May 17, 1949. C. E. ADAMS 2,470,086

HYDRAULIC APPARATUS

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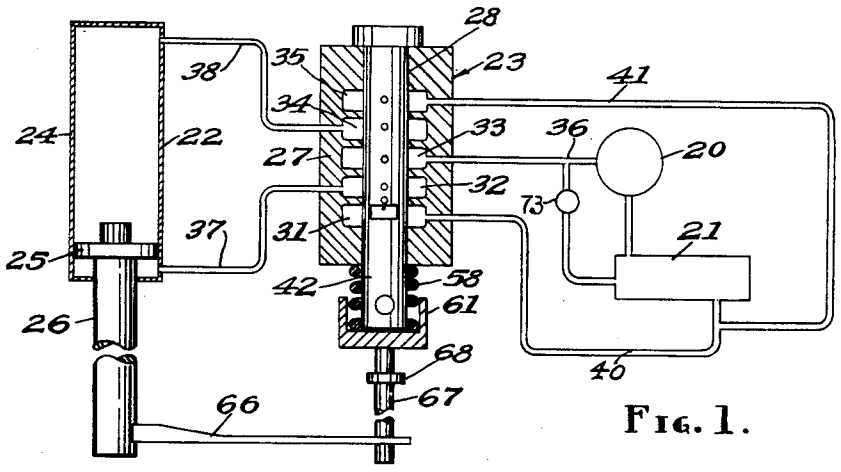

FIG. 1.

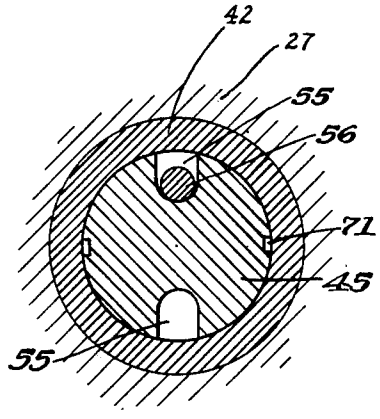

FIG. 6.

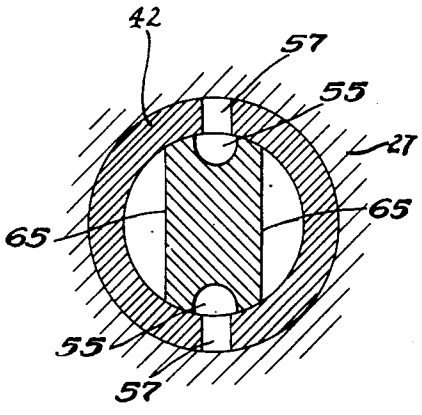

FIG. 5.

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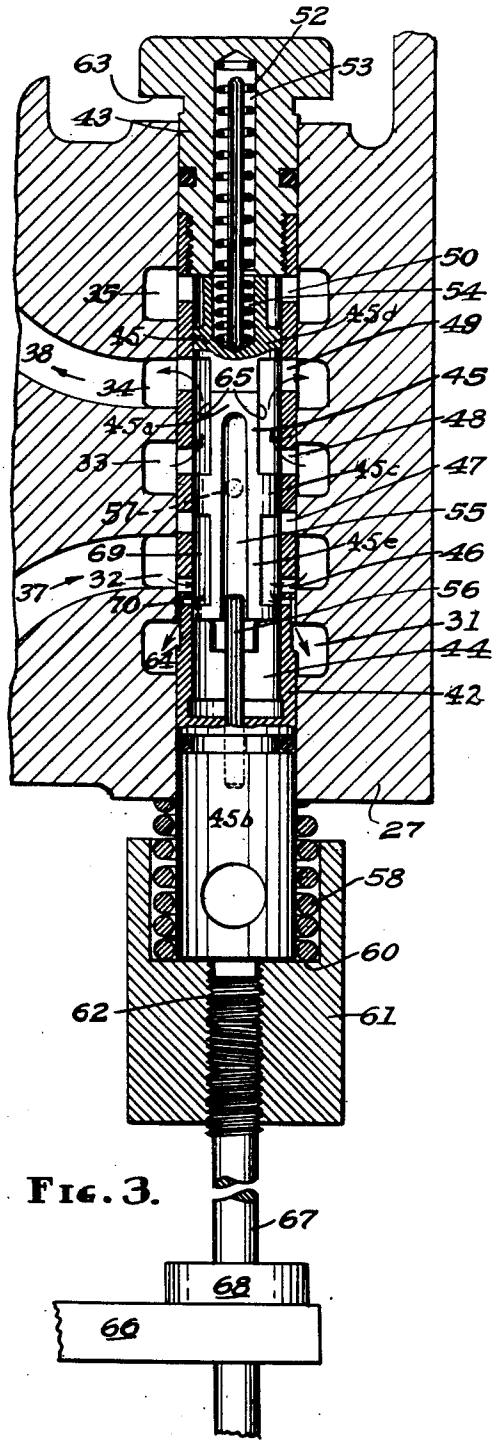

FIG. 3.

