March 4, 1947. G. A. WALDIE 2,416,860

REMOTE CONTROL FOR HYDRAULIC SYSTEMS

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FIG. 1.

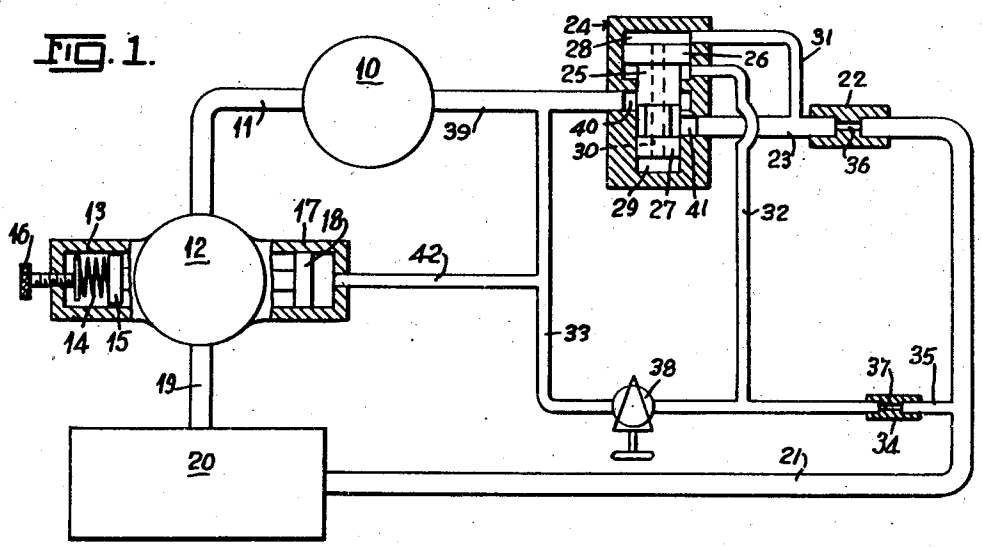
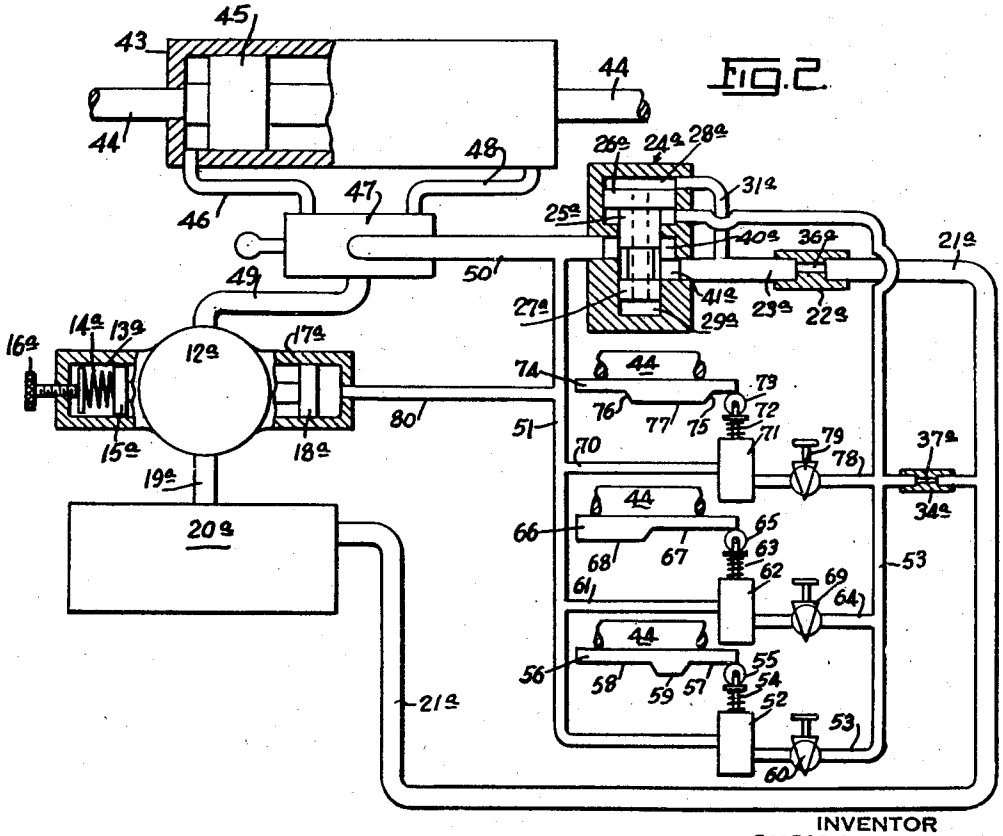


FIG. 2.



