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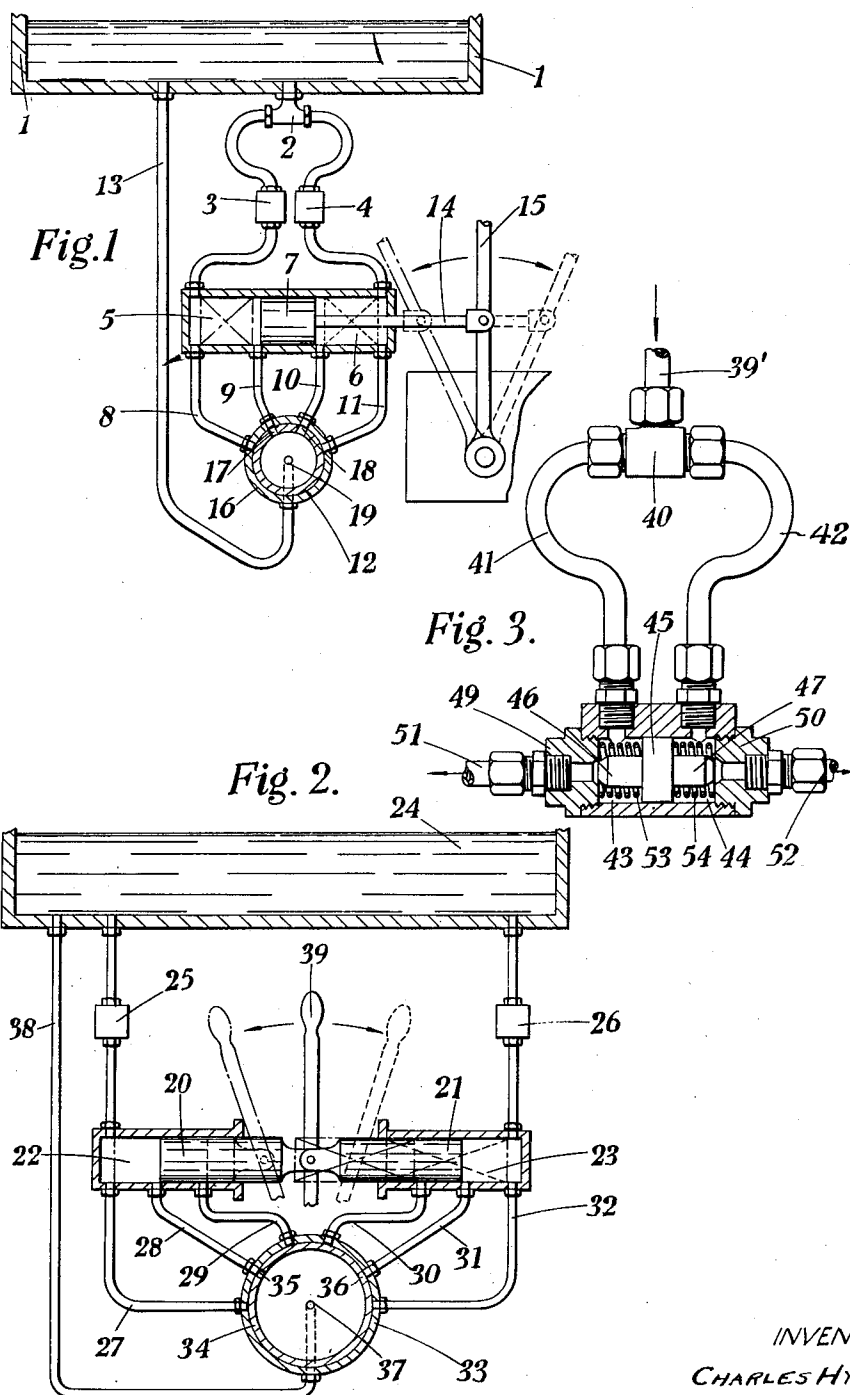
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1,952,806

