Dec. 13, 1949 H. H. MANNING 2,490,823

HYDRAULIC-PNEUMATIC SYSTEM

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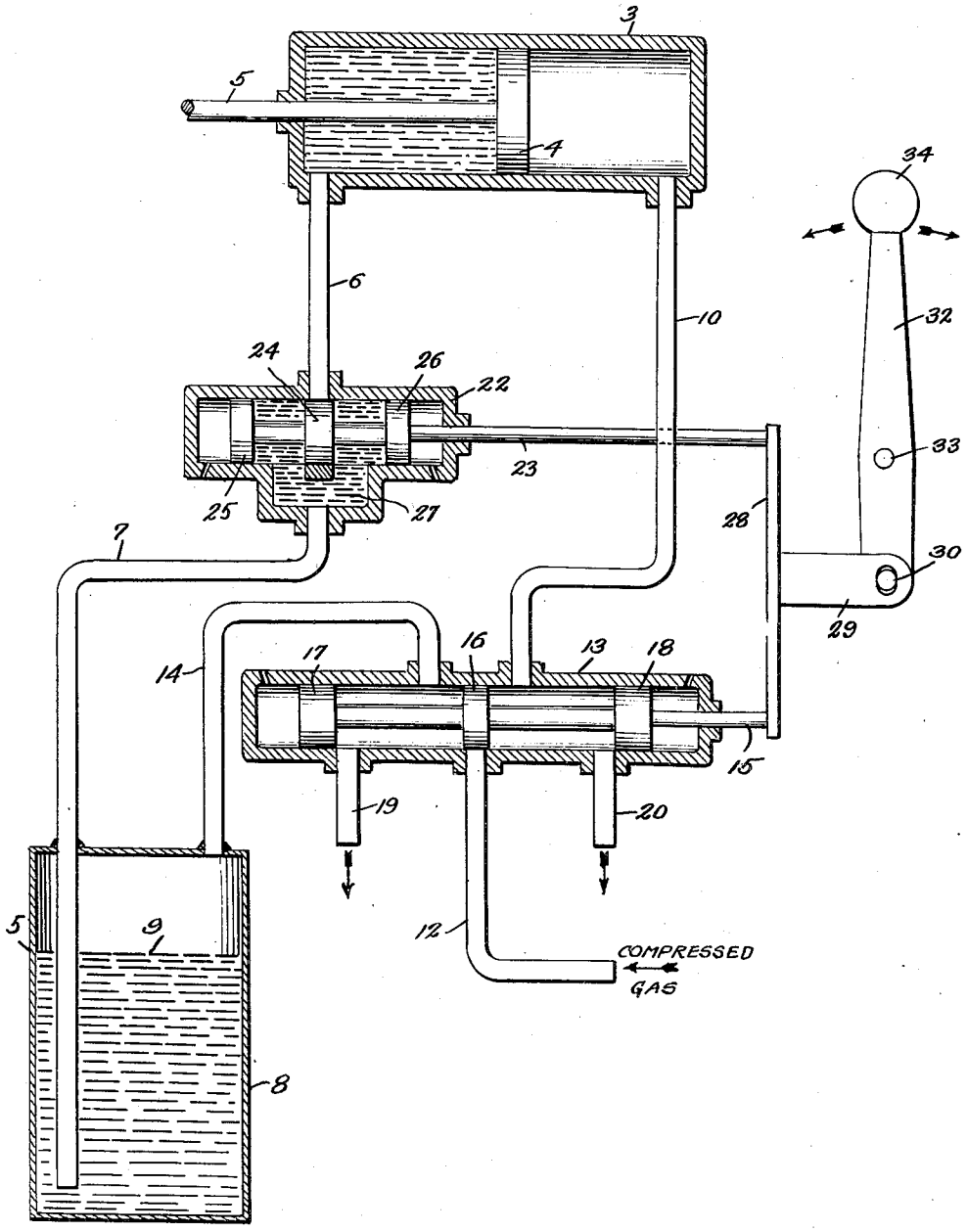


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## HYDRAULIC-PNEUMATIC SYSTEM

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1 Claim. (Cl. 60—51)

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This invention relates to systems embodying fluid motors of the expansible chamber type and controlling means for causing the motors to perform useful work. The word "fluid" is intended to include both gases and liquids.

More particularly, the present invention is concerned with a system embodying a servo-motor that is under selective manual control and sufficiently hydraulic in character to permit the working or moving element of the motor to be stopped and held accurately in any desired position.

Hydraulic apparatus has greater versatility than a similar apparatus operated by compressible fluids, but it is more costly, especially in the pump and in the various parts designed to seal against leakage. However, as above indicated a purely pneumatic system, although more economical, has the disadvantage that its motor piston cannot be moved positively or stopped quickly and accurately.

It is the primary object of my invention to devise a servo-motor system which is partially hydraulic and partially pneumatic, whereby versatility and satisfactory operation are obtainable at a minimum constructional cost.

It is a further object of this invention to devise a system of the character described in which the initial pressure medium is a compressible fluid and is utilized to react upon a liquid for operation of an expansible chamber motor. In this connection, it is an important object to maintain the liquid in a closed system including the motor.

Another important object of my invention resides in the provision of controlling devices of novel design and arrangement for coaction with a combination pneumatic-hydraulic system embodying an expansible chamber servo-motor.

