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POWER AMPLIFYING POSITIONING DEVICE

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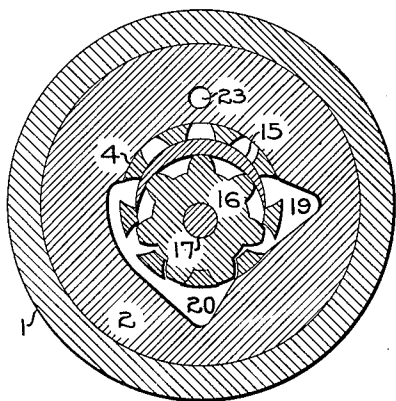


Fig.3

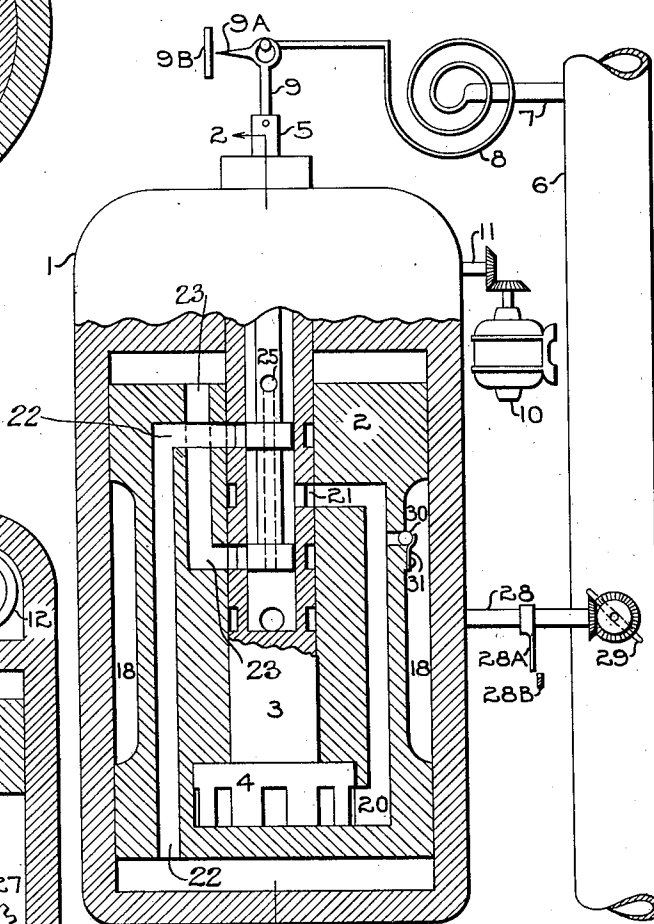


Fig. 1

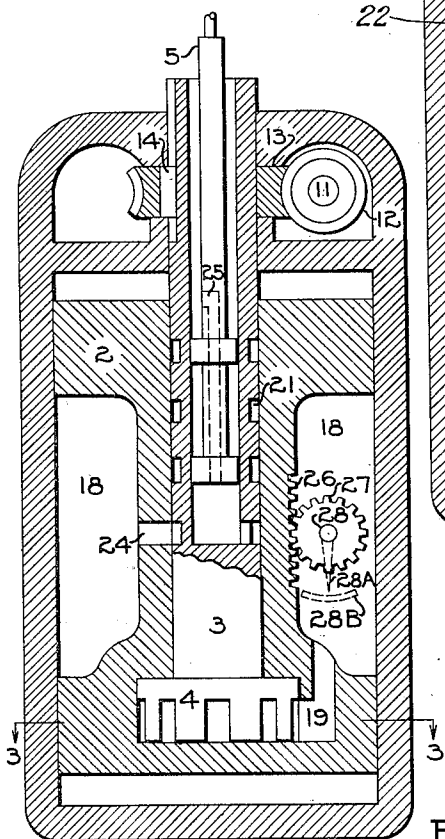


Fig. 2

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POWER AMPLIFYING POSITIONING DEVICE

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No. 498,374. Divided and this application December 15, 1931, Serial No. 581,131

3 Claims. (Cl. 60—52)

This invention relates in general to devices wherein the positioning of a member by a relatively weaker control force results in the positioning of another member by an amplified or relatively greater force to accomplish a useful purpose. The present application is a division of my application Serial No. 498,374 filed in the United States Patent Office November 26, 1930.