FLUID CONTROL APPARATUS

Filed March 2, 1932

4 Sheets-Sheet 1



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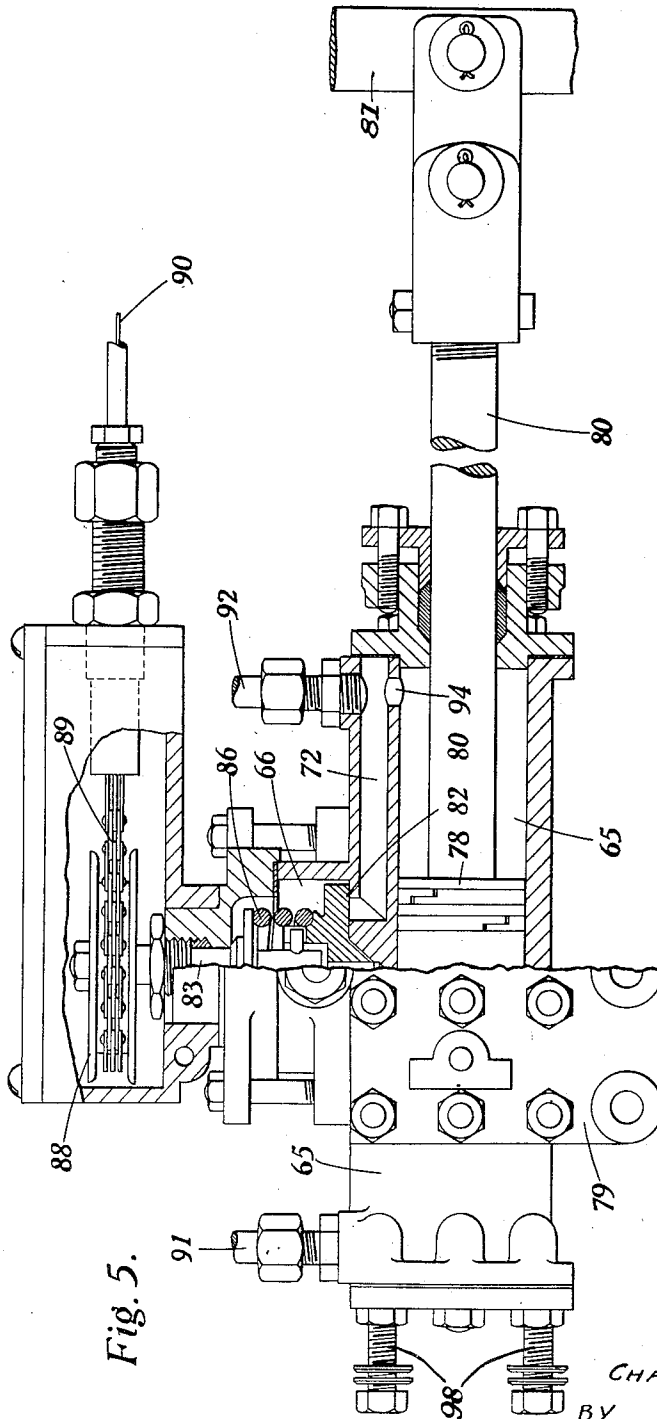
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FLUID CONTROL APPARATUS

