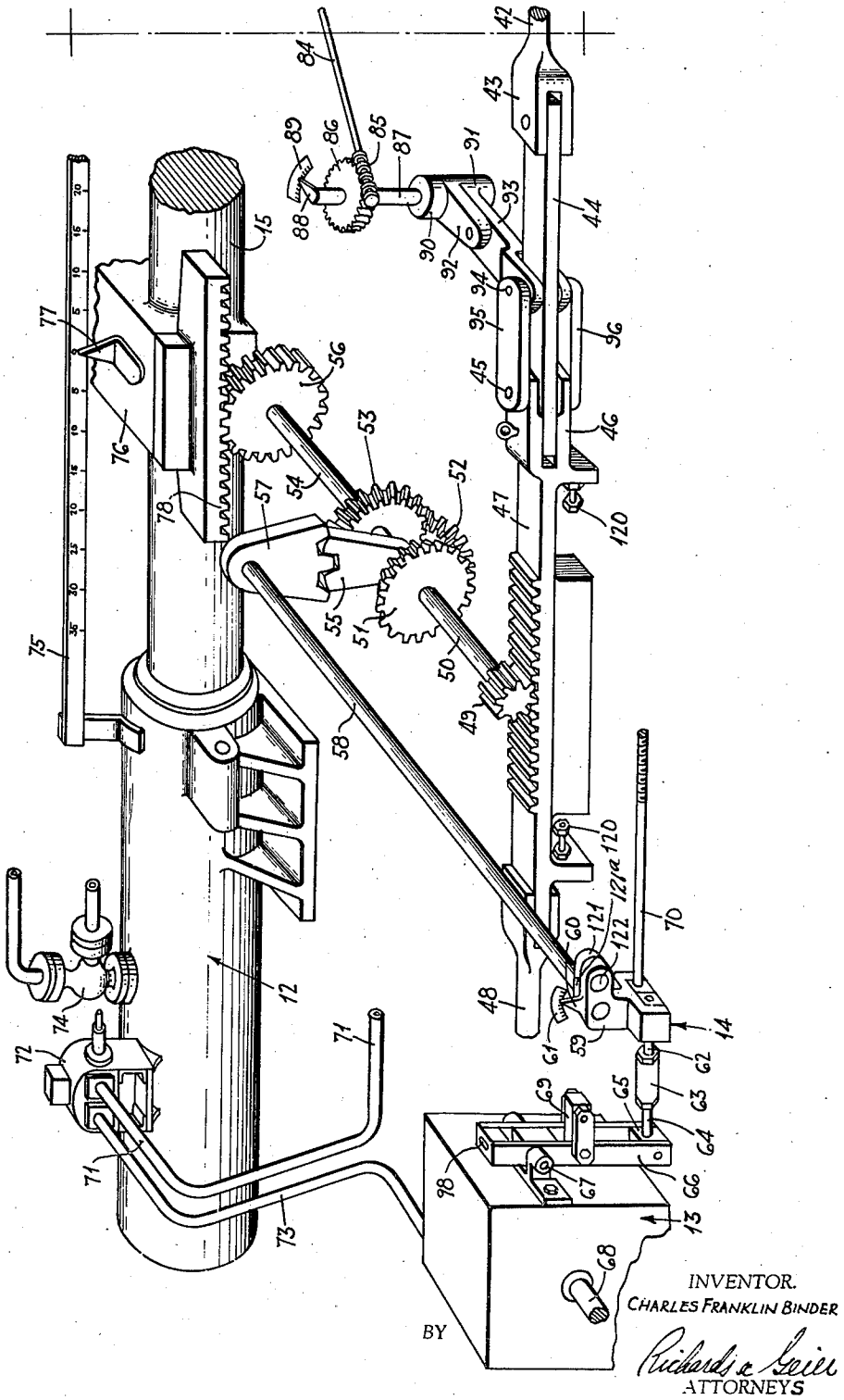
May 9, 1944. C. F. BINDER 2,348,323

TELEMOTOR SYSTEM

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Fig. 1.



