

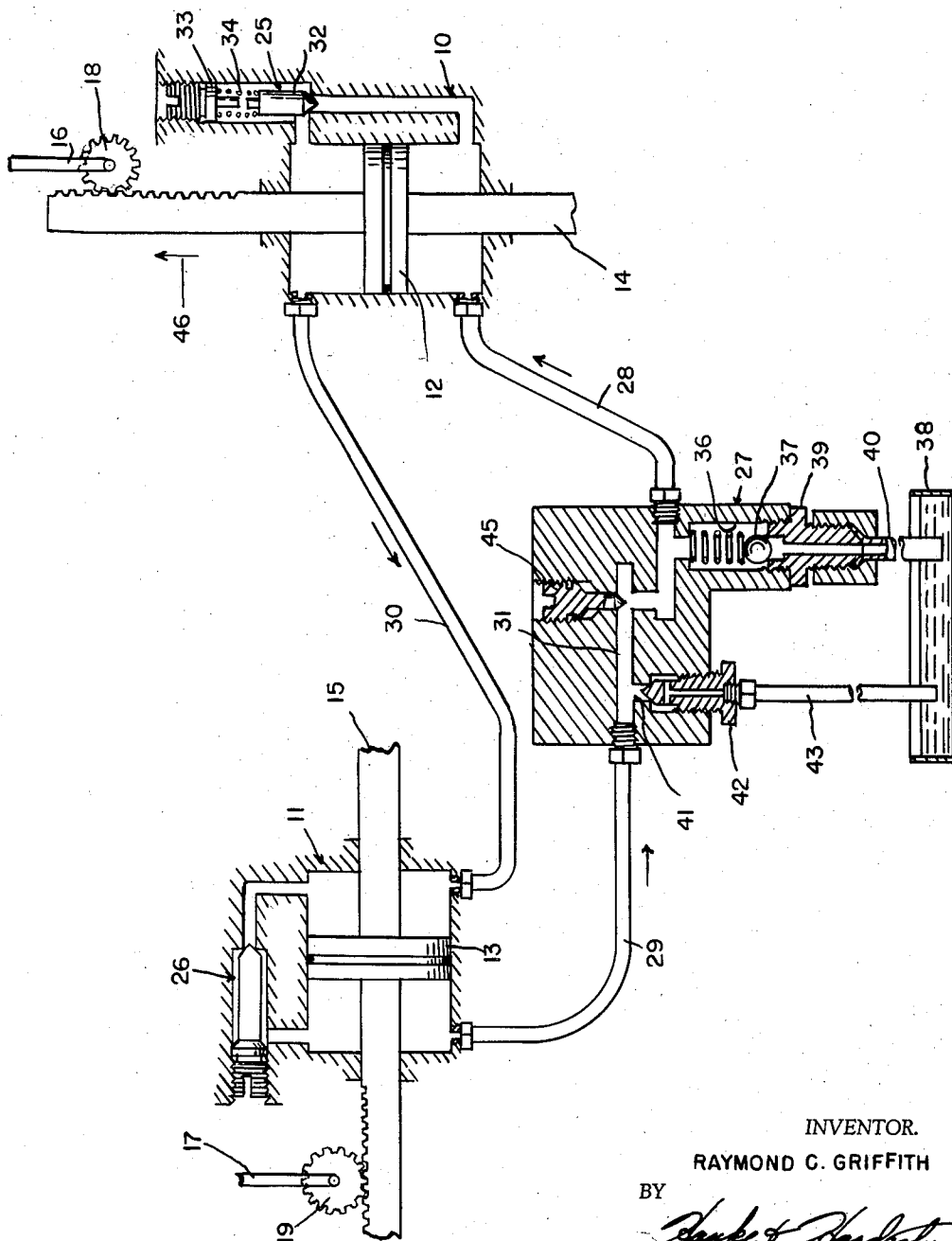
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R. C. GRIFFITH

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HYDRAULIC SYSTEM

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INVENTOR.

RAYMOND C. GRIFFITH

BY

ATTORNEYS

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2,882,686

HYDRAULIC SYSTEM

Raymond C. Griffith, Detroit, Mich.

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My invention relates to hydraulic systems and more particularly to a bleeding and filling means for a closed circuit hydraulic system such as is used for remote control applications.

