

(19) World Intellectual Property Organization
International Bureau



(43) International Publication Date
20 September 2007 (20.09.2007)

PCT

(10) International Publication Number
WO 2007/106730 A1

(51) International Patent Classification:
A47C 27/08 (2006.01)

(21) International Application Number:
PCT/US2007/063650

(22) International Filing Date: 9 March 2007 (09.03.2007)

(25) Filing Language: English

(26) Publication Language: English

(30) Priority Data:
60/780,955 10 March 2006 (10.03.2006) US

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(81) Designated States (unless otherwise indicated, for every kind of national protection available): AE, AG, AL, AM,

AT, AU, AZ, BA, BB, BG, BR, BW, BY, BZ, CA, CH, CN, CO, CR, CU, CZ, DE, DK, DM, DZ, EC, EE, EG, ES, FI, GB, GD, GE, GH, GM, GT, HN, HR, HU, ID, IL, IN, IS, JP, KE, KG, KM, KN, KP, KR, KZ, LA, LC, LK, LR, LS, LT, LU, LY, MA, MD, MG, MK, MN, MW, MX, MY, MZ, NA, NG, NI, NO, NZ, OM, PG, PH, PL, PT, RO, RS, RU, SC, SD, SE, SG, SK, SL, SM, SV, SY, TJ, TM, TN, TR, TT, TZ, UA, UG, US, UZ, VC, VN, ZA, ZM, ZW.

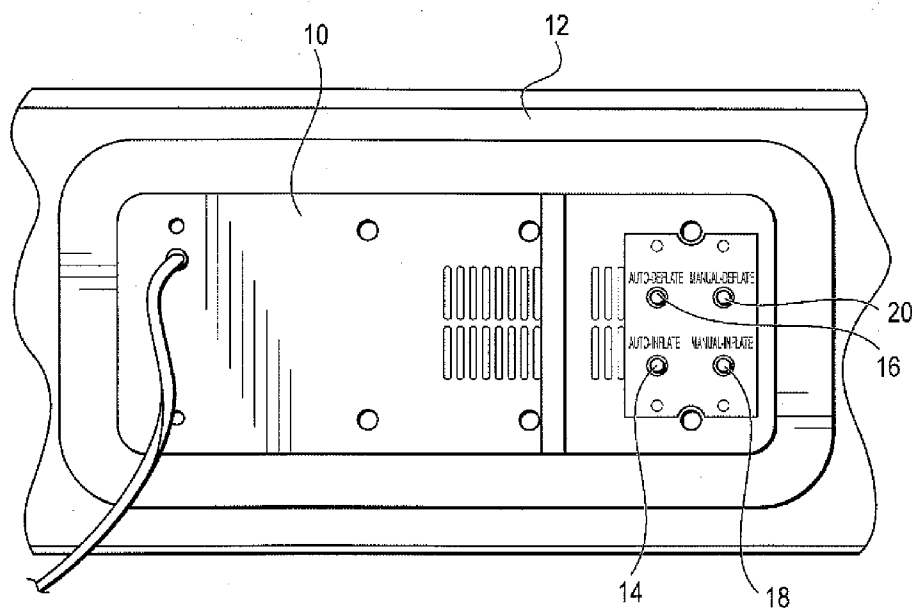
(84) Designated States (unless otherwise indicated, for every kind of regional protection available): ARIPO (BW, GH, GM, KE, LS, MW, MZ, NA, SD, SL, SZ, TZ, UG, ZM, ZW), Eurasian (AM, AZ, BY, KG, KZ, MD, RU, TJ, TM), European (AT, BE, BG, CH, CY, CZ, DE, DK, EE, ES, FI, FR, GB, GR, HU, IE, IS, IT, LT, LU, LV, MC, MT, NL, PL, PT, RO, SE, SI, SK, TR), OAPI (BF, BJ, CF, CG, CI, CM, GA, GN, GQ, GW, ML, MR, NE, SN, TD, TG).

Published:

- with international search report
- before the expiration of the time limit for amending the claims and to be republished in the event of receipt of amendments

For two-letter codes and other abbreviations, refer to the "Guidance Notes on Codes and Abbreviations" appearing at the beginning of each regular issue of the PCT Gazette.

(54) Title: PUMP FOR INFLATABLE OBJECTS WITH AUTOMATIC SHUTOFF TIMING MECHANISMS



(57) Abstract: An inflatable support system (12) includes a substantially fluid impermeable bladder and a pump mounted on the bladder, the pump including timer that operates the pump after activation for a set period of time before automatically shutting off the pump, the timer being built into a circuit board or be an integrated circuit that operates the pump, a pressure sensor also being provided in electrical communication with the timer (or a motor of the pump) and in fluid communication with the bladder to provide a signal for shutting off the pump at a threshold pressure.