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FIG. 3.

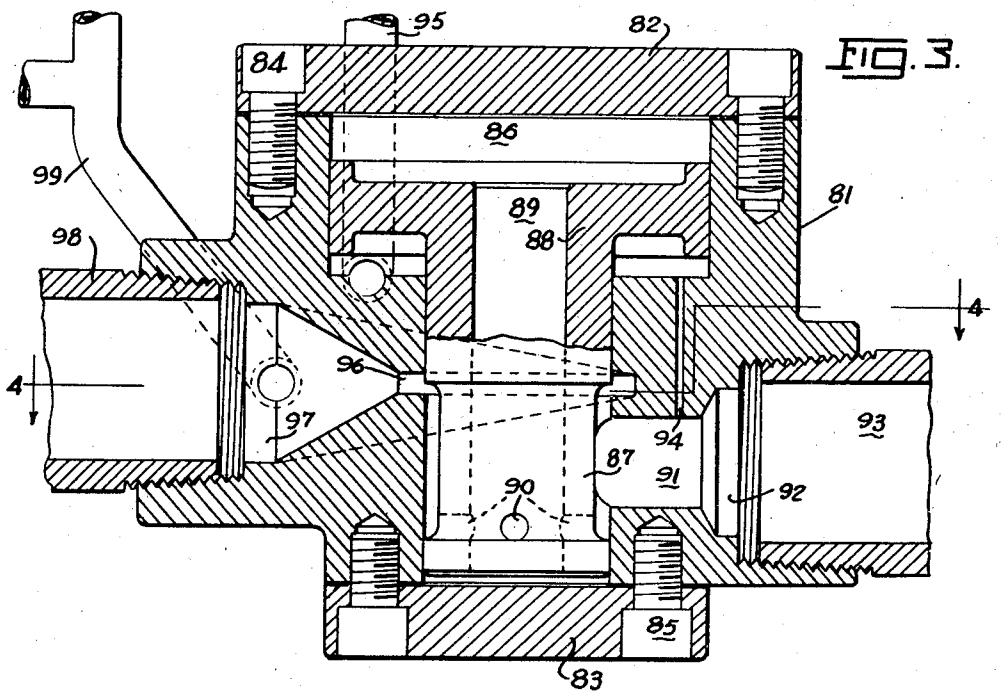
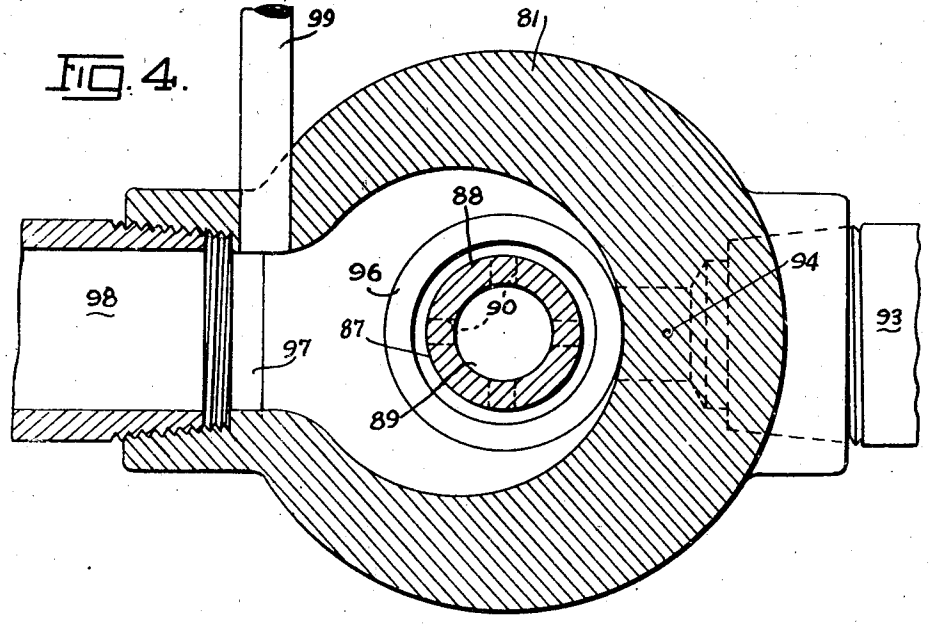


FIG. 4.



