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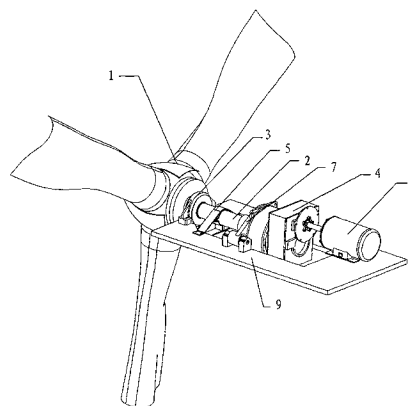
权利要求书 2 页 说明书 4 页 附图 4 页

(54) 实用新型名称

单支撑主轴风力发电机组齿轮箱更换专用卡
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(57) 摘要

本实用新型涉及一种单支撑主轴风力发电机组齿轮箱更换专用卡具,采用夹具A或由夹具A和夹具B共同组成的夹具,夹具A包括上、下压板、托板及桥型压板;上、下压板分别环扣于主轴上且彼此紧固共同将主轴抱紧;托板设于机舱基座下部,两端与机舱基座相固接,中部与下压板下部相固接;桥型压板的桥面紧压于上压板的上部,两端分别固接于风电机组主机架的机舱基座上。夹具B包括上、下抱箍和防转板,上、下抱箍分别环扣于主轴上且彼此紧固共同将主轴抱紧;防转板设于机舱基座下方,两端卡抵于机舱基座上,中部与下抱箍下方相固接。本实用新型用于辅助拆卸齿轮箱,其可有效克服主轴及叶轮重力产生的弯矩和扭转力,提高齿轮箱拆卸速度,节约成本和时间。



1. 一种单支撑主轴风力发电机组齿轮箱更换专用卡具,其特征在于:
包括一组或一组以上的夹具,该夹具为夹具 A,包括上压板、下压板、托板及桥型压板;
上、下压板分别环扣于主轴上且彼此紧固共同将主轴抱紧;
托板设于机舱基座下部,两端与机舱基座相固接,中部与下压板下部相固接;
桥型压板的桥面紧压于上压板的上部,两端分别固接于风电机主机架的机舱基座上。

2. 一种单支撑主轴风力发电机组齿轮箱更换专用卡具,其特征在于:
包括一组或一组以上的夹具,该夹具由夹具 A 和夹具 B 共同组成;

夹具 A 包括上压板、下压板、托板及桥型压板,上、下压板分别环扣于主轴上且彼此紧固共同将主轴抱紧;托板设于机舱基座下部,两端与机舱基座相固接,中部与下压板下部相固接;桥型压板的桥面紧压于上压板的上部,两端分别固接于风电机主机架的机舱基座上;

夹具 B 包括上抱箍、下抱箍和防转板,上、下抱箍分别环扣于主轴上且彼此紧固共同将主轴抱紧;防转板设于机舱基座下方,两端卡抵于机舱基座上,中部与下抱箍下方相固接。

3. 根据权利要求 2 所述的单支撑主轴风力发电机组齿轮箱更换卡具,其特征在于:

所述上抱箍为剖切面呈中部半圆环形且两侧设有向外延伸的外缘的柱体;所述下压板为剖切面呈中部半圆环形、两侧设有向外延伸的外缘且底部设有连接件的柱体。

4. 根据权利要求 2 所述的单支撑主轴风力发电机组齿轮箱更换专用卡具,其特征在于:

所述上抱箍与下抱箍的内侧均设有软性耐磨材料层。

5. 根据权利要求 2 所述的单支撑主轴风力发电机组齿轮箱更换专用卡具,其特征在于:

所述上抱箍和下抱箍内各装设两块弧形钢板,四块钢板组成钢套,钢套内加设软性耐磨材料层;上、下抱箍上分别开设两个以上的螺孔,穿过螺孔的螺栓将钢套紧密压扣在主轴上。

6. 根据权利要求 4 或 5 所述的单支撑主轴风力发电机组齿轮箱更换卡具,其特征在于:

所述的软性耐磨材料层为软布、棉花、泡沫、橡胶或弹性高分子材料层。

7. 根据权利要求 1 或 2 所述的单支撑主轴风力发电机组齿轮箱更换卡具,其特征在于:

所述上压板为剖切面呈中部半圆环形且两侧设有向外延伸的外沿的柱体;所述下压板为剖切面呈中部半圆环形、两侧设有向外延伸的外沿且底部设有连接块的柱体;所述托板为一长方形钢板;所述桥型托板的剖切面呈抛物线形且两侧设有向外延伸的外沿。

8. 根据权利要求 1 或 2 所述的单支撑主轴风力发电机组齿轮箱更换专用卡具,其特征在于:

所述桥型压板的两端及托板的两端通过穿过其上的螺栓共同固接在机舱基座上;所述上压板与下压板两侧的外沿彼此相对,通过螺栓固接在一起;所述下压板与托板通过穿过托板及下压板连接块上的螺栓固接在一起。

9. 根据权利要求 1 或 2 中所述的单支撑主轴风力发电机组齿轮箱更换专用卡具,其特征在于:

所述上压板及下压板内侧加设有软性耐磨层。

10. 根据权利要求 9 中所述的单支撑主轴风力发电机组齿轮箱更换专用卡具,其特征
在于:

所述软性耐磨层为软布、棉花、泡沫、橡胶或弹性高分子材料层。

单支撑主轴风力发电机组齿轮箱更换专用卡具

技术领域

[0001] 本实用新型涉及一种风力发电机齿轮箱的组装或拆卸的辅助装置，具体是涉及一种单支撑主轴风力发电机组齿轮箱更换专用卡具。

背景技术

[0002] 传统的风力发电机组，叶轮通过转动将风能转化为动能，再通过主轴将动力传递给齿轮箱，然后将动能传递给发电机转化为电能输出。单支撑主轴风力发电机组主要为三点式支撑方式，即主轴上的单支撑与齿轮箱的两个弹性支撑形成的三点支撑，这三点支撑都安装在风电机主机架的机舱基座上，主机架又安装在塔筒上。在工作过程中，叶轮的转动及摆动会传递很大的力及力矩给风电机组的各传动部件。而齿轮箱长时间受到无规律的变向变负荷的风力作用以及强阵风的冲击，以及酷暑严寒和极端温差的影响，其故障率比较高。而一旦出现故障，就需要将齿轮箱自塔筒上拆到地面进行维修。

[0003] 目前的拆卸方式需要先拆除叶轮，然后将主轴和齿轮箱一起拆吊。这种方式的拆卸需使用吊车，拆吊的成本较高，而且由于拆卸部件较多，需要时间较长，通常需要两天的时间，发电机组无法快速回复工作，影响供电量，尤其是在用电高峰时段。因此如何能够快速安全的拆卸齿轮箱是本领域亟待解决的一个技术课题。

发明内容

[0004] 本实用新型的目的是针对上述现有技术的缺陷，提供一种结构简单、可在塔筒内快速将齿轮箱自主轴上拆除而不影响主轴及叶轮的稳定性的单支撑主轴风力发电机组齿轮箱更换专用卡具。

[0005] 为达上述目的，本实用新型采用了如下技术方案：

[0006] 一种单支撑主轴风力发电机组齿轮箱更换专用卡具，包括一组或一组以上的夹具，该夹具为夹具 A，包括上压板、下压板、托板及桥型压板；上、下压板分别环扣于主轴上且彼此紧固共同将主轴抱紧；托板设于机舱基座下部，两端与机舱基座相固接，中部与下压板下部相固接；桥型压板的桥面紧压于上压板的上部，两端分别固接于风电机主机架的机舱基座上。

