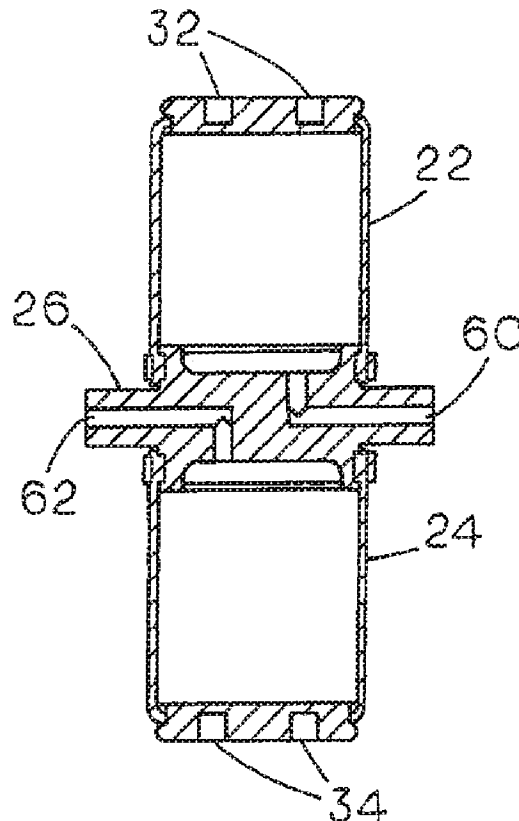




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(54) **Titre : ACTIONNEURS PNEUMATIQUES**
(54) **Title: PNEUMATIC ACTUATORS**



(57) **Abrégé/Abstract:**

A bi-directional pneumatic actuating unit includes a unitary structure having a central base member, a pair of opposed inflatable pneumatic chambers for applying force in different directions, one mounted on either side of the central base member, and air supply and exhaust access ports connected to each of the pneumatic chambers for selectively supplying air to and exhausting air from each of the pneumatic chambers.

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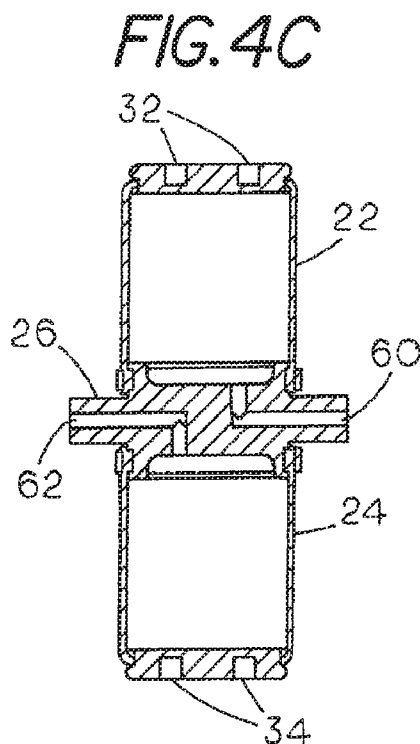


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(54) Title: PNEUMATIC ACTUATORS



(57) Abstract: A bi-directional pneumatic actuating unit includes a unitary structure having a central base member, a pair of opposed inflatable pneumatic chambers for applying force in different directions, one mounted on either side of the central base member, and air supply and exhaust access ports connected to each of the pneumatic chambers for selectively supplying air to and exhausting air from each of the pneumatic chambers.

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-1-

PNEUMATIC ACTUATORS**CROSS-REFERENCED TO RELATED APPLICATIONS**

Not applicable

5

**STATEMENT REGARDING FEDERALLY SPONSORED
RESEARCH OR DEVELOPMENT**

Not applicable

BACKGROUND OF THE INVENTION**I. Field of the Invention**

10

The present invention relates generally to a field including various types of machinery or other devices that can make use of pneumatic actuators for providing deployment and retraction forces during use. More specifically, the present invention relates to a pneumatic actuating system having opposed inflatable pneumatic chambers that enable bi-directional operation.

15

II. Related Art

Pneumatic actuating systems of a variety of types have been associated with the operation of many devices for some time, including mechanical implements of varying kinds. An example of such a concept is illustrated and described in U.S. Patent No. 8,534,373 B2, which shows the use of multiple airbag units to deploy and retract a variety of field-conditioning implements. It would provide a distinct advantage if a compact bi-directional pneumatic actuating unit could be provided to deploy and retract various devices.

20

25

SUMMARY OF THE INVENTION

30

By means of the present invention, there is provided a pneumatic actuator unit concept which includes a unitary structure that has dual inflatable pneumatic air chambers mounted on and fixed to a common central base member or plate member that provides a base for both of

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directions with respect to the base member. The operating air may be supplied by way of access ports in the end of the pneumatic chambers remote from the central base member or via access ports located in the central base member which may include trunnions for mounting. The air chambers are preferably airbag devices which may be sleeve-type airbags, single or multiple convoluted airbags or other inflatable apparatuses.

The pneumatic actuating units of the present invention may be mounted in an arrangement in which the position of each of the remote ends of opposed pneumatic chambers is fixed so that the central base member can be used to apply force and move a load according to the inflation of the opposed pneumatic chambers. The pneumatic actuating unit may also be mounted in a manner that fixes the position of the central base member and allows the ends of the opposed pneumatic chambers remote from the central base member to apply force based on the inflation of the opposed pneumatic chambers and move a load accordingly.