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REMOTE CONTROL FOR HYDRAULIC SYSTEMS

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Application May 8, 1943, Serial No. 486,115

11 Claims. (Cl. 60—52)

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This invention relates to remote controls and, in particular, to remote controls for use in hydraulic systems.

It is an object of this invention to provide a simplified remote control for hydraulically operable means, in which the operation of a control member or mechanism is hydraulically transferred to the hydraulic means to be controlled, to bring about an operation thereof.

It is a further object to provide a hydraulic system which includes hydraulic means to be controlled and manually operable means arranged remote from and hydraulically connected to said hydraulic means, and in which the operation of said manually operable control means brings about a variation in the flow of fluid through said means to be controlled.

It is also an object of this invention to provide a hydraulic system including fluid operable motor means, in which the motor means is operable automatically to vary its speed during its movement in one and the same direction, and in which the respective individual speeds during this movement are adapted to be controlled by means remote from and hydraulically connected to said motor means.

It is a further object to provide a throttle valve, particularly for use in connection with hydraulic remote control systems, in which the valve comprises a plurality of stationary choke valves, and in which a variable choke valve cooperates with said stationary choke valves.

These and other objects and advantages of the invention will appear more clearly from the following specification in connection with the accompanying drawings, in which:

Figure 1 diagrammatically illustrates a first embodiment.

Figure 2 illustrates the remote control of the present invention in connection with motor means adapted to be controlled so as to run at different speeds during one and the same stroke.

Figure 3 is a section through a valve which is particularly advantageous when used in connection with the control systems of Figures 1 and 2.

Figure 4 is a section along the line 4—4 of Figure 3.

General Arrangement

The control system according to the present invention substantially comprises a plurality of stationary fluid flow restrictions and a fluid operable throttle hydraulically connected with a manually operable choke. The arrangement is such that once the manually operable choke has been adjusted, a predetermined flow of fluid will occur through the fluid operable throttle. By varying the adjustment of the manually operable choke, the pressure conditions at the fluid operable throttle are changed in such a manner that the

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said throttle occupies a different position in which a change in the flow of fluid through said throttle will occur. By connecting this hydraulic control system with fluid operable motor means, the speed of the motor means can easily be controlled.

Structural Arrangement

First embodiment

Referring now to the drawings in detail, and Figure 1 thereof in particular, the structure shown therein comprises a fluid operable motor 10 which may be of any standard type adapted to be operated by pressure fluid. The inlet side of the motor 10 is connected through a pressure line 11 with the delivery side of a fluid pressure source of variable delivery which may be of any desired type and, in this instance, is a variable delivery pump 12. The pump has associated therewith a spring chamber 13 housing a spring 14 which, by means of a plunger 15, continuously urges the pump 12 into full delivery position. The thrust of the spring 14 is adjustable by means of an adjusting screw 16. Also connected to the pump 12 is a control cylinder 17 having reciprocably mounted therein a fluid operable plunger 18 adapted, in response to fluid pressure acting thereupon, to reduce the delivery of the pump 12 against the thrust of the spring 14. The suction side of the pump 12 communicates through a suction line 19 with a fluid reservoir or tank 20. Also connected with the tank 20 is an exhaust line 21 leading to a fluid flow restriction 22 which, in its turn, is connected to a conduit 23. The conduit 23 communicates with a fluid operable throttle valve generally designated 24. The valve 24 has reciprocably mounted therein a valve member 25 having connected thereto a piston portion 26 and a piston portion 27. The piston portion 26 is reciprocable in a bore 28, whereas the piston portion 27 is reciprocable in a bore 29. The bore 28 is in continuous fluid connection with the bore 29 through a passageway 30 extending from one end of the valve member 25 through the other end thereof. The dimensions of the piston portions 26 and 27 of the valve member 25 are preferably such that the effective area on one side of the piston portion 26 equals the effective area on the other side of the piston portion 26. It is, however, understood that the two opposed effective areas need not necessarily equal or substantially equal each other, but that the invention will also work properly if the said opposed areas differ materially from each other.