PUMP FOR INFLATABLE OBJECTS WITH AUTOMATIC SHUTOFF TIMING MECHANISMS

RELATED APPLICATIONS

5 This application claims the benefit under 35 U.S.C. § 119(e) of U.S. Provisional Patent Application No. 60/780,955, filed March 10, 2006, and titled “Pump for Inflatable Objects with Timing Mechanism,” which is incorporated herein by specific reference.

BACKGROUND

1. Technical Field

The disclosed embodiments relate to inflatable support systems, and inflation devices for such systems, particularly to a pump for inflatable support systems having a mechanism for automatically shutting off the pump after inflation.

2. Related Art

15 Pumps are known in the art and are used to inflate items of furniture such as air mattresses and beds, which usually contain at least one air bladder. Until now, however, these pumps generally require the user to hold an inflate or deflate button until the respective inflation or deflation has completed. Other pumps may require
20 that the inflation or deflation process be terminated by manually pressing a switch or knob on the pump, else the pump motor would continue to pump and possibly burn out. In either case, a user cannot simply begin the inflation or deflation process and leave the pump unattended to let the process finish.

 Some alternating current (A/C) air pumps have a resettable fuse, which
25 protects the pump by triggering the fuse to blow and the pump to shut off if the motor starts to overheat. This is a safety measure, however, not an intentional benefit to the consumer, and it can take up to a half hour to reset a blown fuse.

SUMMARY

30 Various embodiments are described herein directed to a pump for inflatable support systems having a mechanism for automatically shutting off the pump after inflation.

 In various embodiments, an inflatable support system includes a substantially fluid impermeable bladder and a pump mounted on the bladder. The pump includes

a timer that operates the pump after activation for a set period of time before automatically shutting off the pump. The timer may be built into a circuit board or an integrated circuit that controls operation of the pump. A pressure sensor may also be provided in electrical communication with the timer (or a motor of the pump) and in fluid communication with the bladder to provide a signal for shutting off the pump.

In additional various embodiments, a pump for inflating an air bladder includes a casing, a motor having an impeller to move air, and a timer to trigger the motor to automatically de-energize after a set amount of time, thus shutting off the pump. The timer may include a controlled switch in an integrated circuit that is in electrical communication with the motor. The timer may be in electrical communication with a circuit board, which controls the operation of the motor. A pressure sensor may also be provided in fluid communication with the air bladder and in electrical communication with the motor, wherein when the pressure sensor senses a threshold pressure within the bladder, it signals the motor to de-energize.

BRIEF DESCRIPTION OF THE DRAWINGS

A more particular description of the disclosure briefly described above will be rendered by reference to the appended drawings. Understanding that these drawings only provide information concerning typical embodiments and are not therefore to be considered limiting of its scope, the disclosure will be described and explained with additional specificity and detail through the use of the accompanying drawings.

FIG. 1 is a close up view of the controls of a pump incorporating the present disclosure.

FIG. 2 is a close up view of the controls of an alternative pump incorporating the present disclosure.

FIG. 3 is a close up view of the controls of an alternative pump having a setting selector knob, a light indicator to show the pressure, and a manual shutoff switch.

FIG. 4 is a perspective view of an inflatable mattress incorporating the pump of FIG. 1.

DETAILED DESCRIPTION

In one embodiment of the present disclosure, a pump for inflating an inflatable mattress or other inflatable object is provided. In the Figures provided, the pump is attached to a substantially fluid impermeable bladder 12, such as the inflatable mattress shown in FIGS. 1-4. Other inflatable objects could also be used.

The pump can attach to the mattress either permanently, or in a removable manner. The pump itself can be any type of pump known in the art, such as the pump disclosed in U.S. Patent Application No. 11/084,219 titled "Reversible Inflation System," which is assigned to the assignee of the present application and hereby incorporated by reference. The pump must be able to at least provide air to the inflatable bladder 12. In another embodiment, the pump can both inflate and deflate the inflatable bladder 12, either by reversing direction of the pump's motor, or by reversing the airflow through other means, such as the pump disclosed in U.S. Patent Application No. 11/084,219.

In a preferred embodiment, the pump incorporates an automatic shutoff mechanism. This automatic shutoff mechanism can take many forms, but must be able to automatically stop inflation or deflation of the inflatable object without additional input from a user.

