Aug. 25, 1953 J. H. PROVINCE 2,649,843

DOUBLE DIAPHRAGM UNIT

Filed Aug. 14, 1947 3 Sheets-Sheet 1

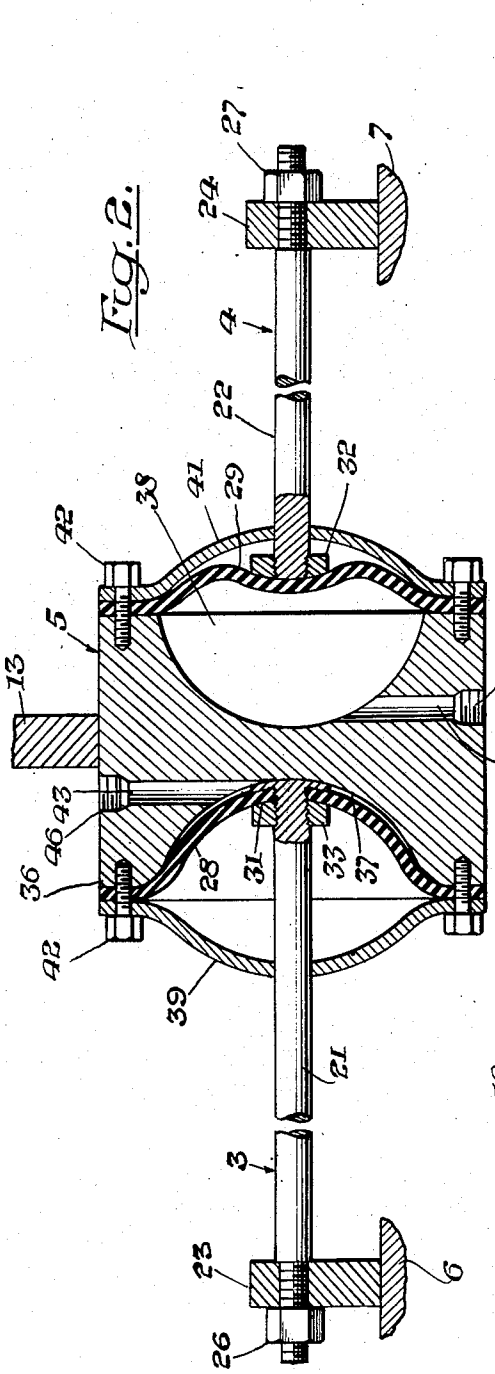


Fig. 2.

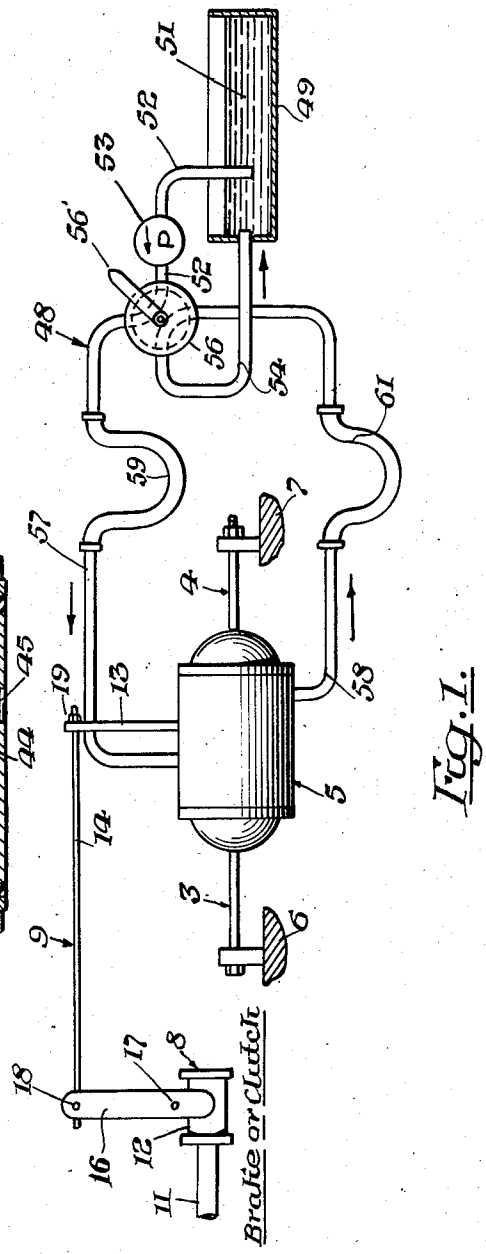


Fig. 1.