The upper portion of the bore 28 communicates through a pilot line 31 with the conduit 23, while the lower portion of the bore 28 communicates through a conduit 32 with the conduit 33. The conduit 33 has one end in fluid communication with a fluid flow restriction 34, the other end of

which communicates through conduit 35 with the conduit 21. The fluid flow restrictions 22 and 34 are preferably so dimensioned that the section of the bore 36, pertaining to the fluid flow restriction 22, is greater than the section of the bore 37 pertaining to the fluid flow restriction 34. The conduit 33 contains a manually adjustable choke 38 and communicates with the outlet conduit 39. One end of the conduit 39 leads to an annular recess 40 in the valve 24. The fluid connection between the recess 40 and the outlet port in the throttle 24 is controlled by the valve means 25. Branching off from the conduit 33 is a conduit 42 leading to the control cylinder 17.

Operation

It may be assumed that the pump 12 has been started while all parts occupy the position shown in Figure 1. Pressure fluid will then be delivered by the pump 12 through the pressure line 11 to the motor 10 and actuate the same. The exhaust fluid expelled from the motor 10 passes through conduit 39 through the partially opened choke 38 and from here in part through the fluid flow restriction 34 into the exhaust line 21, and in part through conduit 32 beneath the lower area of the piston portion 26. Another portion of the fluid expelled by the motor 10 into the outlet conduit 39 passes through the recess 40 and the port 41, into the conduit 23. From here a portion of the fluid passes through conduit 31 into the upper portion of the bore 28 where it acts upon the upper area of the piston portion 26, while the other part of the fluid passes through the fluid flow restriction 22 into the exhaust line 21. It may be assumed that the choke 38 is so adjusted that the pressure difference acting upon the effective upper area of the piston portion 26 and the effective lower area of the piston portion 26 causes the valve member 25 to occupy the position shown in Figure 1. It will now be clear that in view of the respective positions of the choke 38 and the valve member 25, a predetermined back pressure will prevail in the outlet conduit 39. This back pressure will react through conduit 33 and the conduit 42 upon the plunger 18 so as to place the same in a position in which the fluid pressure acting upon the plunger 18 and the thrust of the spring 13 are balanced. The pump 12 will therefore occupy a predetermined delivery position, and the motor 10 will be operated at a predetermined speed.

If it is now desired to vary the speed of the motor 10, for instance, to increase the speed of the motor 10, it is merely necessary to decrease the pressure in the conduit 39. To this end the operator actuates the choke 38 so as to reduce the restriction thereof. Consequently, the pressure between the choke 38 and the fluid flow restriction 34 will increase, which increased pressure will act upon the lower effective area of the piston portion 26, thereby moving the valve member 25 somewhat upwardly. As a result thereof, the restriction between the annular recess 40 and the outlet port 41 is reduced so that more fluid passes therethrough. Consequently, the pressure in the conduit 23 will increase and this increased pressure will be conveyed through the pilot line 31 to the upper effective area of the piston portion 26. The pressure upon the upper and lower effective areas of the piston portion 26 will move the valve member 25 into a balanced position, the net result of which will be a decreased pressure in the conduit 39. This decreased pressure will be conveyed through conduits 33 and 42 to the control cylinder 17 so that the spring 14 will increase the delivery of the pump 12. Therefore, an increased quantity of fluid will now be delivered by the pump 12 to the motor 10 which, therefore, will increase its speed.

If it is desired to decrease the speed of the motor 10, it is merely necessary to actuate the choke 38 so as to increase the flow restriction therethrough. It will be clear that in view of such operation, the pressure drop across the choke 38 will increase, or, in other words, the back pressure in conduit 39 will increase whereas the pressure in the conduit 32 will decrease. Consequently, the pressure acting upon the upper effective area of the piston portion 26 will increase relative to the pressure acting upon the lower effective area of the piston portion 26. As a result thereof, the valve member 25 will be moved downwardly, therefore restricting the fluid communication between the recess 40 and the outlet port 41, and a new balancing position will be established for the valve member 25. In view of the increased back pressure in conduit 39, which pressure acts through conduits 33 and 42 upon the plunger 18, the pump 12 is moved into a reduced delivery position against the thrust of the spring 14. A reduced quantity of fluid will now be delivered to the motor 10 so that the speed thereof will be reduced.

