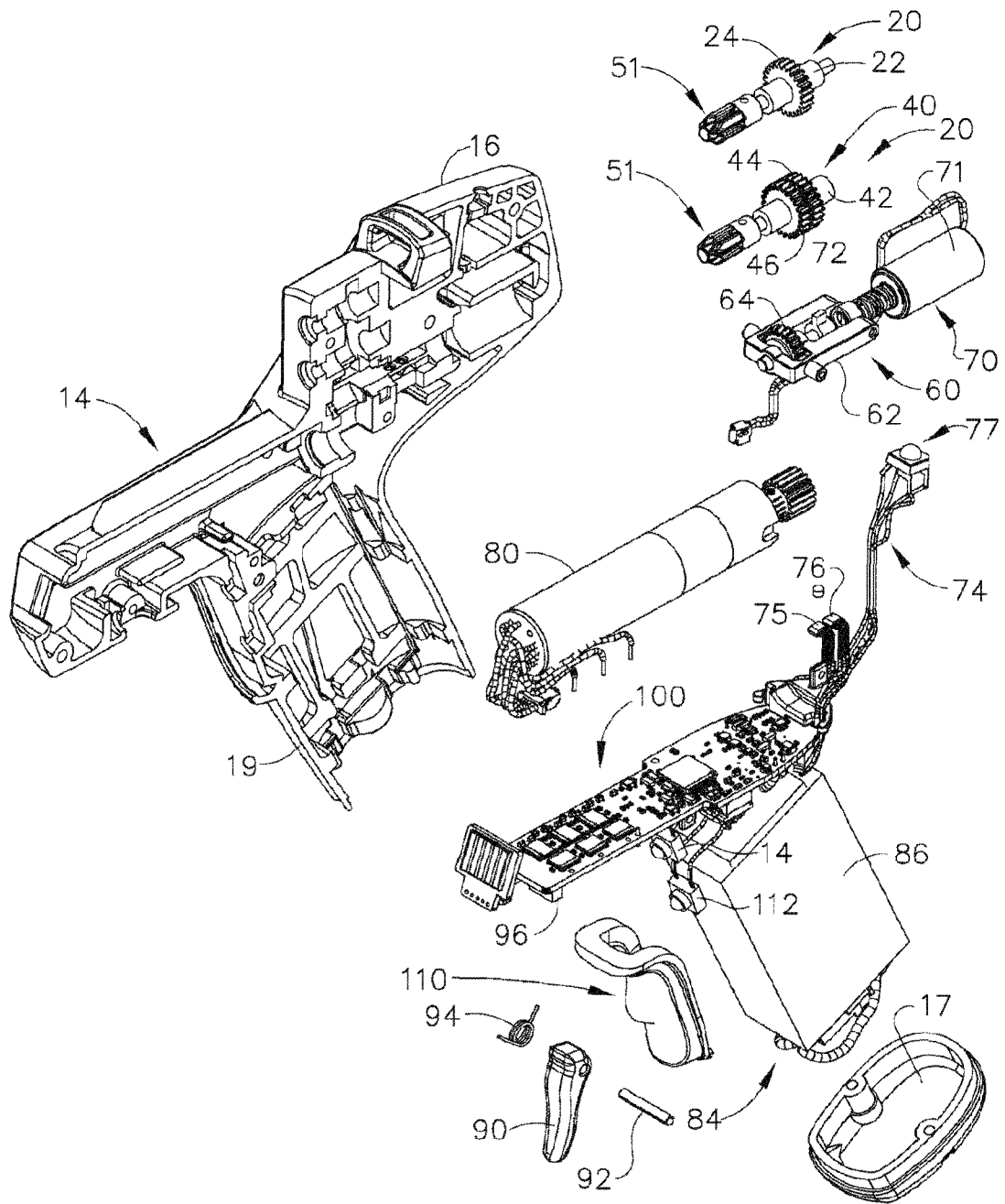


FIG. 3

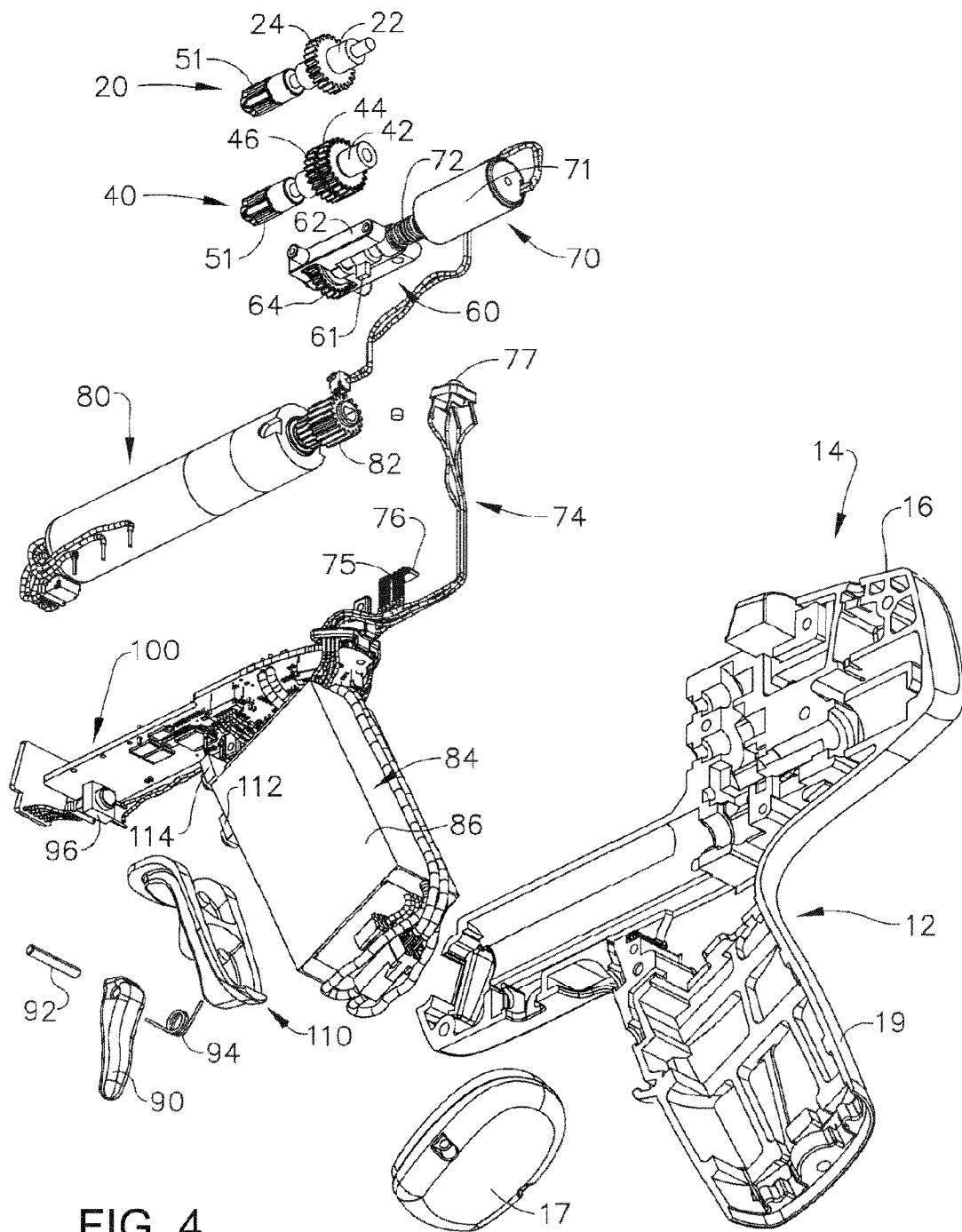
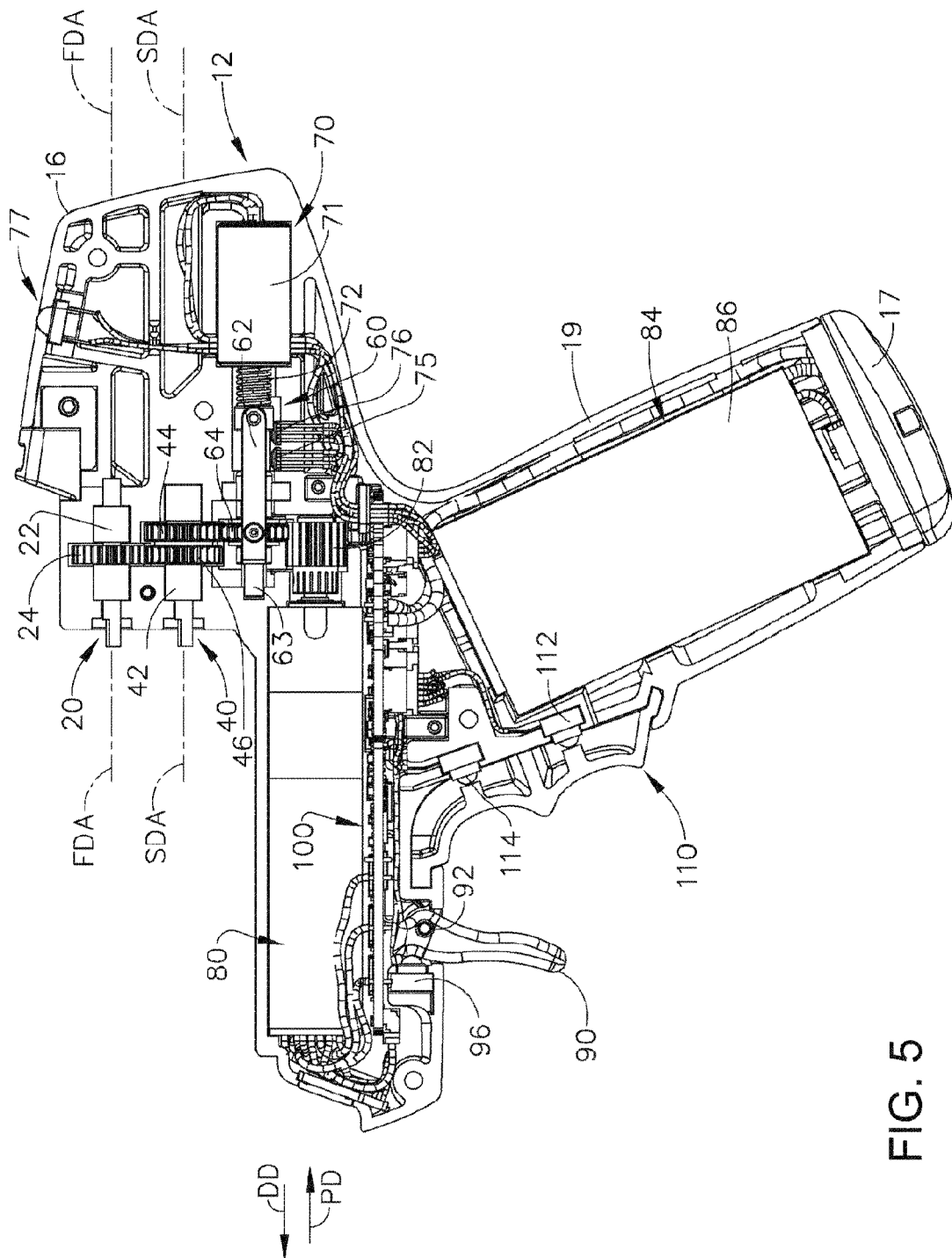


FIG. 4



5
6
7

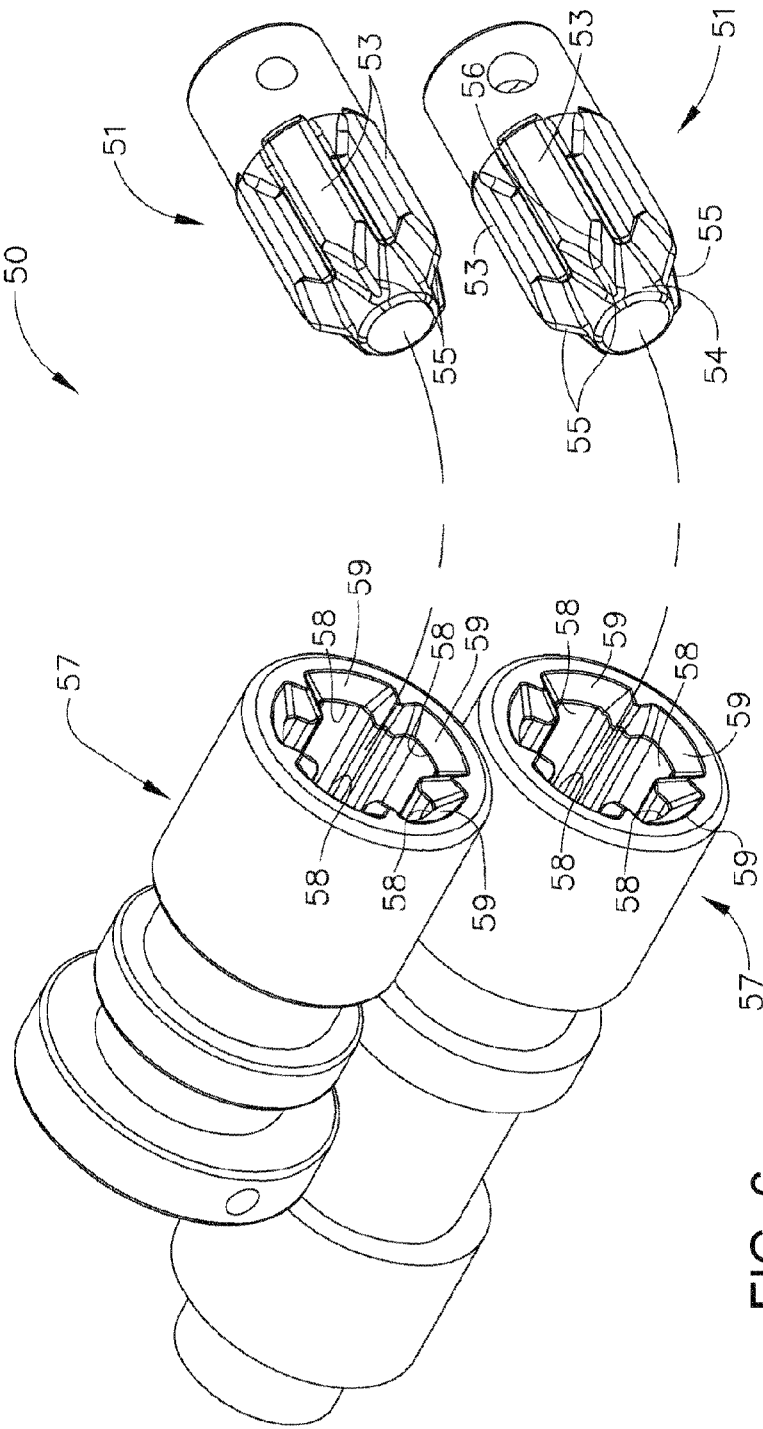


FIG. 6

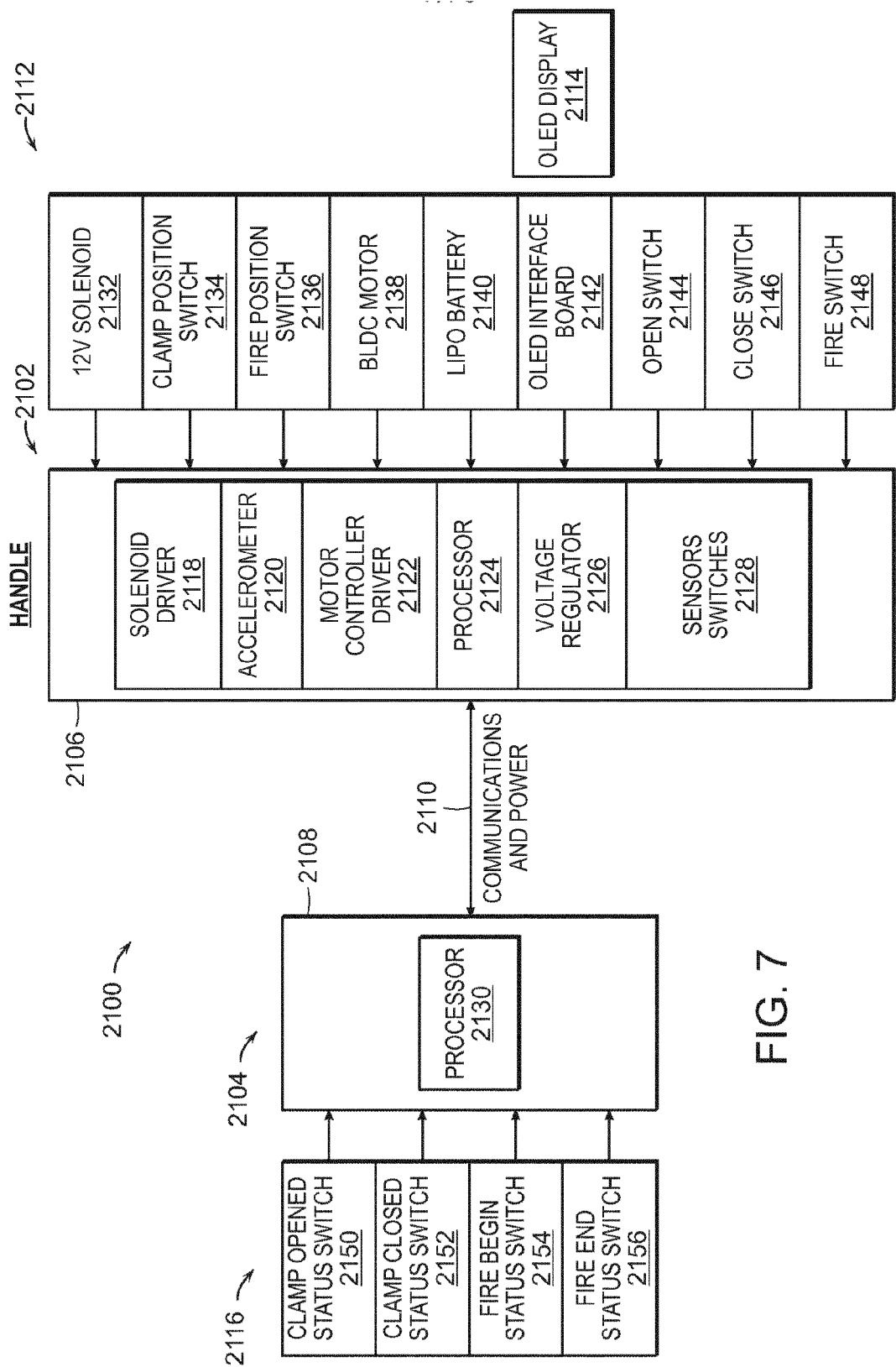


FIG. 7

FIG. 8

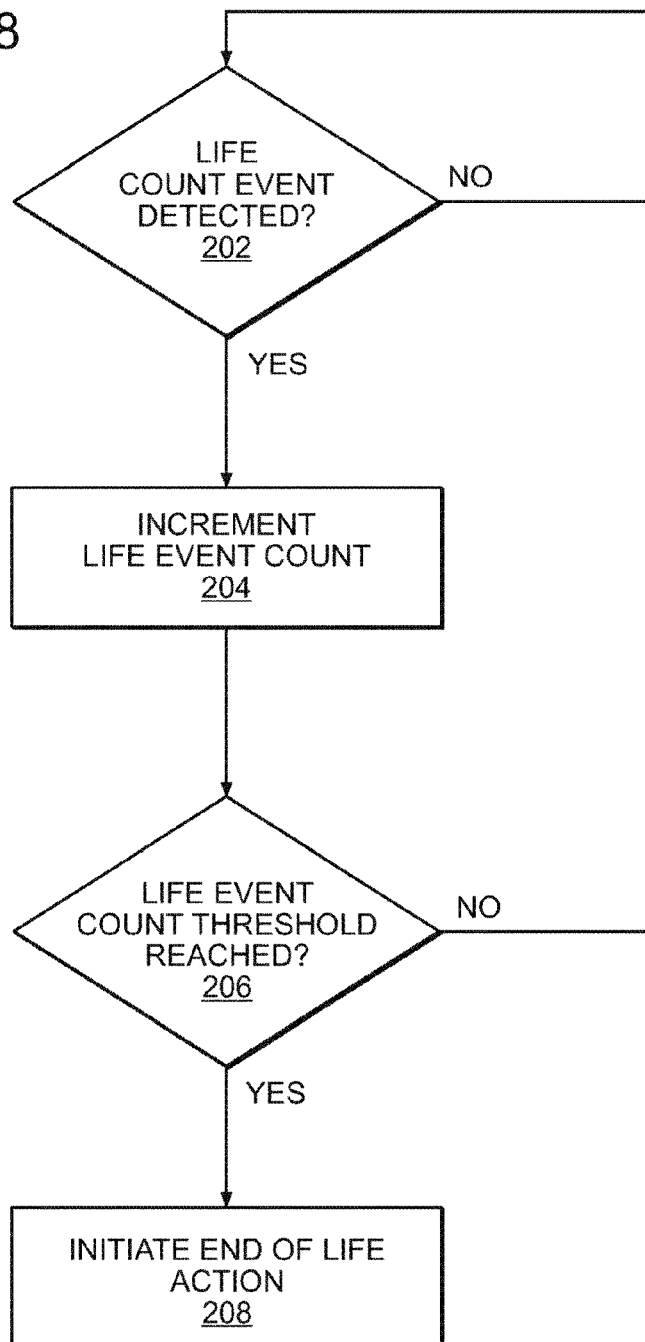
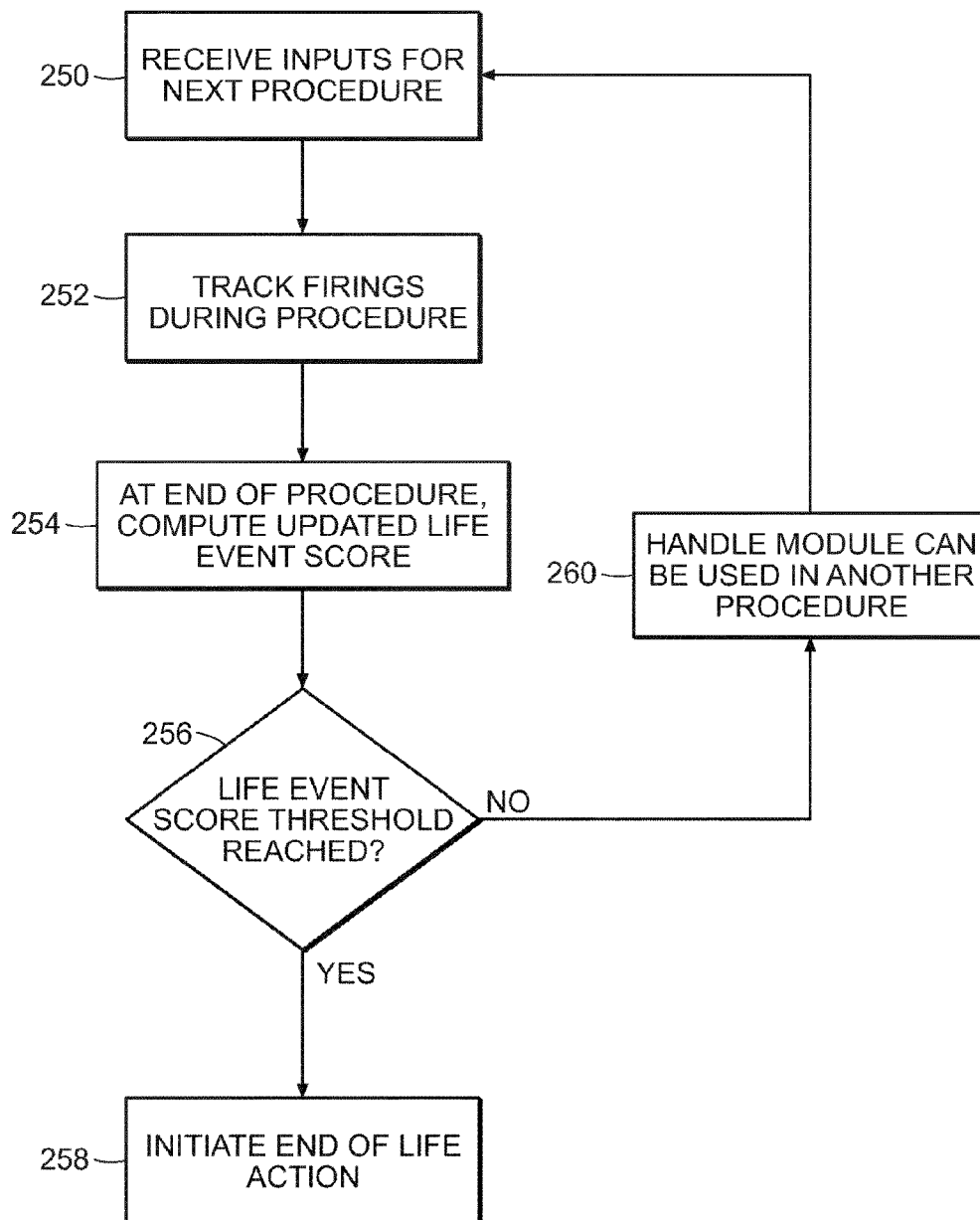


FIG. 9



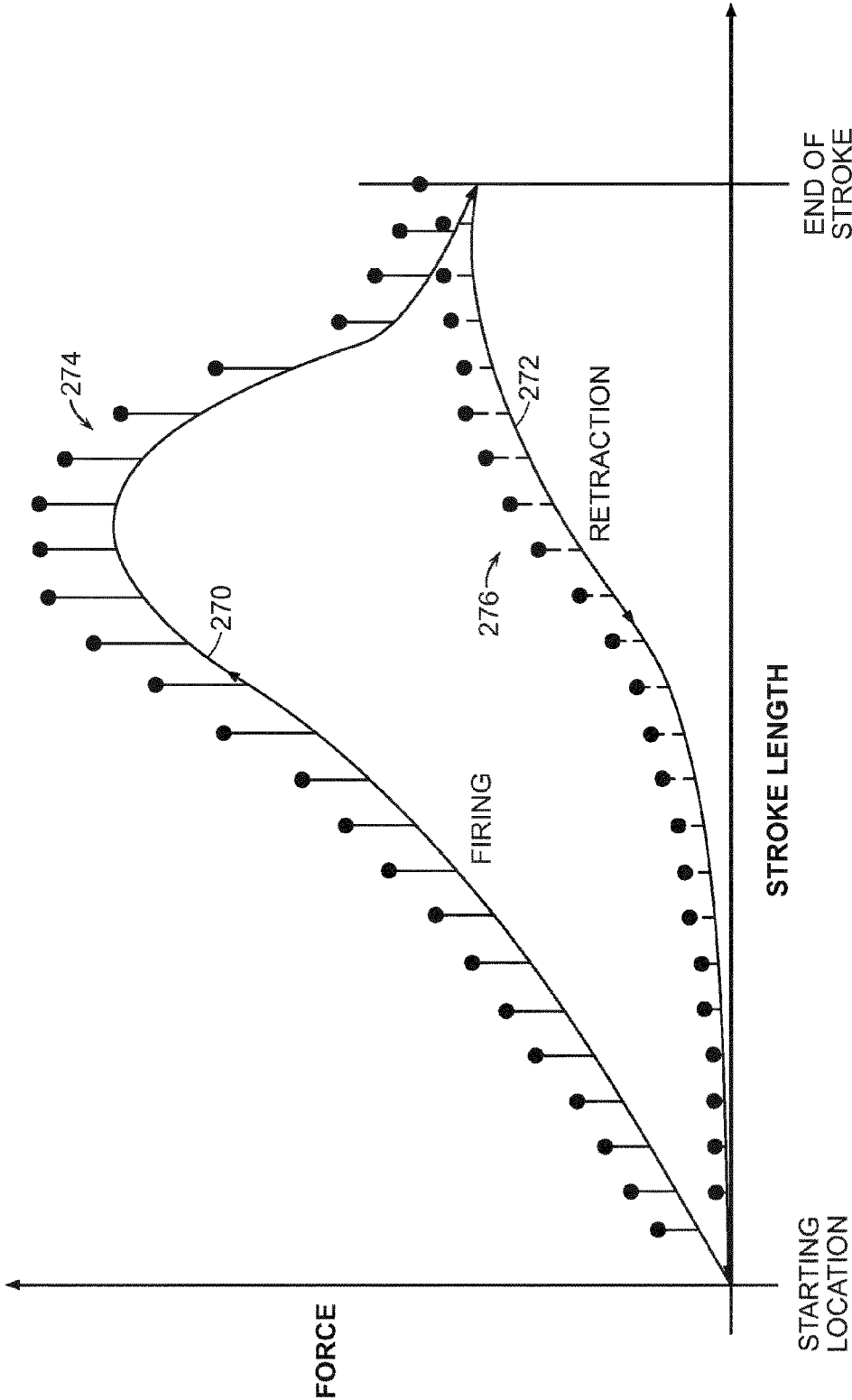
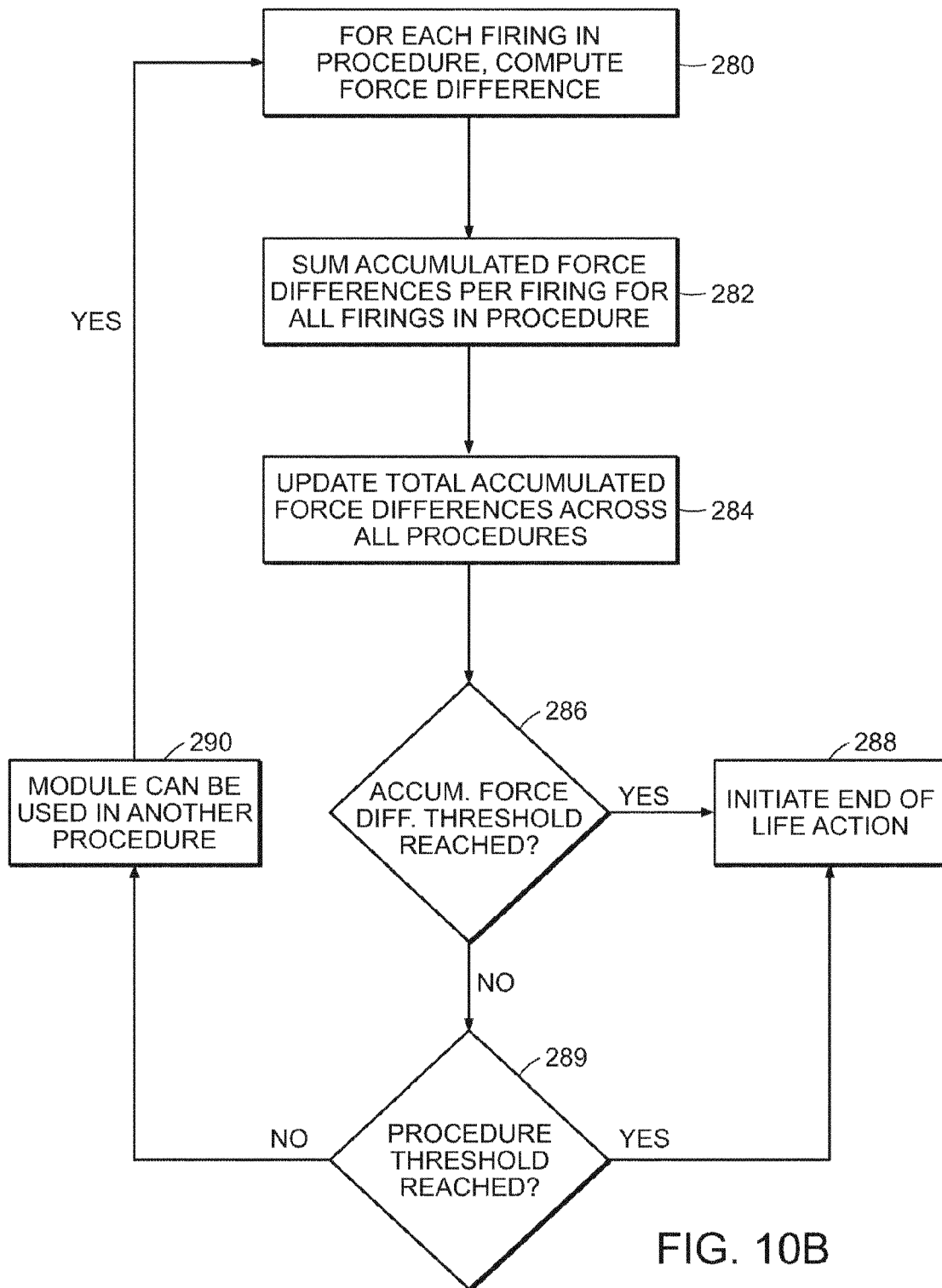


FIG. 10A



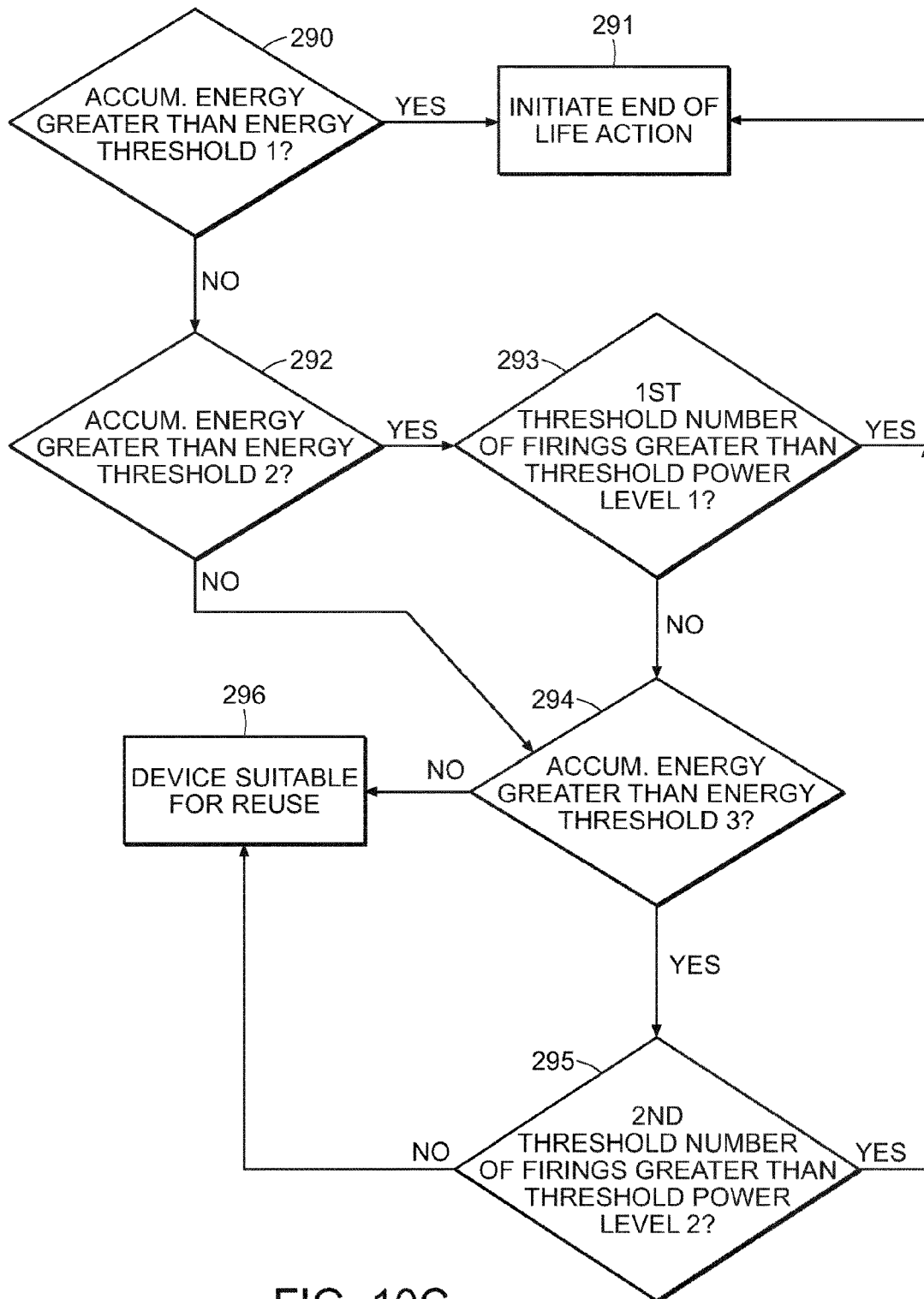


FIG. 10C

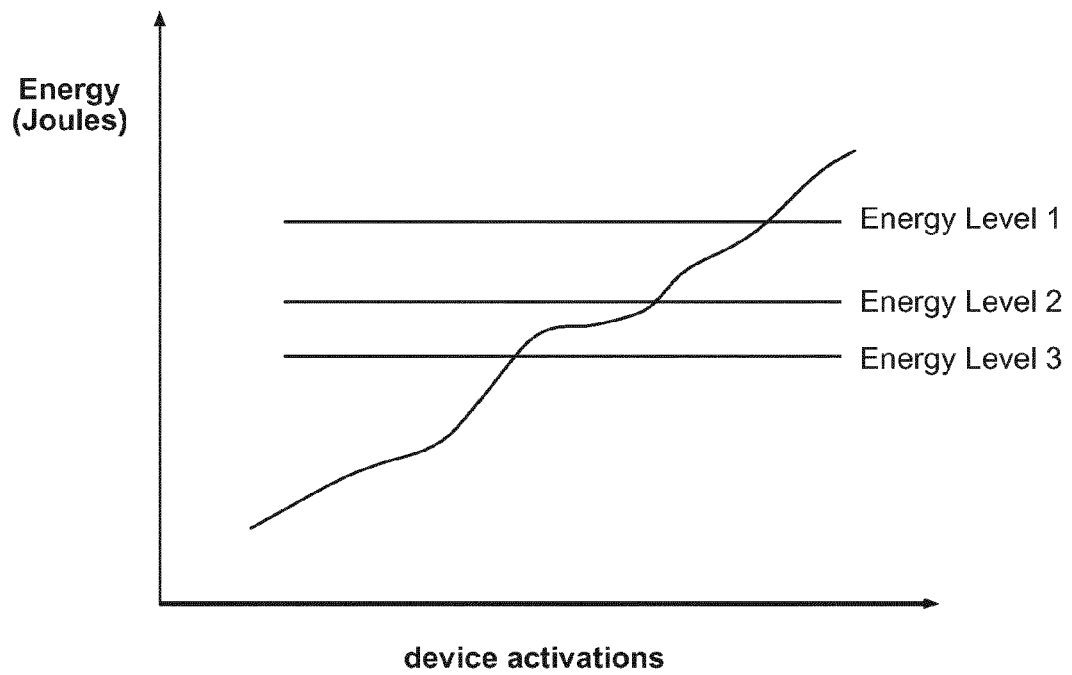


FIG. 10D

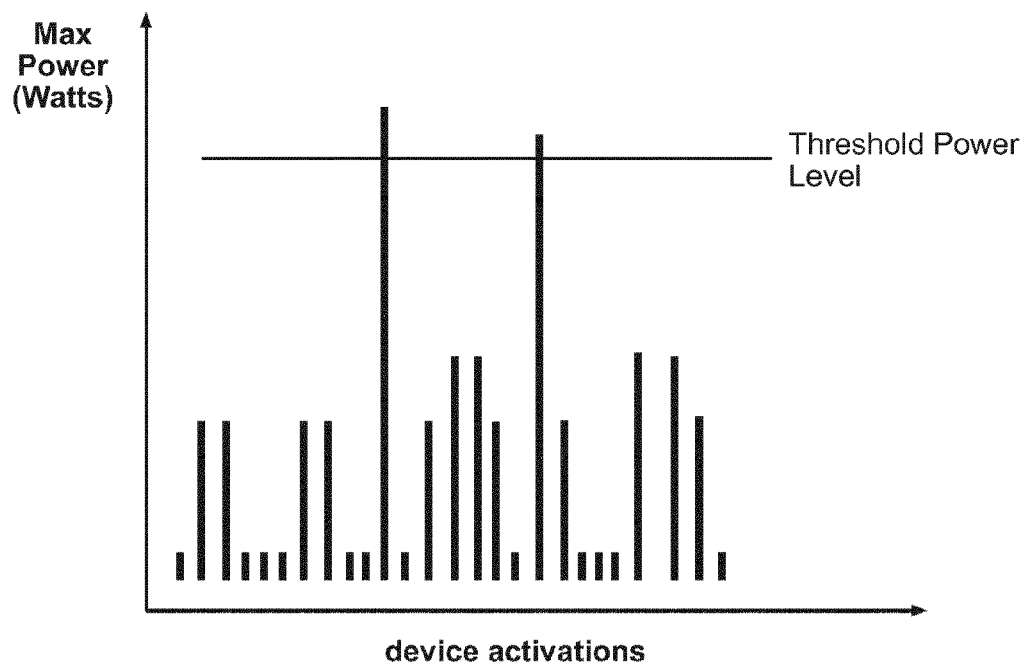


FIG. 10E

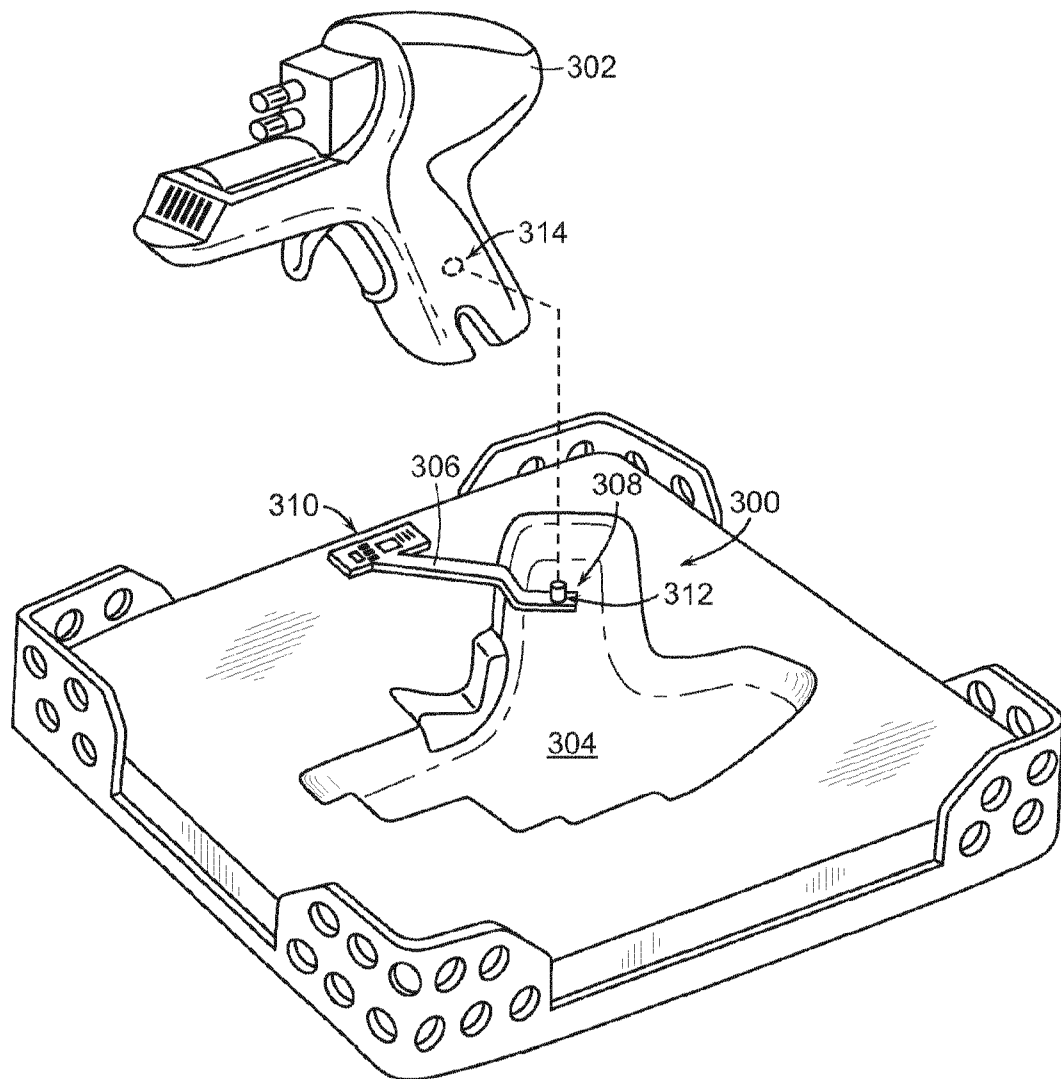


FIG. 11A

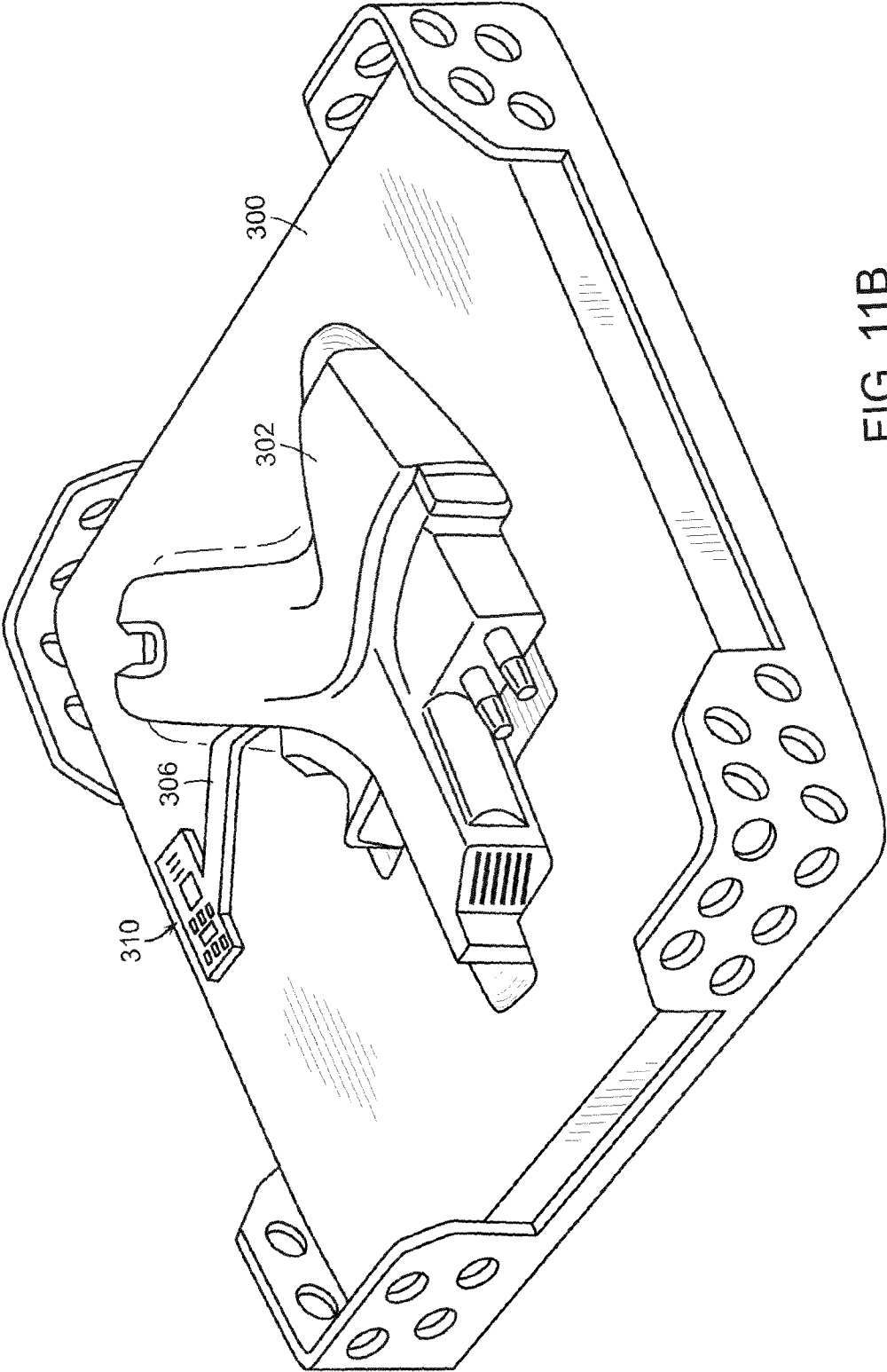


FIG. 11B

FIG. 11C

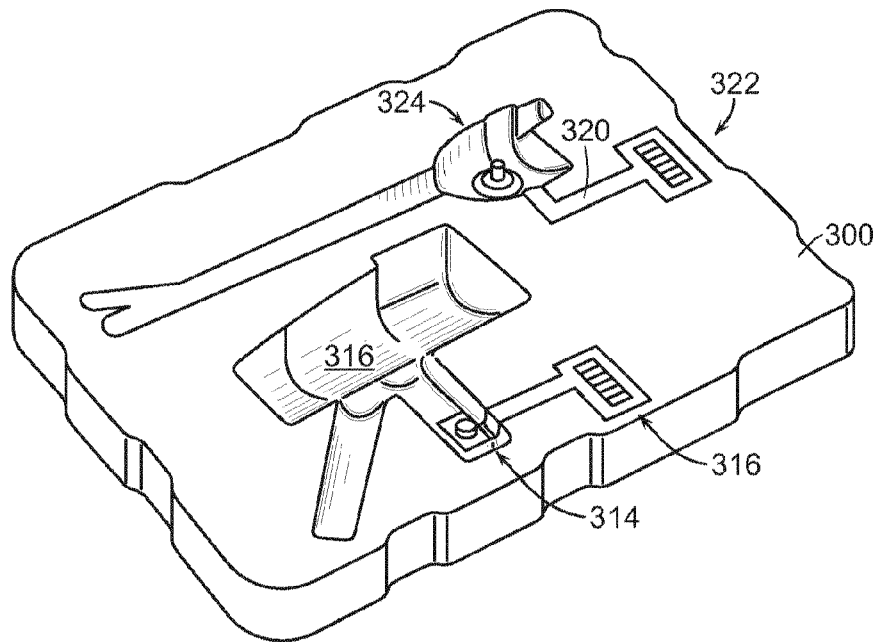
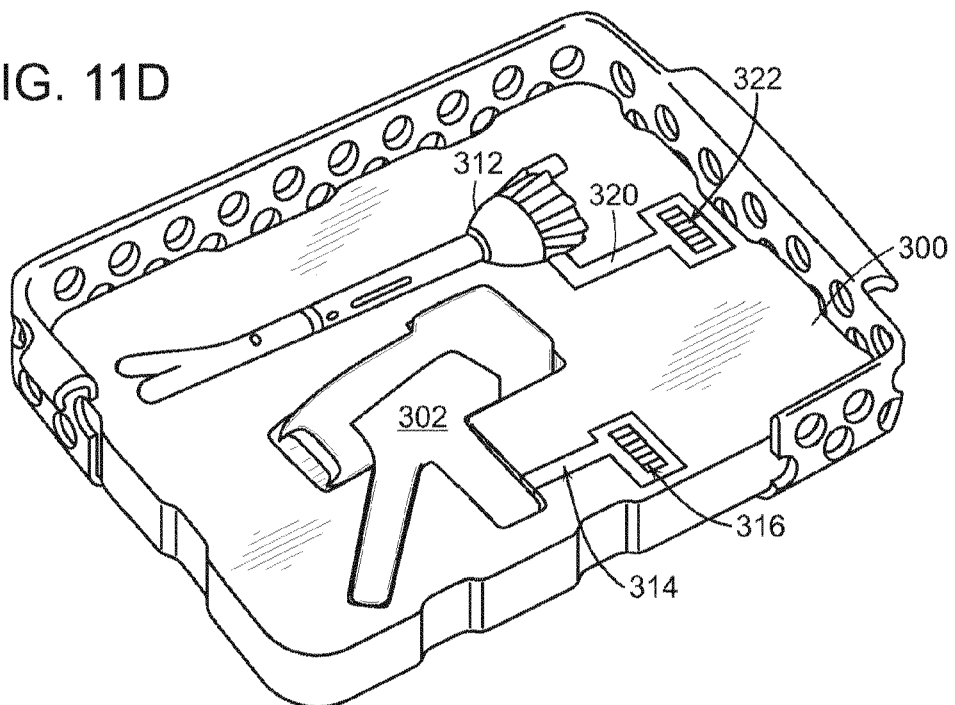