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4 Sheets-Sheet 3



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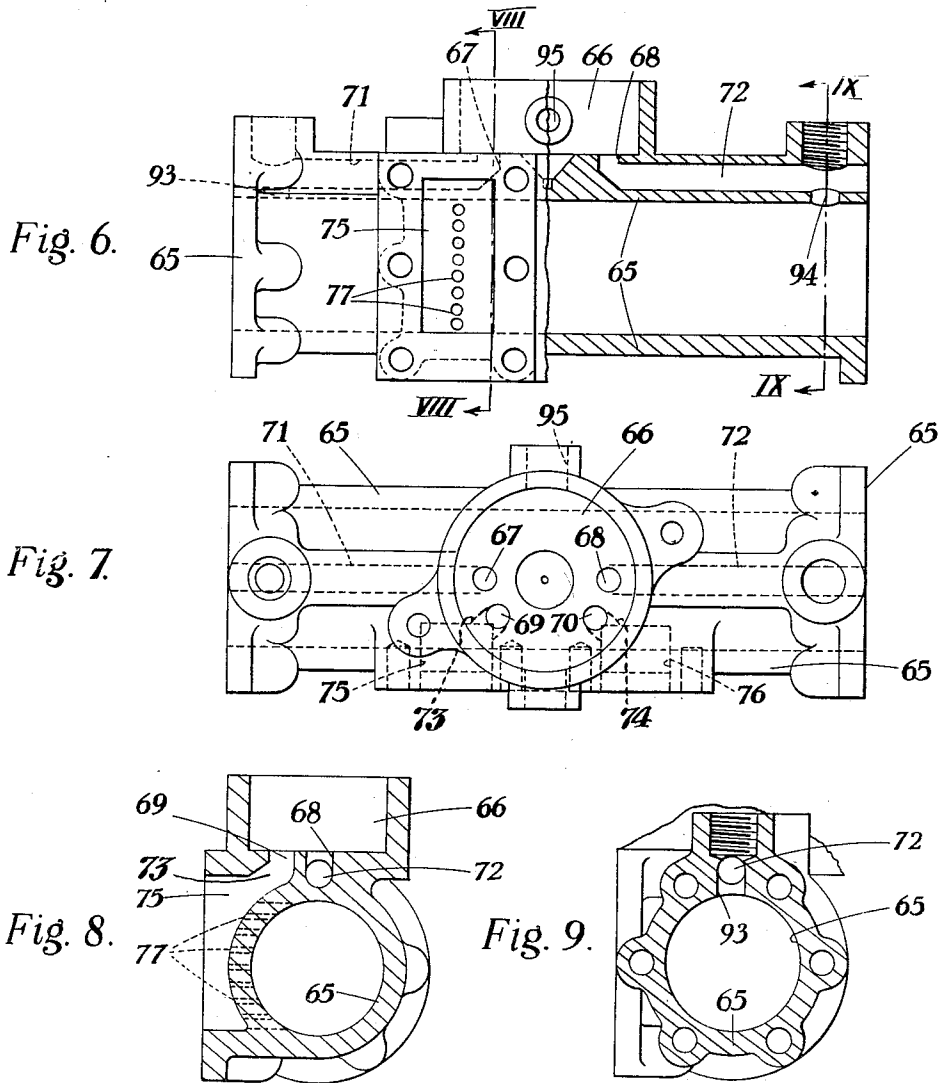
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FLUID CONTROL APPARATUS

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4 Sheets-Sheet 4



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FLUID CONTROL APPARATUS

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4 Claims. (Cl. 121—38)

This invention relates to improvements in fluid operated ram mechanism for controlling machines and other mechanism such for example as the transmission gearing of a motor boat.

It has already been proposed to provide fluid operated control apparatus in which fluid is fed under pressure into opposed ram chambers and such fluid is permitted to escape through outlet ports, said outlet ports being selectively obstructed so that the ram may be urged into one of a plurality of positions within the chambers, i. e. into a position in which there is an unobstructed outlet for the fluid from each of the ram chambers.

One of the objects of the present invention is to provide improved apparatus of the kind referred to and in which the valve mechanism employed is of a very simple nature.

A further object is to provide control mechanism of the kind referred to in which valve mechanism for selectively controlling the outlet ports from the ram chambers may be located on or in part formed integrally with the unit forming said chambers and in which actuation of said valve mechanism is controlled from a distance.

Yet another object of the invention is to provide improved means for effecting the distant control of the reverse gear of a motor boat.

With the above and other objects in view the present invention resides in the construction and arrangement of parts hereinafter described and claimed in the appended claims.

In carrying out the present invention I provide two opposed ram chambers, which may be formed by a cylinder housing a double acting ram or by two opposed cylinders each housing a single acting ram, and along the wall of said chamber I provide outlet ports communicating by means of conduits with ports arranged either around the wall of a cylindrical valve chamber or in the base thereof. In the former case a sleeve valve having ports in its wall is located in the chamber and in the latter case a disc valve having ports passing through it is employed. The ports in said valve and chamber cooperate together in such manner that by turning the valve any pair of ports in the chamber may be uncovered while maintaining the remaining ports in an obstructed condition. Fluid is fed under pressure to each of the aforesaid ram chambers and such fluid will of course urge the ram into a position in which an unobstructed fluid outlet is located between the operative face of the ram and the inlet for the fluid. It will therefore be apparent that there is continuous flow of fluid into each of the

ram chambers and moreover, that there is continuous flow of fluid from said chambers excepting at such times as the ram or rams is or are actually being moved.

The aforesaid actuating fluid may be a liquid or gas although oil will generally be found to be the best medium to employ and this may be fed for example by means of pumps communicating with a reservoir to which the fluid may be returned after it has passed through the control apparatus.

Any desired relief mechanism may of course be provided in order to relieve any undue rise of pressure in the control system and if desired the control valve may itself be of a kind capable of being urged onto its seating by means of a spring.