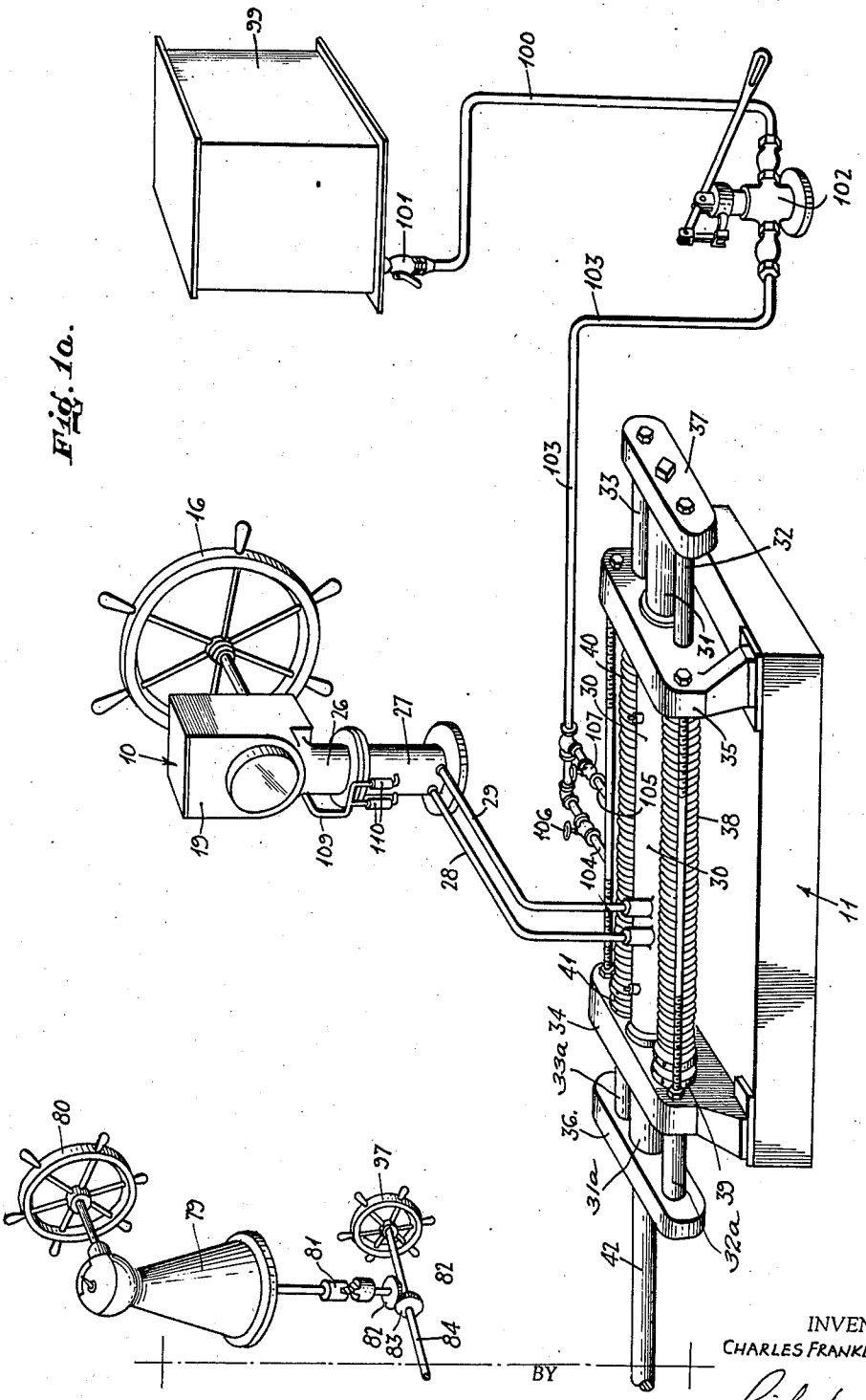
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Fig. 1a.



