

May 25, 1943.

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2,319,950

PNEUMATIC-HYDRAULIC PRESSURE DEVICE

Filed Jan. 18, 1940

4 Sheets-Sheet 1

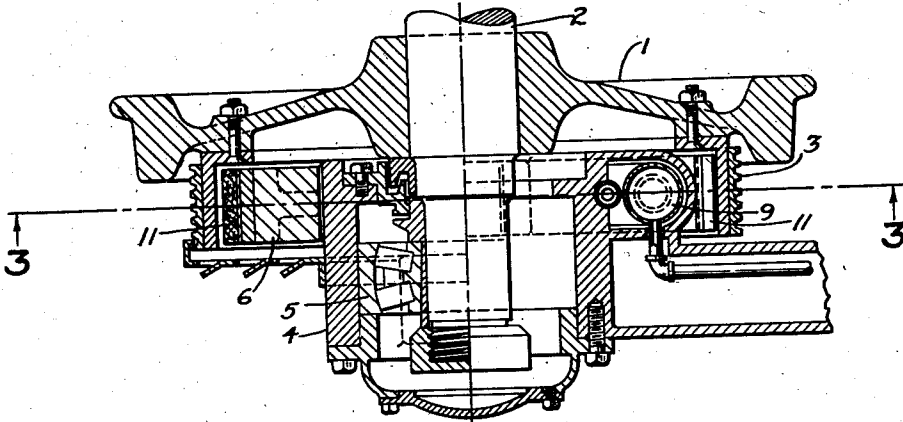


FIG. 2

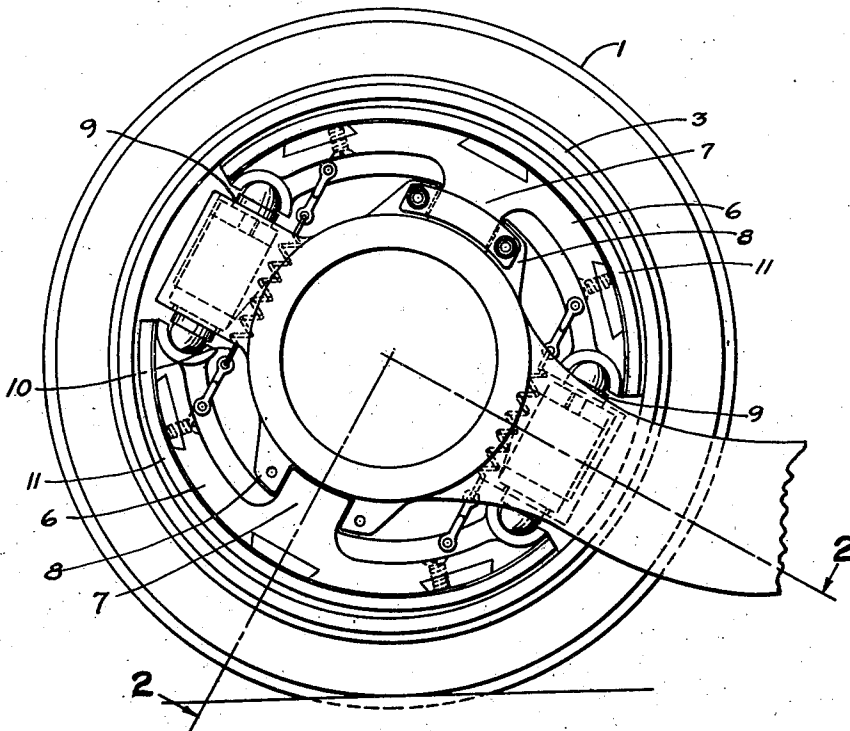


FIG. 1.

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4 Sheets-Sheet 2

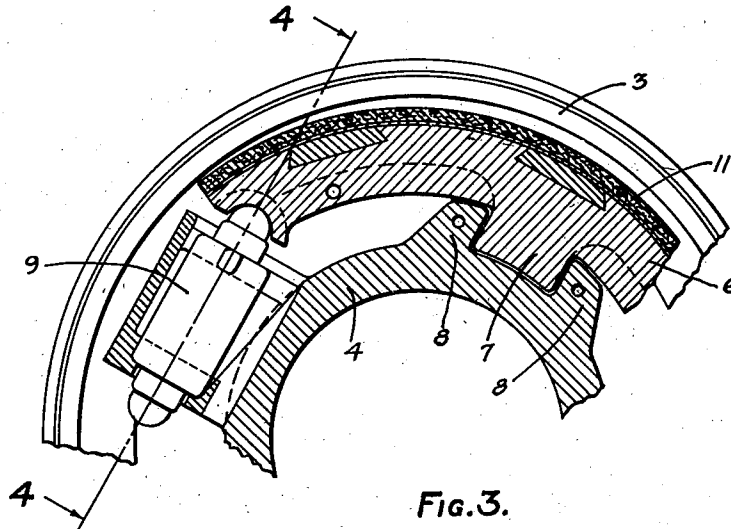


Fig. 3.

