July 6, 1948. H. E. SOMES ET AL 2,444,474

FLUID PRESSURE DEVICE

Filed June 6, 1944

2 Sheets-Sheet 1

Fig. 1.

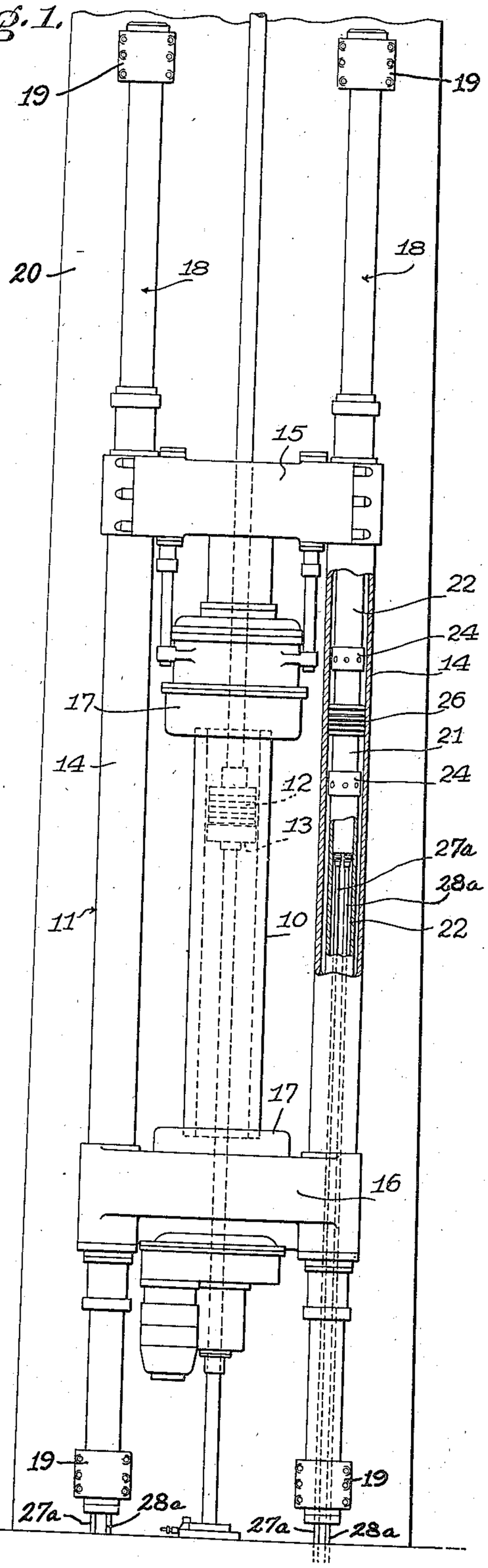
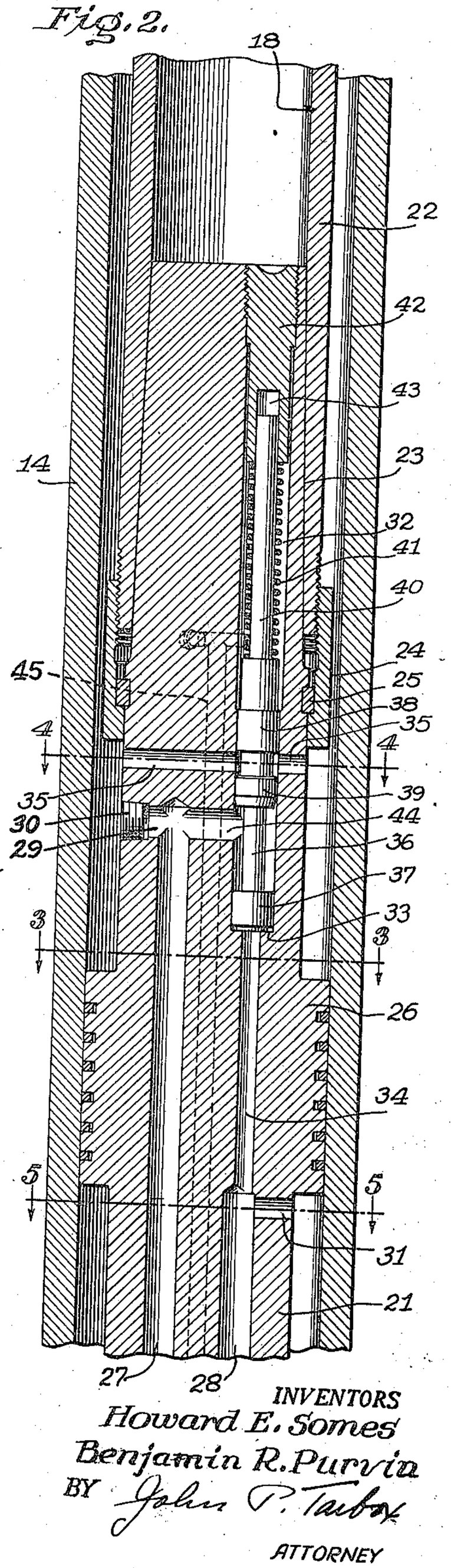