It should be noted that inflatable pneumatic operators in the form of conventional airbags have been found to be a preferred type of pneumatic operator, but other such devices could also be used.

The term "airbag", as used herein, is defined to mean any type of inflatable pneumatic operator, without limitation, including convoluted and non-convoluted devices with single and multiple air access ports, and ports at different locations. Single and double-acting units are also included. The present invention employs opposed units which may function as lift and down-force airbags.

BRIEF DESCRIPTION OF THE DRAWINGS

The foregoing features and advantages of the

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invention will become apparent to those skilled in the art from the following detailed description of one or more preferred embodiments, especially when considered in conjunction with the accompanying drawings in which like numerals depict like parts:

Figure 1A is a top view of one embodiment of a pneumatic actuating unit in accordance with the invention with outer end air fittings;

Figures 1B and 1C are elevational views of the pneumatic actuating unit of Figure 1A;

Figure 1D is a sectional view along line d--d of Figure 1C;

Figures 2A and 2B are elevational views of another embodiment of a pneumatic actuating unit in accordance with the invention with outer end air fittings;

Figure 2C is a sectional view along line c--c of Figure 2B;

Figures 3A-3D illustrate views of another embodiment of a pneumatic actuating unit in accordance with the invention in which the air fittings are provided in the central base member;

Figures 4A-4C illustrate views of yet another modified embodiment of a pneumatic actuating unit of the invention similar to that of Figures 3A-3D, but in which air access is provided through trunnions of the central base member;

Figures 5A-5D provide views of another embodiment of a pneumatic actuating unit in accordance with the invention which utilizes single convoluted airbags joined together by a central plate member with air access provided through the side of the plate member;

Figures 6A-6C illustrate an embodiment similar to that illustrated in Figures 5A-5D, but with the air access ports located in the trunnions of the central

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plate member;

Figures 7A-7D illustrate an embodiment of the pneumatic actuating unit in accordance with the invention utilizing double convoluted airbags with outer end air fittings;

Figures 8A-8D illustrate an embodiment similar to that in Figures 7A-7D with air access through the central plate member;

Figures 9A-9C depict an embodiment similar to that of Figures 8A-8D with the air access ports located in the trunnions of the central base member;

Figure 10A is a side view of another embodiment of the invention in which the actuating unit has pneumatic chambers that are not aligned back-to-back with air access ports between the chambers;

Figure 10B is a perspective view of the embodiment of Figure 10A;

Figures 11A and 11B are perspective views showing the operation of a pneumatic actuating unit in accordance with the invention in which the central base member is fixed and the remote ends of the chambers are attached to operate a mechanical device; and

Figures 12A and 12B depict the operation of a pneumatic actuating unit in accordance with the invention in which the remote ends of the pneumatic chambers are fixed in position and the movement of the central base member is utilized to perform a mechanical function.

DETAILED DESCRIPTION

The detailed description of the illustrative embodiments is intended to illustrate representative examples of the inventive concepts and is not intended to exhaust or limit the scope of those concepts. The examples are to be read in connection with the accompanying drawings, which are to be considered part of

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the entire written description of this invention. In the description, relative terms such as "lower", "upper", "horizontal", "vertical", "above", "below", "up", "down", "top" and "bottom", "left" and "right", as well as derivatives thereof (e.g., "horizontally", "downwardly", "upwardly", etc.) should be construed to refer to the orientation as then described or as shown in the drawings under discussion. These relative terms are for convenience of description and do not require that the apparatus be constructed or operated in a particular orientation. Terms such as "connected", "connecting", "attached", "attaching", "join" and "joining" are used interchangeably and refer to one structure or surface being secured to another structure or surface or integrally fabricated in one piece, unless expressly described otherwise.

Figures 1A-1D depict one embodiment of a bi-directional pneumatic actuating unit generally at 20 having an upper pneumatic or air chamber 22, an opposed lower pneumatic or air chamber 24, and a central base member which includes opposed trunnions 28 and 30. The unit may include upper bolt holes or recesses 32 and lower bolt holes or recesses 34 and an upper air chamber air filling port 36 and a lower air chamber filling port 38 located at the outer or remote ends of the air chambers. Upper air chamber 22 is peripherally fixed to the central base or plate member 26 at 40 and the lower air chamber is similarly fixed to the base member 26 at 42. The air chambers illustrated are sleeve-type airbags.

Figures 3A-3D and 4A-4C illustrate other embodiments of a pneumatic actuating unit, which are of a construction similar to that illustrated in Figures 1A-1D with certain variations. Thus, in Figures 3A-3D, air

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access ports for the upper air chamber 22 and lower air chamber 24 are provided in the central base member as at 50 and 52, respectively. Likewise, Figures 4A-4C depict views of another embodiment that also differs only in the location of the air ports. In this embodiment, upper air chamber air access port 60 and lower air chamber access port 62 are located in the trunnions of the central base member 26.

Figures 2A-2C depict elevation and sectional views of another embodiment of a bi-directional pneumatic actuating unit generally at 70 in which opposed single convoluted upper and lower airbags 72 and 74, respectively, are fixed to a central base member 76. In this embodiment, air fitting access ports are located in the top and bottom outward ends of opposed airbags 72 and 74 at 78 and 80, respectively. As with other embodiments, bolt connection recesses are shown at 82 and 84. These airbags are fixed to the central base member 76 peripherally at 86 and 88.