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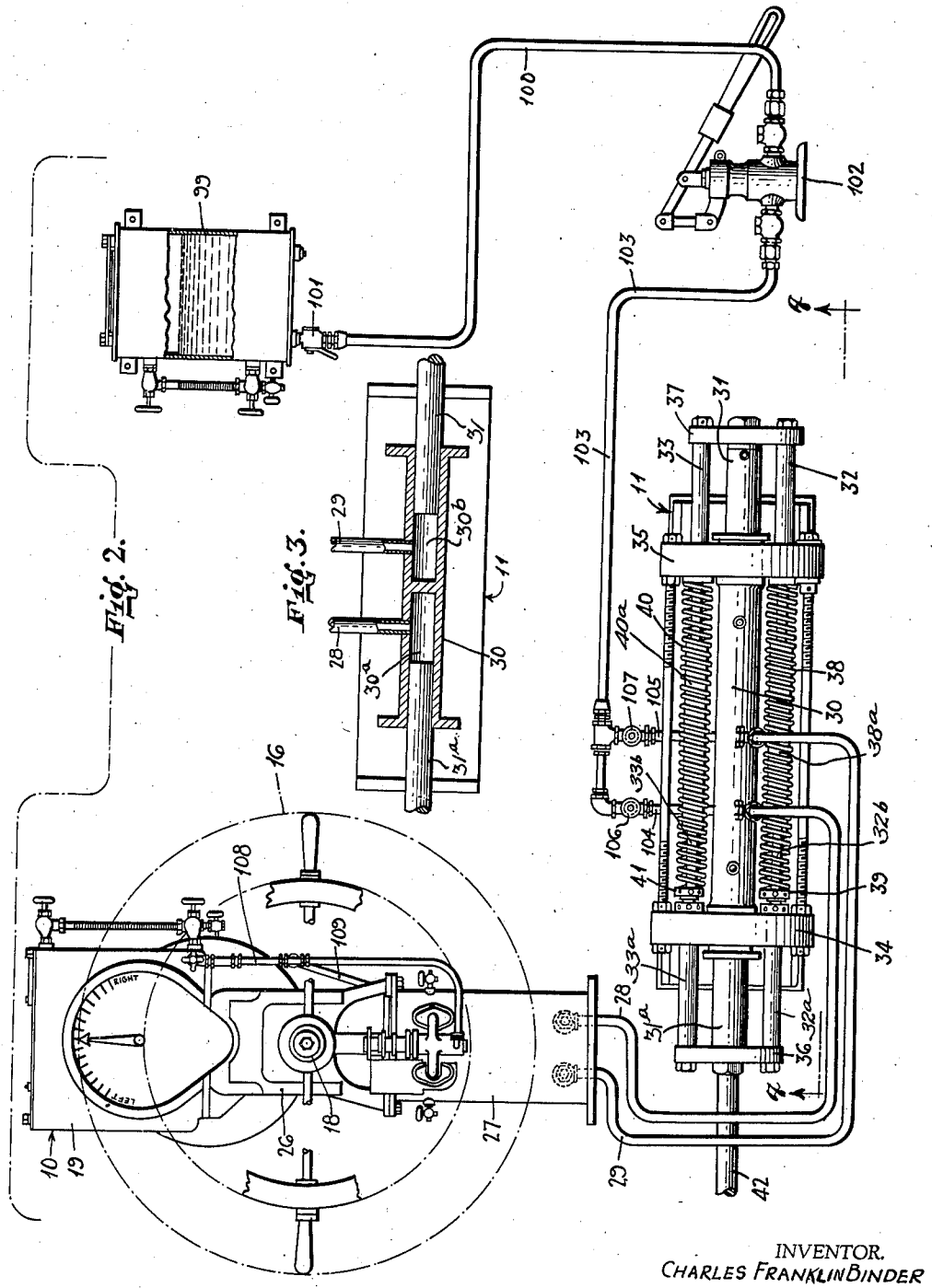


Fig. 2.

Fig. 3.

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Fig. 4.

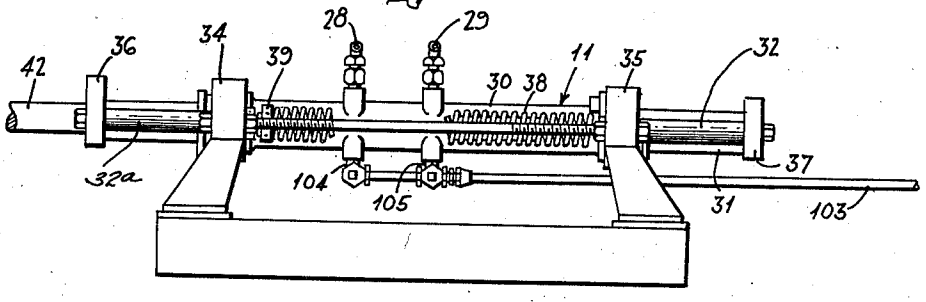


Fig. 5.

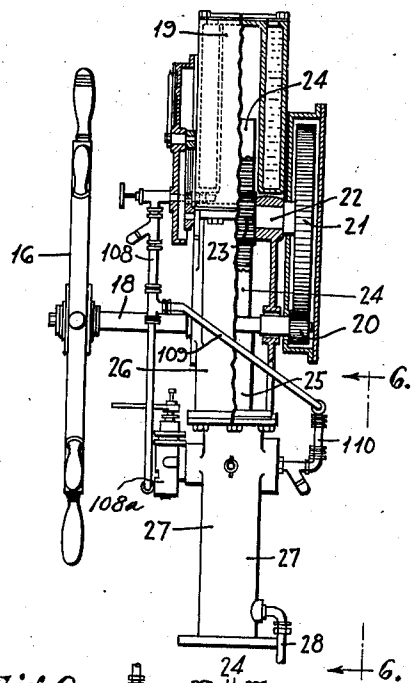


Fig. 6.

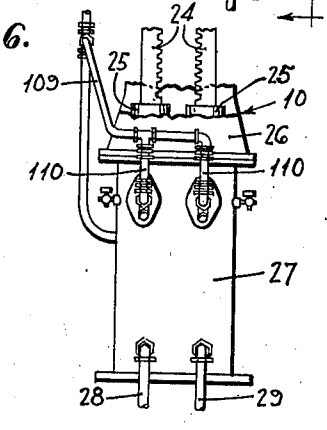
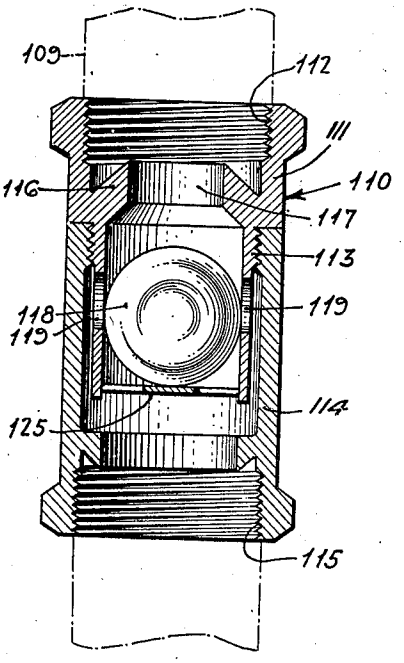


Fig. 7.