The control valve itself may be controlled from a distant point by means of links, light cables or the like. Thus for instance in application to the control of the reverse gearing of a motor boat a telegraph located on the bridge of the boat may be connected to the valve by means of cables, chains or the like. Moreover, more than one control may be provided if desired; thus for instance a second control may be located in the engine room of a boat.

The means for delivering fluid under pressure to the aforesaid ram chambers may be driven by the controlled apparatus or independent motors may be provided for this purpose and in the event of employing a single pump any suitable automatically or positively operated valve mechanism may be employed in order to effect communication with each ram chamber.

In order that my invention may be well understood, I will now describe by way of example some embodiments thereof in application to the reverse gear of a motor boat and will make reference to the accompanying drawings in which:

Figure 1 is a diagrammatic view in part sectional elevation of one form of control mechanism showing the principle of operation.

Figure 2 is a diagrammatic view in part sectional elevation of a modified form of control mechanism, and showing the principle of operation.

Figure 3 shows one form of automatically operated valve mechanism which may be used in combination with a single pump for supplying the fluid under pressure.

Figure 4 shows one form of mechanically operated valve mechanism which may be used in combination with a single pump for selectively delivering fluid to the ram chambers.

Figure 5 is a part sectional front elevation of one form of ram unit,

Figure 6 is a part sectional front elevation of the ram cylinder of the unit shown in Figure 5 with the front cover removed,

Figure 7 is a plan view of said ram cylinder with the cover of the valve chamber removed,

Figure 8 is an end sectional elevation on the line 8—8 of Figure 6,

Figure 9 is an end sectional elevation on the line 9—9 of Figure 6,

Figure 10 is a side sectional elevation of the control valve,

Figure 11 is a plan view of the control valve, and

Figure 12 shows the application of my invention to a motor boat.

Referring to Figure 1 of the drawings the fluid which in this case will be assumed to be oil, is housed in a reservoir 1 whence it is fed through the outlet 2, by means of two pumps 3 and 4, into the chambers 5 and 6 on each side of the double acting ram 7 thence through the appropriate pipes 8, 9, 10 and 11 communicating with said chambers, through the distributor valve 12 and back to the reservoir through the return pipe 13. The ram 7 is fitted with a rod 14 connected for instance with a lever 15 representing the reverse gear lever and this lever may be so formed as to be operable by hand in the event of a break down of the fluid operated control mechanism or under other conditions which may render direct or alternative control desirable. Thus additional means may for instance be provided so as to enable the valve 12 to be operated from two or more different points.

When the ram 7 is in its mid position or in either of its limit positions, all of the cylinder ports communicating with the pipes, 8, 9, 10 and 11 are uncovered.

The distributor valve mechanism employed in this example consists of a cylinder 16 housing a rotary sleeve 12. The pipes 8, 9, 10 and 11 are connected to the cylinder 16 and in register with ports therein and the sleeve 12 is provided with two ports 17 and 18 and an outlet port 19 communicating with the return pipe 13. Said distributor sleeve 12 may be rotated by means of a handle, light cable, link mechanism or the like and this may be controlled from any desired distant point, such for instance as from the bridge of a ship. It is to be observed in this connection that since the valve may be very easily operated the connection between the valve and its controller may consist of a thin steel wire, light cable or the like.

With the parts in the position shown in Figure 1 the two pumps 3 and 4 will be continuously driven during operation of the motor and oil will be fed through each cylinder and through the pipes 9 and 10, valve 12 and then back to the reservoir through the pipe 13. This condition corresponds to the neutral position of the lever 15. If it should be desired to move the lever 15 to the right, the valve 12 is turned in a clockwise direction so that the ports 17 and 18 are brought opposite the outlets from the pipes 10 and 11. This movement of the valve 12 closes the outlets 8 and 9 and there is therefore a rapid rise of pressure in the chamber 5 and consequently the ram 7 moves to the right. When said ram reaches its limit position the outlet through the pipe 10 is open to the chamber on the left side of the ram and there is consequently a free flow of

oil along the following circuit pump 3, chamber 5, pipe 10, valve 12 and return pipe 13.

The last mentioned position of the lever 15 may constitute the "ahead" position and in order to move it to the "reverse" position the valve 12 would be turned in an anti-clockwise direction to its limit position. This moves the ports 17 and 18 over the outlets from the pipes 8 and 9 and closes the outlets from the pipes 10 and 11. There is consequently a rise of pressure in the chamber 6 and the ram 7 will move until the right hand end has moved past the outlet to the pipe 9 whereupon oil will again freely flow through the chamber 6. Similarly the lever 15 may be brought back to neutral position by moving the valve 12 to the position shown in Figure 1 which will cause a difference of pressure to be established on the two sides of the ram unless it is centrally located between the ports to the pipes 9 and 10.