In one embodiment, a circuit board (not shown), or an integrated chip (not shown) that serves as a timer is mounted to such a circuit board, is provided to control the pump. The circuit board or chip is programmed to allow the pump to run for a set period of time after it is activated. For example, in one type of inflatable mattress 12, it may take 60 seconds to adequately inflate the mattress 12. In this case, the circuit board is programmed to run the pump for at least 60 seconds before shutting it off. The circuit board may also be programmed to include a buffer to make sure that the inflatable mattress 12 is adequately inflated. In the above example, the circuit board or chip could be programmed to operate the pump for 70 seconds to assure adequate inflation.

In an embodiment utilizing a pump that can both inflate and deflate an inflatable object, it is beneficial to allow the pump to run longer in the deflation mode than in the inflation mode to ensure that all the air is removed from the inflatable object. For instance, in the above example, the circuit board can be programmed to operate the pump for about 10 seconds longer in the deflation mode

than in the inflation mode. It is to be understood that these timeframes are exemplary only, and the circuit board could be programmed to shut the pump off after any time period, regardless of whether the pump was in inflation or deflation mode. It could also be programmed with different time settings to allow for
5 inflation of the bladder 12 to different firmness levels. Different settings would also allow inflation of various bladder sizes.

Alternatively, instead of the circuit board, a mechanism such as a timer switch (not shown) could be used to automatically shut off the pump. If such a timer switch is used, the switch can be set to allow the pump to run for a set period of time
10 once it is activated, in the same fashion as the circuit board already described.

In another embodiment, a pressure sensor (not shown) can be supplied that shuts the pump off automatically once a certain PSI (pounds per square inch) level is reached within the inflatable object, such as the bladder 12. In such an embodiment, the pressure sensor is in fluid communication with the bladder and in electrical
15 communication with the motor or a controller for the motor, such as the timer or circuit board discussed above. The threshold pressure that would trigger the motor to automatically de-energize, and thus shut off, may be a positive pressure (such as in inflation) or a vacuum pressure (such as in deflation). The process of de-energizing may be nothing more than ceasing to provide power to the motor.

20 In yet another embodiment, a combination of a circuit board and/or an integrated circuit (IC) chip may be used as a timing circuit along with a pressure sensor to provide the timing signal that indicates when terminate pumping. The IC chip may include a controlled switch (not shown) in electrical communication with the pressure sensor, wherein the controlled switch is triggered by signals from the
25 pressure sensor that include threshold pressures, which indicate when the pump is done pumping and should be automatically turned off.

Alternatively, both the pressure sensor and the IC chip may each be separately in electrical communication with the motor, so that the pressure sensor and timer circuit may independently work to shut off the pump. This may provide a
30 failsafe mechanism, wherein if the timing circuit were to malfunction, then the pump would still shut off at a given pressure. Also, if the pressure sensor were to fail, then the timing circuit would still function to limit the ultimate pressure by virtue of stopping after a set period of pumping.

The attached Figures 1-4 show the control elements of a pump incorporating the auto-shut off mechanism of the present disclosure. The pump is located inside a casing 10 which is mounted on a substantially fluid impermeable bladder 12. A motor (not shown) along with an impeller (not shown) to move the air are provided within the casing 10. In the embodiments shown in Figures 1-4, the controls for the pump are located on the outside of the casing 10. It is also possible to provide the controls on a separate wand, or on a remote control, if corresponding remote sensors are included on and/or within the pump. In the embodiment shown, the bladder 12 is an inflatable mattress 12, but other shapes of substantially fluid impermeable bladders could also be utilized.

Multiple ways of controlling the pump are provided in the embodiments in the Figures. In FIG. 1, a user can press the "auto-inflate" button 14 to begin inflation of the inflatable mattress. After pressing this button 14, the pump will operate until it automatically shuts off based on one of the mechanisms described above. A user can press the "auto-deflate" button 16 to begin deflation of the inflatable mattress 12, and the pump will operate until it automatically stops based on one of the mechanisms described above. Manual inflate and deflate buttons 18, 20 are also provided to allow a user to manually adjust the firmness of the inflatable mattress 12. In FIG. 2, the manual deflate button 20 is labeled "Adjustable." Alternatively, inflate and deflate buttons 18, 20 may be integrated into a single toggle switch or button having two positions, one to manually inflate and the other to manually deflate. Therefore, "button" herein may be construed to mean "setting" or "position" as well.

The inflate and deflate buttons 18, 20 correspond, respectively, to signals by which a user causes the pump to incrementally either increase or decrease the pressure within the air bladder 12. The control for the pump, therefore, provides comfort levels through buttons 18 and 20 by allowing a user to fine tune the firmness of the air bladder 12 as desired by the user, after the automatic inflation approximates a generally acceptable level of inflation. Alternatively, the manual deflate button 20 could operate a valve as known in the art to release air from the air bladder 12 without operation of the motor, such as through the use of a solenoid control that opens the valve.