Fig. 2.



INVENTORS
Howard E. Somes
Benjamin R. Purvin
BY John P. Taubman
ATTORNEY

July 6, 1948. H. E. SOMES ET AL 2,444,474

FLUID PRESSURE DEVICE

Filed June 6, 1944

2 Sheets-Sheet 2

Fig. 3.

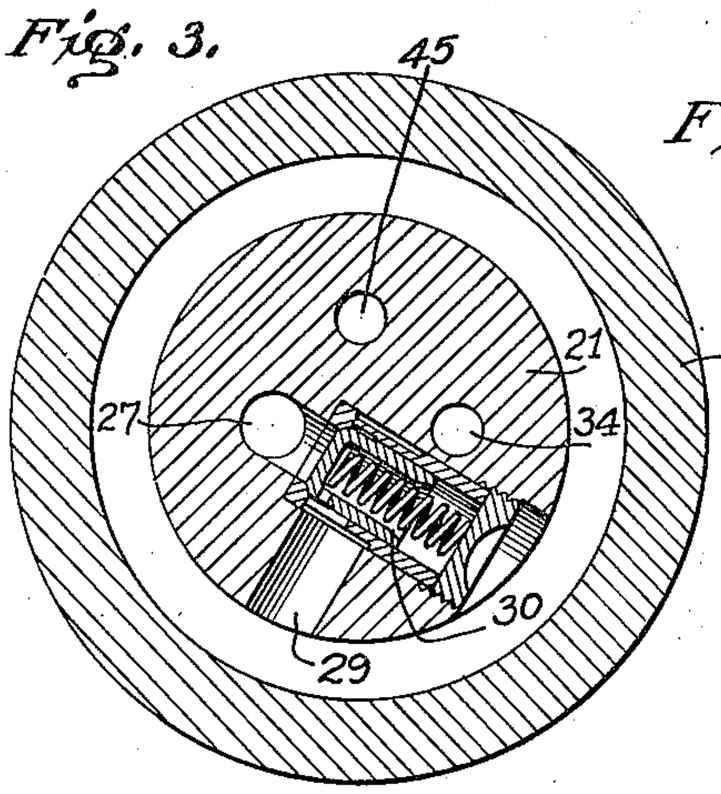


Fig. 4.