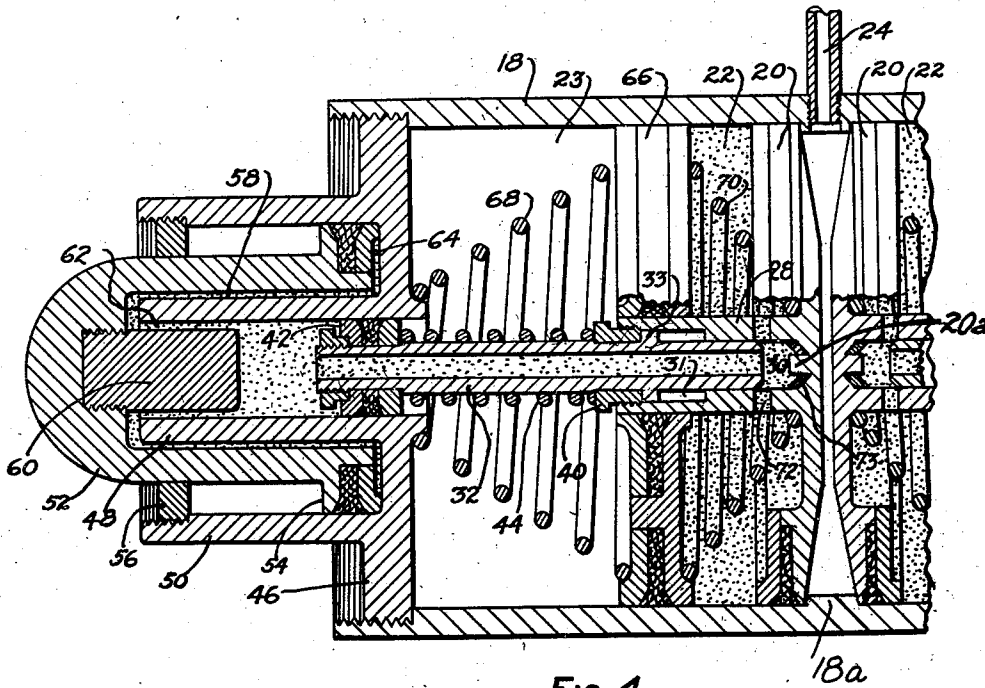


Fig. 4.

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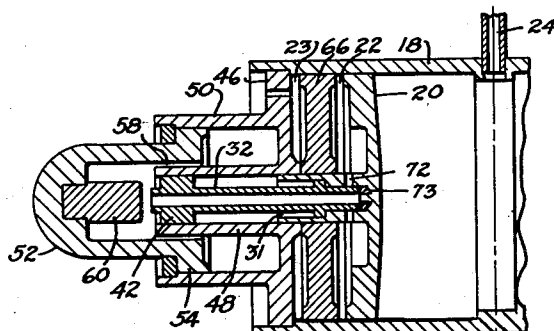
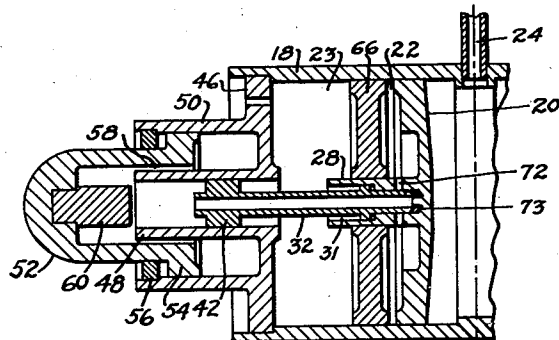
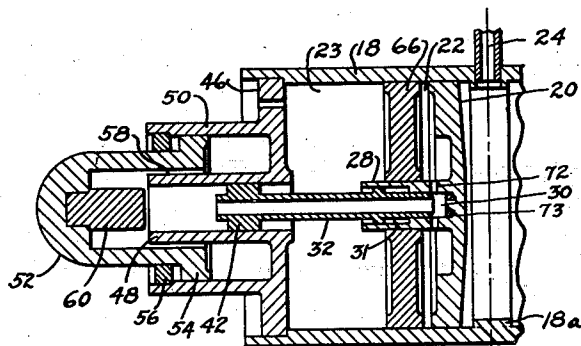
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Filed Jan. 18, 1940