Second embodiment

Referring now to Figure 2, the structure disclosed therein comprises a motor cylinder 43 having reciprocably mounted therein a plunger 44 with a piston portion 45. The left end of the motor cylinder 43 is connected through a conduit 46 with a four-way valve 47 of any standard design. The valve 47 communicates through a conduit 48 with the right hand end portion of the cylinder 43. Also connected to the cylinder 47 is a pressure line 49 communicating with the delivery side of the pump 12*a*. The pump 12*a* and the control means connected thereto fully correspond to the pump 12 and the control means thereof so that the respective parts in Figure 2 have been numbered accordingly but with the additional reference character *a*. The pump 12*a* communicates through a suction line 19*a* with a tank or fluid reservoir 20*a*. Connected to the tank 20*a* is a conduit 21*a* leading to a stationary fluid flow restriction 22*a* with a bore 36*a*. The restriction 22*a* communicates through a conduit 23*a* with a throttle 24*a* fully corresponding to the throttle 24 and, therefore, having the same reference numerals, however, with the additional character *a* applied to the parts thereof. The throttle 24*a* is connected through a conduit 50 with the four-way valve 47. The four-way valve 47 is adapted in one position to establish fluid connection between the conduit 46 and the pressure line 49 while simultaneously connecting the conduit 48 with the conduit 50. When the valve 47 is in another position it will interconnect the conduit 48 and pressure line 49 while simultaneously connecting the conduit 46 with the conduit 50.

Branching off from the conduit 50 is a conduit 51 leading to a two-way valve 52 which, when in open position, establishes fluid communication between the conduit 51 and the conduit 53. The two-way valve 52 is continuously urged into its open position by means of a spring 54 and is provided with a roller 55 adapted to cooperate with a cam generally designated 56. The cam 56, which is connected in any convenient manner

to the plunger 44, has cam areas 57 and 58 which, when engaging the roller 55, allow the spring 54 to move the two-way valve 52 into its open position. The cam 56 is also provided with a cam area 59 which, when engaging the roller 55, closes the valve 52 against the thrust of the spring 54.

The conduit 53 contains a manually operable choke 60 and leads to the lower portion of the bore 28a pertaining to the throttle 24a. Branching off from the conduit 51 is a conduit 61 leading to a two-way valve 62 of the same construction as the valve 52. The valve 62 is also provided with a spring 63 continuously urging the valve 62 into its open position in which fluid communication is established between the conduit 61 and the conduit 64. The valve 62 also includes a roller for cooperation with a cam generally designated 66. When the roller 65 engages the cam area 67, the spring 63 opens the valve 62. However, when the roller 65 is engaged by the cam area 68 the valve 62 is closed against the thrust of the spring 63. The cam 66 is likewise connected in any convenient manner to the plunger 44 and. if desired, may be integral with the cam 56. The conduit 64 comprises a manually operable choke 69 and leads to the conduit 53.

Also branching off from the conduit 51 is a conduit 70 leading to a two-way valve 71 of the same construction as the valves 62 and 52. The valve 71 is continuously urged into its open position by the spring 72 and is provided with a roller 73 for cooperation with a cam generally designated 74. Until the roller 73 engages the cam area 75 or the cam area 76, the valve 71 is in its open position and when engaged by cam 77 it is moved to its closed position. The cam 74 is likewise connected to the plunger 44 and, if desired, may be integral with the cams 56 and 66. When the valve 71 is in its open position, fluid communication is established between the conduit 70 and a conduit 78. The conduit 78 comprises a manually operable choke 79 and leads to the conduit 53. The conduit 53 communicates through a fluid flow restriction 34a having a bore 37a with the conduit 21a. The conduit 51 is also connected through a conduit 80 with the control cylinder 17a.

Operation

It may be assumed that the pump 12a has been started and that the valve 47 occupies a position in which fluid connection is established between the pressure line 49 and the conduit 46 while simultaneously the conduits 48 and 50 communicate with each other. It may furthermore be assumed that the chokes 60, 69 and 79 are differently set, and that the cams 56, 66 and 74 occupy the position shown in the drawing. With these assumptions, it will be clear that pressure fluid delivered by the pump 12a passes through conduit 46 into the left hand portion of the motor cylinder 43 where it will act upon the piston 45 and move the latter rightwardly, valves 52, 62 and 71 being in open position. The fluid expelled during the beginning of the rightward movement of the plunger 44 escapes through conduit 48 into the conduit 50. Since at this time the two-way valves 52, 62 and 71 are in open position, a part of the fluid in conduit 50 passes through conduit 51, the valves 52, 62 and 71, and the chokes 60, 69 and 79 into the conduit 53. From here the fluid passes through the fluid flow restriction 34a and exhaust line 21a into the tank 20a. The pressure prevailing between the outlet