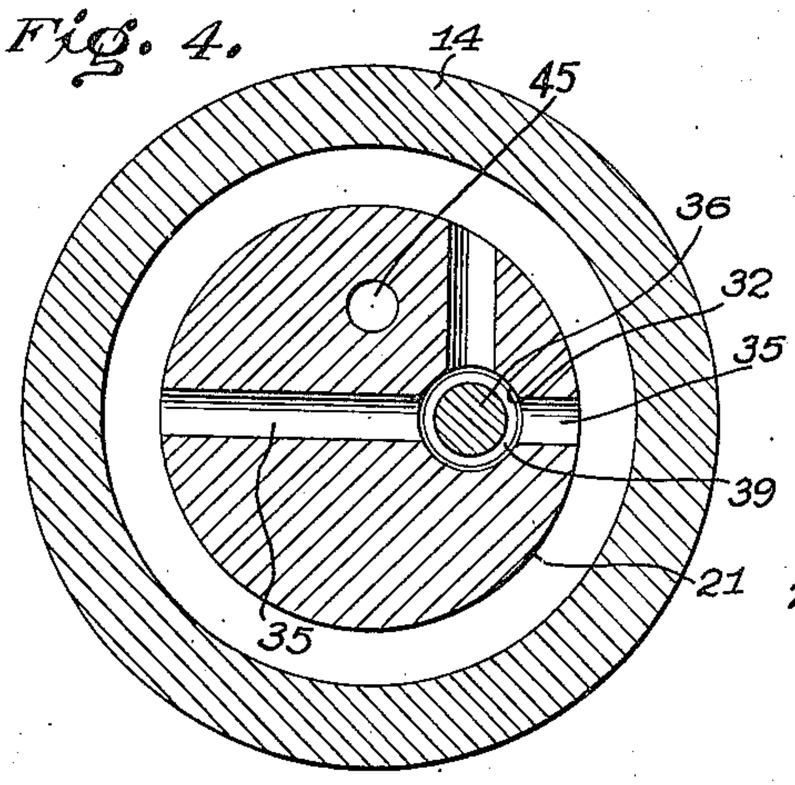


Fig. 5.

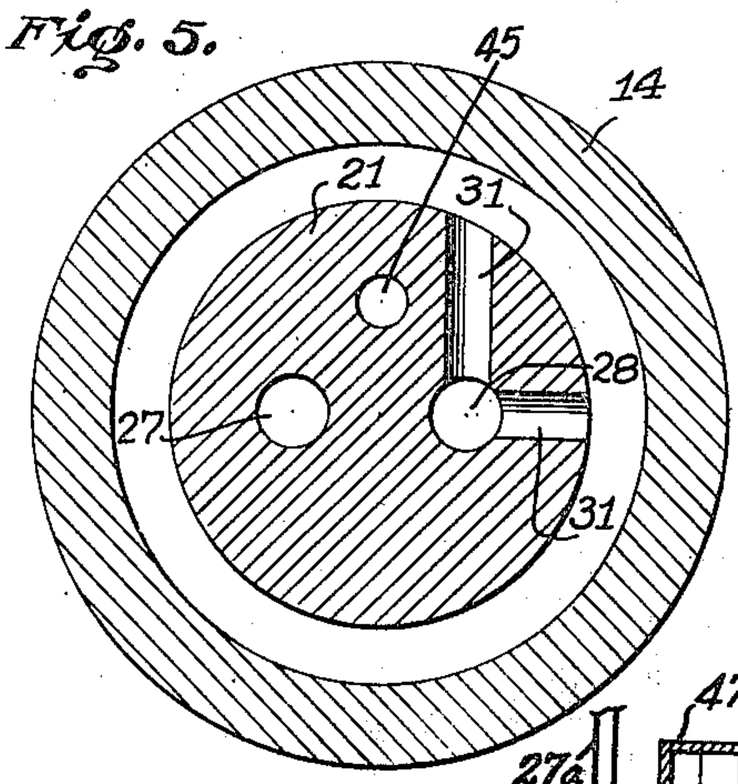


Fig. 8.

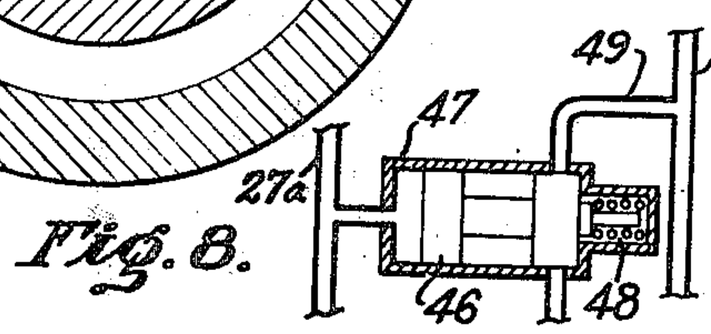


Fig. 6.