FIG. 11D



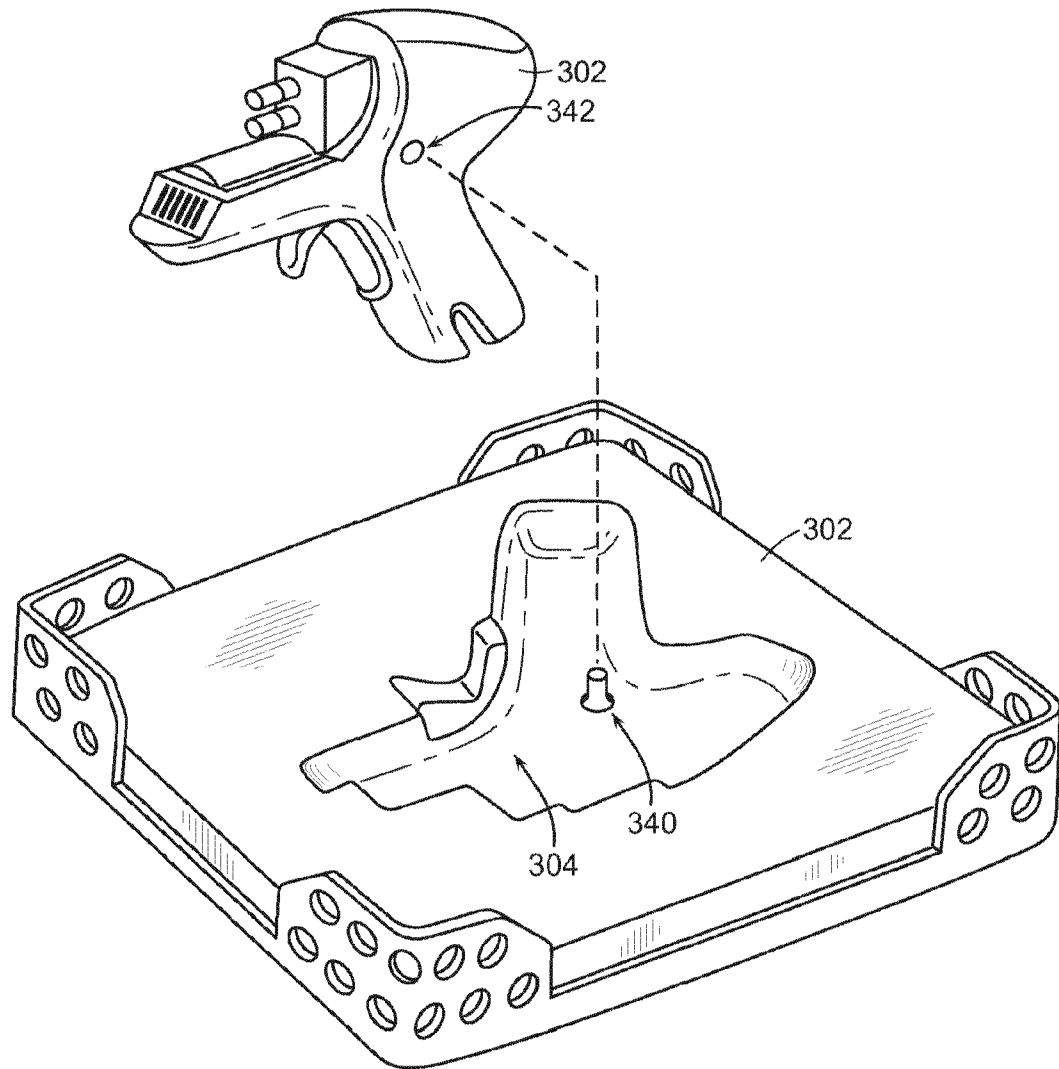


FIG. 11E

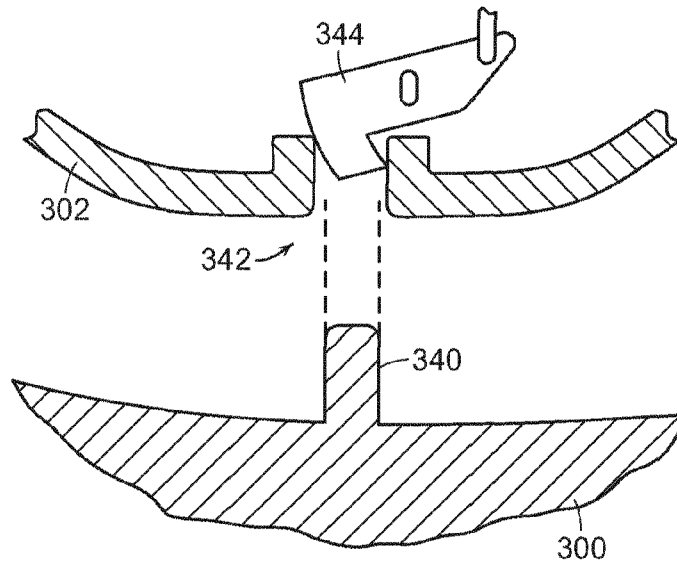


FIG. 11F

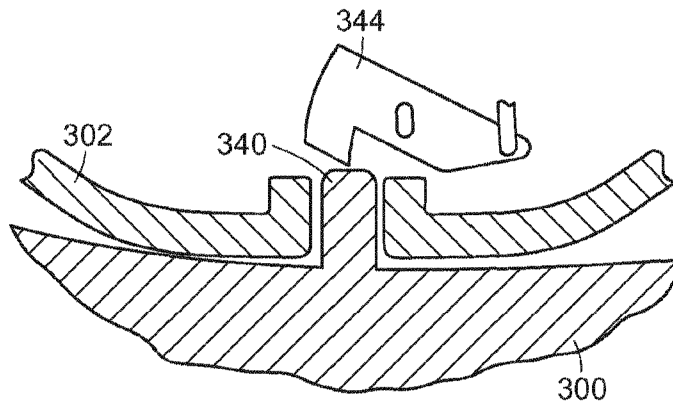


FIG. 11G

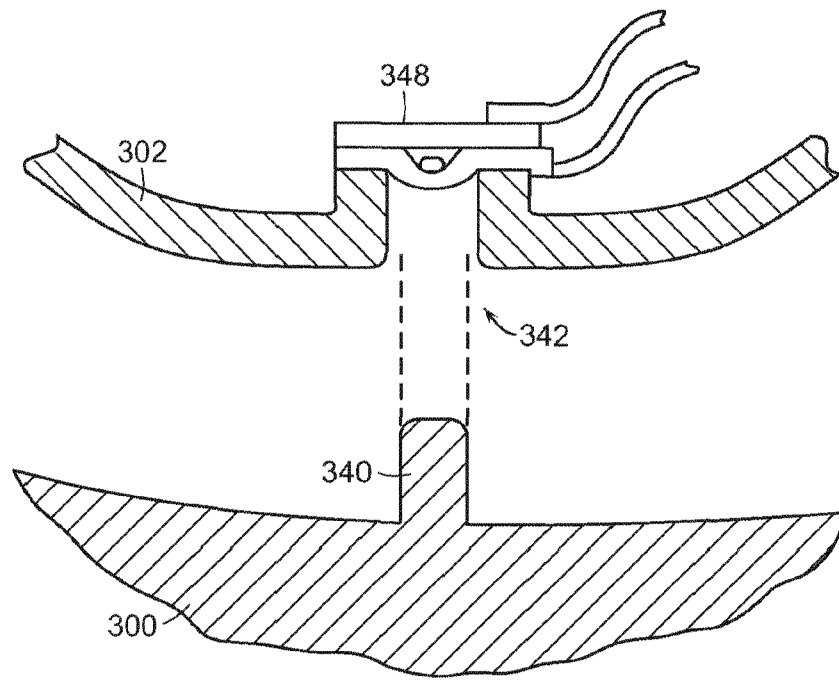


FIG. 11H

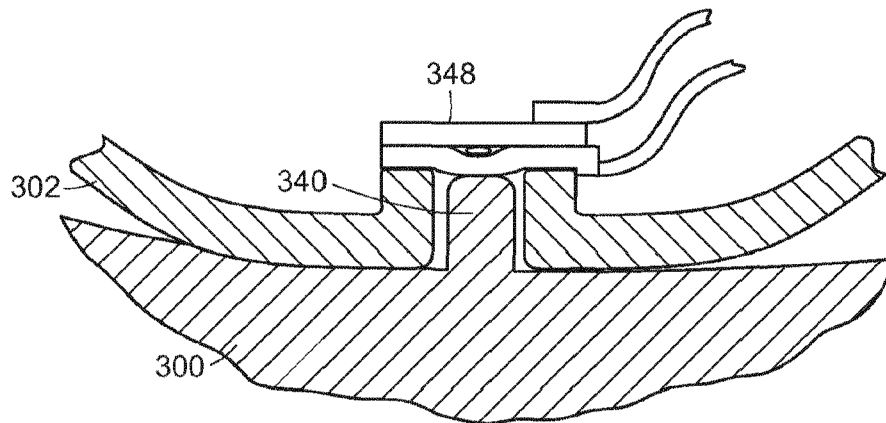
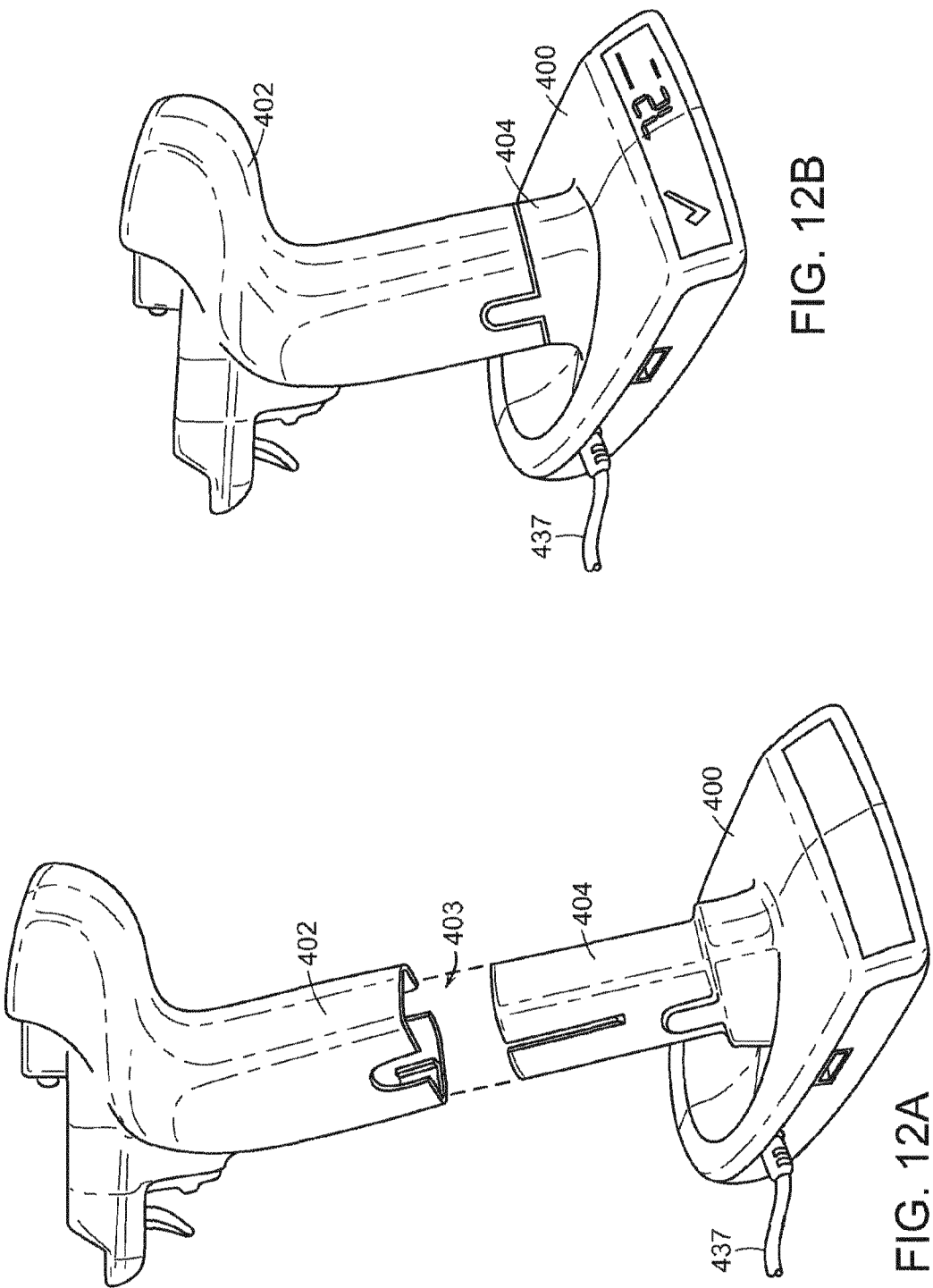


FIG. 11I



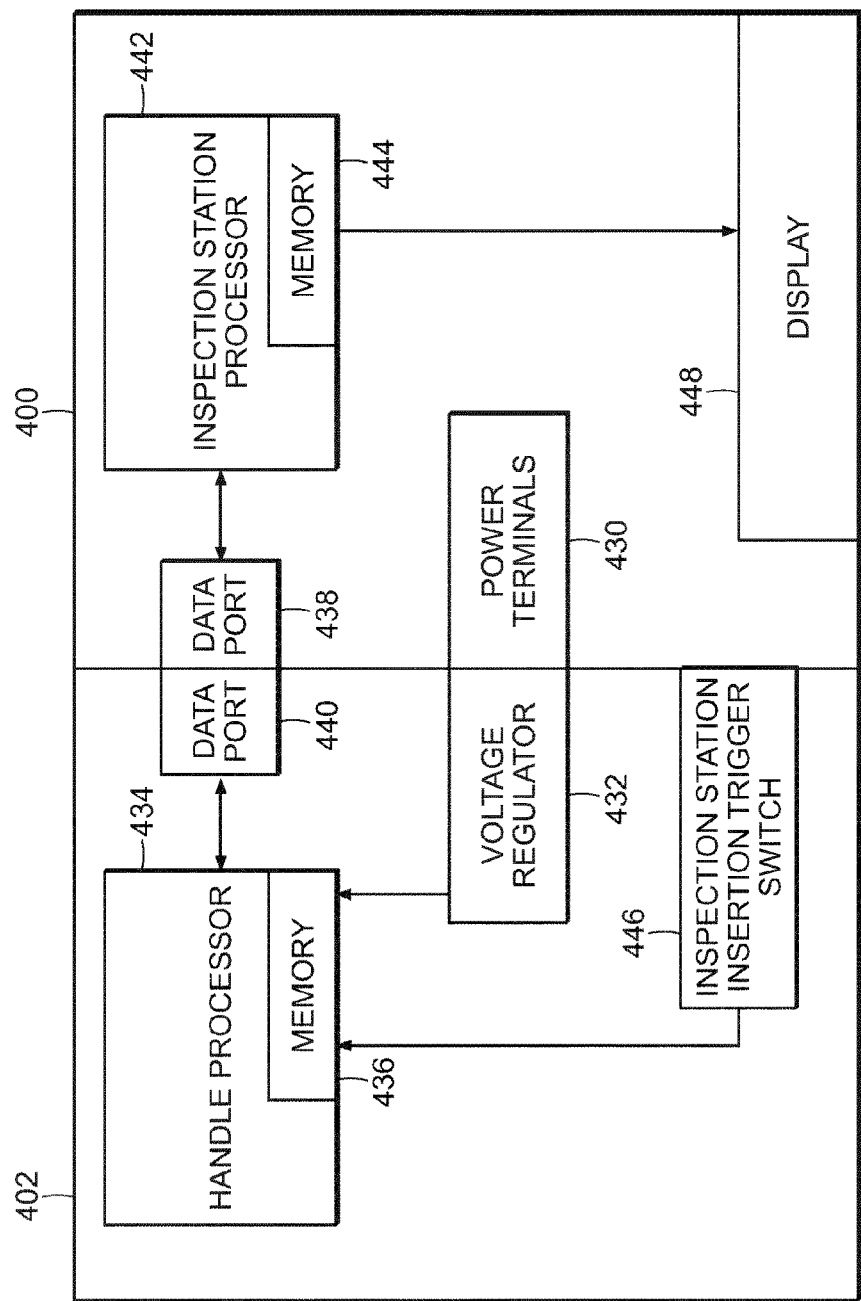


FIG. 12C

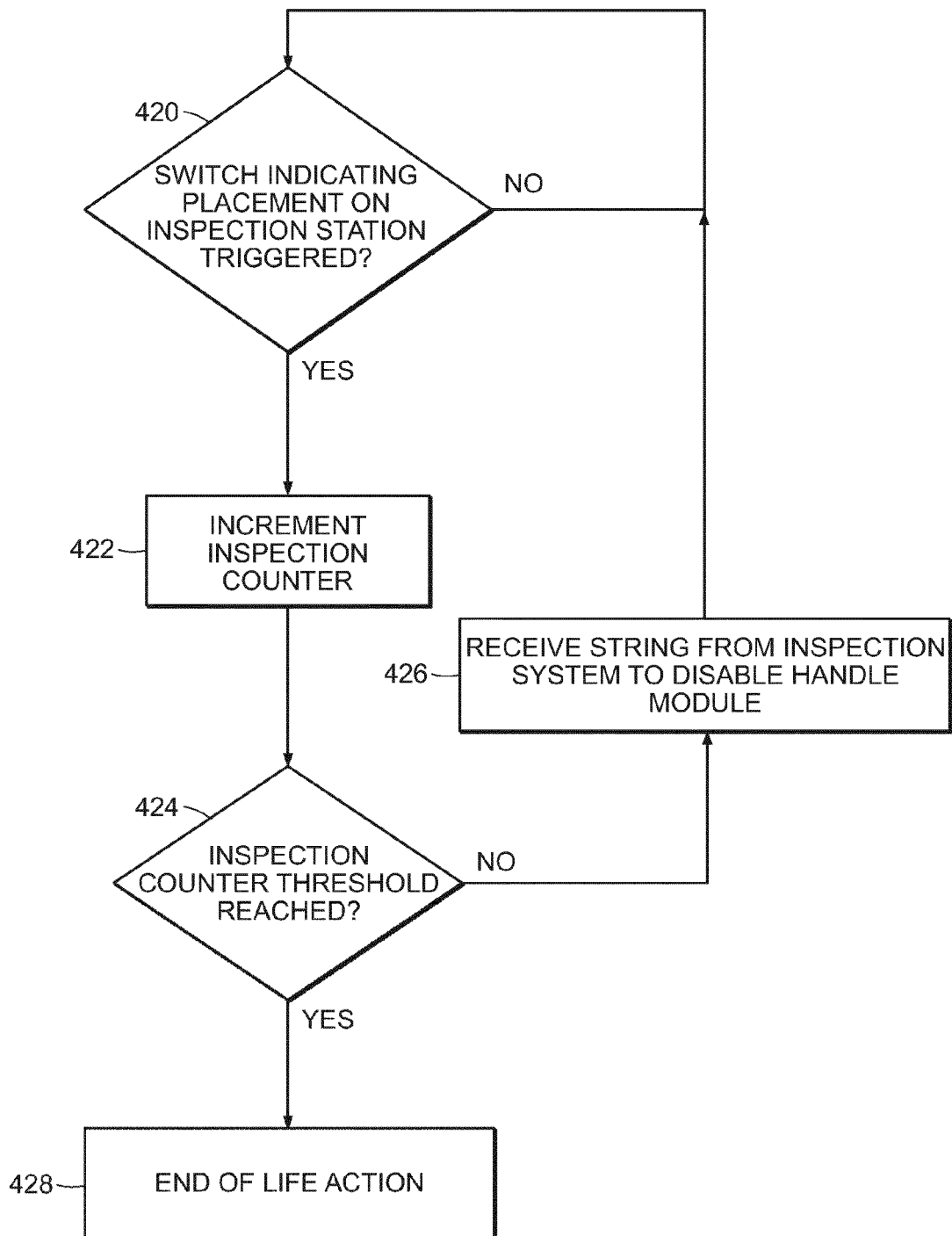


FIG. 12D

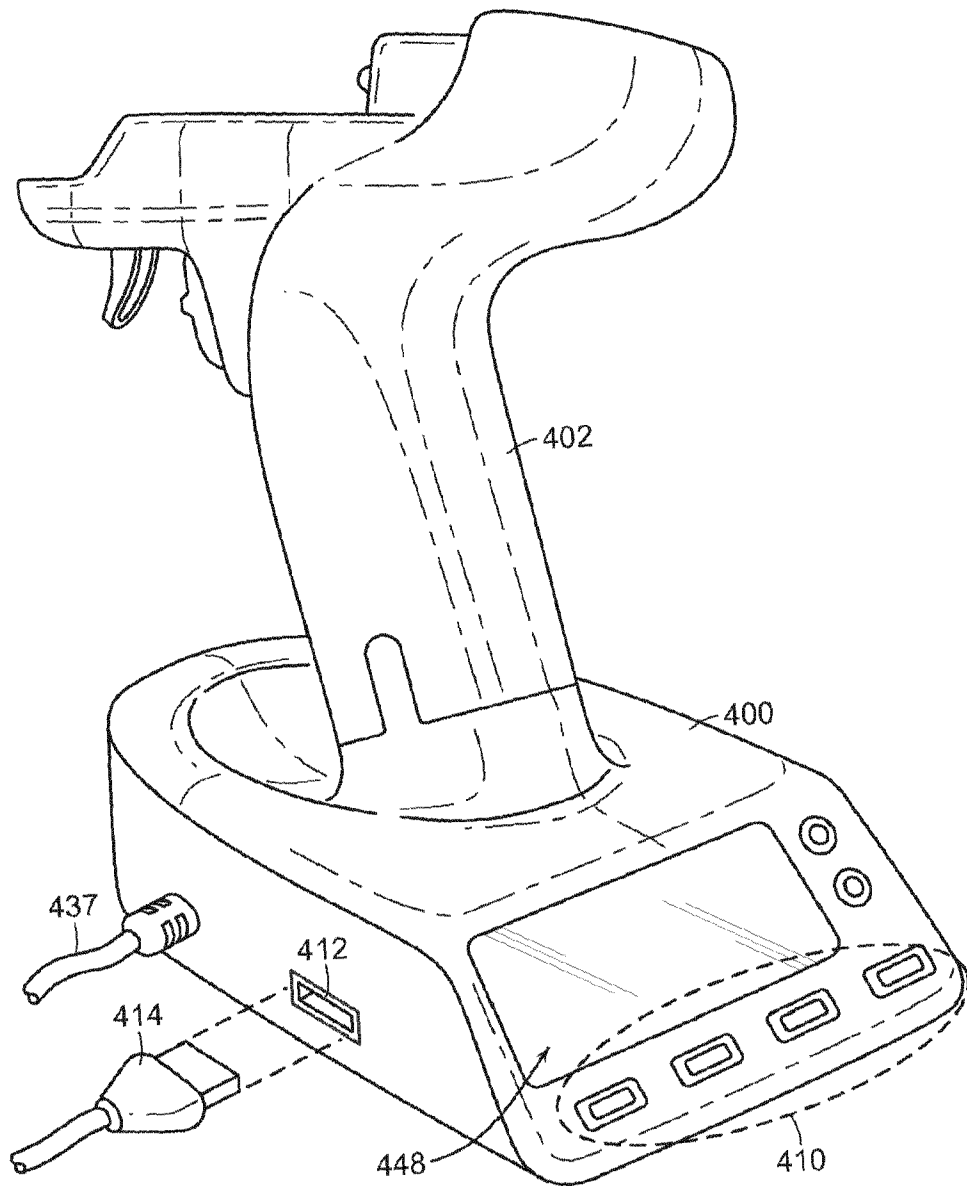


FIG. 12E

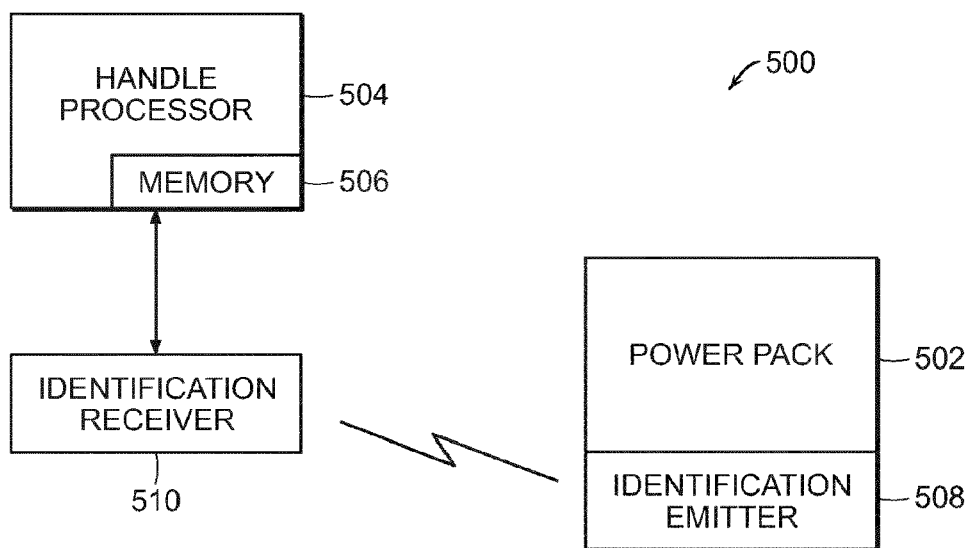


FIG. 13A

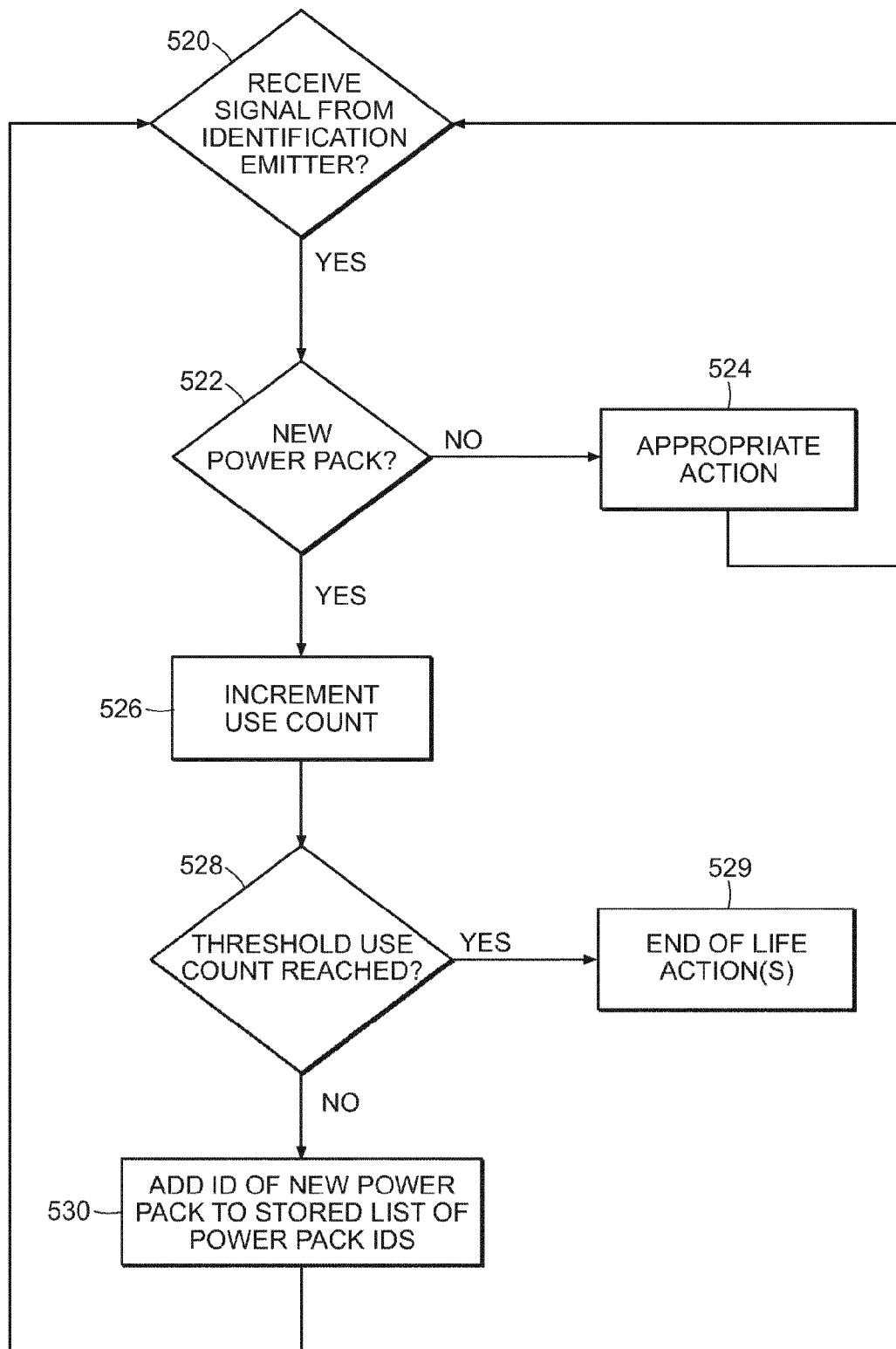


FIG. 13B

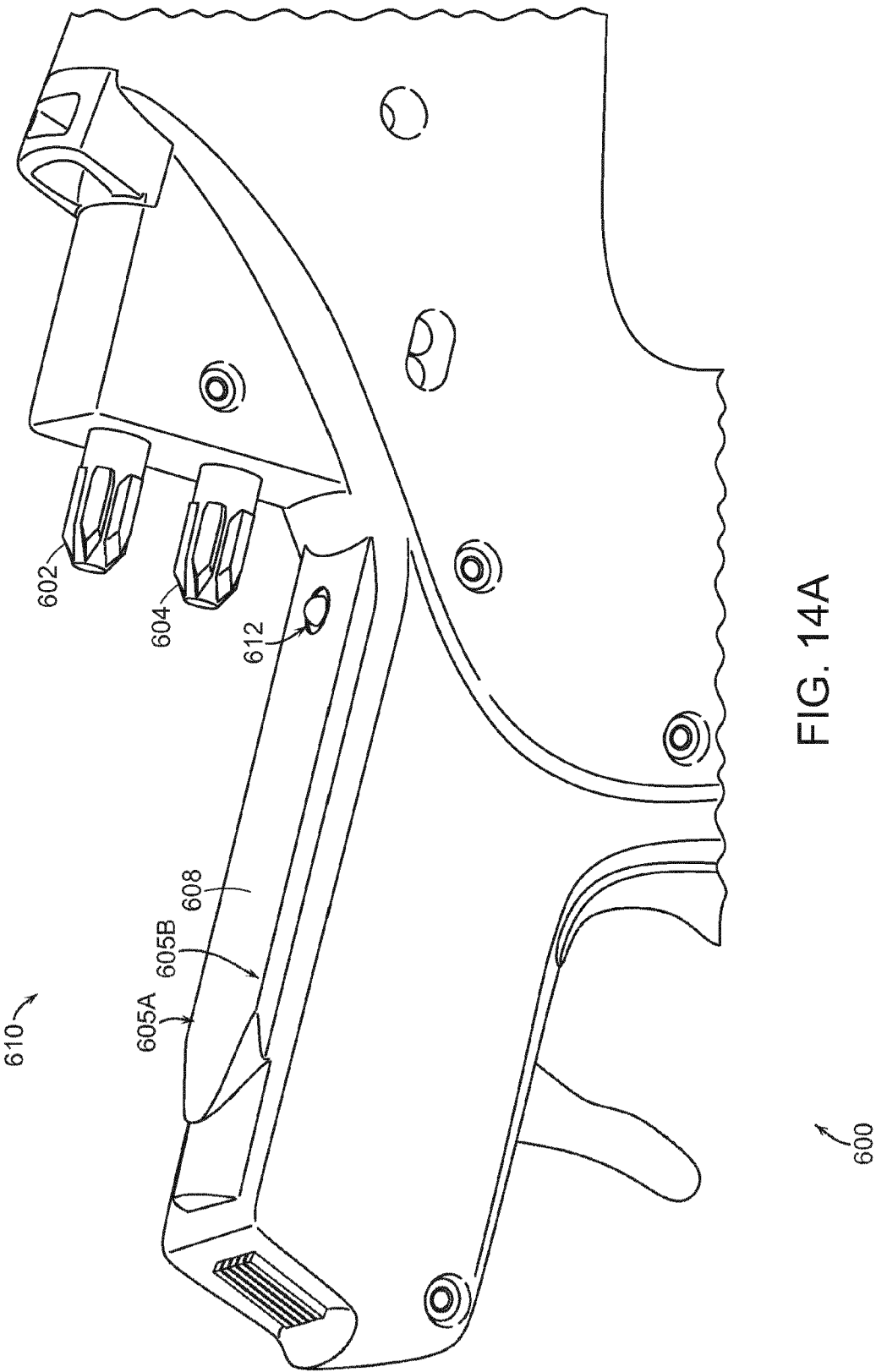


FIG. 14B

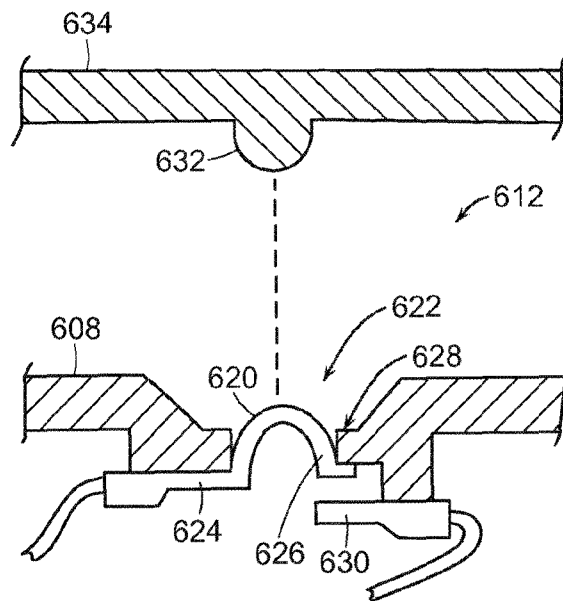
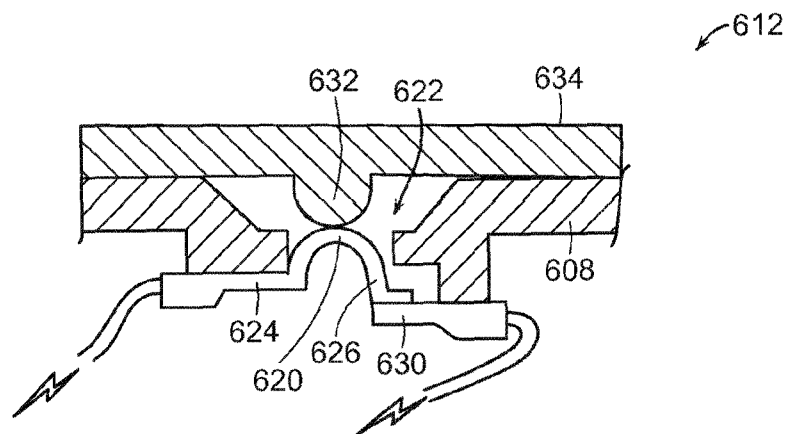