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Fig. 8.

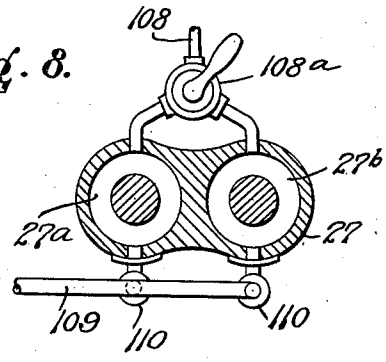
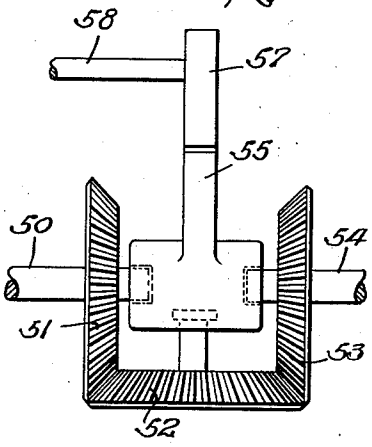


Fig. 11.



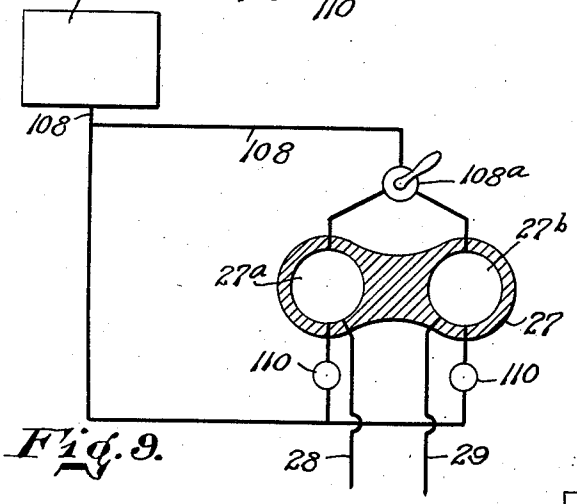


Fig. 9.

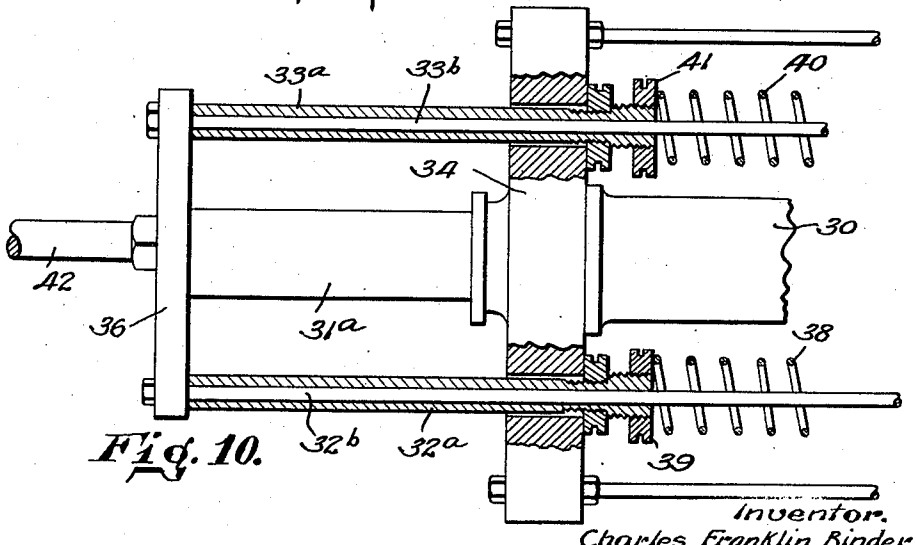


Fig. 10.

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UNITED STATES PATENT OFFICE

2,348,323

TELEMOTOR SYSTEM

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Application October 26, 1939, Serial No. 301,349

1 Claim. (Cl. 60—54.5)

This invention relates to the hydraulic transmission of power and motion and refers more particularly to improvements in hydraulic transmission of power known in the art as a telemotor system.

An object of the present invention is to transmit power and motion hydraulically from one set of pistons to another or series of pistons located adjacent to or remote from the operating pistons.

Another object of the present invention is the provision of a fluid-operated steering mechanism which may be conveniently and adequately replenished with the operating fluid automatically as may be required.