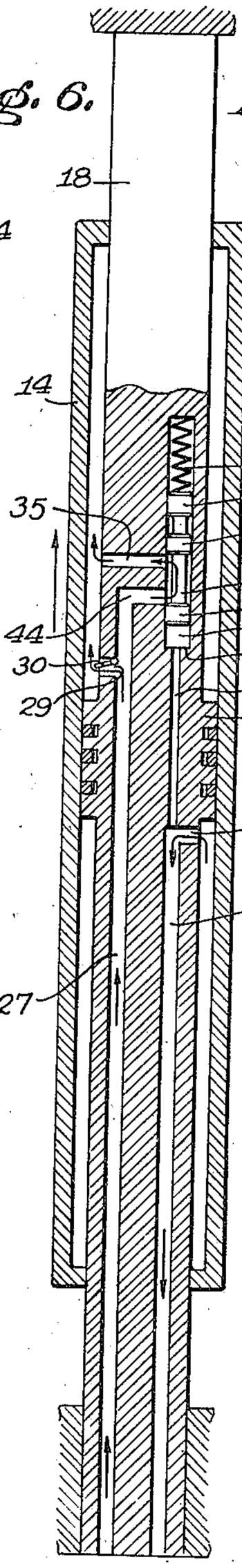
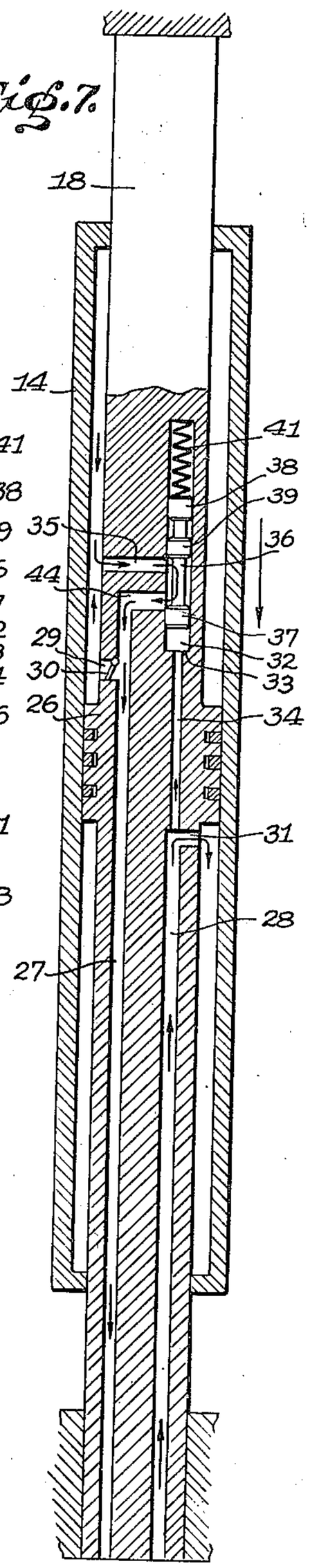


Fig. 7.



INVENTORS
Howard E. Somes
Benjamin R. Purvin
BY John P. Taylor
ATTORNEY

Patented July 6, 1948

2,444,474

UNITED STATES PATENT OFFICE

2,444,474

FLUID PRESSURE DEVICE

Howard E. Somes and Benjamin R. Purvin, Detroit, Mich., assignors, by mesne assignments, to The Ohio Crankshaft Company, Cleveland, Ohio, a corporation of Ohio

Application June 6, 1944, Serial No. 538,976

5 Claims. (Cl. 121—40)

1

This invention relates to reciprocable work supporting carriages and the like, particularly to devices of this nature adapted to be reciprocated in a generally vertical direction through the medium of a fluid under pressure.

In various types of mechanisms, such as for example, machine tools, heat treating equipment and the like, a carriage or head is frequently caused to reciprocate in a generally vertical direction through the provision of fluid pressure cylinders and pistons. Particularly, in constructions of this character wherein the carriage or head and the work or tool carried thereby is several hundred pounds in weight, serious damage to the equipment is likely to result in the event the fluid pressure should fail when the carriage or head is in an elevated position.

The object of the present invention is to provide a generally vertical fluid piston and cylinder arrangement of novel construction wherein improved means is provided for preventing relative movement between the parts in the event of fluid pressure failure.