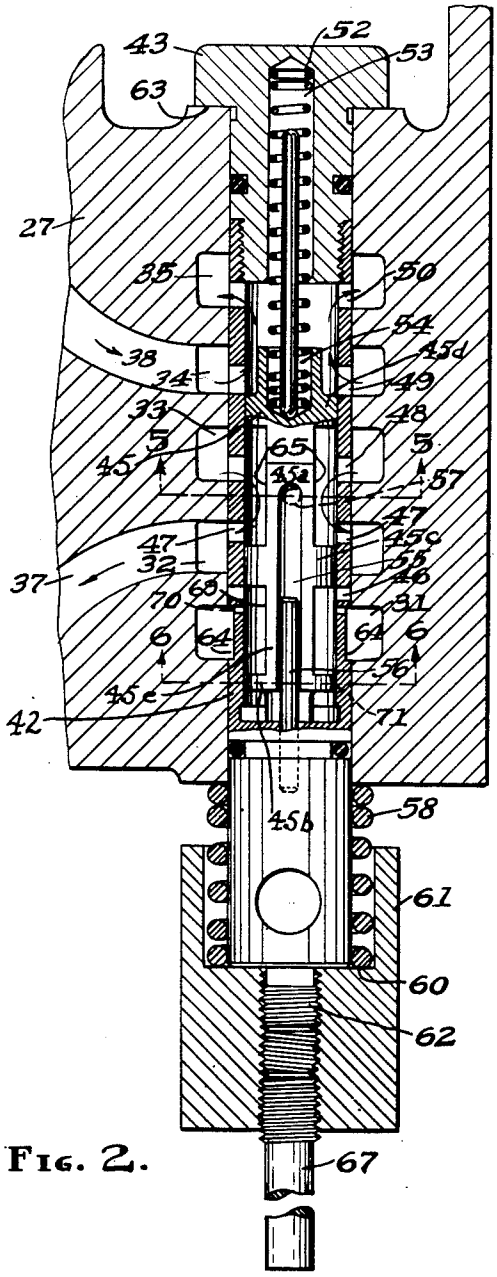

FIG. 2.

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FIG. 7.

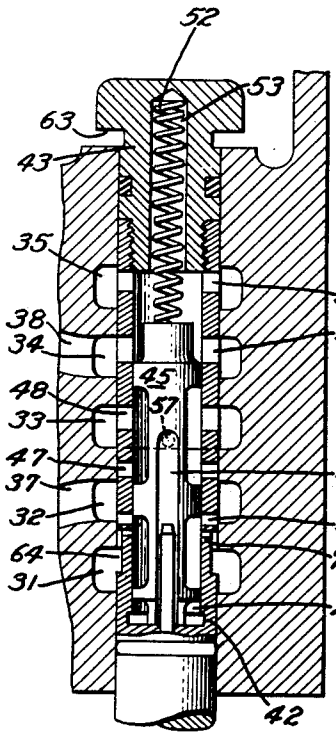
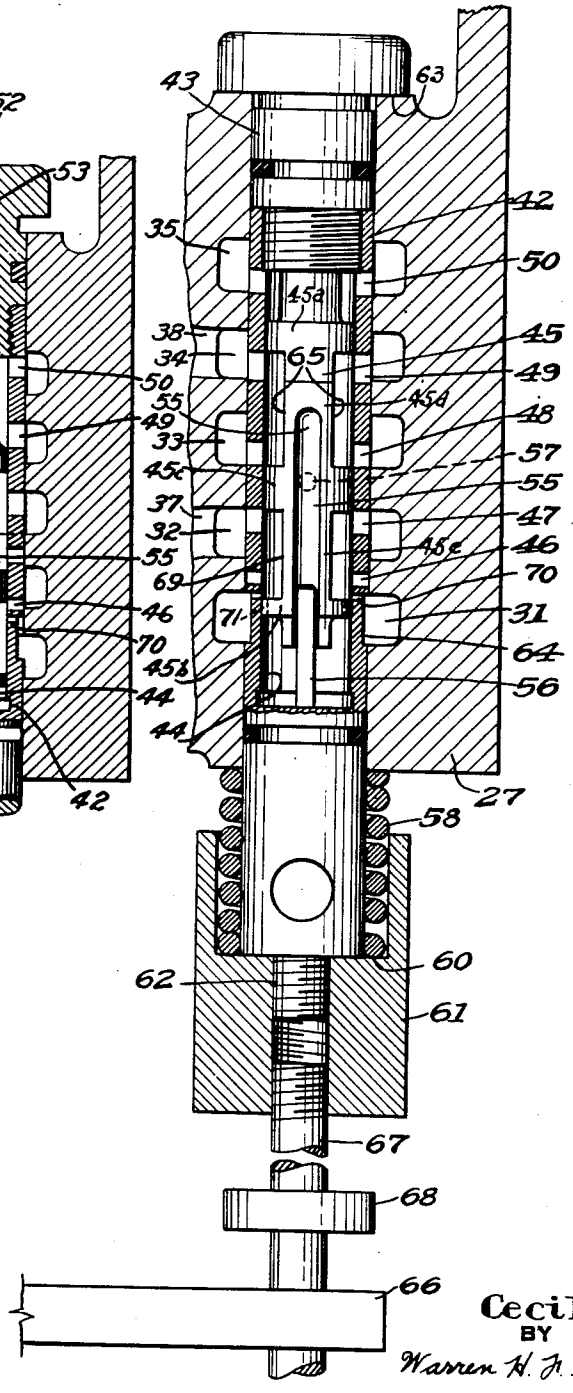