A further object is to eliminate the danger of leakage in a fluid-operated telemotor system and to provide a system which is so constructed that the danger of the penetration of air into various parts of the system is effectively avoided.

Still another object is the provision of a hydraulic telemotor system which is so constructed that the forward and aft pistons remain solidly connected hydraulically with each other continuously by the operating fluid to automatically prevent slack or lost motion in either the forward or aft system.

Another object is the provision of a fluid-operated telemotor system having means for automatically equalizing the expansion and contraction of the operating fluid resulting from temperature variations.

A further object of the invention is the provision of a hydraulic telemotor system whereby the operating fluid may be pumped into the system at the aft telemotor, the lowest point in the system, to the compressor, the highest point in the system, through both connecting pipes simultaneously, thus obtaining a solid operating fluid free from air.

Another object of the invention is the provision of a hydraulic telemotor system which incorporates the use of special check valves to eliminate the necessity of all relief and vacuum valves in the hydraulic system.

Other objects of the present invention will become apparent in the course of the following specification.

The above and other objects of the present invention may be realized by combining a hydraulic system of the telemotor system type with a device adjusting the system in accordance with the expansion and contraction of the operating medium. The adjusting device is preferably connected with the forward compressor located at the highest point of the system and includes check valves of a special type connected between the compressor pistons and the replenishing tank and serve to automatically maintain a solid hydraulic system. A manually operated plug cock is provided across the pistons of the compressor constituting a by-pass for the operating fluid. This plug cock is provided to by-pass operating fluid when the telemotor system is being overhauled by some outside means and is provided with a locking device.

The compressor is operatively connected in the usual manner with the aft telemotor located at the lowest point in the system actuating a rod connected to the mechanism actuating the ram of the ship rudder or to any other mechanism to be actuated or operated by the telemotor system.

In accordance with the present invention, the system is provided with a filling tank operatively connected to a filling pump which is provided with check valves and is connected to the aft telemotor, so that the forward compressor, the aft telemotor, the tank, and the pump are all included in the same fluid circuit, thus making it possible to fill the system through both connecting pipes simultaneously, including the replenishing tank.

Furthermore, in accordance with the present invention, the pistons of the compressor and the aft telemotor are made of a metal which is known on the market under the name of Monel metal, which has been found to be extremely advantageous for these devices.

The invention will appear more clearly from following detailed description when taken in connection with the accompanying drawings, showing by way of example a preferred embodiment of the inventive idea.

In the drawings:

Figure 1 is a diagrammatic perspective view of the hydraulic system used in connection with a ship's steering mechanism.

Figure 1a is a continuation of Figure 1 and shows a part of the hydraulic system in diagrammatic perspective view;

Figure 2 is a detailed diagrammatic view, partly in section, showing the compressor and the parts connected therewith in side elevation, while the aft telemotor is shown in top view.

Figure 3 is a top view showing in section the cylinder of the aft telemotor.

Figure 4 shows the aft telemotor in front

elevation and is a view along the line 4—4 of Figure 2.

Figure 5 shows the compressor in side elevation and partly in section.

Figure 6 is a fragmentary rear view of the compressor along the line 6—6 of Figure 5; and

Figure 7 is a vertical section through one of the equalizing check valves of the compressor.

Figure 8 is a transverse section through the compressor.

Figure 9 is a diagram illustrating the piping connections of the compressor.

Figure 10 is a horizontal section through a part of the aft telemotor.

Figure 11 is a front view of some of the pump actuating means shown in Figure 1.

The telemotor system, shown in the drawings as applied to the steering mechanism of a ship, is operated hydraulically and comprises a compressor 10 (Figure 1a), an aft telemotor 11, a starboard nickel semi-steel cylinder 12 (Figure 1), a variable stroke pump 13, and the pump actuating device 14. The starboard cylinder 12 is used to actuate a forged steel ram 15, which is set athwartship and is connected to the stock of the rudder, not shown in the drawings.

The aft telemotor 11 is somewhat similar to that disclosed in the United States Letters Patent to Johnston, No. 1,302,376.

As shown more clearly in Figures 1a, 2, 5, and 6 of the drawings, the compressor 10, which is located in the pilot house, comprises a handwheel 16 carried by a shaft 18 which extends through a casing 26 communicating with the replenishing tank 19. As shown in Figure 5, one end of the shaft 18 carries a spur gear 20 meshing with a main gear 21 which is firmly connected with a shaft 22. The shaft 22 also carries a gear wheel 23 meshing with two racks 24. The lower ends of the racks 24 are connected to pistons 25 which reciprocate in separate cylinders 27a and 27b enclosed by the casing 27 situated below the replenishing tank 19 and communicating therewith.