[0007] 本实用新型还可采用另一技术方案，该单支撑主轴风力发电机组齿轮箱更换专用卡具亦包括一组或一组以上的夹具，该夹具由夹具 A 和夹具 B 共同组成；夹具 A 包括上压板、下压板、托板及桥型压板，上、下压板分别环扣于主轴上且彼此紧固共同将主轴抱紧；托板设于机舱基座下部，两端与机舱基座相固接，中部与下压板下部相固接；桥型压板的桥面紧压于上压板的上部，两端分别固接于风电机主机架的机舱基座上；夹具 B 包括上抱箍、下抱箍和防转板，上、下抱箍分别环扣于主轴上且彼此紧固共同将主轴抱紧；防转板设于机舱基座下方，其两端卡抵于机舱基座上，中部与下抱箍下方相固接。

[0008] 本实用新型还可采用以下技术方案进一步实现：

[0009] 所述的单支撑主轴风力发电机组齿轮箱更换专用卡具，其中，所述上抱箍为剖切

面呈中部半圆环形且两侧设有向外延伸的外缘的柱体 ;所述下压板为剖切面呈中部半圆环形、两侧设有向外延伸的外缘且底部设有连接件的柱体。

[0010] 所述的单支撑主轴风力发电机组齿轮箱更换专用卡具,其中,所述上抱箍与下抱箍的内侧均设有软性耐磨材料层。

[0011] 所述的单支撑主轴风力发电机组齿轮箱更换专用卡具,其中,所述上抱箍和下抱箍内各装设两块弧形钢板,四块钢板组成钢套,钢套内加设软性耐磨材料层 ;上、下抱箍上分别开设两个以上的螺孔,穿过螺孔的螺栓将钢套紧密压扣在主轴上。

[0012] 所述的单支撑主轴风力发电机组齿轮箱更换专用卡具,其中,所述的软性耐磨材料层为软布、棉花、泡沫、橡胶或弹性高分子材料层。

[0013] 所述的单支撑主轴风力发电机组齿轮箱更换专用卡具,其中,所述上压板为剖切面呈中部半圆环形且两侧设有向外延伸的外沿的柱体 ;所述下压板为剖切面呈中部半圆环形、两侧设有向外延伸的外沿且底部设有连接块的柱体 ;所述托板为一长方形钢板 ;所述桥型托板的剖切面呈抛物线形且两侧设有向外延伸的外沿。

[0014] 所述的单支撑主轴风力发电机组齿轮箱更换专用卡具,其中,所述桥型压板的两端及托板的两端通过穿过其上的螺栓共同固接在机舱基座上 ;所述上压板与下压板两侧的外沿彼此相对,通过螺栓固接在一起 ;所述下压板与托板通过穿过托板及下压板连接块上的螺栓固接在一起。

[0015] 所述的单支撑主轴风力发电机组齿轮箱更换专用卡具,其中,所述上压板及下压板内侧加设有软性耐磨层。该软性耐磨层为软布、棉花、泡沫、橡胶或弹性高分子材料层。

[0016] 本实用新型在单支撑主轴风力发电机组的主轴上预先装设一组或一组以上的卡具将主轴与机舱基座连接在一起。在更换齿轮箱时,该卡具的上、下压板 / 上、下抱箍及桥型压板共同作用,同时起到克服叶轮重力产生的弯矩和扭转力的作用,实现了在不拆卸叶轮和主轴的情况下完成齿轮箱的更换,齿轮箱的更换可直接在风电机组机架上完成,无需动用吊车,且大大缩短了更换时间,基本一天的时间即可完成更换。有效的节约了成本和时间,且安装拆卸顺利,易操作,设计合理,结构简单,经试行,本实用新型完全能够实现主轴及叶轮的防翘及防转功能,安全系数较高,保证了装配工艺要求,宜于推广应用,具有较好的社会经济价值。

附图说明

[0017] 图 1 为本实用新型的单支撑主轴风力发电机组齿轮箱更换专用卡具采用一组夹具的结构示意图 ;

[0018] 图 2 为本实用新型的单支撑主轴风力发电机组齿轮箱更换卡具同时采用一组夹具 A 和夹具 B 的夹具的主视结构示意图 ;

[0019] 图 3 为本实用新型的单支撑主轴风力发电机组齿轮箱更换专用卡具夹具 A 的主视剖视结构示意图及左视结构示意图 ;

[0020] 图 4 为本实用新型的单支撑主轴风力发电机组齿轮箱更换专用卡具夹具 B 的主视剖视结构示意图及左视结构示意图。

[0021] 图中 :1- 叶轮 ;2- 主轴 ;3- 主轴轴承 ;4. 齿轮箱 ;5- 夹具 A, 51. 上压板, 511. 外沿, 52. 下压板, 521. 外沿, 522. 连接块, 53. 托板, 54. 桥型压板, 541. 外沿, 55. 软性耐磨层 ;

6- 夹具 B, 61. 上抱箍, 611. 外缘, 62. 下抱箍, 621. 外缘, 622. 连接件 ; 63. 防转板, 64. 弧形钢板, 65. 软性耐磨材料层 ; 7- 胀紧套装置 ; 8- 发电机 ; 9. 机舱基座 ; 10. 螺栓。

具体实施方式

[0022] 下面结合附图 1-4 详细说明本实用新型。

[0023] 参见图 1 所示, 为单支撑主轴风力发电机组, 该机组的叶轮 1 (图中叶轮叶片未完整显示) 将风能转化为动能, 并通过主轴 2 将动力传递给齿轮箱 4, 然后齿轮箱 4 将动能传递给发电机 8 转化为电能输出。单支撑主轴风力发电机组的主轴 2 前端设有一主轴轴承 3 支撑, 主轴 2 后端与齿轮箱 4 采用胀紧套装置 7 连接。实现三点支撑。这三点支撑都安装在风电机主机架的机舱基座 9 上, 主机架又安装在塔筒上 (主机架及塔筒图中为显示)。为避免在拆卸齿轮箱 4 时因仅剩一个主轴轴承 3 无法支撑起叶轮 1 及主轴 2, 故设计一种单支撑主轴风力发电机组齿轮箱更换专用夹具来克服叶轮 1 及主轴 2 重力产生的弯矩和扭转力, 从而在塔筒上直接实现快速拆卸齿轮箱 4。该专用夹具由一组或一组以上的夹具 A5 组成, 该夹具 A5 包括上压板 51、下压板 52、托板 53 及桥型压板 54 ; 上、下压板 51/52 分别环扣于主轴 2 上且彼此紧固共同将主轴 2 抱紧 ; 托板 53 设于机舱基座 9 下部, 两端与机舱基座 9 相固接, 中部与下压板 52 下部相固接 ; 桥型压板 54 的桥面紧压于上压板 51 的上部, 两端分别固接于风电机主机架的机舱基座 9 上。

[0024] 优选的, 参见图 3 所示, 上压板 51 为剖切面呈中部半圆环形且两侧设有向外延伸的外沿 511 的柱体 ; 下压板 52 为剖切面呈中部半圆环形、两侧设有向外延伸的外沿 521 且底部设有连接块 522 的柱体 ; 托板 53 为一长方形钢板 ; 桥型托板 54 的剖切面呈抛物线形且两侧设有向外延伸的外沿 541。

[0025] 进一步的, 桥型压板 54 的两端及托板 53 的两端通过穿过其上的螺栓 10 共同固接在机舱基座 9 上 ; 所述上压板 51 与下压板 52 两侧的外沿 511/521 彼此相对, 通过螺栓固接在一起 ; 所述下压板 52 与托板 53 通过穿过托板 53 及下压板连接块 522 上的螺栓固接在一起。

[0026] 为了保证更好的贴合, 还可在上压板 51 与下压板 52 的内侧均加设软性耐磨材料层 55。

[0027] 利用上下压板 51/52 与主轴间的摩擦力来克服主轴和叶轮的扭转力和弯矩, 而压紧上压板 51 及被上下压板 51/52 抱紧的主轴 2 的桥型压板 53 则用于克服叶轮及主轴的重力。桥型压板 54 与托板 53 之间是机舱基座 9, 利用机舱基座 9 上的四个定位孔安装 8.8 级 M24 螺栓 10, 使叶轮 1 的中心点和夹具 A5 的中心点距离主轴轴承 3 中心点的距离大致相当。故而比较螺栓 10 的承受能力和叶轮的总重即可校核夹具是否可实现良好防转及防翘功能。