The conventional remote control, closed circuit hydraulic systems in use generally comprise two or more hydraulic piston and cylinder assemblies connected in series by suitable conduits so that operation of one piston will serve to actuate the other pistons in synchronization. A hydraulic remote control system has the advantage over mechanical systems in that the cylinder and piston assemblies may be located at any distance from each other in any desired position, and will provide for efficient synchronized movement around blind corners or otherwise in a more simplified manner, the connections between the cylinders being merely flexible conduits rather than fixed arms, bellcranks, pushrods and cables such as are required for mechanical systems. In such hydraulic systems, the actuating cylinder and piston assembly is usually called the "master," and the actuated cylinder and piston is generally called the "slave."

In order to provide adjusting and synchronizing means, a bypass is conventionally provided for each cylinder and is selectively operable to openly connect the opposite ends of the cylinder, so that the piston may be moved without effecting any corresponding movement of the other pistons in the system.

A disadvantage to utilization of such systems is the difficulty heretofore encountered in bleeding and/or filling the system. Generally, fittings are provided in all the conduits between the cylinders. A hydraulic pump outlet is connected to one fitting in the line leading to one cylinder and a bleed outlet is connected to the other line. The bypass valve of that cylinder only is then opened, and hydraulic fluid is pumped through the cylinder. This bypass valve is then closed, the bypass valve to the other cylinder adjacent the fittings is then opened, and the pump is operated to fill this cylinder.

The process is rather involved, and usually the instructions given by the manufacturer are so detailed as to discourage potential customers from going to such a system. Moreover, a customer who only intends to use a small number of remote controls is required to also secure a hydraulic pump and all the necessary fittings and conduits that must be used. This often makes the cost of hydraulic remote control systems prohibitive.

An object of the present invention is to simplify the bleeding and filling of closed circuit hydraulic systems by providing a single bleeding and filling connection in one of the system conduits constructed to permit one of the pistons to be used as the hydraulic pump.

Another object of the invention is to improve closed circuit hydraulic systems by providing a simplified bleeding and filling device therefore.

A further object of the invention is to provide for bleeding and filling closed circuit hydraulic systems by constructing an improved cylinder bypass valve.

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For a more complete understanding of the invention, reference may be had to the accompanying drawing which illustrates a preferred embodiment of the invention in which the figure is a diagrammatic view of a preferred closed circuit hydraulic remote control system having a bleeding and filling valve structure represented in cross section.

In the system shown, a cylinder 10 is illustrated as being connected in series with a cylinder 11. Additional slave and/or master cylinders may be connected in series if desired, but for purposes of simplification only the two cylinders 10 and 11 are illustrated. Also, it is immaterial which cylinder is called the master and which the slave, since the use of cylinders in a remote control system is a matter of choice. A piston 12 and a piston 13 are provided respectively in the cylinders 10 and 11, and are preferably mounted on shafts 14 and 15 for connection to actuating devices such as levers 16 and 17 through any suitable means such as gears 18 and 19.

Cylinder 10 is provided with a bypass valve means 25 and cylinder 11 has a bypass valve means 26 for selectively bypassing hydraulic liquid through the cylinders and around the pistons. A valve structure 27 is provided in the system, being connected in series with the cylinders 10 and 11 by any means such as conduits 28 and 29. The other sides of the cylinders 10 and 11 are connected preferably by a conduit 30. Conduits 28 and 29 are connected through the valve structure 27 by means of a passage 31 substantially provided as shown. Thus, with the bypass valves 25 and 26 closed, a closed circuit hydraulic system is provided which may be operated as a remote control, operation of either piston 12 or 13 respectively actuating the other piston 13 or 12 in a synchronized manner well known to one skilled in the art to which the system pertains.

The bypass valve means 25 is constructed and arranged to be operated as either a check valve or to be opened completely as a bypass valve, and comprises a valve element 32, an adjustable stop element 33, and a spring 34 intermediate and secured to the elements 32 and 33. When the stop element 33 is screwed inward, it abuts the valve element 32 to hold same in a closed position. When the stop element 33 is unscrewed a small amount, the spring 34, bearing against the valve element 32, resiliently urges same against its seat, and permitting same to open only under pressure in one direction. When the stop element 33 is unscrewed more than the expanded spring length, the spring 34, being secured to both elements, pulls the valve element 32 open.