FIG. 3 is a close up view of the controls of an alternative pump having a setting selector knob 24, indicia in the form of a light indicator 28 to show the pressure during operation of the pump, and a manual shutoff switch 32. In such an embodiment, the user may select from multiple firmness levels (or settings) 34, such as “soft,” “medium,” and “firm” as indicated on the selector knob 24. Other levels 34 may be included for finer tuning of the automatic pressure sensor setting. This knob 24 may be implemented in a series of buttons or in a single switch that may be toggled between the settings 34, among other implementations.

Depending on the selected setting 34, the pressure sensor will shut off the motor once the desired pressure, corresponding to the chosen setting 34, is reached. In this embodiment, the light indicator 28 may be provided on the pump to show the level of firmness as the bladder 12 inflates and deflates. The light indicator 28 may be a single bar, with multiple colors, or a series of bars that increase in size to indicate increasing pressure. A manual shutoff button 32 may also be provided to allow a user to manually stop the pump once a specific visual cue is shown, or the user is on the bladder 12 and feels that the pressure therein matches his or her comfort level. Additionally, although not shown, the controls of FIG. 3 may also include manual inflate and deflate buttons 18, 20 as shown in FIGS. 1 and 2, to provide for fine-tuning the pressure level in the bladder 12. Such buttons 18, 20 may also be included on a remote control, as previously discussed.

It should be noted that a wide range of changes could be made to the present embodiments without departing from the scope of the claimed disclosure. Any type of inflatable bladder 12 can be used with the pump of the present disclosure. If a timer mechanism or circuit board is used, they can be adjusted to adequately inflate and deflate any size of inflatable bladder 12. Any type of pressure sensing mechanism can be used to provide feedback to the pump or the motor. Furthermore, the pressure sensing mechanism can be used alone or in conjunction with the timer switch and/or circuit board. Alternative mechanisms could also be provided in the same pump.

The terms and descriptions used herein are set forth by way of illustration only and are not meant as limitations. Those skilled in the art will recognize that many variations can be made to the details of the above-described embodiments without departing from the underlying principles of the invention. The scope of the

invention should therefore be determined only by the following claims (and their equivalents) in which all terms are to be understood in their broadest reasonable sense unless otherwise indicated.

CLAIMS

1. An inflatable support system comprising:
a substantially fluid impermeable bladder; and
a pump mounted on the bladder, the pump having a timer that operates the
5 pump after activation for a set period of time before automatically shutting off the pump.
2. The inflatable support system of claim 1, wherein the timer is built into a circuit board that controls operation of the pump.
- 10 3. The inflatable support system of claim 2, wherein the timer is an integrated circuit (IC) chip that electrically communicates with the circuit board and which is programmed to shut off the pump after the set period of time.
- 15 4. The inflatable support system of claim 2, further comprising:
a pressure sensor in electrical communication with the timer and in fluid communication with the bladder.
5. The inflatable support system of claim 4, wherein the pressure sensor sends
20 a signal to the circuit board when a specific pressure level is reached within the bladder.
6. The inflatable support system of claim 5, wherein the circuit board shuts off the pump upon reception of the signal from the pressure sensor.
- 25 7. The inflatable support system of claim 1, wherein the pump includes a motor to execute the fluid pumping, further comprising:
a pressure sensor in electrical communication with the motor and in fluid communication with the bladder, the pressure sensor to act as a failsafe together
30 with the timer to ensure that the pump is automatically shut off if one or the other fails.

8. The inflatable support system of claim 1, wherein the timer is a timer switch.
9. The inflatable support system of claim 1, wherein the pump comprises a motor and the motor includes a circuit board programmed to allow the motor to run for the set period of time when activated.
10. The inflatable system of claim 1, wherein the pump comprises an auto-inflate button, which when activated, begins the inflation process until the pump is automatically shut off.
11. The inflatable system of claim 10, wherein the pump comprises manual deflate and inflate buttons, which when either is depressed, operates the pump until the depressed button is released.
12. The inflatable system of claim 11, wherein the pump comprises an auto-deflate button, which when activated, begins the deflation process until the pump is automatically shut off.
13. The inflatable system of claim 12, further comprising:
a controller including the timer in electrical communication with a motor of the pump to cause the motor to automatically de-energize after the set period of time; and
a pressure sensor in electrical communication with the controller and in fluid communication with the bladder to cause the motor to automatically de-energize upon reaching a threshold pressure within the bladder.
14. The inflatable system of claim 13, wherein the threshold pressure comprises at least one of a positive pressure and a vacuum pressure.
15. An inflatable support system comprising:
a substantially fluid impermeable bladder;
a pump mounted on the bladder; and

a pressure-sensing mechanism in fluid communication with the bladder and in electrical communication with the pump to shut off the pump upon sensing a specific pressure within the bladder.