FIG. 14C



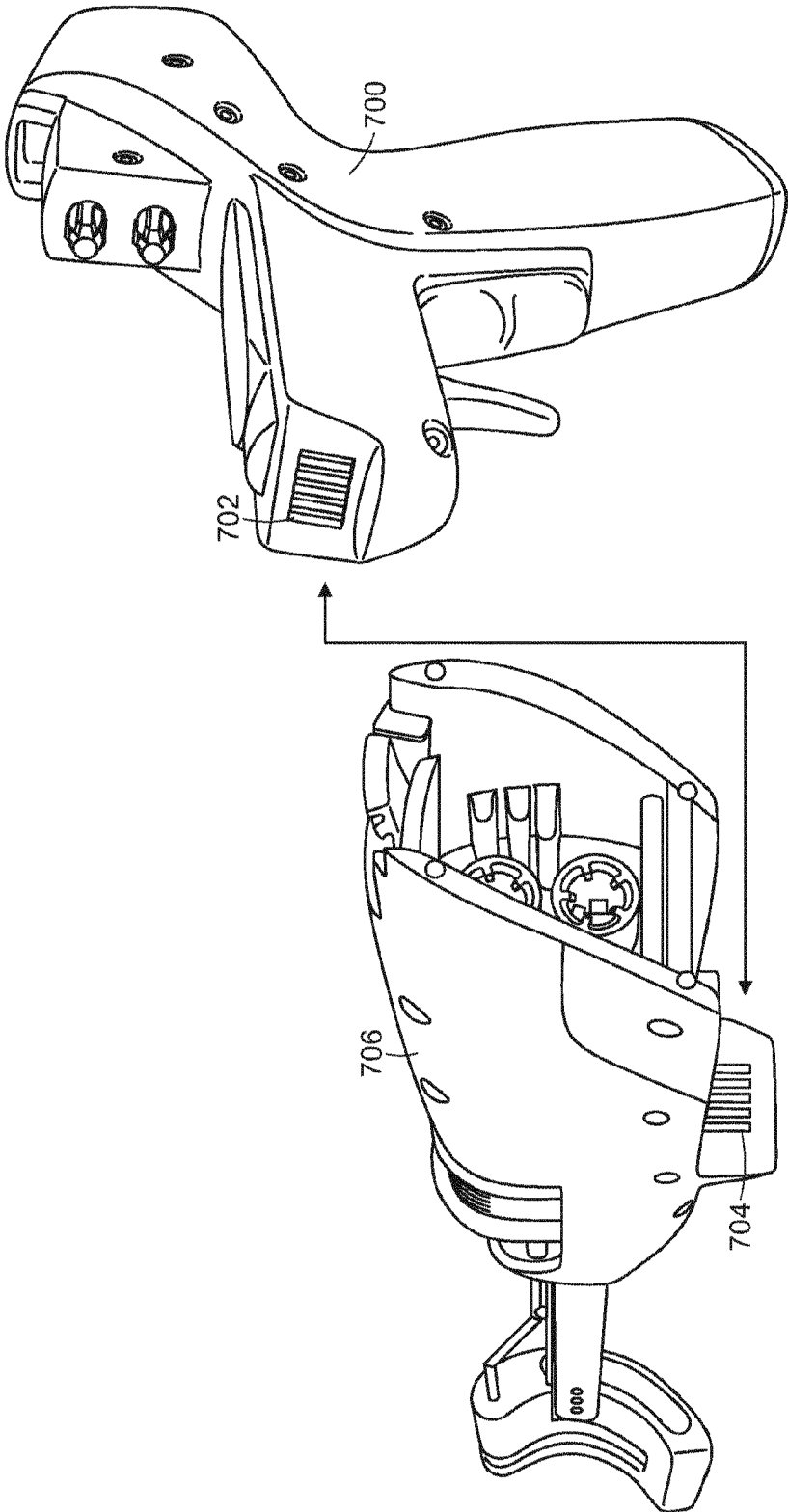


FIG. 14D

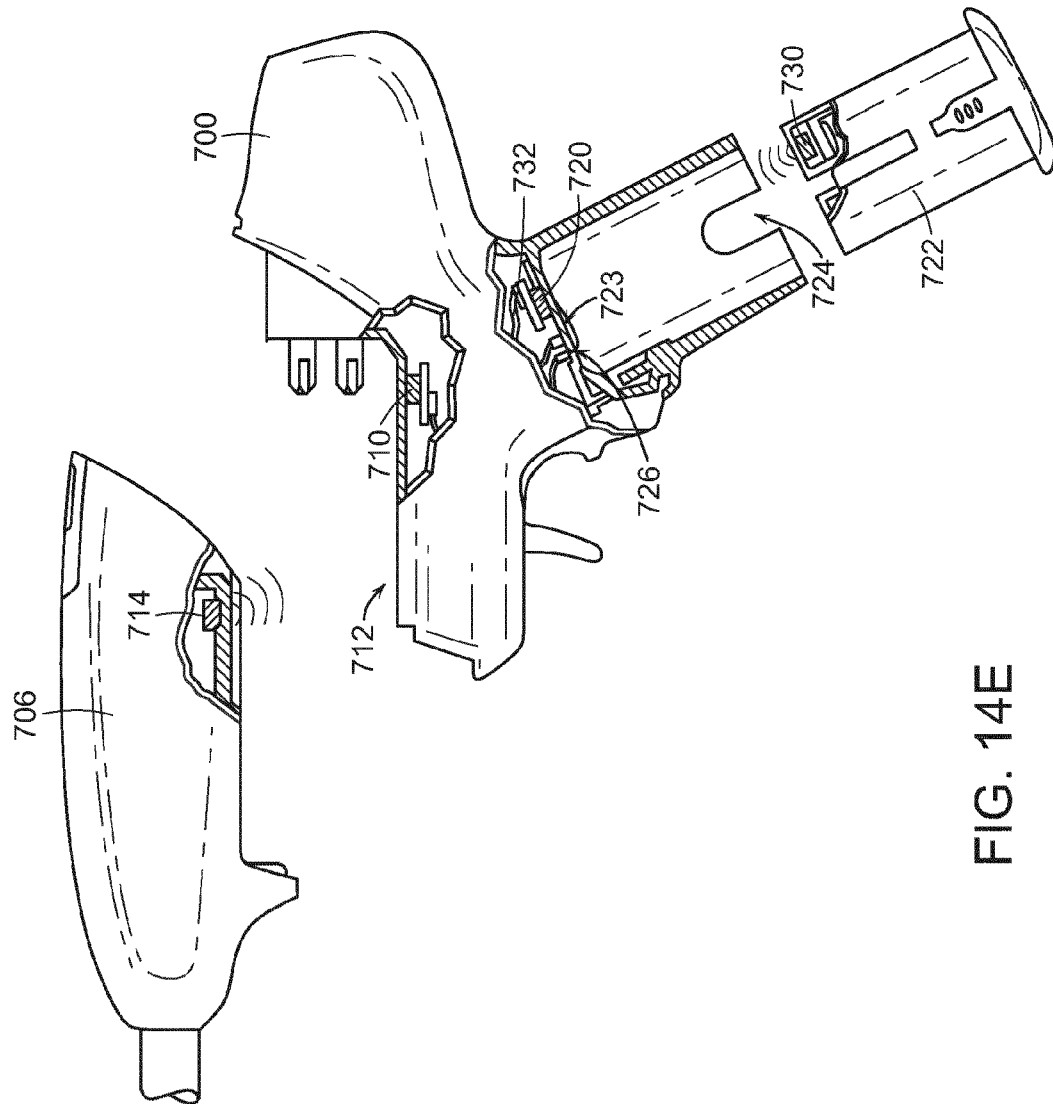


FIG. 14E

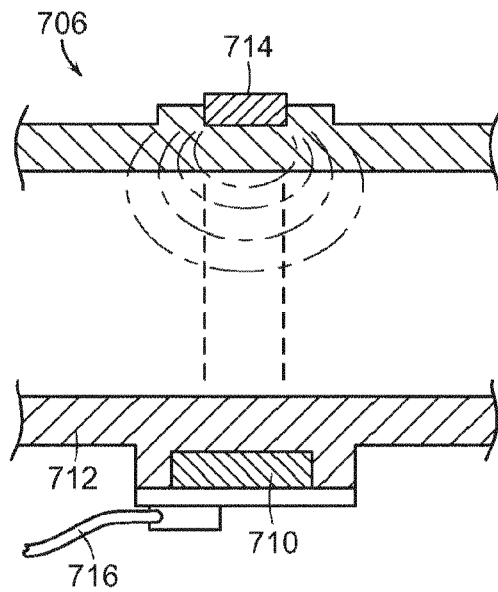


FIG. 14F

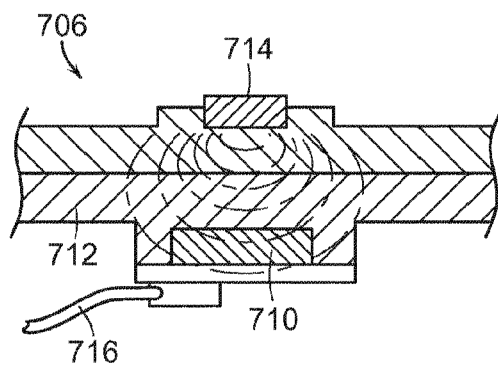


FIG. 14G

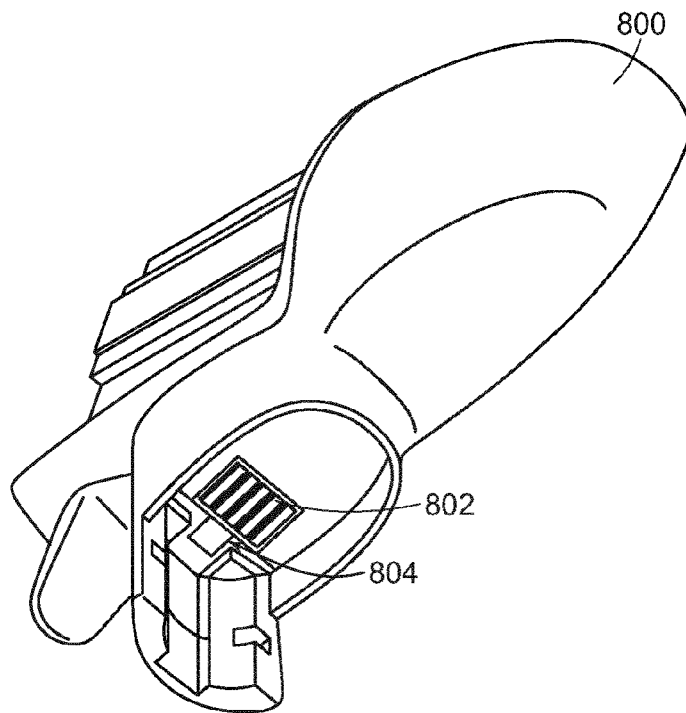


FIG. 15A

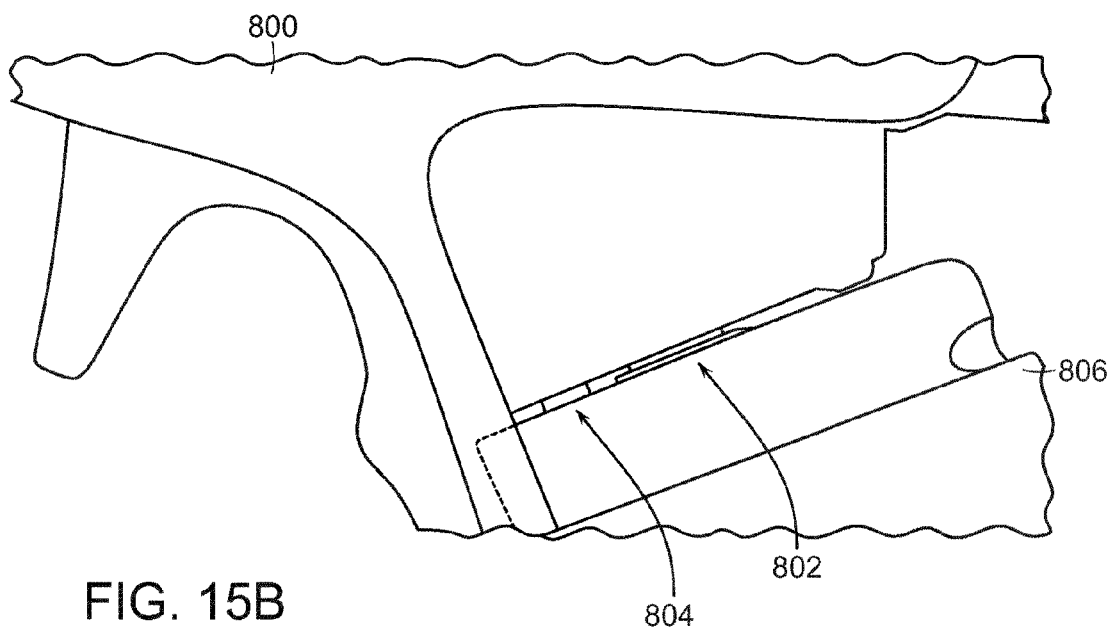


FIG. 15B

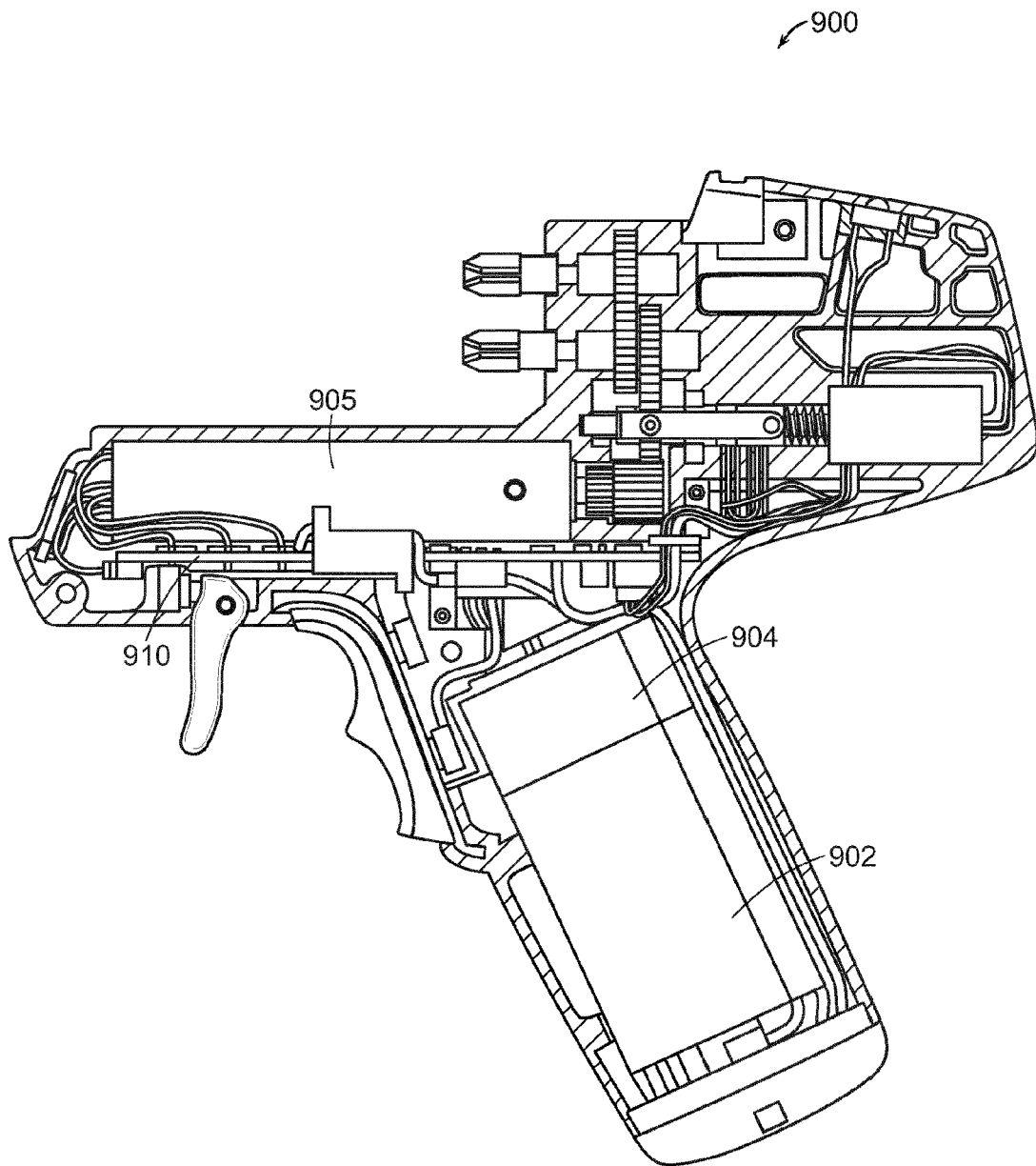


FIG. 16

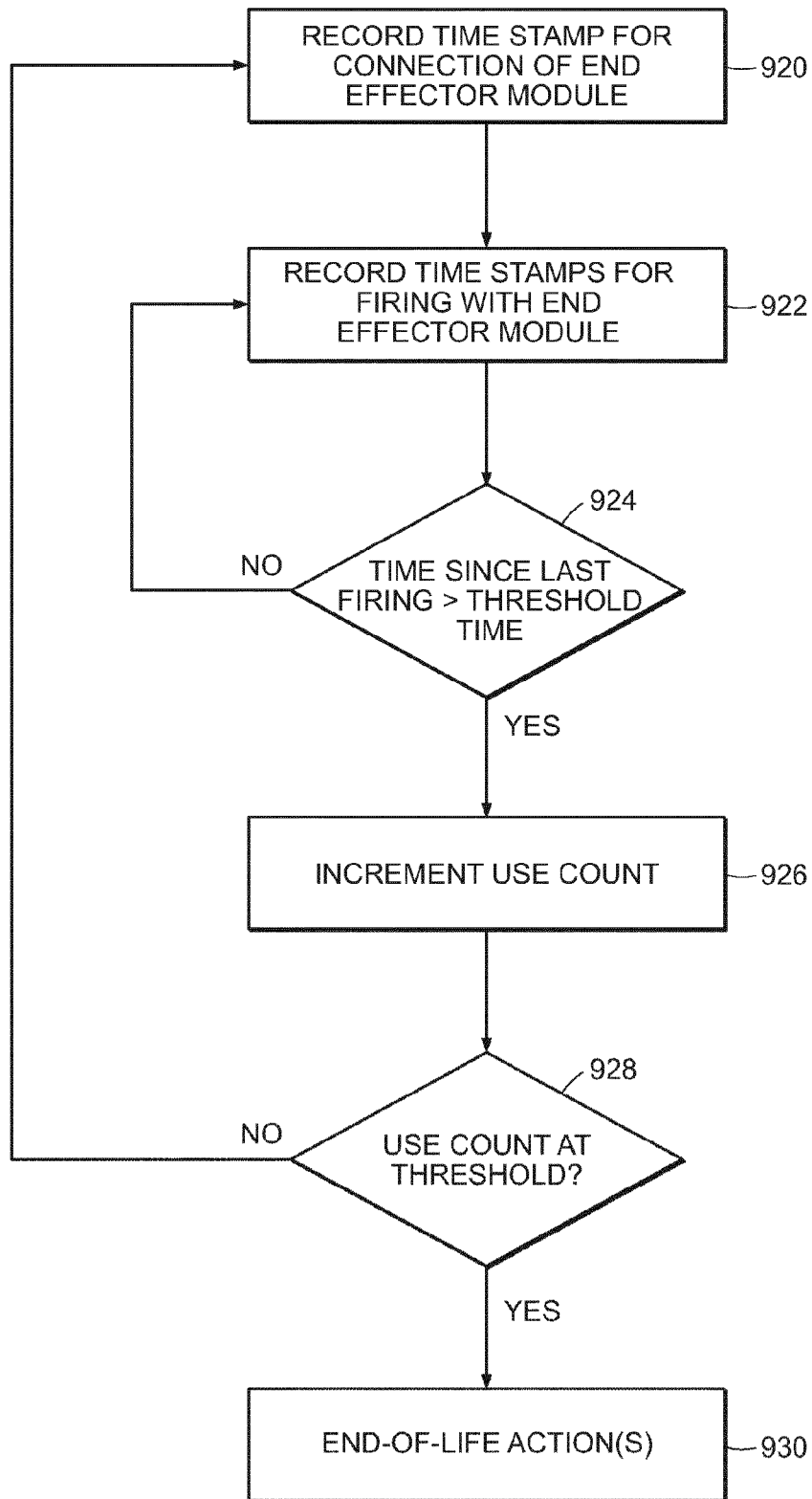


FIG. 17A

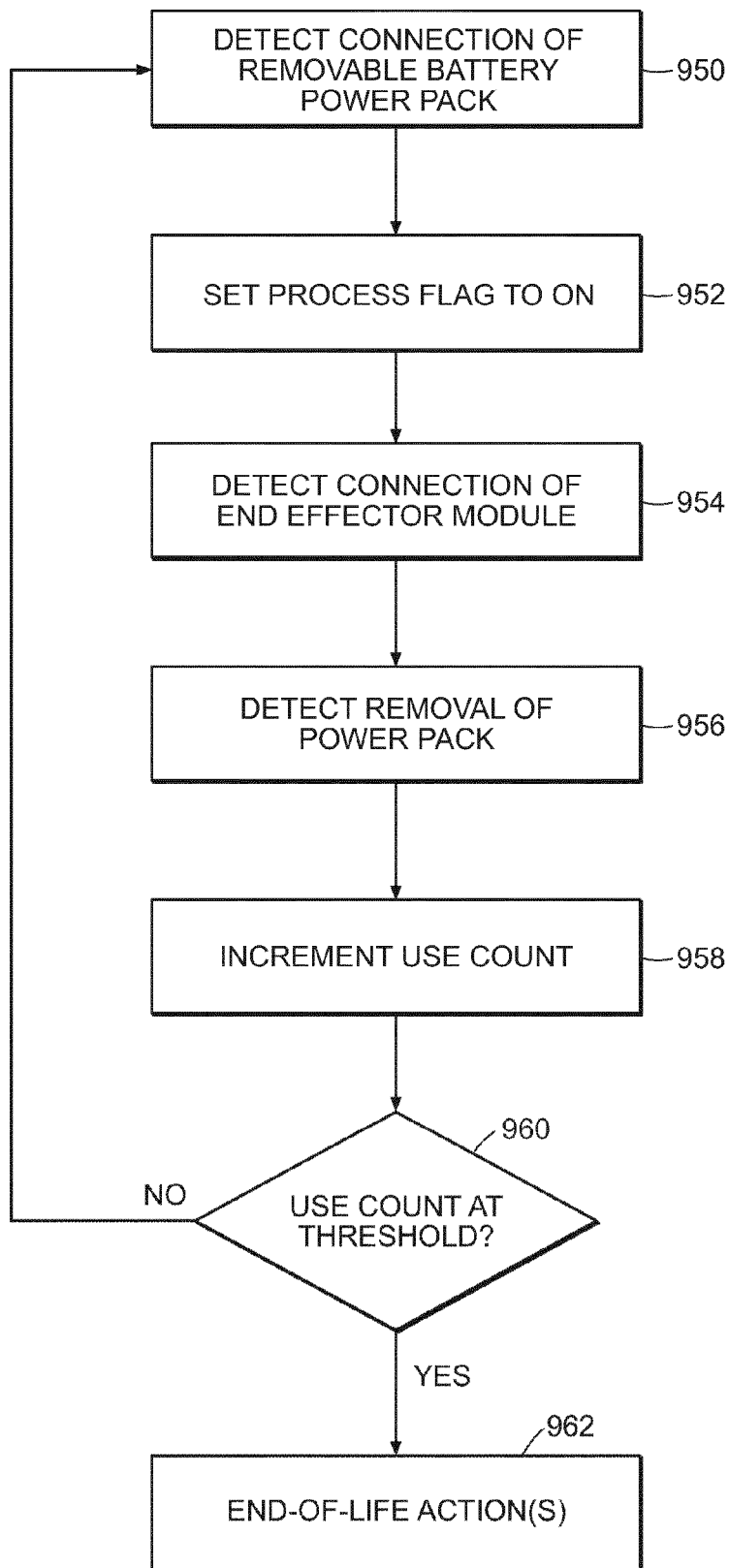


FIG. 17B

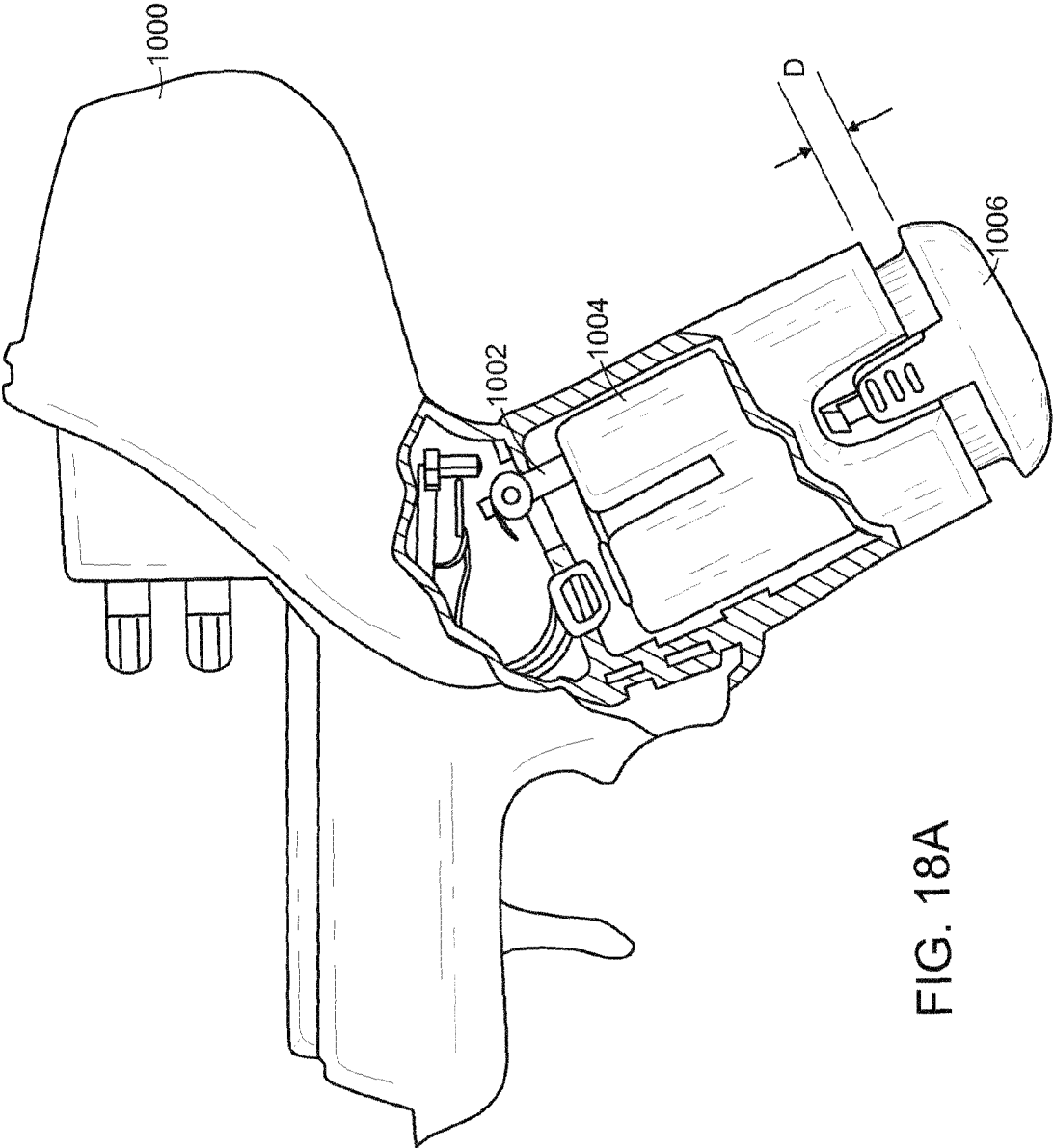


FIG. 18A

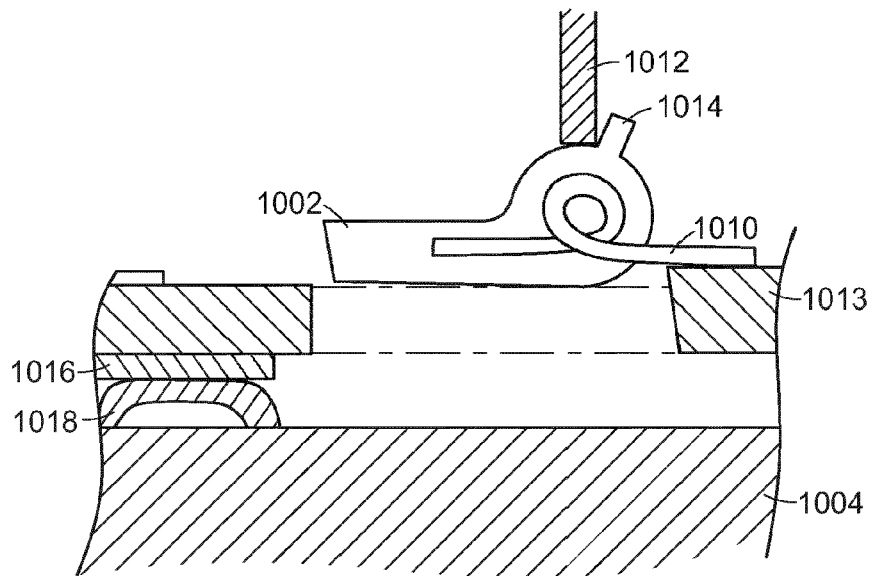


FIG. 18B

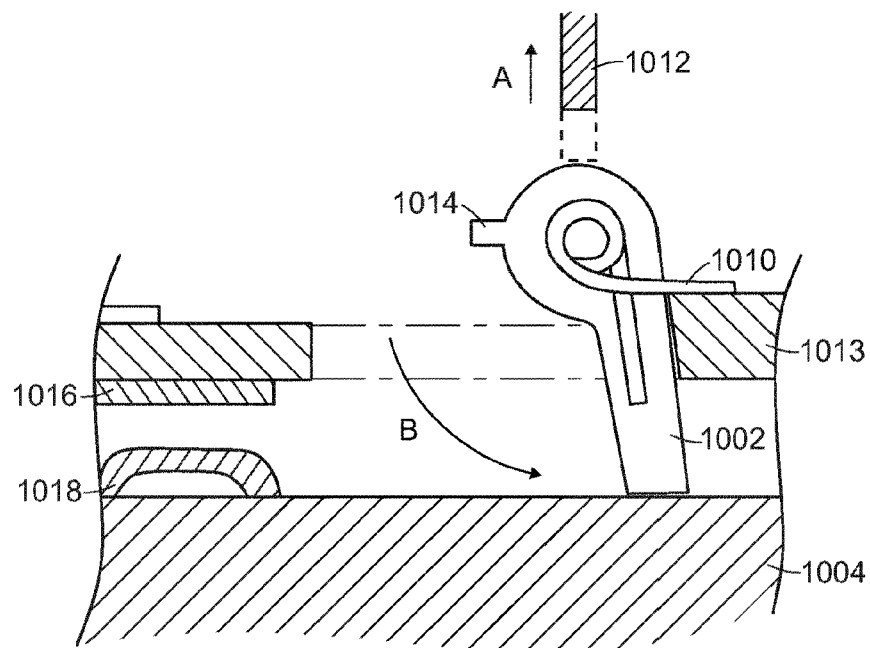


FIG. 18C

FIG. 18D

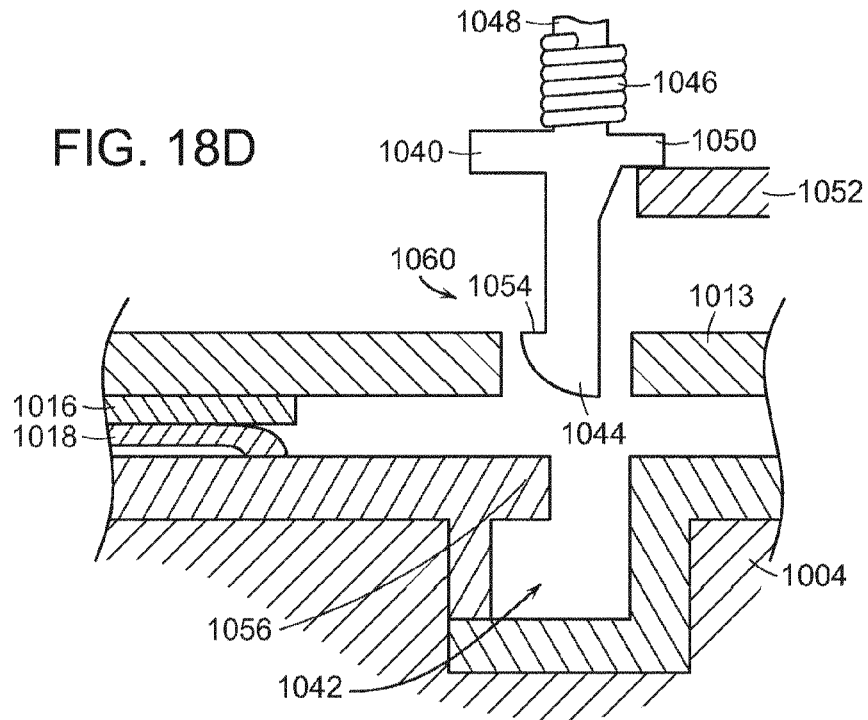
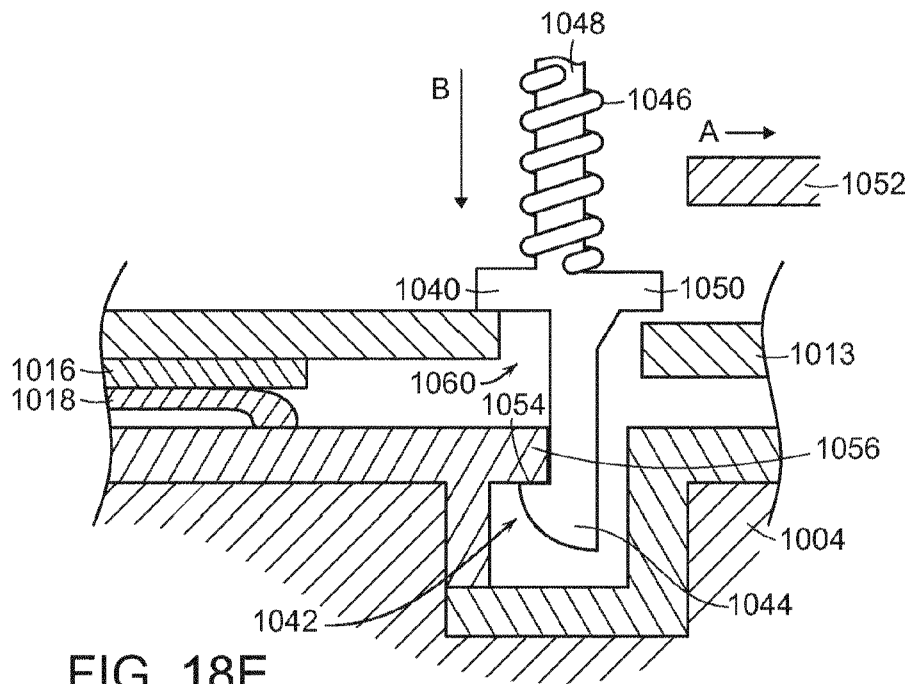
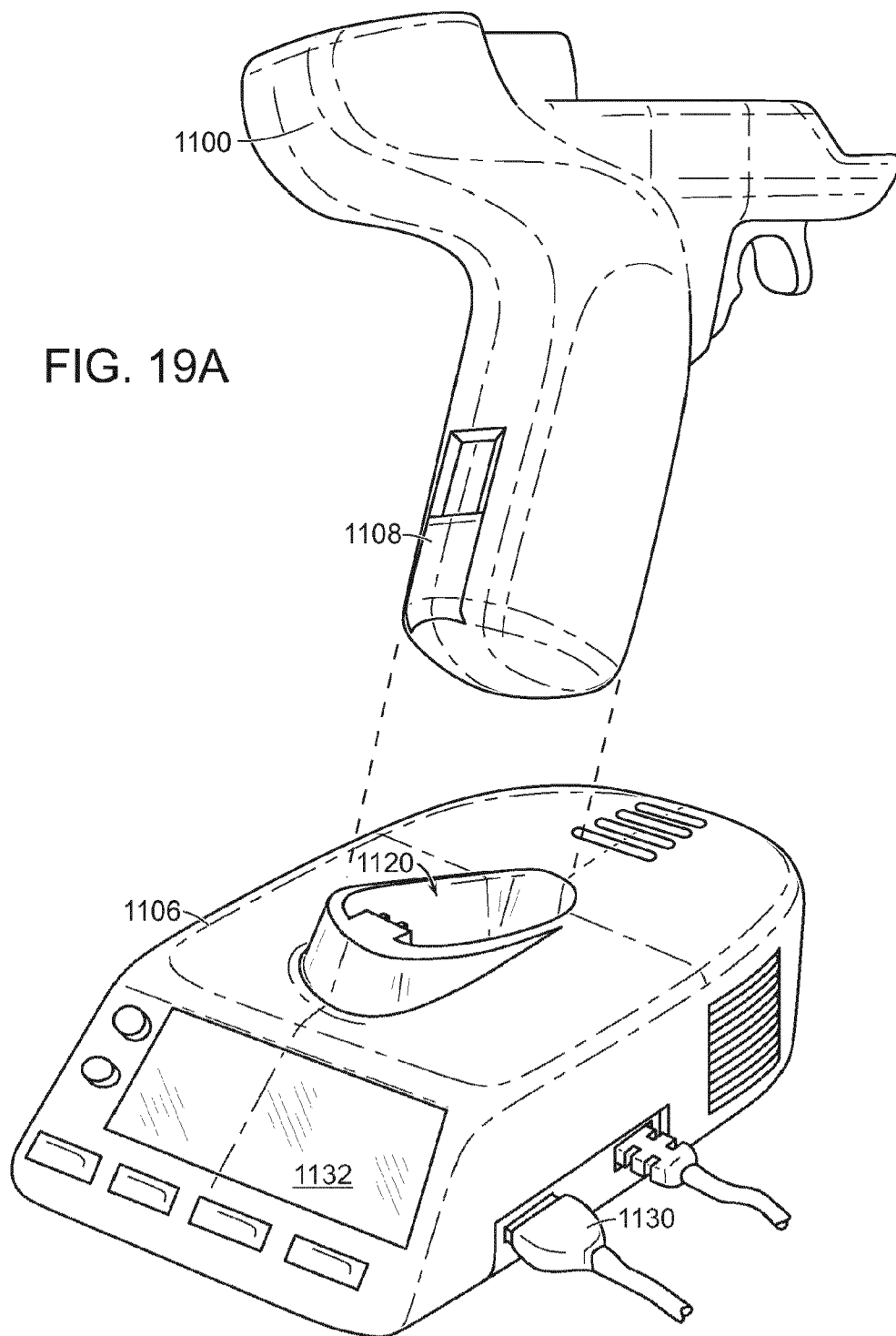


FIG. 18E

FIG. 19A



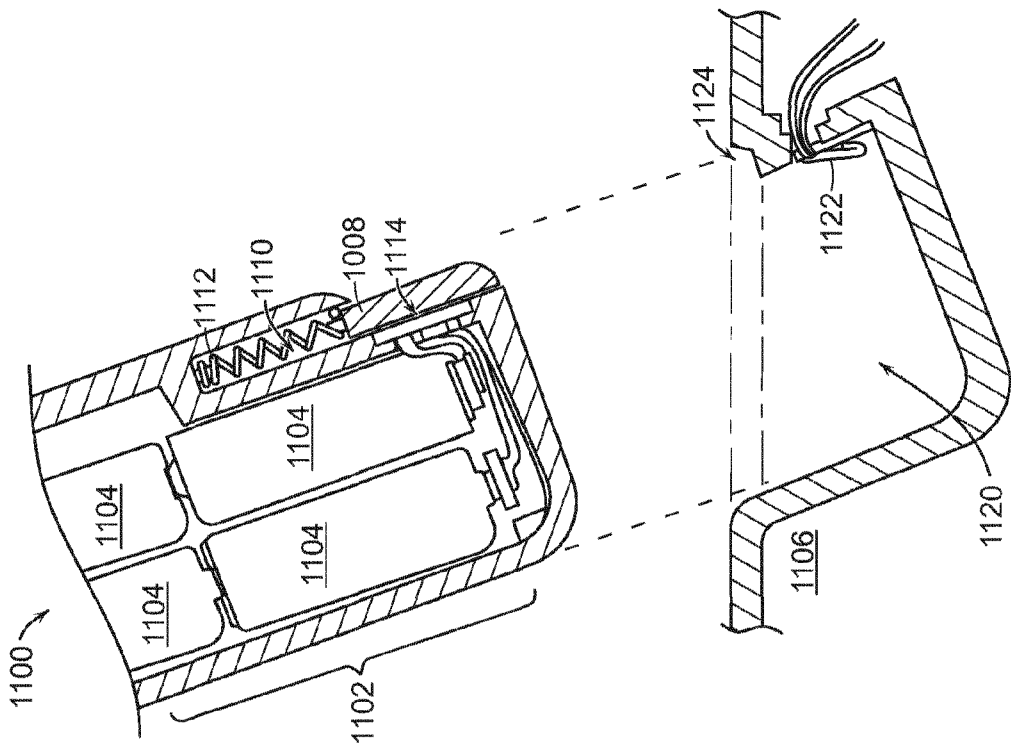


FIG. 19B

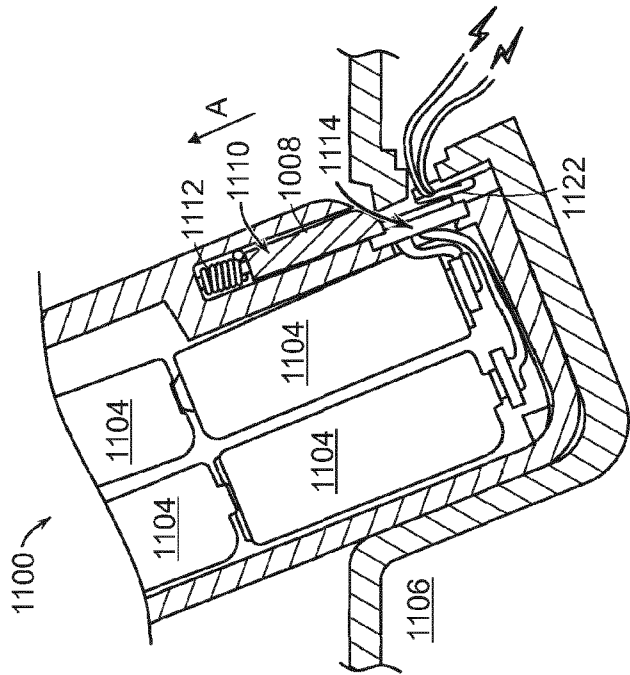


FIG. 19C

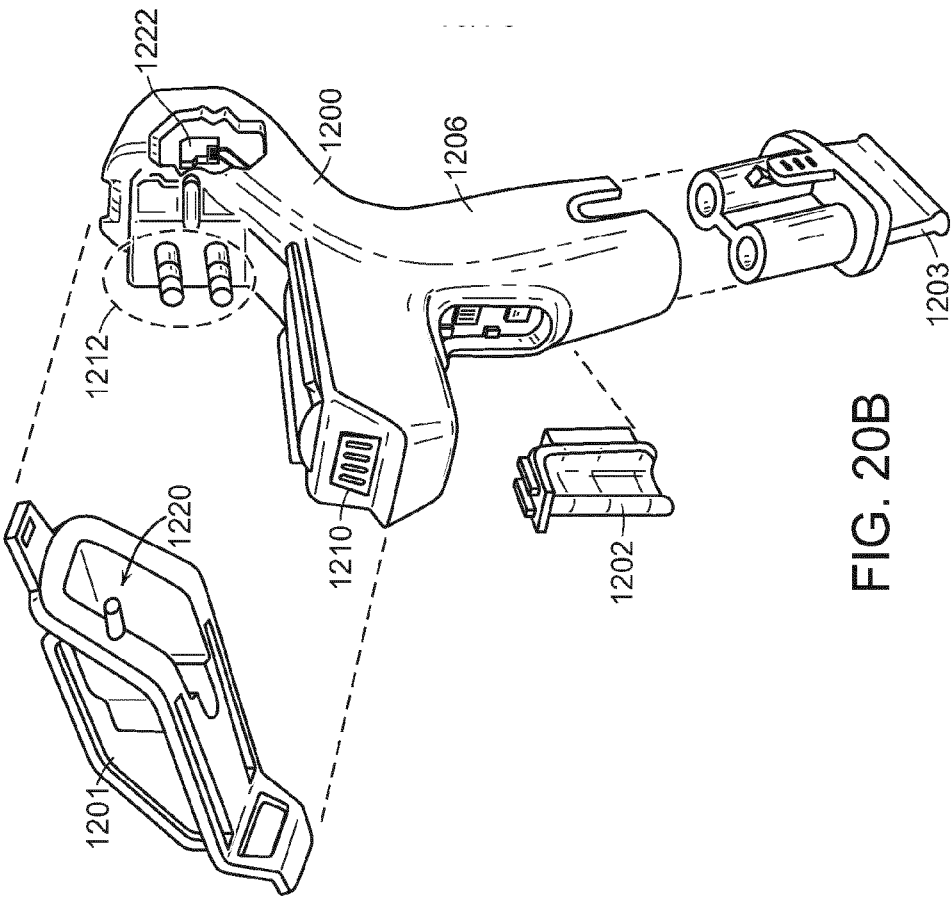


FIG. 20B

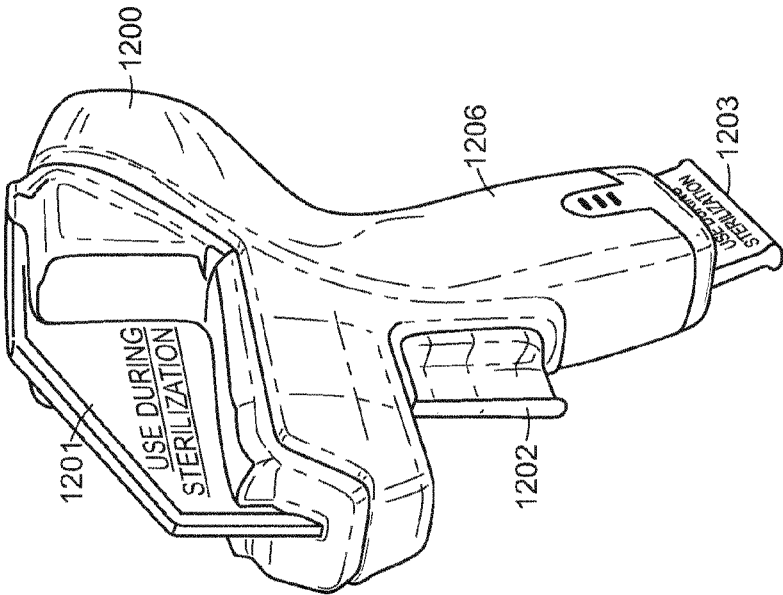


FIG. 20A

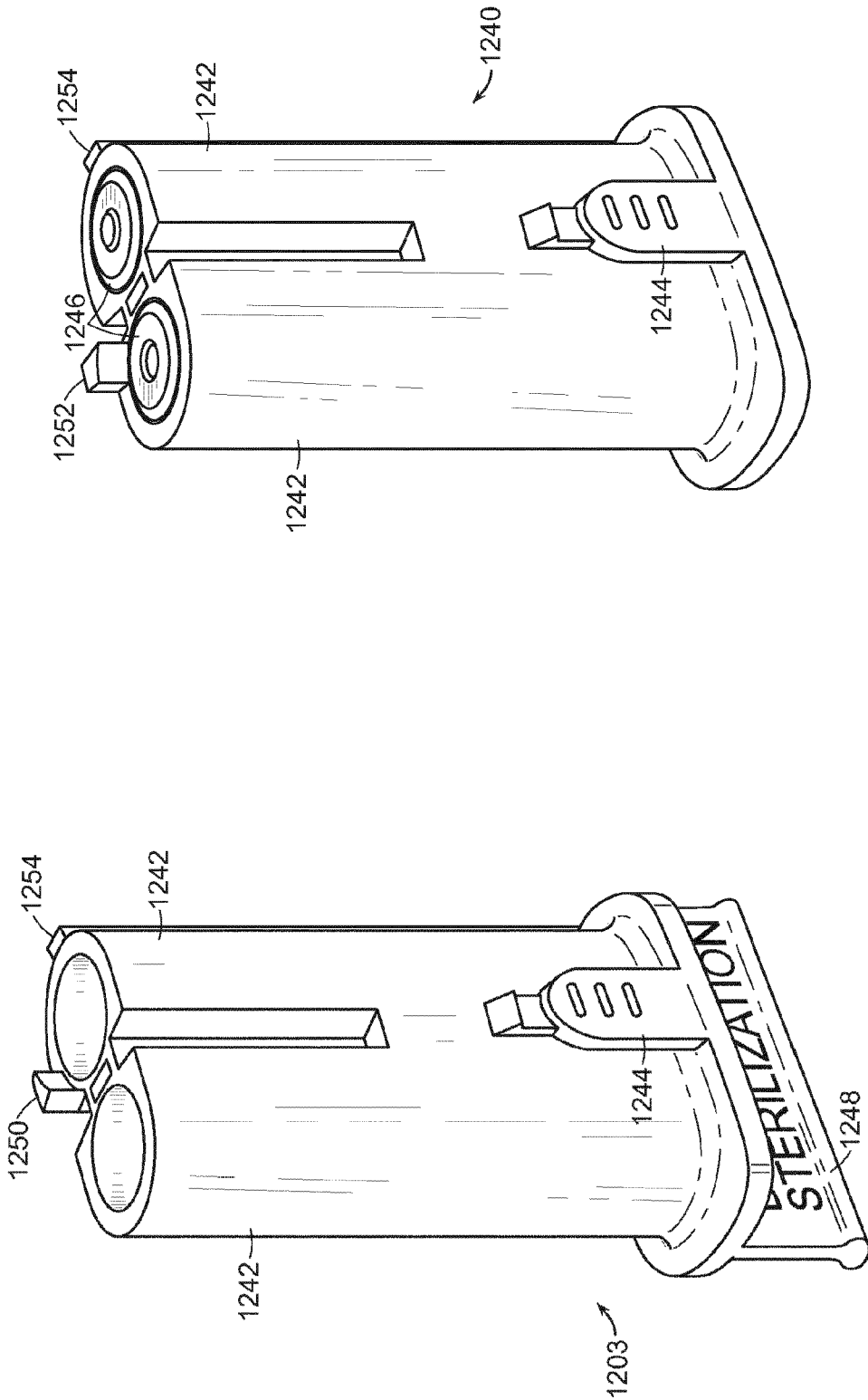


FIG. 20D

FIG. 20C

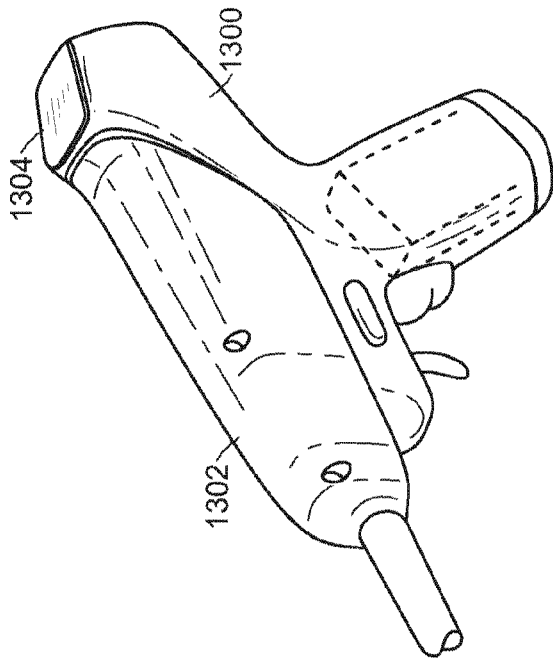


FIG. 21C

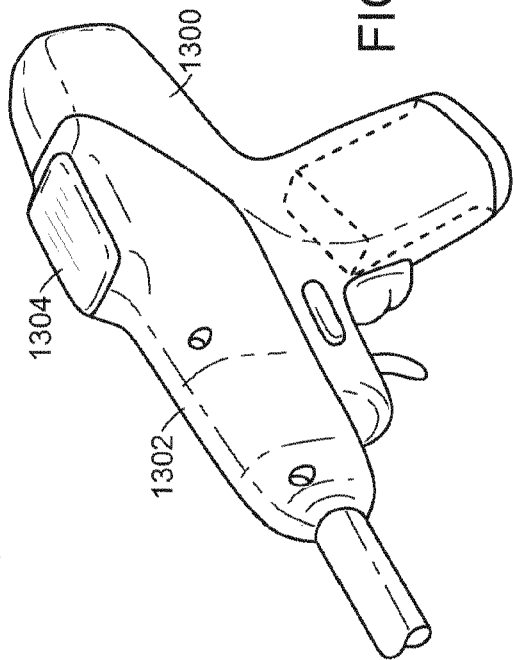


FIG. 21B

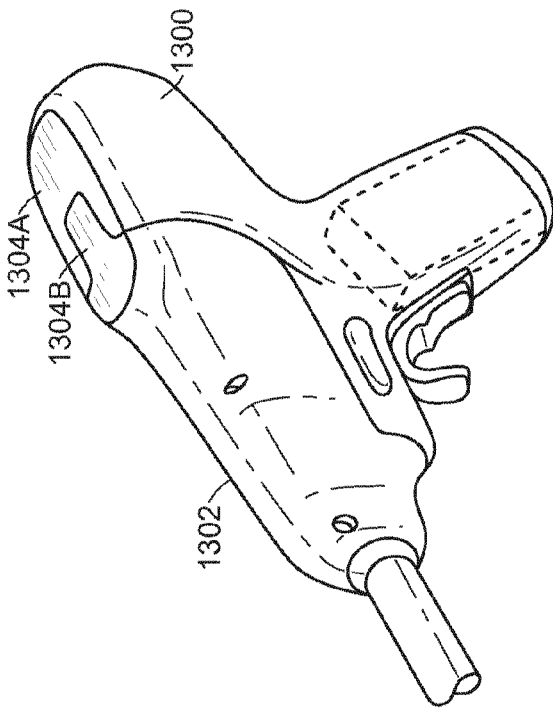


FIG. 21A

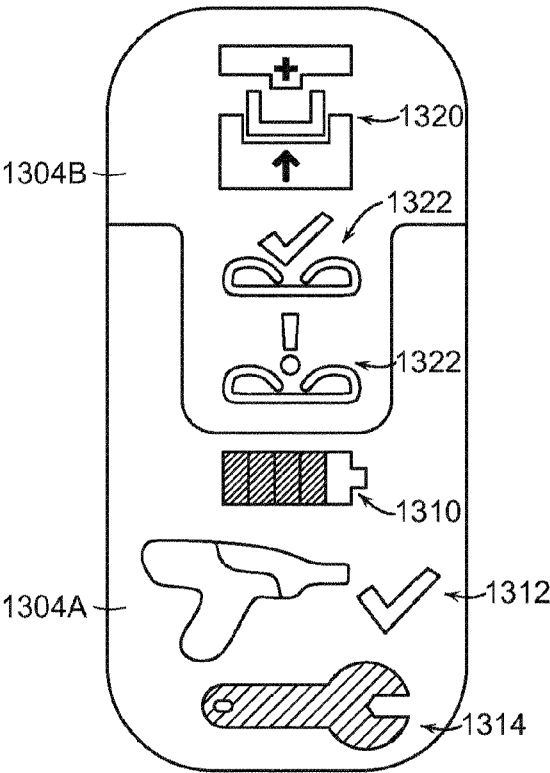


FIG. 21D

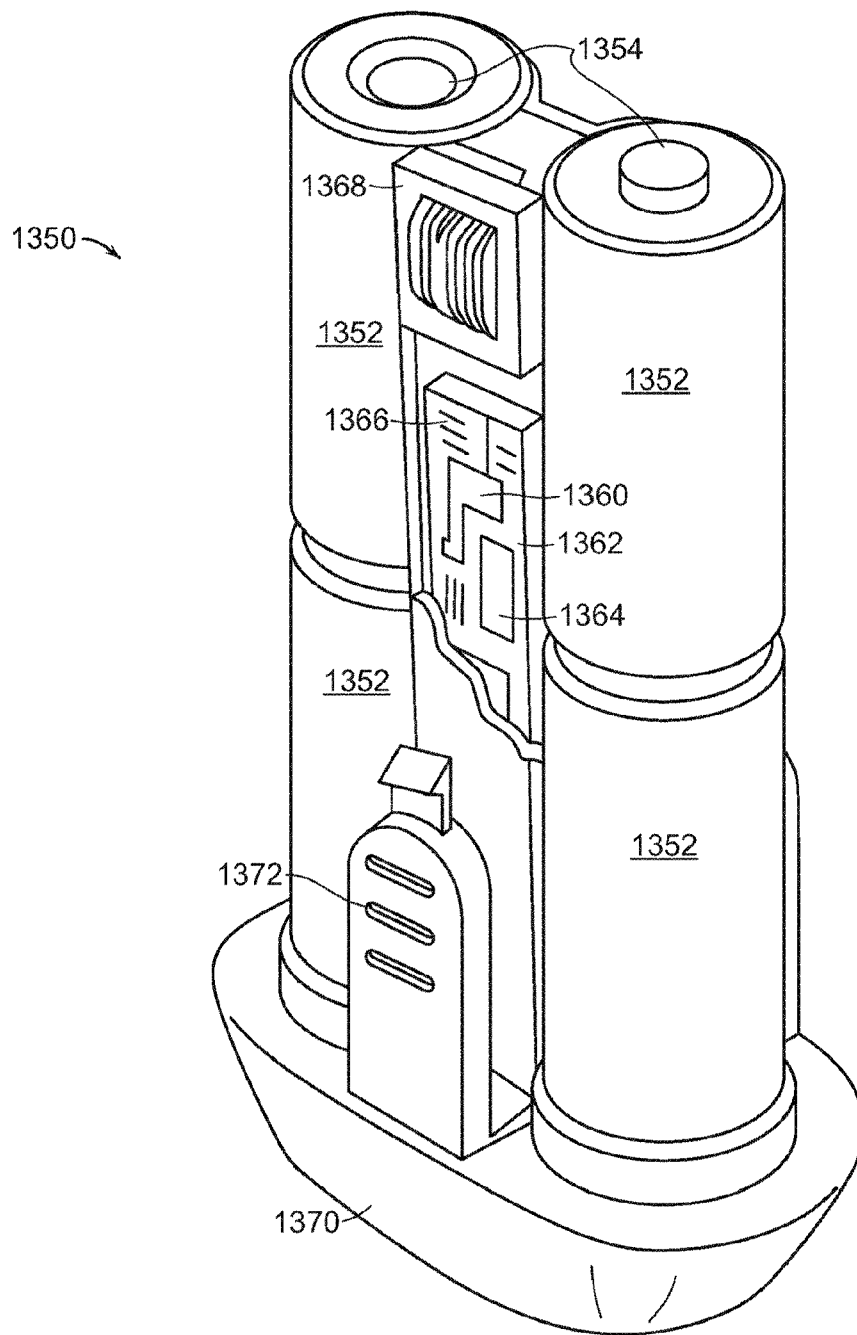
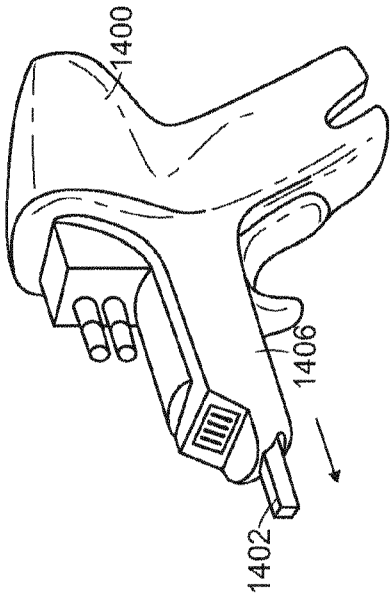
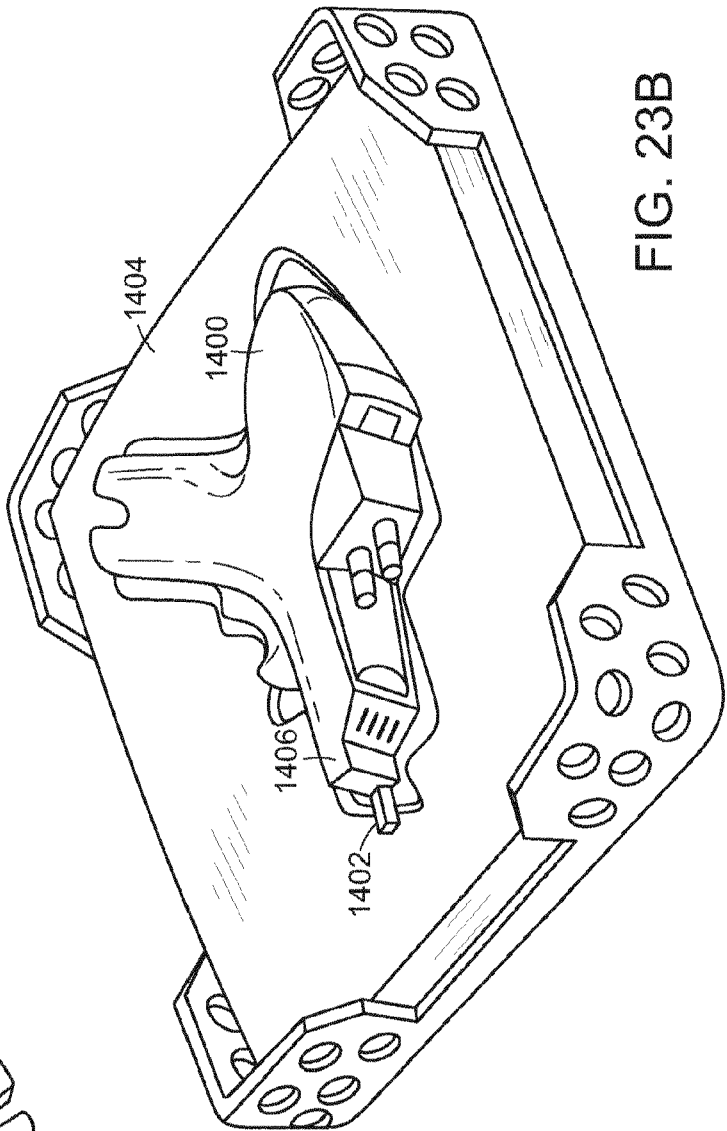


FIG. 22



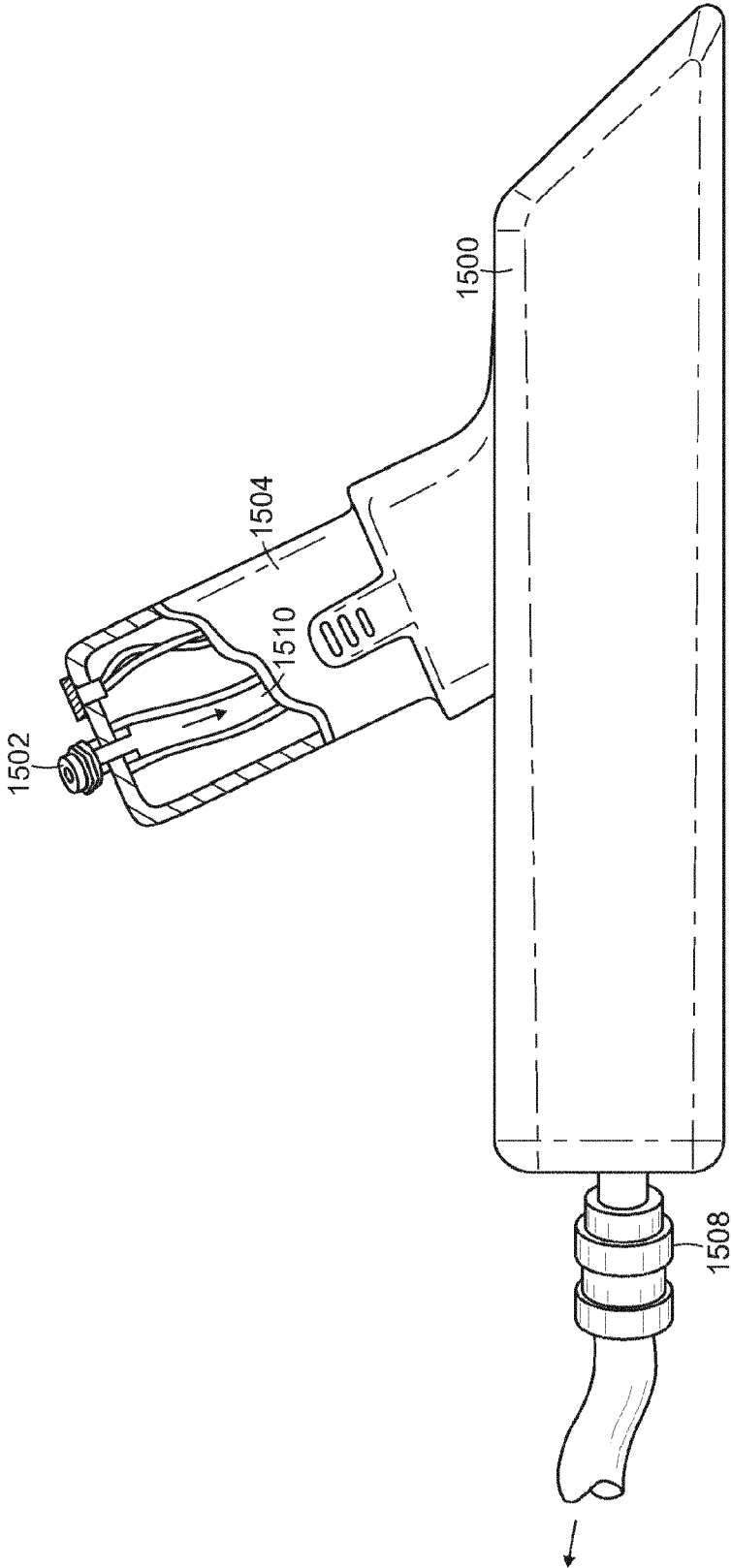


FIG. 24A

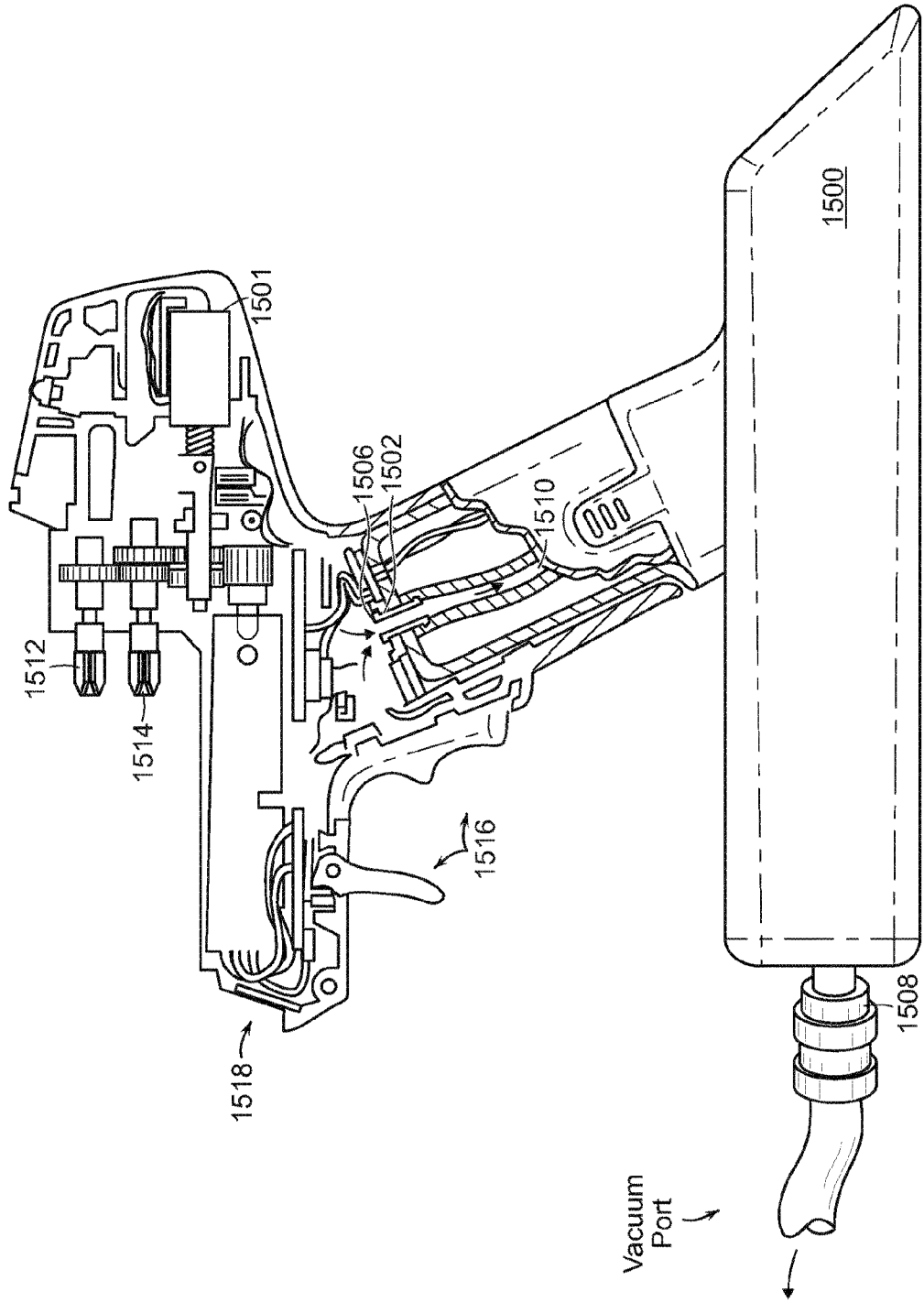


FIG. 24B

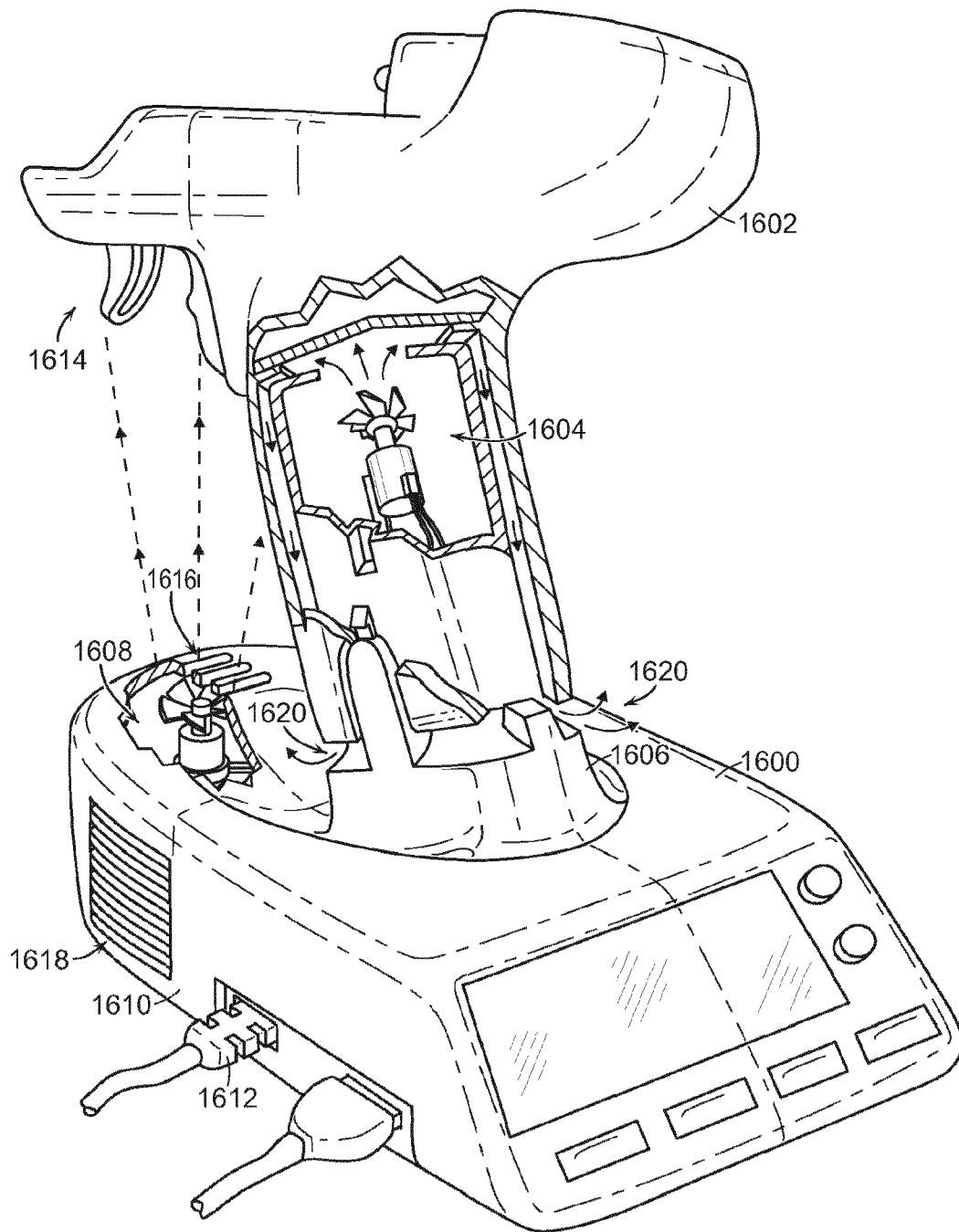


FIG. 25A

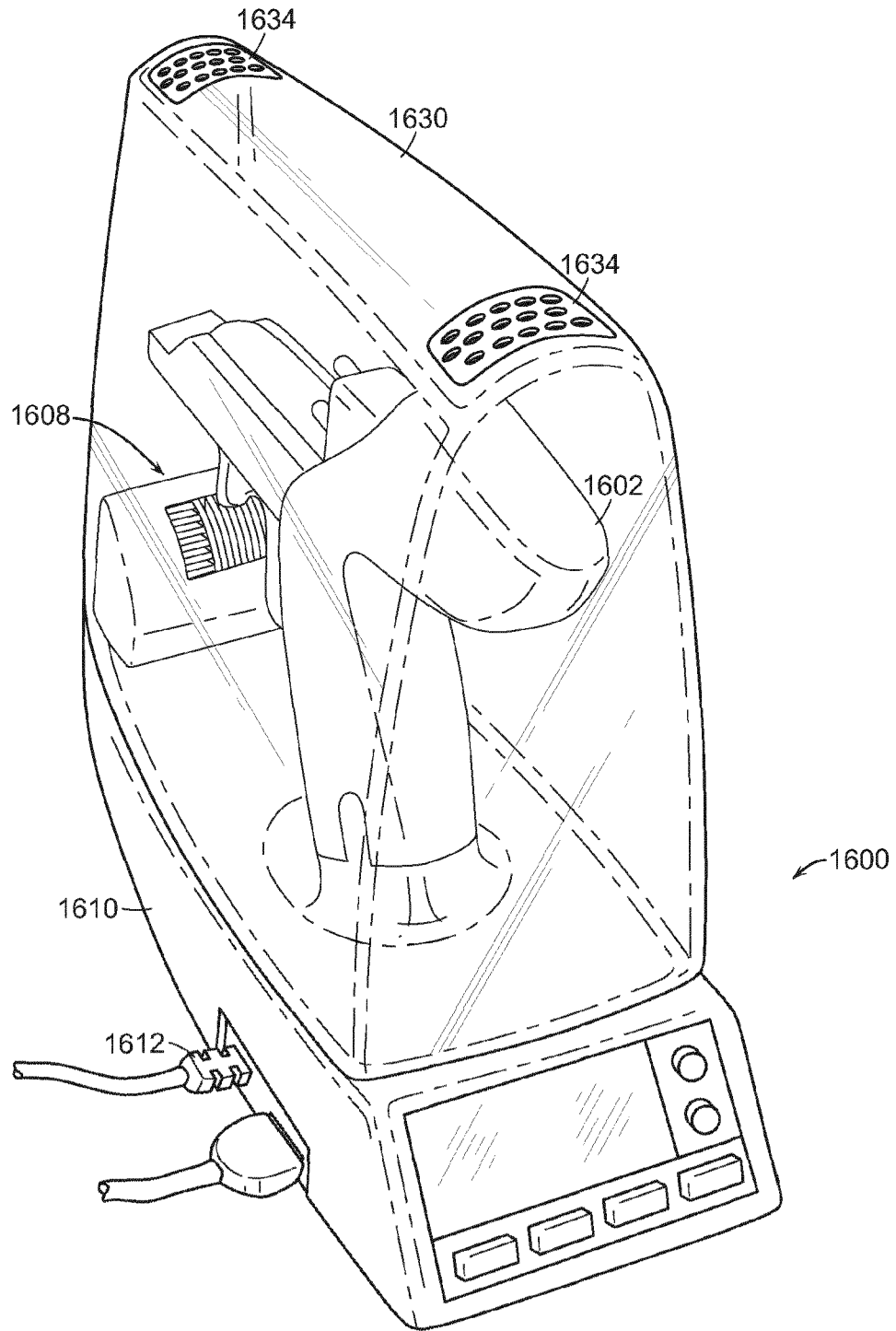


FIG. 25B

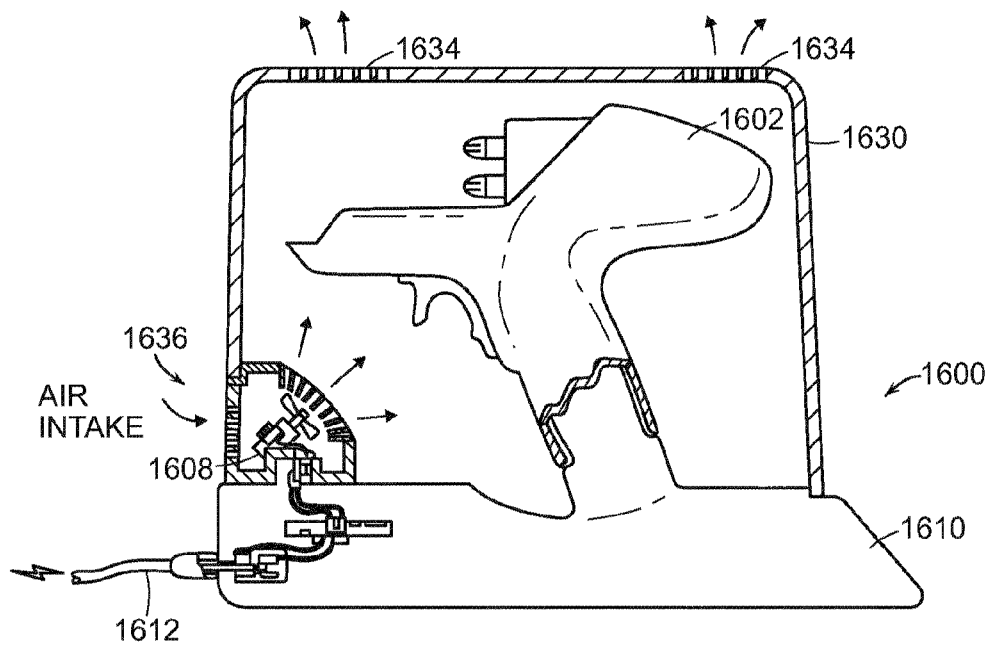


FIG. 25C

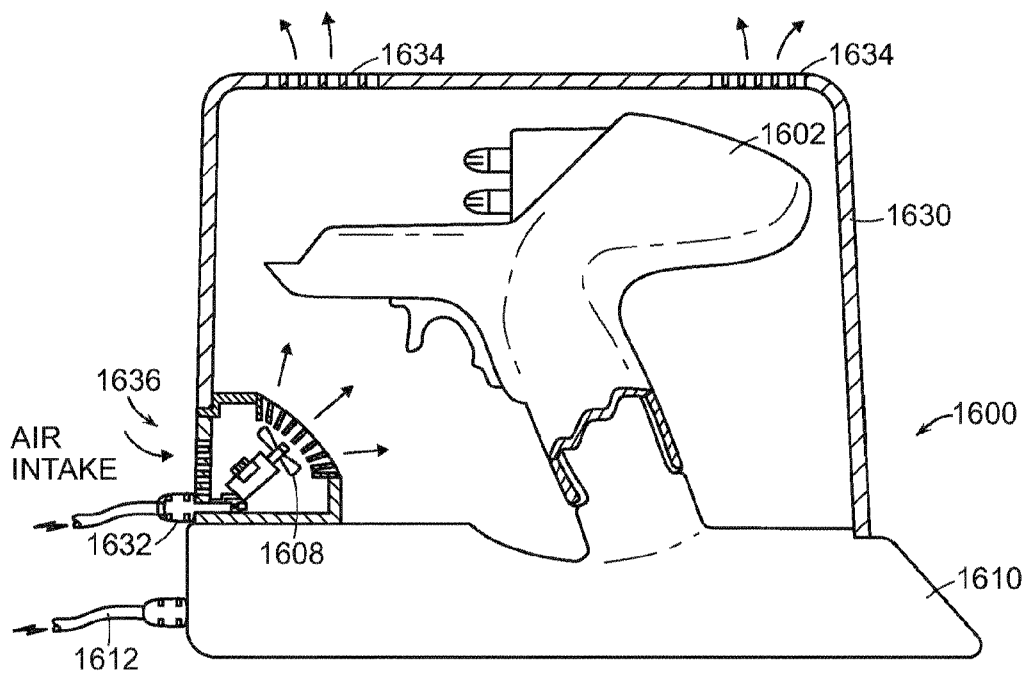
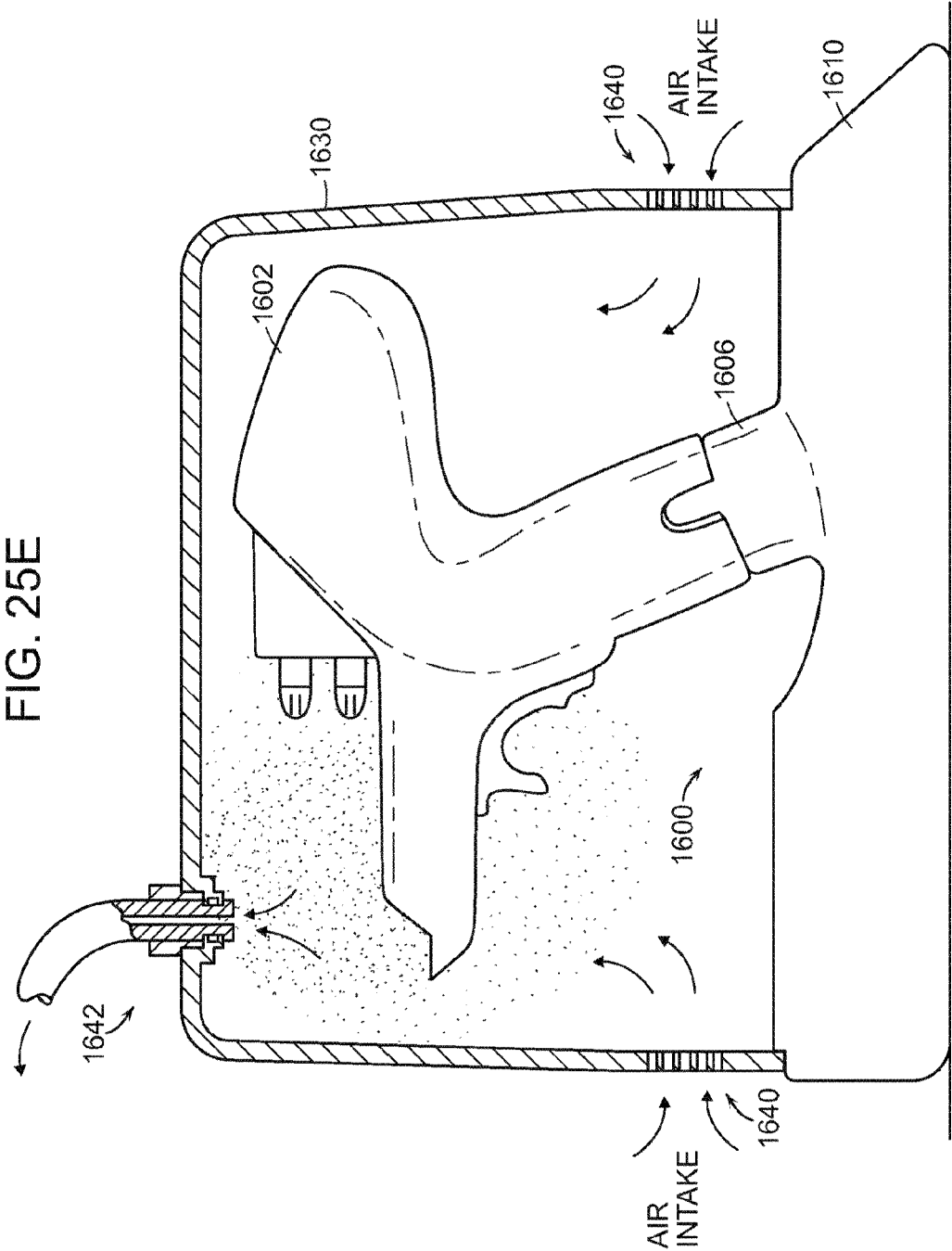