The bypass valve means 26 preferably comprises a conventional adjustable shut-off valve element 35 having only open and closed positions. It will be apparent that either or both of the bypass valve means 25 and 26 may be constructed to operate as a check valve if desired, but for purposes of this discussion only one is so constructed.

When either or both of the bypass valve means 25 and 26 are opened, the pistons 14 and 15 may be relatively adjusted to provide the necessary synchronization of the remote control system.

The valve structure 27 is provided with an inlet passage 36 connected with the passage 31 and provided with a check valve 37 and is adapted for selective connection with a source of liquid supply 38 by any means such as an inlet fitting 39 selectively connected with a conduit 40. A bleed outlet passage 41 is connected with the passage 31 and is preferably provided with a conventional adjustable bleed valve 42 preferably adapted for connection with a bleed conduit 43.

A shutoff valve 45 is provided in the structure 27 and is preferably arranged to be screwed in to shut off or

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otherwise close the passage 31 intermediate the inlet and outlet passages 36 and 41 respectively. Thus, when the valve 45 is closed, the valve 42 opened, the valve 26 is opened, and the valve 32 adjusted to operate as a check valve, the hydraulic system is converted into an open circuit system, arranged to be connected at the upstream end with the source of liquid supply 38 and having a bleed opening at the terminus of the circuit, in such a manner that the piston 12 may be operated as a pump. On the piston stroke represented by the direction arrow 46, liquid will be drawn into the upstream side of the cylinder 10 from the supply source 38, the liquid in the other side of the cylinder 10 being pumped through the conduit 30, the cylinder 11, the conduit 29, and out the bleed valve 42. On the opposite stroke of the piston 12, liquid will be forced from the upstream side of the cylinder 10 through the valve means 25 to the downstream or outlet side of the cylinder 10.

When the bleeding and filling is completed, the valves 42, 25, and 26 will be closed and the valve 45 opened, converting the system once again to a closed series circuit for operation as a remote control system.

Although I have described but one preferred embodiment of my invention, it will be apparent to one skilled in the art to which the invention pertains that various changes and modifications may be made therein without departing from the spirit of the invention or the scope of the appended claims.

I claim:

1. In a hydraulic system comprising a plurality of hydraulic cylinders, a piston operable in each cylinder, and means normally connecting said cylinder and piston assemblies in series to provide a closed continuous double-acting hydraulic circuit, each cylinder and piston assembly having a normally closed bypass means comprising a bypass passage having a bypass valve selectively operable to bypass hydraulic liquid through the cylinder and around the piston, said bypass valve being selectively closed for normal operation of said system, valve means connected with said system and selectively operable to convert same to an open hydraulic circuit provided with an inlet at one end and a bleed outlet at the other end, said inlet provided with a check valve and adapted to be connected with a source of liquid supply, and at least one of said bypass valves constructed and arranged to be selectively operable as a check valve to enable the cylinder and piston assembly associated therewith to be operated as a pump having an intake side and a discharge side for pumping hydraulic liquid through said open circuit system.

2. In a hydraulic system comprising a plurality of hydraulic cylinders, a piston operable in each cylinder and means normally connecting said cylinder and piston assemblies in series to provide a closed continuous double-acting hydraulic circuit, each cylinder and piston assembly having a normally closed bypass means comprising a bypass passage having a bypass valve selectively operable to bypass hydraulic liquid through the cylinder and around the piston, said bypass valve being selectively closed for normal operation of said system, valve means connected with said system and selectively operable to convert same to an open hydraulic circuit, provided with an inlet at one end and a bleed outlet at the other end, said inlet provided with a check valve and adapted to be connected with a source of liquid supply, and at least one of said bypass valves constructed and arranged to be selectively operable as a check valve to enable the cylinder and piston assembly associated therewith to be operated as a pump having an intake side and a discharge side for pumping hydraulic liquid through said open circuit system, said valve means comprising a valve housing structure having a passage connected in series intermediate two of said cylinder and piston assemblies, said inlet and said outlet connected with said passage, and a shutoff valve intermediate said inlet and

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said outlet, said inlet being intermediate said shutoff valve and the intake side of said pumping cylinder.