Another object is the provision in a cylinder and piston arrangement adapted to be relatively reciprocated by fluid under pressure of a novel and improved check valve arangement which quickly and automatically functions to prevent relative reciprocation of the parts in the event of fluid pressure failure.

With the above and other objects in view which will be apparent from the following description to those skilled in the art to which the invention appertains, the present invention consists in certain features of construction and combinations of parts to be hereinafter described with reference to the accompanying drawings, and then claimed.

In the drawings which illustrate a suitable embodiment of the invention:

Figure 1 is a front elevation of a heat treating machine having a vertically reciprocable carriage in which the features of the present invention are incorporated;

Figure 2 is an enlarged longitudinal section of a portion of one of the carriage actuating cylinders and pistons;

Figures 3, 4, and 5 are transverse sections taken substantially on the lines 3—3, 4—4, and 5—5, respectively, of Figure 2;

Figures 6 and 7 are diagrammatic views showing two stages of operation of the cylinder and piston arrangement and

Fig. 8 is a section through an interlocking relief valve.

2

Referring to the drawings, the machine selected for illustration is a heat treating machine adapted to heat treat the bore of an elongated cylindrical member 10 which is moved vertically and longitudinally by the reciprocable carriage, generally designated 11, relative to heating and quenching heads 12 and 13, respectively.

The carriage 11 embodies spaced vertical cylinders 14 interconnected by spaced cross heads 15 and 16 which carry chucking members 17 for holding the tubular member 10 in axial alignment with the heating and quenching heads 12 and 13. The carriage cylinders 14 are reciprocably supported on spaced vertical rods 18 secured by suitable clamps 19 to the machine base 20.

The rods 18 are preferably comprised of a solid intermediate section 21 and tubular upper and lower sections 22 having tapered telescoping fits as indicated at 23 in Figure 2, the intermediate section being provided with coupling collars 24 abutting shoulders 25 and threaded to the tubular upper and lower sections 21.

The intermediate section 21 is provided with an enlarged portion 26 substantially midway between the ends of the rod 18 with which the cylinder 14 has sealed sliding engagement. Although not shown in Figures 1 and 2 of the drawings, the opposite ends of the cylinders have sealed sliding engagement with the rod sections 22.

The intermediate section 21 is provided with two longitudinal passages 27 and 28, the passage 27 opening into the cylinder space above the piston portion 26 through port 29 which is closed by the check valve 30, shown in Figure 3, and the passage 28 opening into the cylinder space below the piston portion 26 through ports 31.

The high pressure passage 27 and low pressure passage 28 are connected by conduits 27*a* and 28*a*, respectively, which extend through the lower rod section 22, with a suitable control valve arrangement (not shown) and source of fluid under pressure.

The intermediate portion 21 is provided from its upper end with a longitudinal passage 32 in alignment with the low pressure passage 28, which terminates in a stop seat 33. The passages 28 and 32 are connected through a reduced passage 34 which opens through the seat 33. Arranged above the seat 33 and intersecting the passage 32 is a cross passage 35 which places the passage 32 in communication with the cylinder space above the piston portion 26. Disposed in the passage 32 is a longitudinally movable slide valve 36 having a lower piston portion 37 and

spaced intermediate piston portions 38 and 39 and an upper shank portion 40 surrounded by a compression spring 41. Threaded in the upper end of the passage 32 is a plug 42 having a recess 43 within which the shank portion 40 is adapted to slide. The compression spring 41 abuts the plug 42 and the piston portion 39 and urges the valve 36 downwardly whereby the lower portion 37 engages seat 33 to halt movement by the spring. In this position of the valve, the spaced piston portions 38 and 39 are disposed as seen in Figure 2 at opposite sides of the cross passages 35. The high pressure passage 27 is also provided with a passage 44 which opens into the passage 32 between the piston portions 37 and 39.

Figure 6 diagrammatically illustrates the fluid flow to one of the cylinders 14 (the upper) during elevation of the carriage 11. Fluid under pressure flowing through the high pressure passage 27 opens the check valve 30 and flows through passage 29 into the upper end of the cylinder. A passage 45 is provided for draining leakage fluid from the passage 32 above the valve 36.