FIG. 4.



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UNITED STATES PATENT OFFICE

2,470,086

HYDRAULIC APPARATUS

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Application July 19, 1944, Serial No. 545,701

15 Claims. (Cl. 60—52)

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This invention relates to fluid pressure apparatus and systems employed in the operation of such apparatus. More particularly, the invention relates to a fluid system having a source of fluid pressure, a power unit and control means for governing the admission of fluid pressure to the power unit and the latter's response thereto.

One object of this invention is to provide a fluid pressure system having a power unit operated by fluid pressure, with novel control mechanism by means of which the power unit will be caused to operate continuously until the operation is manually terminated by the operator.

Another object of the invention is to provide a control mechanism for a fluid pressure operated power unit, which control mechanism is responsive to a predetermined condition in the system embodying the power unit to reverse the direction of movement of the power unit.

A further object of the invention is to provide a control mechanism for governing the flow of fluid from a pump to the power unit and from the latter, the control mechanism being responsive to the return flow of fluid, that is, from the power unit, to reverse the operation of the power unit.

A still further object is to provide a fluid pressure system with a power unit responsive to fluid pressure and a control mechanism governed by the return flow of fluid from the power unit whereby a cessation of return flow will cause a reversal of operation of the power unit.

Another object consists in providing a control mechanism having a chamber with ports communicating with a source of pressure and communicating with separate portions of a power unit and controlling mechanism in the chamber to control fluid flow between the ports to effect the operation of the power unit, means being provided to restrict fluid flow in a portion of the system whereby a fluid pressure will be generated which may be employed to govern the operation of certain parts of the control mechanism, maintenance of the fluid pressure being dependent upon the continuation of certain conditions in the system so that if those certain conditions are not maintained, a predetermined operation of the control mechanism will occur.

Another object is to provide an automatic control mechanism for a reciprocating element which will cause the element to operate repeatedly, thus, if the element is in the form of a ram for a press and the press is performing operations on articles of a certain size and it is desired to perform the operation on an article of a different size, it is merely necessary to present the

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article to the ram and the operation will be performed without requiring any adjustment of the press.

An object also is to provide a flow control mechanism for a fluid pressure operated power unit which mechanism includes a casing with a cylinder having a plurality of ports communicating therewith and movably disposing a barrel member in the cylinder, the barrel member having movable valve means by which communication may be controlled between the ports to govern the operation of the power unit, the barrel member being normally disposed in one position and moved by the power unit at a certain stage of operation thereof to another position wherein the valve means will be exposed to fluid pressure to effect a certain operation thereof, the barrel being returned to another position automatically to discontinue the application of fluid pressure to the valve means after the power unit has passed such certain stage of operation whereby said valve means will respond to another force when predetermined conditions exist in the system controlled by the mechanism.

Further objects and advantages of the present invention will be apparent from the following description, reference being had to the accompanying drawings wherein a preferred form of embodiment of the invention is clearly shown.