[0028] 根据 GB/T 3098.1-2000《螺栓、螺钉和螺柱的机械性能等级》, GB/T 16823.1-1997《螺纹紧固件的应力截面积 (粗牙螺纹)》, 计算得 M24 螺栓的最小拉力载荷为 293000N, 即 29.3t, 4 颗螺栓共计能承受 117.2t 重量。叶片重量 6t/支, 轮毂 13.5t, 叶轮共重 31.5t, 安全系数为 3.72, 故该夹具完全可以在更换齿轮箱 4 时有效起到支撑主轴 2 及叶轮 1, 克服重力产生的弯矩及扭转力。

[0029] 为节省材料, 该单支撑主轴风力发电机组齿轮箱更换专用夹具亦可包括一组或一

组以上的夹具,该夹具由夹具 A5 和夹具 B6 共同组成,参见图 2-4 所示。夹具 A5 包括上压板 51、下压板 52、托板 53 及桥型压板 54。上、下压板 51/52 分别环扣于主轴 2 上且彼此紧固共同将主轴 2 抱紧。托板 53 设于机舱基座 9 下部,两端与机舱基座 9 相固接,中部与下压板 52 下部相固接。桥型压板 54 的桥面紧压于上压板 51 的上部,两端分别固接于风电机主机架的机舱基座 9 上。夹具 B6 包括上抱箍 61、下抱箍 62 和防转板 63,上、下抱箍 61/62 分别环扣于主轴 2 上且彼此紧固共同将主轴 2 抱紧;防转板 63 设于机舱基座 9 下方,其两端卡抵于机舱基座 9 上,中部与下抱箍 62 下方相固接。

[0030] 进一步的,上抱箍 61 为剖切面呈中部半圆环形且两侧设有向外延伸的外缘 611 的柱体;下压板 62 为剖切面呈中部半圆环形、两侧设有向外延伸的外缘 621 且底部设有连接件 622 的柱体。为了保证更好的贴合,还可在上抱箍 61 与下抱箍 62 的内侧均加设软性耐磨材料层 65。

[0031] 为了保证与主轴 2 更好的贴合,避免上下抱箍 61/62 因工艺问题无法完全贴合主轴 2,还可在上抱箍 61 和下抱箍 62 内各装设两块弧形钢板 64,四块钢板 64 组成钢套。上、下抱箍 61/62 上分别开设两个以上的螺孔,穿过螺孔的螺栓 10 将钢套紧密压扣在主轴 2 上,保证面接触。同时为实现更好的密合,还可在钢套内还可加设软性耐磨材料层 65。

[0032] 上压板 51 及下压板 52 内侧的软性耐磨层及上抱箍 61 与下抱箍 62 的内侧加设的软性耐磨材料层 65,其可为软布、棉花、泡沫、橡胶或弹性高分子材料层。

[0033] 其中夹具 A 可克服重力及扭转力和弯矩,而夹具 B 可用于克服扭转力及弯矩。

[0034] 根据主轴扭矩进行校核计算。采用公式 $T = 9550 \cdot P / N$, 其中, T - 扭矩,单位 $N \cdot m$; P - 功率,单位 KW ; N - 转速,单位转 / 分。按照 MICON750 风机技术参数计算最大的主轴扭矩,此时风机为额定功率,转速为 22 转 / 分,计算得 $T = 325KN \cdot m$ 。而夹具 B 或夹具 A 的最大摩擦力计算采用 $T = P \cdot \mu \cdot 2 \pi R \cdot D \cdot R$, 其中 P - 预紧压强,448MPa (0.7 倍屈服极限预紧); μ - 摩擦系数,参考铸铁和橡皮的摩擦系数为 0.8; R - 主轴半径,265mm; D - 夹具宽度,150mm; 计算得 $T = 23708KN \cdot m$, 安全系数为 73。经过计算可知,其完全能够实现防翘和防转的功能且安全性能较强。

[0035] 以上所述,仅为本实用新型的较佳实施例而已,并非对本实用新型做任何形式上的限定。凡本领域的技术人员利用本实用新型的技术方案对上述实施例做出的任何等同的变动、修饰或演变等,均仍属于本实用新型的技术方案的范围内。