FIG. 25D



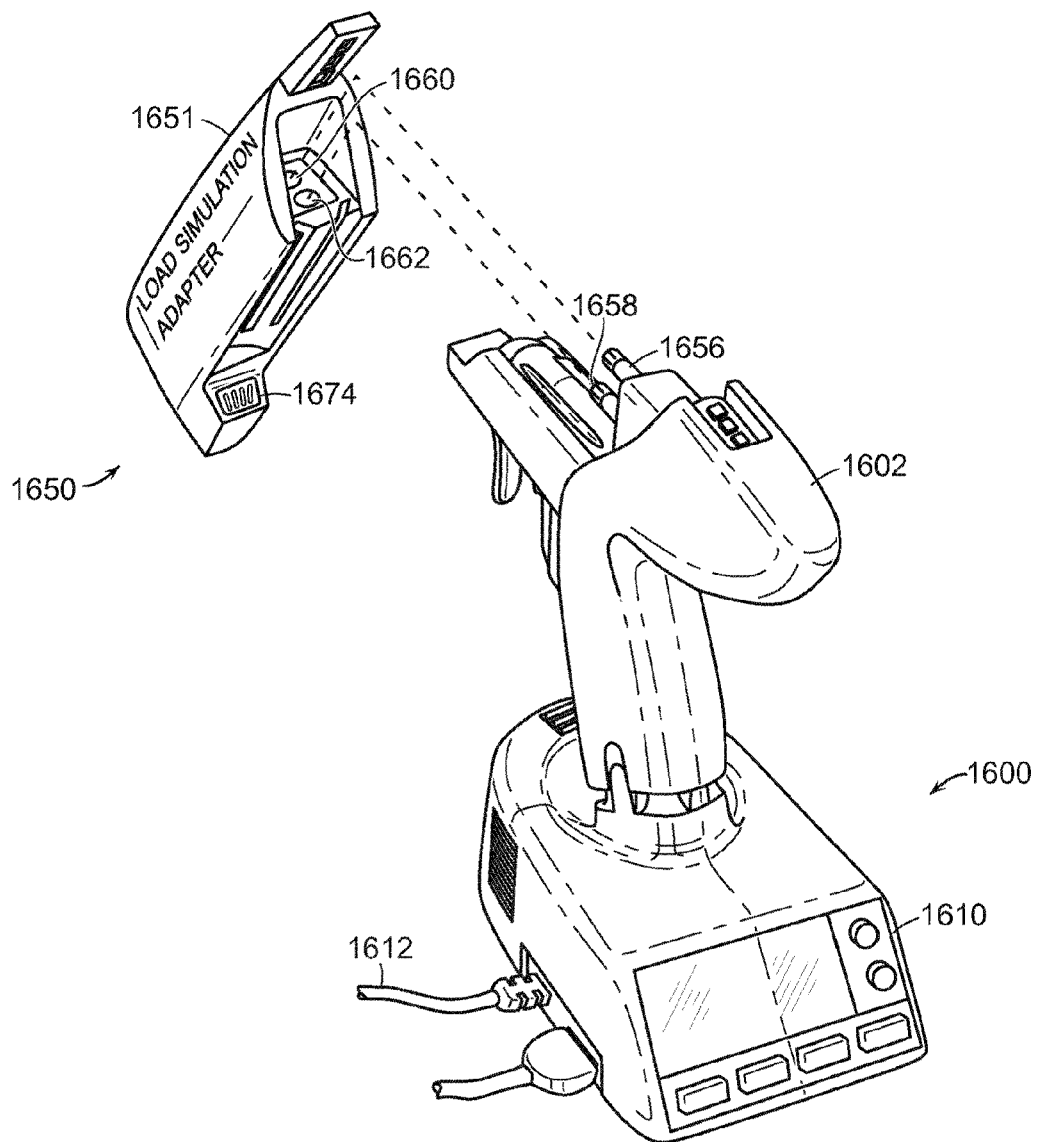


FIG. 26A

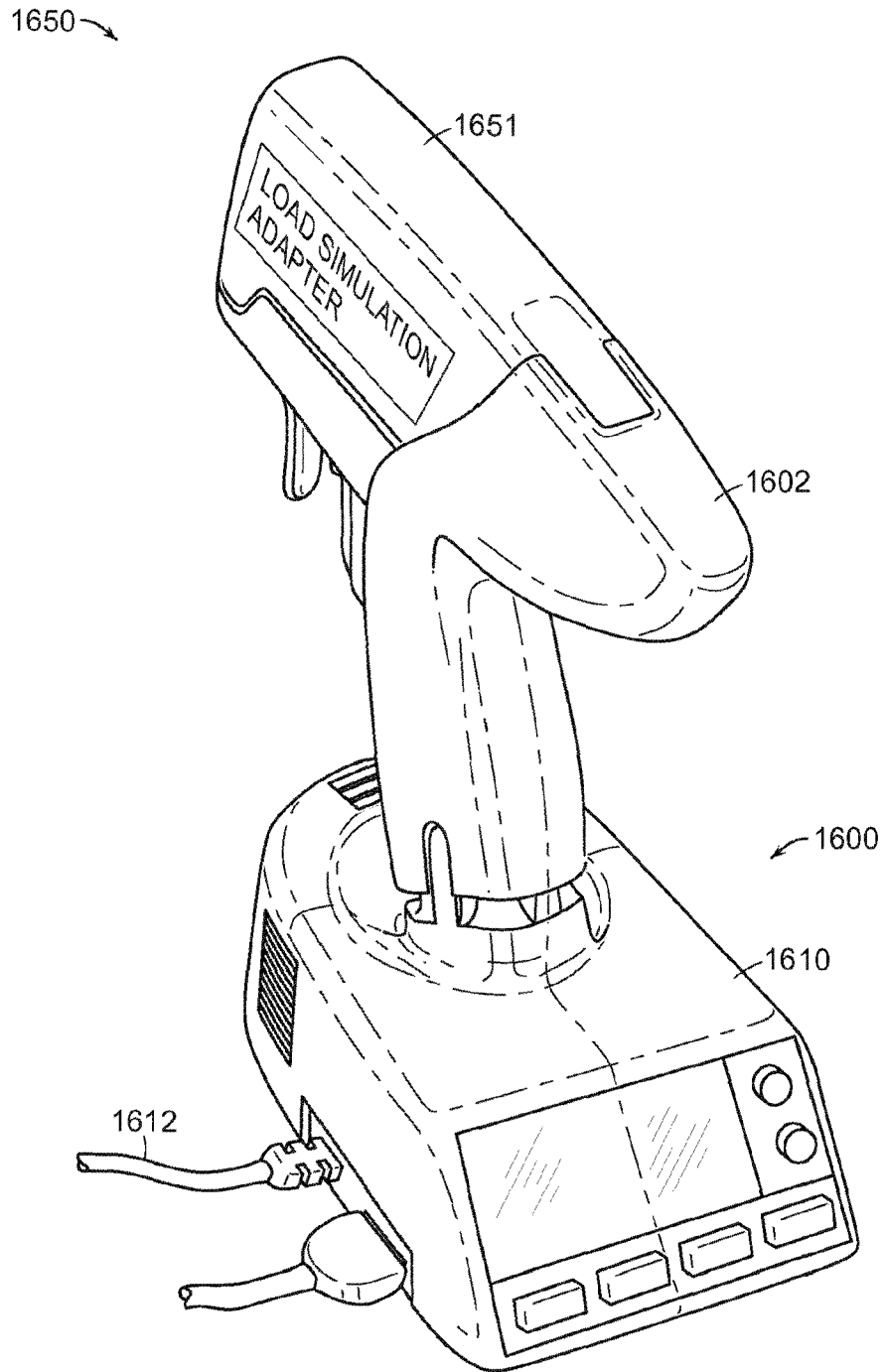


FIG. 26B

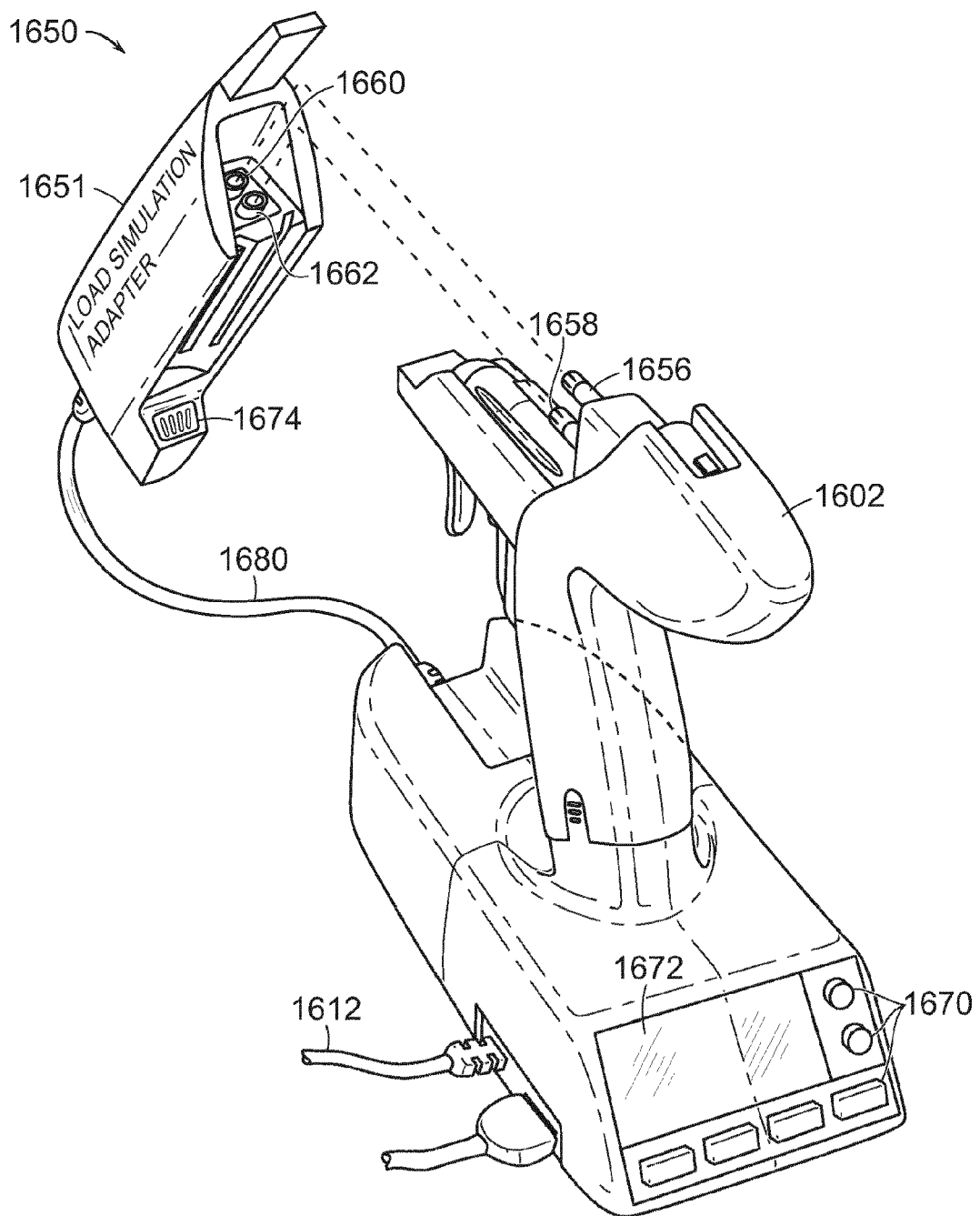


FIG. 26C

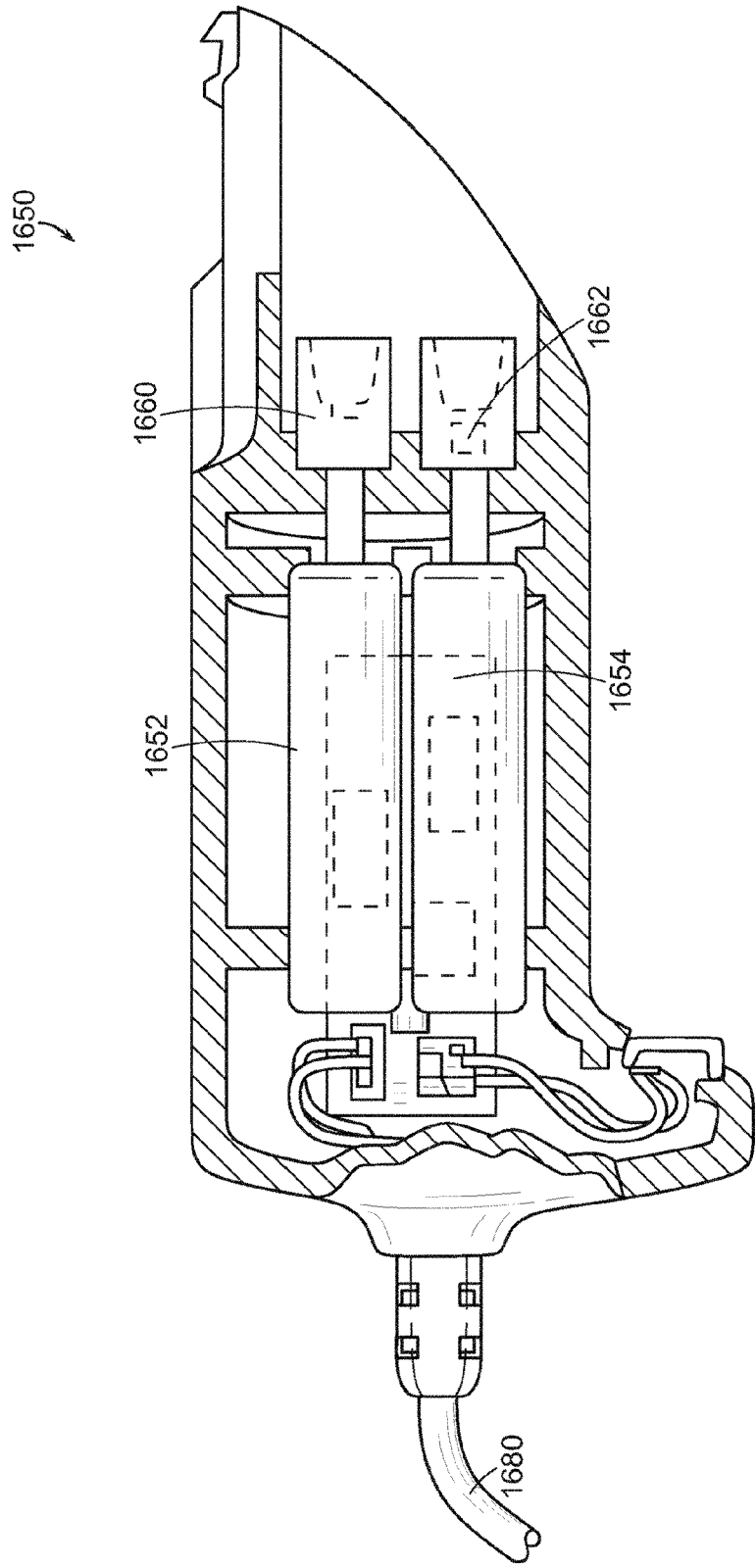
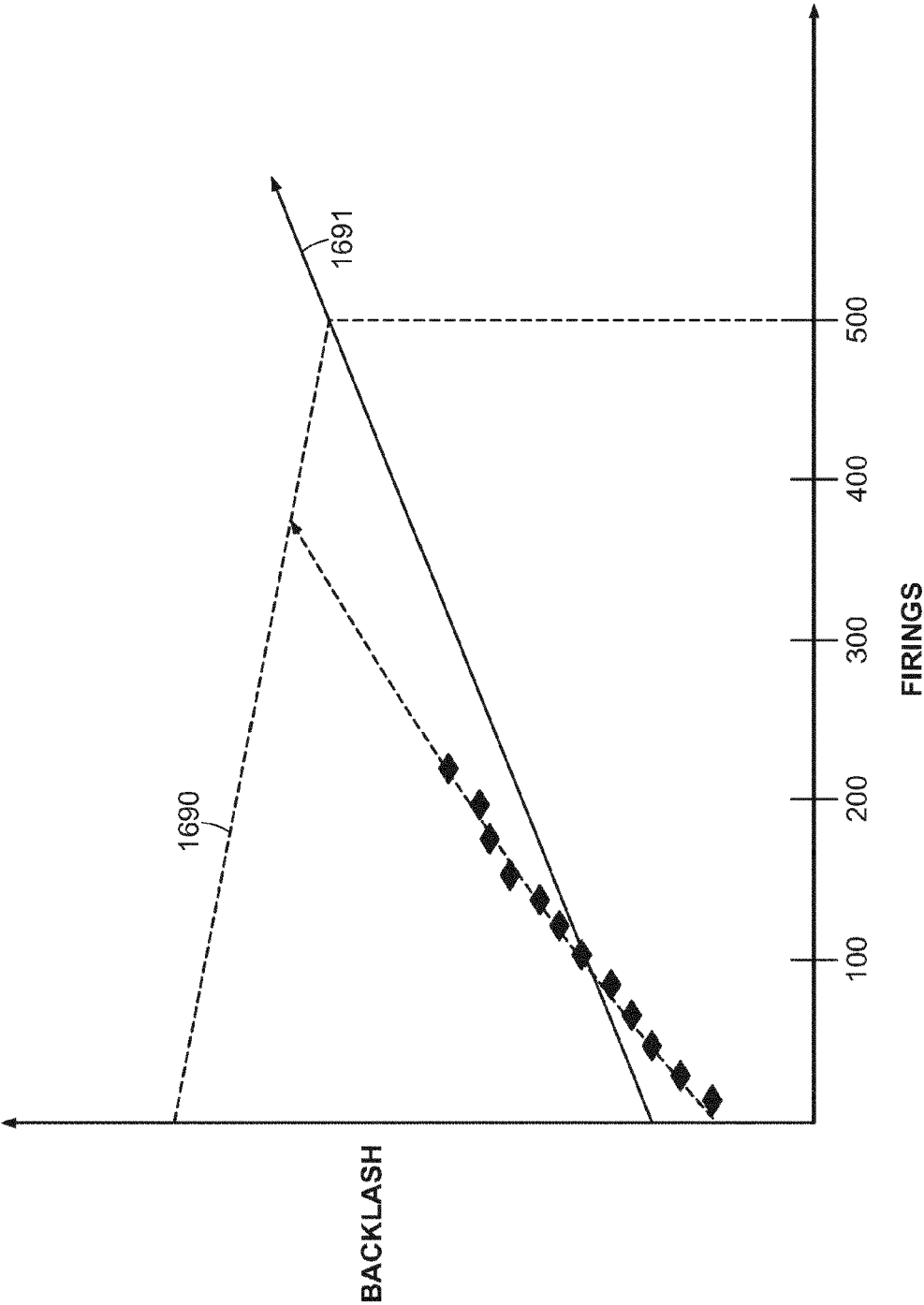
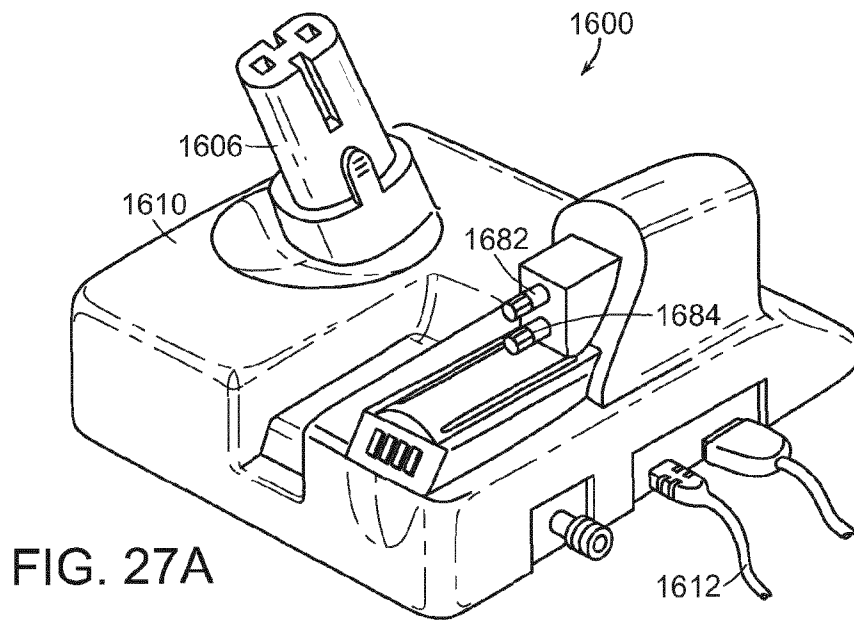
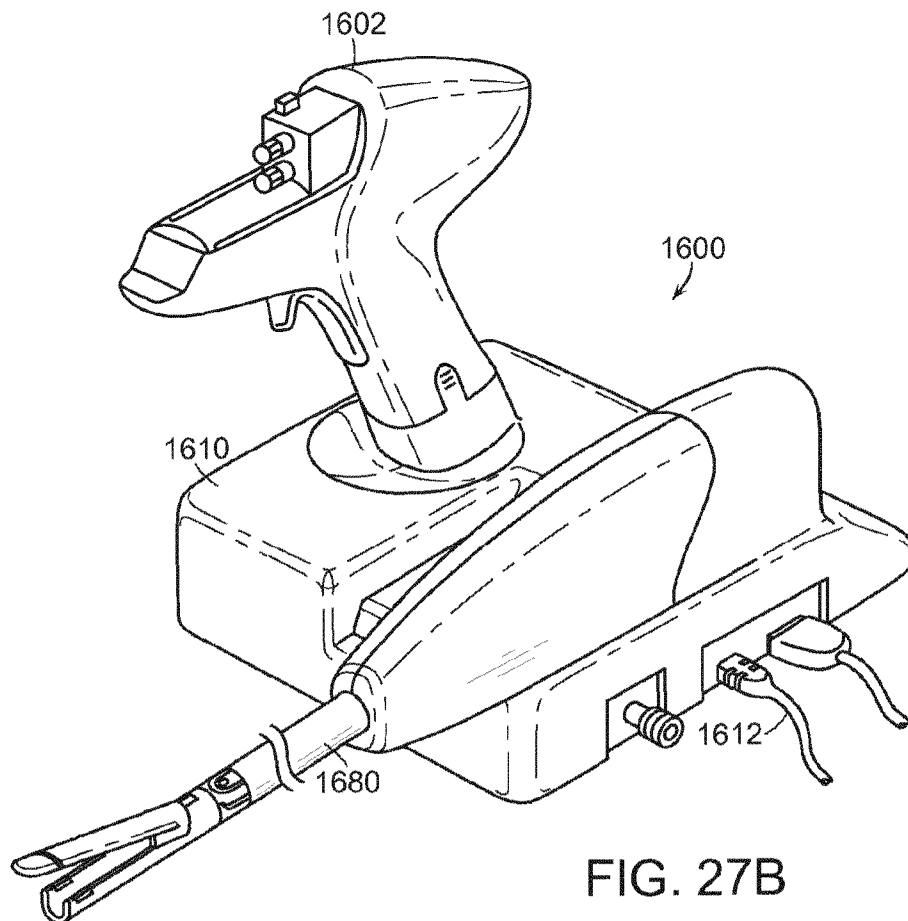
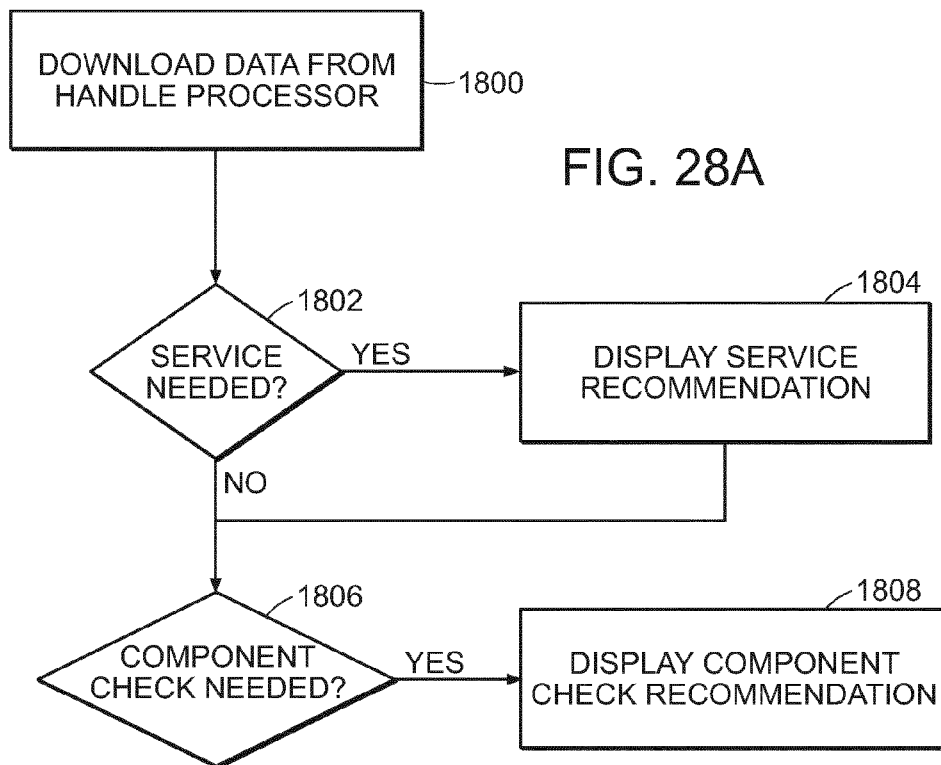
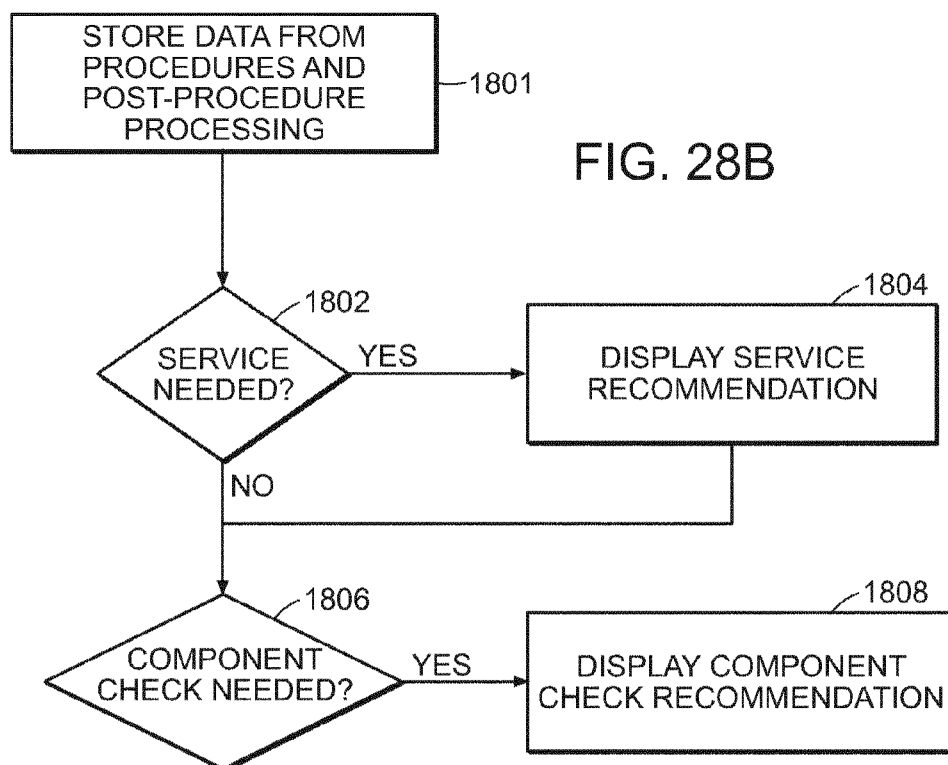