of the choke 79 and the inlet of the flow restriction 34a is conveyed to the lower portion of the bore 28a. The other portion of the fluid in conduit 50 passes through the recess 40a and the port 41a into the conduit 23a. From here the fluid passes through the flow restriction 22a and the line 21a to the tank 20a.

The pressure prevailing in the conduit 23a is conveyed through the pilot line 31a into the upper portion of the bore 28a. It may be assumed that the pressure acting upon the upper and lower effective area of the piston portion 26a causes the valve member 25a to assume the position shown therein.

When the plunger 44 has moved rightwardly a predetermined distance, the cam area 77 comes into engagement with the roller 73 thereby causing the valve 71 to close. Consequently, fluid communication between the conduits 70 and 78 is interrupted and the back pressure in conduit 50 will increase. This increased pressure is conveyed through the recess 40a, conduit 23a and pilot line 31a to the upper portion of the bore 28a where it acts upon the upper valve member 25a in the manner described above so as to cause the valve member 25a to move downwardly. As a result thereof, the fluid flow from conduit 50 into conduit 23a is reduced. The increased back pressure in conduit 50 also acts through conduit 80 upon the control plunger 18a so that the latter decreases the delivery of the pump 12a. Consequently, the speed of the plunger 44 will be reduced.

When the plunger 44 has thus advanced rightwardly at a reduced speed, the cam area 59 engages the roller 55 and causes the valve 52 to close. This in turn creates an increased pressure in conduit 50, and as a result thereof, the delivery of the pump 12a and the speed of the plunger 44 will be further reduced in the manner described above.

When the plunger 44 has advanced at this second reduced speed a predetermined distance, the cam area 59 will leave the roller 55 so that the valve 52 opens again. At about the same time the cam area 68 engages the roller 65 and closes the valve 62. Assuming that the chokes 60 and 69 have the same dimensions and that the choke 60 has been set for a smaller restriction than the choke 69, it will be clear that the plunger 44 will now advance at a speed greater than the second reduced speed.

To reverse the plunger 44, the operator shifts the four-way valve 47 into position for establishing fluid communication between the line 49 and the conduit 48, while simultaneously interconnecting the conduits 46 and 50. The plunger 44 will then move leftwardly, while the speed of the plunger will be controlled automatically in the same manner as described above however, in the reverse order.

To bring about any variations in the speed of the plunger 44, it is merely necessary to operate any of the chokes 60, 69 and 79. These chokes may be arranged on a panel in easy reach of the operator and remote from the motor or other parts of the hydraulic system.

Throttle

The valve shown in Figure 3 substantially consists of a casing 81 closed at its ends by closures 82 and 83 which may be connected to the casing 81 in any convenient manner, for instance, by screws 84 and 85. The casing 81 comprises a stepped bore 86 in which is reciprocably mounted

a plunger 87 with a piston portion 88. The plunger 87 has a longitudinal bore 89 which interconnects the ends of the bore 86. Near the lower end of the plunger 89 are provided radial bores 90 communicating with the longitudinal bore 89. The lower portion of the plunger 87 has a reduced diameter so that it forms an annular chamber with the adjacent wall of the stepped bore 86. This annular chamber communicates through a restricted passageway 91 with a port 92 adapted to be threadedly engaged by a conduit 93. The restricted passageway 91 communicates with a restricted passageway 94 of materially smaller diameter which in its turn connects with the lower area of the piston portion 88. Also connected with the lower area of the piston portion 88 is a conduit 95.

The annular chamber formed by the lower portion of the bore 86 and the lower end of the plunger 87 communicates with an annular recess 96 which, in its turn, communicates with a port 97 adapted threadedly to be engaged by a conduit 98. The port 97 also communicates with a conduit 99.