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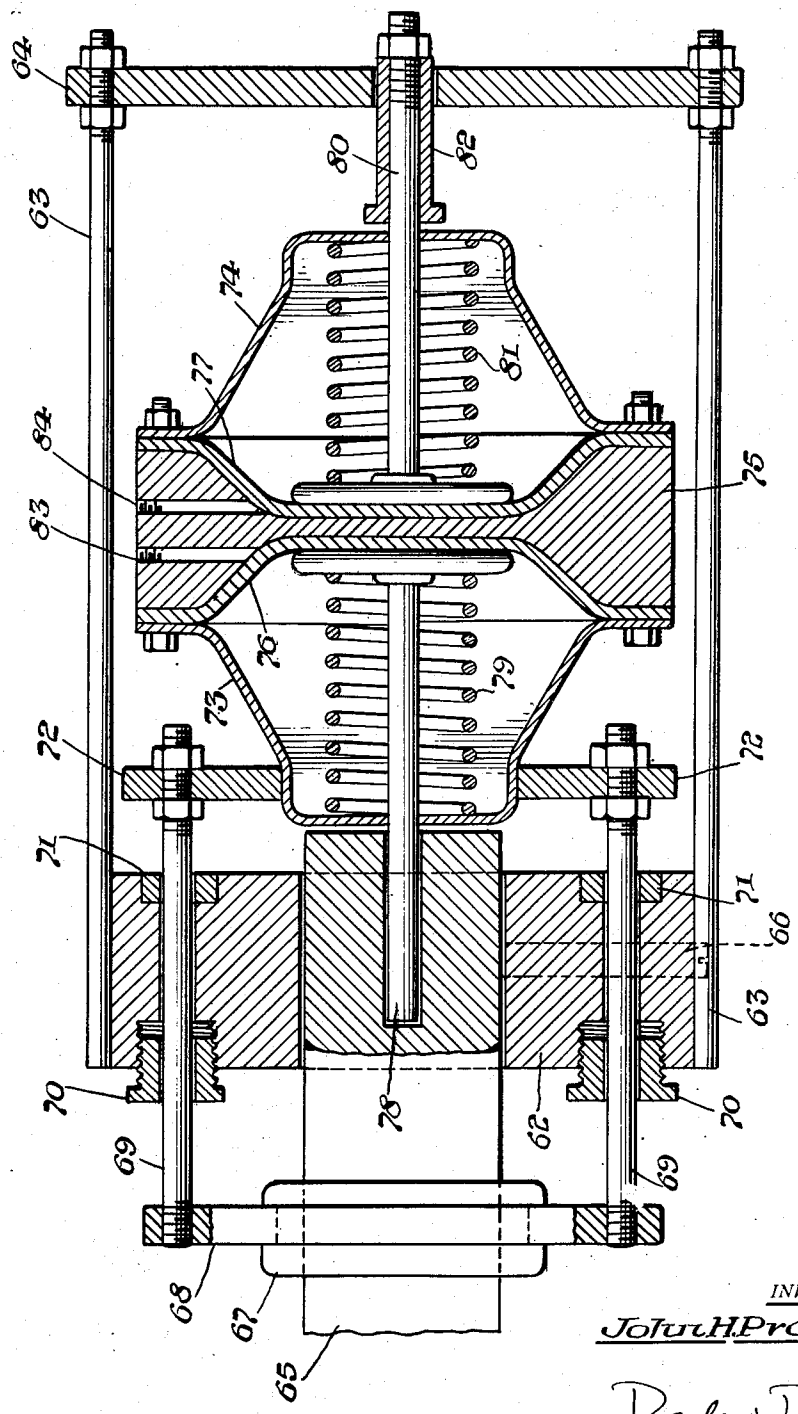


Fig. 3.