In Figure 2 is shown a modification employing two single acting rams 20 and 21 housed in cylinders or chambers 22 and 23. These chambers are fed with oil from the reservoir 24 by means of the pumps 25 and 26 and each cylinder has three outlet ports communicating respectively with the pipes 27, 28, 29 and 30, 31, 32. These pipes communicate with ports in a valve chamber 33 housing a rotary valve 34 having two ports 35 and 36. The valve 34 has a central discharge port 37 communicating with a pipe 38 returning the oil to the reservoir. If desired the heads of the rams 20 and 21 may be united together and be directly connected to the gear control lever 39.

With the valve 34 in the mid position as shown in Fig. 2 only the outlets through the pipes 28 and 31 are uncovered and the rams will therefore be urged into and maintained in their mid positions so constituting the neutral position of the gear lever. Said lever may however be urged into either of its limit positions by turning the valve 34 in the required direction. Thus by turning it to its limit position in a clockwise direction the rams will move to their limit right hand positions before pressure in the chamber 22 is released by uncovering the port communicating with the pipe 29 and upon turning the valve in an anti-clockwise direction the rams will move to their limit left hand positions before pressure in the chamber 23 is released pursuant to opening the port communicating with the pipe 30.

In Figures 1 and 2 the distributor valve has been diagrammatically shown as a member separate from the ram cylinders and connected therewith by a series of pipes. In modifications however the distributor valve cage or box may be cast or be otherwise formed integrally with or be secured directly to the ram cylinders and in such cases the required ports and ducts may be cored in said box. Thus for instance the cylinders and valve chamber may comprise an integral casting of bronze or other suitable material.

Figure 3 shows a suitable form of valve mechanism which in combination with a single pump may be adapted to constitute the two sources of fluid under pressure employed in the above examples. In this figure the pipe 39' represents the delivery pipe from a single pump and this is connected by a T-union 40 to two pipes 41 and 42. These pipes are connected for instance by means of unions to the ends 43 and 44 of a chamber 45 housing a movable valve member or said pipes may be cast or otherwise formed integrally with said chambers. The aforesaid movable valve member includes a central part 45 forming a piston in the chamber 43, 44 and two reduced parts 150

46, 47 having valve faces formed at their ends to co-operate with valve seatings formed on the inside faces of the caps 49 and 50 and around ports communicating with pipes 51, 52 which serve as the pipes for feeding the oil to the ram or rams hereinbefore described. Compression springs 53, 54 are passed over the parts 46, 47 and tend normally to keep the valve member in mid position in which the valve faces at the ends of the parts 46, 47 are lifted from their seatings and consequently there is free flow of oil in each circuit, i. e. the control ram or rams is or are stationary. Suppose now that the valve of the ram control mechanism is moved so that free flow of oil through the pipe 51 is obstructed, i. e. the relevant outlets from the ram cylinder are closed, this will cause an increase of pressure of the fluid in the chamber 43 and the member 45 will move to the right. The end of the part 47 will therefore rest on its seating so that the area exposed to the fluid pressure on this side of the piston 45 is materially reduced and the valve will therefore be kept tightly shut. All of the pump pressure is now available for moving the ram of the control mechanism and immediately this reaches the end of its movement and uncovers a port as hereinbefore described the pressure in the chamber 43 will immediately drop and the spring 54, which of course will have been compressed by movement of the piston 45, will urge the valve member back to its mid position so opening the outlet past the member 47 and oil will again freely flow through each chamber. It will thus be apparent that this valve mechanism is so designed that the desired ram in the control mechanism may be subjected to the full pressure of the pump when it is desired to cause movement of the ram but when this is in one of its determined positions then said valve mechanism provides two fluid supplies one for each circuit through the control mechanism and as aforesaid this continuous and balanced flow is desirable from the point of view of preventing inadvertent movement of the control.

Instead of employing a piston like element 45 in the valve mechanism for use in combination with a single pump I may employ a diaphragm or the like and movement of this diaphragm would control the outlets 51, 52.