FIG. 26D

FIG. 26E







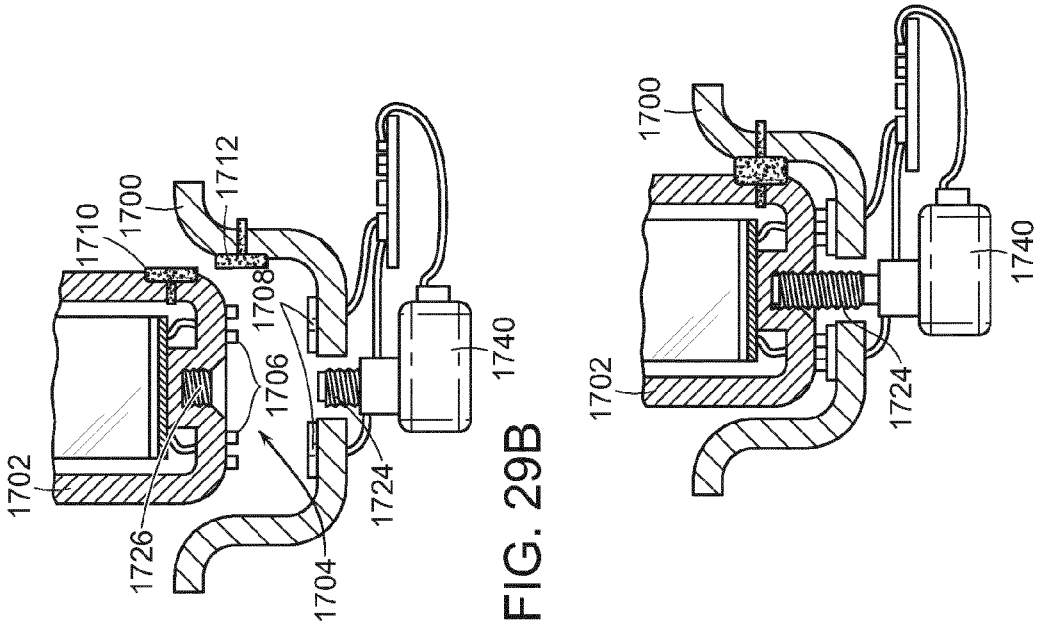


FIG. 29B

FIG. 29C

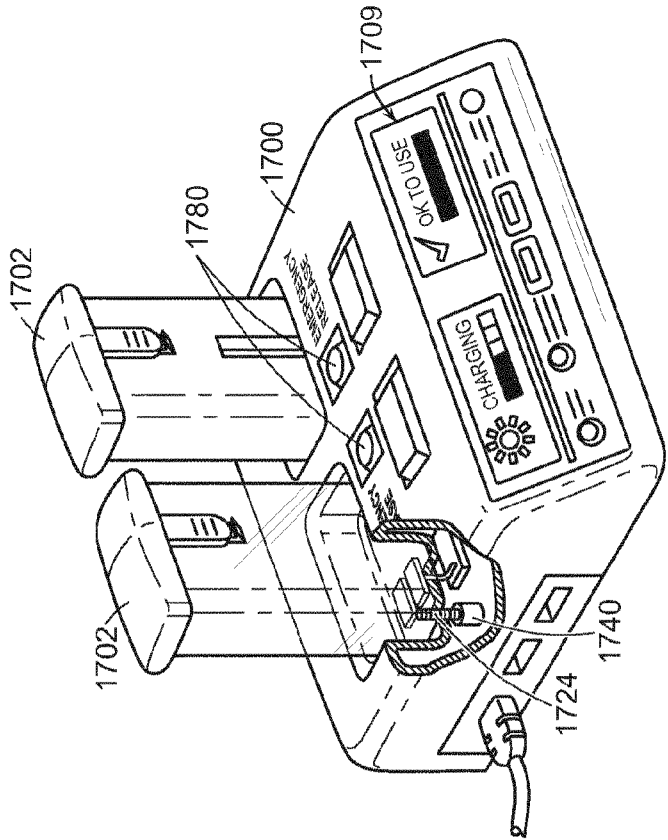


FIG. 29A

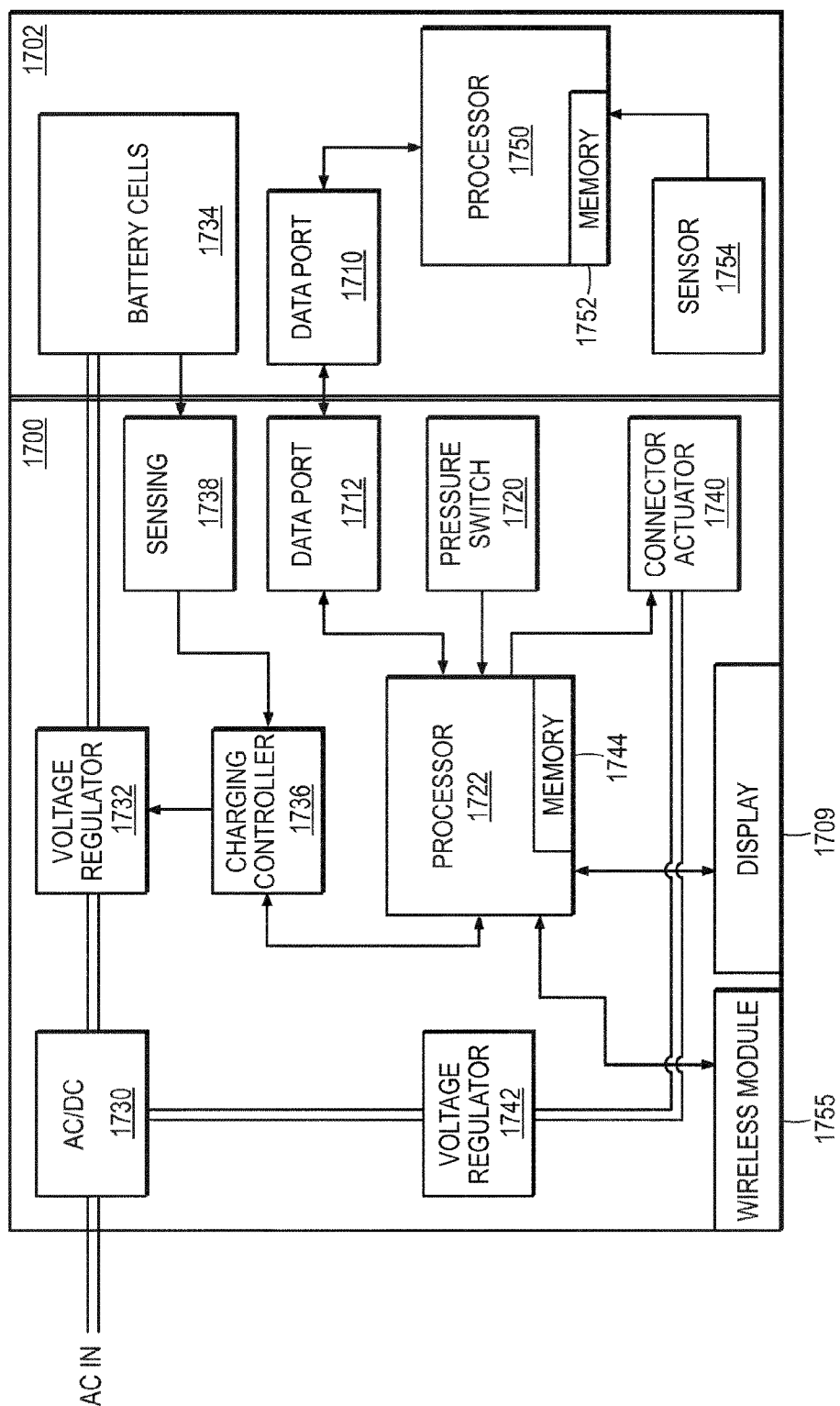


FIG. 29D

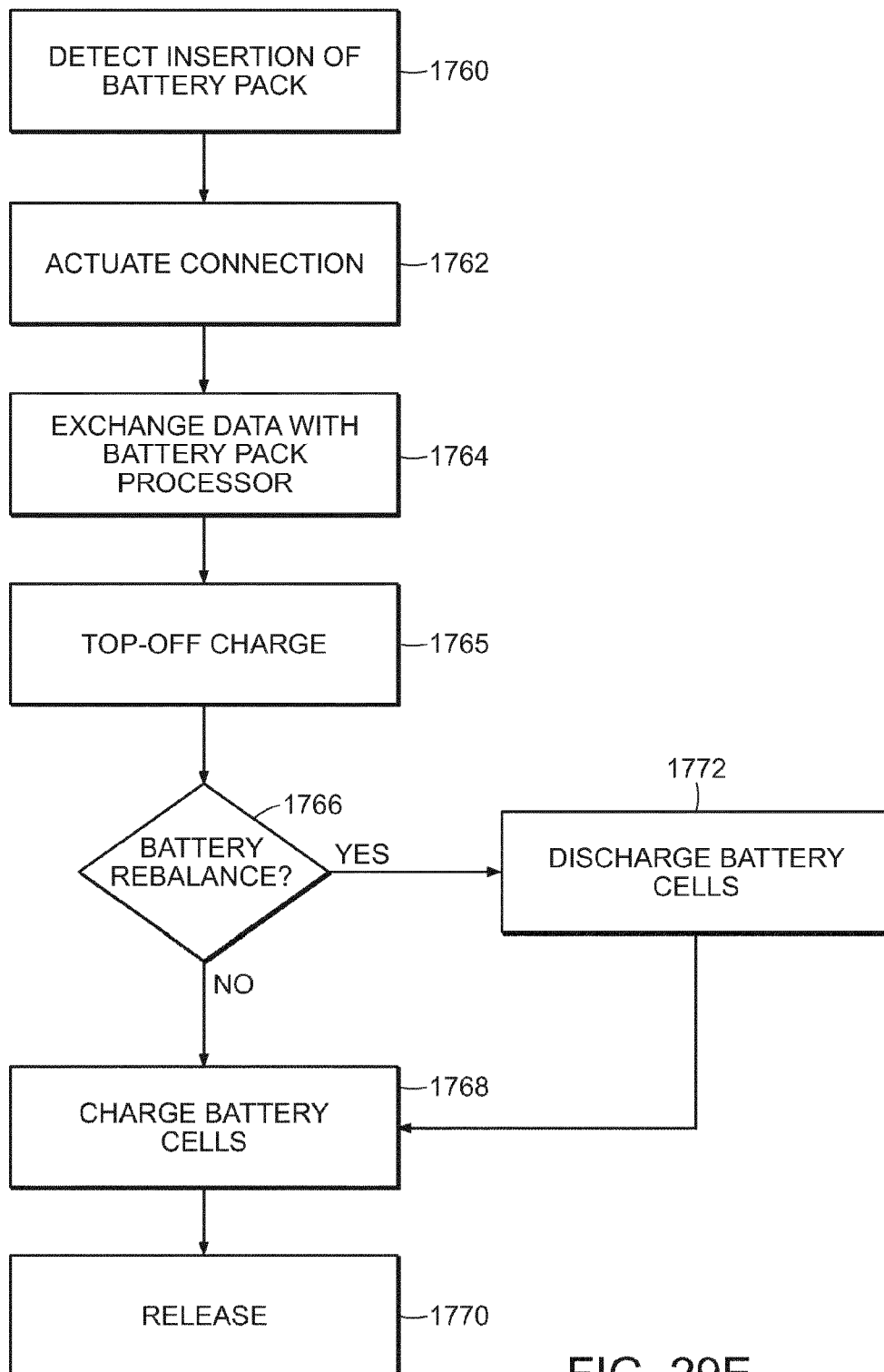


FIG. 29E

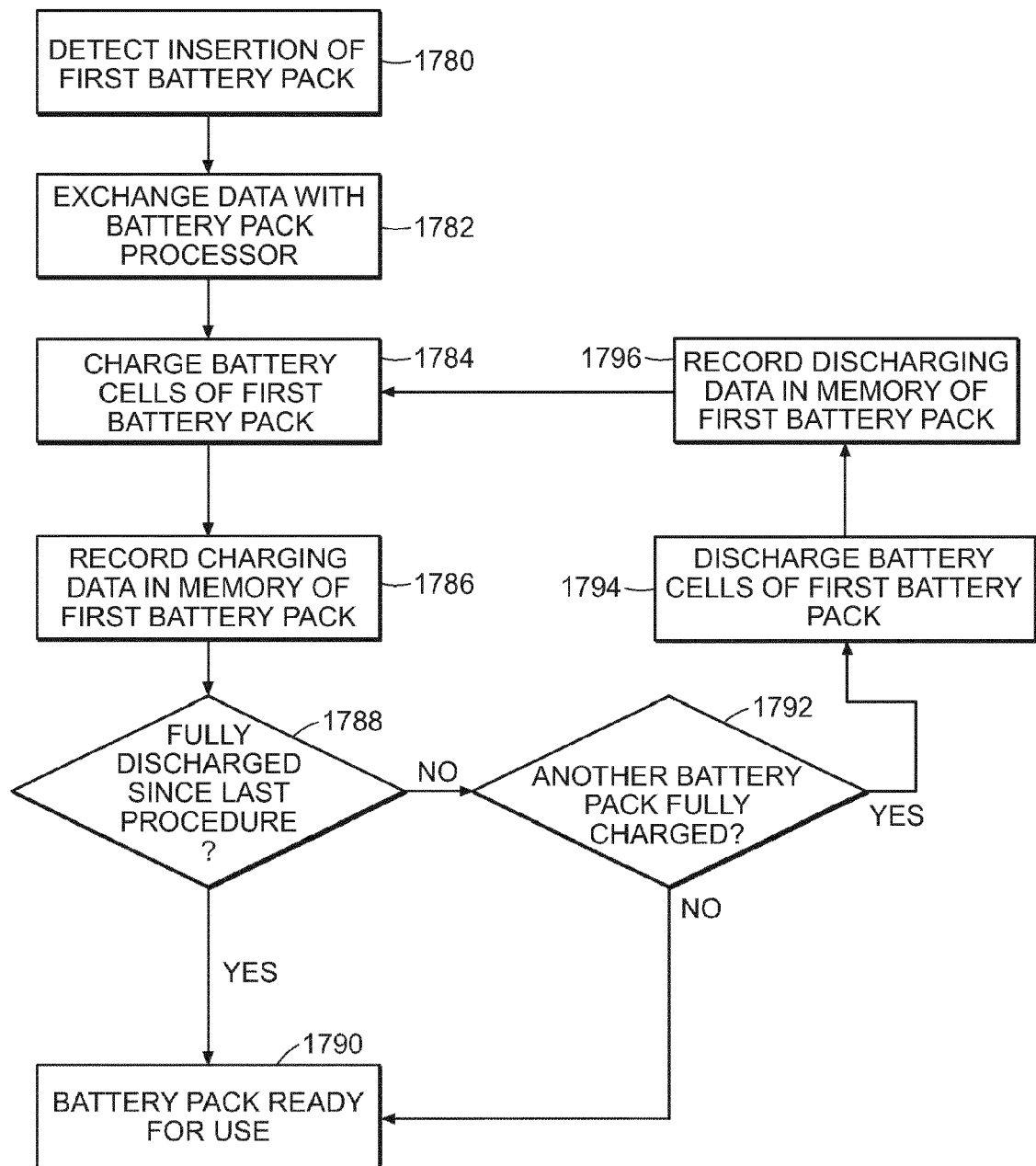


FIG. 30A

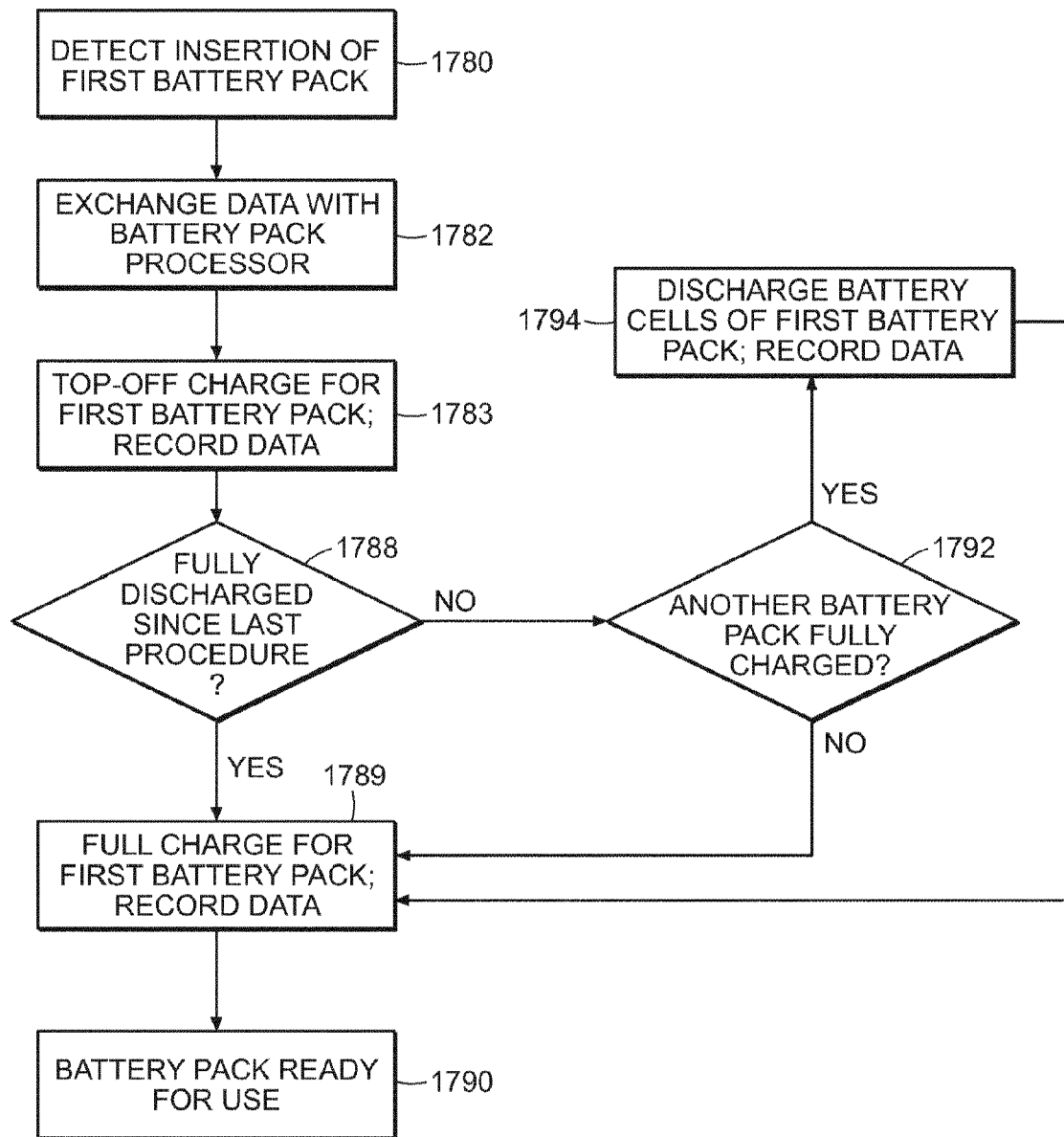


FIG. 30B

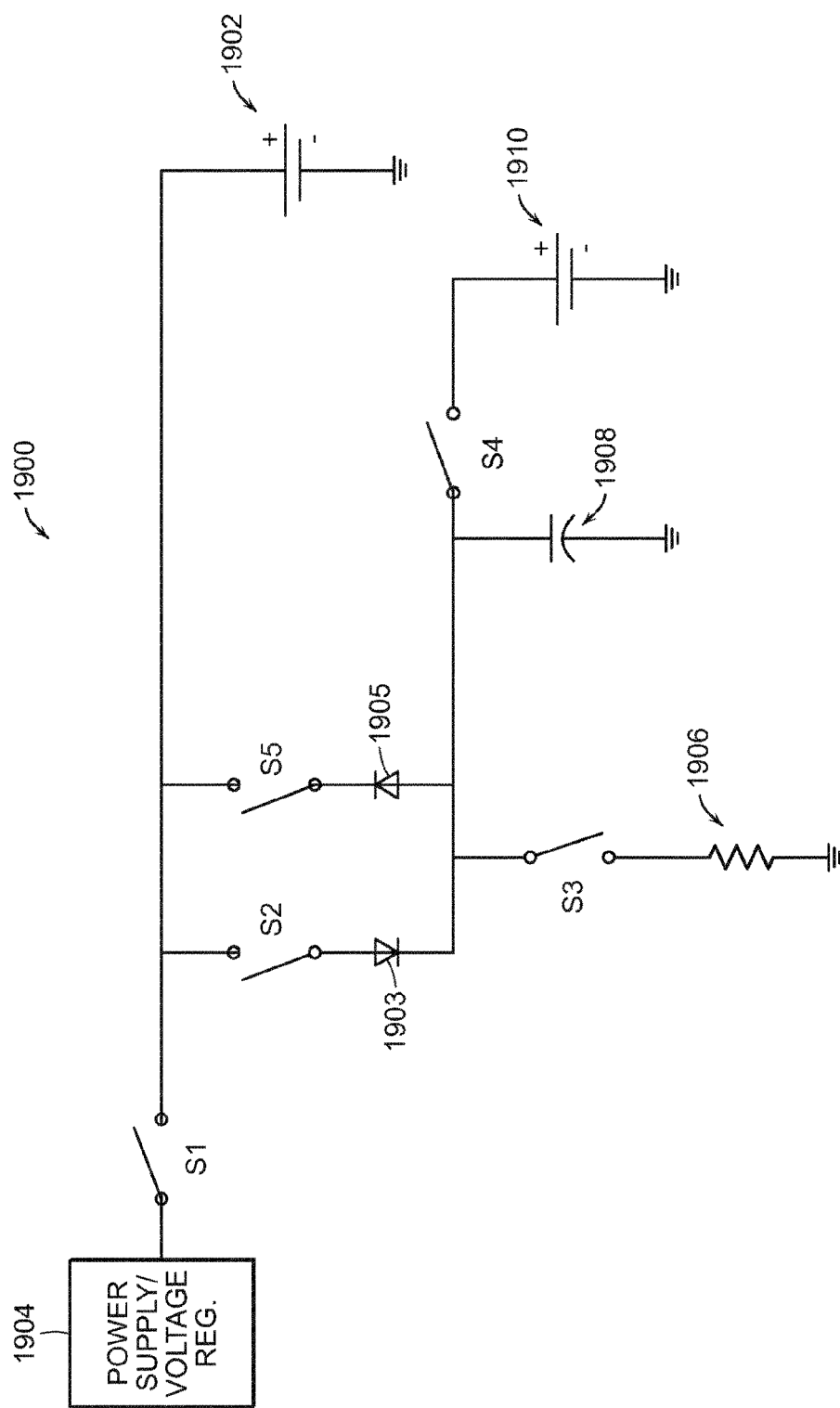


FIG. 31

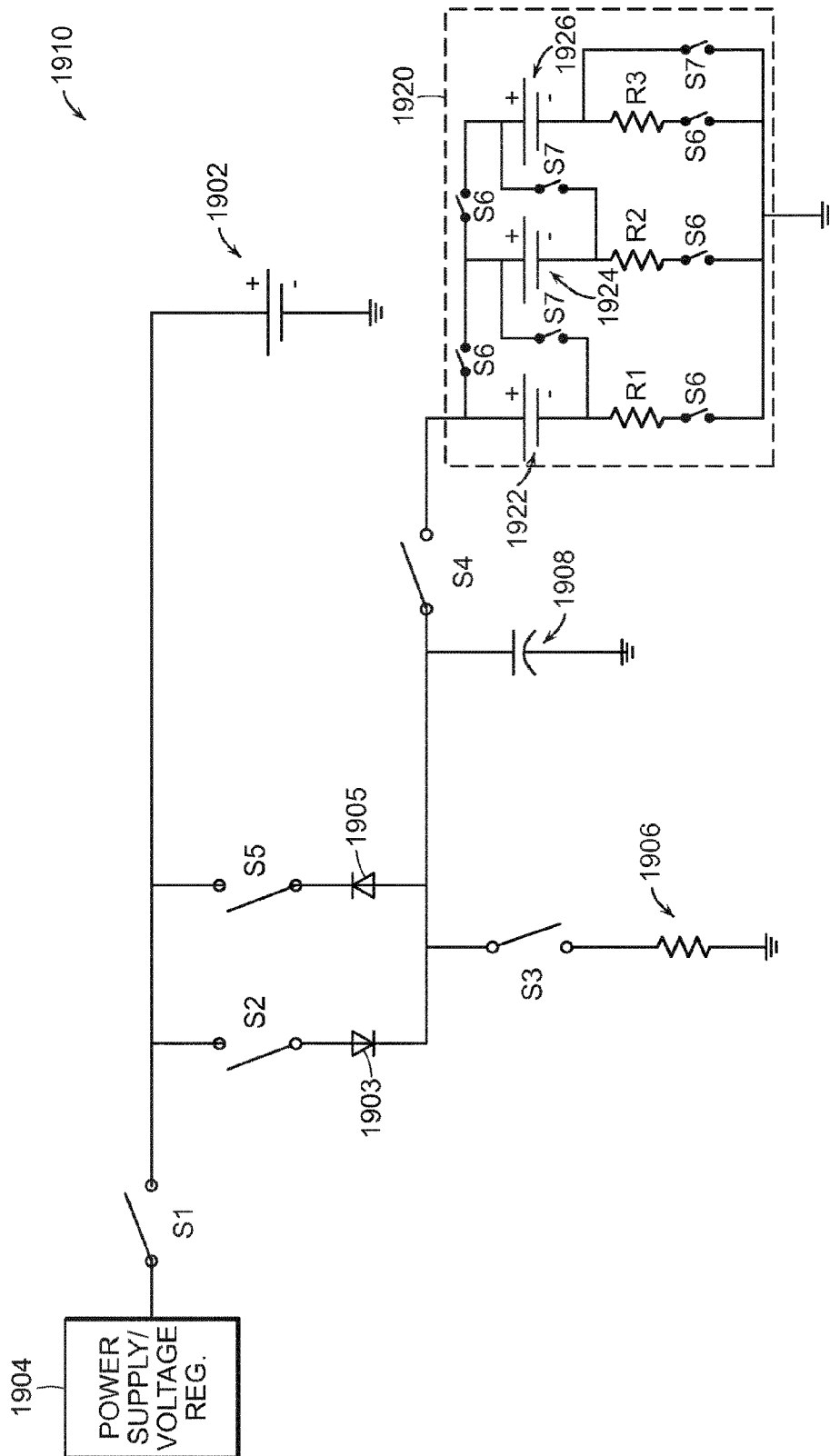


FIG. 32

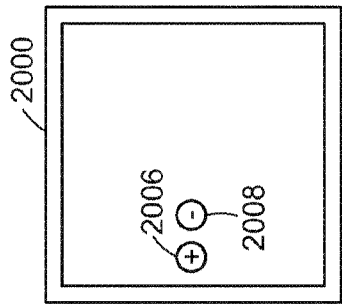


FIG. 33A

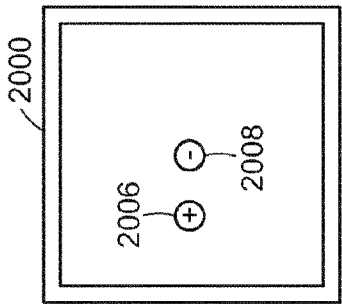


FIG. 34A

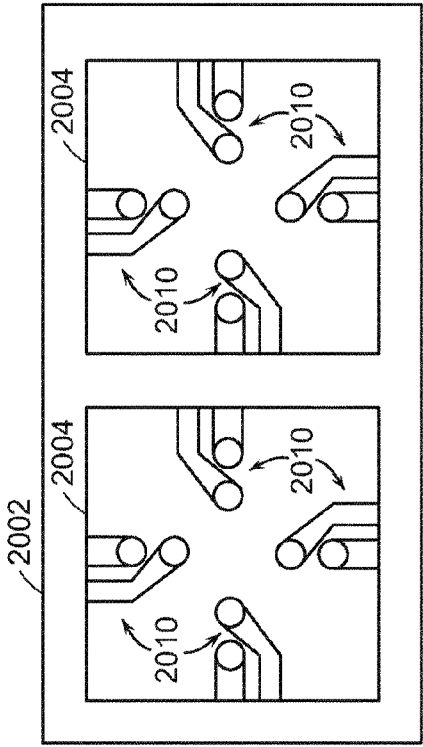


FIG. 33B

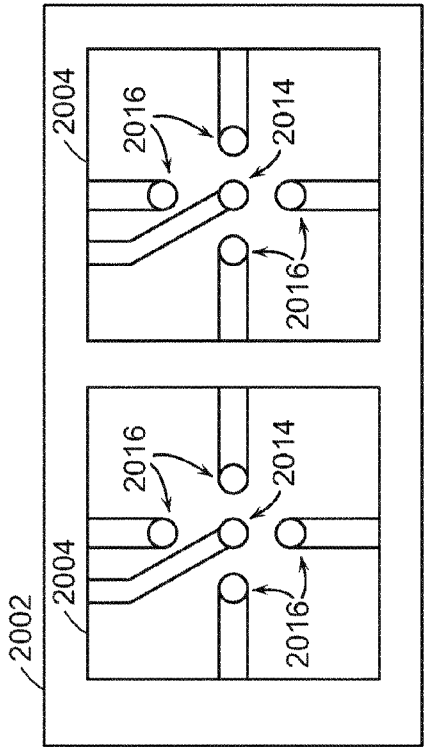


FIG. 34B

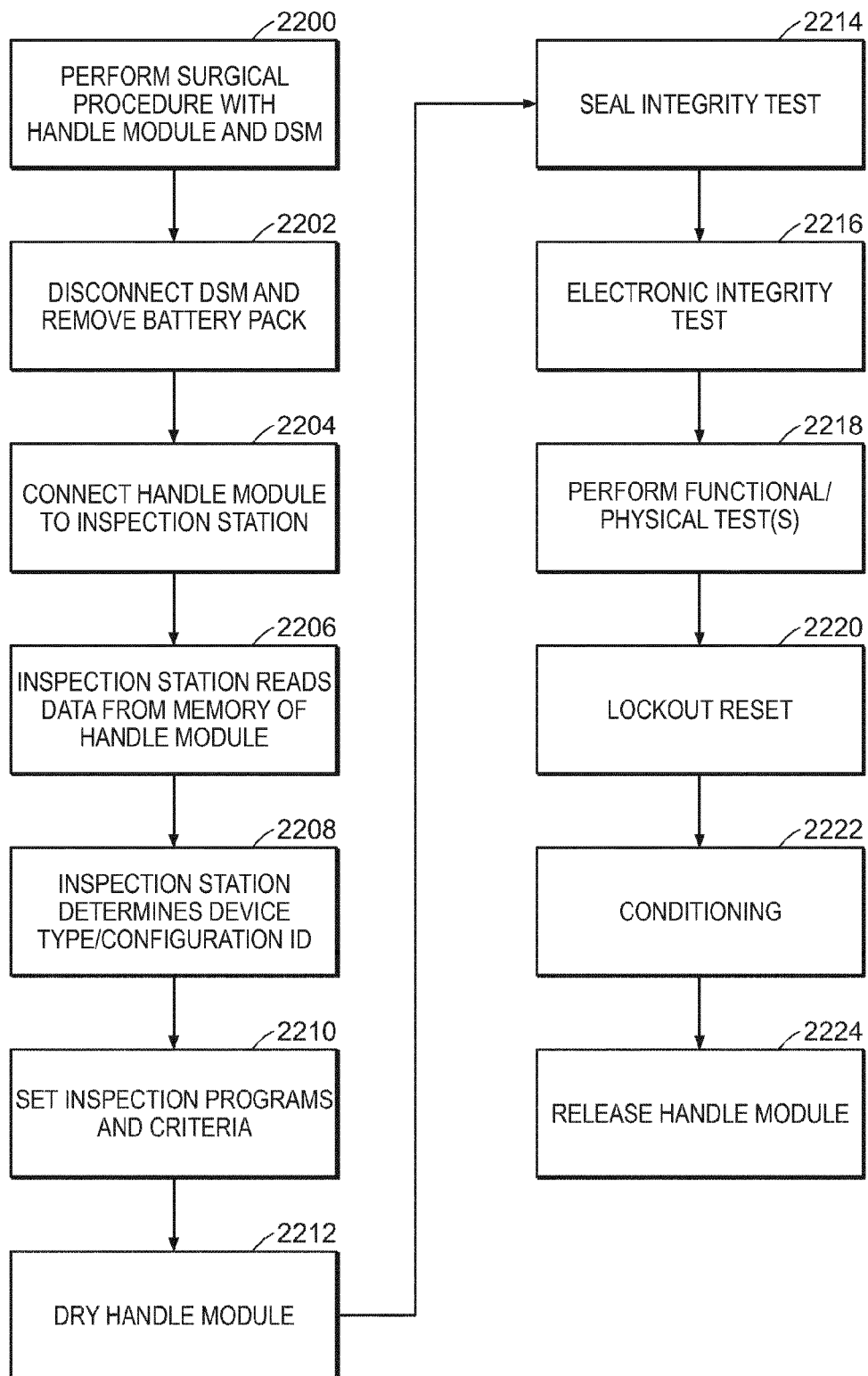


FIG. 35

FIG. 36

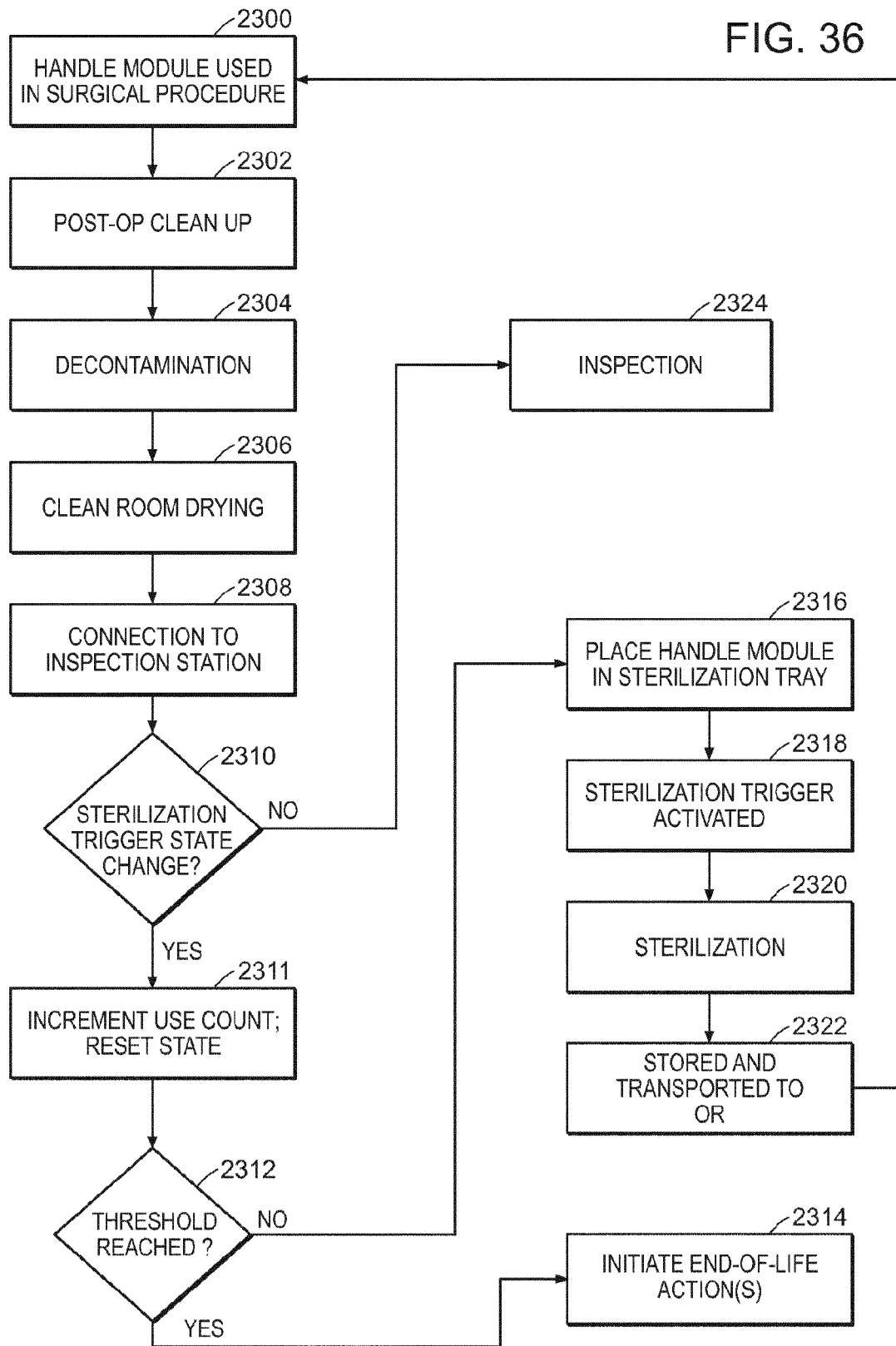
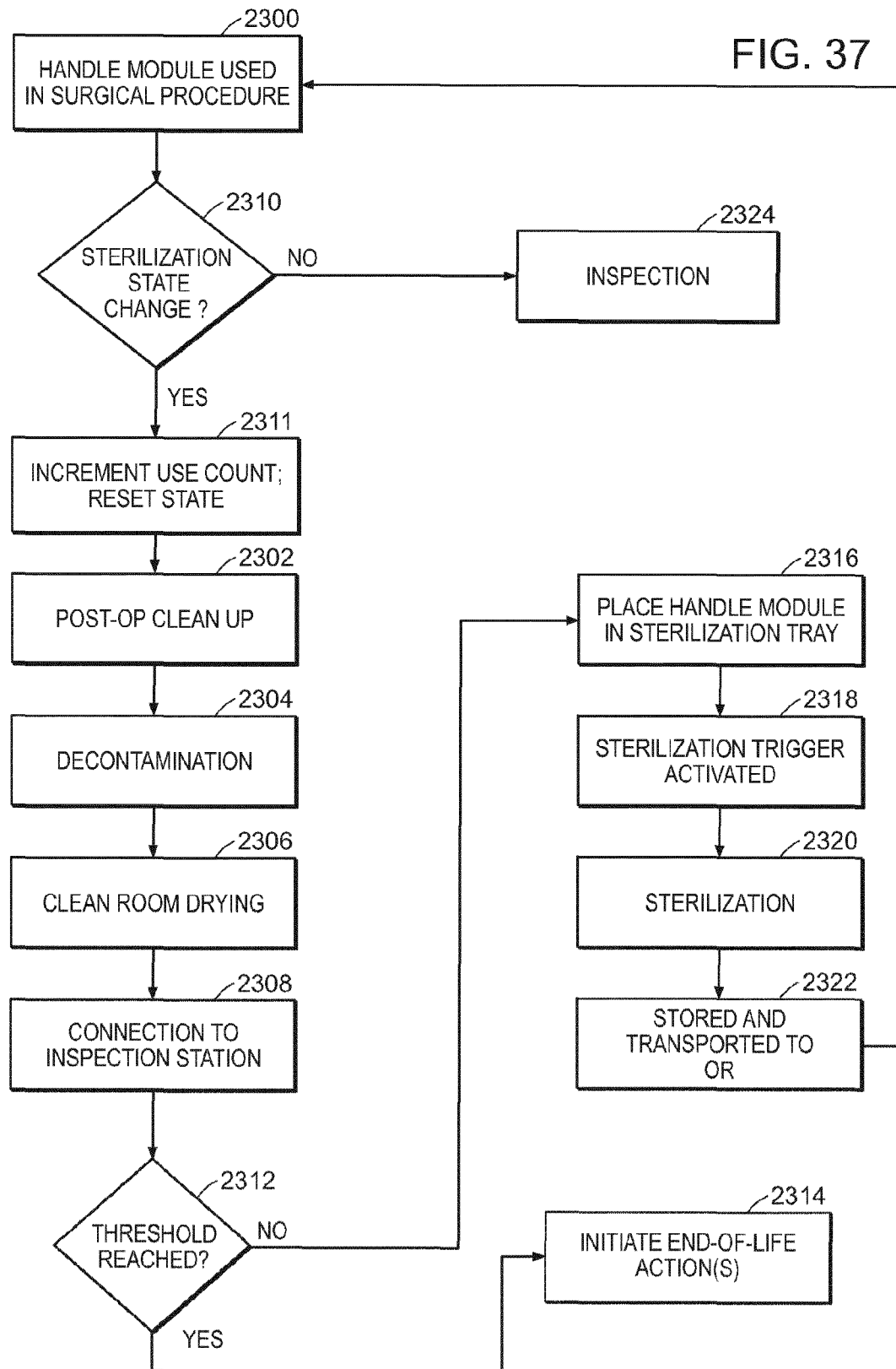


FIG. 37



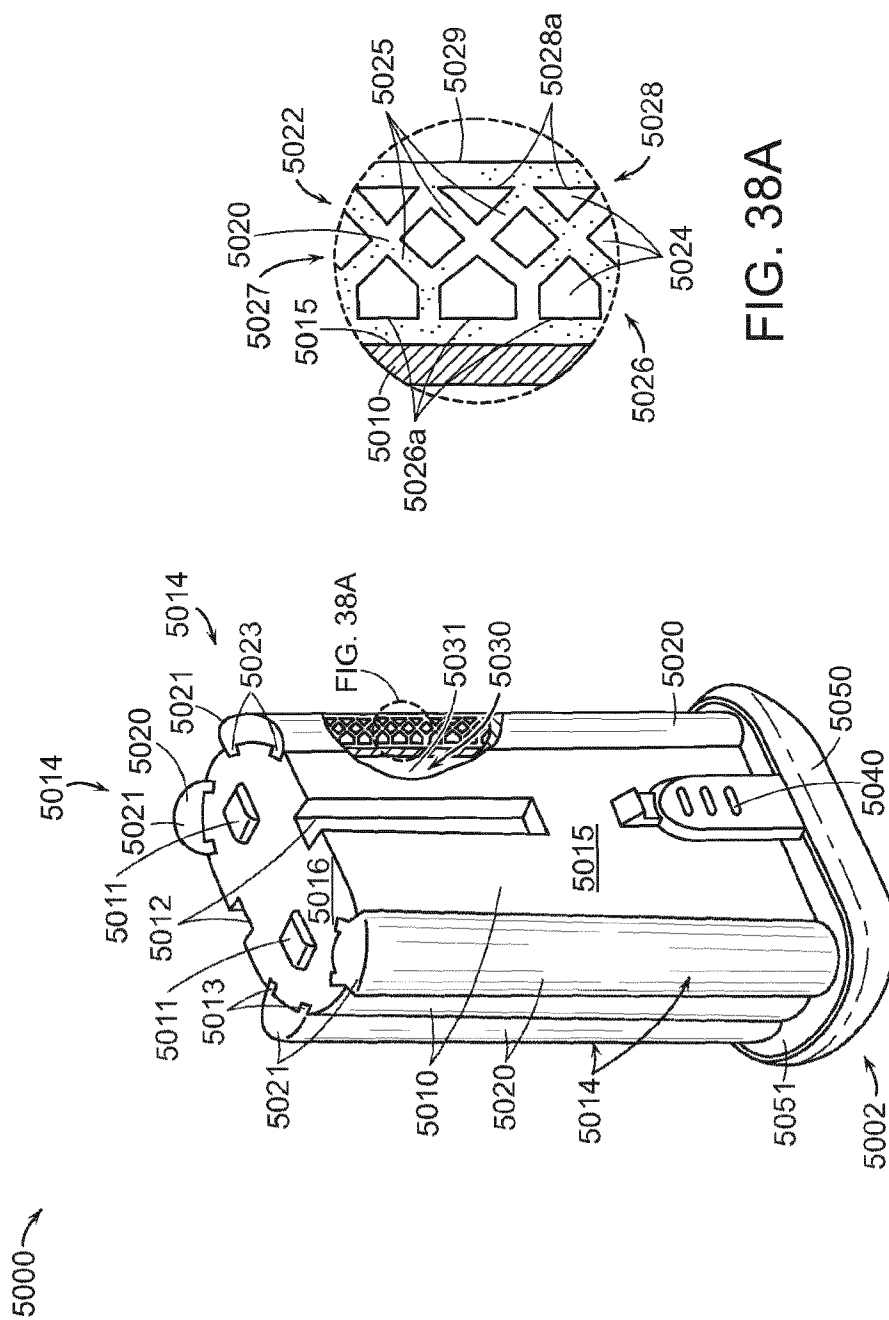


FIG. 38A

Fig. 38

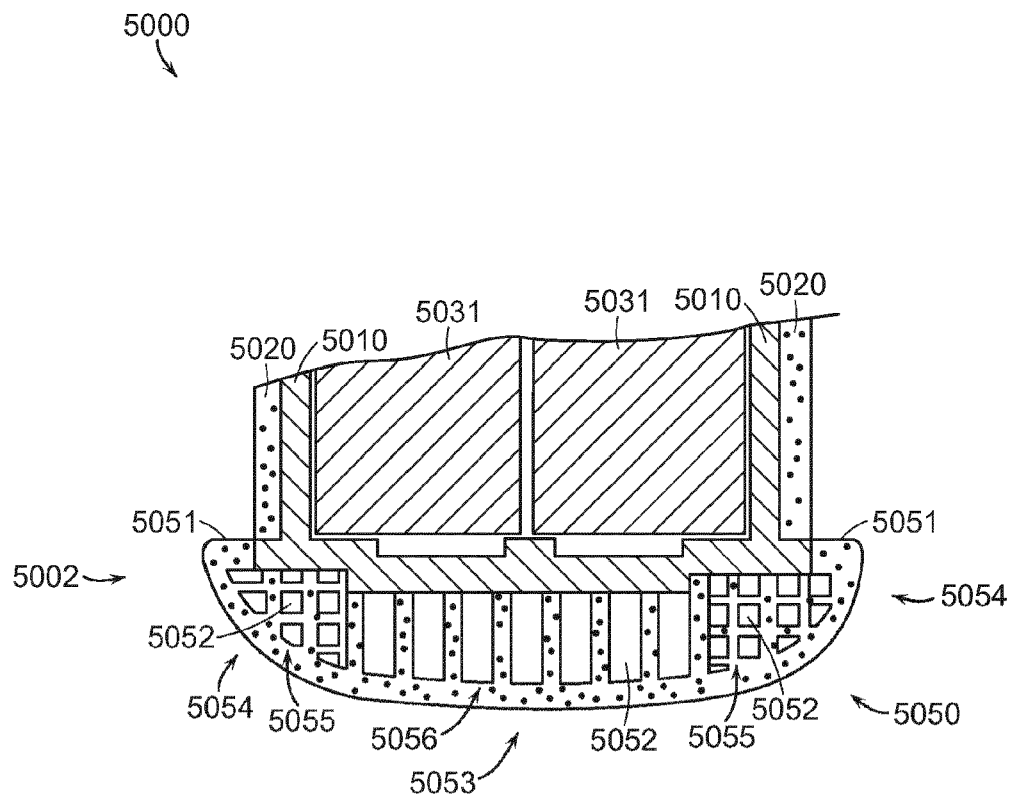
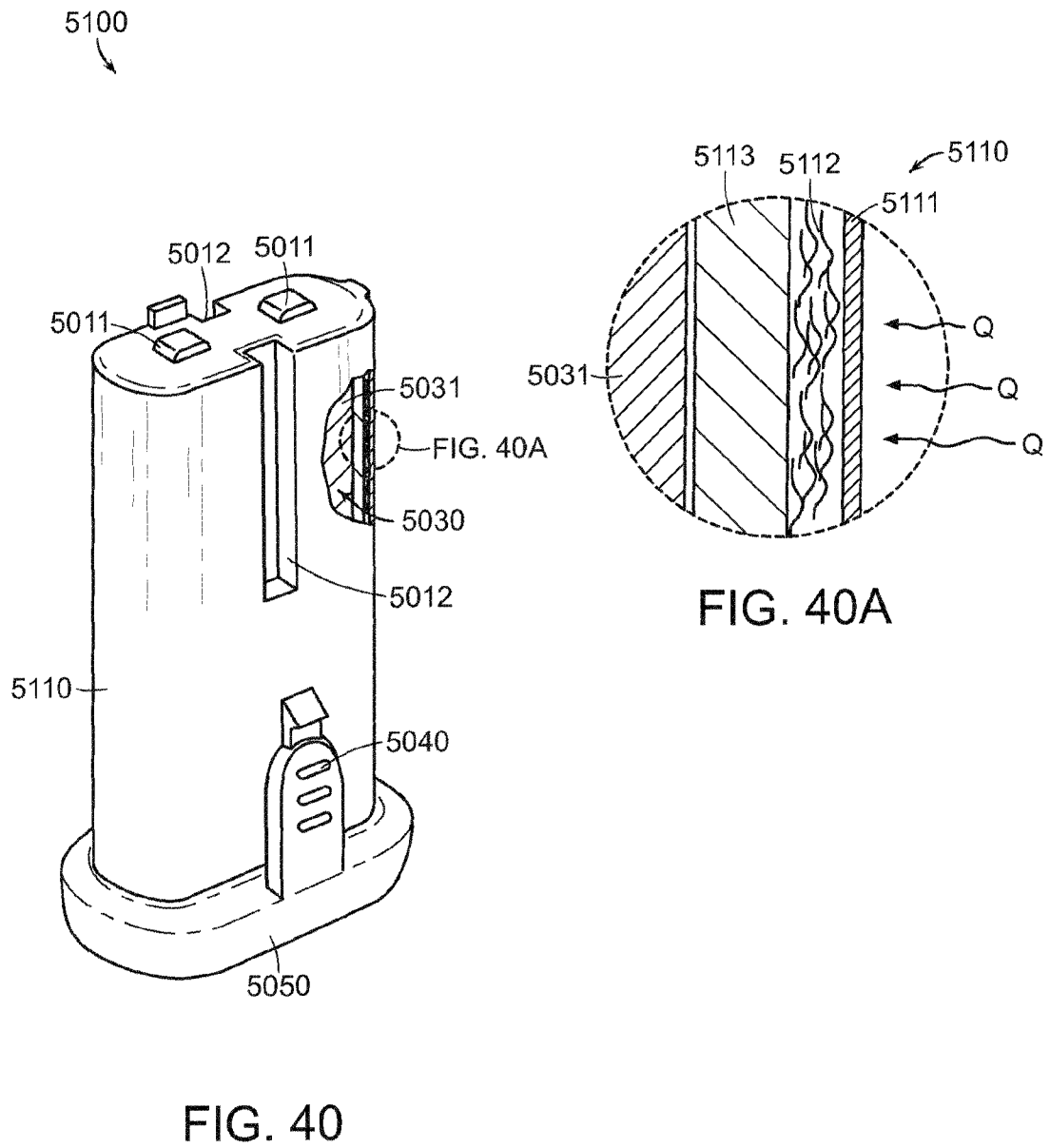


FIG. 39



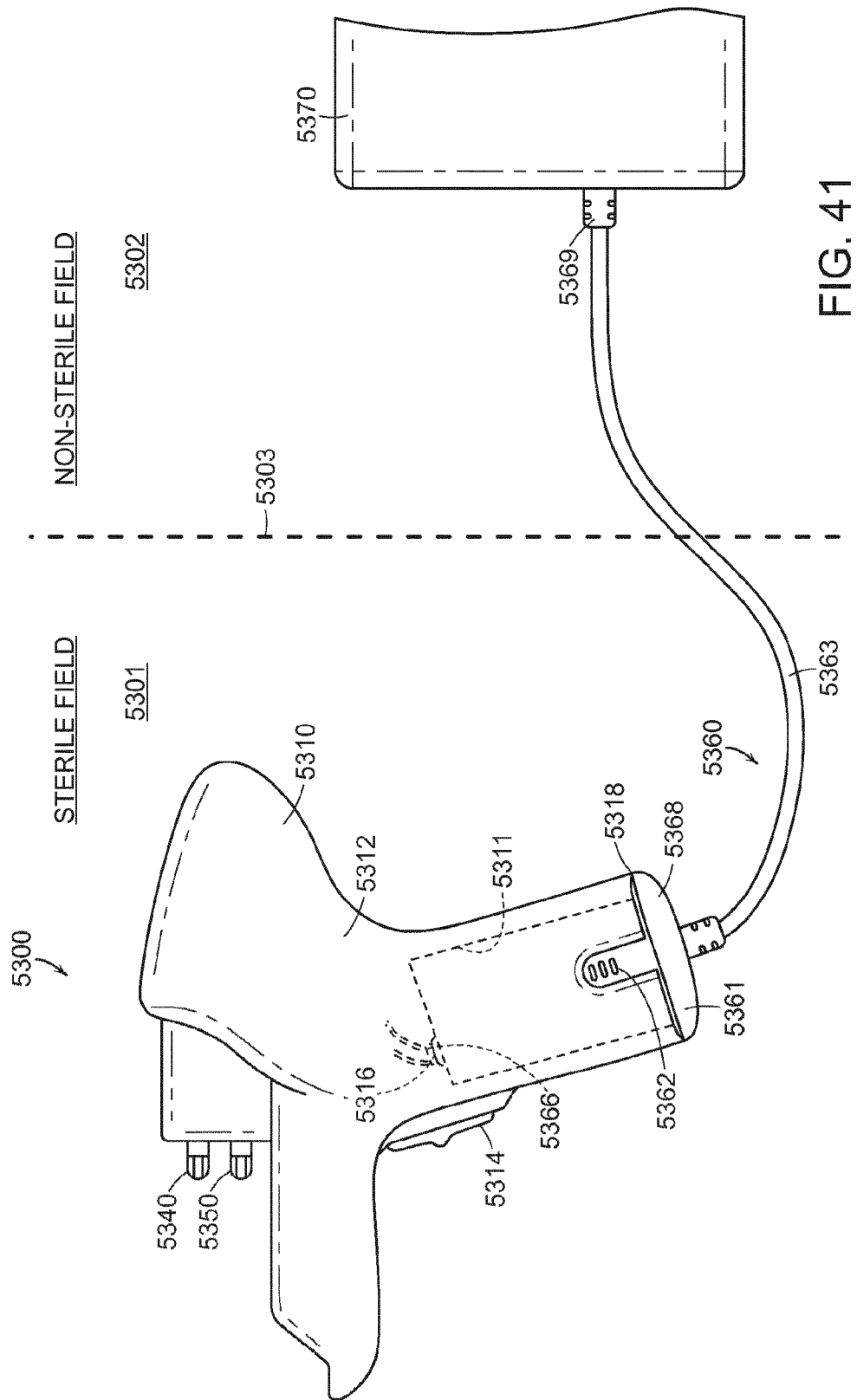


FIG. 41

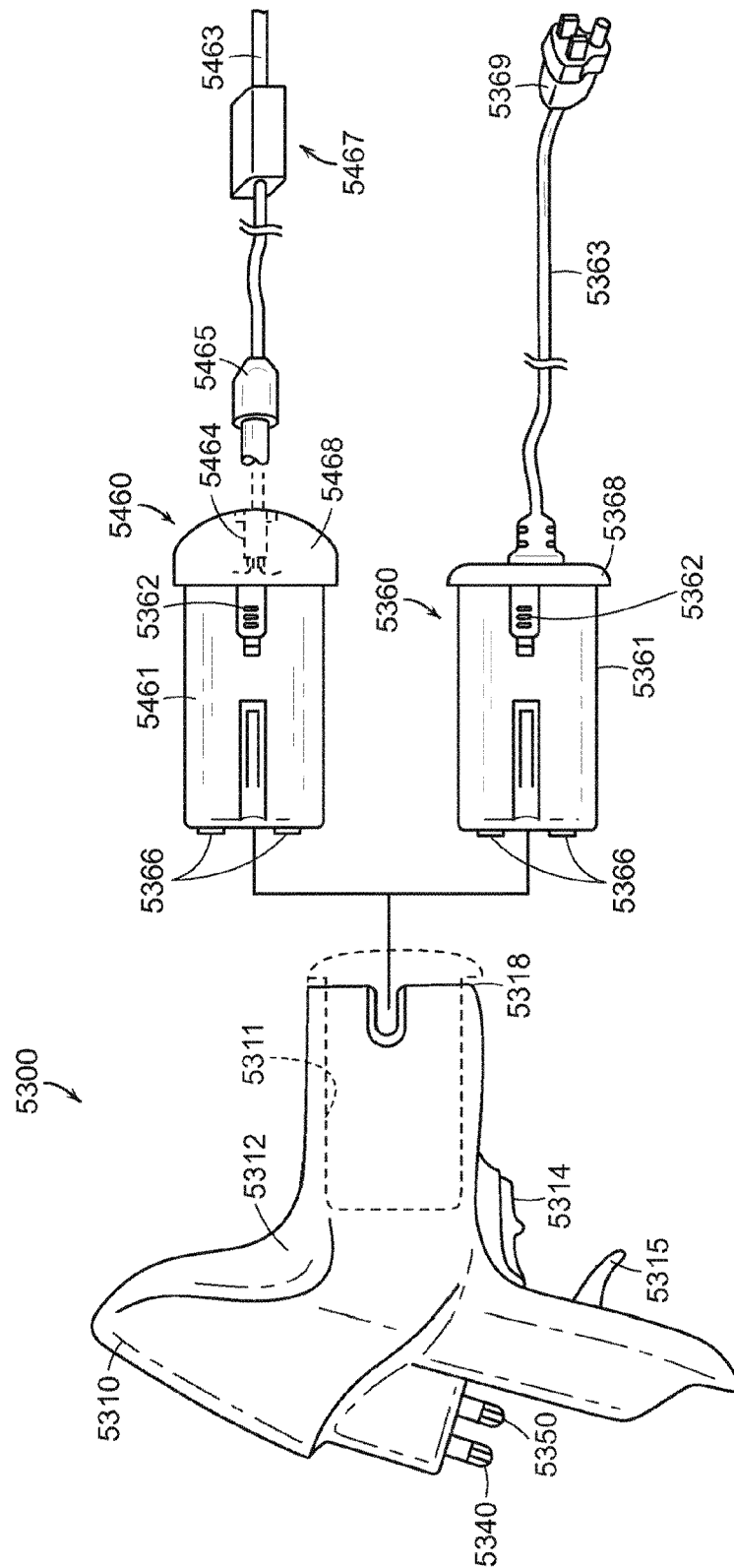


FIG. 42

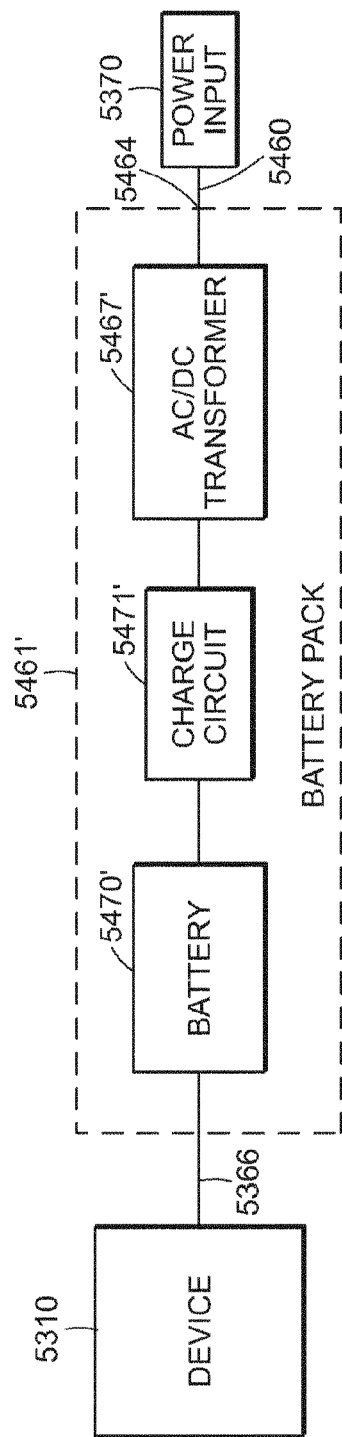


FIG. 43

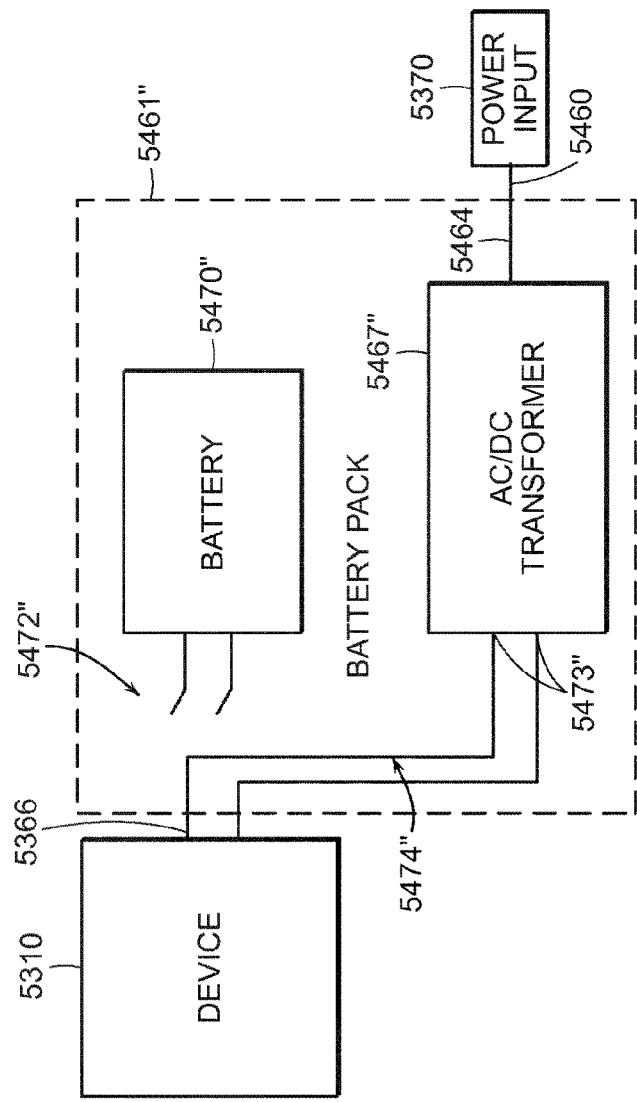


FIG. 44

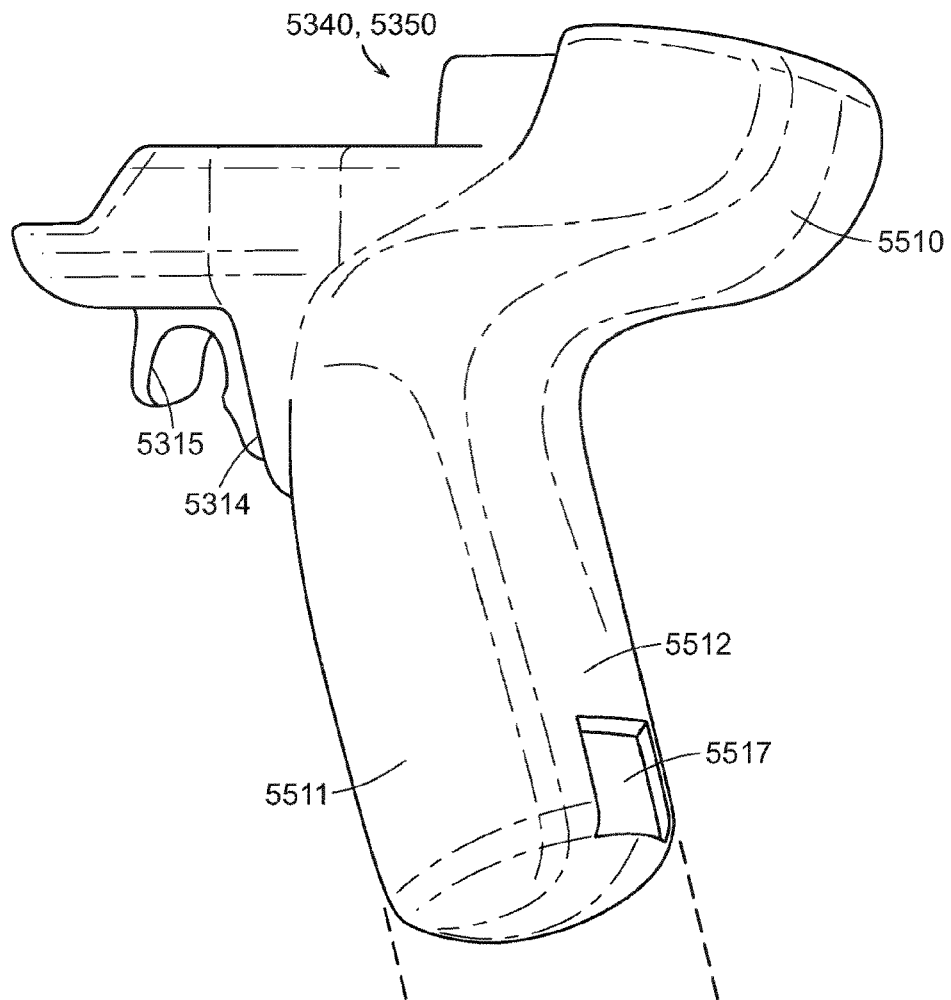


FIG. 45

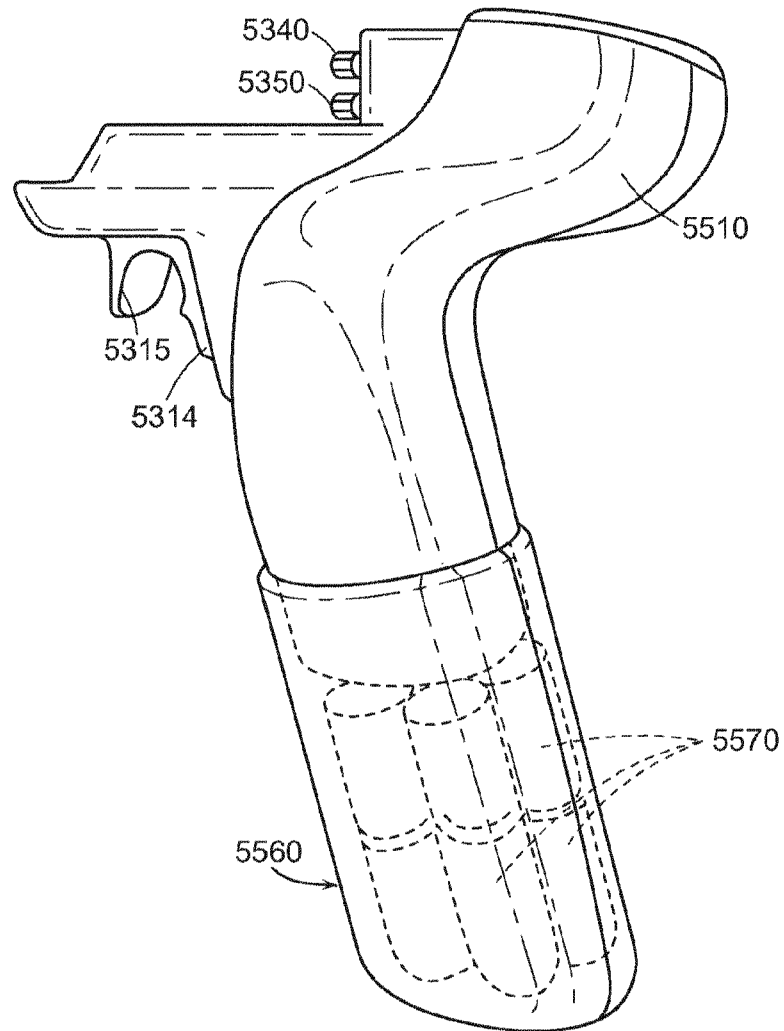


FIG. 46

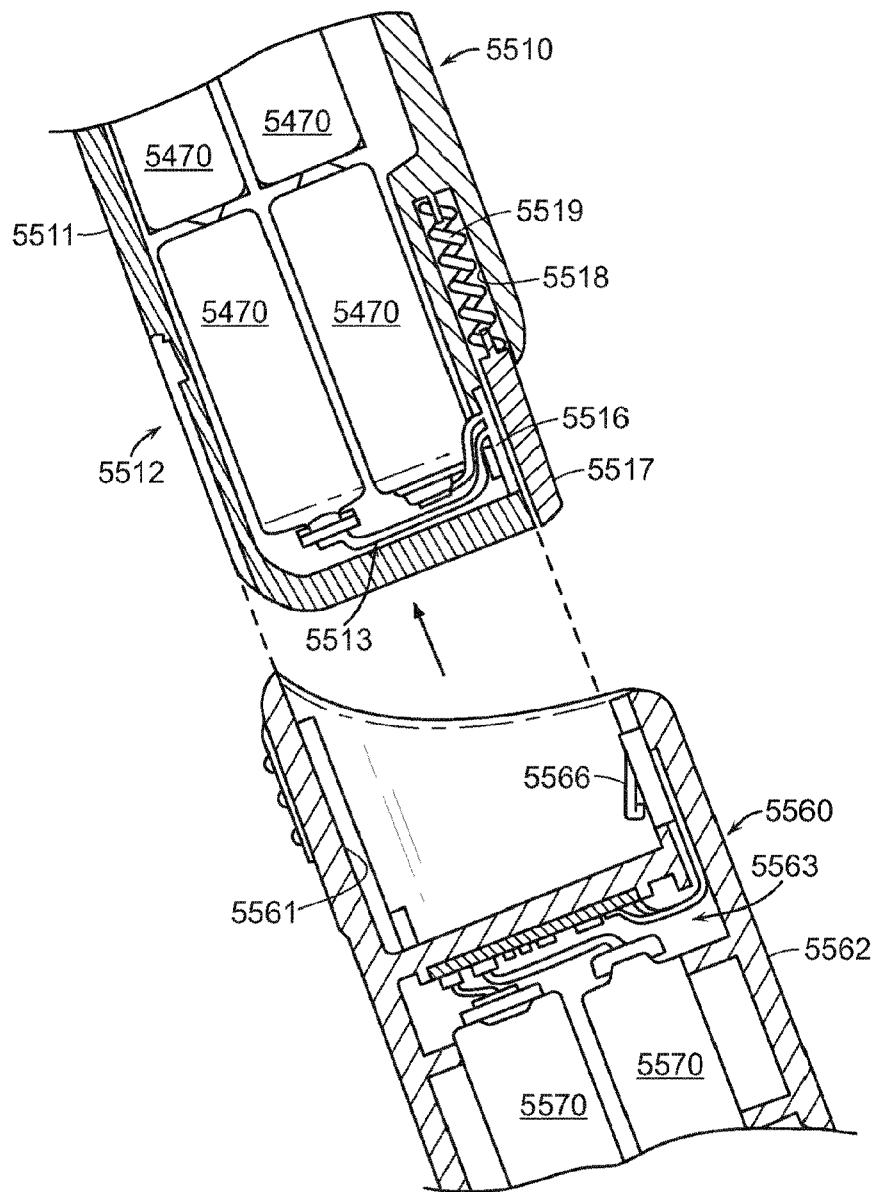


FIG. 47

REFERENCES CITED IN THE DESCRIPTION

This list of references cited by the applicant is for the reader's convenience only. It does not form part of the European patent document. Even though great care has been taken in compiling the references, errors or omissions cannot be excluded and the EPO disclaims all liability in this regard.

Patent documents cited in the description

- US 7794475 B [0002]
- US 24859014 A [0015]

Covid-19 Update

A world-wide collection of industrial designs data; including WIPO Hague registrations and information from participating national offices.

Korean Designs**3020100023508 -Lithium-ion cordless driver drill (DC Driver Drill)**

Status: PostRegistration publication (2011-10-14)

(19)

Identification, using the two-letter code according to WIPO Standard ST.3, of the authority publishing or registering the industrial design

KR

(21)

Application number

3020100023508

(22)

Filing date

2010-05-26

(11)

National Registration Number

3006167690000

(15)

Date of the national registration

2011-10-10

(45)

Date of publication of the registered industrial design by printing or similar process, or making it available to the public by any other means

2011-10-14

(51)

Class and subclass of the Locarno Classification

08-04

(52)

National classification

K1-331

(54)

Indication of products

Lithium-ion rechargeable driver drill (DC Driver Drill)

(57)

Description of the characteristic features of the design(s), or matter for which protection is not sought

1. The product has been miniaturized in consideration of the user's convenience and usability, and the angle of the boomerang design, the symbol mark of imsac, is utilized to express a sleek, understated design. 2. To improve workability, the rubber treatment on the surface of the product enhances the grip, and the grip part is designed as much as possible to suit the body shape of Koreans with small hands. 3. The LED mounted on the front is designed to work conveniently in a dark working environment, so that it is designed to maximize the functions of the product. 4. The lever mounted on the top is a 1 (strong work) to 2 stage (quick work) shifting lever that can be easily used and designed to allow convenient shifting in various jobs. 5. Designed for consumers who prefer lighter products than

existing products with "T" shape design. 6. As a lithium-ion plug-in product, it is small and powerful, and it is designed to be convenient for work that requires light and powerful power when working in a narrow area or high place.

(71)

Name(s) and address(es) of the applicant(s)

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충청북도 청원군 오창읍 송대리 313-1

363-883

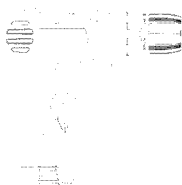
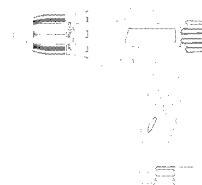
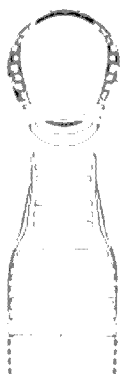
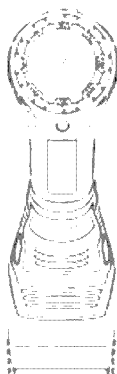
(72)

Name and address of creator of designs

김재홍 (KR)

경기도 수원시 권선구 권선동 대우아파트 323동 302호

441-390





No search results.

	(19) 대한민국특허청(KR)	(45) 공고일자	2011년10월14일
	(12) 등록디자인공보(S)	(11) 등록번호	30-0616769
		(24) 등록일자	2011년10월10일
<hr/>			
(52) 분류	K1-331		
(51) 국제분류	08-04		
(21) 출원번호	30-2010-0023508		
(22) 출원일자	2010년05월26일		
<hr/>			
(73) 등록권자	주식회사 아임삭		
	충청북도 청원군 오창읍 송대리 313-1		
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발달심사관 : 오현자			
<hr/>			
(54) 리튬이온 충전 드라이버 드릴 (DC Driver Drill)			

발명디자인도면

디자인의 대상이 되는 물품

리튬이온 충전 드라이버 드릴 (DC Driver Drill)

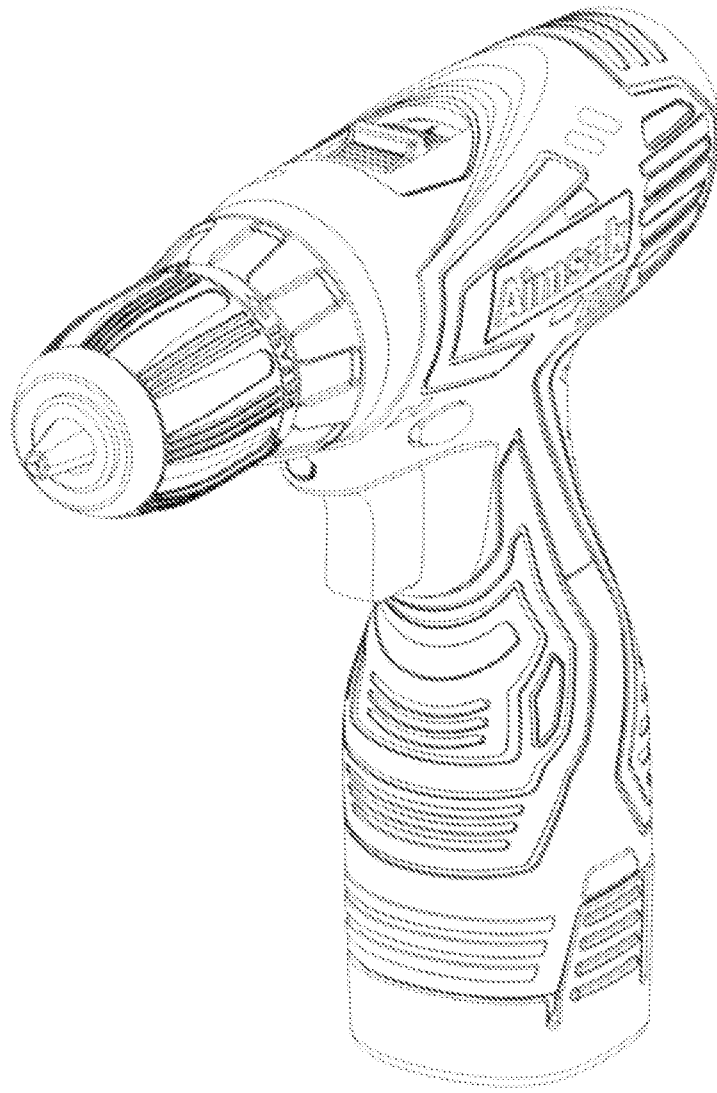
디자인의 설명

1. 체결은 금속재 및 합성 수지제임.
2. 전면 키레스 적에 일자 및 드라이버, 드릴 비트를 장착하여 각종 금속 또는 목재 등에 나사를 체결 및 천공 하는데 사용되는 충전 드라이버 드릴의 디자인임.
3. 토크캡 포지션 선택으로 드라이버, 드릴 작업을 선택 할 수 있음.

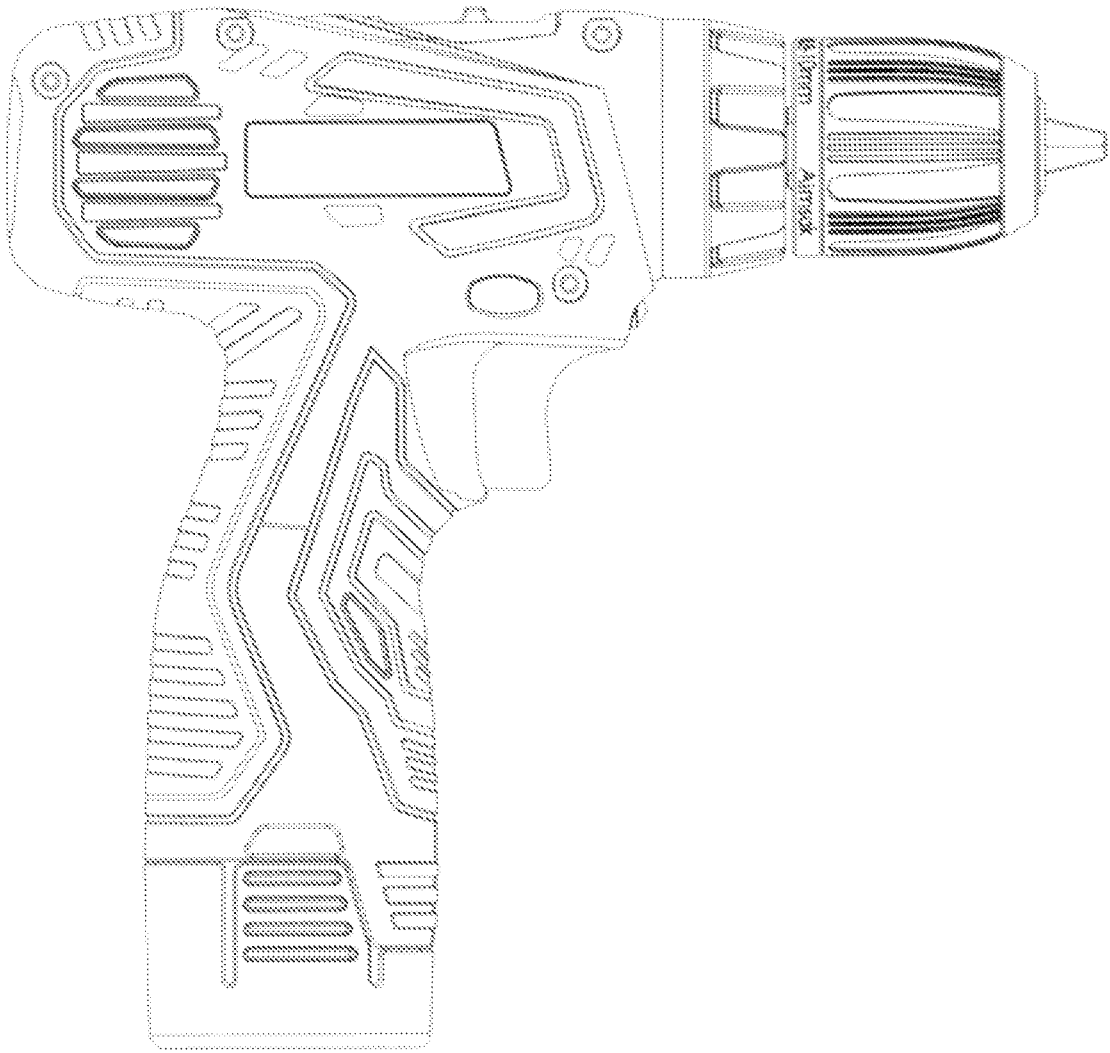
디자인 창작 내용의 요점

1. 사용자의 편의성 및 사용성을 고려하여 제품을 소형화하였고, 아임삭 심볼(Symbol)마크인 부메랑 디자인의 각을 살려 날렵하며, 절제된 디자인을 표현하였음.
2. 작업성을 향상하기 위한 제품 표면의 고무처리로 그림감을 높여 손이 작은 한국인의 체형에 알맞게 그림부를 최대한 편리하게 디자인 하였음.
3. 전면에 장착된 LED는 어두운 작업 환경에서 편리하게 작업할 수 있도록 디자인되어 제품의 기능을 최대한 가질 수 있도록 디자인 하였음.
4. 상단에 장착된 레버는 1(강력한작업)~2단(신속한작업) 변속 레버로서 손쉽게 사용하며, 다양한 작업에서 편리하게 변속할 수 있도록 디자인 하였음.
5. "T"형태의 디자인으로 기존 제품 보다 가벼운 제품을 선호하는 소비자를 위해 디자인 하였음.
6. 리튬이온 Plug In 제품으로 작고 강력하며, 좁은 구역이나 높은 장소에서 작업시 가볍고 강력한 힘을 요하는 작업에 편리하도록 디자인 하였음.

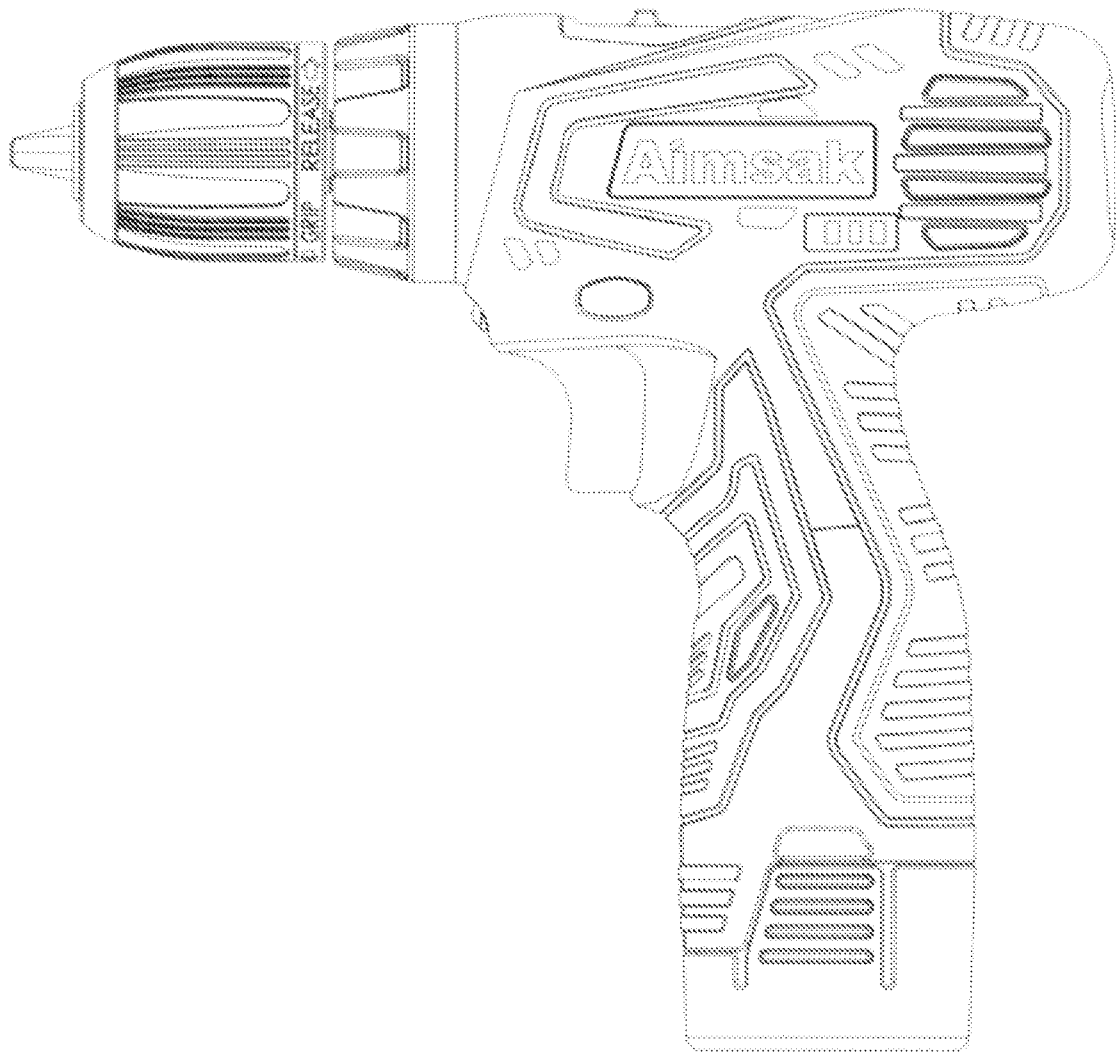
사시도



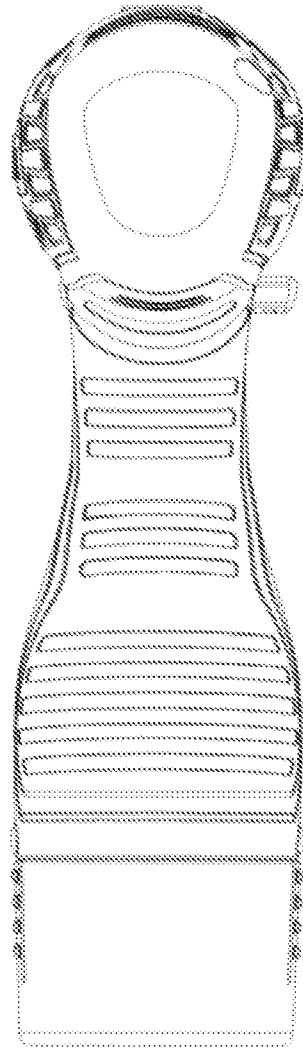
정면도



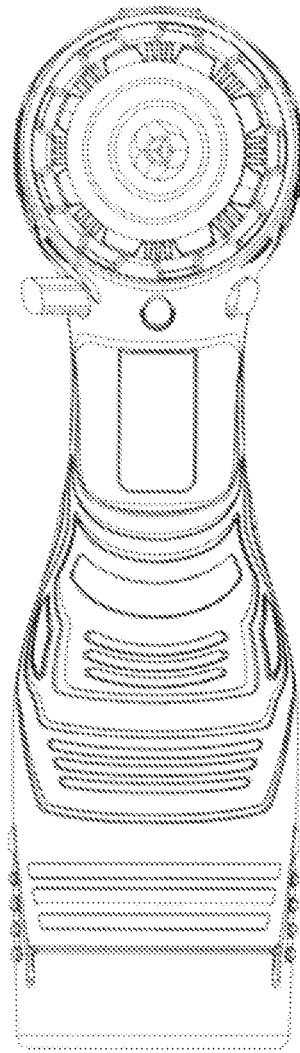
해면도



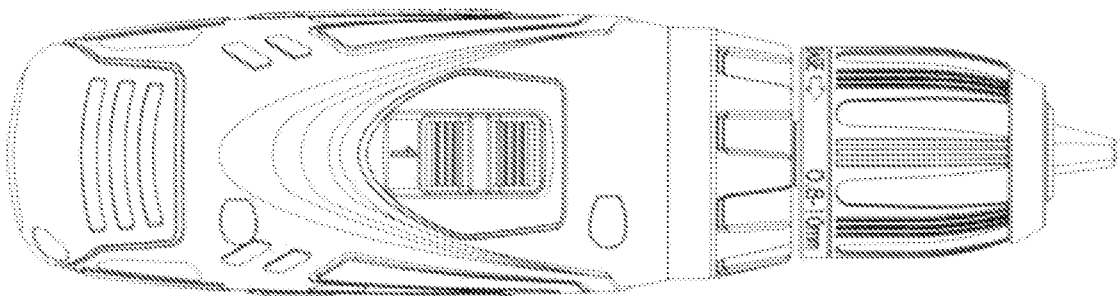
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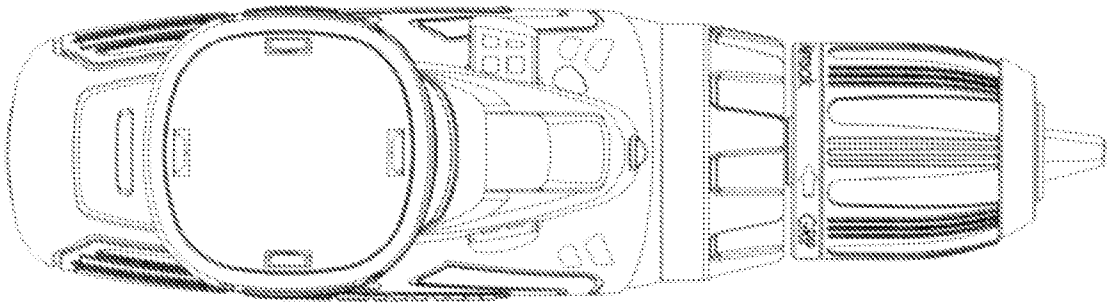
후측면도



정면도



서면도



JPH0992246A BATTERY HOUSING DEVICE

The EPO does not accept responsibility for the accuracy of data originating from authorities other than the EPO, nor does it guarantee that such data is complete, up-to-date or fit for specific purposes.