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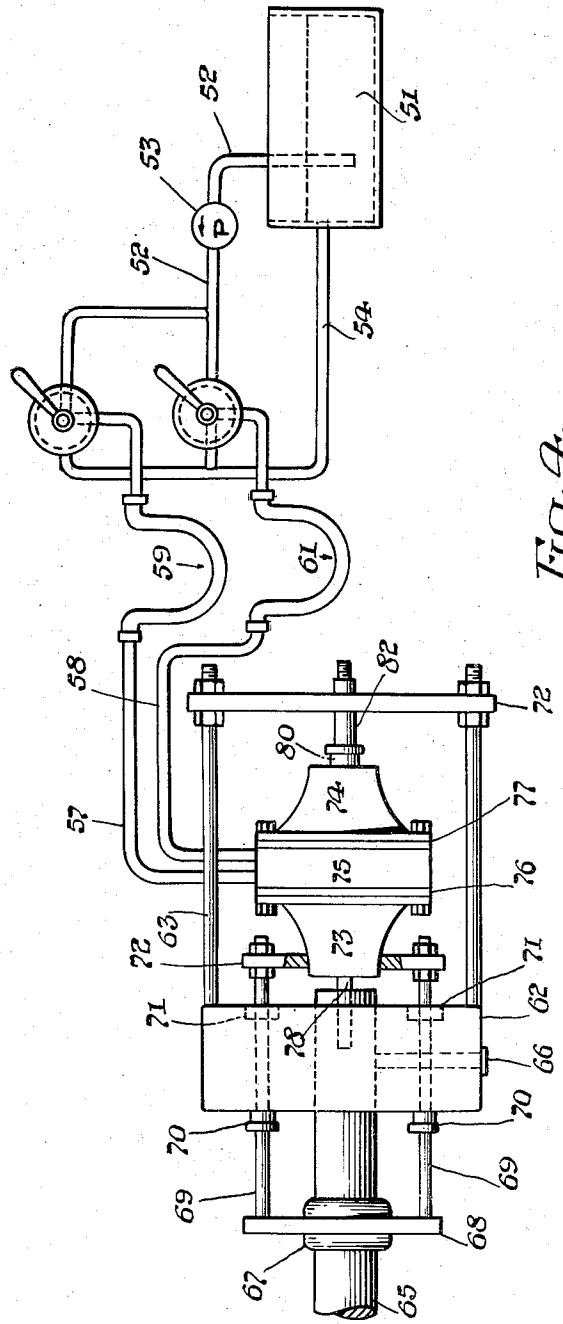


Fig. 4.

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DOUBLE DIAPHRAGM UNIT

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Application August 14, 1947, Serial No. 768,566

5 Claims. (Cl. 121—48)

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This invention relates to pushing and pulling devices. In a more specific aspect it relates to a pushing and pulling device for operating elements such as brakes and clutches of machinery or vehicles. In another more specific aspect it relates to a pushing and pulling device actuated by fluid in chambers formed by two opposing diaphragms.

One object of the invention is to provide a compact, direct acting, simple pushing and pulling device, free from stuffing boxes, leakage of fluid, and complex mechanical linkages.

Another object is to provide a novel and useful pushing and pulling device.

Other objects are to provide a readily reversible pushing and pulling device with as simple and direct acting elements as are necessary for the operation of the same; to provide a novel and useful moving element having chambers at opposite ends and positioned by the diaphragms closing said chambers.

Numerous other objects and advantages will be apparent to those skilled in the art upon studying the accompanying drawings, specification and claims.

This invention resides substantially in the combination, construction, arrangement, and relative location of parts, all as will be hereinafter described.

In the accompanying drawings—

Figure 1 is an elevational view with parts in section and parts broken away of a pushing and pulling device embodying the present invention and applied to the specific problem of actuating a brake or clutch;

Figure 2 is a cross sectional view of a portion of the center part of the device shown in Figure 1;

Figure 3 is a longitudinal central cross sectional view of a modified form of the invention; and

Figure 4 is a diagrammatic layout of the invention.