As will be seen from Figure 3, the effective upper and lower areas of the piston portion 88 equal each other in the same manner as the effective lower and upper areas of the piston portion 26 in the throttle 24. The passageway 94 corresponds to the fluid flow restriction 34 of Figure 1, while the fluid flow restriction 22 of Figure 1 has its equivalent in the restricted passageway 91 of Figure 3. The annular recess 96 in Figure 3 corresponds to the annular recess 40 of Figure 1 while the conduit 39 of Figure 1 has its equivalent in the conduit 98 of Figure 3. Conduits 93, 95 and 99 of Figure 3 correspond to conduits 23, 32 and 33, respectively, of Figure 1. The operation of the throttle shown in Figures 3 and 4 corresponds to the operation of the throttle 24 of Figure 1 so that no further description appears to be necessary.

It will be understood that the present invention is by no means limited to the particular structure shown in the drawings, but also embraces any modifications within the scope of the appended claims.

Having thus fully described my invention what I claim as new and desire to secure by Letters Patent is:

1. In a hydraulic system, a fluid source of variable delivery, fluid operable motor means having its inlet connected with said source to receive actuating fluid therefrom, a first conduit means connecting the outlet of said motor with exhaust and including a fixed restriction adjacent said exhaust and a variable restriction adjacent said motor outlet, a second conduit means connecting said motor outlet with exhaust and including a fixed restriction adjacent said exhaust and an adjustable restriction adjacent said motor, means automatically operative in response to variations in pressure at the inlets of said fixed restrictions for varying said variable restriction, and means responsive to the pressure at said motor outlet for varying the delivery of said fluid source.

2. In a hydraulic system, a fluid source of variable delivery, fluid operable control means associated with said source for varying the delivery thereof, fluid operable motor means having its inlet connected with said source for receiving actuating fluid therefrom, first conduit means connecting said motor outlet with exhaust and comprising a fixed restriction adjacent said exhaust and a variable restriction adjacent said

motor, said variable restriction having fluid operable means associated therewith for effecting said variations, second conduit means connecting said motor outlet with exhaust and comprising a fixed restriction adjacent said exhaust and an adjustable restriction adjacent said motor, means hydraulically connecting the inlets of said fixed restrictions with the fluid operable means associated with said variable restriction, and means hydraulically connecting said motor exhaust with said fluid operable control means whereby the adjustment of said adjustable restriction is effective to vary the delivery of said source and, therefore, the speed of operation of said motor.

3. In a hydraulic system, a fluid source of variable delivery, fluid pressure responsive means associated with said source for varying the delivery thereof, fluid operable motor means having the inlet thereof connected with said source for receiving actuating fluid therefrom, a first conduit means connecting the outlet of said motor with exhaust and including a fixed restriction adjacent said exhaust and a variable restriction adjacent said motor, said variable restriction comprising a movable valve member having opposed fluid operable actuating means associated therewith, a second conduit means connecting said motor outlet with exhaust and including a fixed restriction adjacent said exhaust and a manually adjustable restriction adjacent said motor, conduit means hydraulically connecting one of said fluid operable actuating means with the inlet of one of said fixed restrictions and the other of said fluid operable actuating means with the inlet of the other of said fixed restrictions whereby the actuation of said valve member is responsive to the pressures at the inlets of said fixed restrictions, and means hydraulically connecting said fluid pressure responsive means with the inlet of said manually adjustable restriction whereby the adjustment of said manually adjustable restriction is effective to vary the delivery from said source.

4. In a hydraulic system, a fluid source of variable delivery, a fluid operable motor having its inlet connected with said source for receiving actuating fluid therefrom, fluid pressure responsive means associated with said source for varying the delivery thereof and hydraulically connected with the outlet of said motor, and means for maintaining a predetermined pressure at said motor outlet comprising a first conduit means connected from said motor outlet to exhaust and comprising a fixed restriction adjacent said exhaust and a variable restriction adjacent said motor, said variable restriction comprising a reciprocable valve member having associated therewith opposed and substantially equal fluid operable areas for reciprocating said valve member, a second conduit connecting said motor outlet to exhaust and including a fixed restriction adjacent said exhaust and a manually adjustable restriction adjacent said motor and conduit means respectively connecting said fluid operable areas with the inlets of said fixed restrictions whereby the adjustment of said manually adjustable restriction is effective to vary said variable restriction and the varying of said variable restriction is effective to actuate said fluid pressure responsive means associated with said source.