The foregoing and other objects of the present invention will clearly appear from the following description when studied in conjunction with the accompanying drawing, wherein the single figure is a somewhat diagrammatic view, chiefly in section, depicting a preferred embodiment of the invention.

The illustrated arrangement comprises a motor cylinder 3 containing a piston 4 having a working rod 5. The motor is conventional and will embody suitable seals and packings, as will also the valve structures later described.

One end of the cylinder 3 is connected through a pair of pipe sections 6 and 7 to a reservoir 8, the latter being nearly filled with an incompressible fluid 9, such as oil, and the pipe 7 terminating near the bottom of the reservoir for purposes presently to be seen.

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The other end of the cylinder 3 is connected through pipe sections 10 and 12 to any suitable source of compressible fluid, such as air, these sections being joined by a valve casing 13. A third pipe 14 interconnects the valve casing and the top of the oil reservoir 8. A valve stem 15 extends slidably through one end of the casing and is rigidly connected to a spool type valve unit comprising three spaced apart and integrally joined cylindrical elements 16, 17, 18. Exhaust outlets 19 and 20 are provided at intermediate portions of the casing.

The spacing and arrangement of the valve parts and pipe connections to the casing 13 are such that the element 16 controls the inlet pipe 12, and the elements 17 and 18 control the exhaust pipes 19 and 20, respectively. The pipe 10 always is in communication with the space between elements 16 and 18, and the pipe 14 always is in communication with the space between elements 16 and 17.

Interposed between the pipe sections 6 and 7 there is a second valve casing 22 through one end of which slidably projects a valve stem 23 in parallelism with the other valve stem 15. The stem 23 is rigidly united to a spool valve unit comprising three integrally joined cylindrical elements 24, 25, 26. A U-shaped passage 27 in the casing wall is in communication with the pipe section 7 and constantly interconnects the two spaces formed by the three cylindrical valve elements. The element 24 controls the pipe 6, permitting it either to receive oil from the reservoir 8 or to discharge oil from the motor cylinder back into the reservoir.

The valve stems 15 and 23 have their projecting ends securely connected in any suitable manner to the ends of a bar 28, the latter in turn being rigidly joined to a single operating link 29 through which both valves may be actuated simultaneously. The link is pivotally connected at 30 to one end of a lever 32 that has a stationary pivot 33 between its ends. The upper end of the lever has a knob or handle 34 which may be manipulated to oscillate the lever in the directions of the illustrated arrows, thus to reciprocate the two internal value units simultaneously in one direction or the other.

It should be understood that the two valve structures and their actuating mechanism may take various other designs, it being essential only that they perform the functions outlined in the following statement of operation.

With the parts positioned as in the drawing, the source of compressed air is cut off, and both the reservoir and the right hand end of the motor cylinder are open to atmosphere through the outlets 19 and 20, as shown by the arrows. If the control knob 34 is pushed slightly to the left, both valve units are pulled to the right to permit compressed air to enter the reservoir 8 and to permit oil to be forced into the motor to drive its piston to the right. At this time the exhaust 19 is closed, the exhaust 20 remaining open.

If the control knob is shifted past "neutral" to the right, compressed air is admitted to the motor to force its piston to the left, discharging oil into the reservoir as permitted by exhausting part of the head of air therefrom through the opened outlet 19. At this time the outlet 20 is closed. In either direction of movement the motor piston may be quickly and accurately stopped in any position by snapping the control lever back to its illustrated locking or neutral position to cause complete closure of pipe 6 by the oil valve element 24; and for this purpose a spring arrangement may be provided to kick the lever into "neutral" accurately upon release of the control knob 34.

The lower end of pipe 7 is kept deeply immersed in the oil so that air cannot pass the reservoir. The total quantity of oil is such that the reservoir will be full when the motor piston is in its extreme left hand position, thus precluding the loss of oil to the atmosphere through the pipes 14, 19.

The left end of the motor cylinder may be provided with a bleeder valve to permit escape of any entrapped air and to facilitate initial filling of the pipes 6 and 7 with oil. Also, of course, the reservoir 8 will be equipped with any suitable means for filling the tank and for adding oil to compensate for slight amounts that may escape in the form of vapor or fine particles.

It would seldom if ever be necessary to make the motor completely hydraulic in action but, if desired, this can readily be accomplished by breaking the pipe line 10 in two places and inserting therein a second oil valve and a second reservoir like those illustrated. The second oil valve would be properly controlled by the stem 23 or by another stem connected to the bar 28.



In special installations, the pipe 10 may be omitted and a compression spring may be placed in the right end of the motor cylinder, this spring having a constant tendency to return the piston to its left hand position.

Various other changes in arrangement and design of the parts may be made without departing from the spirit of the invention, all contemplated within the scope of the appended claim.

What is claimed is:

In combination with a closed chamber containing a quantity of liquid never substantially exceeding its full capacity; a motor comprising a cylinder and piston; a conduit connected from one end of said cylinder to said chamber; a stop valve in said conduit; a valve casing connected to a source of compressed air; separate connections from said casing to said chamber and to the other end of said cylinder; a valve in said casing operable to establish communication from said connections either to said source of compressed air or to the ambient atmosphere; and control means common to said valves, and so correlated therewith that said chamber and said other end of said cylinder are open to the atmosphere simultaneously when the first-named conduit is closed by said stop valve.

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