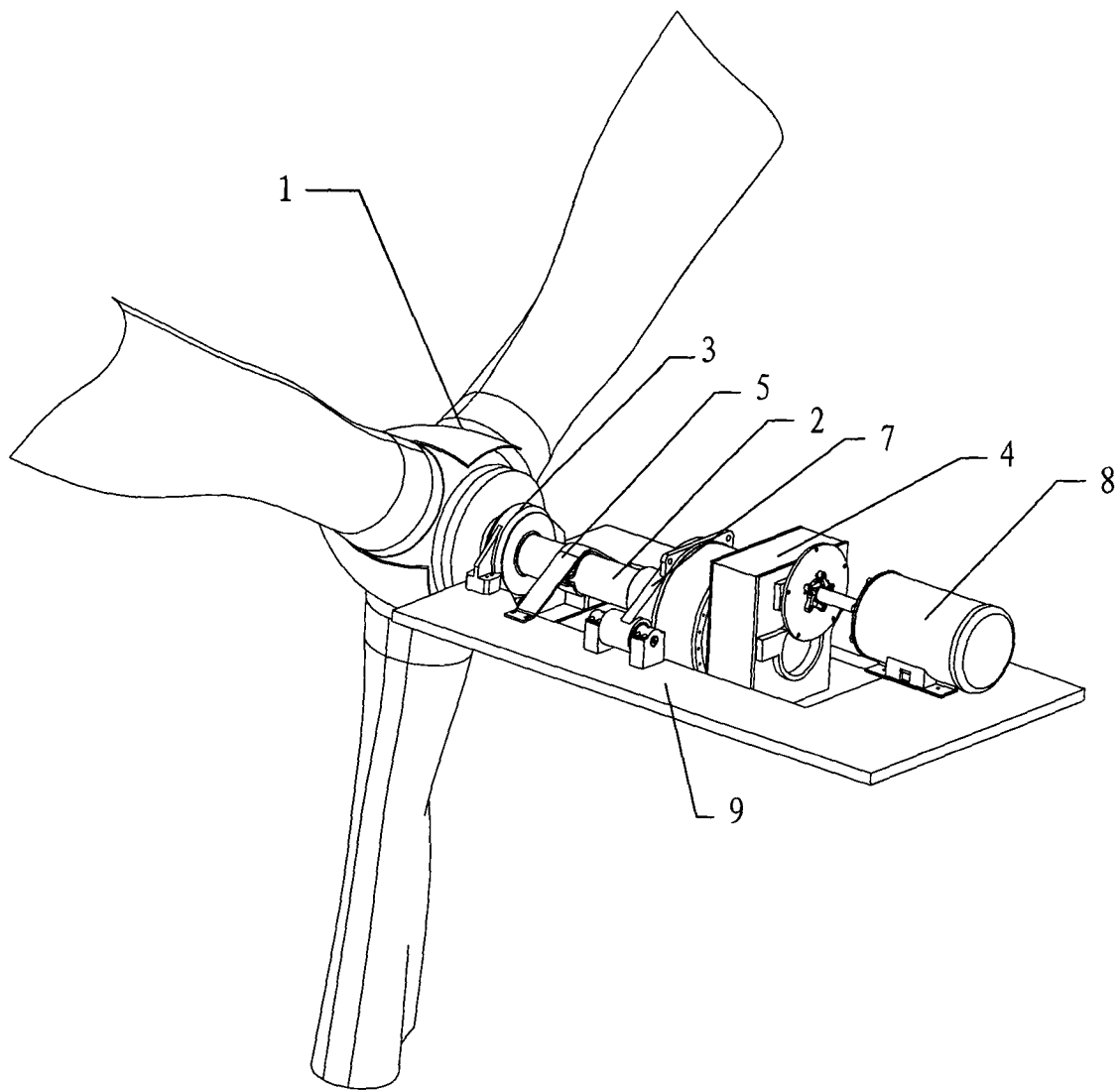


图 1

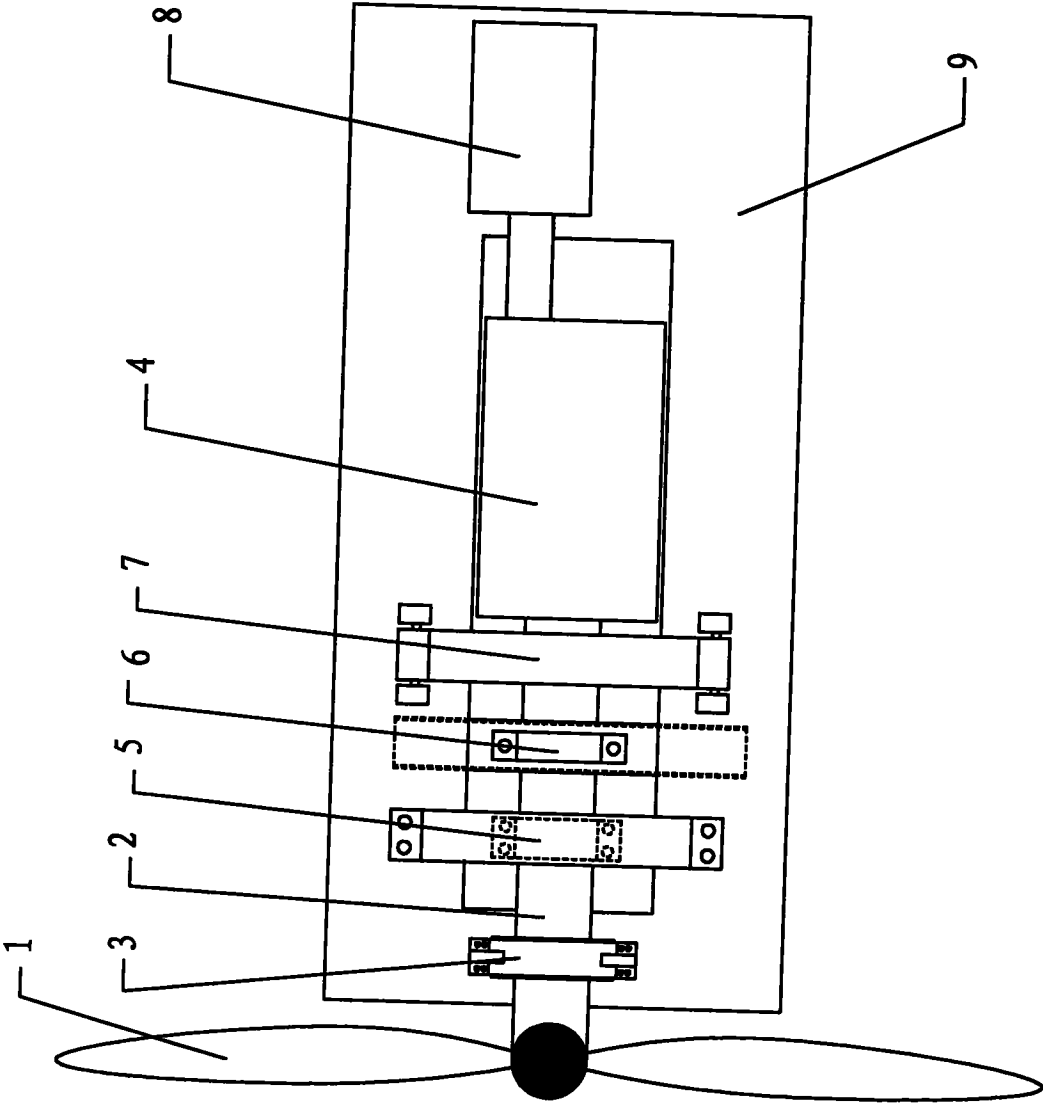


图 2

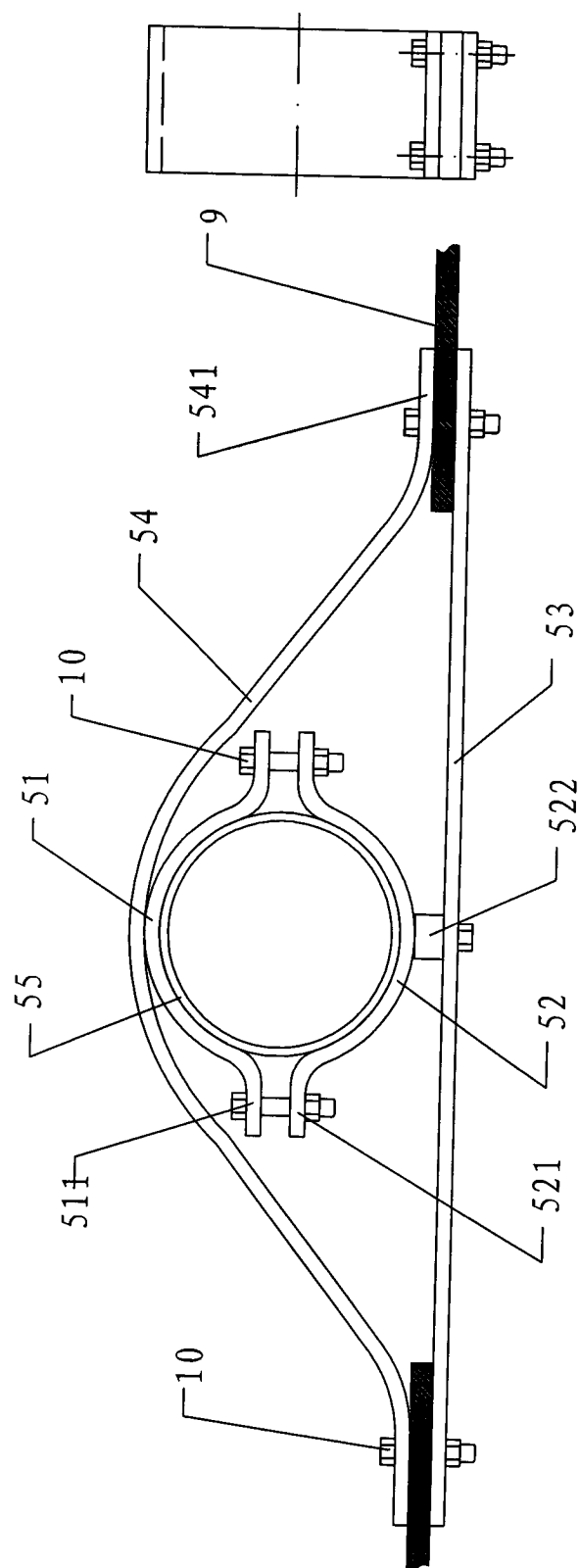


图 3

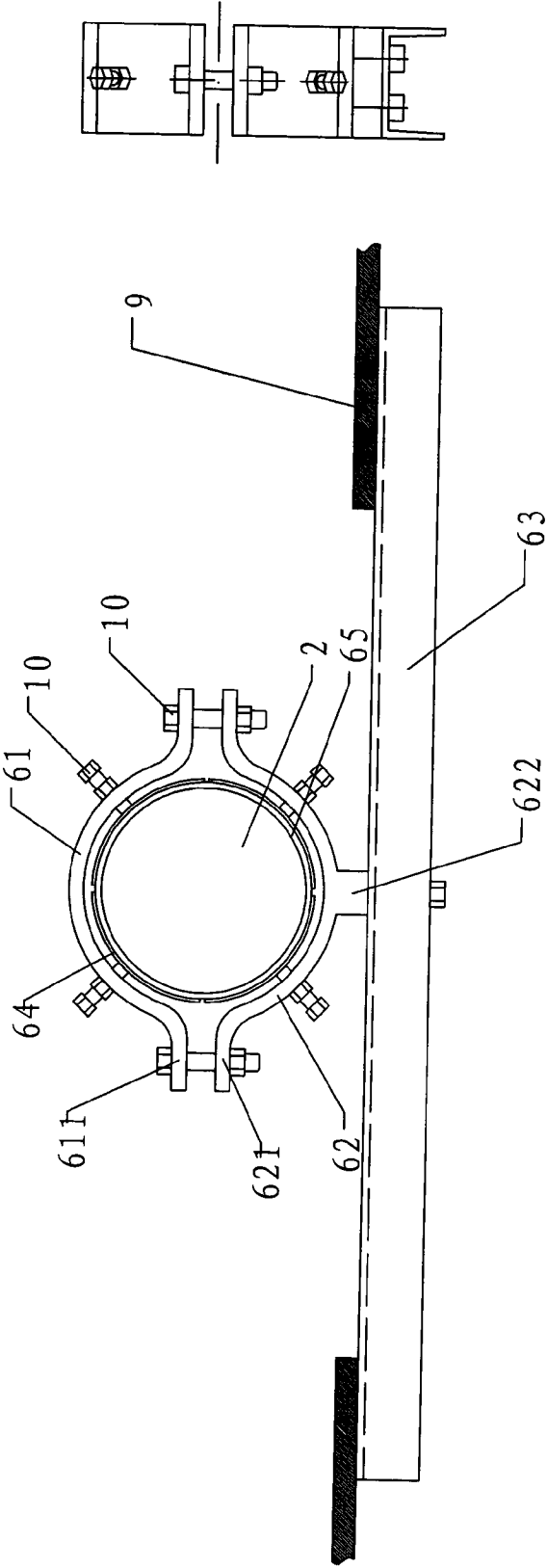


图 4

CERTIFIED TRANSLATION



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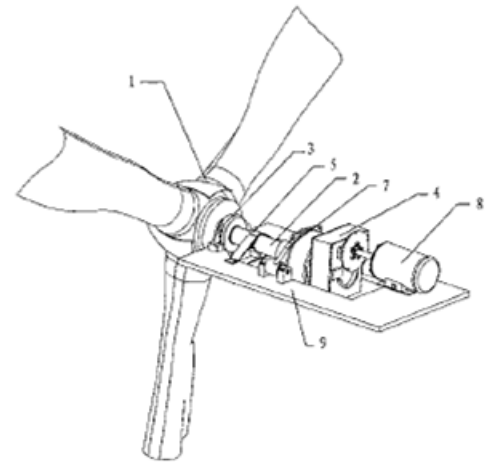
(54) Title of New Utility Model

Special Fixture for Replacing Gearbox of Single-Support Main Shaft Wind Turbine Set

(57) Abstract

This new utility model relates to a special fixture for replacing the gearbox of a single-support main shaft wind turbine set. It employs Fixture A or a combination of Fixture A and Fixture B. Fixture A comprises upper and lower pressing plates, a support plate, and a bridge-shaped pressing plate; the upper and lower pressing plates are respectively wrapped around the main shaft and are fastened together to tightly grip the main shaft. The support plate is located at the lower part of the cabin base, with both ends fixed to the cabin base and the middle part fixed to the lower pressing plate's lower part. The bridge-shaped pressing plate's bridge surface is pressed tightly against the upper part of the upper pressing plate, with both ends fixed to the cabin base of the wind turbine main frame. Fixture B

comprises upper and lower clamps and an anti-rotation plate; the upper and lower clamps are also respectively wrapped around the main shaft and are fastened together to tightly grip the main shaft. The anti-rotation plate is positioned below the cabin base, with both ends resting against the cabin base and the middle part fixed under the lower clamp. This new utility model is used to assist in the disassembly of the gearbox, effectively overcoming the bending moment and torsional force generated by the gravity of the main shaft and blades, improving the speed of gearbox disassembly, and saving costs and time.



CN 201483408 U

1. A special fixture for replacing the gearbox of a single-support main shaft wind turbine set, characterized by:

comprising one or more sets of fixtures; the fixture is Fixture A, which comprises an upper pressing plate, a lower pressing plate, a support plate, and a bridge-shaped pressing plate;

the upper and lower pressing plates are respectively wrapped around the main shaft and are fastened together to tightly grip the main shaft;

the support plate is located at the lower part of the cabin base, with both ends fixed to the cabin base and the middle part fixed to the lower pressing plate's lower part;

the bridge surface of the bridge-shaped pressing plate is tightly pressed against the upper part of the upper pressing plate, with both ends fixed to the cabin base of the wind turbine main frame.

2. A special fixture for replacing the gearbox of a single-support main shaft wind turbine set, characterized by:

comprising one or more sets of fixtures, wherein the fixture is composed of Fixture A and Fixture B;

Fixture A comprises an upper pressing plate, a lower pressing plate, a support plate, and a bridge-shaped pressing plate; the upper and lower pressing plates are respectively wrapped around the main shaft and are fastened together to tightly grip the main shaft;

the support plate is located at the lower part of the cabin base, with both ends fixed to the cabin base and the middle part fixed to the lower pressing plate's lower part;

the bridge surface of the bridge-shaped pressing plate is tightly pressed against the upper part of the upper pressing plate, with both ends fixed to the cabin base of the wind turbine main frame;