5 16. The inflatable support system of claim 15, further comprising:

 a circuit board integrated within the pump that controls the operation of the pump, wherein the pressure-sensing mechanism sends a signal to the circuit board when the specific pressure level is reached.

10 17. The inflatable support system of claim 16, wherein the pressure-sensing mechanism is an integrated circuit (IC) on the circuit board.

 18. The inflatable support system of claim 15, further comprising:

 a firmness level selector including a plurality of settings, wherein when a
15 setting is chosen by a user, a threshold pressure corresponding to the chosen setting is set as the specific pressure.

 19. The inflatable support system of claim 18, wherein the plurality of settings includes at least soft, medium, and firm settings.

20

 20. The inflatable system of claim 18, wherein the pump comprises an auto-inflate button, which when activated, begins the inflation process until the pump is automatically shut off.

25 21. The inflatable system of claim 20, wherein the pump comprises manual deflate and inflate buttons, which when either is depressed, operates the pump until the depressed button is released.

 22. The inflatable system of claim 21, wherein the pump comprises an auto-
30 deflate button, which when activated, begins the deflation process until the pump is automatically shut off.

23. The inflatable support system of claim 15, further comprising:
indicia to show the progress of the pressure level during inflation or
deflation; and
a manual shutoff to allow a user to shut off the pump manually upon the
5 indicia indicating that the bladder has reached a desired pressure.
24. A pump for inflating an air bladder comprising:
a casing;
a motor having an impeller to move air; and
10 a timer to trigger the motor to automatically de-energize after a set amount
of time, to thereby automatically shut off the pump.
25. The pump of claim 24, wherein the timer comprises a controlled switch in an
integrated circuit (IC) that is in electrical communication with the motor.
15
26. The pump of claim 24, further comprising:
a circuit board that controls operation of the motor, wherein the timer is in
electrical communication with the circuit board.
- 20 27. The pump of claim 24, further comprising:
a pressure sensor in fluid communication with the air bladder and in
electrical communication with the motor, wherein when the pressure sensor senses a
threshold pressure within the bladder it signals the motor to de-energize.
- 25 28. A method for automatically stopping a pump for use in inflating an inflatable
object, the method comprising the steps of:
providing a substantially fluid impermeable bladder;
providing a pump attached to the bladder; and
timing the period of operation of the pump with a timer,
30 after a set period of time, de-energizing a motor of the pump to
automatically shut off the pump.

29. The method of claim 28, wherein the timer comprises a circuit board programmed to run the motor for the set period of time.

30. The method of claim 28, further comprising:

5 sensing a threshold pressure within the bladder with a pressure sensor that is in fluid communication with the bladder and in electrical communication with the motor; and

 signaling the motor with the pressure sensor to cause the motor to de-energize upon reaching the threshold pressure within the bladder.

10

31. The method of claim 30, wherein the threshold pressure is at least one of a positive pressure and a vacuum pressure for respective inflation and deflation operations.

15

32. The method of claim 28, further comprising:

 enabling a user of the pump to adjust the pressure within the bladder after inflation by providing controls to manually inflate and deflate the bladder.

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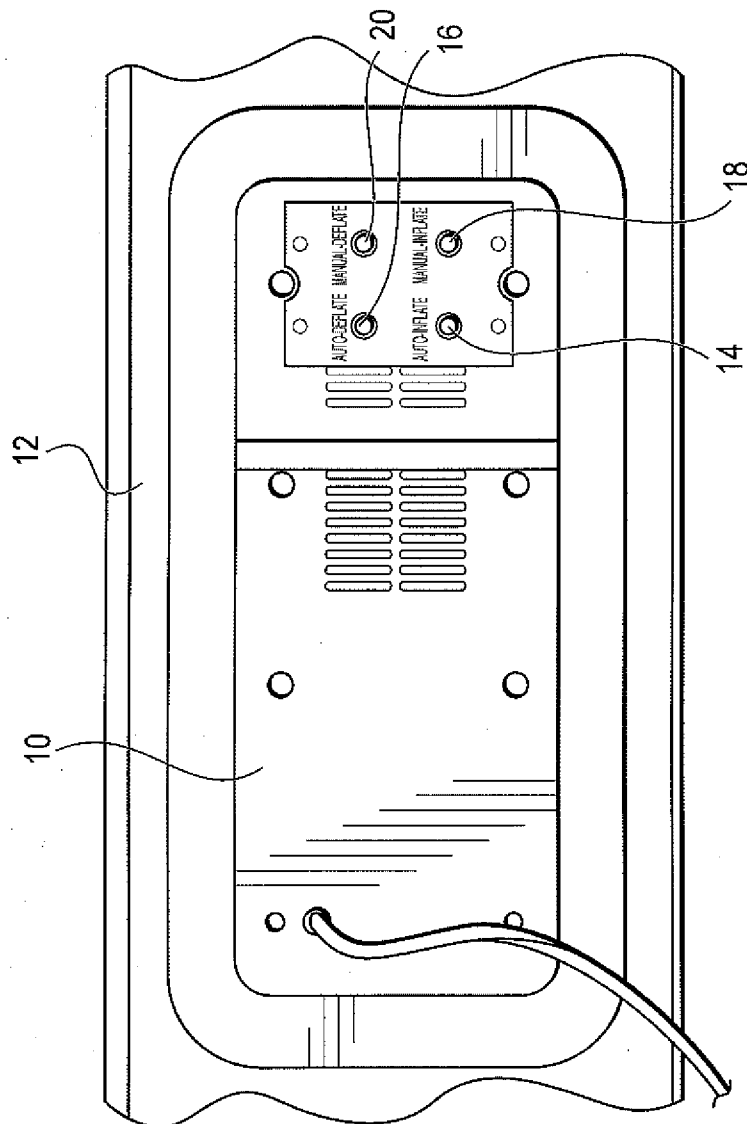