The wording below is an initial machine translation of the original publication. To apply more advanced translation technology, use Patent Translate.

[0001] The present invention relates to relates to a battery housing device for accommodating a battery for supplying power to the printed circuit board.

[0002] In general, a timer setting data, measurement data, in electronic circuits meter reading data and the like are stored in the volatile memory, the battery has been used as a backup power supply, the battery is in such an electronic circuit it is necessary to carry out the battery replacement to a new battery with exhaustion.

[0003] Then, since it is necessary to exchange the battery without erasing stored data stored in the volatile memory in this case, without interruption of the current supplied to the electronic circuit, stably continue to the electronic circuit while supplying a current, it is necessary to exchange the new battery and a used battery. Conventionally, as such a battery replacement method, for example, there is known a method as shown in FIG.

[0004] In this way, on the printed circuit board 11, the power from the battery in order to supply to the electronic circuit, power supply male connector 13, 15 to electrically act on the same are arranged in two places. And, the exchange to the new battery 19 of the used battery 17 is carried out as described below.

[0005] First, connect the female connector 23 of the new battery 19 to the power supply for the male connector 15 with the female connector 21 is not connected of used batteries 17, the female connector 21 of the used battery 17 is a power supply on the printed circuit board 11 It is pulled out from the male connector 13. Next, the printed circuit board 11 used battery 17 is fixed to is removed by bundling band 25, the replacement of the new new battery 19 connected are re-fixed with bundling band 25 on the printed circuit board 11 again the battery It takes place.

[0006] The present invention is, however, in such a conventional battery exchange method, it is necessary to attach and detach the connector in order street, battery replacement work is complicated, the wrong procedure, to erase the memory data because fear is, there is a problem that can not be a battery replacement operation easily. Further, it takes time to attachment and detachment of a battery for holding the battery in the bundling band, much time is disadvantageously needed for replacement work.

[0007] The present invention has been made to solve such conventional problems, and an object thereof is to provide a battery housing device which can perform battery replacement easily, reliably.

[0008] SUMMARY OF THE INVENTION The battery housing device of claim 1, said holder battery discharge port is formed on one surface of the rectangular tube-shaped holder the battery is housed, the battery discharge port of the holder a lid member which is

detachably arranged on the opposite side to cover the battery, and a holder electrode having a substrate mounting terminals connected to the printed board disposed on opposite sides of the holder, the lid-side electrodes arranged on both sides of the lid member When subjected lid side coupling terminal or lid side coupling terminal is formed on the lid side electrode, and, receiving the holder-side coupling terminal receiving or the lid-side coupling terminal is formed in the holder electrode and the lid-side coupling terminal is connected There and having a holder-side coupling terminal to be connected.

[0009] Battery housing device according to claim 2, characterized by comprising providing a battery holding member for opening said battery outlet when replacing the battery in said holder to said battery outlet of the holder.

[0010] [Action] In the battery housing device of claim 1, the exchange of used batteries, first the fitted lid member to the holder is done by withdrawing from the holder, used batteries in this state is held in the holder .

[0011] Then, in this state, current is supplied to the printed circuit board side from the substrate mounting pin. Next, a new battery is mounted to the lid member, the lid member is inserted into the holder. Then, receiving the coupling terminal or coupling terminal formed on both sides of the lid-side electrode of the lid member is connected to the coupling terminal receiving or coupling terminal formed on both sides of the holder electrodes of the holder.

[0012] Then, in this state, the current from the new battery from the board mounting terminal on the printed circuit board side starts to be supplied. In conjunction with the insertion into the holder of the lid member, used batteries is gradually pushed into the battery discharge port formed on one surface of the holder with a new battery.

[0013] And, the last in the lid member is fully inserted into the holder, is completely discharged from the battery discharge port by the new battery is used batteries, is wearing a new battery in the holder, it is fitted lid member and the holder at the same time , replacement of the battery is completed. In the battery housing device of claim 2, in normal cells by cell holding member formed in the battery discharge port side of the holder is held in the holder.

[0014] On the other hand, the battery holding member is opened at the time of battery exchange, used batteries are discharged.

[0015] [Embodiment of the invention will be described below embodiment showing the details of the present invention with reference to the accompanying drawings. Figure 1 shows one embodiment of a battery housing device of the present invention, the battery housing device is mounted on a printed circuit board.

[0016] Reference numeral 31 illustrates, for example a rectangular tubular holder made of ABS resin in FIG. On both sides of the holder 31, the holder electrode 33 made of a conductive material such as copper are placed opposite. Holder electrode 33 is firmly fixed to the holder 31, for example by an adhesive.

[0017] Between the holder electrode 33, the battery 35 is capable of holding. Reference numeral 37 in the figure indicates a box-shaped lid member having an opening for instance the holder 31 side made of ABS resin. On both sides of the lid member 37, lid side electrode 39 made of a conductive material such as copper are placed opposite.

[0018] The lid-side electrode 39 is firmly fixed by the lid member 37, for example, an adhesive. Battery 35 is capable of holding between the lid-side electrode 39. Figure 2 shows the holder electrode 33 and the lid-side electrode 39, the lower end of the square-shaped holder electrode 33, substrate mounting terminal 33a to be connected soldered to the printed circuit board to be described later are integrally formed.

[0019] The bottom of the holder electrodes 33, groove-like holder-side coupling terminal receives 33b are formed. The central portion of the holder electrode 33 holder side contact 33c contacting the electrode of the battery 35 is formed. The lid-side electrode 39 has a square shape, the lid-side coupling terminal 39b that protrudes on the holder electrode 33 side in the lower portion are integrally formed.

[0020] At the center of the holder electrode 33 side of the lid side electrode 39, semicircular convex lid side contact 39c is formed. In this embodiment, on one side of the holder 31 is formed with a battery outlet 41. This up and down of the battery outlet 41, the plate-shaped battery holding member 43 is formed integrally freely open and close the hinge 45 as a fulcrum.

[0021] The battery outlet 41 of the holder 31, locking projections 47 are formed, the locking projections 47 is engaged with the hole portion 49 formed in the cell holding member 43. In the above-described battery housing device is exchanged to a new cell of the used batteries is performed as described below. First, it is performed by pulling out the lid member 37 is fitted into the holder 31, as shown in FIG. 3 (a) from the holder 31, a substrate mounting terminals 33a used battery 35A is held by a holder 31 in this state current is supplied to the printed circuit board 53 side from.

[0022] Next, a new battery 35B is mounted to the lid member 37 as shown in FIG. 3 (b), the lid member 37 is inserted into the holder 31. Then, the lid-side coupling terminal 39b formed on both sides of the lid side electrode 39 of the lid member 37 as shown in FIG. 3 (c), the holder-side coupling terminal receives 33b formed on both sides of the holder electrodes 33 of the holder 31 It is connected to.

[0023] In this state, a current from the new cell 35B mounted on the cover member 37 to the printed circuit board 53 starts to be supplied. In conjunction with the insertion into the holder 31 of the lid member 37, the new battery 35B, used batteries 35A is gradually pushed into the battery discharge port 41 formed on one surface of the holder 31.

[0024] The force which the used batteries 35A is pushed, the engagement of the battery holding member 43 and the holder 31 is released, the battery holding member 43 is opened. Finally, as shown in FIG. 3 (d), when the lid member 37 is fully inserted into the holder 31, is completely discharged from the battery discharge port 41 used batteries 35A is the new battery 35B, the holder 31 the new battery 35B is mounted, fitted lid member 37 and the holder 31 is at the same time, replacement of the battery is completed.

[0025] In an assembled battery housing device as described above, the lid-side coupling terminal 39b provided on the lid side electrode 39, Further, since the holder-side coupling terminal receives 33b provided on the holder electrode 33, is housed in the battery housing device the used batteries 35A, without instantaneous interruption of the current supplied to the electronic circuit formed on the printed circuit board 53, it is possible to replace new

batteries 35B while supplying a current stably continue the electronic circuit, battery replacement work easily, can be reliably performed.

[0026] Further, it is possible to replace the used battery 35A only the battery housing device to the new cell 35B, without using a connector or the like extra parts, it is possible to permit high-density mounting. In addition, since there is provided a board mounting terminal 33a to the holder electrode 33, is the device easily can be fixed on the printed circuit board 53, and, the apparatus fixed this device on the board mounting terminal 33a and the printed circuit board 53 at the same time enables conduction between the pattern, the mounting man-hours can than conventional reduced significantly.

[0027] Incidentally, in the embodiment described above, the holder-side coupling terminal receives 33b provided on the holder electrode 33, an example is described in which a lid-side coupling terminal 39b to the lid-side electrode 39, the present invention is limited to the embodiment of not, the holder-side coupling terminal provided on the holder electrode may be a battery housing device having a cover-side coupling terminal received in the lid-side electrode. Further, in the above embodiment, although the battery of cylindrical been described as an example, the present invention is not intended to be limited to the embodiments according, battery housing device for accommodating a battery such as button shape or a disc-shaped or rectangular But good.

[0028] As described above, according to the present invention, in the battery housing device of claim 1, the installed coupling terminal or coupling terminal received to cover electrode, further, it is provided with the coupling terminal received or coupling terminal to the holder electrode, a battery housing the used batteries housed in the device, without instantaneous interruption of the current supplied to the electronic circuit, it is possible to replace new batteries while supplying a current stably continue the electronic circuitry, battery replacement work the ease, can be reliably performed.

[0029] In the battery housing device of claim 2, is provided with the battery holding member to the battery discharge side of the holder during normal can reliably hold the battery housed in the holder.

[0030] Brief description of the drawings

[0031] Is a perspective view showing an embodiment of a battery housing device of FIG 1 the present invention.

[0032] It is a front view showing the holder electrode and the lid-side electrode of the device of FIG 2 FIG.

[0033] It is a side view showing the operation of the apparatus of Figure 3. Figure 1.

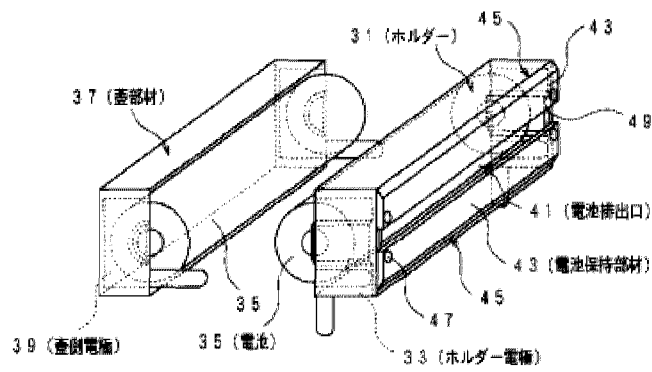
[0034] Figure 4 is an explanatory view showing a conventional battery replacement method.

[0035] Description of the code

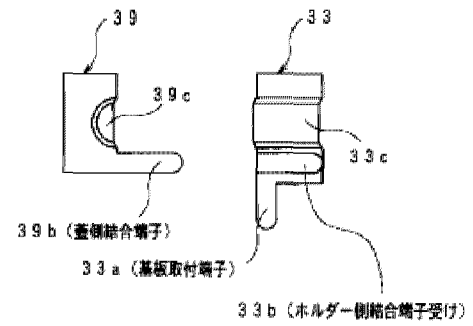
[0036] 31 holder 33 holder electrode 33a board mounting terminal 33b holder side coupling terminal received 35 battery 37 cover member 39 cover-side electrode 39b lid side coupling terminal 41 battery discharge port 43 the cell holding member 53 printed circuit board

Drawings

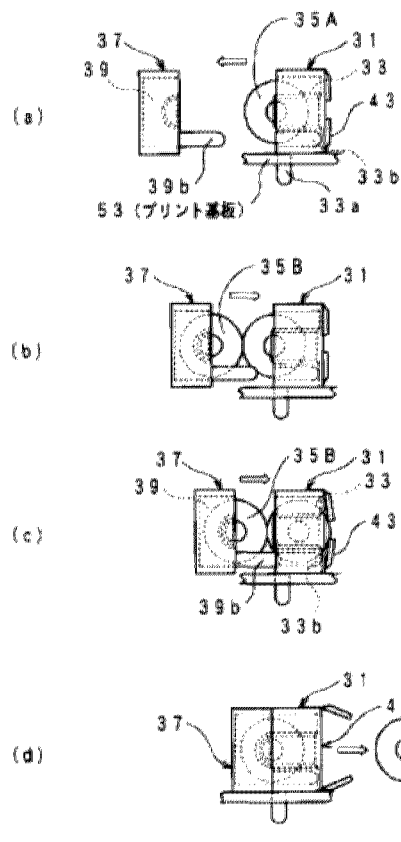
【図1】



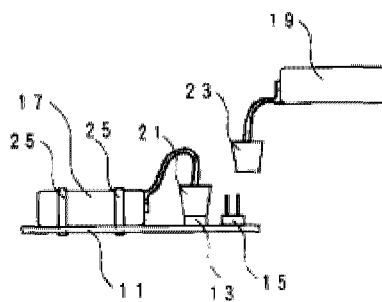
【図2】



【図3】



【図4】



(19)日本国特許庁 (J P)

(12) 公開特許公報 (A)

(11)特許出願公開番号

特開平9-92246

(43)公開日 平成9年(1997)4月4日

(51)Int.Cl.⁶

H 0 1 M 2/10

識別記号

庁内整理番号

F I

H 0 1 M 2/10

技術表示箇所

W

B

H

審査請求 未請求 請求項の数2 O L (全 5 頁)

(21)出願番号

特願平7-242833

(22)出願日

平成7年(1995)9月21日

(71)出願人 000237662

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富士通電装株式会社内

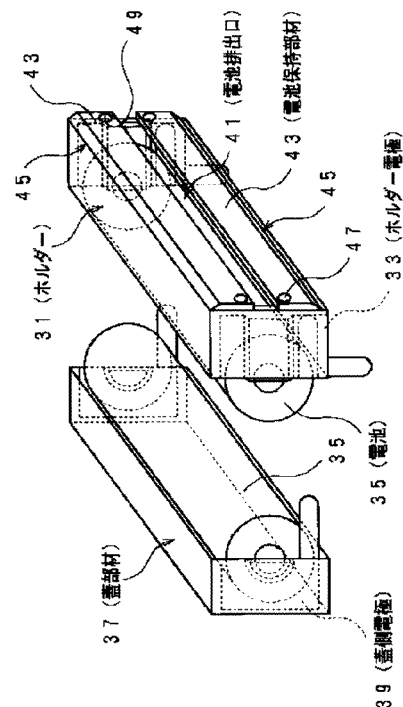
(74)代理人 弁理士 古谷 史旺 (外1名)

(54)【発明の名称】 電池収納装置

(57)【要約】

【課題】 本発明は、プリント基板に電源を供給する電池を収納するための電池収納装置に関し、電池交換を容易、確実に行うことができることを目的とする。

【解決手段】 電池が収納される矩形筒状のホルダーの一面に電池排出口が形成された前記ホルダーと、前記ホルダーの前記電池排出口の反対側に脱着自在に配置され前記電池を覆う蓋部材と、前記ホルダーの両側に配置されプリント基板に接続される基板取付端子を有するホルダー電極と、前記蓋部材の両側に配置される蓋側電極と、前記蓋側電極に形成される蓋側結合端子または蓋側結合端子受け、および、前記ホルダー電極に形成され前記蓋側結合端子が接続されるホルダー側結合端子受けまたは前記蓋側結合端子受けが接続されるホルダー側結合端子とから構成する。



MassagerPriorArt0000497

【特許請求の範囲】

【請求項1】 電池が収納され一面に電池排出口の形成される矩形筒状のホルダーと、
前記ホルダーの前記電池排出口の反対側に着脱自在に配置され前記電池を覆う箱状の蓋部材と、
前記ホルダーの両側に配置されプリント基板に接続される基板取付端子を有するホルダー電極と、
前記蓋部材の両側に配置される蓋側電極と、
前記蓋側電極に形成される蓋側結合端子または蓋側結合端子受けと、
前記ホルダー電極に形成され前記蓋側結合端子が接続されるホルダー側結合端子受けまたは前記蓋側結合端子受けが接続されるホルダー側結合端子と、
を有することを特徴とする電池収納装置。

【請求項2】 請求項1記載の電池収納装置において、
前記ホルダーの前記電池排出口に、前記ホルダー内の電池の交換時に前記電池排出口を開放する板状の電池保持部材を設けてなることを特徴とする電池収納装置。

【発明の詳細な説明】

【0001】

【発明の属する技術分野】本発明は、プリント基板に電源を供給する電池を収納するための電池収納装置に関する。

【0002】

【従来の技術】一般に、タイマー設定データ、測定データ、検針データ等が揮発性メモリに記憶されている電子回路においては、電池がバックアップ用電源として使用されており、このような電子回路では電池の消耗とともに新しい電池への電池交換を行う必要がある。

【0003】そして、この際に揮発性メモリに記憶されている記憶データを消去することなく電池の交換を行う必要があるため、電子回路への供給電流を瞬断させることなく、電子回路に安定継続して電流を供給しながら、使用済み電池と新しい電池の交換を行う必要がある。従来、このような電池交換方法として、例えば、図4に示すような方法が知られている。

【0004】この方法では、プリント基板11上に、電池からの電源を電子回路へ供給するために、電気的に同一に作用するように電源供給用雄コネクタ13、15が2箇所に配置されている。そして、使用済み電池17の新しい電池19への交換は以下述べるように行われる。

【0005】まず、使用済み電池17の雌コネクタ21が接続されていない電源供給用雄コネクタ15に新しい電池19の雌コネクタ23を接続し、使用済み電池17の雌コネクタ21がプリント基板11上の電源供給用雄コネクタ13から抜脱される。次に、結束帯25でプリント基板11に固定されていた使用済み電池17が取り外され、新たに接続した新しい電池19が再度プリント基板11に結束帯25を用いて固定し直され電池の交換が行われる。

【0006】

【発明が解決しようとする課題】しかしながら、このような従来の電池交換方法では、コネクタを順番通りに着脱する必要があり、電池交換作業が煩雑になり、手順を誤って、記憶データを消去させるおそれがあるため、電池交換作業を容易にできないという問題があった。また、電池を結束帯で固定しているため電池の着脱に時間がかかり、交換作業に多大な時間が必要になるという問題があった。

【0007】本発明は、かかる従来の問題を解決するためになされたもので、電池交換を容易、確実に行うことができる電池収納装置を提供することを目的とする。

【0008】

【課題を解決するための手段】請求項1の電池収納装置は、電池が収納される矩形筒状のホルダーの一面に電池排出口が形成された前記ホルダーと、前記ホルダーの前記電池排出口の反対側に着脱自在に配置され前記電池を覆う蓋部材と、前記ホルダーの両側に配置されプリント基板に接続される基板取付端子を有するホルダー電極と、前記蓋部材の両側に配置される蓋側電極と、前記蓋側電極に形成される蓋側結合端子または蓋側結合端子受け、および、前記ホルダー電極に形成され前記蓋側結合端子が接続されるホルダー側結合端子受けまたは前記蓋側結合端子受けが接続されるホルダー側結合端子とを有することを特徴とする。

【0009】請求項2の電池収納装置は、前記ホルダーの前記電池排出口に前記ホルダー内の電池の交換時に前記電池排出口を開放する電池保持部材を設けてなることを特徴とする。

【0010】

【作用】請求項1の電池収納装置では、使用済み電池の交換は、まずホルダーに嵌合された蓋部材をホルダーから引き抜くことにより行われ、この状態では使用済み電池はホルダーに保持されている。

【0011】そして、この状態では、基板取付端子からプリント基板側に電流が供給されている。次に、蓋部材に新しい電池が装着され、蓋部材がホルダーに挿入される。すると、蓋部材の両側の蓋側電極に形成された結合端子または結合端子受けが、ホルダーの両側のホルダー電極に形成された結合端子受けまたは結合端子に接続される。

【0012】そして、この状態では、基板取付端子からプリント基板側に新しい電池からの電流が供給され始める。この蓋部材のホルダーへの挿入に連動して、新しい電池により使用済み電池がホルダーの一面に形成された電池排出口に押し出されていく。

【0013】そして、最後に蓋部材がホルダーに完全に挿入されると、使用済み電池が新しい電池により電池排出口から完全に排出され、ホルダー内に新しい電池が装着され、同時に蓋部材とホルダーが嵌合され、電池の交

換が終了する。請求項2の電池収納装置では、通常時にはホルダーの電池排出口側に形成される電池保持部材により電池がホルダー内に保持される。

【0014】一方、電池交換時には電池保持部材が開かれ、使用済み電池が排出される。

【0015】

【発明の実施の形態】以下、本発明の詳細を図面に示す実施形態について説明する。図1は本発明の電池収納装置の一実施形態を示しており、この電池収納装置はプリント基板に実装される。

【0016】図において符号31は、例えばABS樹脂からなる矩形筒状のホルダーを示している。このホルダー31の両側には、銅等の導電材からなるホルダー電極33が対向して配置されている。ホルダー電極33は、ホルダー31に、例えば接着剤により強固に固定されている。

【0017】このホルダー電極33の間には、電池35が保持可能とされている。図において符号37は、例えばABS樹脂からなるホルダー31側に開口部を有する箱状の蓋部材を示している。蓋部材37の両側には、銅等の導電材でできた蓋側電極39が対向して配置されている。

【0018】蓋側電極39は、蓋部材37に、例えば接着剤により強固に固定されている。この蓋側電極39の間には電池35が保持可能とされている。図2は、ホルダー電極33と蓋側電極39とを示すもので、四角形状のホルダー電極33の下端には、後述するプリント基板に半田付け接続される基板取付端子33aが一体形成されている。

【0019】ホルダー電極33の下部には、凹溝状のホルダー側結合端子受け33bが形成されている。ホルダー電極33の中央部には電池35の電極と接触するホルダー側接点33cが形成されている。蓋側電極39は、四角形状をしており、下部にはホルダー電極33側に突出する蓋側結合端子39bが一体形成されている。

【0020】蓋側電極39の中央のホルダー電極33側には、半円凸状の蓋側接点39cが形成されている。この実施形態では、ホルダー31の一侧には電池排出口41が形成されている。この電池排出口41の上下には、板状の電池保持部材43がヒンジ部45を支点として開閉自在に一体形成されている。

【0021】ホルダー31の電池排出口41には、係止用凸部47が形成されており、この係止用凸部47が電池保持部材43に形成される穴部49に係合されている。上述した電池収納装置では、使用済み電池の新しい電池への交換は以下述べるように行われる。先ず、図3(a)に示すようにホルダー31に嵌合された蓋部材37をホルダー31から引き抜くことにより行われ、この状態では使用済み電池35Aはホルダー31に保持されており基板取付端子33aからプリント基板53側に電

流が供給されている。

【0022】次に、図3(b)に示すように蓋部材37に新しい電池35Bが装着され、蓋部材37がホルダー31に挿入される。すると、図3(c)に示すように蓋部材37の両側の蓋側電極39に形成された蓋側結合端子39bが、ホルダー31の両側のホルダー電極33に形成されたホルダー側結合端子受け33bに接続される。

【0023】この状態で、蓋部材37に装着された新しい電池35Bからプリント基板53に電流が供給され始める。この蓋部材37のホルダー31への挿入に連動して、新しい電池35Bにより、使用済み電池35Aがホルダー31の一面に形成された電池排出口41に押し出されていく。

【0024】この使用済み電池35Aが押し出される力により、電池保持部材43とホルダー31の係合が解かれ、電池保持部材43が開かれる。そして、最後に図3(d)に示すように、蓋部材37がホルダー31に完全に挿入されると、使用済み電池35Aが新しい電池35Bにより電池排出口41から完全に排出され、ホルダー31内に新しい電池35Bが装着され、同時に蓋部材37とホルダー31が嵌合され、電池の交換が終了する。

【0025】以上のように構成された電池収納装置では、蓋側電極39に蓋側結合端子39bを設け、さらに、ホルダー電極33にホルダー側結合端子受け33bを設けたので、電池収納装置に収納されている使用済み電池35Aを、プリント基板53に形成される電子回路への供給電流を瞬断することなく、電子回路に安定継続して電流を供給しながら新しい電池35Bに交換することが可能になり、電池交換作業を容易、確実に行うことができる。

【0026】また、この電池収納装置のみで使用済み電池35Aを新しい電池35Bに交換することができるため、コネクタ等余分な部品を使用することなく、高密度実装を可能にすることができる。さらに、ホルダー電極33に基板取付端子33aを設けたので、プリント基板53上に本装置を容易に固定可能であり、かつ、本装置固定と同時に本装置の基板取付端子33aとプリント基板53上のパターンとの導通が可能となり、実装工数を従来よりも大幅に低減することができる。

【0027】なお、上述した実施形態では、ホルダー電極33にホルダー側結合端子受け33bを設け、蓋側電極39に蓋側結合端子39bを設けた例について説明したが、本発明に係る実施形態に限定されるものではなく、ホルダー電極にホルダー側結合端子を設け、蓋側電極に蓋側結合端子受けを設けた電池収納装置でも良い。また、上述した実施形態では、円柱形の電池を例にして説明したが、本発明に係る実施形態に限定されるものではなく、鉤形や円盤形または直方体等の電池を収納する電池収納装置でも良い。

【0028】

【発明の効果】以上述べたように、請求項1の電池収納装置では、蓋電極に結合端子または結合端子受けを設け、さらに、ホルダー電極に結合端子受けまたは結合端子を設けたので、電池収納装置に収納されている使用済み電池を、電子回路への供給電流を瞬断することなく、電子回路に安定継続して電流を供給しながら新しい電池に交換することが可能になり、電池交換作業を容易、確実に行うことができる。

【0029】請求項2の電池収納装置では、ホルダーの電池排出側に電池保持部材を設けたので、通常時にはホルダー内に収納されている電池を確実に保持することができる。

【図面の簡単な説明】

【図1】本発明の電池収納装置の一実施形態を示す斜視図である。

【図2】図1の装置のホルダー電極と蓋側電極を示す正面図である。

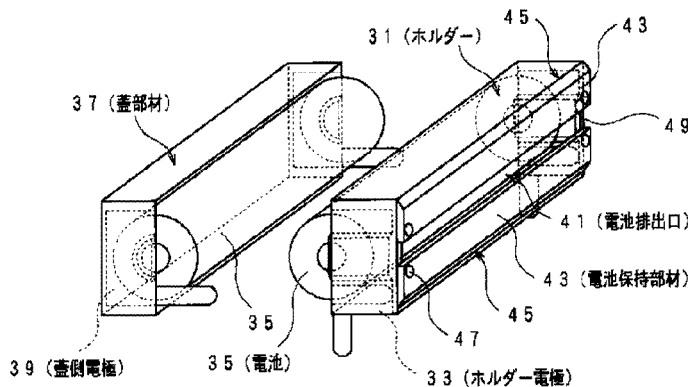
【図3】図1の装置の作用を示す側面図である。

【図4】従来の電池交換方法を示す説明図である。

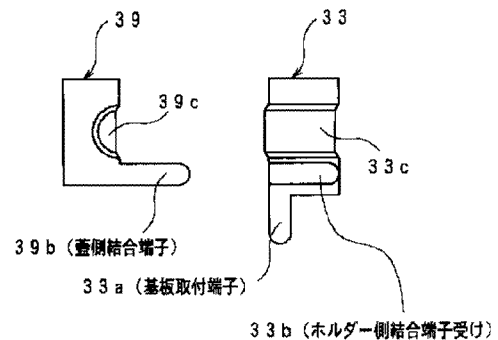
【符号の説明】

- 31 ホルダー
- 33 ホルダー電極
- 33a 基板取付端子
- 33b ホルダー側結合端子受け
- 35 電池
- 37 蓋部材
- 39 蓋側電極
- 39b 蓋側結合端子
- 41 電池排出口
- 43 電池保持部材
- 53 プリント基板

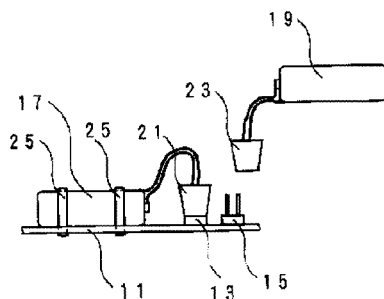
【図1】



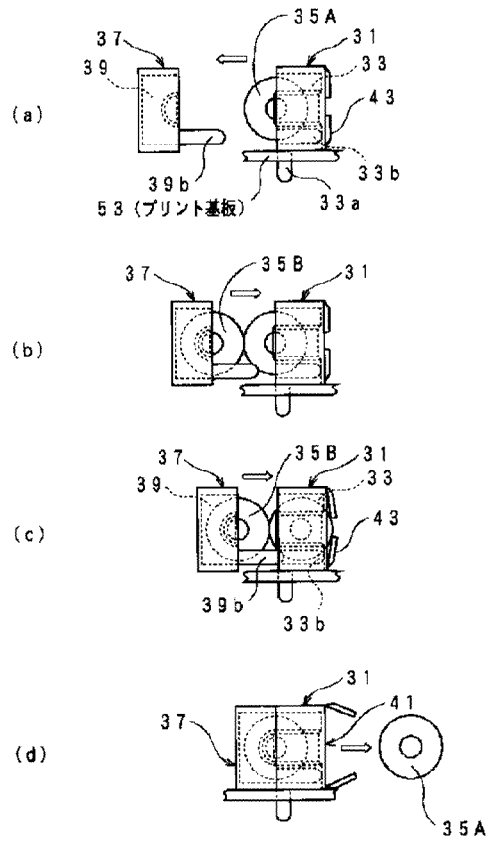
【図2】



【図4】



【図3】



Body building massager

Abstract

The utility model discloses a body building massager used for simultaneously conducting pushing, kneading and massaging. The body building massager comprises a handheld electric part and massaging heads, wherein the two massaging heads are connected with the handheld electric part and arranged at intervals, the heads of the massaging heads are of a round shape or a cone shape. The massaging heads can be connected with the handheld electric part through a first connecting piece and a second connecting piece, and connecting sleeves are arranged among internal constituent parts of the first connecting piece and between the first connecting piece and the second connecting piece. The body care massager can simultaneously conduct pushing, kneading and massaging on the nose, the underjaw, fingers and other parts, the massaging effect is remarkable, by the adoption of the connecting structure of the connecting sleeves, a user can not be scratched in the process of use, pains can be avoided, and the defects of unattractive appearance and the like can be overcome.

Description

A kind of body shaping masseur

Technical field

This utility model relates to aesthetic health care massage field, particularly, relates to a kind of body shaping masseur.

Background technology

With advancing age and the reason such as ultraviolet, various pressure easily cause human body skin catabiosis to occur. Have faint electric current in the human body, normal current flowing can make face keep normal blood circulation and lymph circulation, thereby makes facial metabolism vigorous, and skin is full of elasticity and vigor. But on the market at present known thin face electric massager be mainly the thin face masseur of 7 fonts or T font massage head, it can only satisfy one-side promotion massage, can not promote simultaneously positions such as nose, lower jaw, fingers, kneading massage.

The utility model content

The purpose of this utility model is to provide a kind of body shaping masseur, can be simultaneously to the positions such as nose, lower jaw, finger promote simultaneously, kneading massage.

To achieve these goals, this utility model adopts following technical scheme:

A kind of body shaping masseur is used for promoting simultaneously, kneading massage, comprises hand electric parts and the massage head that is connected with the hand electric parts, and described massage head is that two intervals arrange, head is circle or conical massage head.

Further, described massage head comprises that a head is circular or conical massage headgear, and the endoporus of massage headgear is built-in with a sleeve, and the endoporus top of sleeve and massage headgear forms a draw-in groove, massage head also comprises a massage head body, and an end inlay card of massage head body is also rotatable in draw-in groove.

Further, described massage head is connected with the hand electric parts by the first connector; The first connector is A shape, H shape, N shape, X-shaped or π shape, and massage head is connected on two lower extreme points of the first connector; Or first connector be Y shape, and massage head is connected on two upper extreme points of the first connector.

Further, also be provided with the bradyseism circle between two of described the first connector end points and the massage head.

Further, described the first connector is connected the second connector and hand electric element coaxial and vertical with the plane at the first connector place by the second connector with the hand electric parts.

Further, be provided with adapter sleeve between described the first connector and the second connector.

Further, described the first connector is Y shape, comprises V or U-shaped parts and in-line parts, is provided with adapter sleeve between in-line parts and V or the U-shaped parts.

Further, described in-line parts are threaded with V or U-shaped parts, and the first connector is threaded with the second connector.

Further, described hand electric parts comprise cell tube, the cell tube upper end is equipped with motor cover, motor is equipped with in cell tube inside, the motor upper end is equipped with eccentric and is inserted in the motor cover, be welded with motor spring on the negative terminal of motor lower end, the motor spring outer ring sleeve has the bradyseism pad, and motor spring is higher than the bradyseism pad; In described cell tube, the lower end of motor spring is equipped with battery, and the battery lower end is equipped with the switch fuse, and switch fuse inward turning enters to have switch, and the cell tube lower end also is equipped with bonnet, and the switch fuse inserts bonnet by straight pin, and bonnet is inserted in the lower end of switch.

Further, between described motor cover and the cell tube, be provided with the cell tube sealing ring between switch fuse and the cell tube, and between described bonnet and switch fuse, be provided with the bonnet sealing ring.

Compared with prior art, the utility model has following beneficial effect:

That the massage head that 1, will be connected with the hand electric parts is designed to is that two intervals arrange, head is circular or conical massage head, can promote simultaneously positions such as nose, lower jaw, fingers, kneading massage.

2, be connected by first, second connector between massage head and the hand electric parts, the second connector and hand electric element coaxial and vertical with the plane at the first connector place, by above-mentioned good angle design, can guarantee to promote the remarkably productive of massage and kneading massage.

3, be provided with adapter sleeve between the first connector and the second connector, when the first connector is Y shape, be provided with adapter sleeve between its building block, syndeton by adapter sleeve, the user in use can scratch skin, not only can avoid the pain of injury can avoid causing the defectives such as outward appearance is not attractive in appearance yet.

Below by drawings and Examples, the technical solution of the utility model is described in further detail.

Description of drawings

Fig. 1 is body shaping masseur perspective view of the present utility model;

Fig. 2 is the sectional structure schematic diagram of massage head and the first connector;

Fig. 3 is the sectional structure schematic diagram (part is cutd open) of body shaping masseur of the present utility model;

Fig. 4 is the comparison structure schematic diagram of the body shaping masseur of variform.

The specific embodiment

Below in conjunction with accompanying drawing preferred embodiment of the present utility model is described, should be appreciated that preferred embodiment described herein only is used for description and interpretation this utility model, and be not used in restriction this utility model.

As shown in Figure 1, a kind of body shaping masseur of the present utility model comprises hand electric parts 1 and the massage head 2 that is connected with hand electric parts 1, and massage head 2 is that two intervals arrange, head is circle or conical massage head. By said structure design, can promote simultaneously positions such as nose, lower jaw, fingers, kneading massage.

Cooperate shown in Figure 2, massage head 2 comprises that a head is circular or conical massage headgear 21, the endoporus of massage headgear 21 is built-in with a sleeve 22, sleeve 22 forms a draw-in groove with the endoporus top of massage headgear 21, massage head 2 also comprises a massage head body 23, and an end inlay card of massage head body 23 is also rotatable in draw-in groove.

Above-mentioned massage head 2 can be connected with hand electric parts 1 by the first connector 3. followingly is elaborated take the first connector as Y shape as example. Massage

head body 23 is connected on two upper extreme points of the first connector 3, and also is provided with bradyseism circle 4 between the two.

The first connector comprises V or U-shaped parts 31 and in-line parts 32, and both are threaded and also are provided with adapter sleeve 7 between the two.

Cooperate shown in Figure 3ly, the first connector 3 also can be connected with hand electric parts 1 by the second connector 5, and the second connector 5 is coaxial and vertical with the plane at the first connector 3 places with hand electric parts 1, and this kind structural design angle is reasonable, and is easy to use.

The first connector 3 is threaded with the second connector 5, and also is provided with adapter sleeve 6 between the two.

Hand electric parts 1 comprise cell tube 101, cell tube 101 upper ends are equipped with motor cover 102, be provided with cell tube sealing ring 103 between motor cover 102 and the cell tube 101, motor 104 is equipped with in cell tube 101 inside, motor 104 upper ends are equipped with eccentric 105 and are inserted in the motor cover 102, be welded with motor spring 106 on the negative terminal of motor 104 lower ends, motor spring 106 outer ring sleeves have bradyseism pad 107, and motor spring 106 is higher than bradyseism pad 107; In cell tube 101, the lower end of motor spring 106 is equipped with battery 108, battery 108 lower ends are equipped with switch fuse 109, switch fuse 109 interior screw-ins have switch 110, be provided with cell tube sealing ring 111 between switch fuse 109 and the cell tube 101, cell tube 101 lower ends also are equipped with bonnet 112, and switch fuse 109 inserts bonnet 112 by straight pin 113, be provided with bonnet sealing ring 114 between bonnet 112 and the switch fuse 109, bonnet 112 is inserted in the lower end of switch 110.

Each assembly of above-mentioned body shaping masseur can be installed according to the following procedure:

First sleeve 22 is pressed in the endoporus of massage headgear 21, and be pressed onto assigned address, then massage head body 23 1 ends are packed in the draw-in groove that massage headgear 21 and sleeve 22 form, and nature is rotated in assurance, again bradyseism circle 4 is inserted in massage head body 23 other ends, and this end of massage head body 23 is respectively charged in the hole of the first connector 3 correspondences.

The in-line parts 32 of the first connector 3 are fixed in the screwed hole of V or U-shaped parts 31 with after adapter sleeve 7 links to each other.

The second connector 5 is also with after adapter sleeve 6 is connected, and is fixed in the screwed hole of in-line parts 32 of the first connector 3.

Cell tube sealing ring 103 is inserted in the seal groove of motor cover 102, is threaded fixing with the second connector 5 usefulness motor cover 102 again.

Motor spring 106 is welded on the negative terminal of motor 104, and crosses motor spring 106 with the spring borehole jack of bradyseism pad 107, make motor spring 106 be higher than bradyseism pad 107, convenient energising.

Motor 104 after the assembling is equipped with eccentric 105 these ends to be inserted in the motor hole of motor cover 102.

Straight pin 113 is packed in the pin-and-hole of bonnet 112, be used for follow-up location.

Switch 110 is screwed in the screwed hole of switch fuse 109, and slightly be lower than switch fuse 109 end faces, then bonnet sealing ring 114, cell tube sealing ring 111 are respectively charged in the seal groove of switch fuse 109 correspondences.

The square column that switch fuse 109 is connected with bonnet 112 inserts in the cross recess of bonnet 112, and is seated.

With battery 108(5 battery) in the cell tube 101 of packing into, the negative pole of battery 108 communicates with motor spring 106, and tightens cell tube 101 with rear case component.

If the end face of switch 110 is lower than switch fuse 109, then battery 108 energising that is connected with switch fuse 109 then, motor 104 work; If the end face of switch 110 is higher than switch fuse 109, then outage, motor 104 quits work.

Above-mentioned only describe take the first connector as Y shape as example, the first connector can also adopt multiple other forms except Y shape, can be A shape, H shape, N shape, X-shaped or π shape, at this moment massage head is connected on two lower extreme points of the first connector (please cooperate consult shown in Figure 4).

It should be noted that at last: the above only is preferred embodiment of the present utility model, be not limited to this utility model, although with reference to previous embodiment this utility model is had been described in detail, for a person skilled in the art, it still can be made amendment to the technical scheme that previous embodiment is put down in writing, and perhaps part technical characterictic wherein is equal to replacement. All within spirit of the present utility model and principle, any modification of doing, be equal to replacement, improvement etc., all should be included within the protection domain of the present utility model

Drawings

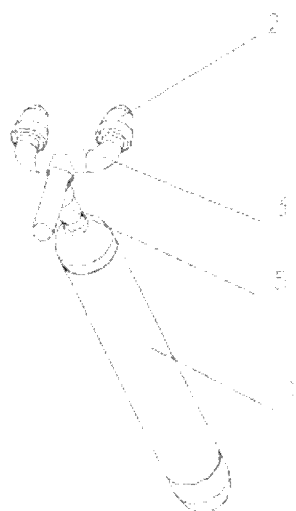


图 1

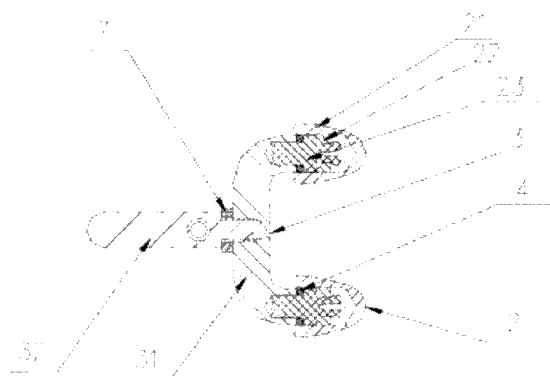


图 2

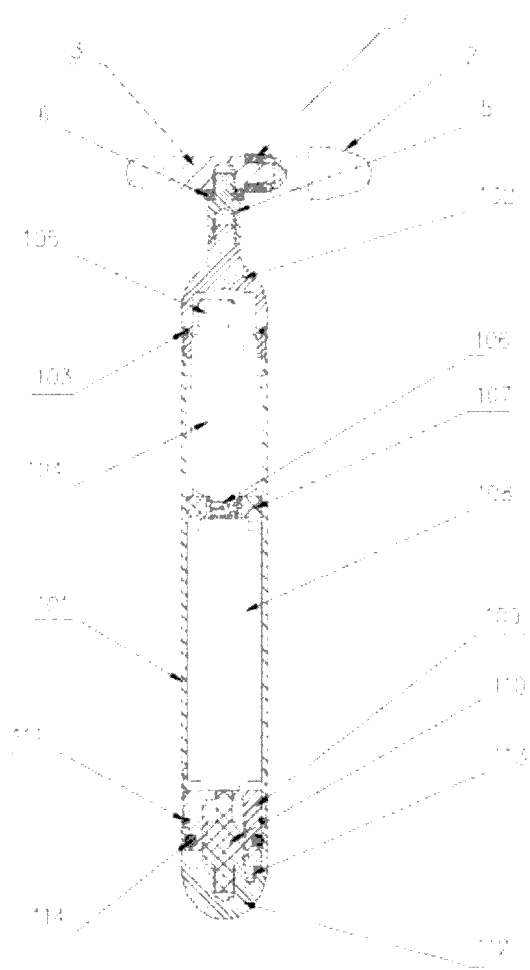


图 3

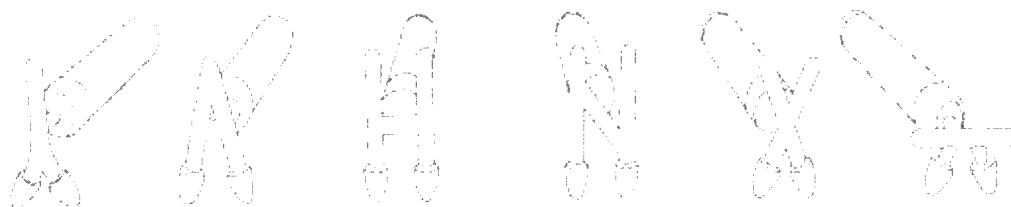
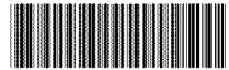


图 4



(12) 实用新型专利

(10) 授权公告号 CN 203195947 U

(45) 授权公告日 2013.09.18

(21) 申请号 201320197852.5

(22) 申请日 2013.04.18

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(51) Int. Cl.

A61H 23/02 (2006.01)

A61H 15/00 (2006.01)

权利要求书1页 说明书3页 附图2页

(54) 实用新型名称

一种美体按摩器

(57) 摘要

本实用新型公开了一种美体按摩器,用于同时进行推动、揉捏按摩,包括手持电动部件及与手持电动部件连接的按摩头,所述按摩头为两个间隔设置的、头部为圆形或圆锥形的按摩头;按摩头可通过第一连接件、第二连接件与手持电动部件连接,第一连接件内部组成部件之间以及第一连接件与第二连接件之间设置有连接套。本实用新型的美体按摩器能够对鼻部、下颌、手指等部位同时进行推动、揉捏按摩,按摩效果突出,并且通过连接套的连接结构,用户在使用时不会刮伤皮肤,不仅可以避免伤痛也可以避免造成外观不美观等缺陷。



CN 203195947 U

MassagerPriorArt0000591

1. 一种美体按摩器,用于同时进行推动、揉捏按摩,其特征在于,包括手持电动部件及与手持电动部件连接的按摩头,所述按摩头为两个间隔设置的、头部为圆形或圆锥形的按摩头。
2. 根据权利要求1所述的美体按摩器,其特征在于,所述按摩头包括一头部为圆形或圆锥形的按摩头套,按摩头套的内孔内置有一套筒,套筒与按摩头套的内孔顶端形成一卡槽,按摩头还包括一按摩头本体,按摩头本体的一端卡嵌在卡槽内并可转动。
3. 根据权利要求1或2所述的美体按摩器,其特征在于,所述按摩头通过第一连接件与手持电动部件连接;第一连接件为 Λ 形、H形、N形、X形或 π 形,且按摩头连接在第一连接件的两个下端点上;或第一连接件为Y形,且按摩头连接在第一连接件的两个上端点上。
4. 根据权利要求3所述的美体按摩器,其特征在于,所述第一连接件的两个端点与按摩头之间还设置有缓震圈。
5. 根据权利要求3所述的美体按摩器,其特征在于,所述第一连接件通过第二连接件与手持电动部件连接,第二连接件与手持电动部件同轴并且与第一连接件所在的平面垂直。
6. 根据权利要求5所述的美体按摩器,其特征在于,所述第一连接件与第二连接件之间设置有连接套。
7. 根据权利要求6所述的美体按摩器,其特征在于,所述第一连接件为Y形,包括V或U形部件及一字形部件,一字形部件与V或U形部件之间设置有连接套。
8. 根据权利要求7所述的美体按摩器,其特征在于,所述一字形部件与V或U形部件螺纹连接,第一连接件与第二连接件螺纹连接。
9. 根据权利要求1所述的美体按摩器,其特征在于,所述手持电动部件包括电池管,电池管上端安装有电机盖,电池管内部装有电机,电机上端装有偏心轮并套入电机盖内,电机下端的负极端子上焊接有电机弹簧,电机弹簧外圈套有缓震垫,且电机弹簧高于缓震垫;在所述电池管内,电机弹簧的下端安装有电池,电池下端安装有开关芯子,开关芯子内旋入有开关,电池管下端还安装有后盖,开关芯子通过圆柱销插入后盖,开关的下端插入后盖。
10. 根据权利要求9所述的美体按摩器,其特征在于,在所述电机盖与电池管之间、开关芯子与电池管之间均设置有电池管密封圈,且在所述后盖与开关芯子之间设置有后盖密封圈。

一种美体按摩器

技术领域

[0001] 本实用新型涉及美容保健按摩领域，具体地，涉及一种美体按摩器。

背景技术

[0002] 随着年龄的增长以及紫外线、各种压力等原因容易导致人体皮肤出现老化现象。人体内存在微弱的电流，正常的电流流通可以使面部维持正常的血液循环和淋巴循环，从而使面部新陈代谢旺盛，皮肤充满弹性和活力。但市场上目前公知瘦脸电动按摩器主要为 7 字形或 T 字形按摩头的瘦脸按摩器，其只能满足单方面的推动按摩，也不能对鼻部、下颌、手指等部位同时进行推动、揉捏按摩。

实用新型内容

[0003] 本实用新型的目的在于提供一种美体按摩器，可同时对鼻部、下颌、手指等部位同时进行推动、揉捏按摩。

[0004] 为了实现上述目的，本实用新型采用如下技术方案：

[0005] 一种美体按摩器，用于同时进行推动、揉捏按摩，包括手持电动部件及与手持电动部件连接的按摩头，所述按摩头为两个间隔设置的、头部为圆形或圆锥形的按摩头。

[0006] 进一步地，所述按摩头包括一头部为圆形或圆锥形的按摩头套，按摩头套的内孔内置有一套筒，套筒与按摩头套的内孔顶端形成一卡槽，按摩头还包括一按摩头本体，按摩头本体的一端卡嵌在卡槽内并可转动。

[0007] 进一步地，所述按摩头通过第一连接件与手持电动部件连接；第一连接件为 A 形、H 形、N 形、X 形或 π 形，且按摩头连接在第一连接件的两个下端点上；或第一连接件为 Y 形，且按摩头连接在第一连接件的两个上端点上。

[0008] 进一步地，所述第一连接件的两个端点与按摩头之间还设置有缓震圈。

[0009] 进一步地，所述第一连接件通过第二连接件与手持电动部件连接，第二连接件与手持电动部件同轴并且与第一连接件所在的平面垂直。

[0010] 进一步地，所述第一连接件与第二连接件之间设置有连接套。

[0011] 进一步地，所述第一连接件为 Y 形，包括 V 或 U 形部件及一字形部件，一字形部件与 V 或 U 形部件之间设置有连接套。

[0012] 进一步地，所述一字形部件与 V 或 U 形部件螺纹连接，第一连接件与第二连接件螺纹连接。

[0013] 进一步地，所述手持电动部件包括电池管，电池管上端安装有电机盖，电池管内部装有电机，电机上端装有偏心轮并套入电机盖内，电机下端的负极端子上焊接有电机弹簧，电机弹簧外圈套有缓震垫，且电机弹簧高于缓震垫；在所述电池管内，电机弹簧的下端安装有电池，电池下端安装有开关芯子，开关芯子内旋入有开关，电池管下端还安装有后盖，开关芯子通过圆柱销插入后盖，开关的下端插入后盖。

[0014] 进一步地，在所述电机盖与电池管之间、开关芯子与电池管之间均设置有电池管

密封圈,且在所述后盖与开关芯子之间设置有后盖密封圈。

[0015] 与现有技术相比,本实用新型具有以下有益效果:

[0016] 1、将与手持电动部件连接的按摩头设计为两个间隔设置的、头部为圆形或圆锥形的按摩头,能够对鼻部、下颌、手指等部位同时进行推动、揉捏按摩。

[0017] 2、按摩头与手持电动部件之间通过第一、第二连接件连接,第二连接件与手持电动部件同轴并且与第一连接件所在的平面垂直,通过上述良好的角度设计,能保证推动按摩及揉捏按摩的效果突出。

[0018] 3、第一连接件与第二连接件之间设置有连接套,当第一连接件为Y形时,其组成部件之间设置有连接套,通过连接套的连接结构,用户在使用时不会刮伤皮肤,不仅可以避免伤痛也可以避免造成外观不美观等缺陷。

[0019] 下面通过附图和实施例,对本实用新型的技术方案做进一步的详细描述。

附图说明

[0020] 图1为本实用新型的美体按摩器立体结构示意图;

[0021] 图2为按摩头及第一连接件的剖视结构示意图;

[0022] 图3为本实用新型的美体按摩器的剖视结构示意图(部分剖);

[0023] 图4为多种形态的美体按摩器的对比结构示意图。

具体实施方式

[0024] 以下结合附图对本实用新型的优选实施例进行说明,应当理解,此处所描述的优选实施例仅用于说明和解释本实用新型,并不用于限定本实用新型。

[0025] 如图1所示,本实用新型的一种美体按摩器,包括手持电动部件1及与手持电动部件1连接的按摩头2,按摩头2为两个间隔设置的、头部为圆形或圆锥形的按摩头。通过上述结构设计,能够对鼻部、下颌、手指等部位同时进行推动、揉捏按摩。

[0026] 配合图2所示,按摩头2包括一头部为圆形或圆锥形的按摩头套21,按摩头套21的内孔内置有一套筒22,套筒22与按摩头套21的内孔顶端形成一卡槽,按摩头2还包括一按摩头本体23,按摩头本体23的一端卡嵌在卡槽内并可转动。

[0027] 上述按摩头2可通过第一连接件3与手持电动部件1连接。下面以第一连接件为Y形为例进行详细说明。按摩头本体23连接在第一连接件3的两个上端点上,且两者之间还设置有缓震圈4。

[0028] 第一连接件包括V或U形部件31及一字形部件32,两者螺纹连接且两者之间还设置有连接套7。

[0029] 配合图3所示,第一连接件3还可通过第二连接件5与手持电动部件1连接,第二连接件5与手持电动部件1同轴并且与第一连接件3所在的平面垂直,此种结构设计角度合理,使用方便。

[0030] 第一连接件3与第二连接件5螺纹连接,并且两者之间还设置有连接套6。

[0031] 手持电动部件1包括电池管101,电池管101上端安装有电机盖102,电机盖102与电池管101之间设置有电池管密封圈103,电池管101内部装有电机104,电机104上端装有偏心轮105并套入电机盖102内,电机104下端的负极端子上焊接有电机弹簧106,电

机弹簧 106 外圈套有缓震垫 107, 且电机弹簧 106 高于缓震垫 107; 在电池管 101 内, 电机弹簧 106 的下端安装有电池 108, 电池 108 下端安装有开关芯子 109, 开关芯子 109 内旋入有开关 110, 开关芯子 109 与电池管 101 之间设置有电池管密封圈 111, 电池管 101 下端还安装有后盖 112, 开关芯子 109 通过圆柱销 113 插入后盖 112, 后盖 112 与开关芯子 109 之间设置有后盖密封圈 114, 开关 110 的下端插入后盖 112。

[0032] 上述美体按摩器的各组件可按如下过程进行安装:

[0033] 先将套筒 22 压入按摩头套 21 的内孔内, 并压到指定位置, 然后将按摩头本体 23 一端装入按摩头套 21 与套筒 22 形成的卡槽内, 并保证转动自然, 再将缓震圈 4 套入按摩头本体 23 另一端, 并将按摩头本体 23 的该端分别装入第一连接件 3 对应的孔内。

[0034] 第一连接件 3 的一字形部件 32 与连接套 7 相连后, 固定在 V 或 U 形部件 31 的螺纹孔内。

[0035] 第二连接件 5 也与连接套 6 相连接后, 固定在第一连接件 3 的一字形部件 32 的螺纹孔内。

[0036] 将电池管密封圈 103 套入电机盖 102 的密封圈槽内, 再将电机盖 102 与第二连接件 5 用螺纹连接固定。

[0037] 将电机弹簧 106 焊接在电机 104 的负极端子上, 并用缓震垫 107 的弹簧孔套过电机弹簧 106, 使电机弹簧 106 高于缓震垫 107, 方便通电。

[0038] 将装配后的电机 104 装有偏心轮 105 这端套入电机盖 102 的电机孔内。

[0039] 将圆柱销 113 装入后盖 112 的销孔内, 用于后续的定位。

[0040] 将开关 110 旋入开关芯子 109 的螺纹孔内, 并稍低于开关芯子 109 端面, 然后将后盖密封圈 114、电池管密封圈 111 分别装入开关芯子 109 对应的密封槽内。

[0041] 将开关芯子 109 与后盖 112 相连接的方柱插入后盖 112 的十字槽内, 并装配到位。

[0042] 将电池 108 (5 号电池) 装入电池管 101 内, 电池 108 的负极与电机弹簧 106 相通, 并用后盖组件拧紧电池管 101。

[0043] 若开关 110 的端面低于开关芯子 109, 则电池 108 与开关芯子 109 相连接则通电, 电机 104 工作; 若开关 110 的端面高于开关芯子 109, 则断电, 电机 104 停止工作。

[0044] 上述仅以第一连接件为 Y 形为例进行说明, 第一连接件还可以采用除 Y 形以外的多种其他形式, 可以为 A 形、H 形、N 形、X 形或 π 形, 这时按摩头连接在第一连接件的两个下端点上 (请配合参阅图 4 所示)。

[0045] 最后应说明的是: 以上所述仅为本实用新型的优选实施例而已, 并不用于限制本实用新型, 尽管参照前述实施例对本实用新型进行了详细的说明, 对于本领域的技术人员来说, 其依然可以对前述实施例所记载的技术方案进行修改, 或者对其中部分技术特征进行等同替换。凡在本实用新型的精神和原则之内, 所作的任何修改、等同替换、改进等, 均应包含在本实用新型的保护范围之内。

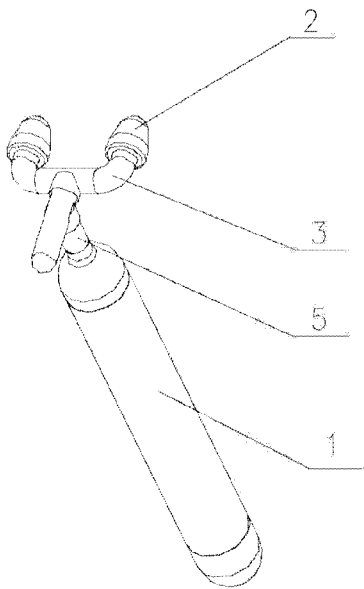


图 1

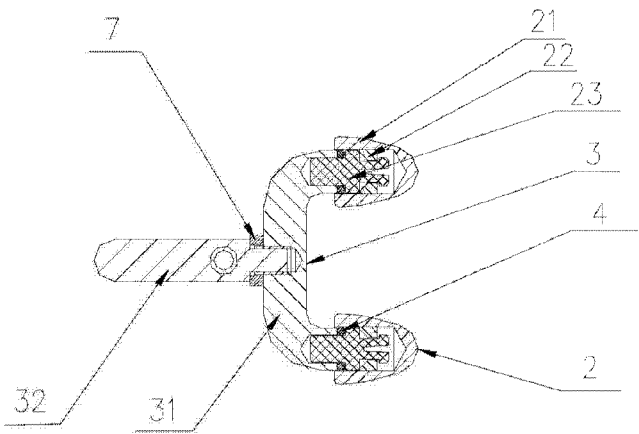


图 2

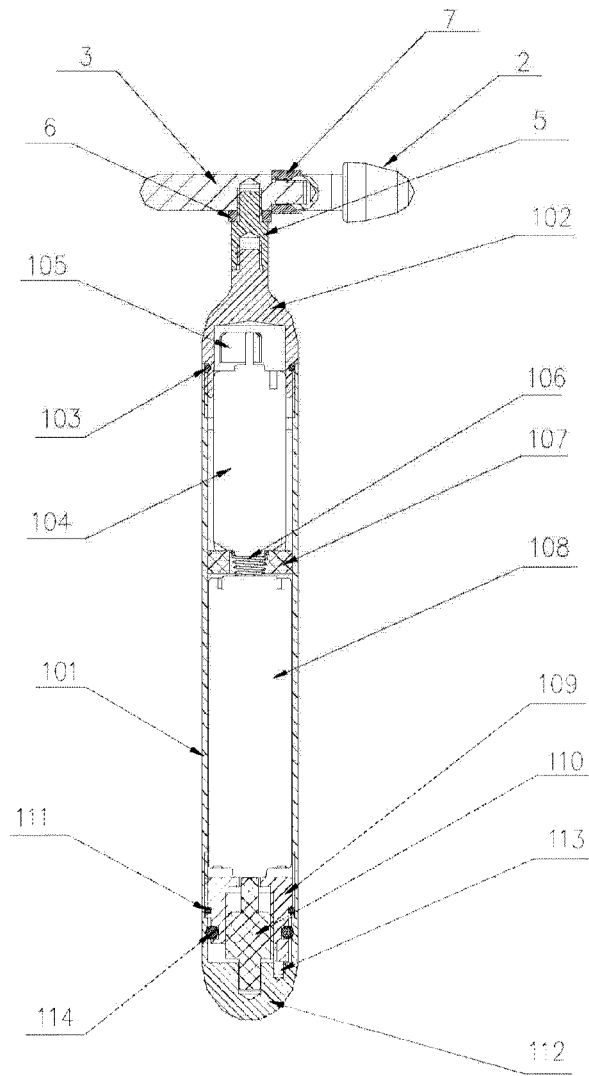


图 3

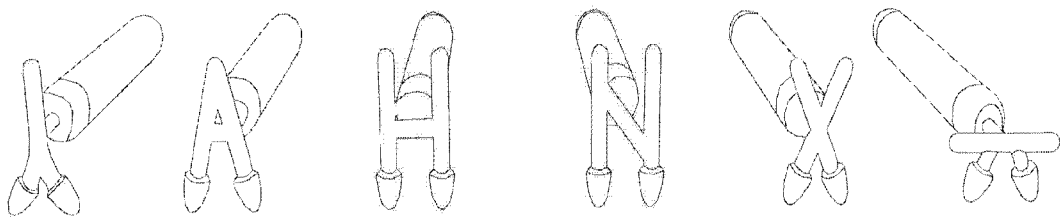


图 4

Notice

This translation is machine-generated. It cannot be guaranteed that it is intelligible, accurate, complete, reliable or fit for specific purposes. Critical decisions, such as commercially relevant or financial decisions, should not be based on machine-translation output.