The elongated cylinder 30 comprises two separate chambers 30a and 30b as shown more particularly in Figure 3 of the drawings. A piston 31 is adapted to reciprocate in the chamber 30b while a piston 31a is adapted to reciprocate in the chamber 30a. These pistons in accordance with the present invention are made of "Monel" metal. A pipe 28 connects the cylinder 27a of the compressor 10 with the chamber 30a of the cylinder 30 while a pipe 29 connects the cylinder 27b with the chamber 30b. Two guides 32 and 33 extend on both sides of the piston 31 and are carried by the support 35. Two similar guides 32a and 33a extend on both sides of the piston 31a and through the support 34. The support 34 also supports one end of the piston 31a while the support 35 supports one end of the piston 31. A rod 32b extends through the guides 32 and 32a, while a similar rod 33b extends through the guides 33 and 33a. A transverse connection piece 36 connects the outer end of the piston 31a with adjacent ends of the rods 32b and 33b while the transverse connection piece 37 connects the outer end of the piston 31 with the opposite ends of the rods 32b and 33b. The rods 32b and 33b are preferably also made of "Monel" metal.

A spring 38 encloses the major portion of the rod 32b. One end of the spring 38 is connected with the support 35 while the opposite end of the spring 38 is connected with a disc or plate 39, which is firmly attached to the guide 32a. Floating sleeves 38a and 40a enclose the rods 32b and 33b, respectively, and are used to prevent the springs 38 and 40 from sagging.

The spring 40 encloses the rod 33b and is connected with the support 35 and a plate 41 movable along with the guide 33a.

One end of the piston 31a is firmly connected with the rod 42, the opposite end 43 of which, shown in Figure 1, is bifurcated and is pivotally connected with a link 44. The link 44 is connected by a pivot 45 to the bifurcated end 46 of a member 47 having the form of a rack and constituting a part of a bevel gear differential. The free end of the rack 47 may be connected by a link 48 to an electric telemotor system or a gyro pilot not shown in the drawings.

The rack 47 meshes with the pinion 49 connected by a shaft 50 with a bevel gear 51 keyed upon the shaft 50 and meshing with a bevel gear 52. The bevel gear 52 meshes with another bevel gear 53 which is connected by a shaft 54 with a pinion 56. This construction is used when the rudder stock is aft of the rams. The pinion 56 meshes with a rack 78.

A toothed segment 55 which is connected with the bevel gear 52 meshes with another toothed segment 57 which is connected by a shaft or rod 58 with two levers 59 and 121. When the bevel gear 51 is rotated, the bevel gear 52 will carry out a planetary movement, turning the segment 55. The lever 121 is secured to the shaft 58 by a set screw 121a and is connected by a bolt 122 with the lever 59 which is free to revolve on the shaft 58 and is provided with a pointer 60 which is movable over a scale 61. The lever 59 also carries a rod 62 which is connected by a turnbuckle 63 with a rod 64 connected with the rectangular body 65 which is pivotally supported in the pump stroke lever or switch lever 66. The lever 66 swivels in a bracket 67 secured to the casing of the starboard variable delivery pump 13.

The shaft 68 of the pump 13 leads to an electrical motor which is not shown in the drawings. The lever 66 caries a mechanism 69 which is only diagrammatically indicated in the drawings and which projects into the interior of the pump 13 for the purpose of actuating a valve situated therein. This valve is also not shown in the drawings.

The lever 59 is also connected with a rod 70 leading to another independent pump which is similar to the pump 13 and which is not shown in the drawings. This pump which is usually designated as the port pump, is connected by a seamless steel tube or pipe 71 with a multi-port balanced piston valve 72. The valve 72 is connected with a similar valve carried by another cylinder (not shown) and the two valves are operated simultaneously.

The pipe 73 connects the piston valve 72 with the starboard pump 13. The cylinder 12 which encloses one end of the ram 15, also carries an automatic by-pass valve 74 which is mechanically operated by a device not shown in the drawings, to prevent the rudder from being forced into hardover stops under pressure. Furthermore, the cylinder 12 carries a rudder angle scale 75.

The ram 15 is firmly connected with a rudder crosshead 76 made of cast steel and carrying a pointer 77 which moves in front of the scale 75. The crosshead 76 also carries a rack 78 which meshes with the pinion 56.

The illustrated system is provided with a num-

ber of auxiliary devices which are operable only when the compressor 10 is out of order.

One of these auxiliary devices consists of the aft steering column 79 illustrated diagrammatically in Figure 1a and operated by a hand-wheel 80. The aft steering column 79 includes a clutch 81, which may be brought into engagement with a bevel wheel 82 meshing with a bevel wheel 83 carried by a rod 84. As shown in Figure 1, an end of the rod 84 carries a worm 85 meshing with a worm gear 86 mounted upon a shaft 87 having a pointer 88 which moves over a scale 89. The shaft 87 carries sleeves 90 and 91 provided with levers 92 and 93, respectively. The lever 93 is pivotally connected at 94 with links 95, 96 and 44, while the links 95 and 96 are connected at 45 with the bifurcated end 46 of the rack 47.

Another auxiliary device comprises a trick wheel 97 carried by the shaft 84 and located in the steering gear room of the ship.