Figures 5A-5D and 6A-6C depict view of other embodiments that are variations on the embodiment of Figures 2A-2C in which the air access fillings or ports are located in the central base member. Thus, in the embodiments of Figures 5A-5D, upper and lower air access ports are in the side of central base member 76 at 90 and 92, respectively. In the embodiment of Figures 6A-6C, upper and lower air access ports 94 and 96 are located in the trunnions of the central base member 76.

Figures 7A-7D, 8A-8D and 9A-9C depict views of embodiments that are similar to those of Figures 2A-2C, 5A-5D and 6A-6C using convoluted airbags that have a plurality of convolutions. In Figures 7A-7D, the unit includes an upper double convoluted airbag 100 and lower double convoluted airbag 102 with central base member

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includes an upper double convoluted airbag 100 and lower double convoluted airbag 102 with central base member 104.

5 The upper airbag 100 is fixed peripherally to the central base member 104 at 106 and the lower airbag 102 is fixed in a like manner at 108. In this arrangement, air access ports are provided at the outer extremes of the upper and lower airbags at 110 and 112, respectively. Attachment recesses are shown at 114 and 116.

10 Similarly constructed arrangements are shown in Figures 8A-8D and 9A-9C with the exception of the location of the air access ports, which are located in the central base members. In the case of Figures 8A-8D, the air access ports are located in central base member 15 120 at 122 and 124 as upper and lower access ports. In the embodiment of Figures 9A-9C, the air access ports are provided through the trunnions of central base member 130 at 132 (upper) and 134 (lower).

20 Figures 10A and 10B depict another embodiment in which the opposed inflatable pneumatic chambers are not aligned back-to-back, but at an angle determined by the shape of the intermediate mount. Inflatable chambers 140 and 142 are separated by a wedge-shaped intermediate mount 144 which has corresponding air access ports at 146 25 and 148. Connection openings are shown at 150 and 152.

Figures 11A and 11B illustrate one mounting mode of a pneumatic actuating unit in accordance with the invention. The unit, generally 200, includes an upper airbag 202, a lower airbag 204 and a central base member 30 206. The central base member 206 is fixed to a structural beam member 208 by gusset plates 210, as shown. The outer or remote ends of the airbags 202 and 204 are connected to upper and lower operating linkage assemblies 212 and 214, respectively at 216 and 218.

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about an attachment point illustrated at 222.

As shown in Figure 11A, the airbags 202 and 204 are both collapsed causing the assemblies 212 and 214 to assume a fully separated position. Conversely in Figures 5 11B, the airbags 202 and 204 are shown fully inflated forcing the assemblies 212 and 214 to assume a closed or closer together position. It will be understood that with the central base member mounted in a fixed position, either or both airbags can be inflated in a controlled 10 position to exert forces away from the central base member.

Figures 12A and 12B illustrate another mounting arrangement for the pneumatic actuating units of the invention. In that arrangement, an actuating unit is 15 shown with opposed upper and lower airbags 250 and 252 mounted on central base member 254. A mounting yoke arrangement 256 with arm members 258 and 260 is pivotally attached to plates 262 as at 264. A wheel 266 is mounted at the other end of the yoke 256. The members 258 and 20 260 are further fixed to central base member 254 as at 268. The unit is fixed to the flanges 270 and 272 of a mount as at 274 so that the ends of the unit cannot move. As can be seen in the drawing figures, inflation of the lower airbag 252 deflated upper airbag 250 and raises the 25 wheel 266. Conversely, inflation of the upper airbag 250 collapses the lower airbag 252 and lowers the wheel 266. Of course, air can be supplied to both bags to adjust the net upward or downward force as desired.

An important aspect of the present invention is the 30 unitary construction of the bi-directional actuating system that utilizes a common central base to mount opposed pneumatic devices that can apply force in two directions by two modes. The mounting of the unit and the location of the air access ports or fillings can be

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arranged to best suit the particular application.

This invention has been described herein in
considerable detail in order to comply with the patent
statutes and to provide those skilled in the art with the
5 information needed to apply the novel principles and to
construct and use embodiments of the example as required.
However, it is to be understood that the invention can be
carried out by specifically different devices and that
various modifications can be accomplished without
10 departing from the scope of the invention itself.

What is claimed is:

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CLAIMS

1. A bi-directional pneumatic actuating unit having a plurality of inflatable pneumatic chambers, comprising:

- 5 (a) a central base member having two surfaces that may be opposed or at an angle with each other;
- (b) a pair of opposed inflatable pneumatic chambers for applying force in different directions, each one mounted on and fixed to a different
- 10 one of said two surfaces of said central base member; and
- (c) air supply and exhaust access ports connected to communicate with each of said pneumatic chambers for selectively supplying air to
- 15 inflate and expand exhausting air to deflate and collapse each of said pneumatic chambers through separate external connections.

2. A pneumatic actuating unit as in claim 1 wherein said central base member further comprises

20 trunnions.

3. A pneumatic actuating unit as in claim 1 wherein said air supply and exhaust access ports are located in ends of said pneumatic chambers remote from said central base member.

25 4. A pneumatic actuating unit as in claim 1 wherein said air supply and exhaust access ports are located in said central base member.

5. A pneumatic actuating unit as in claim 1 wherein said pneumatic chambers are sleeve-type airbags.

30 6. A pneumatic actuating unit as in claim 1 wherein said pneumatic chambers are multiple convoluted airbags.

7. A pneumatic actuating unit as in claim 1 wherein said pneumatic chambers are single convoluted

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airbags.