4 Sheets-Sheet 3



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Filed Jan. 18, 1940

4 Sheets-Sheet 4

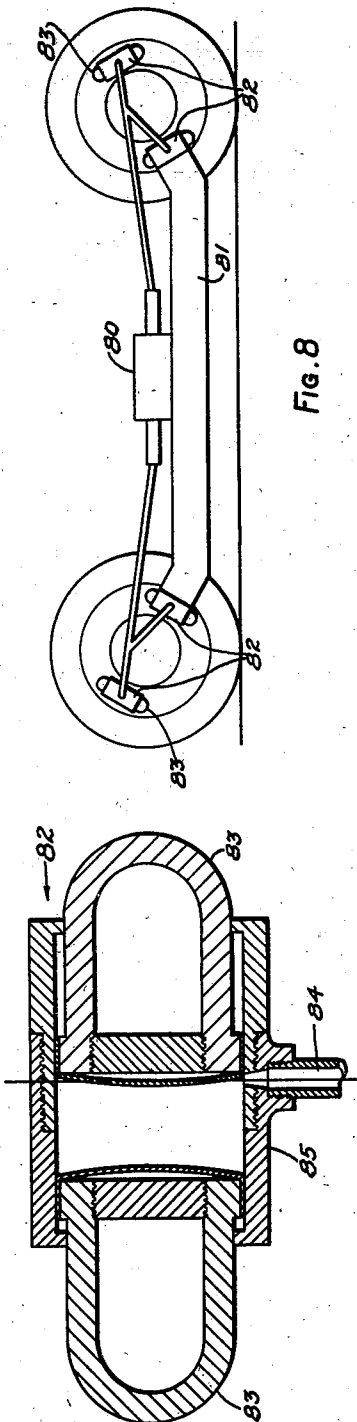


Fig. 8

Fig. 10

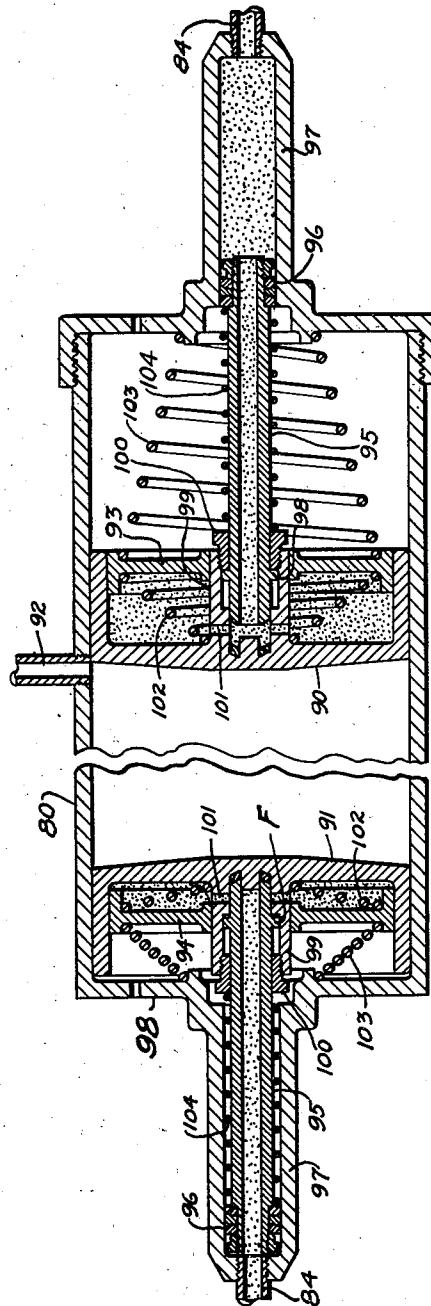


Fig. 9

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UNITED STATES PATENT OFFICE

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PNEUMATIC-HYDRAULIC PRESSURE
DEVICE

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Application January 18, 1940, Serial No. 314,432

21 Claims. (Cl. 60—54.5)

The invention relates to a fluid pressure device adapted for many purposes such as clutches, transmissions, lifting jacks, swinging bulk heads and other movable objects, but the invention is particularly adapted for brakes on vehicles such as automobiles, railway cars, etc.

The main object of the invention is to transmit thrust from air or other compressible fluids under comparatively low pressure through a hydraulically operated cylinder and piston structure by which a substantially greater thrust may be delivered to an external element.

Another object is to assemble a combination of low pressure and high pressure actuated parts to provide a quick take up for slack or other extended movement of the delivery element of the device without requiring substantial consumption of the motivating fluid.

Another object is to utilize fluid under relatively low pressure to operate the device until a predetermined amount of resistance is encountered whereupon fluid is automatically placed under relatively high pressure to effect the remainder of the operation.

Another object is to utilize a pneumatic fluid operated mechanism in combination with a hydraulic fluid operated mechanism so that the latter mechanism may be actuated repeatedly by discharge of the pneumatic fluid from a closed line, in the manner of usual railway air brake operation, without discharging any hydraulic fluid.

Another object is to combine a low pressure cylinder and a high pressure cylinder in a single compact unit and, preferably, in combination with brake shoes arranged to contact with a wheel drum.

Another object is to combine a low pressure cylinder and a slack take-up mechanism in a single compact unit and preferably in combination with brakes for wheels or the like.