Fixture B comprises an upper clamp, a lower clamp, and an anti-rotation plate; the upper and lower clamps are also respectively wrapped around the main shaft and are fastened together to tightly grip the main shaft;

the anti-rotation plate is positioned below the cabin base, with both ends resting against the cabin base and the middle part fixed under the lower clamp.

3. The special fixture for replacing the gearbox of a single-support main shaft wind turbine set according to Claim 2, characterized by:

the aforementioned upper clamp having a cross-section that is a semi-circular ring in the middle with outwardly extending edges on both sides; the aforementioned lower pressing plate being a column with

a cross-section that is a semi-circular ring in the middle, with outwardly extending edges on both sides and a connecting piece at the bottom.

4. The special fixture for replacing the gearbox of a single-support main shaft wind turbine set according to Claim 2, characterized by:

the aforementioned upper fixture And lower clamp each having a layer of soft wear-resistant material on their inner sides.

5. The special fixture for replacing the gearbox of a single-support main shaft wind turbine set according to Claim 2, characterized by:

the aforementioned upper fixture And lower clamp each having two arc-shaped steel plates installed inside, forming a steel sleeve with four steel plates, and the steel sleeve having a layer of soft wear-resistant material inside;

the upper and lower clamps each having more than two screw holes, through which bolts pass to tightly press the steel sleeve onto the main shaft.

6. The special fixture for replacing the gearbox of a single-support main shaft wind turbine set according to Claim 4 or 5, characterized by:

the aforementioned soft wear-resistant material layer being made of soft cloth, cotton, foam, rubber, or elastic polymer material.

7. The special fixture for replacing the gearbox of a single-support main shaft wind turbine set according to Claim 1 or 2, characterized by:

the aforementioned upper pressing plate being a column with a cross-section that is a semi-circular ring in the middle and outwardly extending outer edges on both sides;

the aforementioned lower pressing plate being a column with a cross-section that is a semi-circular ring in the middle, outwardly extending outer edges on both sides, and a connecting block at the bottom;

the aforementioned support plate being a rectangular steel plate;

the aforementioned bridge-shaped pressing plate having a parabolic cross-section with outwardly extending outer edges on both sides.

8. The special fixture for replacing the gearbox of a single-support main shaft wind turbine set according to Claim 1 or 2, characterized by:

both ends of the aforementioned bridge-shaped pressing plate and the support plate being simultaneously fixed to the cabin base by bolts passing through them;

the aforementioned upper pressing plate and lower pressing plate having their outward edges facing each other and being fixed together by bolts;

the aforementioned lower pressing plate being fixed to the support plate by bolts passing through the support plate and the connecting block of the lower pressing plate.

9. The special fixture for replacing the gearbox of a single-support main shaft wind turbine set according to Claim 1 or 2, characterized by:

the aforementioned upper pressing plate and lower pressing plate having a layer of soft wear-resistant material added to their inner sides.