8. A pneumatic actuating unit as in claim 2 wherein said air supply and exhaust ports are located in said central base member.

5 9. A pneumatic actuating unit as in claim 2 wherein said air supply and exhaust ports are located in said trunnions.

10 10. A pneumatic actuating unit as in claim 4 further comprising central valves for controlling said air supply and exhaust to and from said pair of inflatable pneumatic chambers.

15 11. A pneumatic actuating unit as in claim 1 comprising a mounting arrangement that fixes the position of the ends of said pneumatic chambers remote from said central base member so that the central base member can selectively apply force and move a load in two directions.

20 12. A pneumatic actuating unit as in claim 1 comprising a mounting arrangement that fixes the position of said central base member so that each of the ends of said pneumatic chambers remote from said central base member can selectively apply force and move a load accordingly.

25 13. A pneumatic actuating unit as in claim 1 wherein said two surfaces of said central base member are opposed and aligned along a common axis.

14. A pneumatic actuating unit as in claim 1 wherein said two surfaces of said central base member of opposed pneumatic chambers are at an angle.

30 15. A bi-directional pneumatic actuating unit having a pair of opposed inflatable pneumatic chambers comprising:

- (a) a central base member having two surfaces;
- (b) a pair of inflatable and collapsible pneumatic

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chambers, each mounted on and fixed to a different one of said two surfaces of said central base member; and

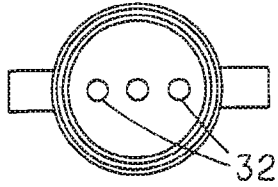
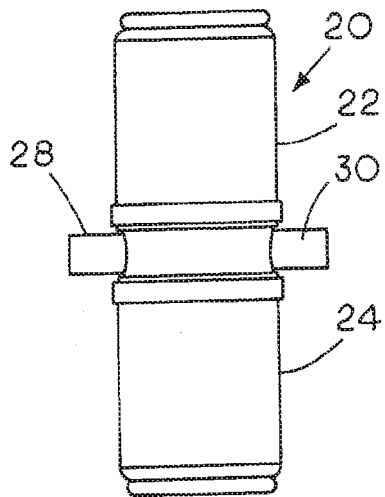
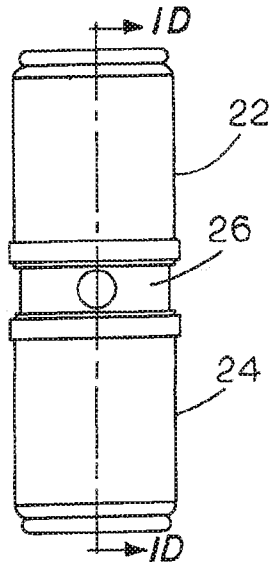
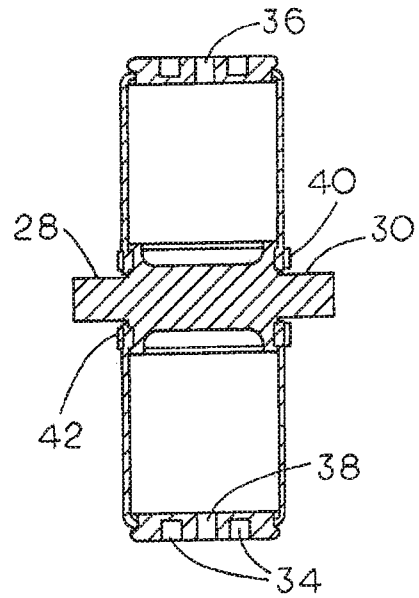
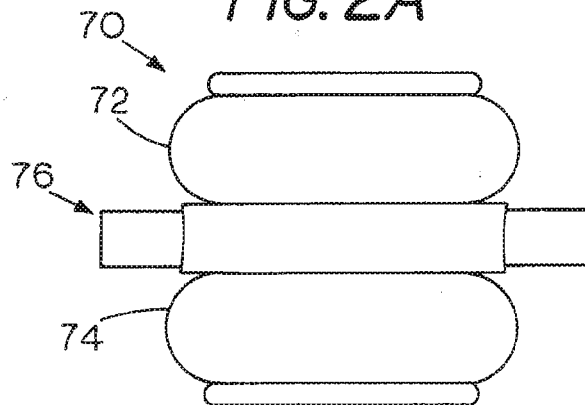
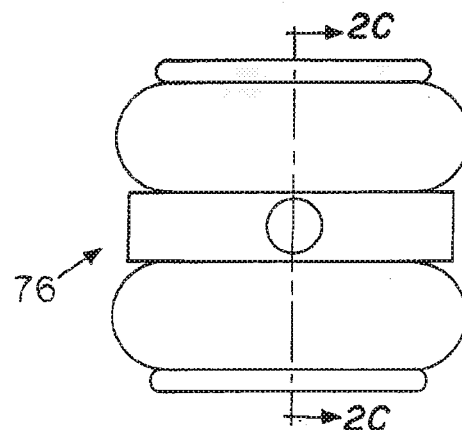
- 5 (c) air supply and exhaust access ports in said central base member connected to each of said pneumatic actuators for selectively and separately supplying air to and exhausting air from each of said pneumatic chambers.

10 16. A bi-directional pneumatic actuating unit as in claim 15 wherein said inflatable pneumatic chambers are selected from the group of sleeve type and convoluted airbags.