3. In a hydraulic system comprising a plurality of hydraulic cylinders, a piston operable in each cylinder and means normally connecting said cylinder and piston assemblies in series to provide a closed continuous double-acting hydraulic circuit, each cylinder and piston assembly having a normally closed bypass means comprising a bypass passage having a bypass valve selectively operable to bypass hydraulic liquid through the cylinder and around the piston, said bypass valve being selectively closed for normal operation of said system, valve means connected with said system and selectively operable to convert same to an open hydraulic circuit provided with an inlet at one end and a bleed outlet at the other end, said inlet provided with a check valve and adapted to be connected with a source of liquid supply, and at least one of said bypass valves constructed and arranged to be selectively operable as a check valve to enable the cylinder and piston assembly associated therewith to be operated as a pump having an intake side and a discharge side for pumping hydraulic liquid through said open circuit system, said check valve operable bypass valve means comprising a valve element, an adjustable stop element selectively adjusted to abut said valve element to hold same closed for normal operation of the closed circuit system and to be selectively separated from said valve element to enable same to open, and a spring disposed between said elements to resiliently urge said valve element closed when said elements are separated.

4. In a hydraulic system comprising a plurality of hydraulic cylinders, a piston operable in each cylinder and means normally connecting said cylinder and piston assemblies in series to provide a closed continuous double-acting hydraulic circuit, each cylinder and piston assembly having a normally closed bypass means comprising a bypass passage having a bypass valve selectively operable to bypass hydraulic liquid through the cylinder and around the piston, said bypass valve being selectively closed for normal operation of said system, valve means connected with said system and selectively operable to convert same to an open hydraulic circuit provided with an inlet at one end and a bleed outlet at the other end, said inlet provided with a check valve and adapted to be connected with a source of liquid supply, and at least one of said bypass valves constructed and arranged to be selectively operable as a check valve to enable the cylinder and piston assembly associated therewith to be operated as a pump having an intake side and a discharge side for pumping hydraulic liquid through said open circuit system, said check valve operable bypass valve means comprising a valve element, an adjustable stop element selectively adjusted to abut said valve element to hold same closed for normal operation of the closed circuit system and to be selectively separated from said valve element to enable same to open, and a spring disposed between said elements to resiliently urge said valve element closed when said elements are separated, said spring being secured to said elements so that selective separation of same beyond a predetermined distance will open said valve for bypass operation.

5. In a hydraulic system comprising a plurality of hydraulic cylinders, a piston operable in each cylinder, and means normally connecting said cylinder and piston assemblies in series to provide a closed continuous double-acting hydraulic circuit, each cylinder and piston assembly having a normally closed bypass means comprising a bypass passage having a bypass valve selectively operable to bypass hydraulic liquid through the cylinder and around the piston, said bypass valve being selectively closed for normal operation of said system, valve means connected with said system and selectively operable to convert same to an open hydraulic circuit, said valve means comprising a unitary valve housing structure having a passage connected in series intermediate two of said

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cylinder and piston assemblies, an inlet passage in said housing structure and connected with said first passage, said inlet passage having a check valve therein and adapted to be selectively connected with a source of liquid supply, an outlet passage in said housing structure and connected with said first passage, a bleed valve in said outlet passage and constructed and arranged to be selectively opened when said system is converted to an open circuit, and a shutoff valve in said housing structure and selectively operable to close said first passage intermediate said inlet and outlet passages, at least one of said bypass valves constructed and arranged to be selectively operable as a check valve to enable the cylinder and piston assembly associated therewith to be operated as a pump having an intake side and a discharge side for pumping hydraulic liquid through said system when the shutoff valve is closed and said bleed valve is open, and said inlet passage of said housing structure being intermediate the shutoff valve and the intake side of the pumping cylinder.

6. In a hydraulic system comprising a plurality of hydraulic cylinders, a piston operable in each cylinder, and means normally connecting said cylinders in a closed

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continuous double-acting hydraulic circuit, each cylinder and piston assembly having a normally closed bypass means operable to be selectively opened to bypass hydraulic liquid around said piston, means selectively operable to convert said system to an open hydraulic circuit provided with an inlet at one end and an outlet at the other end, said inlet being provided with a check valve and adapted to be connected with a source of liquid supply, and at least one of said bypass means being selectively adjusted to operate as a check valve to enable the cylinder and piston assembly associated therewith to be operated as a pump for pumping hydraulic liquid through said open circuit system.

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