The fluid control system is so arranged that under normal operation a predetermined pressure is maintained in the low pressure passage 28 during the up stroke of the cylinder 14 and in the event of a drop in pressure in the line 27, the pressure in passage 28 will drop below the predetermined value. This pressure in passage 28 in normal operation is such that upon initial upward movement it will raise the slide valve 36 from its seat to the position shown in Figure 6, thus placing the cross passages 35 and 44 in communication with each other.

During the downward movement of the carriage, as depicted in Figure 7, low pressure fluid flows through passage 28 and thence through passage 31 into the lower end of the cylinder to cause the downward movement. This fluid is under sufficient pressure to flow through passage 34 and keep the slide valve 36 raised from its stop seat against the resistance of the spring 41 which keeps the passages 35 and 44 in communication with each other whereby the fluid in the upper end of the cylinder flows through these passages and thence through passage 27 back to the source of fluid supply. During this movement, the check valve 30 maintains the passage 29 closed.

Should the fluid pressure in passage 28 fail, incident to fluid line breakage to either conduit 27*a* or 28*a*, pressure pump failure or any other cause, during either upward or downward movement of the carriage and drop below the predetermined value necessary to overcome the resistance of the compression spring 41, the compression spring 41 immediately moves the slide valve 36 downwardly to its seat 33, this being the position shown in Figure 2. The valve portion 39 thus closes passage 32 between the passages 35 and 44. Also, under the condition of a drop in pressure in the high pressure line 27 the check valve 30 closes communication between the passages 27 and 29, just as it does for all return flow from the cylinder to the passage 27.

The fluid in the upper end of the cylinder 14 which normally flows back to the source through passage 27 is thus trapped in this end of the cylinder and accordingly prevents the cylinders and the carriage supported thereby from dropping and causing damage to the mechanism or the work or tools supported by the carriage.

To summarize, in normal operation as long as working pressure is maintained in the passage 27 the pressure in passage 28 is permitted to remain at least high enough to hold the valve 36 in its upper position against the spring 41 and the passages 35 and 44 are continuously kept in communication with each other. Under these normal conditions the parts are lowered by an active pressure in conduit 28 which, with the assistance of gravity, is sufficiently high to force the parts down against the reduced pressure in the conduit 27. Due to resistance in conduit 27 to the outflow of fluid, after the high pressure supply has been cut off and the passage has been opened to exhaust, and to the action of fluid in passage 28 on the cylinder, the pressure in conduit 27 is still high enough to elevate the parts and would do so except for the greater pressure in conduit 28 tending to force the parts down. But if the pressure in conduit 27 fails this causes pressure in conduit 28 to fall below that necessary to hold valve 36 open and when this valve closes it traps fluid in the upper end of the cylinder (check valve 30 closing against any outflow through passage 29) so that it is impossible for the parts to fall until the normal minimum pressure is again established in conduit 27. The low pressure or lack of pressure established in conduit 28, permitting valve 36 to close, prevents any appreciable tendency to force the parts down against the fluid trapped in the upper cylinder chamber.

A simple device for providing this control is shown in Fig. 8 where a piston 46 in a cylinder 47 is moved by high pressure in conduit 27*a* against a spring 48 to keep closed a relief line 49 from the low pressure conduit 28*a*. When pressure in conduit 27*a* fails, it opens the relief line 49, thus lowering the pressure in conduit 28*a* and permitting valve 36 to close to trap fluid in the upper end of the cylinder to prevent it from falling.

While the invention is shown and described in connection with one cylinder and piston arrangement only, it is to be understood that it may be under for both cylinder and piston arrangements if necessary. It is to be understood also that the invention is applicable to any character of machine having a single or multiple cylinder carriage.

Various changes may be made in the detailed construction and arrangement of the parts described without departing from the spirit and substance of the invention, the scope of which is defined by the appended claims.