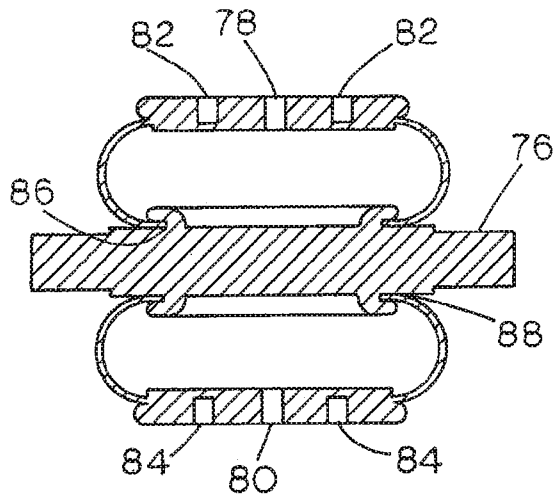
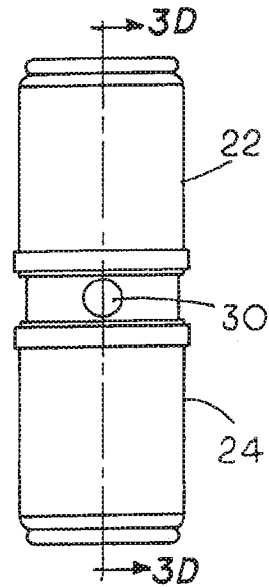
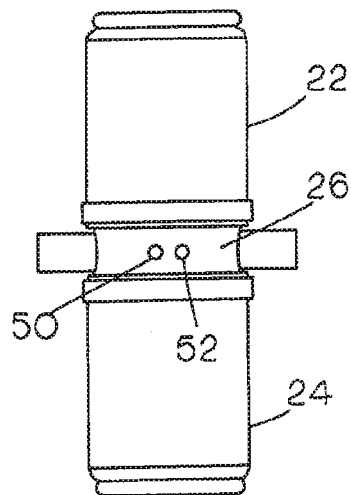
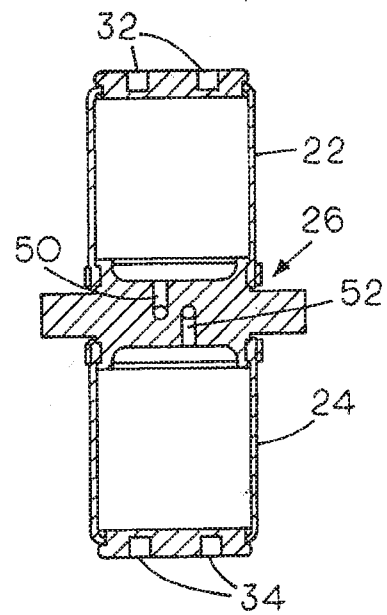
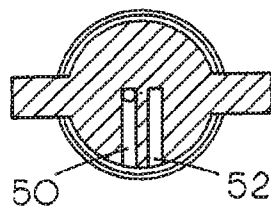
15 17. A pneumatic actuating unit as in claim 16 comprising a mounting arrangement that fixes the position of the ends of said opposed pneumatic chambers remote from said central base member so that the central base member can apply force and move a load in two directions.

20 18. A pneumatic actuating unit as in claim 16 comprising a mounting arrangement that fixes the position of said central base member so that each of the ends of said opposed pneumatic chambers remote from said central base member can apply force and move a load accordingly.

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FIG. 1A*FIG. 1B**FIG. 1C**FIG. 1D**FIG. 2A**FIG. 2B*

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FIG. 2C*FIG. 3C**FIG. 3A**FIG. 3D**FIG. 3B*