In the drawing:

Fig. 1 is a diagrammatic view of a hydraulic system embodying the present invention;

Fig. 2 is a vertical longitudinal sectional view taken through the mechanism for controlling the operation of the system shown in Fig. 1, the control mechanism being shown in a condition to cause the power unit of the system to assume an initial or starting position;

Fig. 3 is a similar view showing the control mechanism in condition to cause the power unit to start the performance of a working stroke;

Fig. 4 is a similar view showing the control mechanism in another condition which it will assume during the performance of a working stroke by the power unit;

Fig. 5 is a detail horizontal sectional view taken on the plane indicated by the line 5—5 of Fig. 2; and

Fig. 6 is a similar view taken on the plane indicated by the line 6—6 of Fig. 2.

Fig. 7 is a detailed vertical longitudinal sectional view taken through the control mechanism, showing the parts thereof in the positions occupied at the termination of a full stroke of

the ram immediately before the successive down stroke is initiated.

In carrying out the present invention, the fluid pressure system is disclosed as a hydraulic system shown in Fig. 1 in which there is arranged a motor driven pump **20**, a reservoir **21** for hydraulic fluid, a power unit **22** and a control mechanism **23** for governing the operation of the system. The power unit **22** selected for illustration includes a cylinder **24**, a piston **25** and a ram **26** projecting from the piston through the lower end of the cylinder. The piston is slidably arranged in the cylinder, the latter being illustrated in an upright position so that the piston and ram will move vertically.

The control mechanism **23** includes a casing **27** which is provided with a cylindrical chamber **28** and a plurality of longitudinally disposed ports **31** to **35**, inclusive. Port **33** constitutes the inlet or pressure chamber and it is connected by a conduit **36** with the pump **20** to receive fluid under pressure therefrom. Ports **32** and **34** constitute work chambers and these are located on either side of the inlet **33**; they are connected with the lower and upper ends of the power cylinder **24** by conduits **37** and **38**, respectively. Ports **31** and **35** hereinafter called outlet ports, are disposed on the opposite sides of said work ports from said inlet **33** and are connected by conduits **40** and **41** with the reservoir **21** to complete the hydraulic circuit.

A barrel **42** is disposed for sliding movement in the chamber **28**, this barrel being of tubular formation, is closed at its lower end and is provided with a cap **43** at its upper end. The barrel forms an internal cylindrical chamber **44** to slidably receive a double spool valve **45**. Valve **45** includes end heads **45***a* and **45***b*, an intermediate head **45***c* and upper and lower interconnecting shanks **45***d* and **45***e*. The heads closely fit the cylinder **44** and are employed to control communication through the cylinder **44** between ports **46** to **50**, inclusive, formed in the wall of the barrel **42**. Restricted passages **71** are provided in head **45***b* to permit limited flow of fluid to opposite sides of the head **45***b*. When the space between heads **45***b* and **45***c* is connected to the outlet port **31**, as shown in Fig. 2, wherein said space is connected to port **31** by passage **70**, fluid can escape from below head **45***b* through passages **71**. In the position shown in Fig. 2, the valve **45** has been urged to its lowermost position by a coil spring **52** disposed in socket **53** of the cap **43** and socket **54** in the upper end of valve **45**.

The lower portion of the valve **45** has oppositely disposed grooves **55** formed therein, one of these grooves receiving a pin **56** projecting into the lower end of cylinder **44** from the lower portion of the barrel **42**. The arrangement of this pin in the groove permits the spool valve to slide freely in the cylinder **44** but prevents rotation thereof, thus insuring communication between additional ports **57** in the barrel **42** and the lower end of the cylinder **44** through the grooves **55**.

The barrel **42** is resiliently urged by a coil spring **58** to its lowered position shown in Fig. 2. This spring **58** surrounds the lower end of the barrel and engages the bottom wall **60** of a cup **61** carried by the barrel **42** through a threaded connection **62** therewith. The upper portion of the spring **58** engages the underside of the casing **27** and the spring **58** tends to hold the barrel in its lowered position against a shoulder **63** on the cap **43**. When these parts are in this position, grooves **64**, formed in the barrel **42**, will be in registration with the outlet port **31**. The ports **47** in the barrel will be in communication with work port **32** and ports **48** will be in registration with the inlet **33** so that fluid under pressure may flow from the inlet **33** through ports **48**, along flats **65** formed in the spool shank **45***d* and through conduit **37** to the lower end of the power cylinder **24**.