In Figure 1, stationary members generally designated as 3 and 4 are provided which may be secured to any object, relative to which a body member generally designated as 5 is movable. For example, stationary members 3 and 4 may be secured to the body of a truck or other vehicle in which case they are stationary relative to the vehicle but not relative to the ground. The fact members 3 and 4 are stationary to the degree indicated above is represented by conventional symbols 6 and 7. The elements shown which comprise the stationary members will be discussed in more detail relative to Figure 2 where they are shown on an enlarged scale, but obviously

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the specific arrangement shown is merely for purposes of illustration and is not limiting as the stationary members may be changed considerably without departing from the invention.

Movable body 5 is connected to the work object, generally designated as 8, by any suitable linkage generally designated as 9. For purpose of illustration, the work object has been shown as comprising a rod 11 and collar 12 which is a common feature of many brakes and clutches of the prior art. Obviously the work object may be entirely different as long as linkage 9 operates the same by pushing or pulling due to the movement of body 5.

For purposes of illustration, linkage 9 is shown comprising an arm 13 rigidly secured to body 5 and to an operating rod 14 which in turn moves lever 16 around pivot 17 by means of pivot 18. In many instances, however, a more direct connection can be used, for example, arm 13 could extend directly to work object 8 and be secured thereto by a simple swivel connection (not shown) or even be attached directly thereto (not shown). As shown, rod 14 is secured to arm 13 by nut 19.

Before describing the actuating means of Figure 1 it is believed desirable to describe Figure 2. In Figure 2 movable body 5 is shown in cooperative relationship with stationary members 3 and 4. Members 3 and 4 are shown comprising rods 21 and 22 secured to bases 6 and 7 respectively and end plates 23 and 24 and nuts 26 and 27. The inner ends of rods 21 and 22 are provided with means for connecting them to flexible diaphragms 28 and 29 comprising heads 31 and 32 and nut 33 cooperating with head 31.

It will be noted that head 31 extends on to the inner side of diaphragm 28 whereas head 32 is entirely on the outside of diaphragm 29. Diaphragm 28 is therefore perforated to allow for the passage of rod 21 and nut 33 provides a seal by forcing diaphragm 28 into close contact with head 31. However, if any leakage through such a seal is to be completely obviated a head of the type shown as head 32 may be employed, in which case diaphragm 29 is without any perforations.

In assembling the device, it is preferred to use similar heads on both diaphragms 28 and 29 either both the type of the head 31 or both of the type of head 32. I prefer to use those of the type of head 32 as the diaphragms are less likely to leak after long usage. Obviously when heads of the type 32 are employed the guiding action of cover 41 becomes more important than when heads of the type 31 are used.

The body member 5 comprises a member 36

preferably hollowed out to form chambers 37 and 38, which chambers are respectively closed by diaphragms 28 and 29, the edges of the diaphragms being preferably secured to 36 by means of chamber heads 39 and 41 secured by bolts 42. While heads 39 and 41 could merely be rings or eliminated entirely if diaphragms 28 and 29 are secured to 36 by other means, it is preferred to have heads 39 and 41 fulfill two additional functions, namely, by having a sliding fit with rods 21 and 22 the heads protect the diaphragms from contacting dirt, oil and mechanical damage and the heads also provide a guide for rods 21 and 22 which results in taking substantially all of the lateral stress off of diaphragms 28 and 29 which results in a longer life for said diaphragms.

Passages 43 and 44 provide conduits connecting chambers 37 and 38 with the fluid actuating means to be described and suitable connections 45 and 46 are provided for this purpose. Passages 43 and 44 preferably terminate adjacent the reinforced areas of the diaphragms but for convenience in illustration are not so shown in Figure 2.

Returning to Figure 1, the actuating means generally designated as 48 will now be described. A source of actuating fluid 49 is provided and while this fluid is shown as a liquid 51, it is within the scope of the present invention to use gas in which case 49 could be a closed container or merely be the atmosphere itself in which case no container would be needed. Fluid from whatever source is provided, such as 49, is drawn through pressure line 52 by any pump 53 suitable for such fluid and an exhaust line 54 is provided to return the fluid to source 49. A valve 56 is provided for connecting one of conduits 52 and 54 with conduit 57 and the other to conduit 58.