Such devices are known as torque or power amplifiers, and may position the second member directly in step with the first member, or the movement of the second member may bear a functional relation to the movement of the first member or in relation to the amount and direction of departure of the first member from a given position; but in any event the second member is caused to move or to be positioned as the result of a change in position of the first member, and with a force relatively greater than the force imparted to the first member.

The first member may be positioned or caused to depart from a given position through various causes; for example, by variations in pressure, differential pressure, temperature, rate of fluid flow, or in fact any variable factor or relation whose force is desirably magnified to position a second member requiring a relatively greater force for such positioning. The second member so positioned may move an indicator or can be used to move a damper or valve or desirable regulable mechanism whose movement may or may not result in a change in value of the factor which caused the initial movement of the first member.

My invention resides in certain improvements and arrangement of parts in such devices wherein many advantages are obtained.

One object is to provide such a torque or power amplifier utilizing hydraulic power.

Another object is to arrange the hydraulic power producing and controlling parts in a single unit.

A further object is to provide means wherein the movement of the secondary member may bear a desirable relation to the movement of the primary member.

A still further object is to provide a construction wherein the pilot controlling the passage of hydraulic fluid moves axially relative to and within the amplified power piston.

Another object is to provide a construction wherein the pump for providing hydraulic fluid is located in and axially moved with the amplified power piston.

A still further object is to have the movement

of the second member result in shutting off of the amplified power effective in causing such a movement.

With these and further objects in view, I will now describe a preferred embodiment of my invention.

In the drawing:

Fig. 1 is an arrangement, partly diagrammatic and partly in sectional elevation of an embodiment of the invention wherein is shown a certain preferred arrangement of parts.

Fig. 2 is a sectional elevation along the line 2—2, in the direction of the arrows, of Fig. 1.

Fig. 3 is a section in plan along the line 3—3, in the direction of the arrows, of Fig. 2.

I have illustrated an arrangement wherein an amplified power piston is located concentric with and movable axially relative to a pilot, and wherein means for providing hydraulic fluid under pressure for positioning the power piston is located in and axially positioned with the power piston.

A casing 1 has cooperating therein a piston 2 which in turn encases a sleeve member 3 carrying at its lower end the rotor 4 of a pump for providing hydraulic fluid under pressure. Within the sleeve member 3 and axially movable therein is a pilot 5 having lands spaced along the length of the pilot, cooperating with ports or passages through the sleeve member.

I have shown the pilot 5 capable of being positioned axially in the assembly by variations in pressure of a fluid in a duct 6 effective at the pipe 7 upon a Bourdon tube 8 and through the intermediary of a linkage 9. The link 9, pivotally connected to the pilot 5 for positioning the same, further carries an extension forming a pointer 9A cooperating with an index 9B, for advising the value of the fluid pressure and/or of the position axially of the pilot 5.

To overcome a tendency toward resistance to axial positioning of the pilot 5 I preferably rotate the sleeve 3, and in so doing effect an operation of the pump rotor 4. Such rotation is obtained from a motor shown at 10, driving through suitable gearing a shaft 11 carrying thereon a worm 12 meshing with and driving a worm wheel 13 splined to the sleeve 3 at 14. The sleeve member 3 is thus continually rotated, driving the pump rotor 4, and capable of axial positioning through the medium of the spline 14.

The pump as shown more in detail in Fig. 3 has a stationary part 15 of the piston 2 forming a shield between the rotor 4 and a rotor 16, the latter carried on a shaft 17 fixed to the piston 2,

to the end that rotation of the rotor 4 results in rotation in the same direction of the rotor 16, but at a different speed.

A sump or reservoir 18 surrounds the piston 2 between its ends and moves in effect relative to the cylinder 1 as the piston is vertically positioned in the cylinder. A passage 19 permits hydraulic fluid, preferably oil, to enter the pump from the reservoir 18. The oil is then discharged, when needed, through a passage 20 to an annular channel 21 around the sleeve member 3, said channel having an opening at one or more points through the sleeve to the interior of the sleeve and between the lands of the pilot 5.

A passage 22 communicates between the interior of the sleeve member 3 and that part of the cylinder 1 below the piston 2, while a passage 23 communicates between the interior of the sleeve member 3 and that part of the cylinder 1 lying above the piston 2. A drain is provided from the interior of the sleeve 3 through a passage 24 to the reservoir 18 from below the pilot 5, while a drain from above the lands of the pilot 5 is provided through the passage 25 down through the pilot, to communicate to the space below the pilot and the drain connection 24.