When the control mechanism is thus disposed, the upper end of the power cylinder will be vented to the reservoir through conduit **38**, work chamber **34**, ports **49**, the upper portion of chamber **44**, ports **50**, outlet port **35** and conduit **41**. Since fluid under pressure is being directed to the lower end of the power cylinder and the upper end thereof is connected with the reservoir, piston **25** and ram **26** will move upwardly. As they approach the upper limit of movement, a fork **66** secured to the ram and straddling a rod **67** depending from the cup **61**, will engage a collar **68** adjustably attached to the rod **67**, and move the barrel **42** upwardly in opposition to the force of spring **58**. The spool **45** will also be moved upwardly. This upward movement will cause the ports **47** to be moved toward their nonregistering position with ports **32** to impede the flow of fluid from inlet port **33** to the conduit **37** and simultaneously will cause port **57**, in barrel **42**, to be brought in communication with inlet port **33**. High pressure fluid will then pass from the inlet port **33**, port **57** and groove **55** to the under side of head **45***b* of spool **45** and since restriction is offered by the passage **71** to the flow of fluid through the head **45***b*, high pressure fluid, on the under side of head **45***b*, will cause the spool to rise immediately. This pressure on the under side of the head **45***b* of spool **45** augments the action imparted by the fork **66** so that both the barrel and the spool are moved quickly from the positions shown in Fig. 2, to the positions shown in Fig. 3. In the positions shown in Fig. 3, ports **46** of the barrel are in communication with work port **32**; these ports together with flats **69**, in spool shank **45***e*, ports **70** and grooves **64** in barrel **42** will establish communication between work port **32** and outlet port **31**. The ports **70** are of such size as to provide only restricted communication between chambers **31** and **32**. The reason for this restriction will presently be set forth.

At this time, grooves **65** in the spool will establish communication between ports **48** which are in registration with the inlet port **33**, and ports **49** then in registration with work port **34**. Fluid will then flow from the inlet **33** through ports **48**, grooves **65**, ports **49** and port **34** to conduit **38** and the upper end of the power cylinder **24**. This fluid under pressure will exert a downward force on the piston **25** and since the lower end of the power cylinder **24** is in communication with reservoir **21** through conduit **37**, port **32**, ports **46**, grooves **69**, ports **70**, grooves **64**, port **31** and conduit **40**, the piston **25** and ram **26** will move downwardly. The initial downward movement of these members will cause fork **66** to move away from collar **68** and permit spring **58** to return barrel **42** to its lower or normal position as illustrated in Fig. 4. This movement will interrupt communication between ports **57** and the inlet port **33** so that fluid under pressure cannot flow from the port **33** to the lower end of the cylinder **44**. There will be a tendency at this time for the spool **45** to move downwardly due to the force of spring **52**. This movement, however, will be prevented until the ram has completed its downward stroke, as will be seen hereinafter. When the parts are

in the position shown in Fig. 4, fluid being discharged from the cylinder **24** below the piston **25** must escape through the ports **70**. The restriction offered by the limited size of port **70** is such that a pressure will be generated in the chamber **44** between the lower head **45***b* and intermediate head **45***c* of spool valve **45**. The pressure in chamber **44** between heads **45***c* and **45***b* is such that the fluid pressure below the head **45***b* will not be relieved until the working stroke of the ram is completed. The spool or shuttle valve **45** will be held in the position shown in Fig. 4 due to the differential in pressure between the pressure on the underside of head or land **45***b* and the top side of head or land **45***a*, the latter being open to the reservoir and under no pressure.

When the working stroke of the ram is completed, as for example, when it is stopped by the work being performed, fluid will no longer flow from the underside of piston **25** through the conduit **37** and, consequently, the pressure in port **32** and in the cylinder intermediate heads **45***b* and **45***c* will be reduced, due to the release of fluid through the passages **70**. When this pressure is reduced, fluid can escape from the under side of head **45***b* through the restricted passages **71** and the spring **53** will then return the spool **45** from the position shown in Fig. 4 to the position shown in Fig. 2. Obviously, when the barrel **42** and the spool **45** are in the position shown in Fig. 2, the cycle of operation will be completed, namely, fluid under pressure will be delivered to the under side of the piston **25** and the fluid above the piston **25** will escape through ports **34** and **35** and be returned to the tank.

One of the many advantages of the present invention lies in the delayed action effected during the period of time in which the fluid escapes from below shuttle land **45***b* through orifices **71** after completion of the major portion of the downstroke of the ram **26**. That is, after the ram has completed or substantially completed the major portion of its movement and is stopped or retarded to such an extent that the fluid pressure decreases in chamber **32**, the application of pressure is continued on the top side of piston **25** until land **45***b* of shuttle valve **45** blocks port **49** so that a setting force can be applied and maintained by the ram on the work being performed thereby. In other words, after the ram reaches its lowermost position or substantially its lowermost position, there will be a delay before the ram is retracted. Obviously, the time interval of this delay may be regulated by suitably restricting the flow by the land **45***b*. In the present illustrations, the interval of delay is effected by providing several shuttle valves each having restriction **71** of different size and selecting the shuttle valve which insures the time delay desired.