FIG. 1

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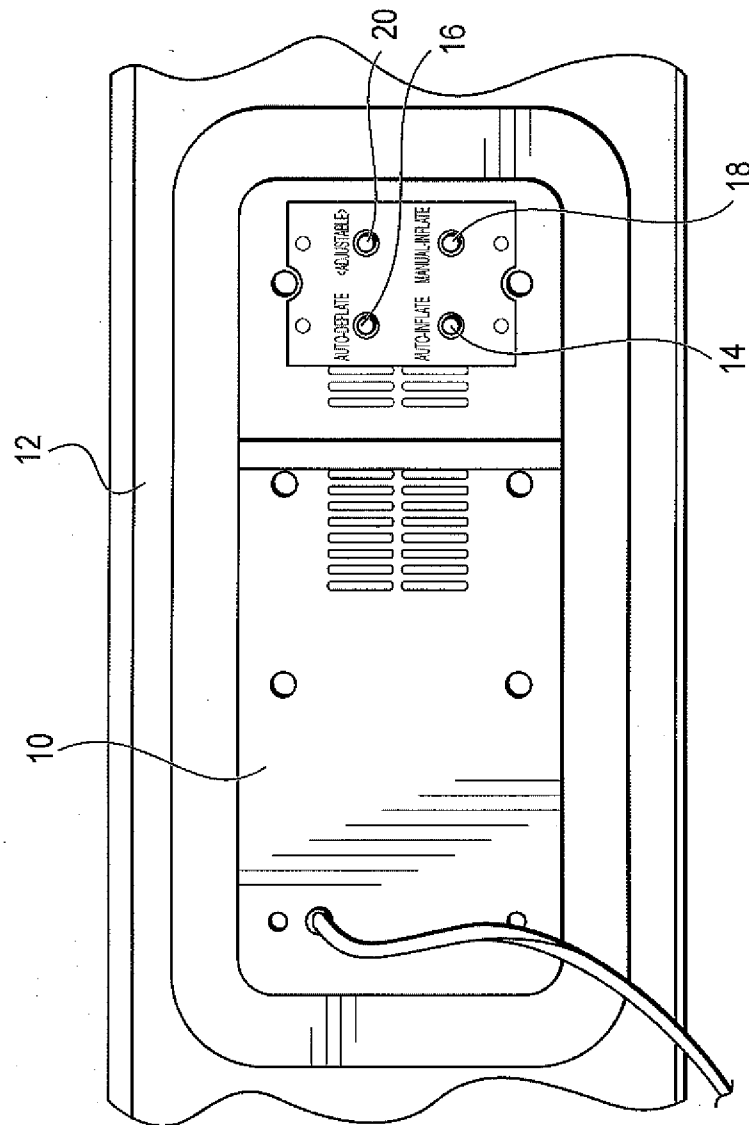