A third auxiliary device for hand stroking the pump 13 (Figure 1) comprises an opening 98 provided in the top part of the pump stoke lever 66. This hole or opening 98 is used for the insertion of a hand lever through the use of which the switch lever 66 may be operated manually in case the compressor and aft telemotor fail.

In accordance with the present invention, the fluid-operated system shown in Figures 1a and 2, which includes the compressor 10 and the aft telemotor 11, is provided with a filling tank 99 which is preferably situated high above the aft telemotor 11 and which is connected to a pipe 100 carrying a hand-operated valve or petcock 101 and a filling hand-pump 102. A pipe 103 connects the pump 102 with the pipe 104 leading to the section 30a of the cylinder 30 and with the pipe 105 leading to the section 30b of the cylinder 30. The pipe 104 carries a valve 106, while the pipe 105 carries a valve 107. The valves or cocks 106 and 107 are normally locked and are opened only when the system is being filled with the operating fluid.

The device used for compensating for the expansion or contraction of the water, oil or other operating fluid is shown in Figures 1a, 2, 5, 6, and 7 of the drawings. The device comprises a pipe 108 (Figures 2 and 5) having one end which communicates with the interior of the replenishing tank 19. Another pipe 109 is attached to the pipe 108. The lower end of the pipe 108 is connected with a hand-operated by-pass valve 108a which is in communication with the cylinders 27a and 27b.

The pipe 109 carries two equalizing check valves 110, one of which is shown in section in Figure 6 of the drawings. The lower end of the pipe 109 is connected with both cylinders 27a and 27b through the valves 110. Each valve 110 comprises an upper annular body 111 having inner screw-threads 112 meshing with the screw-threads of the adjacent end of a pipe. The lower end of the member 111 has the form of a cylinder 113 having screw threads meshing with the inner threads provided upon the upper end of a sleeve 114. The opposite end of the sleeve 114 has inner threads 115 by means of which the sleeve 114 may be screwed upon a threaded end of an adjacent pipe.

The upper member 111 has an inner flange 116 enclosing an opening 117 which may be closed by a ball 118. The ball 118 is situated within the cylinder 113 constituting a part of the member 111 and provided with diametrically opposed openings 119 and a perforated bottom 125 which may have the form of a cross or the like.

The device is operated as follows:

The pilot desiring to move the rudder of the ship turns the wheel 16 (Figure 1a). Since the wheel 16 is connected by a shaft 18, the spur wheel 20 (Figure 5), the gear wheel 21, the shaft 22, and the gear wheel 23 with two racks 24, the rotation of the wheel 16 will cause one of these racks to move upwardly while the other rack will move downwardly to the same extent. As has been mentioned already, each of these racks is connected to a separate piston 25. These pistons move in separate cylinders enclosed by the casing 27 and communicating with the replenishing tank 19 through the pipes 108 and 109 as well as with the pipes 28 and 29 respectively (Figure 1a). Therefore, the turning of the wheel 16 in one or the other direction will cause a flow of the operating fluid through either the pipe 28 or the pipe 29.

Since the pipes 28 and 29 communicate with the chambers 30a and 30b, respectively, in the interior of the cylinder 30, said chambers enclosing the pistons 31 and 31a, the fluid arriving through the pipe 28 will cause a movement of the piston 31a in one direction, while the fluid arriving through the pipe 29 will cause a movement of the piston 31 in the opposite direction.

Let it be assumed, for instance, that the fluid flows through the pipe 28 into the chamber 30a. This fluid will move the piston 31a to the left (looking in the direction of Figs. 2 and 10). Since the piston 31a is connected by the transverse piece 35 with the rods 32b and 33b which are connected with the transverse piece 37, the transverse piece 37 and the piston 31 will move along with the piston 31a in the same direction. The piston 31 will drive the fluid in the chamber 30b through the pipe 29 and into the cylinder 27b to fill the space produced by the upward movement of a piston 25.

Since the piston 31a is connected with the rod 42, this rod will move along with the pistons 31 and 31a.

The movement of the rod 42 will be communicated to the link 44 and the rack 47 (Figure 1). The rack 47 will actuate the pinion 49, which is connected to the shaft 50. The shaft 50 will rotate the bevel gear 51 which meshes with the bevel gear 52. Thus the rotation of the bevel gear 51 will cause the bevel gear 52 to carry out a rotary planetary movement. Since the segment 55 is connected with the bevel gear 52, it will turn while the gear 52 is moving. The turning of the segment 55 is transmitted by the segment 57 to the shaft 58 and lever 59. Any movement of the ram 15 will also turn the segment 57 through the rack 78, the spur gear 56, the shaft 54, the bevel gear 53 and the bevel gear 52. As already stated, the lever 59 is connected by a rod 64 to the pump stroke lever 66 of the pump 13, while a rod 70 connects the lever 59 to the port delivery pump, not shown in the drawings. The movement of the rack 47 is limited by the stops 120.