These and other detailed objects of the invention as will appear from the following description are attained by the structure illustrated in the accompanying drawings in which—

Figure 1 is a side elevation of a railway car wheel, mounting a brake drum, and a brake shoe and fluid pressure operating device therefor.

Figure 2 is a transverse section taken on the line 2—2 of Figure 1.

Figure 3 is a detail transverse section taken on the line 3—3 of Figure 2, i. e. on a plane parallel to Figure 1.

Figure 4 is a section, on an enlarged scale, through one-half of one of the actuating units, and is taken on the line 4—4 of Figure 3.

Figures 5 and 6 are diagrammatic illustrations of the parts illustrated in Figure 4 showing the same in successive positions during a normal operation of the device.

Figure 7 is a similar diagrammatic illustration showing the same parts after a maximum take up and brake setting operation which would occur only after the brake lining or other parts had experienced abnormal wear.

Figure 8 is a diagrammatic view of another arrangement of the units of the device applied to a railway truck.

Figure 9 is an enlarged detail section through the air actuated cylinder indicated at the center of Figure 8.

Figure 10 is an enlarged section through one of the hydraulic actuated cylinder and piston units associated with the brake shown in Figure 8.

In the structure illustrated in Figures 1 to 7 the vehicle wheel 1 is mounted upon the axle 2 in the usual manner and a brake drum 3 is bolted to the wheel disk. The journal box 4 is mounted on the axle journal by a roller bearing unit 5 and a pair of brake shoes 6 are seated by lug 7 in recesses formed by ears 8 on opposite sides of box 4. Combined pneumatic and hydraulic cylinder units 9 are positioned between the adjacent ends of the two brake shoes and are constructed and operated as described below to thrust the brake shoes apart. Springs 10 pull the brake shoes towards each other when pressure is released. Preferably shoes 6 are equipped with suitable lining 11 to provide maximum friction and readily replaceable wear elements.

Each unit 9 comprises a cylinder 18, opposing pistons 20 therein and duplicate structures associated with said pistons, one of which structures is detailed in Figure 4. An inlet 24 admits a compressible fluid (such as air) between the pistons. Each piston 20 includes a hub-like hollow extension 28 projecting towards the outer end of the cylinder and forming a shouldered chamber 30, 31 the smaller and larger diameter portions of which respectively slidably receive one end of a sleeve 32 and its flange 33. The outer end of chamber 31 mounts a bushing 40 which cooperates with flange 33 to limit the left-hand movement of sleeve 32. The outer end of sleeve 32 mounts a piston 42; a spring 44 is compressed between bushing 40 and piston 42 and normally holds sleeve 32 and piston 42 in the extended position shown in Figure 4.

The outer head 46 of the cylinder forms two outwardly opening high-pressure cylinders 48 and 50 respectively, and cylinder 48 receives piston 42. A thrust delivering member 52 has a piston-like portion 54 slidable in cylinder 50 and is limited in its outward movement by a stop ring 56 in the outer end of cylinder 50. Member 52 is fluted around the outside wall of cylinder 48 forming a fluid passageway 58 between them. A plug 60 in the hollow portion of member 52 projects into cylinder 48, thereby substantially reducing the effective volume of the cylinder,

when member 52 is in the retracted position indicated in Figure 4, and forming at 62 a continuation of passageway 58. Piston 54 is recessed at 64 to increase the initial effective area of the piston face.

An annular piston 66 is slidable in the space indicated at 23 in cylinder 18 and on hub-like extension 28 of piston 20 and normally is thrust to the right by a spring 68. A relatively lighter spring 70 seated against piston 66 normally thrusts piston 20 to the right.

Pistons 20 and 66 and the wall of cylinder 18 form a fluid reservoir 22 in communication with the chamber 30 through a port 72 in extension 28. The connected spaces between the pistons 20 and 66, in extension 28, in sleeve 32, in cylinder 48, in passageway 58—62 and in recess 64 contain a liquid, indicated by the dotted areas, such as is commonly used in hydraulic brakes.

Springs 44 and 68 are stiff enough to avoid yielding under the slack take-up load, spring 44 being somewhat stiffer than spring 68. In other words, all of the slack take-up action is accommodated by the yielding of spring 70.

Operation.—In normal or fully retracted position (Figure 4), the two fluid actuated pistons 20 nearly abut but their adjacent ends engage a cylinder rib 18a to provide space for the admission of air under pressure through inlet 24 to the chamber in cylinder 18 between the two pistons. The air under pressure quickly moves each piston to the position shown in Figure 5, each piston 66 and the hydraulic fluid in the corresponding reservoir 22 moving with the corresponding piston 20 except that piston 66 will have somewhat less movement than piston 20 because some of the fluid in chamber 22 is forced therefrom through port 72 into sleeve 32, cylinder 48, passageway 62, 58 and the inner end of cylinder 50, thereby moving piston member 54, 52 outwardly until the brake shoes have contacted the brake drum, but without exerting an effective braking force.