5. In a hydraulic system, a fluid operable motor, a fluid source connected with the inlet of said motor for supplying actuating fluid thereto, fluid pressure responsive means associated with said source for varying the delivery thereof and hy-

draulically connected with the outlet of said motor, means for varying the pressure at said motor outlet thereby to actuate said fluid pressure responsive means to vary the delivery of said source and, therefore, the speed of said motor comprising a first conduit means connecting said motor outlet to exhaust including a fixed restriction adjacent said exhaust and a variable restriction adjacent said motor, said variable restriction comprising a valve member having opposed fluid operable areas thereon, a second conduit means connecting said motor outlet to exhaust and including a fixed restriction adjacent said exhaust and a plurality of manually adjustable restrictions connected in parallel adjacent said motor, each of said manually adjustable restrictions having associated therewith valve means effective to disconnect said manually adjustable restrictions from said motor outlet, means responsive to the travel of said motor for selectively actuating said valve means, and means hydraulically connecting said opposed fluid operable areas of said variable restriction respectively with the inlets of said fixed restrictions.

6. In a hydraulic system, a fluid source, a fluid motor connected to receive fluid from said source, fluid pressure responsive means operable to vary the relative displacements of said source and motor and hydraulically connected with the outlet of said motor, a pair of paralleled conduits serially connected between said motor outlet and an exhaust and each comprising a pair of restrictions in series, manual means for adjusting at least one of the restrictions in one of said conduits, opposed fluid operable areas for adjusting one of said restrictions in the other of said conduits, and channel means connecting said fluid operable areas to said conduits between said restrictions.

7. In a hydraulic system, a pump and a motor connected in series, means for varying the relative displacements of said pump and motor, fluid pressure responsive means for actuating said displacement varying means and connected with the outlet of said motor, a pair of paralleled conduits connecting said motor outlet with an exhaust and each comprising a pair of restrictions in series, manual means for adjusting at least one of the restrictions in one of said conduits, opposed fluid operable areas for adjusting one of the restrictions in the other of said conduits, and means hydraulically connecting said opposed fluid operable areas with points on said paralleled conduits between the restrictions therein whereby said fluid operable areas are actuated in response to variations from a predetermined ratio of the pressures at said points.

8. In a hydraulic system, a pump and a motor connected in series, means responsive to the pressure at said motor outlet for varying the relative displacement of said pump and motor, first and second conduits connecting said motor outlet with an exhaust and each including a pair of restrictions in series, one of said restrictions in one of said conduits being adjustable and another of said restrictions in the other of said conduits being variable, opposed fluid operable areas for effecting the variations of said variable restrictor, means hydraulically connecting one of said fluid operable areas with a point on said first conduit between the restrictions therein, and means connecting the other of said fluid operable areas with a point on said second conduit between the restrictions therein, said fluid operable areas being proportioned to exert equal thrusts when the system is in a state of balance.

9. In a hydraulic system, a pump, a motor supplied by said pump, fluid operable control means for varying the relative displacements of said pump and motor, a first flow restriction connected between said motor outlet and an exhaust, a variable flow restrictor connected between said first restrictor and said motor outlet, a second restrictor connected between said motor outlet and an exhaust, a manually adjustable flow restrictor interposed between said second restrictor and said motor outlet for varying the rate of fluid flow through said second restrictor, means connecting said fluid operable control means with said motor outlet, and opposed fluid operable areas operable to vary said variable restrictor and connected to be responsive to variations in pressure at the inlets of said first and second restrictors respectively.

10. In a hydraulic system, a pump and motor connected in series, fluid operable control means hydraulically connected with said motor outlet for varying the relative displacements of said pump and motor, paralleled conduits connecting said motor outlet with exhaust and each comprising a pair of restrictions in series, at least one of said restrictions in one of said conduits being variable and another of said restrictions in the other of said conduits comprising a plurality of restrictions in parallel, means operated in response to movements of the motor for making said paralleled restrictions selectively effective, and fluid operable areas operable to vary said variable restriction and each connected with a different of said conduits between the restrictions therein.

11. In a hydraulic system, a pressure fluid source, a fluid operable motor serially connected with said source to be actuated by pressure fluid therefrom, paralleled conduits serially connected between said motor outlet and an exhaust and each comprising a pair of flow restrictions in series, opposed fluid operable areas for adjusting one of said restrictions, and means connecting said fluid operable areas to be responsive to changes in the ratio of pressures in the said conduits at points between the restrictions therein.

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