10. The special fixture for replacing the gearbox of a single-support main shaft wind turbine set according to Claim 9, characterized by:

the aforementioned soft wear-resistant material layer being made of soft cloth, cotton, foam, rubber, or elastic polymer material.

Special Fixture for Replacing the Gearbox of a Single-Support Main Shaft Wind Turbine Set

Technical Field

[0001] This new utility model relates to an auxiliary device for assembling or disassembling the gearbox of a wind turbine, specifically to a special fixture for replacing the gearbox of a single-support main shaft wind turbine set.

Background Technology

[0002] Traditional wind turbines convert wind energy into kinetic energy through the rotation of blades, then transmit the power to the gearbox via the main shaft, which in turn converts the kinetic energy into electrical energy output by the generator. The single-support main shaft wind turbine set primarily uses a three-point support method, where the single support on the main shaft and two elastic supports of the gearbox form a three-point support. These three point supports are installed on the cabin base of the wind turbine main frame, which is mounted on the tower. During operation, the rotation and oscillation of the blades transmit significant forces and torques to various transmission components of the wind turbine. In addition, the gearbox is subjected to irregular directional and variable loads from the wind, as well as impacts from strong gusts, and it faces high failure rates due to extreme heat, cold, and temperature fluctuations. Once a failure occurs, the gearbox needs to be disassembled from the tower to the ground for maintenance.

[0003] Currently, the disassembly method requires first removing the blades and then hoisting the main shaft and gearbox together. This disassembly method requires a crane, incurs high costs, and takes a long time due to the large number of components involved, usually needing about two days, which prevents the generator set from quickly resuming operation and affects the power supply, especially during peak electricity usage. Therefore, how to quickly and safely disassemble the gearbox is an urgent technical problem that needs to be solved in this field.

Content of Invention

[0004] The purpose of this new utility model is to address the defects of the existing technologies and provide a simple structure that can quickly disassemble the gearbox from the main shaft within the tower without affecting the stability of the main shaft and blades - a special fixture for replacing the gearbox of a single-support main shaft wind turbine set.

[0005] To achieve the above objective, this new utility model adopts the following technical solution:

[0006] A special fixture for replacing the gearbox of a single-support main shaft wind turbine set, comprising one or more sets of fixtures; the fixture is Fixture A, which comprises an upper pressing plate, a lower pressing plate, a support plate, and a bridge-shaped pressing plate; the upper and lower pressing plates are respectively wrapped around the main shaft and are fastened together to tightly grip the main shaft; the support plate is located at the lower part of the cabin base, with both ends fixed to the cabin base and the middle part fixed to the lower pressing plate's lower part; the bridge surface of the bridge-shaped pressing plate is tightly pressed against the upper part of the upper pressing plate, with both ends fixed to the cabin base of the wind turbine main frame.

[0007] This new utility model may also adopt another technical solution, wherein the special fixture for replacing the gearbox of a single-support main shaft wind turbine set also comprises one or more sets of fixtures, which consist of Fixture A and Fixture B; Fixture A comprises an upper pressing plate, a lower pressing plate, a support plate, and a bridge-shaped pressing plate; the upper and lower pressing plates are respectively wrapped around the main shaft and are fastened together to tightly grip the main shaft; the support plate is located at the lower part of the cabin base, with both ends fixed to the cabin base and the middle part fixed to the lower pressing plate's lower part; the bridge surface of the bridge-shaped pressing plate is tightly pressed against the upper part of the upper pressing plate, with both ends fixed to the cabin base of the wind turbine main frame; Fixture B comprises an upper clamp, a lower clamp, and an anti-rotation plate; the upper and lower clamps are also respectively wrapped around the main shaft and are fastened together to tightly grip the main shaft; the anti-rotation plate is positioned below the cabin base, with both ends resting against the cabin base and the middle part fixed under the lower clamp.

[0008] This new utility model may further implement the following technical solutions:

[0009] The aforementioned special fixture for replacing the gearbox of a single-support main shaft wind turbine set, wherein the aforementioned upper clamp has a cross-section that is a semi-circular ring in the middle with outwardly extending edges on both sides; the aforementioned lower pressing plate is a column with a cross-section that is a semi-circular ring in the middle, with outwardly extending edges on both sides and a connecting piece at the bottom.

[0010] The aforementioned special fixture for replacing the gearbox of a single-support main shaft wind turbine set, wherein the inner sides of the aforementioned upper and lower clamps are both provided with a layer of soft wear-resistant material.

[0011] The aforementioned special fixture for replacing the gearbox of a single-support main shaft wind turbine set, wherein each of the aforementioned upper and lower clamps is equipped with two arc-shaped steel plates, and four steel plates form a steel sleeve, with a soft wear-resistant material layer added inside the steel sleeve; the upper and lower clamps are each provided with more than two screw holes, and bolts passing through these screw holes tightly clamp the steel sleeve onto the main shaft.

[0012] The aforementioned special fixture for replacing the gearbox of a single-support main shaft wind turbine set, wherein the aforementioned soft wear-resistant material layer is made of soft cloth, cotton, foam, rubber, or elastic polymer material layer.

[0013] The aforementioned special fixture for replacing the gearbox of a single-support main shaft wind turbine set, wherein the aforementioned upper pressing plate is a cylindrical body with a cross-section that appears as a semi-circular ring in the middle and has outwardly extending edges on both sides; the aforementioned lower pressing plate is also a cylindrical body with a cross-section that appears as a semi-circular ring in the middle, having outwardly extending edges on both sides and a connecting piece at the bottom; the aforementioned support plate is a rectangular steel plate; the aforementioned bridge-shaped pressing plate has a parabolic-shaped cross-section with outwardly extending edges on both sides.

[0014] The aforementioned special fixture for replacing the gearbox of a single-support main shaft wind turbine set, wherein both ends of the aforementioned bridge-shaped pressing plate and both ends of the support plate are connected to the cabin base via bolts passing through them; the outer edges of the upper and lower pressing plates face each other and are connected together by bolts; the lower pressing plate and the support plate are connected together via bolts passing through the support plate and the connecting piece on the lower pressing plate.

[0015] The aforementioned special fixture for replacing the gearbox of a single-support main shaft wind turbine set, wherein the inner sides of the aforementioned upper and lower pressing plates are additionally provided with a soft wear-resistant layer. The soft wear-resistant layer is made of soft cloth, cotton, foam, rubber, or elastic polymer material layer.

[0016] This new utility model pre-installs one or more sets of clamps on the main shaft of the single-support main shaft wind turbine set to connect the main shaft with the cabin base. During the gearbox

replacement, the upper and lower pressing plates/upper and lower clamps and the bridge-shaped pressing plate work together to overcome the bending moment and torsional force generated by the weight of the rotor, achieving gearbox replacement without disassembling the rotor and main shaft. The gearbox can be replaced directly on the wind turbine frame without using a crane, significantly shortening the replacement time to about one day. This effectively saves costs and time, ensures smooth installation and disassembly, is easy to operate, has a reasonable design, and a simple structure. After trials, this new utility model can fully realize the prevention of tilting and rotation of the main shaft and rotor, has a high safety factor, meets assembly process requirements, is suitable for widespread application, and has good social and economic value.

Explanation of the Attached Figures

[0017] Fig. 1 is a schematic structural diagram of the special fixture for replacing the gearbox of a single-support main shaft wind turbine set using one set of clamps.

[0018] Fig. 2 is a front view schematic structural diagram of the special fixture for replacing the gearbox of a single-support main shaft wind turbine set simultaneously using a set of Fixture A and Fixture B.

[0019] Fig. 3 is a front cross-sectional schematic structural diagram and left side view schematic structural diagram of Fixture A of the special fixture for replacing the gearbox of a single-support main shaft wind turbine set.

[0020] Fig. 4 is a front cross-sectional schematic structural diagram and left side view schematic structural diagram of Fixture B of the special fixture for replacing the gearbox of a single-support main shaft wind turbine set.