Preferably, a relief valve **73** is interposed between high pressure conduit **36** and the tank **21** which opens automatically to return fluid from conduit **36** to the tank when the pressure exceeds the highest pressure desirable in the system.

It will be seen from the foregoing, that a control mechanism has been provided which will cause continuous, repeated operation of a power unit, at least a portion of the controlling operation being governed by the return flow of fluid from the power unit to the source of supply. This method of control will cause the direction of movement of the piston **25** and ram **26** to be automatically reversed at any stage of their working stroke when an obstruction, which will stop the movement of these members, is encountered.

The control mechanism shown herein may be combined with the control mechanism shown in my application Serial Number 545,700, filed on July 19, 1944, to produce a control mechanism which will effect continuous or repeated operation of a power unit and govern the operating speed thereof particularly during the working stroke whereby the power of the unit will be maintained regardless of the rate of movement of the ram.

While the form of embodiment of the present invention as herein disclosed constitutes a preferred form, it is to be understood that other forms might be adopted, all coming within the scope of the claims which follow.

I claim:

1. Control mechanism for fluid pressure operated apparatus comprising, in combination, a body having a chamber and a plurality of ports including work ports, and inlet and outlet ports; means slidable in said chamber for movement between two positions, said means having a series of ports communicating with the ports in said body in either position of said means, said means having an additional port communicating with said inlet in one position only of said slidable means; means tending to urge said slidable means out of the said one position; flow controlling means movable between two positions, one of said means forming a passage extending from said additional port to one end of said flow controlling means to apply fluid pressure to the latter to move said latter means into a position to establish open communication between a predetermined work port and said inlet and restricted communication between a second work port and an outlet, one of said means forming a restricted passage to conduct fluid from said second work port to said one end of the flow controlling means to maintain the same in the communication establishing position after said first means is moved by said urging means, the fluid being dissipated through the last-mentioned restricted passage when flow from said second work port ceases to permit said flow-controlling means to move to a position to establish communication between the second work port and the inlet and the predetermined work port and an outlet.

2. A fluid pressure system comprising, in combination, a source of fluid under pressure; a fluid motor having a cylinder and piston; means for controlling the operation of said motor, said means including a body having a chamber and inlet, outlet and work ports communicating therewith; means connecting the inlet port with said fluid pressure source, the work ports with said fluid motor on opposite sides of said piston and the outlet ports to exhaust; means slidably disposed in said body, said slidable means having ports continuously communicating with the ports in said body, a port communicating with one outlet port being restricted, said slidable means having an additional port communicating with said inlet in one position only of said slidable means; means operated by said piston to move said slidable means to such position; means tending to urge said slidable means away from such position; means slidably engaging the first mentioned slidable means to control fluid flow between the ports in said first mentioned slidable means, one of said slidable means forming a passage extending from said additional port to one end of the second mentioned slidable means; means tending to retain the second mentioned slidable means in a position to establish communication between a selected work port and

said inlet and the other work port and an outlet, fluid pressure admitted through said additional port and passage to said one end of the second mentioned slidable means serving to move said second mentioned slidable means to a position to connect the selected work port with said restricted outlet and the other work port with said inlet, one of said slidable means forming a restricted passage to conduct fluid from said selected work port to said one end of said second slidable means to retain the same in the last mentioned position.

3. Flow control mechanism comprising, in combination, a body having a chamber and inlet, outlet, and work ports, communicating therewith; a ported sleeve member disposed for movement in said chamber between two positions, certain ports in said sleeve communicating with the ports in said body in both positions of movement of said sleeve and at least one of the ports in said sleeve communicating with the inlet port in one position only of said sleeve; means tending to move said sleeve out of said one position; a spool member disposed in said sleeve for movement between two positions, said spool serving to connect certain sleeve ports in one position and other sleeve ports in the other position; resilient means tending to urge said spool toward one position of movement; and passage means in one of said members for directing fluid pressure from the port communicating with the inlet port in one position only of said sleeve to one end of said spool to move the same in opposition to said resilient means.