FIG. 2

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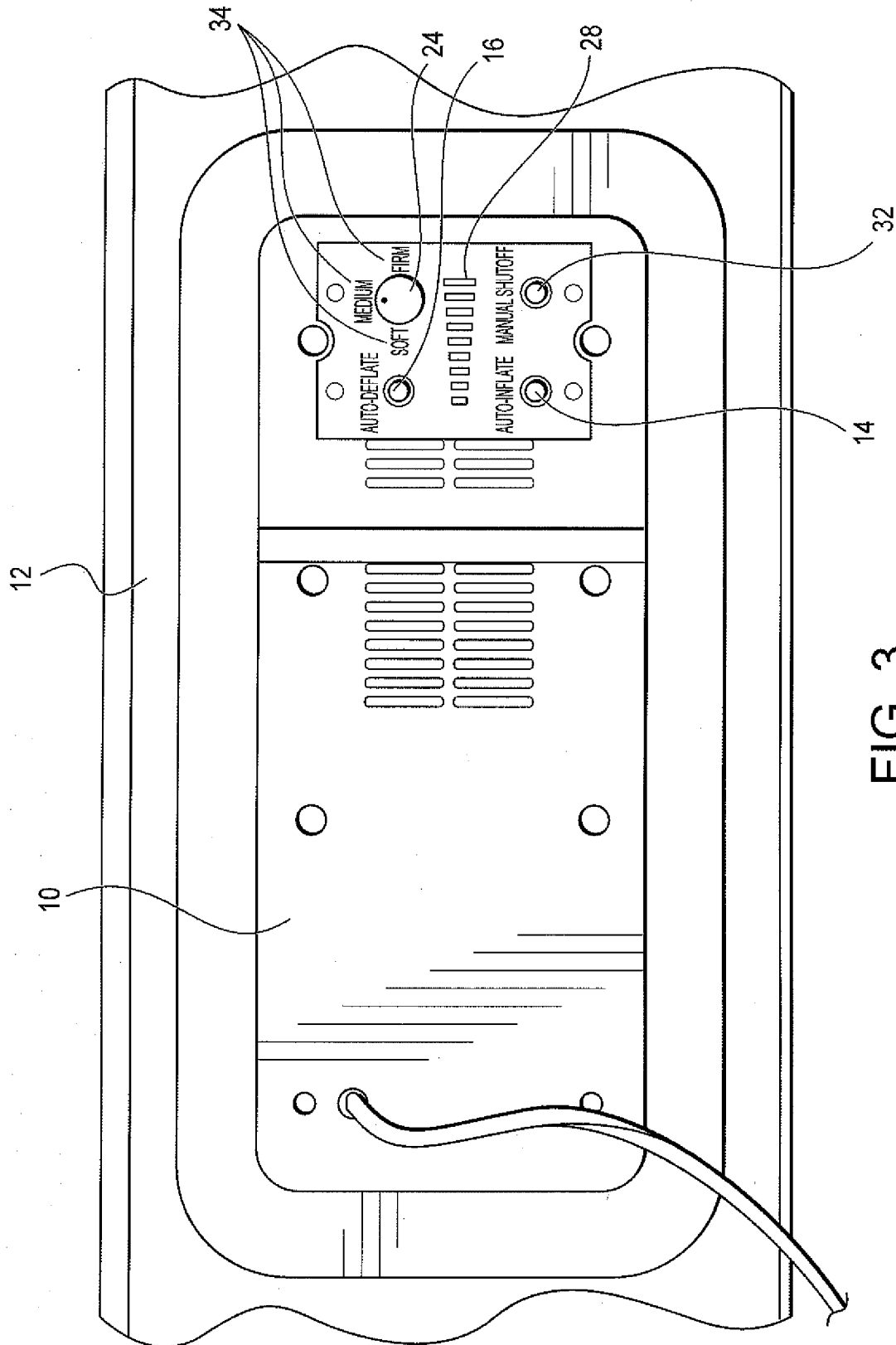