Vertical motion or positioning of the piston 2 within the cylinder 1 is transmitted external of the cylinder through a rack 26 driving a pinion 27, the pinion having a shaft 28 extending through suitable fluid tight bushings externally to position an indicator 28A relative to an index 28B, or as shown in Fig. 1, through proper gearing, position a damper 29 to control the pressure effective at the pipe 7.

In operation, a change in pressure within the duct 6 results in a movement of the Bourdon tube 8, and assuming that the pressure has increased, then the Bourdon tube tends to move counterclockwise and positions the pilot 5 downwardly so that the lands move downwardly out of alignment with the ports in the sleeve 3. If the pump rotor 4 is being rotated by the motor 10, then hydraulic fluid under pressure is available through the passage 20 and the annular chamber 21 at the interior of the sleeve 3 between the lands of the pilot 5. Immediately upon movement of the lands downwardly out of alignment with the ports, there will be a flow of hydraulic fluid through the passageway 23 to the upper side of the piston 2, and simultaneously a drainage of fluid from below the piston 2 through the passage 22, the opening 25 and the drain passage 24, all resulting in a downward movement of the piston 2 an amount proportional to the displacement of the pilot from its original position. The downward motion of the piston 2 results in a positioning of the ports opposite the lands to shut off flow of hydraulic fluid, as well as rotation of the externally extending shaft 28 which may position an indicator 28A of the pressure effective at the pipe 7, or position a damper or valve means 29 to control such pressure. In any event, the shaft extension 28 is positioned to a definite point for each pressure within the range of operation, and with a power amplified over that available to position the pilot 5 through the linkage 9.

So long as the lands of the pilot 5 are aligned with the ports of the sleeve 3, no hydraulic fluid

passes through the ports from the pump rotor 4, and assuming that the rotor is in continued rotation, then pressure developed thereby is relieved from passage 20 to reservoir 18 through a ball valve 30 spring backed by a spring 31.

I have provided an amplified power positioning device wherein a relatively weaker control force positions a member to result in the positioning of a second member with greater force, thereby indicating the positioning or movement of the first member as an indication of the position or variation in position or amount of a factor whose variation results in the relatively weaker control force; or the motion of the second member having relatively greater power may accomplish useful work such as controlling the factor, or some other factor.

I preferably provide that a self-contained, compact unit is formed wherein the controlling pilot is surrounded by the amplified power piston which further carries the pump for supplying hydraulic fluid under pressure. It will be understood that I have illustrated and described a certain preferred embodiment of my invention, but that I am not to be limited thereby other than as claimed in view of prior art.

What I claim as new and desire to secure by Letters Patent of the United States, is:

1. In a power amplifying mechanism, in combination, an axially movable pilot capable of being positioned by a relatively weak control force, a rotatable and axially movable sleeve surrounding the pilot and having ports for the passage of hydraulic fluid, rotating means for said sleeve, a fluid pump fastened to said sleeve and operated thereby, an axially movable piston defining a casing for the sleeve and the pump and cooperating in a cylinder, fluid passages in the piston, the pilot arranged upon axial positioning to control passage of hydraulic fluid from the pump to the cylinder at one end or the other of the piston to cause a movement thereof, said movement effecting a closing of passage to said cylinder, the wall of said piston intermediate its ends defining with the wall of said cylinder a fluid storage space, and means extending external of the cylinder positioned by the piston.

2. In a power amplifying mechanism, in combination, a source of hydraulic fluid, a cylinder, a pilot for controlling passage of the hydraulic fluid to the cylinder, a piston positioned in the cylinder by the hydraulic fluid, the piston surrounding the pilot and capable of being positioned axially relative to the pilot, a pilot sleeve surrounding the pilot and adapted for axial movement relative to the pilot, a fluid pump carried by the sleeve, and rotating means for the pilot sleeve.

3. In combination, a member capable of being positioned by a relatively weaker control force and comprising a pilot, fluid means controlled by the pilot to provide an amplified force, a piston positioned in a cylinder by said fluid means, the piston concentric with the pilot, a pilot sleeve surrounding the pilot forming a casing therefor and adapted for axial movement relative thereto, a fluid pump carried by the sleeve, and rotating means for the sleeve.

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