[0021] In the figure: 1 - Rotor; 2 - Main Shaft; 3 - Main Shaft Bearing; 4 - Gearbox; 5 - Fixture A, 51 - Upper Pressing Plate, 511 - Outer Edge, 52 - Lower Pressing Plate, 521 - Outer Edge, 522 - Connecting Block, 53 - Support Plate, 54 - Bridge-Shaped Pressing Plate, 541 - Outer Edge, 55 - Soft Wear-Resistant Layer; 6 - Fixture B, 61 - Upper Clamping Hoop, 611 - Outer Edge, 62 - Lower Clamping Hoop, 621 - Outer Edge, 622 - Connector; 63 - Anti-Rotation Plate, 64 - Arc-Shaped Steel Plate, 65 - Soft Wear-Resistant Material Layer; 7 - Expansion Sleeve Device; 8 - Generator; 9 - Cabin Base; 10 - Bolt.

Specific Implementation Methods

[0022] The following is a detailed description of this new utility model in conjunction with Figs. 1-4.

[0023] Referring to Fig. 1, for the single-support main shaft wind turbine set, the rotor 1 (the rotor blades are not fully shown in the figure) converts wind energy into kinetic energy and transmits it to the gearbox 4 through the main shaft 2. The gearbox 4 then transfers the kinetic energy to the generator 8 to convert it into electric energy output. The front end of the main shaft 2 of the single-support main shaft wind turbine set is supported by a main shaft bearing 3, while the rear end of the main shaft 2 connects to the gearbox 4 using an expansion sleeve device 7, achieving three-point support. All three points are installed on the cabin base 9 of the wind turbine frame, which is mounted on the tower (the main frame and tower are shown for display purposes). To avoid the issue of only having one main shaft bearing 3 to support the rotor 1 and main shaft 2 when disassembling the gearbox 4, a special fixture for replacing the gearbox of the single-support main shaft wind turbine set has been designed to overcome the bending moment and torsional force generated by the weight of the rotor 1 and main shaft 2, allowing for rapid disassembly of the gearbox 4 directly on the tower. This special fixture consists of one or more sets of clamps A5, which include an upper pressing plate 51, a lower pressing plate 52, a support plate 53, and a bridge-shaped pressing plate 54. The upper and lower pressing plates 51/52 encircle the main shaft 2 and are securely fastened together to tightly hold the main shaft 2. The support plate 53 is located at the lower part of the cabin base 9, fixed at both ends to the cabin base 9, and connected at the middle to the lower pressing plate 52. The top surface of the bridge-shaped pressing plate 54 is pressed against the upper pressing plate 51, with both ends connected to the cabin base 9 of the wind turbine frame.

[0024] Preferably, referring to Fig. 3, the upper pressing plate 51 is a cylindrical body with a cross-section that appears as a semi-circular ring in the middle and has outwardly extending edges 511 on both sides; the lower pressing plate 52 is also a cylindrical body with a cross-section that appears as a semi-circular ring in the middle, having outwardly extending edges 521 on both sides and a connecting block 522 at the bottom; the support plate 53 is a rectangular steel plate; the bridge-shaped pressing plate 54 has a parabolic-shaped cross-section with outwardly extending edges 541 on both sides.

[0025] Furthermore, the two ends of the bridge-shaped pressing plate 54 and the two ends of the support plate 53 are jointly secured to the cabin base 9 using bolts 10 that pass through them; the outer edges 511/521 of the aforementioned upper pressing plate 51 and lower pressing plate 52 face each other and are secured together using bolts; the lower pressing plate 52 and the support plate 53 are connected

together using bolts that pass through the support plate 53 and the connecting block 522 of the lower pressing plate.

[0026] To ensure better fitting, a soft wear-resistant material layer 55 can also be added to the inner sides of the upper pressing plate 51 and lower pressing plate 52.

[0027] The friction between the upper and lower pressing plates 51/52 and the main shaft is utilized to overcome the torsional force and bending moment of the main shaft and rotor, while the bridge-shaped pressing plate 54 compresses the upper pressing plate 51 and the main shaft 2 clamped by the upper and lower pressing plates 51/52, providing support against the weight of the rotor and main shaft. Between the bridge-shaped pressing plate 54 and the support plate 53 is the cabin base 9, using four positioning holes on the cabin base 9 to install M24 bolts 10 rated at 8.8, ensuring that the distance from the center point of the rotor 1 to the center point of the fixture A5 is approximately equal to the distance from the center point of the main shaft bearing 3. Therefore, by comparing the load capacity of the bolts 10 and the total weight of the rotor, it is possible to verify whether the fixture can effectively prevent rotation and tilting.

[0028] According to GB/T 3098.1-2000 "Mechanical Performance Grades of Bolts, Screws, and Studs" and GB/T 16823.1-1997 "Stress Cross-Section Area of Threaded Fasteners (Coarse Thread)", the minimum tensile load capacity of an M24 bolt is calculated to be 293000N, which is equivalent to 29.3t. With 4 bolts, they can collectively withstand a weight of 117.2t. The weight of each blade is 6t, the hub is 13.5t, and the total weight of the rotor is 31.5t. The safety factor is 3.72, hence this fixture can effectively support the main shaft 2 and rotor 1 when replacing the gearbox 4, overcoming the bending moment and torsional force generated by gravity.

[0029] In order to save materials, this specialized fixture for the gearbox replacement of the single-support main shaft wind turbine set may also include one or more sets of clamps. This fixture consists of fixture A5 and fixture B6, as shown in Figs. 2-4. Fixture A5 comprises the upper pressing plate 51, lower pressing plate 52, support plate 53, and bridge-shaped pressing plate 54. The upper and lower pressing plates 51/52 encircle the main shaft 2 and are securely fastened together to tightly hold the main shaft 2. The support plate 53 is located at the lower part of the cabin base 9, fixed at both ends to the cabin base 9, and connected at the middle to the lower pressing plate 52. The top surface of the bridge-shaped pressing plate 54 presses against the upper pressing plate 51, with both ends fixed to the cabin base 9 of the wind turbine frame. Fixture B6 comprises the upper clamping hoop 61, lower clamping hoop 62, and anti-rotation plate 63. The upper and lower clamping hoops 61/62 encircle the main shaft 2 and are securely fastened together to tightly hold the main shaft 2; the anti-rotation plate 63

is positioned below the cabin base 9, with both ends secured against the cabin base 9, and the middle connected to the lower clamping hoop 62.

[0030] Furthermore, the upper clamping hoop 61 has a cross-section shaped like a semicircular ring in the middle, with outwardly extending outer edges 611 on both sides; the lower pressing plate 62 has a cross-section also resembling a semicircular ring in the middle, with outwardly extending outer edges 621 on both sides and a connector 622 at the bottom. To ensure better fitting, a layer of soft wear-resistant material 65 can be additionally provided on the inner side of both the upper clamping hoop 61 and the lower clamping hoop 62.

[0031] In order to achieve better fitting with the main shaft 2 and to prevent the upper and lower clamping hoops 61/62 from failing to fully conform to the main shaft 2 due to manufacturing issues, two arc-shaped steel plates 64 can be installed inside each of the upper clamping hoop 61 and the lower clamping hoop 62, forming a steel sleeve with four steel plates 64. More than two screw holes are provided on the upper and lower clamping hoops 61/62, and bolts 10 passing through these screw holes will tightly press the steel sleeve against the main shaft 2 to ensure surface contact. In addition, a layer of soft wear-resistant material 65 can also be added inside the steel sleeve for better sealing.

[0032] The soft wear-resistant layers on the inner sides of the upper pressing plate 51 and lower pressing plate 52, as well as the soft wear-resistant material layer 65 added to the inner sides of the upper clamping hoop 61 and lower clamping hoop 62, can be made of soft fabric, cotton, foam, rubber, or elastic polymer material layers.

[0033] Fixture A can overcome gravity, torsional forces, and bending moments, while Fixture B can be used to overcome torsional forces and bending moments.