In Figure 4 is shown a mechanically operated valve for use with a single pump. In this case the pump delivers oil to the pipe 55 whence it is fed through the chambers 56, 57 to the pipes 58, 59 communicating with the two ram chambers of the control device. A piston 60 is located in the valve unit so that it may be caused to move and thereby obstruct fluid flow into and from either of the chambers 56 and 57, and provision is made whereby this piston can come to rest only in a position in which the ports associated with one or other of these chambers are obstructed. Thus in the case illustrated a spring loaded detent 61 co-operates with two inclined depressions 62, 63 so that said piston will always be urged from the position shown in the drawings to one of its limit positions. The rod 64 of the piston 60 passes through a stuffing box and is connected to the control valve hereinbefore described in connection with the ram cylinders.

In this way when say the valve 12 shown in Figure 1 is moved to open the left hand pair of ports the outlet 58 (Figure 4) would be obstructed and the full delivery of the pump would be directed into the chamber 6 (Figure 1) and cause the ram 7 to move until the port 9 is uncovered,

thereupon fluid would freely flow through the chamber 6. By opening the right hand ports in the chamber 6 the outlet 59 would be closed and the piston 7 would be caused to move to the right in Figure 1 until the port to the pipe 10 is uncovered.

Now referring to Figures 5 to 9 of the drawings which show in greater detail a practical form of ram unit including a double acting ram. The cylinder 65 has a valve chest 66 formed integrally therewith and from ports 67, 68 69 and 70 in said chest are cored conduits 71 and 72 communicating with ports leading to the ends of the cylinder and conduits 73 and 74 leading to front chambers 75, 76 which have communication with the cylinder barrel by reason of two series of ports cut in the barrel at the back of said chambers. One of these series of ports is shown at 77 in Figure 6 and the two series are so spaced that they are both uncovered when the piston 78 is in its mid position. Said chambers 75 and 76 are provided with detachable cover plates one of which is shown at 79 in Figure 5.

The rod 80 of the piston 78 passes through a stuffing box at the end of the ram chamber and is connected by a forked union or in other suitable manner to the gear lever 81.

A flat plate valve 82 is housed within the valve chamber 66 and is secured to a spindle 83 for instance by means of a pin carried on the spindle and engaging slots 84, 85 in the valve body. Said valve is pressed onto its seating by means of a compression spring 86 and the spindle 83 makes fluid tight junction with the cover member 87 of the valve chamber. The base of the valve 82 is preferably conical as shown and co-operates with a conical seating so that it may be properly guided during its rotation.

The spindle 83 may be rotated in any convenient manner, in the example illustrated a sprocket wheel 88 is secured to said spindle and cooperates with a chain 89 to each end of which is connected a wire 90 leading to any desired distant control point.

Oil is admitted to the ram chambers through the two pipes 91, 92 into the cored conduits 71 and 72 and through the ports 93 and 94 into the ends of the ram cylinder 65. The return flow of the oil through the ports 67, 68, 69 and 70 will of course be determined by the position of the valve 82 and the oil will eventually leave the valve chamber 66 through the port 95.

The aforesaid valve 82 is provided with a series of holes 96 and along the underpart of said valve there is cut an arcuate recess 97 the length of this recess being equal to the distance apart of the ports 69 and 70.

A ram unit as above described may be mounted in any convenient way, thus studs 98 or the like may project from the cover at the rear end of the ram cylinder or from any other convenient part of the unit.

A ram unit according to my invention may be made from any suitable material or materials, thus for instance the ram chamber, end covers and glands may be of gunmetal, the piston or ram may be of phosphor bronze and the valve may be of cast iron. It is of course very important for the ram to fit its cylinder very closely and in order to achieve the desired fit the cylinder may be reamed and lapped and the piston should be ground.

The operation of the device as shown in Figures 4 to 9 is as follows:—Oil is fed under pressure

through the pipes 91 and 92 continuously during operation of the device so that pressure is always maintained in the chambers on each side of the ram. If the valve 82 is so positioned that its ports are located over the ports 69 and 70 the ram will be urged into a position in which the ports 77 in the cylinder are uncovered, i. e. the ram will be urged into and maintained in a central position, so that oil may flow from the pipe 91 through port 93, the chamber on the left of the ram in Figure 5, ports 77, chamber 75, conduit 73, port 69 in the valve chamber and through the exhaust port 95. Similarly oil may flow from the pipe 92, port 94, right hand ram chamber, cylinder ports corresponding to ports 77, chamber 76, conduit 74, port 70 in the valve chamber and through the valve to the exhaust port 95. The ram will thus be urged into and maintained in a central position and the gear lever 81 coupled to the ram 78 will be kept in its neutral position.