As body 5 would generally move relative to system 48 as it would generally be more convenient to fasten 48 to the bases 6 and 7, it is necessary to provide flexible sections 59 and 61 in conduits 57 and 58. 59 and 61 are shown as flexible rubber tubing, but obviously telescopic metal joints (not shown) or other means known to the art could be provided to allow movement of 5 relative to 48. As shown, conduit 57 is secured in connection with passage 43 at 46 and conduit 58 is similarly secured in communication with passage 44 at 45.

A handle 56' is provided to change the position of valve 56, which valve is shown as a rotary four-way valve of common construction.

Operation

With valve handle 56' in the position shown and pump 53 operating, pump 53 draws fluid 51 from source 49 through pipe 52 and forces the same through conduit 57 into chamber 37 as shown by the arrows indicating direction of flow. Increased pressure in chamber 37 forces body 5 away from stationary member 3 resulting in increased pressure in chamber 38. As chamber 38 is connected by conduit 58, valve 56 and line 54 to a region of lower pressure 49, the fluid in chamber 38 flows as indicated by the arrows into 49.

The result is that body 5 moves to the right relative to stationary members 3 and 4 carrying linkage 9 along with it and pushing work object 8 to the left due to pivot 17. The movement comes to an end when chamber 37 is full.

When valve handle 56' is moved to rotate valve 56 through an angle of 90°, pipes 57 and 58 are then connected to pipes 54 and 52 respectively whereupon pump 53 fills chamber 38 in a similar manner moving body 5 to the left relative to the stationary members 3 and 4. At 45° all flow is shut off.

In the structure previously described and illustrated in Figure 2, the motor housing 36 remains in the position to which it is moved as long as the pressure chamber 38 is pressurized and chamber 37 is vented. The clutch may be disengaged only by releasing the pressure in chamber 38 and simultaneously pressurizing chamber 37. This may be done by manipulating four way valve 56. This type of device proves satisfactory for clutches that require actual force to keep them engaged with the load. However, a great many clutches are of the so-called over-center type which when once engaged with the load remain in that position until forcibly disengaged. For this type of clutch, it is preferred to use a spring loaded unit as shown in Figure 3. It should be noted that the operation of the unit requires that each expansible chamber be capable of being exhausted without the other side being pressurized, therefore the four way valve 56 must be replaced with two separate three way valves. The pressure end of each valve would be connected with pressure line 52 and the exhaust end of each valve would be connected to exhaust line 54. The work end of one valve would be connected to line 58 and the work end of the second valve to line 57.

The modification of Figure 3 consists of a fixed standard or block 62 to which are secured at the sides in any suitable manner, as by welding, a pair of rods or bars 63 connected at their outer end by a cross-brace 64. Adjustably mounted in the block 62 is a support 65 (which may be a shaft) which is secured therein in adjusted longitudinal relation by means of a set screw 66 or some equivalent thereof. Slidably mounted on the support 65 is a collar 67 engaged by a clutch shifter yoke 68. This yoke in turn is connected to a pair of slidable rods 69 which pass through pairs of aligned bushings 70 and 71 mounted in the block 62. The opposite ends of the rod 69 are bolted to the bracket 72 in turn secured to the cover 73 of the double diaphragm fluid pressure motor. This motor consists of the body portion 75 and another cover 74 extending in the opposite direction to the cover 73. Clamped between the body portion 75 and the covers 73 and 74 by means of bolts are a pair of diaphragms 76 and 77. Engaging the outer faces of the diaphragms by means of the disked ends as shown are a pair of rods 78 and 80 which pass through holes in the end walls of the covers 73 and 74 respectively. Compression springs 79 and 81 encircle the shafts 78 and 80 and lie between the ends of the respective covers and the enlarged ends of these rods which bear on the diaphragm. The rod 78 projects into a recess in the support 65. The rod 80 is provided with a threaded end on which is mounted a flanged sleeve 82 which is locked thereon for movement therewith. This sleeve slides in an opening in the cross-brace 64. The body portion of the motor is provided with fluid passages 83 and 84 opening into the expansible chambers formed by the body portion 75 and the diaphragms 76 and 77.