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FIG. 4A

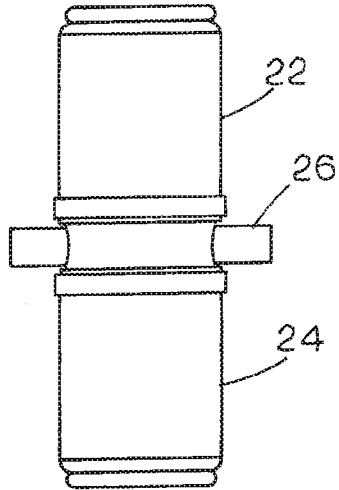


FIG. 4C

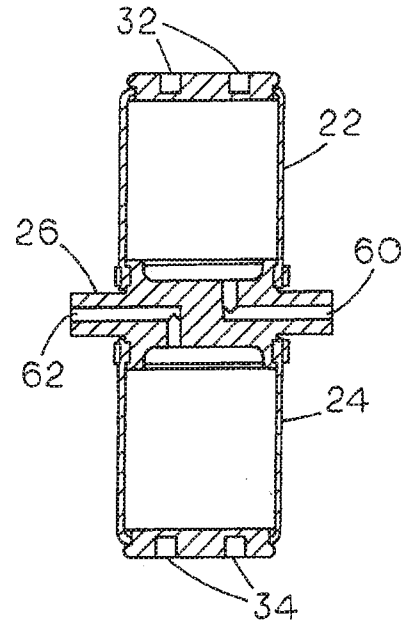


FIG. 4B

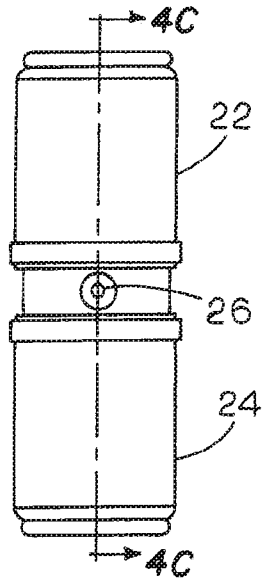


FIG. 5A

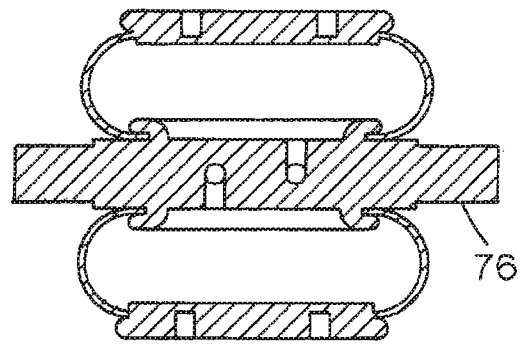
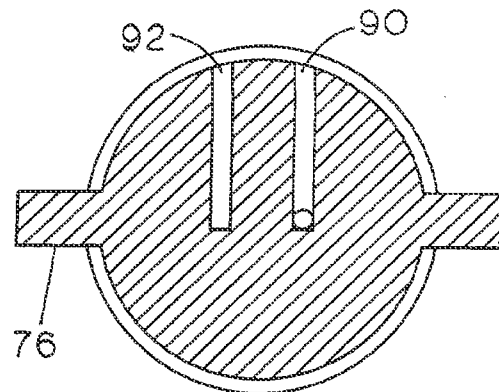
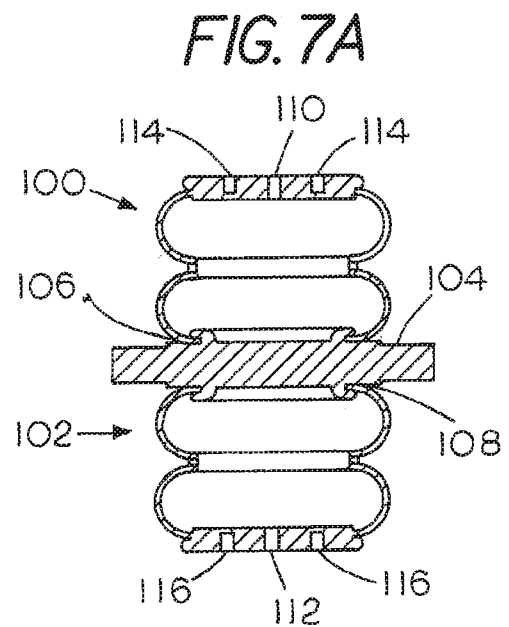
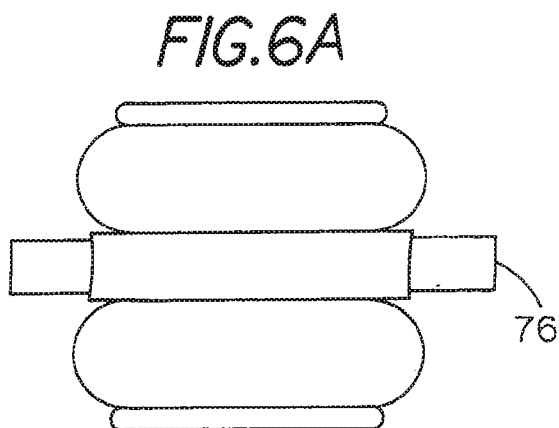
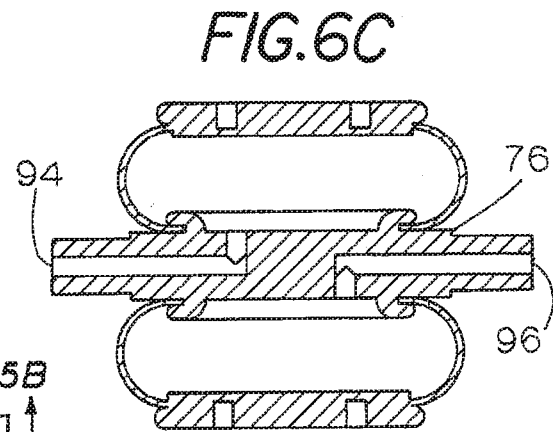
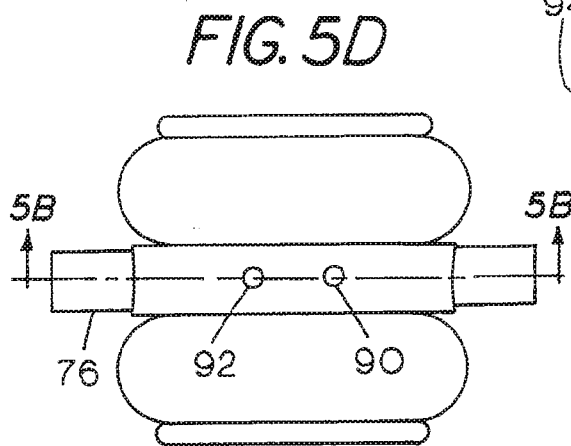
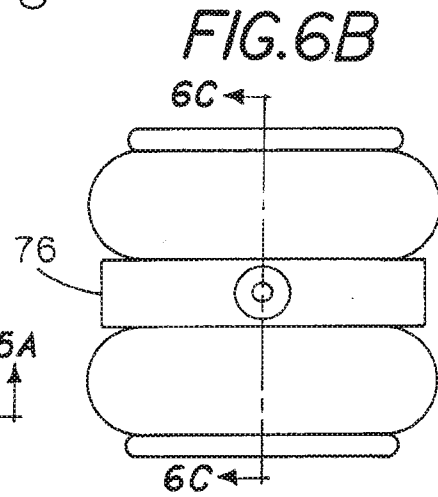
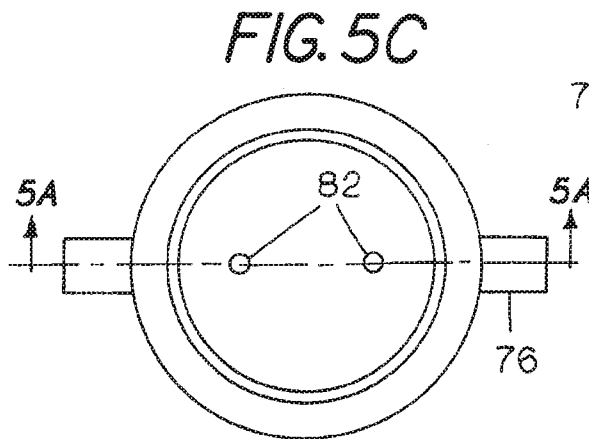