When it is desired to move the gear lever to the left in Figure 5, that is, say for ahead running, the valve 82 is turned in a clockwise direction as seen in plan view so as to bring the ports in the valve opposite ports 67 and 69 in the valve chamber. Oil meanwhile will flow continuously into the chambers and the ram will be caused to move to the left in Figure 5 until the ports 77 are uncovered by the right hand face of the ram 78; thereupon oil can freely flow from pipe 92, inlet 94, right hand ram chamber, ports 77, chamber 75, conduit 73, port 69, through the valve 82 to exhaust port 95 and oil can flow continuously from pipe 91 through conduit 71, port 67 and through the valve to the exhaust port 95. Similarly the ram and with it the lever 81 can be moved to the right in Figure 5 by turning the valve 82 to its limit position in an anti-clockwise direction so providing a free outlet for the oil from pipe 92, through conduit 72 and port 68 but only allowing outlet for oil from supply pipe 91 when the ram uncovers cylinder ports permitting flow to the chamber 76, conduit 74 and port 70.

In Figure 12 is shown one example of the application of my invention to the reverse gear of a motor boat. In this figure the telegraph 99 is located on the bridge of the boat and is connected by means of light cables, wires or the like 100 to the control valve spindle within the casing 101 fitted to the head of the ram unit 102. The aforesaid cables or the like 100 may of course be passed over any desired guide pulleys or the like 103 and strainers or adjusters 104 may also be fitted between such wires in order to adjust the control mechanism. Instead of employing bare cables or wires 100, enclosed cables may be employed and in the drawings the cables 105 passing between the bracket 106 and the head 101 of the control device consist of solid drawn high tensile steel wire housed within a brass tube. The ram rod 107 of the unit 102 is connected with the gear lever 108 of the transmission gear box 109 and oil or other suitable fluid is fed to the ram chambers by means of pumping unit 110 having two delivery pipes 111 and 112 leading to the ends of the ram chamber. If desired the oil for the control device may be drawn from the sump of the engine and in this way the lubricating oil of the engine may be cooled.

If desired and in cases wherein a boat has more than one engine then separate means according to my invention may be applied to each engine and if desired the control valve of a device according to this invention may be adapted

to be operated from more than one point. Thus a telegraph or other suitable control may for instance be located on the bridge and a second control may be situated near the engine so that the gear may be operated either from the bridge or from the engine room.

In the foregoing examples reference has been made to rotary valve mechanism in the control apparatus; it is of course apparent however that a slide valve, piston valve or other suitable form of valve gear may be employed.

The pumps hereinbefore referred to may be of any suitable kind, thus for instance they may be of the gear type or they may consist of simple plungers caused to oscillate by cam mechanism driven by the motor to which the control apparatus is applied.

In operation of control means according to my invention, it will be appreciated that material work is only done at such times as the control lever is actually being moved from one position to another. Thus movement of the control piston or pistons is brought about by closing one or more cylinder ports on one side of the piston or in one cylinder so that the piston is subjected to rapidly increasing pressure, when the piston reaches its determined position however a port is opened by said piston so that the fluid pressure is immediately released and the parts will come to rest although the oil will continue to flow but in an unobstructed circuit. This fluid flow will however keep the control piston or pistons in equilibrium and will effectively overcome any tendency for the piston or pistons to wander from a determined position.

I claim:—

1. In combination, an element whose position is to be controlled, a ram chamber, a double-acting ram therein, a connection between the ram and the element, a fluid inlet to each end of the ram chamber, said inlets being connected to a source of continuous fluid pressure, an exhaust chamber having a return connection to said source of fluid pressure, a fluid by-pass conduit extending between each of said inlets and the exhaust chamber, a fluid outlet for each end of the ram chamber, said fluid outlets being spaced with relation to each other and along the length of the ram chamber as to be uncovered when the ram is in its mid and extreme positions, exhaust conduits extending between the fluid outlets and the exhaust chamber, and a valve in the exhaust chamber movable into neutral, forward and reverse positions, said valve in neutral position being operative to interrupt communication between the by-pass conduits and the exhaust chamber and to establish communication between the exhaust conduits and the exhaust chamber, the valve in its forward and reverse positions, respectively, being operative to interrupt communication between the exhaust chamber and the by-pass and the exhaust conduits of one end of the ram chamber while establishing communication between the exhaust chamber and the by-pass and the exhaust conduits of the other end of the ram chamber so that the ram is actuated into said other end of the ram chamber to its extreme position and uncovers the fluid outlet of said other end of the ram chamber, whereupon fluid behind the ram is exhausted through said last-named fluid outlet to the exhaust chamber and at the same time fluid from the inlet to said other end of the ram chamber is by-passed to said exhaust chamber.