What is claimed is:

1. A fluid operated device including a cylinder element and a piston element operating in the cylinder to define two pressure chambers therewith and having a piston rod extending in sealed relation therefrom, one of said elements of the fluid operating device being fixed and the other being movable, a first passageway in said piston rod opening into a first one of said cylinder chambers on one side of the piston, a second passageway in said piston rod opening into a second one of said cylinder chambers on the other side of the piston, a valve chamber in said piston rod, axially spaced passages opening from said valve chamber, one into said first passageway and the other into said first cylinder chamber, a third valve passage connecting one end of the valve chamber with said second passageway, a valve in said valve chamber, spring means urging said valve into position to close the connection between said first and second valve passages,

and said third valve passage entering the valve chamber at one end of the valve to permit fluid from the second passageway to move it against its spring to keep the first and second valve passages connected as long as sufficient pressure exits in said second passageway and to close the connection when the pressure drops below that necessary to oppose the spring.

2. A fluid operated device including a cylinder element and a piston element operating in the cylinder to define two pressure chambers therewith, said fluid operated device having first and second fluid passageways for conducting fluid to and from said chambers to effect elevating and lowering movement of one of said elements and means for maintaining a predetermined pressure on fluid being conducted from one chamber of the cylinder by the second of said passageways as a result of fluid being conducted to the other chamber of the cylinder by the first said passageway, two outlets from the first passageway to its cylinder chamber, a check valve for a first one of said outlets for preventing return flow from the chamber to said first passageway, valve means for the second one of said outlets, spring means urging said valve means to a position to close said second outlet, said valve means being responsive to fluid pressure in said second passageway during elevating and lowering movements to open said second outlet and being responsive to drop in pressure below a predetermined limit necessary to oppose said spring to close said second outlet and trap fluid in the chamber of the cylinder to prevent said lowering movement.

3. A fluid operated device including a cylinder element and a piston element operating in the cylinder to define two pressure chambers therewith and having a piston rod extending in sealed relation therefrom, one of said elements of the fluid operated device being fixed and the other being movable, a first passageway in said piston rod opening into a first one of said cylinder chambers on one side of the piston and a second passageway in said piston rod opening into the second one of said cylinder chambers on the other side of the piston, valve means for controlling the flow of fluid from said first chamber to said first passageway, and means responsive directly to pressure of fluid in said second passageway for keeping said valve means open, said last-mentioned means being responsive to a failure of pressure in said second passageway for closing said valve to trap fluid in said first chamber, the control system for the said first and second passageways including means for causing pressure in the second passageway to fall below the predetermined value necessary to keep said valve means open upon sufficient failure of pressure in said first passageway.

4. A fluid operated device including a cylinder element and a piston element operating in the cylinder to define two pressure chambers therewith, said fluid operated device having first and second fluid passageways for conducting fluid to and from said chambers to effect elevating and lowering movement of one of said elements, two outlets from the first passageway to its cylinder chamber, a check valve for a first one of said outlets for preventing return flow from the chamber to said first passageway, valve means for the second one of said outlets, and means responsive directly to pressure of fluid in said second passageway and through the pressure of fluid in said second passageway which is made dependent upon pressure of fluid in said first passageway for keeping said valve means open during operation except upon pressure failure in either the first or second passageway.

5. A fluid operated device including a cylinder element and a piston element operating in the cylinder to define two pressure chambers therewith and having a piston rod extending in sealed relation therefrom, one of said elements of the fluid operated device being fixed and the other being movable, a first passageway opening into a first one of said cylinder chambers on one side of the piston and a second passageway opening into the second one of said cylinder chambers on the other side of the piston, and control means, including a valve for controlling the flow of fluid from said first chamber to said first passageway, for closing said first passageway upon failure of pressure in either of said passageways, said control means including interacting means for causing pressure in said second passageway to drop and said valve to close upon failure of pressure in said first passageway.

HOWARD E. SOMES.
BENJAMIN R. PURVIN.

REFERENCES CITED

The following references are of record in the file of this patent:

UNITED STATES PATENTS

Number	Name	Date
993,967	Debauche	May 30, 1911
1,960,379	Havens	May 29, 1934
2,027,706	Schauer	Jan. 14, 1936
2,186,266	Onions	Jan. 9, 1940
2,216,486	Cooke	Oct. 1, 1940
2,328,979	Herman	Sept. 7, 1943
2,363,196	Nye	Nov. 21, 1944

FOREIGN PATENTS

Number	Country	Date
432,390	Great Britain	July 25, 1933