DESCRIPTION CN 204246459U

10 The utility model provides a merididian massage gun, which comprises a gun-shaped shell, a base, an electric motor, a swing member, a slide rail, a sliding block group, a passive component, a massage head and at least one stretcher spring; when the electric motor drives the swing member to move the slider group along the slide rail to the rear end of the gun-shaped shell, the slider group will elongate the tension spring, and when the swing member passes the sliding at the position of the block group, the sliding block group will be pulled by the tension spring and hit the passive component to drive the massage head to extend outwards. After the swing member rotates once, the sliding block is moved again. When the group moves to the rear end of the gun-shaped shell, the passive component is no longer impacted and the massage head is retracted inward, and the above actions are repeated so that the massage head is continuously extended and retracted; It achieves the effects of labor saving, simple structure and low cost.

20 Electric Meridian Massage Gun

21 Technical field

22 The utility model relates to a massage appliance, more specifically, an electric merididian massage gun.

23 Background technique

24 At present, common massage appliances are mainly divided into two types: electric and manual. Among them, the structure of electric-driven massage appliances is too complicated, resulting in extremely high manufacturing costs. For ordinary people or those engaged in merididian massage, it is a big one. burden. The manually driven massage appliance has a simple structure and low cost, but it is quite laborious to use.

28 Therefore, how to provide an electric merididian massage appliance that is labor-saving, simple in structure, and capable of reducing manufacturing costs is an urgent issue for the relevant industry.

30 Utility model content

31 In view of this, the present utility model provides an electric merididian massage gun, which aims to improve the labor-intensive, complicated structure and high manufacturing cost of the existing massager in the prior art.

33 In order to achieve the above purpose, the technical solution adopted by the present utility model is:

34 An electric merididian massage gun, which is characterized in that it mainly contains:

35 A gun-shaped shell;

36 A base set in the gun-shaped shell;

37 An electric motor is fixed on the base to output a rotational power;

- 38 A swinging part connected with the electric motor to be driven by the electric motor to perform circular swinging;
- 40 A sliding rail is arranged on the base;
- 41 A sliding block group is slidably connected to the sliding rail, and can be subjected to external force to perform linear reciprocating sliding along the sliding rail;
- 43 A passive component is arranged in the gun-shaped casing and partially extends outside the gun-shaped casing;
- 45 A massage head is detachably connected to the part of the passive component protruding out of the gun-shaped shell;
- 47 At least one tension spring connected between the slider group and the passive component;
- 48 When the swing member moves the slider group along the slide rail to the rear end of the gun-shaped housing, the slider group will elongate the tension spring. When the swing member passes the position of the slider group, the slider set will be pulled by the tension spring and hit the passive component to drive the massage head to extend outwards. After the swing member rotates once, the slider set will be moved to the gun-shaped shell again. When the rear end moves, the passive component is no longer hit and retracts the massage head inward.
- 54 Wherein, the gun-shaped shell is formed by butting two half shells, and the gun-shaped shell defines a receiving portion and a holding portion connected to the bottom of the middle section of the receiving portion, so that the receiving portion provides the base, the electric motor, the swing member, the sliding rail, the sliding block group and the passive component are accommodated, and the grip part is for the user to hold.
- 58 Wherein, the slider set has a body, a toggle, an impact head, and a buffer spring; the body is slidably connected to the slide rail, and is subjected to external force to slide back and forth in a straight line along the slide rail. Part is connected with the tension spring, the toggle part is arranged at the rear end of the body to be moved by the swing member, the impact head is connected to the front end of the body, and the buffer spring abuts against the impact head. Between the body and the body; when the tension spring pulls the body, the impact head hits the passive component.
- 64 Wherein, the passive component has a fixed sleeve, a shaft, an impact tail, and a return spring. The fixed sleeve is fixed in the gun-shaped housing and connected with the tension spring. The shaft passes through the fixed sleeve, the front end of which protrudes outside the front end of the gun-shaped shell and is connected with the massage head, the impact tail is connected to the rear end of the shaft, and the return spring abuts between the impact tail and the fixed sleeve. When the slider set hits the impact tail, the shaft will drive the massage head to extend, when the slider set no longer hits the impact tail, the return spring will pull the shaft back, retract the massage head.
- 71 Wherein, it also includes a switch button, the switch button is arranged at the outer position of the gun-shaped shell, and is electrically connected with the electric motor to control the start and stop of the electric motor.
- 73 Wherein, it also includes a power adjustment button, the power adjustment button is arranged at the rear end of the gun-shaped shell, and is electrically connected with the electric motor to control the rotation speed of the electric motor, thereby adjusting the massage head extend and retract frequency.
- 76 Wherein, it also includes a depth adjustment button, which is arranged at the front end of the gun-shaped shell and is connected with the passive component, so that by turning the depth adjustment button, the passive component can be adjusted to extend and retract the massage head depth.
- 79 Wherein, it also includes a safety restricting element. One side of the passive component has a restricting

groove. One end of the safety restricting element is locked in from one side of the gun-shaped housing and is located in the restricting groove to prevent the passive component from generating Excessive displacement stroke.

83 Among them, the massage head is U-shaped.

84 Among them, the massage head has a disc shape.

85 Compared with the prior art, the utility model has the beneficial effects of labor saving, simple structure and low cost.

87 Description of the drawings

88 Fig. 1 is a perspective view of a preferred embodiment of the present invention.

89 Fig. 2 is an exploded perspective view of the embodiment shown in Fig. 1.

90 Fig. 3 is a cross-sectional view of the embodiment shown in Fig. 1.

91 4 to 8 are schematic diagrams of the operation of the embodiment shown in FIG. 1.

92 Fig. 9 is a three-dimensional assembled view of another embodiment of the present invention.

93 Description of reference signs: electric meridian massage gun 100; gun-shaped shell 10; half shell 11; accommodating portion 12; grip portion 13; base 20; electric motor 30; swing member 40; slide rail 50; slider Group 60; body 61; dial 62; impact head 63; buffer spring 64; passive component 70; fixed sleeve 71; shaft 72; restricting groove 721; impact tail 73; return spring 74; massage head 80; Extension spring 90; switch button 91; power adjustment button 92; depth adjustment button 93; safety restriction 94.

98 detailed description

99 In order to enable your reviewer to have a further understanding and recognition of the features and characteristics of the utility model, the following preferred embodiments are enumerated as follows with accompanying drawings:

102 Please refer to Figures 1 to 8, which is an electric meridian massage gun 100 provided by a preferred embodiment of the present utility model. It mainly includes a gun-shaped housing 10, a base 20, an electric motor 30, and a rotary Pendulum 40, a sliding rail 50, a sliding block group 60, a passive component 70, a massage head 80 and two tension springs 90, of which:

106 1 to 4, the gun-shaped housing 10 is formed by butting two half-shells 11, and the gun-shaped housing 10 can define a receiving portion 12 and an idle section connected to the receiving portion 12 The holding portion 13 at the bottom is used for the holding portion 12 to accommodate other components, and the holding portion 13 for the user to hold.

110 Please refer to FIG S. 1 to 4, the base 20 is fixed in the receiving portion 12 of the gun-shaped housing 10.

111 1 to 4, the electric motor 30 is located in the accommodating portion 12 of the gun-shaped housing 10 and is fixed on the base 20 to output a rotational power.

113 1 to 4, the swing member 40 is located in the accommodating portion 12 of the gun-shaped housing 10, and one end is fixed to the electric motor 30 to be driven by the electric motor 30 to perform circular rotation put.

115 Please refer to FIG S. 1 to 4, the sliding rail 50 is disposed in the receiving portion 12 of the gun-shaped housing 10 and fixed on the base 20.

117 1 to 4, the sliding block group 60 is located in the accommodating portion 12 of the gun-shaped shell 10, and is slidably connected to the slide rail 50, and can be subjected to external force to perform a straight line along the slide rail 50 The reciprocating slip. The slider set 60 has a body 61, a toggle portion 62, an impact head 63 and a buffer spring 64; the body 61 is slidably connected to the slide rail 50, and can be moved along the slide rail by external force. 50 for linear reciprocating sliding movement, the toggle portion 62 is arranged at the

rear end of the body 61 to be moved by the swing member 40, the impact head 63 is connected to the front end of the body 61, the buffer spring 64 abuts between the striking head 63 and the body 61.

124 Please refer to FIG S. 1 to 4, the passive component 70 is located in the accommodating portion 12 of the gun-shaped housing 10 and partially protrudes outside the front end of the gun-shaped housing 10. The passive component 70 has a fixed sleeve 71, a shaft 72, an impact tail 73, and a return spring 74. The fixed sleeve 71 is fixed in the accommodating portion 12 of the gun-shaped housing 10. The body 72 passes through the fixed sleeve 71, and the front end extends out of the front end of the gun-shaped housing 10. The impact tail 73 is connected to the rear end of the shaft 72, and the return spring 74 abuts against the impact tail 73 and the fixed sleeve 71.

131 1 to 4, the massage head 80 is U-shaped, and is detachably connected to the passive component 70 on the front end of the shaft 71 protruding out of the front end of the gun-shaped housing 10 to interact with the passive component 70 moves simultaneously.

134 Please refer to FIG S. 1 to 4, the tension springs 90 described are connected between the body 61 of the slider group 60 and the fixed sleeve 71 of the passive component 70.

136 Therefore, the foregoing is an introduction to the various components and assembly methods of an electric meridian massage gun 100 provided by a preferred embodiment of the present invention, and then its use characteristics are described as follows:

139 First, when the user controls and drives the electric motor 30 to output rotational power, the swing member 40 is driven by the electric motor 30 to rotate, and moves the dial 62 of the slider group 60 along the rotating path. The rear end is moved, so that the slider group 60 is pulled back, and the tension spring 90 is stretched (as shown in FIG .5), until the swing member 40 passes through the toggle portion 62 of the slider group 60. After that, the tension spring 90 pulls the slider assembly 60 to the front end, so that the body 61 of the slider assembly 60 slides along the slide rail 50 to move forward, and is hit by the striking head 63. The impact tail 73 of the passive component 70 (as shown in FIG .6) causes the shaft 72 of the passive component 70 to be impacted and move forward (as shown in FIG .7), and the massage head 80 is driven to apply pressure at the position of the meridian of the human body, then, after the swing member 40 rotates one circle, the dial 62 of the slider group 60 is moved again, and the slider group 60 is pulled back (as shown in FIG .8). The impact head 63 of the slider group 60 is separated from the impact tail 73 of the passive component 70, and the shaft 72 and the massage head 80 are pulled back by the elastic force of the return spring 74 (as shown in FIG .8). The massage head 80 is no longer in contact with the meridian position of the human body at this time. By repeating this, the massage head 80 can be continuously extended and retracted to achieve the effect of massaging the meridians of the human body.

154 Therefore, because the utility model outputs power by the electric motor, it can achieve the effect of saving labor.

156 In addition, as shown in FIG .9, the massage head 80 in the present invention can also have a disc shape or other shapes, so as to be suitable for massaging different positions of the human body.

158 Furthermore, as shown in Figure 2, the present utility model also includes a switch button 91 and a power adjustment button 92. The switch button 91 is arranged at a position outside the accommodating portion 12 of the gun-shaped housing 10 and is connected to the electric motor 30. The electric motor 30 is electrically connected to control the start and stop of the electric motor 30; and the power adjustment button 92 is arranged at the rear end of the accommodating portion 12 of the gun-shaped housing 10 and is electrically connected to the electric motor 30. Sexual connection to control the rotation speed of the electric motor 30 to adjust the

extension and retraction frequency of the massage head 90.

165 Secondly, as shown in FIG. 2, the present invention may further include a depth adjustment button 93, which is arranged at the front end of the accommodating portion 12 of the gun-shaped housing 10 and is connected to the passive component 70 to adjust the depth by rotating. The button 93 can adjust the extending and retracting depth of the passive component 70 to drive the massage head 80, so as to achieve the effect of generating different shocks to the human body.

170 The above-mentioned present utility model, as shown in FIG. 4, may further include a safety restriction member 94; the shaft 72 of the passive component 70 has a restriction groove 721 on one side, and one end of the safety restriction member 94 is from the gun-shaped shell. One side of the accommodating portion 12 of the body 10 is locked in and is located in the restriction groove 721 to prevent the shaft 72 from generating an excessive displacement stroke.

175 The above description is only illustrative but not restrictive to the present utility model. Those of ordinary skill in the art understand that many modifications, changes or equivalents can be made without departing from the spirit and scope defined by the claims. But all will fall into the protection scope of the utility model.



(12) 实用新型专利

(10) 授权公告号 CN 204246459 U

(45) 授权公告日 2015. 04. 08

(21) 申请号 201420546827. 8

(22) 申请日 2014. 09. 22

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(51) Int. Cl.

A61H 23/02(2006. 01)

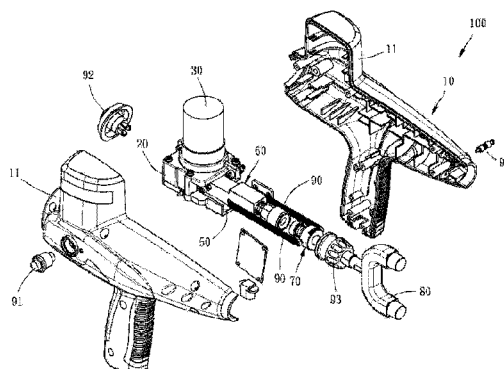
权利要求书2页 说明书4页 附图9页

(54) 实用新型名称

电动经络按摩枪

(57) 摘要

本实用新型提供一种经络按摩枪,包含有一枪形壳体、一基座、一电动马达、一旋摆件、一滑轨、一滑块组、一被动组件、一按摩头及至少一拉伸弹簧;当该电动马达带动该旋摆件拨动该滑块组沿该滑轨往枪形壳体的后端移动时,该滑块组会拉长该拉伸弹簧,当该旋摆件通过该滑块组的位置时,该滑块组会被该拉伸弹簧所拉动而撞击于该被动组件上,以带动该按摩头向外伸出,待该旋摆件旋转一圈后再度拨动该滑块组往枪形壳体后端移动时,该被动组件不再受到撞击而将该按摩头往内缩回,如此重复上述动作,而达到将该按摩头进行持续地伸出与缩回动作;以达到省力、结构简单、成本低廉等功效。



1. 一种电动经络按摩枪, 其特征在于, 其主要包含有:
 - 一枪形壳体;
 - 一基座, 设置于该枪形壳体内;
 - 一电动马达, 同设于该基座上, 用以输出一旋转动力;
 - 一旋摆件, 与该电动马达连结, 以受该电动马达所带动而进行圆周旋摆;
 - 一滑轨, 设置于该基座上;
 - 一滑块组, 滑接于该滑轨上, 而可受外力作用而沿该滑轨进行直线的往复滑移;
 - 一被动组件, 设置于该枪形壳体内, 并局部伸出于该枪形壳体外;
 - 一按摩头, 以可拆离的方式连结于该被动组件伸出于该枪形壳体外的部位上;
 - 至少一拉伸弹簧, 连结于该滑块组与该被动组件间;

当该旋摆件拨动该滑块组沿该滑轨往枪形壳体的后端移动时, 该滑块组会拉长该拉伸弹簧, 当该旋摆件通过该滑块组的位置时, 该滑块组会被该拉伸弹簧所拉动而撞击于该被动组件上, 以带动该按摩头向外伸出, 待该旋摆件旋转一圈后再度拨动该滑块组往枪形壳体后端移动时, 该被动组件不再受到撞击而将该按摩头往内缩回。

2. 根据权利要求 1 所述的电动经络按摩枪, 其特征在于, 该枪形壳体由二半壳体所对接而成, 该枪形壳体界定出一容置部及一连接于该容置部中段底部的握持部, 以由该容置部供该基座、电动马达、旋摆件、滑轨、滑块组及被动组件容置, 而由该握持部供使用者加以握持。

3. 根据权利要求 1 所述的电动经络按摩枪, 其特征在于, 该滑块组具有一身部、一拨动部、一撞击头部及一缓冲弹簧; 该身部与该滑轨滑接, 受外力作用进行沿该滑轨的直线往复滑移, 该身部与该拉伸弹簧连接, 该拨动部设置于该身部后端, 以受该旋摆件所拨动, 该撞击头部连接于该身部的前端, 该缓冲弹簧抵接于该撞击头部与该身部间; 当该拉伸弹簧拉动该身部时, 由该撞击头部撞击于该被动组件上。

4. 根据权利要求 1 所述的电动经络按摩枪, 其特征在于, 该被动组件具有一固定套筒、一杆身、一撞击尾部及一复位弹簧, 该固定套筒固设于该枪形壳体内, 并与该拉伸弹簧连接, 该杆身穿经该固定套筒, 且前端伸出于该枪形壳体的前端外, 并与该按摩头连接, 该撞击尾部连结于该杆身后端, 该复位弹簧抵接于该撞击尾部与该固定套筒间; 当该滑块组撞击于该撞击尾部时, 该杆身会带动该按摩头伸出, 当该滑块组不再撞击于该撞击尾部上时, 该复位弹簧会将该杆身拉回, 使该按摩头缩回。

5. 根据权利要求 1 所述的电动经络按摩枪, 其特征在于, 还包含有一开关钮, 该开关钮设置于该枪形壳体的外侧位置处, 并与该电动马达电性连接, 以控制该电动马达的启动与停止。

6. 根据权利要求 1 所述的电动经络按摩枪, 其特征在于, 还包含有一动力调整钮, 该动力调整钮设置于该枪形壳体后端位置处, 并与该电动马达电性连接, 以控制该电动马达的转动速度, 进而达到调整该按摩头的伸出、缩回频率。

7. 根据权利要求 1 所述的电动经络按摩枪, 其特征在于, 还包含有一深度调整钮, 设置于该枪形壳体的前端, 并与该被动组件连结, 以凭借旋动该深度调整钮而能调整该被动组件带动按摩头所能伸出与缩回的深度。

8. 根据权利要求 1 所述的电动经络按摩枪, 其特征在于, 还包含有一安全限制件, 该被

动组件一侧具有一限制槽,该安全限制件的一端自该枪形壳体的一侧锁入,并位于该限制槽中,以防止该被动组件产生过大的位移行程。

9. 根据权利要求 1 所述的电动经络按摩枪,其特征在于,该按摩头呈 U 形。

10. 根据权利要求 1 所述的电动经络按摩枪,其特征在于,该按摩头呈盘形。

电动经络按摩枪

技术领域

[0001] 本实用新型涉及一种按摩器具,更详而言之是指一种电动经络按摩枪。

背景技术

[0002] 目前常见的按摩器具,主要分为电动与手动二种,其中以电动驱动的按摩器具,其结构过于复杂,导致制造成本相当的高昂,对于一般人或从事经络按摩的业者来说,都为一大负担。而手动驱动的按摩器具,虽然结构简单、成本较低,但在使用时却相当的费力。

[0003] 因此,如何能提供一种省力、结构简单、能降低制造成本的电动经络按摩器具,便为目前相关业者所急需解决的课题。

实用新型内容

[0004] 有鉴于此,本实用新型提供一种电动经络按摩枪,目的在于:改善现有技术中现有按摩器具具有的费力、结构复杂、制造成本较高等问题。

[0005] 为实现上述目的,本实用新型采用的技术方案是:

[0006] 一种电动经络按摩枪,其特征在于,其主要包含有:

[0007] 一枪形壳体;

[0008] 一基座,设置于该枪形壳体内;

[0009] 一电动马达,固设于该基座上,用以输出一旋转动力;

[0010] 一旋摆件,与该电动马达连结,以受该电动马达所带动而进行圆周旋摆;

[0011] 一滑轨,设置于该基座上;

[0012] 一滑块组,滑接于该滑轨上,而可受外力作用而沿该滑轨进行直线的往复滑移;

[0013] 一被动组件,设置于该枪形壳体内,并局部伸出于该枪形壳体外;

[0014] 一按摩头,以可拆离的方式连结于该被动组件伸出于该枪形壳体外的部位上;

[0015] 至少一拉伸弹簧,连结于该滑块组与该被动组件间;

[0016] 当该旋摆件拨动该滑块组沿该滑轨往枪形壳体的后端移动时,该滑块组会拉长该拉伸弹簧,当该旋摆件通过该滑块组的位置时,该滑块组会被该拉伸弹簧所拉动而撞击于该被动组件上,以带动该按摩头向外伸出,待该旋摆件旋转一圈后再度拨动该滑块组往枪形壳体后端移动时,该被动组件不再受到撞击而将该按摩头往内缩回。

[0017] 其中,该枪形壳体由二半壳体所对接而成,该枪形壳体界定出一容置部及一连接于该容置部中段底部的握持部,以由该容置部供该基座、电动马达、旋摆件、滑轨、滑块组及被动组件容置,而由该握持部供使用者加以握持。

[0018] 其中,该滑块组具有一身部、一拨动部、一撞击头部及一缓冲弹簧;该身部与该滑轨滑接,受外力作用进行沿该滑轨的直线往复滑移,该身部与该拉伸弹簧连接,该拨动部设置于该身部后端,以受该旋摆件所拨动,该撞击头部连接于该身部的前端,该缓冲弹簧抵接于该撞击头部与该身部间;当该拉伸弹簧拉动该身部时,由该撞击头部撞击于该被动组件上。

[0019] 其中,该被动组件具有一固定套筒、一杆身、一撞击尾部及一复位弹簧,该固定套筒固设于该枪形壳体内,并与该拉伸弹簧连接,该杆身穿经该固定套筒,且前端伸出于该枪形壳体的前端外,并与该按摩头连接,该撞击尾部连结于该杆身后端,该复位弹簧抵接于该撞击尾部与该固定套筒间;当该滑块组撞击于该撞击尾部时,该杆身会带动该按摩头伸出,当该滑块组不再撞击于该撞击尾部上时,该复位弹簧会将该杆身拉回,使该按摩头缩回。

[0020] 其中,还包含有一开关钮,该开关钮设置于该枪形壳体的外侧位置处,并与该电动马达电性连接,以控制该电动马达的启动与停止。

[0021] 其中,还包含有一动力调整钮,该动力调整钮设置于该枪形壳体后端位置处,并与该电动马达电性连接,以控制该电动马达的转动速度,进而达到调整该按摩头的伸出、缩回频率。

[0022] 其中,还包含有一深度调整钮,设置于该枪形壳体的前端,并与该被动组件连结,以凭借旋动该深度调整钮而能调整该被动组件带动按摩头所能伸出与缩回的深度。

[0023] 其中,还包含有一安全限制件,该被动组件一侧具有一限制槽,该安全限制件的一端自该枪形壳体的一侧锁入,并位于该限制槽中,以防止该被动组件产生过大的位移行程。

[0024] 其中,该按摩头呈U形。

[0025] 其中,该按摩头呈盘形。

[0026] 与现有技术相比较,本实用新型具有省力、结构简单、成本低廉的有益效果。

附图说明

[0027] 图1是本实用新型一较佳实施例的立体组合图。

[0028] 图2是图1所示实施例的立体分解图。

[0029] 图3是图1所示实施例的剖视图。

[0030] 图4~图8是图1所示实施例的动作示意图。

[0031] 图9是本实用新型另一实施态样的立体组合图。

[0032] 附图标记说明:电动经络按摩枪100;枪形壳体10;半球体11;容置部12;握持部13;基座20;电动马达30;旋摆件40;滑轨50;滑块组60;身部61;拨动部62;撞击头部63;缓冲弹簧64;被动组件70;固定套筒71;杆身72;限制槽721;撞击尾部73;复位弹簧74;按摩头80;拉伸弹簧90;开关钮91;动力调整钮92;深度调整钮93;安全限制件94。

具体实施方式

[0033] 为使贵审查委员能对本实用新型的特征与其特点有更进一步的了解与认同,兹列举以下较佳的实施例并配合图式说明如下:

[0034] 请参阅图1至图8,是本实用新型一较佳实施例所提供的一种电动经络按摩枪100,其主要包含有一枪形壳体10、一基座20、一电动马达30、一旋摆件40、一滑轨50、一滑块组60、一被动组件70、一按摩头80及二拉伸弹簧90,其中:

[0035] 请参阅图1至图4,该枪形壳体10,由二半球体11所对接而成,该枪形壳体10可界定出一容置部12及一连接于该容置部12中段底部的握持部13,以由该容置部12供其余构件容置,而由该握持部13供使用者加以握持。

[0036] 请参阅图1至图4,该基座20,是固设于该枪形壳体10的容置部12内。

[0037] 请参阅图 1 至图 4, 该电动马达 30, 位于该枪形壳体 10 的容置部 12 内, 并固设于该基座 20 上, 用以输出一旋转动力。

[0038] 请参阅图 1 至图 4, 该旋摆件 40, 位于该枪形壳体 10 的容置部 12 内, 并以一端与该电动马达 30 固接, 以受该电动马达 30 所驱动而进行圆周旋摆。

[0039] 请参阅图 1 至图 4, 该滑轨 50, 设位于该枪形壳体 10 的容置部 12 内, 并固设于该基座 20 上。

[0040] 请参阅图 1 至图 4, 该滑块组 60, 位于该枪形壳体 10 的容置部 12 内, 并与该滑轨 50 滑接, 而可受外力作用而进行沿该滑轨 50 进行直线的往复滑移。该滑块组 60 具有一身部 61、一拨动部 62、一撞击头部 63 及一缓冲弹簧 64; 该身部 61 与该滑轨 50 滑接, 而可受外力作用而进行沿该滑轨 50 的直线往复滑移者, 该拨动部 62 设置于该身部 61 后端, 以受该旋摆件 40 所拨动者, 该撞击头部 63 连接于该身部 61 的前端, 该缓冲弹簧 64 抵接于该撞击头部 63 与该身部 61 间。

[0041] 请参阅图 1 至图 4, 该被动组件 70, 位于该枪形壳体 10 的容置部 12 内, 并局部伸出该枪形壳体 10 的前端外。该被动组件 70 具有一固定套筒 71、一杆身 72、一撞击尾部 73 及一复位弹簧 74, 该固定套筒 71 是固设于该枪形壳体 10 的容置部 12 内, 该杆身 72 是穿经该固定套筒 71, 且前端是伸出该枪形壳体 10 的前端外, 该撞击尾部 73 是连结于该杆身 72 后端, 该复位弹簧 74 抵接于该撞击尾部 73 与该固定套筒 71 间。

[0042] 请参阅图 1 至图 4, 该按摩头 80, 呈 U 形, 是以可拆离的方式连接于该被动组件 70 伸出该枪形壳体 10 前端外的杆身 71 前端上, 以与该被动组件 70 加以同动。

[0043] 请参阅图 1 至图 4, 所述的这些拉伸弹簧 90, 是连结于该滑块组 60 的身部 61 与该被动组件 70 的固定套筒 71 间。

[0044] 是以, 上述即为本实用新型一较佳实施例所提供的一种电动经络按摩枪 100 各构件及其组装方式的介绍, 接着再将其使用特点说明如下:

[0045] 首先, 当使用者控制而驱动该电动马达 30 输出旋转动力时, 该旋摆件 40 会受该电动马达 30 所带动而旋转, 并在旋转的路径上将该滑块组 60 的拨动部 62 往后端拨动, 使该滑块组 60 被往后拉, 并将该拉伸弹簧 90 加以拉伸 (如图 5 所示), 待该旋摆件 40 通过该滑块组 60 的拨动部 62 后, 该拉伸弹簧 90 便将该滑块组 60 往前端拉, 使该滑块组 60 的身部 61 沿着该滑轨 50 滑动而往前位移, 并由该撞击头部 63 撞击于该被动组件 70 的撞击尾部 73 上 (如图 6 所示), 使该被动组件 70 的杆身 72 受到撞击而往前伸出移动 (如图 7 所示), 而带动该按摩头 80 施压于人体的经络位置处, 接着, 再由该旋摆件 40 旋转一周后再度拨动该滑块组 60 的拨动部 62, 而将该滑块组 60 往后拉 (如图 8 所示), 使该滑块组 60 的撞击头部 63 与该被动组件 70 的撞击尾部 73 分离, 而由该复位弹簧 74 的弹力将该杆身 72 及该按摩头 80 拉回 (如图 8 所示), 使该按摩头 80 此时不再接触于人体的经络位置上。以此重复, 便能持续地将该按摩头 80 持续地进行伸出、缩回, 以达到按摩人体经络的功效。

[0046] 是以, 由于本实用新型由电动马达输出动力, 因此可达到省力的功效。

[0047] 另外, 如图 9 所示, 本实用新型中的按摩头 80 也可呈盘状或其他的造型, 以适用于对人体的不同位置处进行按摩。

[0048] 再者, 如图 2 所示, 本实用新型中还包含有一开关钮 91 及一动力调整钮 92, 该开关钮 91 设置于该枪形壳体 10 的容置部 12 外侧位置处, 并与该电动马达 30 电性连接, 以控制

该电动马达 30 的启动与停止 ; 而该动力调整钮 92 则设置于该枪形壳体 10 的容置部 12 后端位置处, 并与该电动马达 30 电性连接, 以控制该电动马达 30 的转动速度, 进而达到调整该按摩头 90 的伸出、缩回频率。

[0049] 其次, 如图 2 所示, 本实用新型更可包含有一深度调整钮 93, 设置于该枪形壳体 10 的容置部 12 前端, 并与该被动组件 70 连结, 以凭借旋动该深度调整钮 93 而能调整该被动组件 70 带动按摩头 80 所能伸出与缩回的深度, 而达到对人体产生不同震度的功效。

[0050] 上述本实用新型中, 如图 4 所示, 更可包含有一安全限制件 94 ; 该被动组件 70 的杆身 72 一侧具有一限制槽 721, 该安全限制件 94 的一端是自该枪形壳体 10 的容置部 12 一侧锁入, 并位于该限制槽 721 中, 以防止该杆身 72 产生过大的位移行程。

[0051] 以上说明对本实用新型而言只是说明性的, 而非限制性的, 本领域普通技术人员理解, 在不脱离权利要求所限定的精神和范围的情况下, 可作出许多修改、变化或等效, 但都将落入本实用新型的保护范围之内。

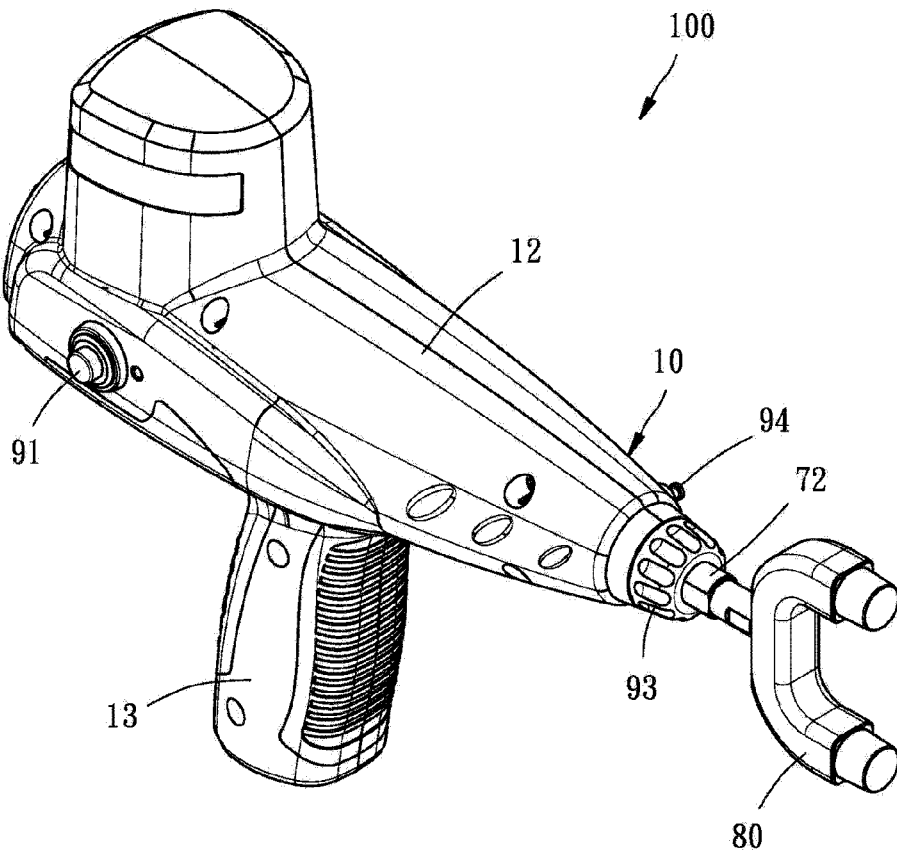


图 1

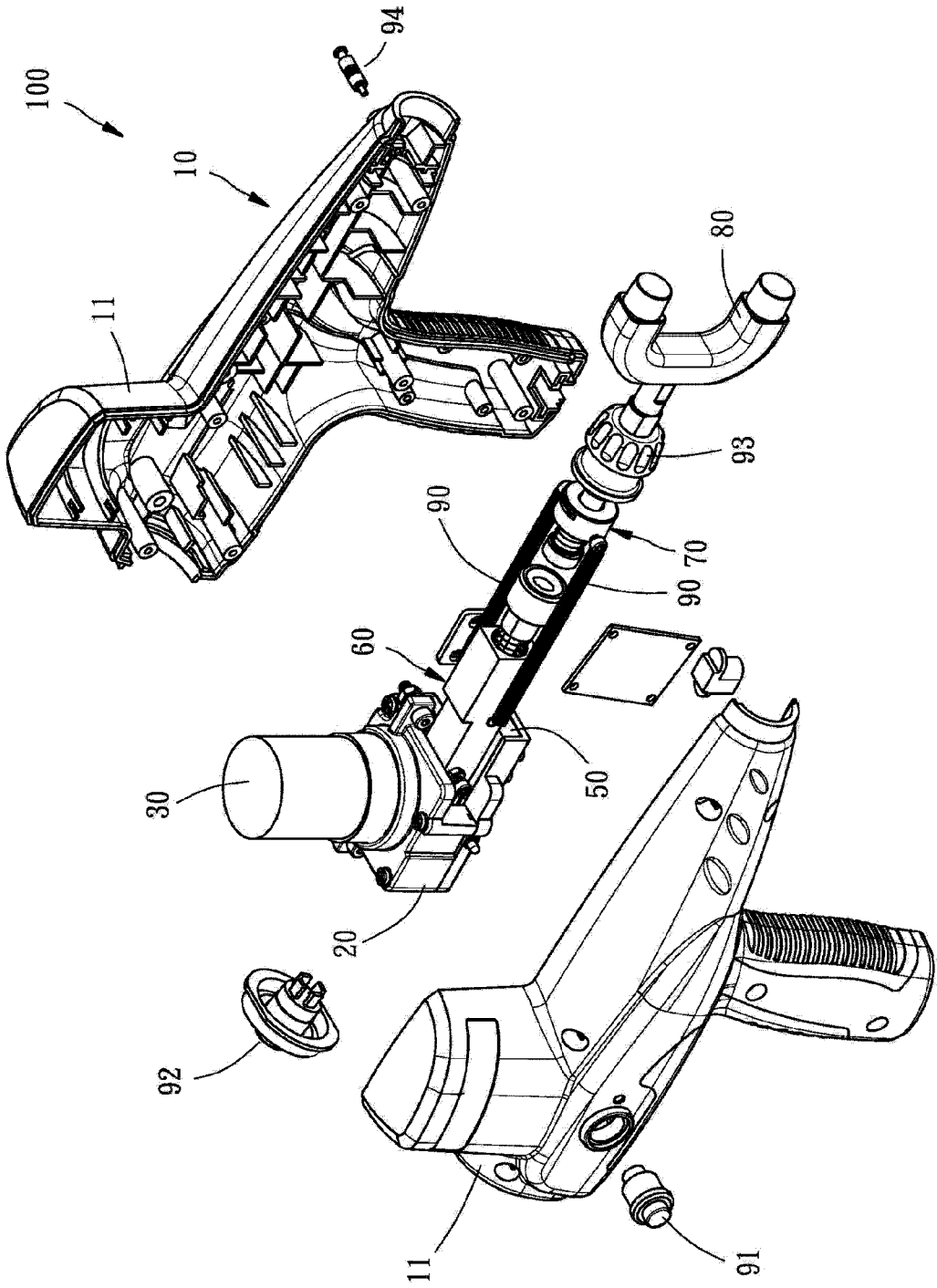


图 2

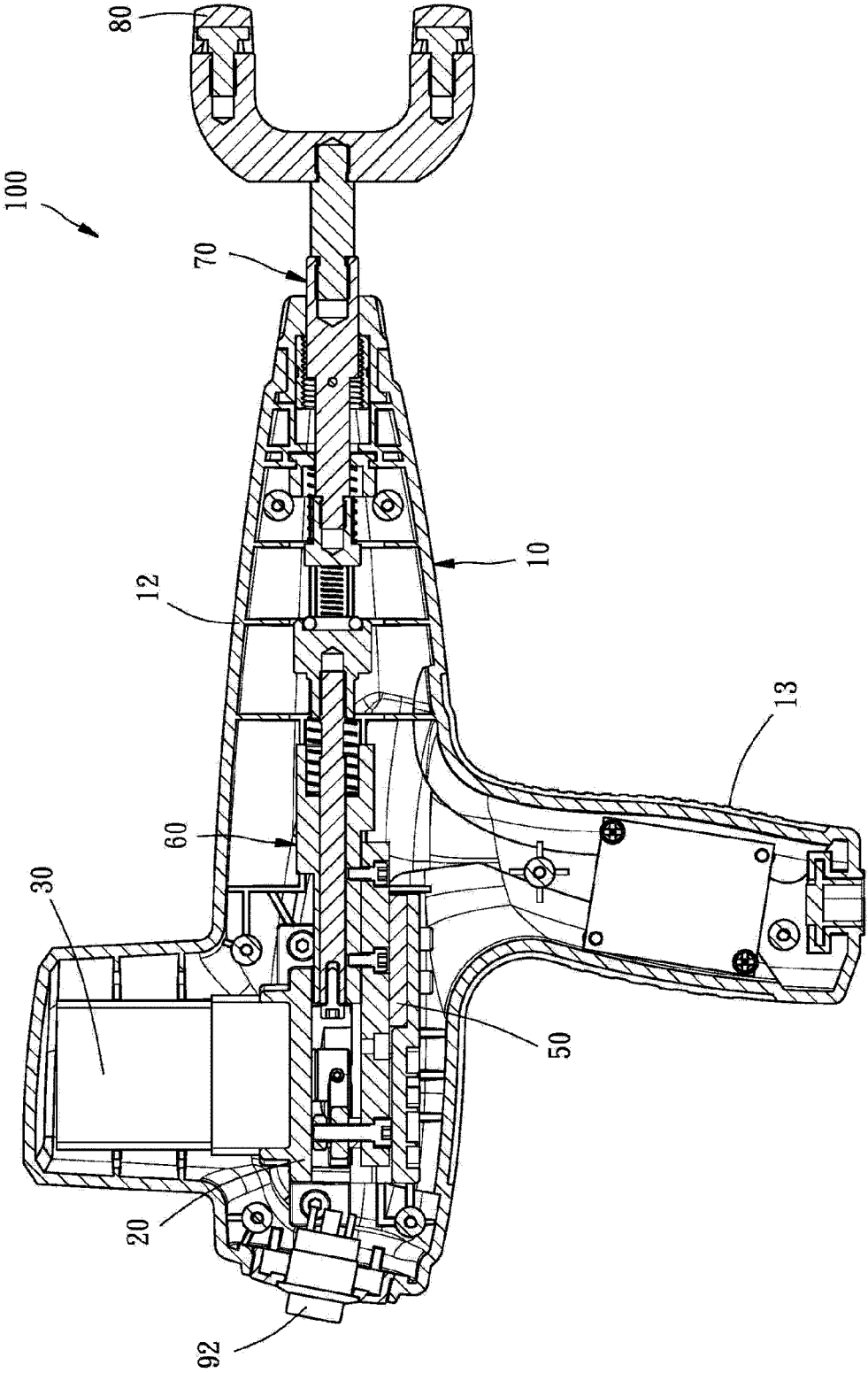


图 3

10

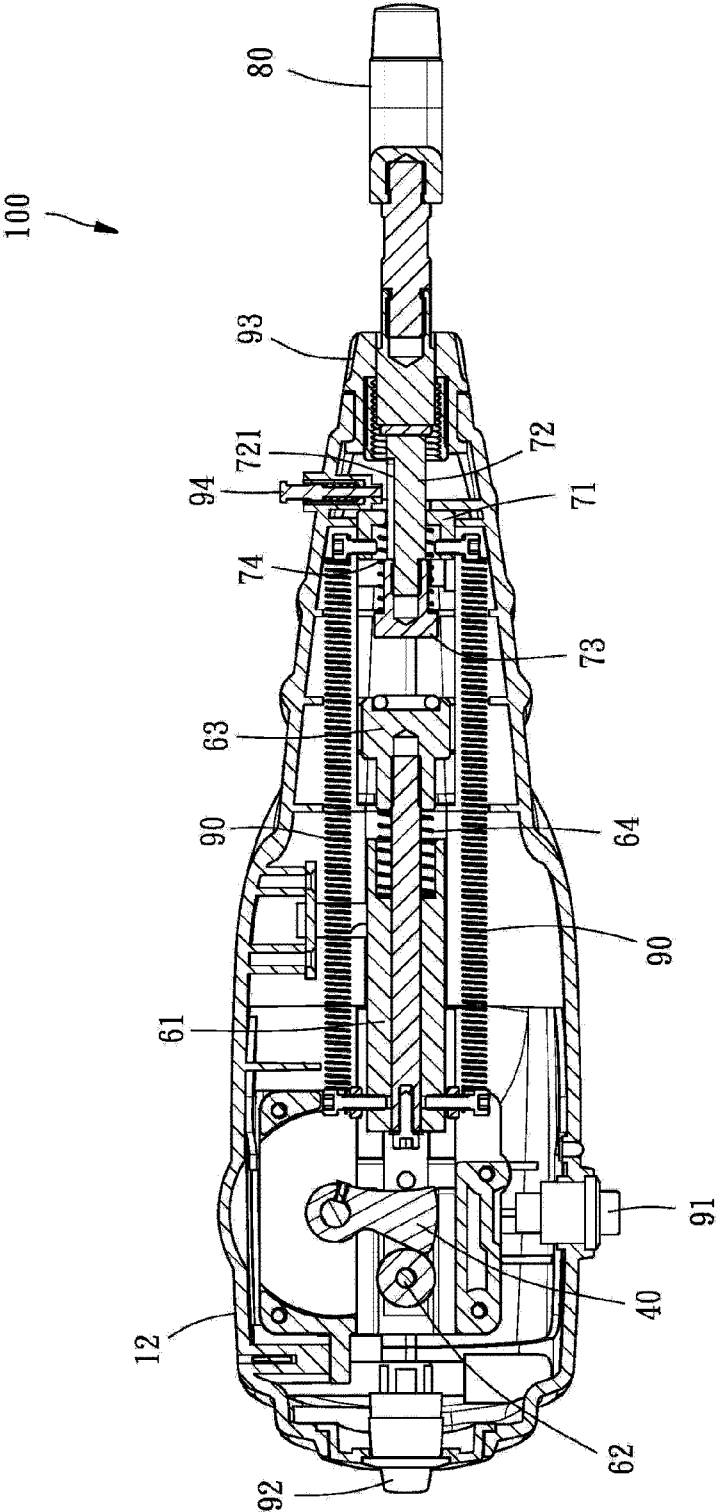


图 4

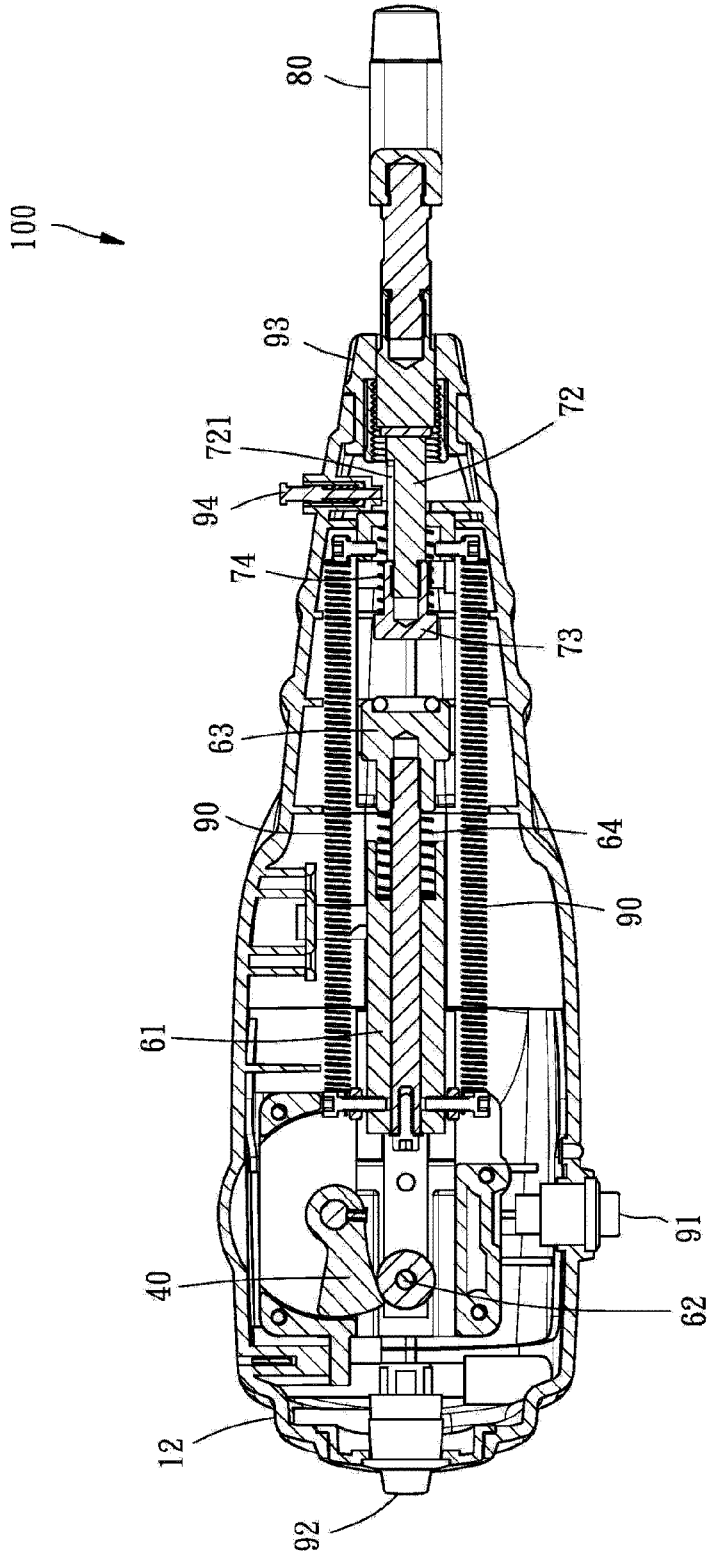


图 5

12

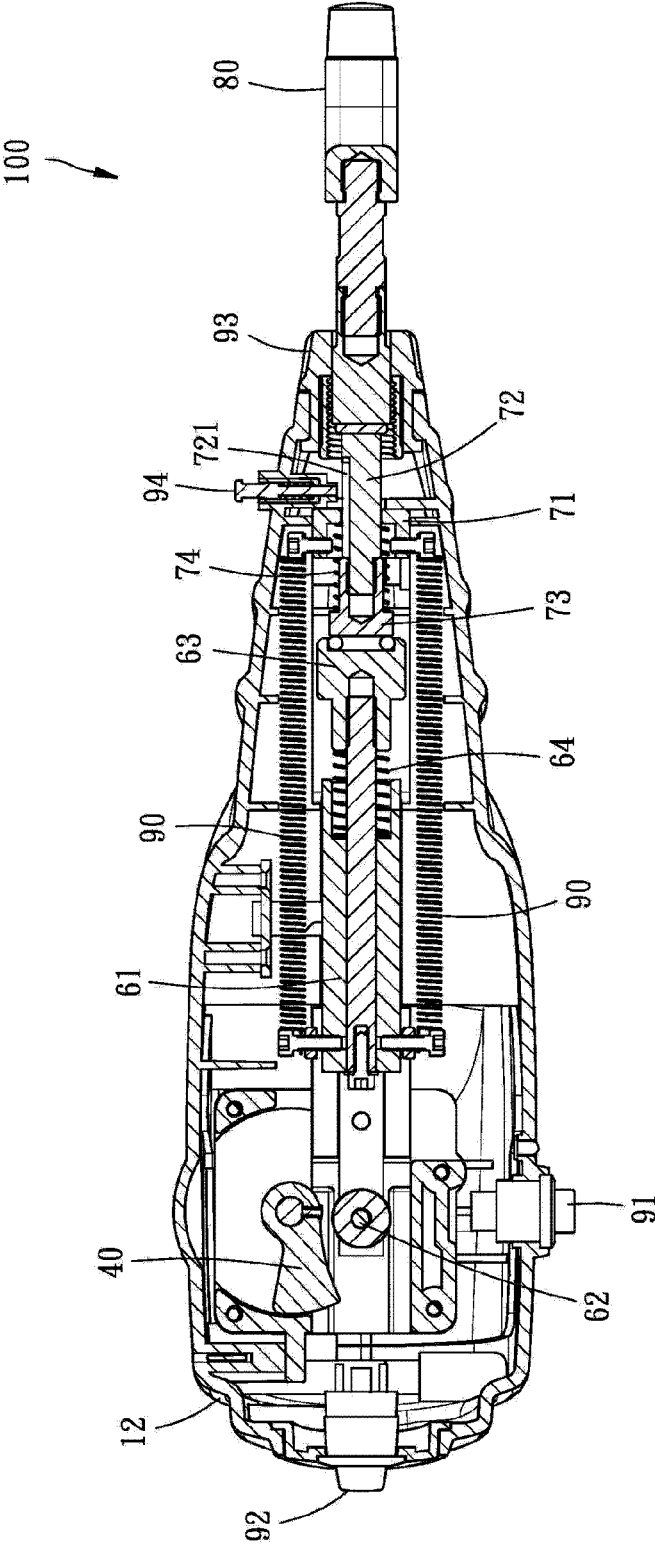


图 6

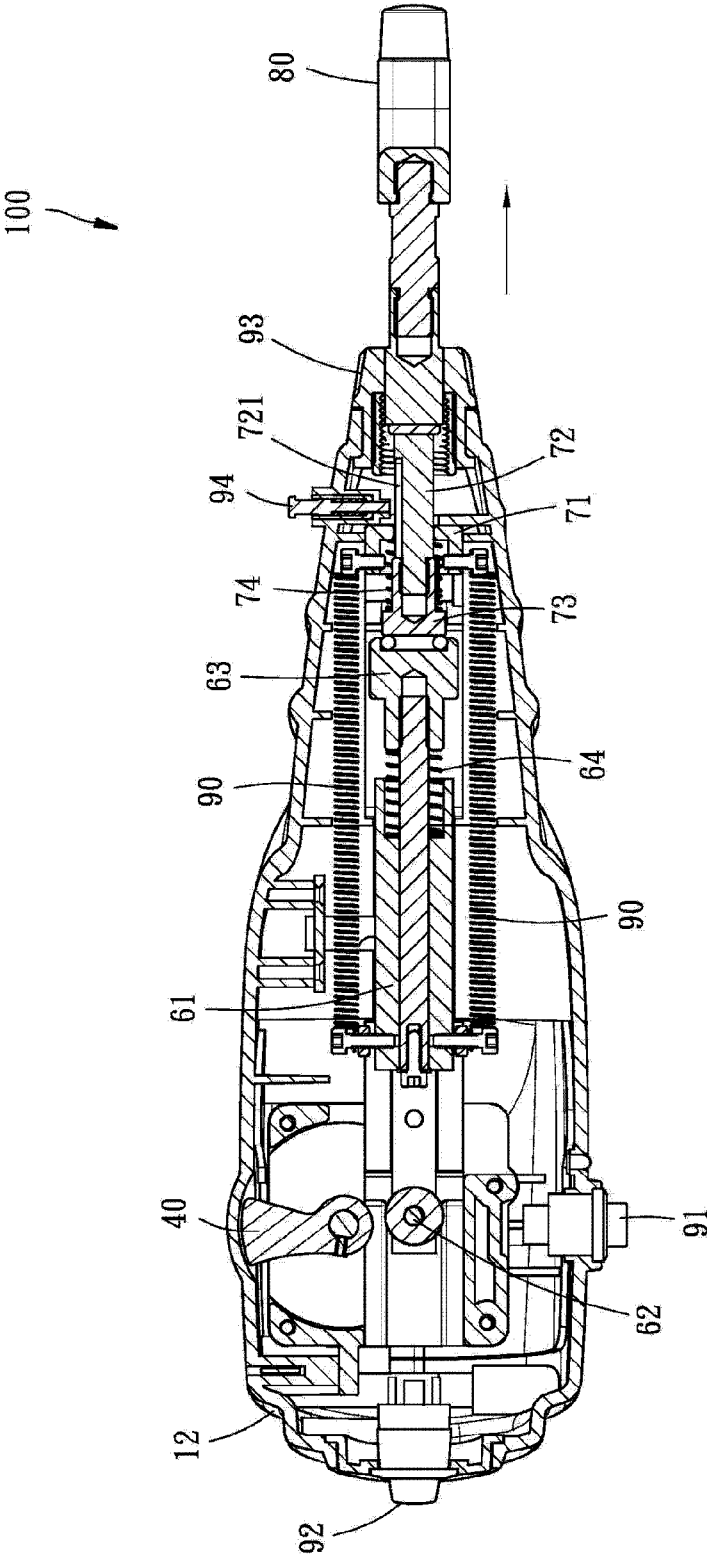


图 7

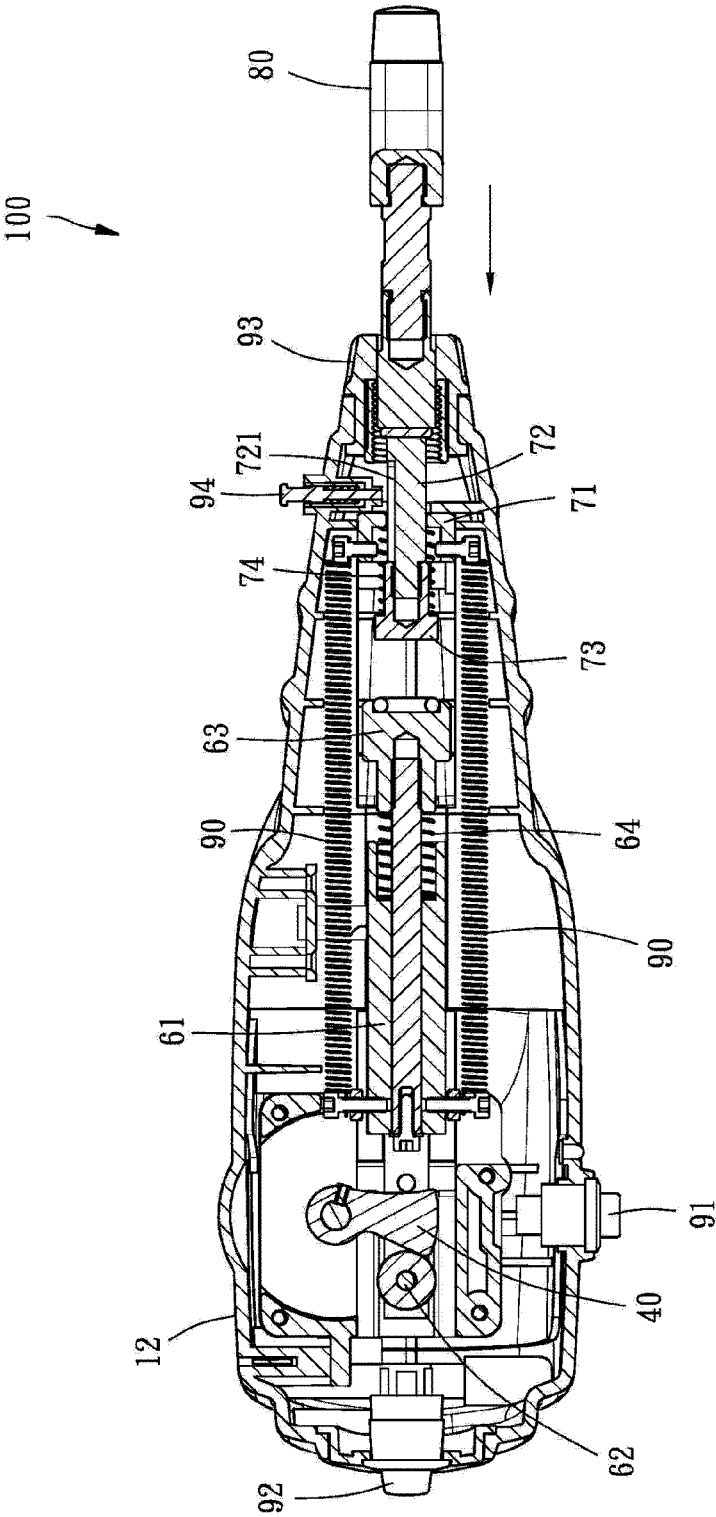


图 8

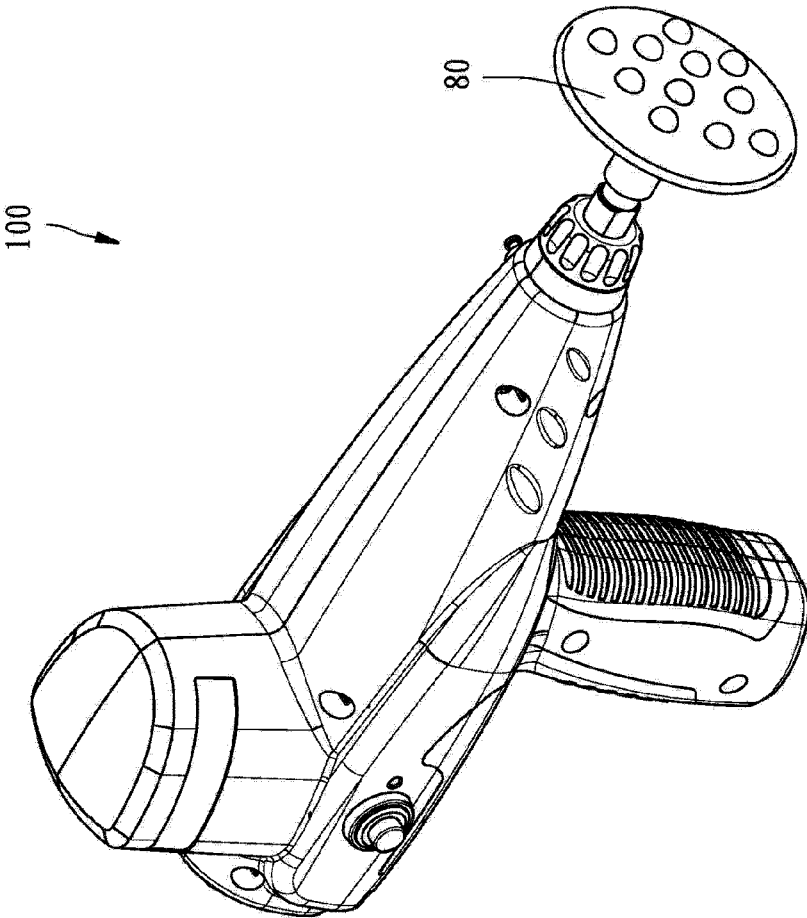


图 9

Muscle-slackening stimulator

Abstract

The present invention provides a muscle stimulation relaxer (100). The muscle stimulator 100 has a slide member 30 which is installed in the inner cavity 45 of the housing 40. The slide member 30 receives the eccentric rotation of the motor (M) to reciprocate back and forth in the cavity (45).