2. In combination, an element whose position

is to be controlled, a ram chamber, a double-acting ram therein, a connection between the ram and the element, a fluid inlet to each end of the ram chamber, said inlets being connected to a source of continuous fluid pressure, an exhaust chamber disposed intermediate the ends of the ram chamber and having a return connection to said source of fluid pressure, a fluid by-pass conduit extending through the ram chamber wall and between each of said inlets and the exhaust chamber, a fluid outlet for each end of the ram chamber, said fluid outlets being spaced with relation to each other and along the length of the ram chamber as to be uncovered when the ram is in its mid and extreme positions, exhaust conduits extending between the fluid outlets and the exhaust chamber, and a valve in the exhaust chamber movable into neutral, forward and reverse positions, said valve in neutral position being operative to interrupt communication between the by-pass conduits and the exhaust chamber and to establish communication between the exhaust conduits and the exhaust chamber, the valve in its forward and reverse positions, respectively, being operative to interrupt communication between the exhaust chamber and the by-pass and the exhaust conduits of one end of the ram chamber while establishing communication between the exhaust chamber and the by-pass and the exhaust conduits of the other end of the ram chamber so that the ram is actuated into said other end of the ram chamber to its extreme position and uncovers the fluid outlet of said other end of the ram chamber, whereupon fluid behind the ram is exhausted through said last-named fluid outlet to the exhaust chamber and at the same time fluid from the inlet to said other end of the ram chamber is by-passed to said exhaust chamber.

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4. In combination, an element whose position is to be controlled, a ram chamber, a double-acting ram therein, a connection between the ram, and the element, a fluid inlet to each end of the ram chamber, said inlets being connected to a source of continuous fluid pressure, an exhaust chamber disposed intermediate the ends of the ram chamber and having a return connection to said source of fluid pressure, a fluid by-pass conduit extending through the ram chamber wall and between each of said inlets and the exhaust chamber, a fluid outlet for each end of the ram chamber, said fluid outlets being spaced with relation to each other and along the length of the ram chamber as to be uncovered when the ram is in its mid and extreme positions, exhaust conduits extending between the fluid outlets and the exhaust chamber, a rotatable valve located in said exhaust chamber adapted to turn about an axis at right angles to the axial movement of the ram, and means for turning the valve to neutral, forward and reverse positions, said valve in neutral position being operative to interrupt communication between the by-pass conduits and the exhaust chamber and to establish communication between the exhaust conduits and the exhaust chamber, the valve in its forward and reverse positions, respectively, being operative to interrupt communication between the exhaust chamber and the by-pass and the exhaust conduits of one end of the ram chamber while establishing communication between the exhaust chamber and the by-pass and the exhaust conduits of the other end of the ram chamber so that the ram is actuated into said other end of the ram chamber to its extreme position and uncovers the fluid outlet of said other end of the ram chamber, whereupon fluid behind the ram is exhausted through said last-named fluid outlet to the exhaust chamber and at the same time fluid from the inlet to said other end of the ram chamber is by-passed to said exhaust chamber.

3. In combination, an element whose position is to be controlled, a ram chamber, a double-acting ram therein, a connection between the ram and the element, a fluid inlet to each end of the ram chamber, said inlets being connected to a source of continuous fluid pressure, an exhaust chamber having a return connection to said source of fluid pressure, a fluid by-pass conduit extending through the wall of the ram chamber and between each of said inlets and the exhaust chamber, a fluid outlet for each end of the ram chamber, said fluid outlets being spaced with relation to each other and along the length of the ram chamber as to be uncovered when the ram is in its mid and extreme positions, exhaust conduits extending between the fluid outlets and the exhaust chamber, a rotatable valve located in said exhaust chamber adapted to turn about an axis at right angles to the axial movement of the ram, and means for turning said valve to neutral, forward and reverse positions, said valve in neutral position being operative to interrupt communication between the by-pass conduits and

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