FIG. 5B



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FIG. 7B

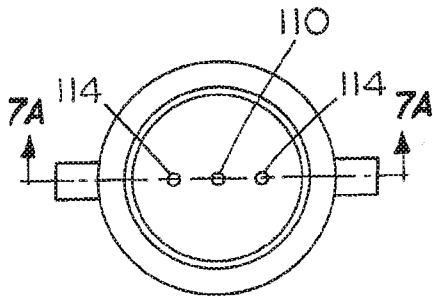


FIG. 8A

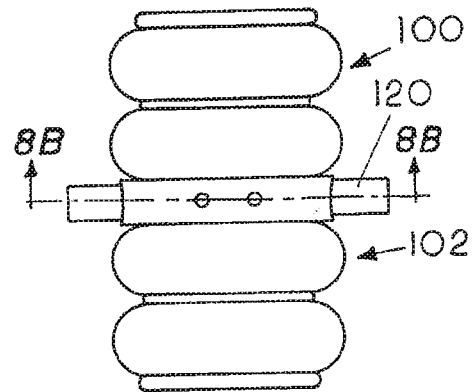


FIG. 7C

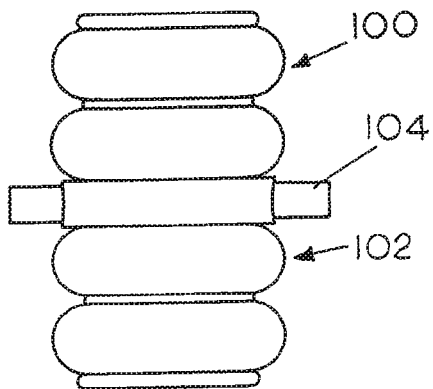


FIG. 8B

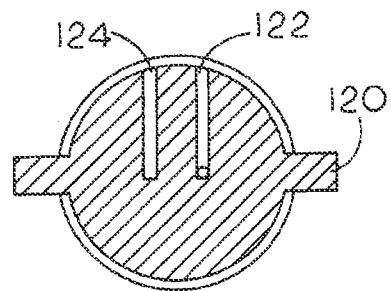


FIG. 7D

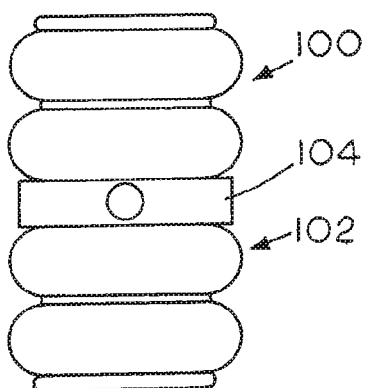
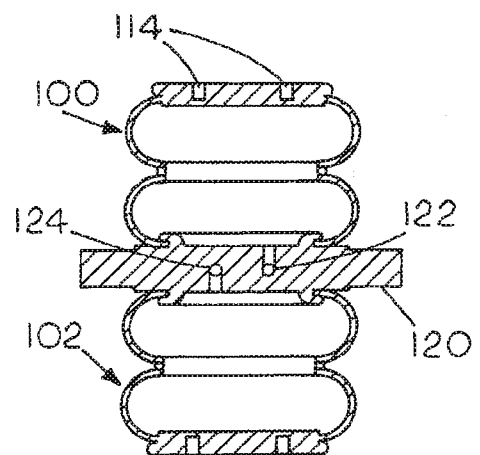