Thereafter, since member 52—54 is held against movement and since the hydraulic fluid in cylinders 48 and 50 is incompressible, piston 42 and sleeve 32 are held against further movement to the left, and further movement of piston 20 results in the relative movement of extension 28, against the resistance of spring 44, and port 72 in projection 28 passes the inner end of sleeve 32 but before port 72 has been completely closed a small amount of the hydraulic fluid in chamber 30 will be displaced and will flow back into main reservoir 22, spring 68 yielding to permit piston 66 to move slightly to accommodate this fluid. When port 72 is closed, relative movement of piston 20 and sleeve 32 continues and the greater the movement past the port the better the seal provided by the sleeve. The continued movement of piston 20 will result in the shifting of piston 52 to the left, displacing hydraulic fluid remaining in chamber 30 and forcing it through the sleeve into cylinder 48 until the right hand end of the sleeve engages a seat 73 on the inner end of projection 28.

All of the movement of the parts up to this point may be termed a "slack take-up" movement. Thereafter, the pressure of the fluid on the right hand face of piston 20 and the opposing fluid pressure on the left hand face of piston 42 will hold the inner end of sleeve 32 tightly against seat 73 to form a more effective seal to prevent the loss of fluid from the sleeve 32, passageway 58—62, and the hydraulic cylinders 48—50. 75

Washer seat 73 is held against undue distortion by the central lug 20a on piston 20, which lug is small enough to enter sleeve 32 without interfering with the movement of the hydraulic fluid.

Subsequent pressure on piston 20 will be transmitted by sleeve 32 direct to piston 42 and by the latter to the hydraulic fluid in cylinders 48 and 50 and to hydraulic piston 54 and through the latter and member 52 to the brake shoes (see Figure 6).

This structure transforms a relatively low pressure per square inch on piston 20 to a relatively high pressure per square inch on piston 54.

The hydraulic or noncompressible fluid may be oil which has lubricating qualities and thereby the movable parts of the device would be automatically lubricated.

The construction described facilitates the use of a very short cylinder 18 and provides for successful operation by the use of a comparatively small volume of compressible fluid, and at the same time results in a very short period of time for taking up slack and applying the brakes. A combination of air and hydraulic fluid adapts the construction particularly for use on railway trains without change in the air compressors on the locomotives, the train lines, the individual air reservoirs on the cars, and makes possible the operation of hydraulic brakes by the reduction of the train line pressure the same as in ordinary air brake equipment. Accordingly the brakes will be set in the event of accidental breaking of the train line at a coupling between cars or elsewhere.

On reduction of the pressure on the fluid admitted through inlet 24, springs 44, 68 and 70 move pistons 20 and 66 and sleeve 32 to their original relative positions, opening port 72 whereupon hydraulic fluid is sucked back into the reservoir between pistons 20 and 66. Member 52 is also retracted by the vacuum action of the liquid returning to the reservoir and by the action of springs 10 on shoes 6.

Figure 7 indicates an extreme movement of the pistons and member 52 such as is likely to occur only after the brake shoes have worn down or some of the hydraulic fluid has escaped.

Figures 8, 9, and 10 illustrate another form of the invention with the hydraulic and pneumatic unit 80 mounted on the frame 81 of a railway truck and used as a master cylinder actuated by pneumatic fluid to distribute noncompressible hydraulic fluid to a plurality of brake actuating units 82 associated with the truck wheels as are the units 9 previously described. The members 83 correspond to the members 52 and similarly actuate brake shoes as detailed in Figures 1, 2 and 3 but not shown in Figure 8.

Figure 10 shows one member in initial position and one member in extended position. Hydraulic fluid from the master cylinder is supplied by conduit 84 to the interior of the unit cylinder 85, being admitted to the space between the members.

Figure 9 shows the master cylinder 80 with one low pressure piston 90 in initial position and one low pressure piston 91 in maximum projected position. Compressible fluid is admitted from the car reservoir through conduit 92 into the space between the two low pressure pistons. The low pressure pistons 93 and 94 correspond to piston 66 previously described, and sleeve 95 corresponds to sleeve 32 previously described. The outer end of each sleeve 95 mounts a piston 96 corresponding to piston 42 previously described and slidable in a relatively small diameter cylinder.

der 97 formed on the head 98 of cylinder 80. The differential in the area of piston 91 and that of piston 96 results in high pressure on the hydraulic fluid leading to units 82. A flange F on sleeve 95 moves in the extension 99 of piston 91, its outward movement being limited by a stop collar 100 in the end of extension 99. Port 101 in extension 99 provides for the passage of hydraulic fluid from between pistons 91 and 94 to the interior of sleeve 95 and to conduits 84. Springs 102, 103 and 104 serve to return the parts to initial position as do the springs in the structure previously described.