Classifications

■ A61H22/0224 Percussion or vibration massage, e.g. using supersonic vibration; Suction-vibration massage; Massage with moving diaphragms with electric or magnetic drive with rotary motor

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Claims (5)

1. (a) a housing having a cavity formed therein and having an opening formed therein in communication with the cavity;
(b) a slide member which is installed in the cavity of the housing and moves forward and backward along its longitudinal direction, in front of which is provided with a stimulating member for stimulating the muscles and an inner groove formed in the lower surface thereof; ;
(c) the case;

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- (d) an eccentric is installed in the case, the eccentric moves eccentrically according to the rotation of the power shaft, and the eccentric includes a motor passing through the opening of the housing and placed in the inner groove of the lower side of the slide member;
- (e) The eccentric rotates eccentrically in the groove according to the rotation of the power shaft of the motor, whereby the slide member slides back and forth within the cavity of the housing so that the magnetic pole member in front of the motor periodically rotates. Muscle stimulator, characterized in that it can stimulate.
2. The method of claim 1,
And the eccentric to which the eccentric is attached to the motor power shaft of the motor to which the eccentric is attached.
 3. The method according to claim 1 or 2,
The slide member is a muscle stimulator, characterized in that the step of lowering the height is formed in the front side and the stopper is applied to the end of the cavity of the housing is formed.
 4. The method of claim 3,
Muscle back stimulator, characterized in that the weight portion of the housing is formed in the rear portion of the housing is formed with an air hole formed through the inside.
 5. The method of claim 4, wherein the motor
(a) a diode D1 connected between the AC power input terminal AC1 and the first node N1, and a capacitor C1 connected between the AC power input terminal AC1 and the second node N2. And a diode D2 connected between the AC power input terminal AC1 and the third node N3, a resistor R1 connected between the output terminal and the first node N1, the output terminal and the first node. A resistor R2, a switch SW, a variable resistor VR and a resistor R3 connected in series between two nodes N2, and a resistor R4 connected between the output terminal and the third node N3. The thyristor (A) and the cathode (K) are connected to the output terminal and the AC power input terminal (AC1), respectively, and the gate (G) is connected to the second node (N2) through the diac (DIAC). A phase control unit made of TYN);
(b) a muscle stimulation relaxation device, characterized in that it is driven by a motor drive unit comprising a rectifying unit for converting the AC power controlled phase by the phase control unit to a DC power source.

Description

Muscle-slackening stimulator

The present invention relates to a muscle stimulator. According to the present invention, when the muscle is contracted or damaged due to overload or abnormalities in blood circulation of the muscle area, effective treatment is possible.

Excessive use of body muscles or heavy loads can cause muscle tissue to contract or damage. In addition, in this case, the abnormal blood flow (血流) associated with muscle tissue can cause problems in the use of muscle. Conventional treatments in this case were to knead the muscles by hand or to exercise lightly. However, following these methods requires a lot of time and is not very efficient. Particularly, in case of exercise, a certain space and tools are required, which is a burden on the patient's point of view.

The conventional massager is to vibrate the muscles by vibrating according to the eccentric rotation of the weight connected to the motor, and may not give a direct stimulus to the muscles periodically. Therefore, there is a need for a device capable of treating muscle damage by relaxing muscles by giving direct stimulation to the muscles at regular intervals.

The present invention satisfies the aforementioned request. Therefore, an object of the present invention is to provide a muscle stimulation diastolic that can cure muscle damage caused by overload by stimulating the muscles to relax the muscles. Particularly, according to the present invention, the slide member equipped with the muscle stimulation member reciprocates back and forth, thereby stimulating the muscle, thereby achieving relaxation of the muscle.

According to the present invention, a muscle stimulation relaxation device according to the purpose is provided with a cavity formed therein and an opening communicating with the cavity at the bottom thereof, and installed in the cavity of the housing to move forward and backward along its longitudinal direction. In front of it, a stimulation member for stimulating muscles is provided, the lower surface is provided with a slide member having an inner groove formed therein, a case, and an eccentric which is installed in the case and eccentrically moves according to the rotation of the power shaft. The eccentric may include a motor passing through an opening of the housing and placed in an inner groove of a lower side of the slide member. According to this configuration, the eccentric rotates eccentrically in the groove according to the rotation of the power shaft of the motor, so that the slide member slides back and forth in the cavity of the housing so that the magnetic pole member in front of the muscle it can be stimulated periodically.

In one embodiment of the present invention, the eccentric is attached to the motor by being coupled to the power shaft of the additional motor to which the eccentric is attached.

In addition, the slide member is formed with a step of lowering its height toward the front side, and a stopper that is caught by the end is formed in the cavity of the housing.

In particular, according to the present invention, it is preferable that the weight portion having an air hole formed through the inside thereof is coupled to the rear portion of the housing.

In addition, the motor includes a diode D1 connected between the AC power input terminal AC1 and the first node N1, and a capacitor C1 connected between the AC power input terminal AC1 and the second node N2. A diode D2 connected between the AC power input terminal AC1 and the third node N3, a resistor R1 connected between the output terminal and the first node N1, the output terminal and A resistor R2, a switch SW, a variable resistor VR and a resistor R3 connected in series between the second node N2, and a resistor R4 connected between the output terminal and the third node N3. An anode A and a cathode K are connected to the output terminal and the AC power input terminal AC1, respectively, and a gate G is connected to the second node N2 through a diac DIAC. And a rectifier for converting the AC power whose phase is controlled through the phase controller to DC power through a phase control part formed of a connected thyristor (TYN). It is driven by a motor drive.

1 is an exploded perspective view of a muscle stimulation relaxer according to the present invention;

2 is a cross-sectional view of the present invention;

3 is an example of a circuit for controlling a motor in the present invention; And

Figure 4 is a view showing a state in which the muscle relaxer assembled according to the present invention.

<Description of Major Symbols in Drawing>

100: muscle stimulation relaxer 30: slide member 40: housing

M: motor 80: mold part 60: case

Now, with reference to the accompanying drawings, preferred embodiments of the present invention will be described.

1 is an exploded perspective view of the muscle stimulation relaxation device 100 according to the present invention and Figure 2 is a cross-sectional view of the combined state.

As shown in Figures 1 and 2, the muscle stimulation relaxer 100 according to the present invention has a housing 40, the cavity 45 is formed therein. An opening 48 is formed in the lower surface of the housing 40 to communicate with the cavity 45. In this embodiment, the opening 48 has a female threaded portion. In addition, as

shown, the rear portion of the cavity portion 45 is formed with a screw portion 455 therein, the weight 50 may be coupled thereto.

A slide member 30 is installed in the cavity 45 of the housing 40, and periodically and reciprocates periodically according to the eccentric rotation of the eccentric 15 of the motor M as described below.

The slide member 30 has a stage 375 having a height lowered toward the front side, and a screw 408 is installed at the front portion of the housing 40 through the cavity 45 to the stage 305.), And acts as a stopper 403 that prevents the slide member 30 from moving forward or more.

A bolt portion 31 is formed at the front of the slide member 30 and coupled to the female screw portion 91 of the muscle stimulation member 90. The muscle stimulating member 90 is made of a soft material such as silicon or rubber.

The lower surface of the slide member 30 is formed with an end inward to form an inner groove 328.

The slide member 40 is installed in the cavity 45 of the housing 40 so that the inner groove 328 of the slide member 30 and the opening 48 in which the female thread of the housing 40 is formed correspond to each other. do.

In the present embodiment, the housing 40 is fixedly installed in the cavity 85 of the mold part 80 and corresponds to the opening 48 of the housing 40 in the cavity part 85 of the mold part 80. The opening 88 is formed at the position to be.

The slide member 40 according to the present invention forms a reciprocating motion back and forth according to the rotation of the motor (M). The motor M is built in the case 60, and the power shaft 3 is coupled to the penetrating portion 13 of the weight 10 to which the eccentric 15 is attached. Accordingly, when the power shaft 3 of the motor M rotates, the weight 10 rotates, and thus the eccentric 15 forms an eccentric rotational motion. 18 is a bearing member 15 which is coupled to the eccentric 15.

As shown in the figure, the motor M has a cylindrical shape in which a screw portion 28 is formed on its outer circumferential surface, and a coupling member 20 having a wing portion on its lower surface is coupled via a screw 7. The weight 10 coupled with the motor M is placed in the cavity of the cylinder of the coupling member 20 and forms a rotation therein.

The screw portion 28 of the coupling member 20 penetrates through the opening 88 of the mold portion 80 and is coupled to the opening 48 having a female thread formed on the lower surface of the housing 40. At this time, the eccentric 15 of the eccentric weight 10 is placed inside the groove 328 installed in the cavity 45 of the housing 40.

Accordingly, when the eccentric 15 rotates eccentrically according to the rotation of the power shaft 3 of the motor M, the eccentric 15 hits the inner surface of the groove 328 and consequently the slide. In the cavity 45 of the housing 40, the member 30 forms a reciprocating movement forward and backward according to the eccentric movement period of the eccentric 15.

The weight 50 may be coupled to the rear end of the housing 40. The weight 50 is balanced by applying a stimulus to the muscle by using the muscle stimulation relaxation device 100 according to the present invention and also reduces the vibration due to the eccentric rotation of the motor. In the embodiment of the present invention, the weight 50 is composed of two 51, 53, each is detachably coupled by the coupling of the bolt portion 511 and the corresponding female screw portion 531. . In addition, the weight 51 is coupled to the bolt portion 515 of the weight 51 to the female screw portion 455 formed on the inner surface of the opening of the housing 40. In this case, the cavity portions 512 and 532 communicating with the outside are formed in the weights 51 and 53, respectively. This is to discharge the compressed air formed therein as the slide member 30 performs the forward and backward reciprocating slide movement in the interior of the housing 40.

3 shows a driving circuit for driving the motor M according to the present invention.

In the motor driving unit 200 of the present invention, the phase control unit 10 connected to the first AC power input terminal AC1, the first and second input terminals, the output terminal of the phase control unit 10 and the second AC power input terminal (Rectifiers 20 respectively connected to AC2) and the motor M operated by a DC voltage output from the rectifier 20.

The phase controller 10 is connected between a diode D1 connected between a first AC power input terminal AC1 and a first node N1, a first AC power input terminal AC1, and a second node N2. The diode D2 connected between the capacitor C1, the first AC power input terminal AC1, and the third node N3, the resistor R1, the output terminal, and the first connected between the output terminal and the first node N1. The resistor R2, the switch SW, the variable resistor VR, and the resistor R3 connected in series between the two nodes N2, the resistor R4 connected between the output terminal and the third node N3, and the anode (A) and the cathode (K) are connected to the output terminal and the first AC power input terminal (AC1), respectively, and the gate (G) to the thyristor (TYN) connected to the second node (N2) through the DIAC (DIAC) it is composed.

Accordingly, when the AC voltage is input through the first and second AC power input terminals AC1 and AC2 while the switch SW is turned off, the diode D2 and the resistor R4 of the phase controller 10 are input.) Or a DC voltage is output from the rectifier 20 by the flow of current through the resistor R1 and the diode D1, thereby driving the motor 30.

In this state, when the switch SW is turned on, charging occurs in the capacitor C1 by forming a path through the resistor R2, the variable resistor VR, and the resistor R3, and the charging is completed after a predetermined time. When the potential of the second node N2 is increased, the diode DIAC conducts, and thus a current flows through the thyristor TYN. At this time, the flow time of the current through the thyristor (TYN) is determined by the resistance value of the variable resistor (VR) and resistor (R3) and the time constant of the capacitor (C1). For example, when the resistance value of the variable resistor VR increases, the flow time of the current through the thyristor TYN becomes long, and when the resistance value of the variable resistor VR decreases, the flow time of the current through the thyristor TYN increases. Will be shortened.

Accordingly, the waveform of the DC voltage output from the rectifying unit 20 changes according to the phase control of the AC power, thereby driving time and driving force of the motor 30 are controlled. In FIGS. 1 and 2, the variable switch 70 controlling the phase controller 10 is exposed to the outside of the case 60.

In the figure, diodes D3 and D4 serve to prevent reverse current flow between nodes N2 and N1 and nodes N3 and N2, and capacitor C2 increases the efficiency of the motor 30 and removes ripple. It plays a role.

4 shows a state in which the muscle stimulation relaxer 100 is assembled according to the present invention.

As such, the present invention provides a muscle stimulation relaxer having a slide member that receives an eccentric rotation of the motor and moves back and forth within the housing. The slide member is equipped with a muscle stimulation member in front of the slide member to stimulate the muscles periodically according to the reciprocating movement of the slide member, thereby relaxing the muscles.

It will be understood that the purpose of the present invention has been achieved.

Although the present invention has been described with reference to the embodiments, the present invention is not limited thereto. In accordance with the spirit of the present invention, the scope of the present invention is defined by the following claims.

Cited By (2)

Publication number	Priority date	Publication date	Assignee	Title
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WO/2019/164555A1 *	2018-02-22	2019-08-29	Hyper Ice, Inc.	Battery-powered percussive massage device
Family To Family Citations				

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Priority And Related Applications

Priority Applications (1)				▲
Application	Priority date	Filing date	Title	
KR20-2003-0001034U	2003-01-14	2003-01-14	Muscle-slackening stimulator	

Applications Claiming Priority (1)				▲
Application	Filing date	Title		
KR20-2003-0001034U	2003-01-14	Muscle-slackening stimulator		

Legal Events				▲
Date	Code	Title	Description	
2003-04-10	REGI	Registration of establishment		
2004-01-14	T201	Request for technology evaluation of utility model		
2005-01-07	T701	Written decision to grant on technology evaluation		
2012-04-24	FPAY	Annual fee payment	Payment date: 20120424 Year of fee payment: 10	
2013-01-15	EXPY	Expiration of term		

Concepts				▲
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Name	Image	Sections	Count	Query match
⌘ Muscles		claims,abstract,description	42	0.000
⌘ stimulation		claims,abstract,description	16	0.000

⌘ capacitor	claims,description	6	0.000
⌘ stimulating	claims,description	6	0.000
Show all concepts from the description section			

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(19)대한민국특허청(KR)
(12) 등록실용신안공보(Y1)

(51) 。 Int. Cl. 7
A61H 23/02

(45) 공고일자 2003년05월01일
(11) 등록번호 20- 0311328
(24) 등록일자 2003년04월10일

(21) 출원번호 20- 2003- 0001084
(22) 출원일자 2003년01월14일

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기술적요건 심사관 : 변종진

기술평가청구 : 없음

(54)근육자극이완기

요약

본 고안은 근육자극이완기(100)를 제공한다. 상기 근육자극이완기(100)는 하우징(40)의 내부공동부(45)에 설치되는 슬라이드부재(30)를 가진다. 상기 슬라이드부재(30)는 모터(M)의 편심 회전운동을 받아 상기 공동부(45)에서 전후로 왕복운동을 이룬다.

배표도

도 2

색인어

근육자극, 이완, 슬라이드, 편심

명세서

도면의 간단한 설명

도 1은 본 고안에 따른 근육자극이완기의 분해사시도;

도 2는 본 고안의 단면도;

도 3은 본 고안에서 모터를 제어하는 회로의 일 예; 그리고

도 4는 본 고안에 따른 근육이완기가 조립된 상태를 보이는 도면.

<도면의 주요부호에 대한 설명>

100: 근육자극이완기 30: 슬라이드부재 40: 하우징

M:모터 80: 몰드부 60: 케이스

고안의 상세한 설명

고안의 목적

고안이 속하는 기술 및 그 분야의 종래기술

본 고안은 근육자극이완기에 관한 것이다. 본 고안에 따라서 과부하에 의하여 근육이 수축 또는 손상되거나 근육부위의 혈액순환 등에 이상이 있는 경우 효과적인 치료가 가능하게 된다.

신체 근육을 과도하게 사용하거나 또는 과중한 짐을 옮기거나 하는 등의 경우 근육조직이 수축되거나 손상될 수 있다. 또한, 이러한 경우 근육조직과 관련된 혈류(血流)에 이상이 생겨 근육의 사용에 문제를 일으킬 수 있다. 종래 이러한 경우의 치료법은 근육을 손으로 주무르거나 가벼운 운동을 하는 것이 있었다. 그러나, 이러한 방법을 따를 경우 많은 시간이 필요하여 그리 효율적이지 못하였으며, 특별히 운동의 경우는 일정공간과 도구가 필요하여 환자의 입장에서 부담이 되고 있다.

종래의 안마기는 모터에 연결된 웨이트(weight)의 편심 회전에 따른 진동으로 근육에 진동을 주는 것으로서 근육에 주기적으로 직접적인 자극을 줄 수 있는 것은 아니다. 따라서, 일정 주기로 근육에 직접적인 자극을 주어 근육을 이완시켜 근육손상 등을 치료할 수 있는 장치가 요망된다.

고안이 이루고자 하는 기술적 과제

본 고안은 상술한 요청을 만족시킨다. 따라서, 본 고안의 목적은 근육에 자극을 주어 근육을 이완시켜 과부하 등에 의하여 근육에 생긴 손상을 치료할 수 있는 근육자극 이완기를 제공하는 것이다. 특별히, 본 발명에 따를 경우 근육자극 부재가 장착된 슬라이드 부재가 전후로 왕복운동을 이르며 근육을 자극하여 이에 따라 근육의 이완을 이룬다.

이러한 본 고안에 목적에 따른 근육자극이완기는 내부에 공동부가 형성되며 그 하부에 상기 공동부와 연통하는 개구부가 형성된 하우징과, 상기 하우징의 공동부에 설치되어 그 길이방향을 따라 전.후진하는 것으로서, 그 전방에는 근육에 자극을 주기 위한 자극부재가 설치되어 있고 그 하부면에는 내측 홈이 형성되어 있는 슬라이드 부재와, 케이스와, 상기 케이스 내에 설치되며, 동력축의 회전에 따라 편심 운동하는 편심자가 부착되고, 상기 편심자는 상기 하우징의 개구부를 통과하여 상기 슬라이드 부재의 하측면의 내측 홈에 놓이는 모터를 포함하여 이루어지는 것을 특징으로 한다. 이러한 구성에 따라서, 상기 모터의 동력축의 회전에 따라 상기 편심자가 상기 홈 내부에서 편심회전운동을 하고 이에 따라 상기 슬라이드부재가 상기 하우징의 공동부내에서 전후로 슬라이드 운동을 하여 그 전방의 자극부재가 근육에 주기적으로 자극을 줄 수 있게 된다.

본 고안의 일 실시 예에서, 상기 편심자가 부착된 추가 상기 모터의 동력축에 결합되어 상기 모터에 대하여 상기 편심자가 부착된다.

또한, 상기 슬라이드 부재는 전방측으로 그 높이가 낮아지는 단이 형성되며 상기 하우징의 공동부에는 상기 단에 걸리는 스톱퍼가 형성되어 있다.

특별히, 본 고안에 따를 경우, 상기 하우징의 후부에는 그 내부를 관통하여 형성되는 공기구멍이 형성된 무게추가 결합되어 있는 것이 바람직하다.

또한, 상기 모터는 상기 교류전원 입력단자(AC1) 및 제 1 노드(N1) 간에 접속된 다이오드(D1)와, 상기 교류전원 입력단자(AC1) 및 제 2 노드(N2) 간에 접속된 캐패시터(C1)와, 상기 교류전원 입력단자(AC1) 및 제 3 노드(N3) 간에 접속된 다이오드(D2)와, 출력단자 및 상기 제 1 노드(N1) 간에는 접속된 저항(R1)과, 상기 출력단자 및 상기 제 2 노드(N2) 간에 직렬 접속된 저항(R2), 스위치(SW), 가변저항(VR) 및 저항(R3)과, 상기 출력단자 및 상기 제 3 노드(N3) 간에 접속된 저항(R4)과, 애노드(A) 및 캐소드(K)가 상기 출력단자 및 교류전원 입력단자(AC1)에 각각 접속되며, 게이트(G)가 다이악(DIAC)을 통해 상기 제 2 노드(N2)에 연결된 사이리스터(TYN)로 이루어진 위상제어부와, 상기 위상제어부를 통해 위상이 제어된 상기 교류전원을 직류전원으로 변환하는 정류부를 포함하여 이루어지는 모터 구동부에 의하여 구동된다.

고안의 구성 및 작용

이제, 본 고안의 바람직한 실시예를 첨부한 도면을 참고로 하여 설명한다.

도 1은 본 고안에 따른 근육자극이완기(100)의 분해사시도이고 도 2는 결합된 상태의 단면도이다.

도 1 및 도 2에서 도시된 바와 같이, 본 고안에 따른 근육자극이완기(100)는 그 내부에 공동부(45)가 형성되는 하우징(40)을 가진다. 상기 하우징(40)의 그 하부면에는 상기 공동부(45)와 연통하는 개구부(48)가 형성되며 본 실시예에서 상기 개구부(48)에는 암나사부가 형성되어 있다. 또한 도시한 바와 같이 상기 공동부(45)의 그 후부측에는 내부에 나사부(455)가 형성되어 여기에 무게추(50)가 결합될 수 있다.

상기 하우징(40)의 공동부(45)에는 슬라이드부재(30)가 설치되어, 후술하는 바와 같이 모터(M)의 편심자(15)의 편심회전에 따라 주기적으로 전후 왕복운동을 이룬다.

상기 슬라이드부재(30)는 전방측으로 높이가 낮아지는 단(375)이 형성되며, 상기 하우징(40)의 전방부에는 그 공동부(45)를 관통하여 나사(408)가 설치되어 상기 단(305)에 걸리며, 상기 슬라이드부재(30)가 전방으로 일정 이상 움직이지 못하게 하는 스톱퍼(403)역할을 한다.

상기 슬라이드부재(30)의 전방에는 볼트부(31)가 형성되어 근육자극부재(90)의 암나사부(91)에 결합된다. 상기 근육자극부재(90)는 실리콘이나 고무과 같은 연질재질로 이루어진다.

상기 슬라이드부재(30)의 하부면에는 안쪽으로 단이 형성되어 내측 홈(328)이 형성된다.

상기 슬라이드부재(30)의 내측홈(328)과 상기 하우징(40)의 암나사가 형성된 개구부(48)가 대응되도록 하여 상기 슬라이드부재(40)는 상기 하우징(40)의 공동부(45)에 설치된다.

본 실시예에서 상기 하우징(40)은 몰드부(80)의 공동부(85)에 고정설치되며 상기 몰드부(80)의 공동부(85)에서 상기 하우징(40)의 개구부(48)와 대응되는 위치에는 개구부(88)가 형성된다.

본 고안에 따른 상기 슬라이드부재(40)는 모터(M)의 회전에 따라 전후로 왕복운동을 이룬다. 상기 모터(M)는 케이스(60)에 내장되며, 그 동력축(3)이 편심자(15)가 부착된 추(10)의 관통부(13)에 결합된다. 따라서, 상기 모터(M)의 동력축(3)이 회전하면 상기 추(10)가 회전하며 이에 따라 상기 편심자(15)는 편심회전운동을 이룬다. 도시부호 18은 상기 편심자(15)에 결합되는 베어링 부재(15)이다.

상기 모터(M)에는, 도시한 것과 같이, 그 외주면에 나사부(28)가 형성되는 실린더 형상으로 그 하면에 날개부를 가지는 결합부재(20)가 나사(7)를 통하여 결합된다. 상기 모터(M)와 결합된 상기 추(10)는 상기 결합부재(20)의 실린더의 공동부에 놓이며 그 내부에서 회전을 이룬다.

상기 결합부재(20)의 나사부(28)는 상기 몰드부(80)의 개구부(88)를 관통하여 상기 하우징(40)의 하면의 암나사가 형성된 개구부(48)에 결합된다. 이때, 상기 편심추(10)의 편심자(15)가 상기 하우징(40)의 공동부(45)에 설치된 홈부(328)의 내부에 놓이게 된다.

따라서, 상기 모터(M)의 동력축(3)의 회전에 따라 상기 편심자(15)가 편심회전을 하면, 상기 편심자(15)는 상기 홈부(328)의 내면을 치게되어 결과적으로 상기 슬라이드부재(30)는 상기 하우징(40)의 공동부(45)에서 그 길이방향을 따라, 상기 편심자(15)의 편심운동주기에 따라 전후왕복운동을 이루게 된다.

상기 하우징(40)의 후단에는 무게추(50)가 결합될 수 있다. 상기 무게추(50)는 본 고안에 따른 근육자극이완기(100)를 이용하여 근육에 자극을 가할 때 밸런스(balance)를 맞추어주며 또한 모터의 편심회전에 따른 진동을 감소시킨다.

본 고안의 실시예에서, 상기 무계추(50)는 두 개(51)(53)로 이루어지며 각각은 볼트부(511)와 이에 대응하는 암나사부(531)의 결합에 의하여 분리 가능하게 결합된다. 또한 무계추(51)는 상기 하우징(40)의 개구부의 내면에 형성된 암나사부(455)부에 상기 무계추(51)의 볼트부(515)가 결합된다. 이때 상기 무계추(51)(53)의 내부에는 외부로 연통되는 공동부(512)(532)가 각각 형성된다. 이것은 상기 슬라이드부재(30)가 상기 하우징(40)의 내부에서 전후 왕복 슬라이드 운동을 함에 따라 그 내부에서 형성되는 압축공기를 외부로 배출하기 위함이다.

도 3은 본 고안에 따른 모터(M)를 구동시키는 구동회로를 보인다.

본 고안의 모터구동부(200)는 제 1 교류전원 입력단자(AC1)에 연결된 위상 제어부(10), 제 1 및 제 2 입력단자가 위상 제어부(10)의 출력단자 및 제 2 교류전원 입력단자(AC2)에 각각 연결된 정류부(20), 그리고 정류부(20)로부터 출력되는 직류 전압에 의해 동작되는 상기 모터(M)로 이루어진다.

상기 위상 제어부(10)는 제 1 교류전원 입력단자(AC1) 및 제 1 노드(N1) 간에 접속된 다이오드(D1), 제 1 교류전원 입력단자(AC1) 및 제 2 노드(N2) 간에 접속된 캐패시터(C1), 제 1 교류전원 입력단자(AC1) 및 제 3 노드(N3) 간에 접속된 다이오드(D2), 출력단자 및 제 1 노드(N1) 간에는 접속된 저항(R1), 출력단자 및 제 2 노드(N2) 간에 직렬 접속된 저항(R2), 스위치(SW), 가변저항(VR) 및 저항(R3), 출력단자 및 제 3 노드(N3) 간에 접속된 저항(R4), 그리고 에노드(A) 및 캐소드(K)가 출력단자 및 제 1 교류전원 입력단자(AC1)에 각각 접속되며 게이트(G)가 다이악(DIAC)을 통해 제 2 노드(N2)에 연결된 사이리스터(TYN)로 구성된다.

이에 따라, 스위치(SW)가 오프(Off)된 상태에서 제 1 및 제 2 교류전원 입력단자(AC1 및 AC2)를 통해 교류전압이 입력되면 위상 제어부(10)의 다이오드(D2) 및 저항(R4) 또는 저항(R1) 및 다이오드(D1)를 통한 전류의 흐름에 의해 정류부(20)로부터 직류전압이 출력되고, 이에 의해 모터(30)의 구동이 이루어진다.

이 상태에서 스위치(SW)가 온(On)되면 저항(R2), 가변저항(VR) 및 저항(R3)을 통한 경로의 형성에 의해 캐패시터(C1)에 충전이 일어나는데, 소정 시간 후 충전이 완료되면 제 2 노드(N2)의 전위가 상승되어 다이악(DIAC)이 도통되고, 이에 따라 사이리스터(TYN)를 통한 전류의 흐름이 발생된다. 이 때, 사이리스터(TYN)를 통한 전류의 흐름 시간은 가변저항(VR) 및 저항(R3)의 저항값과 캐패시터(C1)의 시상수에 의해 정해진다. 예를 들어, 가변저항(VR)의 저항값이 커지면 사이리스터(TYN)를 통한 전류의 흐름 시간이 길어지고, 가변저항(VR)의 저항값이 작아지면 사이리스터(TYN)를 통한 전류의 흐름 시간이 짧아지게 된다.

따라서 이와 같은 교류전원의 위상제어에 따라 정류부(20)로부터 출력되는 직류전압의 파형이 변화되고, 이에 따라 모터(30)의 구동시간 및 구동력이 제어된다. 도 1 및 2에서 상기 위상제어부(10)를 제어하는 가변 스위치(70)가 케이스(60)의 외부에 노출된다.

도면에서 다이오드(D3 및 D4)는 노드(N2 및 N1) 그리고 노드(N3 및 N2) 간의 역전류 흐름을 방지하는 역할을 하며, 캐패시터(C2)는 모터(30)의 효율을 높이는 동시에 리플을 제거하는 역할을 한다.

도 4는 본 고안에 따른 근육자극이완기(100)가 조립된 상태를 보인다.

고안의 효과

이와 같이 본 고안은, 모터의 편심회전운동을 받아 하우징내부에서 전후 왕복운동을 하는 슬라이드 부재를 가지는 근육자극이완기를 제공한다. 상기 슬라이드부재는 그 전방에 근육자극부재가 장착되어, 슬라이드부재의 왕복운동에 따라 주기적으로 근육을 자극하게 되고 이에 따라 근육이 이완된다.

이로서 본 고안의 목적이 달성되었음을 이해할 수 있을 것이다.

본 고안은 실시예를 중심으로 설명되었으나, 이에 한정되지 않으며, 본 고안의 사상에 따라 그 권리범위는 다음의 청구범위에 의한다.

(57) 청구의 범위

청구항 1.

(a) 내부에 공동부가 형성되며 그 하부에 상기 공동부와 연통하는 개구부가 형성된 하우징과;

(b) 상기 하우징의 공동부에 설치되어 그 길이방향을 따라 전.후진하는 것으로서, 그 전방에는 근육에 자극을 주기 위한 자극부재가 설치되어 있고 그 하부면에는 내측 홈이 형성되어 있는 슬라이드 부재와;

(c) 케이스와;

(d) 상기 케이스 내에 설치되며, 동력축의 회전에 따라 편심 운동하는 편심자가 부착되고, 상기 편심자는 상기 하우징의 개구부를 통과하여 상기 슬라이드 부재의 하측면의 내측 홈에 놓이는 모터를 포함하여 이루어져;

(e) 상기 모터의 동력축의 회전에 따라 상기 편심자가 상기 홈 내부에서 편심회전운동을 하고 이에 따라 상기 슬라이드부재가 상기 하우징의 공동부내에서 전후로 슬라이드 운동을 하여 그 전방의 자극부재가 근육에 주기적으로 자극을 줄 수 있음을 특징으로 하는 근육자극이완기.

청구항 2

제1항에 있어서,

상기 편심자가 부착된 추가 상기 모터의 동력축에 결합되어 상기 모터에 대하여 상기 편심자가 부착되는 것을 특징으로 하는 근육자극이완기.

청구항 3

제1항 또는 제2항에 있어서,

상기 슬라이드 부재는 전방측으로 그 높이가 낮아지는 단이 형성되며 상기 하우징의 공동부에는 상기 단에 걸리는 스톱퍼가 형성되어 있음을 특징으로 하는 근육자극이완기.

청구항 4

제3항에 있어서,

상기 하우징의 후부에는 그 내부를 관통하여 형성되는 공기구멍이 형성된 무게추가 결합되어 있는 것을 특징으로 하는 근육자극이완기.

청구항 5

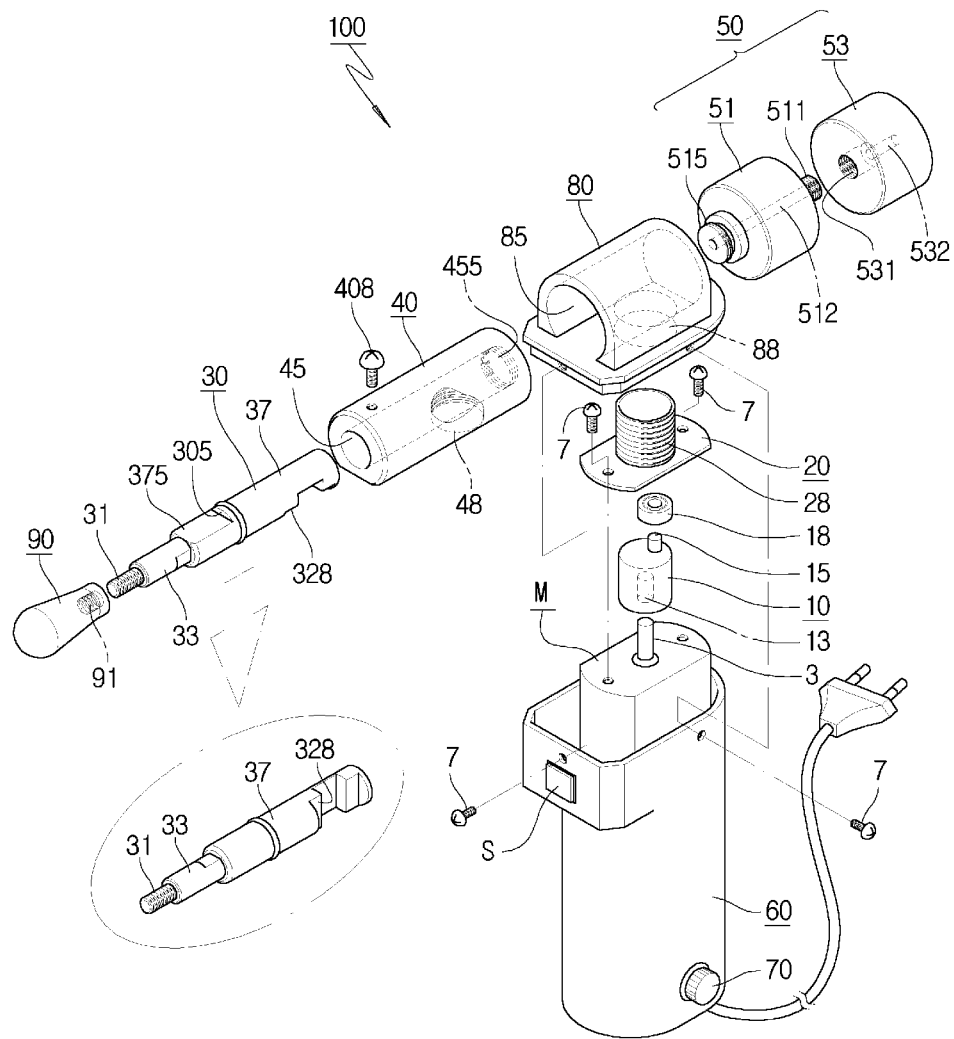
제4항에 있어서, 상기 모터는

(a) 상기 교류전원 입력단자(AC1) 및 제 1 노드(N1) 간에 접속된 다이오드(D1)와, 상기 교류전원 입력단자(AC1) 및 제 2 노드(N2) 간에 접속된 캐패시터(C1)와, 상기 교류전원 입력단자(AC1) 및 제 3 노드(N3) 간에 접속된 다이오드(D2)와, 출력단자 및 상기 제 1 노드(N1) 간에는 접속된 저항(R1)과, 상기 출력단자 및 상기 제 2 노드(N2) 간에 직렬 접속된 저항(R2), 스위치(SW), 가변저항(VR) 및 저항(R3)과, 상기 출력단자 및 상기 제 3 노드(N3) 간에 접속된 저항(R4)과, 에노드(A) 및 캐소드(K)가 상기 출력단자 및 교류전원 입력단자(AC1)에 각각 접속되며, 게이트(G)가 다이악(DIAC)을 통해 상기 제 2 노드(N2)에 연결된 사이리스터(TYN)로 이루어진 위상제어부와;

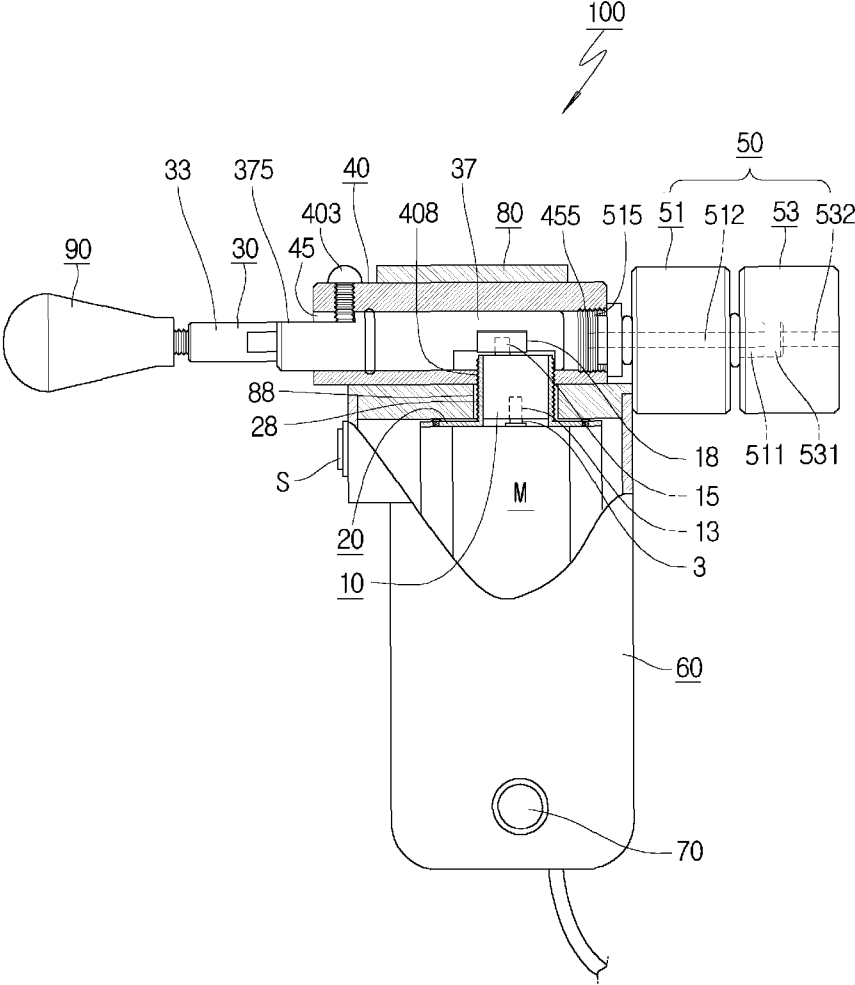
(b) 상기 위상 제어부를 통해 위상이 제어된 상기 교류전원을 직류전원으로 변환하는 정류부를 포함하여 이루어지는 모터 구동부에 의하여 구동되는 것을 특징으로 하는 근육자극이완기.

도면

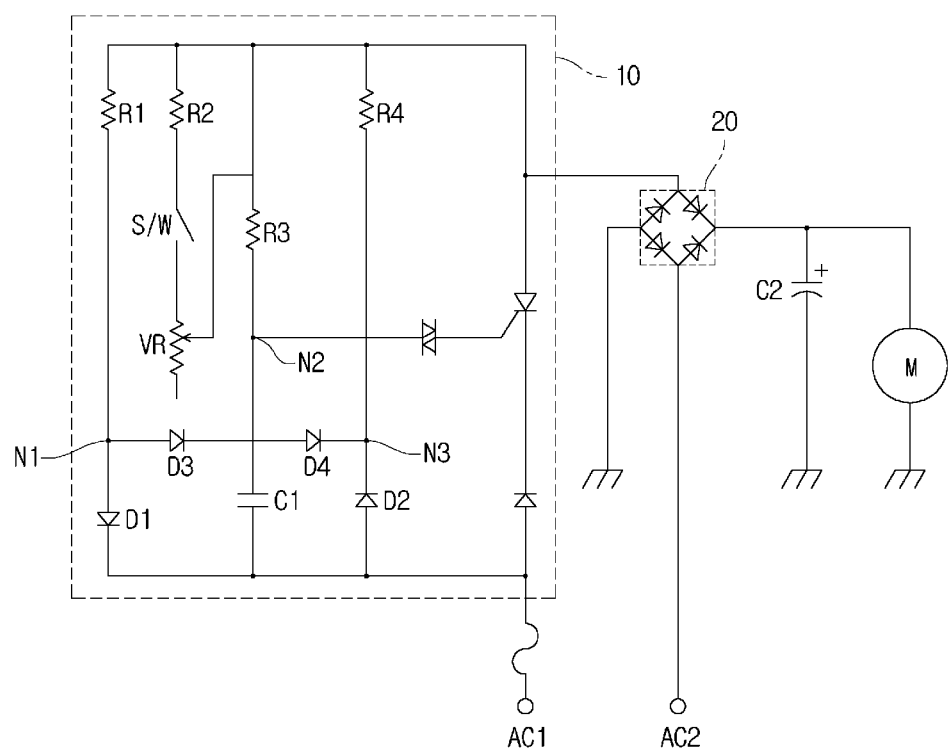
594



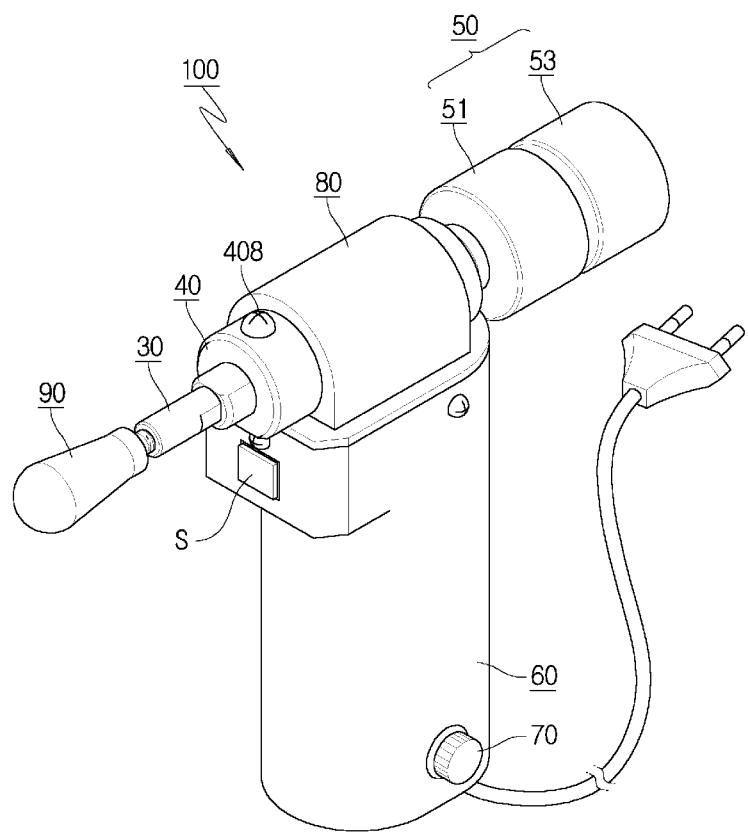
도면 2



도면3



도면4





[12] 实用新型专利说明书

[21] ZL 专利号 03262687.8

[45] 授权公告日 2005 年 4 月 27 日

[11] 授权公告号 CN 2694966Y

[22] 申请日 2003.8.27 [21] 申请号 03262687.8

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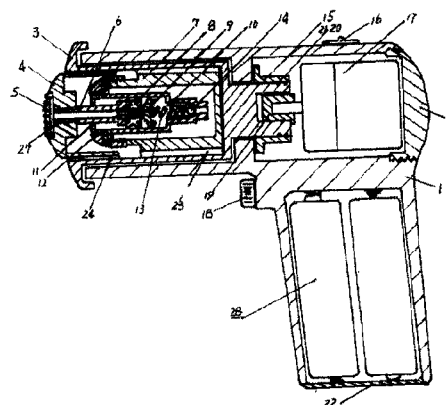
[72] 设计人 张 禄

权利要求书 1 页 说明书 3 页 附图 1 页

[54] 实用新型名称 一种可以喷施美容护肤液的便携式面部按摩器

[57] 摘要

本实用新型公开了一种可以喷施美容护肤液的便携式面部按摩器，是由塑料外壳，机械传动装置、喷施按摩头组成，采用这种按摩器不需对面部进行提前处理便可直接按摩，并在按摩的过程中可随时喷出美容护肤清洗液对面部进行美容按摩，特别对面部有色素沉积者，在使用本按摩器的同时可直接喷入祛斑药物进行综合按摩治疗，具有体积小，使用便捷，集医疗、保健、美容于一体的特点。



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MassagerPriorArt0000525

Petitioner Therabody Ex-1013, 2086

ISSN 1008-4274

1、一种可以喷施美容护肤液的便携式面部按摩器，是由塑料壳体、机械传动装置、喷施器及驱动电路组成，其特征是：在塑料壳体(1)上装有一个逆顺开关(16)和一个变阻器(18)，壳体(1)内的电池组(28)通过导线将其顺次连接并接入驱动电机(17)内，机械传动装置中的转动轴筒(3)从塑料壳体(1)的前端伸入该壳体(1)的内腔中，该转动轴筒(3)的前端带有向外翻的边沿，轴筒(3)的后端沿轴向向下延伸出一圆柱形转轴，转轴近端部的外壁上有环形凹槽(20)，一圆柱管形止锁套(15)沿轴向从后盖(2)处进入塑料壳体(1)内与转动轴筒(3)后端的转轴套合，止锁套(15)上的凸台(21)卡入转动轴筒(3)后端的凹槽(20)内，带有联轴器(19)的驱动电机(17)从塑料壳体(1)的后盖(2)处进入塑料壳体(1)内与转动轴筒(3)后端转轴上的内孔插接，在转动轴筒(3)的内腔壁上有铸造线，内腔中插入并固定着外表面带有铸造线的喷施器。

2、根据权利要求1所述的一种可以喷施美容护肤液的便携式面部按摩器，其特征是：喷施器的顶端是一个外表面为圆弧形的管状按摩触头(4)，按摩触头(4)的外表面中心镶嵌有一个圆形的触头压盖(5)，压盖(5)上均布着出液孔，按摩触头(4)内侧的中心孔中紧配合装有管状的输液管压轴(6)，沿输液管压轴(6)向下一端，活塞导向体(9)延轴向套入活塞(8)内孔中并插入固定在输液管压轴(6)的内孔中，与弹簧(13)、止逆球(14)顺次连接安装在活塞缸(10)内，活塞缸(10)的上沿与活塞缸上压盖(11)对接并通过喷施器壳体盖(12)旋紧在喷施器壳体(7)上。

3、根据权利要求2所述的一种可以喷施美容护肤液的便携式面部按摩器，其特征是：按摩触头(4)的圆弧形外表面可制成光滑的弧形表面和均布小点的弧形表面二种形式。

4、根据权利要求1所述的一种可以喷施美容护肤液的便携式面部按摩器，其特征是：转动轴筒(3)向外翻边的圆弧形表面可制成光滑的弧面和均布小点的弧形表面二种形式。

一种可以喷施美容护肤液的便携式面部按摩器

所属技术领域

本实用新型涉及一种面部按摩器，尤其是一种可以喷施美容护肤液的便携式面部按摩器。

背景技术

目前，市场上可见到的面部按摩器品种很少，且功能单纯，一般多为单纯的振动式的或是旋转式的，所以在使用过程中往往由于不能及时的配合使用护肤液而在按摩过程中产生许多不适的感觉，使面部按摩效果明显降低。

发明内容

为了克服现有的面部按摩器使用功能单调，不能及时与涂抹护肤液配合进行同步使用这一不足，本实用新型提供一种可以喷施美容护肤液的便携式面部按摩器，这种按摩器可以在对面部实施按摩的同时向按摩部位喷施美容护肤液，使面部按摩趋于更加完美。

本实用新型解决其技术问题所采用的技术方案是：一种可以喷施美容护肤液的便携式面部按摩器，是由塑料壳体、机械传动装置、喷施器及驱动电路组成，在塑料壳体上装有一个逆顺开关和一个变阻器，壳体内部的电池组通过导线将其顺次连接并接入驱动电机内。机械传动装置中的转动轴筒从塑料壳体的前端伸入该壳体的内腔中，转动轴筒的前端带有向外翻的边沿，轴筒的后端沿轴向向下延伸出一圆柱形转轴，转轴近端部的外壁上有环形凹槽，为防止转动轴筒松动，有一圆柱管形止锁套沿轴向从后盖处进入塑料壳体内与转动轴筒后端的转轴套合，止锁套上的凸台卡入转动轴筒后端转轴上的凹槽内，带有联轴器的驱动电机从塑料壳体的后盖处进入塑料壳体内与转动轴筒后端转轴上的内孔插接，在转动轴筒的内腔壁上有铸造线，内腔中插入并固定着外表面带有铸造线的喷施器，向外翻边的圆弧形表面可制成光滑的弧形表面和均布小点的弧形表面二种形式。

该喷施器的顶端是一个外表面为弧形的管状按摩触头，按摩触头的外表面中心镶嵌有一个圆形的触头压盖，压盖上均布着出液孔，按摩触头内侧的中心孔中紧配合装有管状的输液管压轴，沿输液管压轴向下一端，活塞导向体延轴向套入活塞内孔中并插入固定在输液管压轴的内孔中，与弹簧、止逆球顺次连接安装在活塞缸内，活塞缸的上沿与活塞缸上压盖对接并通过喷施器壳体盖旋紧在喷施器壳体上。所述按摩触头的圆弧形外表面可制成光滑的弧形表面和均