FIG. 8C



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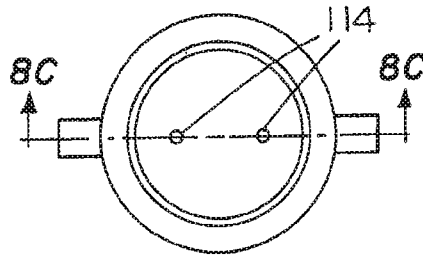
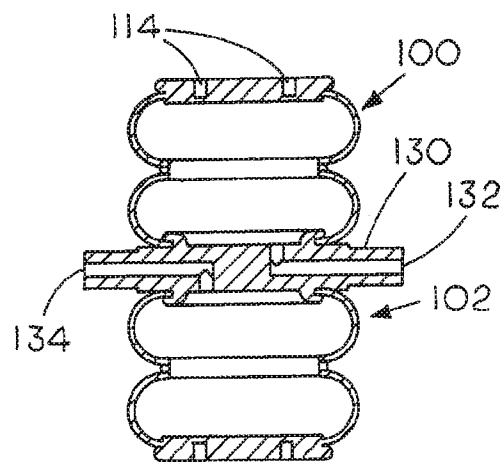
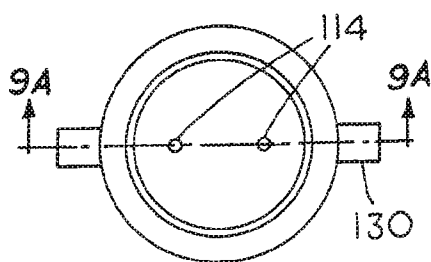
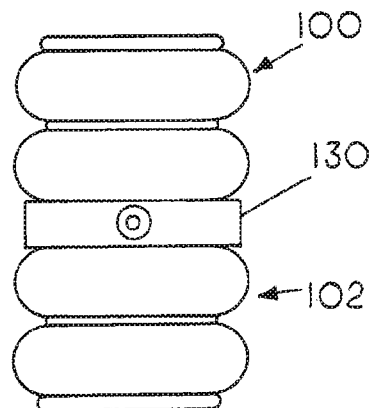
FIG. 8D*FIG. 9A**FIG. 9B**FIG. 9C*

FIG. 10A

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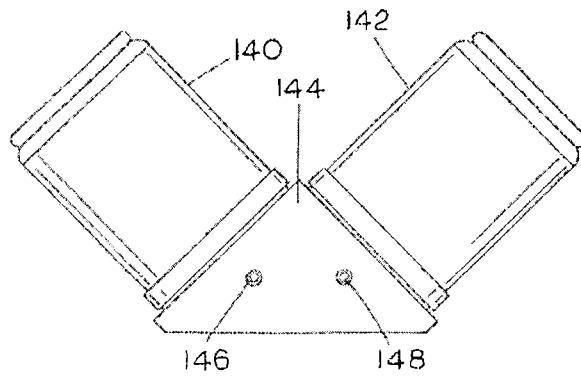


FIG. 10B

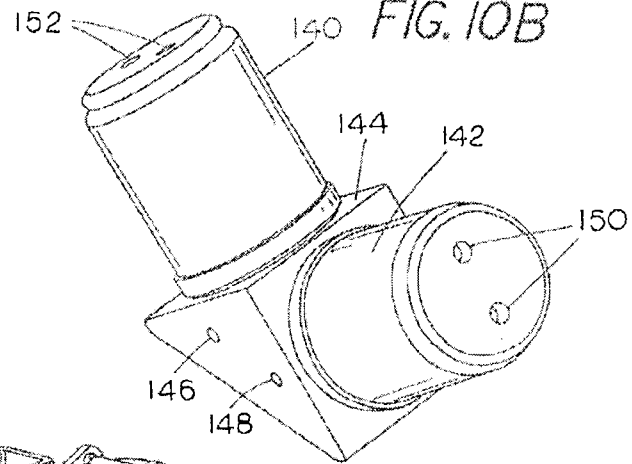
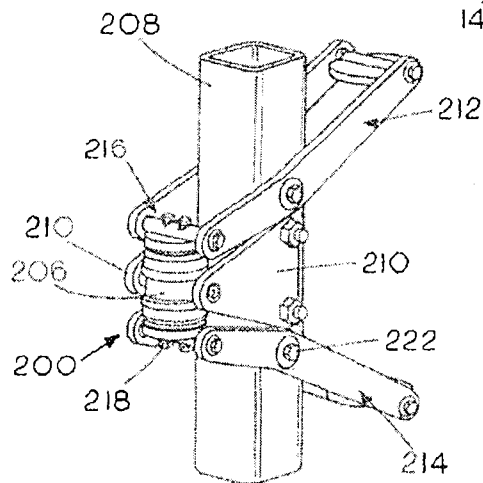


FIG. 11A



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FIG. 11B

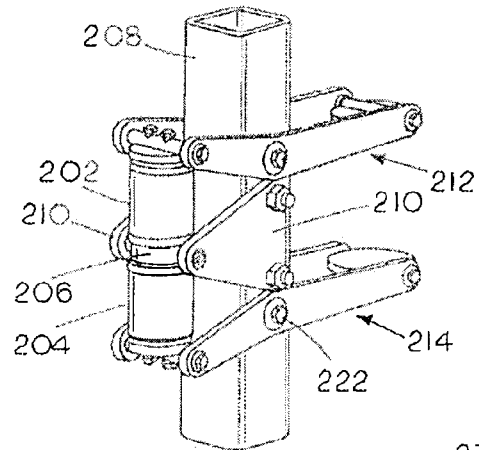


FIG. 12A

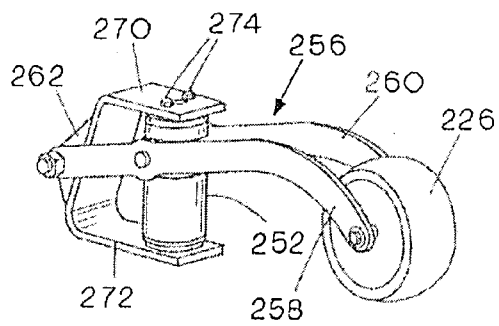


FIG. 12B