In the first form of the invention illustrated in Figures 1-7 the compressible fluid is distributed to each brake shoe actuating unit while in the form of invention illustrated in Figures 8, 9 and 10 only the master cylinder 80 spaced from the wheels receives the compressible fluid and distributes the hydraulic fluid to a plurality of shoe actuating units spaced from the master cylinder. Both forms of the invention involve an initial low pressure slack take-up step and a subsequent high pressure short movement brake applying step. While the invention is illustrated and described as applied to railway trucks, it may also be used on other vehicles and machines and may include only a single low pressure piston moving in one direction. The structure may be otherwise modified and its details may be varied substantially without departing from the spirit of the invention and the exclusive use of such modifications as come within the scope of the claims is contemplated.

What is claimed is:

1. In a device of the class described, a chamber with a pair of movable pistons therein and opposing each other, one of said pistons being arranged to receive thrust from an external source and having a hollow stem slidable through the other piston, a hollow sleeve slidable in said stem and projecting through the end of said chamber, a cylinder with an end wall forming a wall of said chamber and surrounding the projecting end of said sleeve, a thrust delivering member in said cylinder, there being a noncompressible fluid between said pistons, and there being a passageway through said stem communicating with the hollow of said sleeve in release position, said sleeve and stem so arranged that said passageway is opened and closed by the relative movement of said piston stem and sleeve.

2. In a device of the class described, a fluid reservoir, a piston arranged to receive thrust from an external source and to apply the same to fluid in said reservoir, said piston having a hollow stem extending through said fluid and through the end wall of said reservoir, a hollow sleeve slidable in said stem and projecting therefrom beyond said reservoir, a cylinder with an end wall surrounding the projecting end of said sleeve, a thrust delivering piston member in said cylinder, there being a passageway through said stem from said reservoir to the interior of said sleeve and arranged to be opened and closed by the relative movement of said sleeve and stem, said passageway extending through the other end of the sleeve and opening into said cylinder.

3. In a device of the class described, a housing having a chamber arranged to receive fluid under pressure from an external source, a large diameter piston arranged to receive thrust on one side from said fluid and having a tubular extension on its other side, there being a lateral port through said extension, an annular piston

in said chamber and slidable over said extension and forming with said large diameter piston and the wall of said chamber a reservoir for a second fluid, said reservoir communicating with the interior of said extension through said port, a hollow sleeve having one end slidably fitting in said extension and movable to close said port, the other end of said sleeve so arranged to form a small diameter member, yielding means normally holding said hollow sleeve in position to uncover said port, said housing also forming a cylinder for receiving said small diameter member and communicating with said reservoir through said sleeve and port, an outwardly opening cylinder in communication with said small diameter member cylinder, and a thrust transmitting piston in said outwardly opening cylinder and actuated by the pressure on the fluid.

4. A device as described in claim 3 in which resistance to movement of the member moves the sleeve to close the port between the reservoir and the interior of the hollow extension of the first mentioned piston.

5. A device as described in claim 3 in which when pressure on the fluid from an external source is relieved the annular piston is positioned by yielding resistance means between the same and the head of the chamber in which it moves and by a relatively weaker yielding resistance means between the annular piston and the first mentioned large diameter piston to withdraw the second fluid from the outwardly opening cylinder back through the port to the reservoir.

6. In a device of the class described, a cylinder, a piston slidable therein, there being a fluid chamber on one side of said piston and a hydraulic fluid chamber on the other side of said piston, said piston having a tubular projection on its latter mentioned side, a sleeve slidable in said projection to a seat provided therefor at the inner end of said projection, the wall of said projection having a port connecting the interior of said projection with said latter mentioned chamber, said port being spaced from said seat and normally open, but arranged to be closed by said sleeve as the latter moves towards said seat and before it reaches said seat, a secondary cylinder, a secondary piston therein on the end of said sleeve, and a thrust transmitting piston in said secondary cylinder actuated by the pressure in said secondary cylinder by said secondary piston.

7. In a device of the class described, a relatively large diameter cylinder, a corresponding piston slidable therein, there being a chamber on one side of said piston for fluid through which pressure is applied to said piston and there being a chamber on the other side of said piston for hydraulic fluid, said piston having a tubular projection on its latter mentioned side, a sleeve slidable in said projection and having a piston at its outer end of smaller diameter than said large diameter piston, a relatively small diameter cylinder slidably receiving said small diameter piston and filled with hydraulic fluid, a piston operable by the fluid in said latter mentioned cylinder, there being a port through said projection normally connecting said hydraulic fluid chamber with the interior of said sleeve, said sleeve being slidable past said port to seat on the inner end of said projection and being thrust against said seat by the pressure of fluid in said first mentioned chamber on said large diameter piston and by the opposing pressure of hydraulic fluid

in said latter mentioned cylinder on said small diameter piston.