4. In a fluid pressure system, a source of fluid pressure, a fluid motor; means for controlling the flow of fluid from said source to said motor, said means having a body with a bore and inlet, outlet and motor ports communicating therewith; a sleeve disposed for movement in said bore, said sleeve having ports formed therein for registration with the ports in said body in all positions of movement of said sleeve, and an additional port registering with the inlet portion in one position only of said sleeve; means tending to urge said sleeve out of said one position; spool means movably disposed in said sleeve and operative in one position to direct fluid from said inlet port to said fluid motor to operate the same in one direction, said spool means being operative in another position to direct fluid from the inlet port to said fluid motor to operate the same in the reverse direction; passage means for directing fluid from said additional port against said spool to move the same to the second position; means urging said spool means toward the first position; and means actuated by said fluid motor when operating in the reverse direction to move said sleeve means to the position wherein the additional port registers with said inlet port.

5. In mechanism of the character described, a source of fluid pressure, a power cylinder, a shuttle valve for controlling the flow of pressure fluid from said source to each of the opposite ends of said cylinder alternatively and from the remaining end to exhaust, a spring tending to move said valve in one direction, means for utilizing pressure from said source momentarily to move said valve in opposition to said spring, means for restricting the exhaust flow from said cylinder to create back pressure; means for utilizing the back pressure from said power cylinder to oppose the action of said spring, and means for dissipating said back pressure when exhaust flow from said cylinder is diminished, whereby said spring shifts said valve automatically.

6. In mechanism of the character described, a source of fluid pressure, a power cylinder, a barrel valve, a shuttle valve slidable endwise within said barrel valve for controlling the flow of pressure fluid from said source to each of the opposite ends of said cylinder alternatively and from the remaining end to exhaust, a spring tending to move said shuttle valve in one direction means responsive to the movement of said barrel valve and said spring actuated shuttle valve in one direction for utilizing momentarily pressure from said source to shift said shuttle valve against the action of said spring, means for restricting the exhaust flow from said cylinder to create back pressure; means for utilizing the back pressure from said cylinder to maintain said shuttle valve in its shifted position, and means for dissipating said back pressure when exhaust flow from said cylinder is diminished.

7. In mechanism of the character described, a source of liquid under pressure; a reversible fluid motor; a valve for controlling the flow of liquid from said source to and from said motor to govern the direction of operation thereof; means for momentarily utilizing liquid under pressure from said source to move said valve to a position to cause the operation of said motor in a certain direction; orifice means for resisting flow of liquid from said motor when operating in said certain direction to create a back pressure; means for returning said valve to a second position to cause the operation of said motor in the reverse direction and means for utilizing back pressure to hold said valve in the first-mentioned position and delay the return of said valve by said returning means until the operation of said motor in said certain direction has been terminated.

8. In a fluid pressure system, a source of fluid pressure; a reversible fluid motor; a valve for controlling the flow of fluid to and from said motor to govern the direction of operation thereof; means actuated by said motor when operating in one direction for directing fluid pressure from said source against said valve to move the same to a position to cause the operation of said motor in a certain direction; means for restricting fluid flow from said motor while operating in said certain direction to create a back pressure; means for returning said valve to a second position to cause the operation of said motor in the reverse direction; and means for utilizing the back pressure to hold said valve in the first-mentioned position and delay the return of said valve by said returning means until the operation of said motor in said certain direction has been terminated.

9. In a fluid pressure system, a source of fluid pressure; a reversible fluid motor; a valve for controlling the flow of fluid to and from said motor to govern the direction of operation thereof; means operative in one position to direct fluid from said source into contact with said valve to move the same to a position to cause the operation of said motor in a certain direction; means tending to urge said first-named means out of said one position; means for restricting fluid from said motor while operating in said certain direction to create a back pressure; means for returning said valve to a second position to cause said motor to operate in a reverse direction; means for utilizing the back pressure to hold said valve in the first-mentioned position and delay the return of said valve for said returning means until the operation of said motor in said certain

direction has been terminated; and means actuated by said motor when operating in the reverse direction to move said first-mentioned means to said one position in opposition to said urging means.

10. In a fluid pressure system, a source of fluid pressure, a fluid motor, means for controlling the operation of said motor having a casing with inlet and exhaust ports and forward and reverse motor ports; movable valve elements in said casing operative in one position to cause fluid flow from said inlet to the reverse motor port and from the forward motor port to exhaust; means actuated by said motor during reverse movement thereof to shift one of said elements to a position to interrupt fluid flow between said inlet and reverse ports; a passage way formed by said elements, said passage way being operative in the second position of said one element to direct fluid from said inlet to the other element to move the same to a position to cause fluid flow from said inlet to the forward motor port and from the reverse motor port to an outlet, said passage way being rendered operative before fluid flow is interrupted between said inlet and reverse ports.