In describing the operation of this modification it will again be assumed that the yoke 68 and collar 67 are part of the shifting mechanism of a clutch which will be assumed to be disengaged with the parts shown in the position of Figure 3.

To engage the clutch pressure fluid in a system like that of Figure 1 is supplied to the passage 83. The manner in which such a system is connected is illustrated in Figure 4, wherein the fluid system of Figure 1, using the same numerical designation, is applied to the mechanism shown in Figure 3. Conduits 57 and 58 are applied to inlets 83 and 84. Pressure will build up in the chamber of which the diaphragm 76 forms a part and as the rod 78 is seated in the recess of the fixed support 65 the body portion 75 will move to the right carrying rod 80 and connected parts with it. As the motor housing moves to the right it will carry with it of course the bracket 72 and the attached parts 69. This will move the yoke 68 and collar 67 to the right on the support 65 engaging the clutch. By the time the engaging movement of the clutch has been completed, the motor and attached parts will have moved to the right so that the shouldered end of the sleeve 82 will engage the cross-brace 64. As soon as the pressure fluid is exhausted from the lefthand cylinder, spring 79 which has become compressed will move the rod 78 and the diaphragm 76 back to the position with relation to the motor body shown in Figure 3 said body however remaining at the extreme limit of its travel in a direction toward cross-brace 64.

In order to disengage the clutch, pressure fluid is supplied to the passage 84. As the pressure builds up in the righthand cylinder of the motor the motor body and attached parts will move to the left as the sleeve 82 now bears against the cross-brace 64. These movements continue to the left and of course the shifter yoke 68 and collar 67 will slide to the left on the support 65. The motor and attached parts will return to the position shown in Figure 3 with the exception of the diaphragm 77, rod 80 and attached parts, and spring 81 which has been compressed during these return movements. However, as soon as the pressure fluid is exhausted from the righthand cylinder, spring 81 will collapse the diaphragm 77 and return the rod 80 and attached parts to the position shown in Figure 3. Thus, with the motor at rest in either extreme position and the cylinders open to exhaust, the motor parts, that is, the diaphragms 76 and 77, the rods 78 and 80 (with attached parts) and the springs 79 and 81 will be in their normal relaxed position with respect to the motor body.

While I have shown in the drawings, several particular illustrative forms of my invention, various modifications may be made in the same and in the various features of construction, without materially changing the invention therein, and formal changes may be made in the specific embodiment of the invention described without departing from the spirit or substance of the broad invention, the scope of which is commensurate with the appended claims.

What is claimed is:

1. A combination as disclosed comprising a work object shiftable to either of two positions, a fixed support, said work object and said support being held in such relation as to maintain said work object in either of said two positions an abutment member fixedly mounted in spaced relation to said support, a motor body lying between said support and member, means connecting said motor body with said work object, a pair of flexible diaphragms attached to opposite sides of said body and forming expansible chambers, and a pair of spring biased rods bearing on said diaphragms, said rods slidably engaging said support and member whereby pressure fluid supplied to one chamber shifts said body and work object to one position of the latter and pressure fluid thereafter supplied to the other chamber shifts said body and work object back to the initial position of the latter, and the motor assumes neutral position with respect to its associated operating parts when fluid pressure is exhausted from the pressurized chamber in either position of said body while said work object remains in either of the positions to which it is shifted.

2. In the combination of claim 1, means for fixing said abutment to said support.

3. In the combination of claim 1, means for fixing said abutment to said support comprising a second pair of rods lying on opposite sides of said motor body.

4. In the combination of claim 1, said abutment including a fixed member and a member slidable therein and attached to the adjacent rod.

5. A combination as described comprising a work object shiftable to either of two positions, a pair of spaced fixed abutment members, a motor body longitudinally movable in the space between said abutment members, means for connecting said body with said work object, means forming with said motor body a pair of expansible chambers, a pair of rods engaging said means and slidably engaging said abutment members, and springs interposed between said rods and adjacent portions of said motor body to cause them to engage sadi means at all times whereby upon exhaust of pressure fluid from both of said chambers said motor assumes a neutral position with respect to said rods independent of the position of said work object.

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