8. In a device of the class described, a cylinder, a pair of relatively movable opposing pistons in said cylinder, one of said pistons being arranged to receive thrusts from an external source, a secondary cylinder, a secondary piston therein, there being a passageway leading from the space between said opposing pistons to said secondary cylinder, there being a non-compressible fluid between said opposing pistons and in said passageway and in said secondary cylinder, the area of at least one of said opposing pistons exceeding the area of said secondary piston which is exposed to the non-compressible fluid, a valve in said passageway disposed to be closed and opened by the relative movements of the thrust-receiving piston, and the secondary piston to slack-take-up position and to release position respectively, there being a rigid member receiving thrust directly from said thrust-receiving piston when slack take-up movement is completed and transmitting the thrust to said secondary piston.

9. In a device of the class described, a cylinder, a relatively large area piston slidable therein, means for supplying fluid under pressure to one side of said piston, a chamber head slidable in said cylinder at the other side of said piston, a spring thrusting said head toward each piston, opposing sides of said piston and head forming with said cylinder a fluid chamber, a second cylinder and a relatively small area piston slidable therein, there being a passageway from said chamber to said second cylinder at the rear of said small area piston, means associated with said first-mentioned piston for closing said passageway by movement of said first-mentioned piston in one direction, continued thrust on said first-mentioned piston being transmitted through said second-mentioned means and the fluid in said second cylinder to the face of said small area piston to move it toward said large area piston, elements associated with said pistons contacted by such movement of said small area piston, and a thrust applying member actuated by movement of both of the pistons as a unit in said direction.

10. In a device of the class described, a primary cylinder, a secondary cylinder of smaller diameter, a primary thrust-receiving piston in said primary cylinder, a spring-supported floating piston opposing said primary piston, a secondary piston in said secondary cylinder, said primary and secondary pistons being telescopically assembled with each other, a spring normally thrusting said primary and secondary pistons apart, a passageway between said cylinders through extensions on said primary and secondary pistons, stops on said primary and secondary pistons limiting their telescoping movement, a valve in said passageway closed by movement of said primary and secondary pistons to stop-engaging position, a body of fluid confined in said cylinders and passageway, the cross-sectional area of the face of said primary piston opposing the fluid in its cylinder being greater than the cross-sectional area of the face of said secondary piston opposing the fluid in said secondary cylinder, and a thrust-delivering piston actuated by the pressure on the fluid in said secondary cylinder by said secondary piston.

11. A device as described in claim 10 which includes a cylinder wall surrounding but spaced from the side wall of the secondary cylinder and forming therewith an annular chamber, the

thrust-delivering piston being of U shaped longitudinal section with its cross piece extending over and spaced from the open end of the secondary cylinder and with its legs extending into said annular chamber and slidable along its outer periphery but spaced slightly from the outer periphery of the secondary cylinder, so that the fluid in the secondary cylinder is admitted to the annular chamber, whereby a single body of fluid may be confined in the cylinders, passageway and chamber, and the movement of the large diameter primary piston will quickly take up slack in the device, and the subsequent movement of the primary piston will be transmitted directly to the small diameter secondary piston, irrespective of the fluid in the primary cylinder, and the thrust of the secondary piston on the fluid in its cylinder and the annular chamber will be transmitted to the relatively large diameter thrust delivering piston.

12. A device for moving a pair of spaced apart elements away from each other comprising a unit interposed between said elements and including a central cylinder portion and a pair of pistons therein adapted to receive compressible fluid between them, another cylinder portion on each side of said central portion, a piston in each second mentioned cylinder portion adapted to contact a corresponding one of said elements, and non-compressible fluid interposed between each first-mentioned piston and the adjacent second-mentioned piston, a passageway for said fluid between each first-mentioned cylinder and each second-mentioned cylinder, a portion of each body of said fluid being located in a reservoir, one wall of which is formed by the corresponding one of said first-mentioned pistons, a valve in each passageway actuated by movement, whereby, after slack take-up by initial movement of said pistons, said passageways are closed and pressure applied by said compressible fluid between said first-mentioned pair of pistons is transmitted to the portion of said noncompressible fluid trapped between each piston in said central cylinder portion and the associated piston in a second-mentioned cylinder portion and to said second-mentioned pistons and from the latter to said elements without transmitting pressure to that portion of the body of fluid in said reservoir.

13. A device as described in claim 12 in which the first-mentioned pistons have means associated therewith whereby the thrust acting on said first-mentioned pistons by the compressible fluid is transmitted to the non-compressible fluid to transmit increased pressure to said second-mentioned pistons to be delivered to said spaced apart elements.

14. A device as described in claim 12 including another piston on the side of each of the first-mentioned pistons opposite to the side which receives the thrust from the compressible fluid and in which the spaces in said housing between said first-mentioned pistons and the latter-mentioned pistons form fluid reservoirs for the noncompressible fluid.