11. A flow control for a liquid pressure operated system comprising, in combination, a casing member forming a chamber with a liquid inlet port, a work port adapted to be connected with liquid pressure operated mechanism and an outlet port adapted to be connected with the discharge conduit of said mechanism; a valve member disposed for movement in said chamber to control the flow of liquid from the inlet port to the work port; means in said chamber normally tending to urge said valve to a position to diminish the flow of liquid between the inlet and work port; means in said casing for restricting liquid flow from the discharge conduit to exhaust to create a back pressure, one of said members forming a restricted passage to conduct such back pressure to an end of said chamber and apply the same to an end of said valve member to oppose movement thereof by said urging means.

12. In a hydraulic system, a source of fluid pressure; a fluid motor of the piston and cylinder type, valve means for directing fluid to one end of said cylinder to cause movement of said piston in one direction, and a second valve means operated by said piston for simultaneously interrupting fluid flow to said one end of said cylinder and applying full fluid pressure from said source to shift said first valve means whereby movement of said piston in said one direction will cease and the first-mentioned valve means will be in a position to direct fluid from said source to the other end of said cylinder to cause movement of said piston in the opposite direction.

13. A hydraulic system comprising a source of fluid pressure; a power cylinder; control mechanism between said pressure source and said power cylinder said mechanism having a casing, a pair of relatively movable valve elements disposed in said casing for movement between two positions relative to said casing and to one another, said elements forming a chamber for receiving fluid pressure to effect relative movement therebetween, said elements in one relative position serving to connect said chamber with said pressure source and both ends of said power cylinder to exhaust, the admission of pressure to said chamber serving to dispose said elements in a second relative position in which a predetermined end of said power cylinder is connected with said pressure source and the other end is connected with exhaust; means for restricting fluid flow between the latter end of said power cylinder and exhaust to create a back pressure, said elements forming a passage to conduct such back pressure to said chamber to maintain said elements in the second relative position, means for moving said elements relative to said casing to disconnect said chamber from said pressure source; and means operative upon the diminution of back pressure to move one of said elements relative to the other element and said casing to connect said predetermined end of said power cylinder with exhaust and the other end with said pressure source.

14. A hydraulic system comprising, in combination, a source of liquid pressure; a liquid pressure operated power unit; valve means for controlling the flow of liquid to said power unit and from said power unit to exhaust, said valve means being disposed for movement between first and second positions; means constantly tending to retain said valve means in the first position to cause operation of said power unit in a first direction; additional valve means for applying liquid from said source to said first-mentioned valve means to move the same to the second position to cause operation of said power unit in a second direction, said additional valve means being rendered ineffective to apply liquid from said source to said first-mentioned valve means as a result of initial operation of said power unit in said second direction; means for restricting liquid flow which occurs only during the operation of said power unit in said second direction to create a pressure differential; and means for applying the higher pressure of said pressure differential to said first-mentioned valve means to maintain the same in position to continue the operation of said power unit in said second direction after said additional valve means has been rendered ineffective to apply liquid from said source to said first-mentioned valve means.

15. A hydraulic system comprising, in combination, a source of liquid pressure; a liquid pressure operated power unit; valve means for controlling the flow of liquid to said power unit and from said unit to exhaust, said valve means being disposed for movement between first and second positions; means constantly tending to retain said valve means in the first position to cause operation of said power unit in a first direction; additional valve means for applying liquid from said source to said first-mentioned valve means to move the same to the second position to cause operation of said power unit in a second direction, said additional valve means being rendered ineffective to apply liquid from said source to said first-mentioned valve means as a result of initial operation of said power unit in said second direction; means for restricting liquid flow which occurs only during the operation of said power unit in said second direction to create a pressure differential; means for applying the higher pressure of said pressure differential to said first-mentioned valve means to maintain the same in position to continue the operation of said power unit in said second direction after said additional valve means has been rendered ineffective to apply liquid from source to said first-mentioned valve means; and means for equalizing the pressure differential when operation of the power unit in said second direction is discontinued to permit said first-mentioned valve means to return to said first position.

CECIL E. ADAMS.

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Certificate of Correction

Patent No. 2,470,086. May 17, 1949.

CECIL E. ADAMS

It is hereby certified that error appears in the printed specification of the above numbered patent requiring correction as follows:

Column 8, line 74, claim 9, for the word "for" read *by*;

and that the said Letters Patent should be read with this correction therein that the same may conform to the record of the case in the Patent Office.

Signed and sealed this 6th day of December, A. D. 1949.

[SEAL]

THOMAS F. MURPHY,
Assistant Commissioner of Patents.