[0034] The torque of the main shaft is recalculated based on the formula:

$T = 9550 * P / N$, where T is torque (in $N \cdot m$);

P is power (in kW); and N is speed (in revolutions per minute). By calculating the maximum torque of the main shaft according to the technical parameters of the MICON750 wind turbine, assuming the turbine is at rated power with a speed of 22 revolutions per minute, we find that:

$T = 325 \text{ KN} \cdot m$. The maximum friction force of either fixture B or fixture A is calculated using:

$T = P * \mu * 2\pi R * D * R$, where P is the pre-tightening pressure, 448 MPa (0.7 times the yield strength pre-tightening); μ is the coefficient of friction, with a reference value of 0.8 for cast iron and rubber; R is the radius of the main shaft, 265 mm; and D is the width of the clamp, 150 mm. The calculation yields: $T = 23708 \text{ KN} \cdot m$, with a safety factor of 73. The calculations indicate that it is fully capable of preventing warping and rotation while maintaining strong safety performance.

[0035] The above-mentioned is merely a preferred embodiment of this new utility model and does not impose any form of limitations on this new utility model. Any equivalent modifications, alterations, or evolutions made by those skilled in the art using the technical solutions of this new utility model concerning the aforementioned embodiment still fall within the scope of the technical solutions of this new utility model.

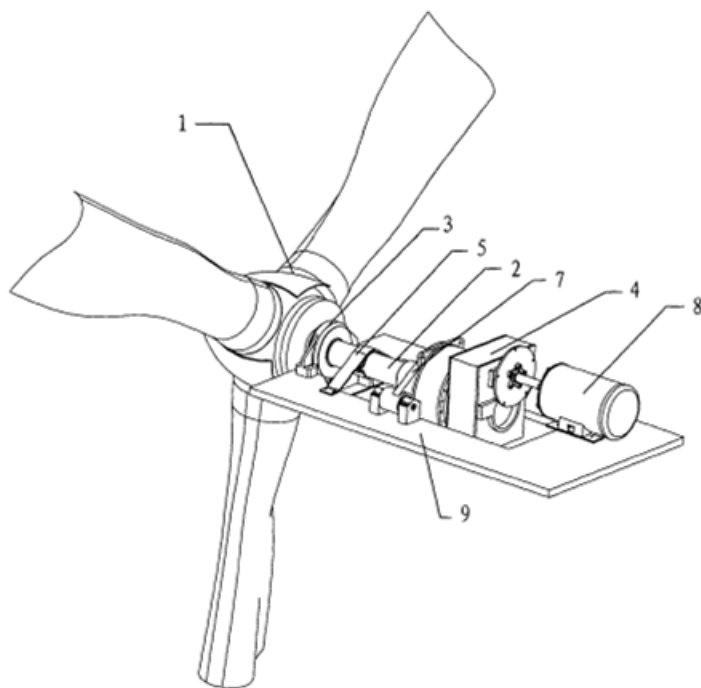


Fig. 1

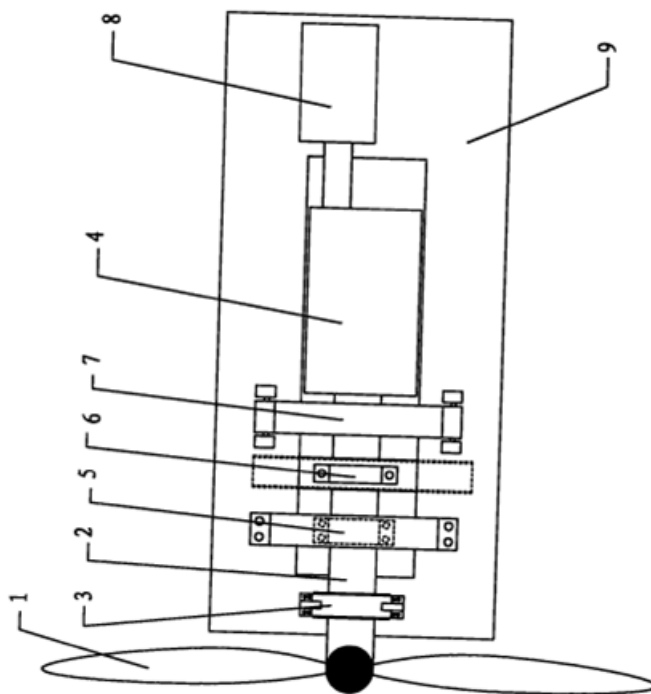


Fig. 2

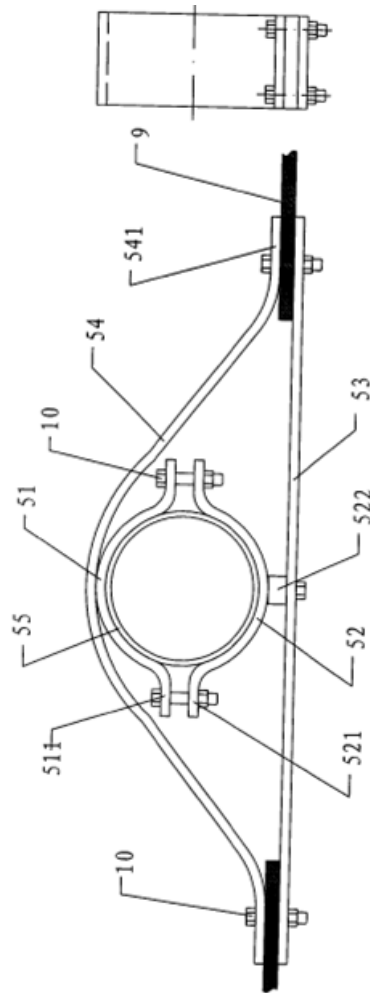


Fig. 3

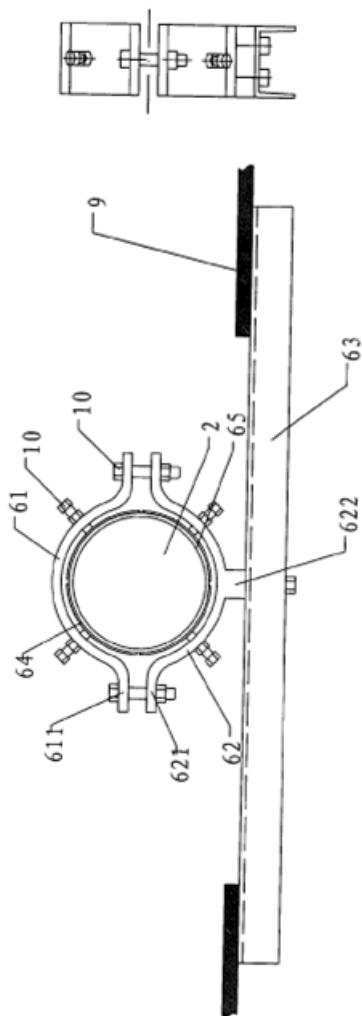


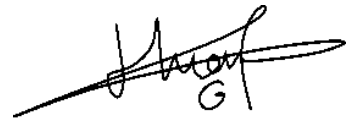
Fig. 4

Declaration of Dr. Huang Gao

1. I, Dr. Huang Gao, hereby certify that I am a professional translator fluent in both Chinese and English and I am competent to translate from Chinese into English.
2. I hereby certify that I prepared the foregoing translation of CN201483408U – Application Number 200920223083.5 - New Utility Model Patent and that it is, to the best of my knowledge and belief, a true and accurate English translation of this Chinese document.
3. I acknowledge that willful false statements and the like are punishable by fine and/or imprisonment.
4. All statements made herein of my own knowledge are true and all statements made on information and belief are believed to be true.
5. I declare under penalty of perjury that all statements made herein of my own knowledge are true and all statements made on information and belief are believed to be true, and further that these statements were made with the knowledge that willful false statements and the like are punishable by fine or imprisonment, or both, under 18 U.S.C. § 1001.

Executed on: October 15, 2025

Signed:

A handwritten signature in black ink, appearing to be 'Huang Gao', written over a horizontal line.

Dr. Huang Gao