15. In a device of the class described, a chamber, a pair of relatively movable opposing pistons in said chamber, one of said pistons being arranged to receive thrust from an external source, there being a non-compressible fluid between said pistons, a cylinder, and a thrust-delivering piston member therein, a sleeve with one end slidably mounting said thrust-receiving piston and with its other end extending from said

latter-mentioned piston into said cylinder, and means at the thrust-receiving piston mounting end of said sleeve forming a passageway from the interior of said sleeve to said chamber and opened and closed by relative movement of said sleeve and the thrust-receiving piston mounted thereon, the area of the face of said thrust-receiving piston exceeding the area of the face of said thrust-delivering piston member.

16. In a device of the class described, a housing having a chamber arranged to receive fluid under pressure from an external source, a large diameter piston arranged to receive thrust on one side from said fluid and having a tubular extension on its other side, there being a lateral port through said extension, an annular piston in said chamber and slidable over said extension and forming with said large diameter piston and the wall of said chamber a reservoir for a second fluid, said reservoir communicating with the interior of said extension through said port, a hollow sleeve having one end slidably fitting in said extension and movable to close said port, the other end of said sleeve so arranged to form a small diameter member, yielding means normally holding said hollow sleeve in position to uncover said port, said housing also forming a cylinder for receiving said small diameter member and communicating with said reservoir through said sleeve and port, and a thrust-transmitting piston in said latter-mentioned cylinder and actuated by the pressure on said fluid.

17. A device of the class described for applying pressure to a pressure receiving element, said device comprising a body having two chambers with peripheral walls and structure between said walls whereby said chambers are separated from each other, said structure including a hollow portion between said chambers, said portion having a peripheral wall, an initial thrust receiving member in one of said chambers and slidably engaging the corresponding peripheral wall, a separate thrust delivering member in the other of said chambers and slidably engaging the corresponding peripheral wall, a projection on said thrust receiving member extending into said hollow portion of said structure and slidably engaging the peripheral wall of said hollow portion, there being a valve passageway between said chambers and through said projection, a fluid in said chambers and passageway, said projection being movable with said thrust receiving member during movement of said fluid from the chamber for the thrust receiving member to the chamber for the thrust delivering member for slack take-up, the cross sectional area of said projection engaged by the body of said fluid in the thrust delivering member chamber being less than the cross sectional area of said thrust delivering member so engaged, and means controlled by movement of said receiving member for closing and opening the valve in said passageway.

18. A device as described in claim 17 in which said projection includes a hollow sleeve, the hollow of which forms a portion of said passageway, said sleeve slidably fitting in said thrust receiving member, and a spring between said sleeve and said thrust receiving member for holding said sleeve in position relative to said member so that said valve is held open during the slack take-up operation.

19. A device of the class described for applying pressure to a pressure receiving element, a housing, a transverse partition therein, there being chambers on opposite sides of said partition, a piston head slidably fitting in one of said chambers, a thrust receiving piston slidable in the other of said chambers and having a tubular extension, a hollow sleeve with one end extending through and fixed to said piston head and with its other end slidably received in said extension, there being a valved passageway between the interior of said sleeve and the sleeve receiving extension of said piston, movement of said piston towards said piston head closing said passageway and seating said piston on the adjacent end of said sleeve to provide direct thrust by said piston on said piston head, a thrust delivering member slidable in the first of said chambers and adapted to directly contact said pressure receiving element, and hydraulic fluid in said chambers and sleeve, the area of said piston head engaging said fluid being smaller than the area of said thrust receiving piston engaging said fluid.

20. In a device of the type described, a housing forming a cylinder, an initial thrust receiving piston slidably fitting in said cylinder, said housing also forming another cylinder, a thrust delivering piston slidably fitting therein and separate from said thrust receiving piston, means for applying thrust to one side of said first-mentioned piston, a movable member on said other side of said first-mentioned piston, said member and first-mentioned piston and its cylinder forming a reservoir, a noncompressible fluid therein, means forming a passageway, during slack take-up movement, between said reservoir and said second-mentioned cylinder, and means acting on said member to maintain pressure on the fluid in said reservoir, the thrust applied to said first-mentioned piston, after slack has been taken up, being transmitted to the thrust delivering piston independently of said movable member and the fluid in said reservoir.

21. In a device of the class described, a housing having a chamber arranged to receive fluid under pressure from an external source, a piston slidable in said chamber to receive thrust on one side from said fluid, there being a hydraulic fluid reservoir in said chamber on the other side of said piston, said housing also forming a hydraulic fluid chamber, a piston slidable in said second-mentioned chamber, a member on said first-mentioned piston operable in said second-mentioned chamber to displace hydraulic fluid therein to operate the piston therein, and there being a passageway between said reservoir and said second-mentioned chamber for passage of fluid from said reservoir to the second-mentioned chamber during slack take-up movement, the thrust applied to said first-mentioned piston being transmitted to said second-mentioned piston independently of the fluid in said reservoir after slack has been taken up, and the relation and proportions of said pistons being such that the pressure delivered by the second-mentioned piston substantially exceeds the pressure applied to the first-mentioned piston by fluid from the external source.

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