FIG. 3

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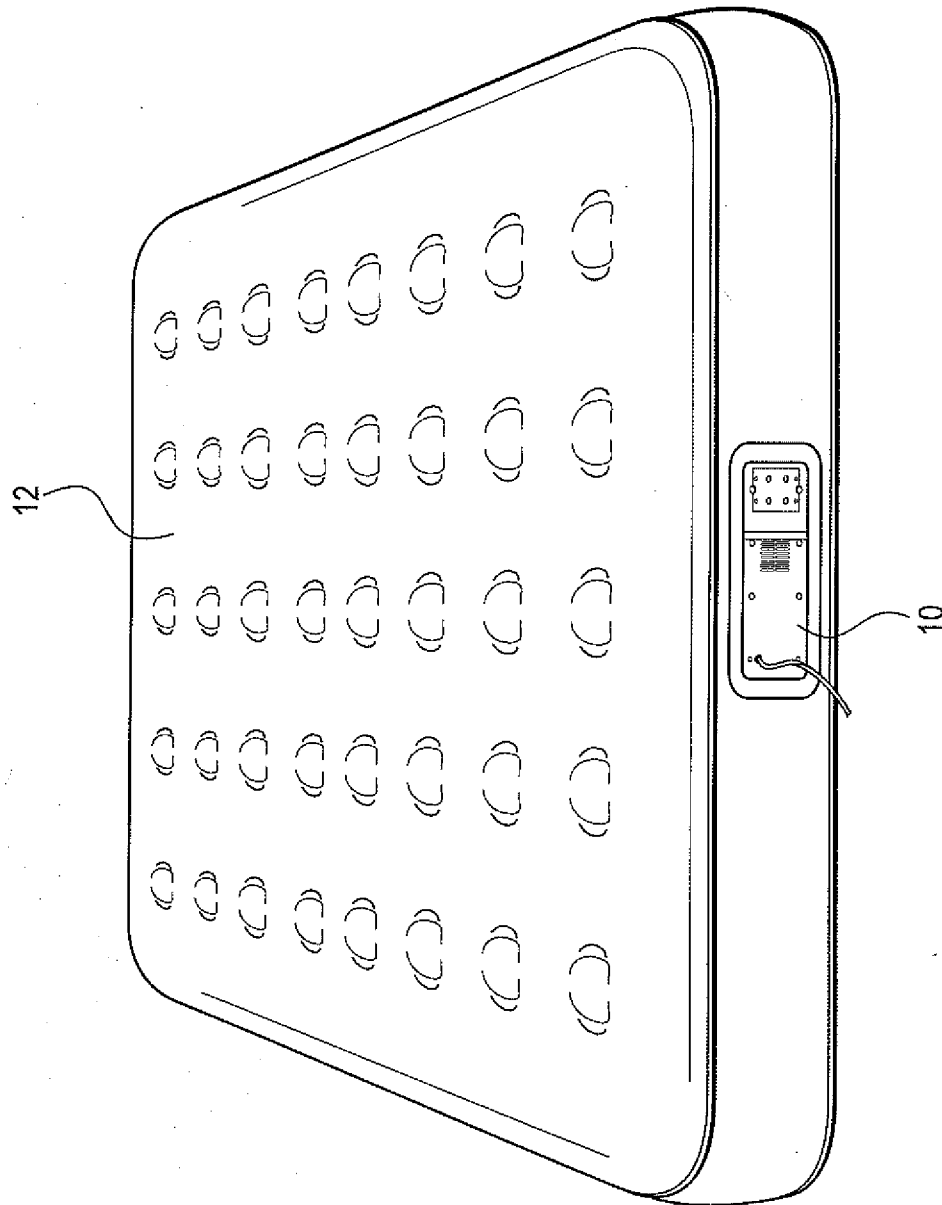


FIG. 4

INTERNATIONAL SEARCH REPORT

International application No

PCT/US2007/063650

A. CLASSIFICATION OF SUBJECT MATTER

INV. A47C27/08

According to International Patent Classification (IPC) or to both national classification and IPC

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)

A47C A61G A61C A61H B60N

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

Electronic data base consulted during the international search (name of data base and, where practical, search terms used)

EPO-Internal, WPI Data

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X	US 5 020 176 A (DOTSON DEREK P [US]) 4 June 1991 (1991-06-04) abstract column 4, line 20 - column 6, line 33 figures 1-5	1-9, 15-17, 24-30
X	US 6 014 784 A (TAYLOR REX E [US] ET AL) 18 January 2000 (2000-01-18) abstract column 3 - column 6 figures 1-3 ----- -/--	1-9, 15-17, 24-30

☒ Further documents are listed in the continuation of Box C.

☒ See patent family annex.

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Date of the actual completion of the international search

15 June 2007

Date of mailing of the international search report

10/07/2007

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INTERNATIONAL SEARCH REPORT

International application No

PCT/US2007/063650

C(Continuation). DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X	DE 38 04 960 A1 (VDO SCHINDLING [DE] MANNESMANN VDO AG [DE]) 31 August 1989 (1989-08-31) abstract column 2, line 22 - column 3, line 48 figures 1,2	1-9, 15-17, 24-30
X	US 2005/137506 A1 (CHOW LOYAL [US]) 23 June 2005 (2005-06-23) abstract page 2, paragraph 37 - page 3, paragraph 45 figures 1-6	1,2,8,9
X	US 4 833 614 A (SAITOH MASATSUGU [JP] ET AL) 23 May 1989 (1989-05-23) abstract; figure 2	15-17

INTERNATIONAL SEARCH REPORT

Information on patent family members

International application No

PCT/US2007/063650

Patent document cited in search report		Publication date	Patent family member(s)	Publication date
US 5020176	A	04-06-1991	NONE	
US 6014784	A	18-01-2000	NONE	
DE 3804960	A1	31-08-1989	NONE	
US 2005137506	A1	23-06-2005	NONE	
US 4833614	A	23-05-1989	JP 62238142 A	19-10-1987