A movement of the rod 64 caused by the turning of the shaft 58 will cause the lever 66 to swing about its bracket 67 and to operate the device 69, which extends into the interior of the casing of the pump 13 and which actuates there a valve of standard construction, which is not shown in the drawings.

This valve will cause oil or other operating

fluid to flow from the pump 13 through the pipe 73 to the valve 72 and the interior of the cylinder 12. At the same time, the rod 70 will actuate the port pump, which is not shown in the drawings, and which will cause the fluid to flow from that pump through the line 71 into the valve 72 and the interior of the cylinder 12.

The operating fluid flowing through the lines 73 and 71 into the cylinder 12 will actuate the ram 15, which in its turn will move the stock and the rudder, not shown in the drawings.

If for some reason the compressor 10 or the aft telemotor 11 (Figure 1a) are out of order, the rudder is actuated by turning the hand-wheel 80 of the aft steering column 78, which transmits its movement through the clutch 81 and the bevel gears 82 and 83 to the rod 84; the worm 85 (Figure 1), the worm gear 86, the shaft 87, the sleeves 90 and 91, and the levers 92 and 93 to the link 44 connected with the rack 47.

If the compressor 10 and the aft steering column 79 are both out of order, the rudder may be operated by turning the trick wheel 97, which is connected with the shaft 84.

If all of these devices are out of order, the rudder may be actuated manually by inserting a lever into the opening 98 to turn the lever 66, which actuates the pump 13 and which is connected to the port pump (not shown) by means of the rods 64 and 62, the lever 59 and the rod 70.

Due to the provision of the filling tank 99 and the hand-pump 102 (Figures 1a and 2), the fluid circuit which includes the compressor 10 and the aft telemotor 11 is always filled with the required amount of the operating fluid. The valves 106 and 107 are usually closed and are opened only when the filling pump 102 is actuated.

When one of the pistons 25, for example, the one to the right of Figure 6, is caused to move downwardly against the fluid in the right hand cylinder 27b in casing 27, within which the said piston operates, pressure is transmitted through the pipe 29 to the piston 31 of the aft telemotor 11 moving said piston to the right (Figure 3). Movement of the piston 31 to the right will move the piston 31a to the right also, since the pistons 31 and 31a are connected through the transverse connection pieces 37 and 36 and rods 32b and 33b. Then the fluid in the chamber 30a is displaced through the pipe 28, and into the left hand cylinder 27a in the casing 27 (Figure 6). This pressure will cause fluid to pass through the perforated bottom 125 of the check valve 110 on the right hand side of the casing 27 (Figure 6) forcing the ball 118 against the flange 116, closing the opening 117 and preventing fluid from passing into the pipe 109. At this time the ball in the check valve 110 on the left of the casing 27 (Figure 6) is in its rest position (shown in Figure 7), it being possible for fluid to pass from the replenishing tank 19 into the pipe 109, thence through the openings 117 and 119 of the check valve 110 into the pipe 28, thereby replenishing any fluid which may have become lost and maintain a solid fluid system.

The valve 108a is closed during normal operation and is opened by means of its hand lever when the hydraulic system is to be overhauled to by-pass the cylinders 27a and 27b.

Compression is created by the turning of the steering wheel. When the fluid expands due to heat or some other causes, the velocity rate of the fluid is very slow and not sufficient to cause the ball to move upwardly to close the passage; therefore, a surplus of liquid caused by expansion may flow around the ball 118 into the tank 19. Upon movement of the wheel to cause compression, the velocity rate of the fluid becomes high enough to seat the ball 118.

Should expansion or contraction of the operating fluid resulting from temperature variations take place, the fluid will be able to flow through the openings 119 of the cylinder 113 and around the ball 118, provided that the latter is in its rest position, shown in Figure 7. Thus, due to the provision of the check valves 110, the system is adequately compensated for temperature variations and there is no danger that the increased pressure of the operating fluid will result in leakage.

It is apparent that the specific illustrations shown above have been given by way of illustration and not by way of limitation, and that the structures above described are subject to wide variation and modification without departing from the scope or intent of the invention, all of which variations and modifications are to be included within the scope of the appended claim.

What is claimed is:

In a power-transmitting mechanism, the combination of a forward compressor, an aft fluid-operated telemotor comprising two longitudinally disposed cylinders and pistons movable within each of said cylinders, connections between said pistons, means for connecting said pistons to a power-transmitting mechanism; and two pipe lines each connecting said forward compressor with one cylinder of said aft telemotor; with a filling tank situated substantially above said aft telemotor, a hand pump, a pipe line having an equalizing valve and connected to said tank and one end of said pump, another pipe line connected to the other end of said pump, two pipes one end of said pipes being connected with the other ppie line and each one of the opposite ends being connected with each of the cylinders of said aft telemotor, respectively, and valves carried by these two pipes and controlling the flow of fluid therethrough.

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