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MEANS FOR COMPENSATING FOR FLUID LOSS
IN HYDRAULIC TRANSMISSION SYSTEMS
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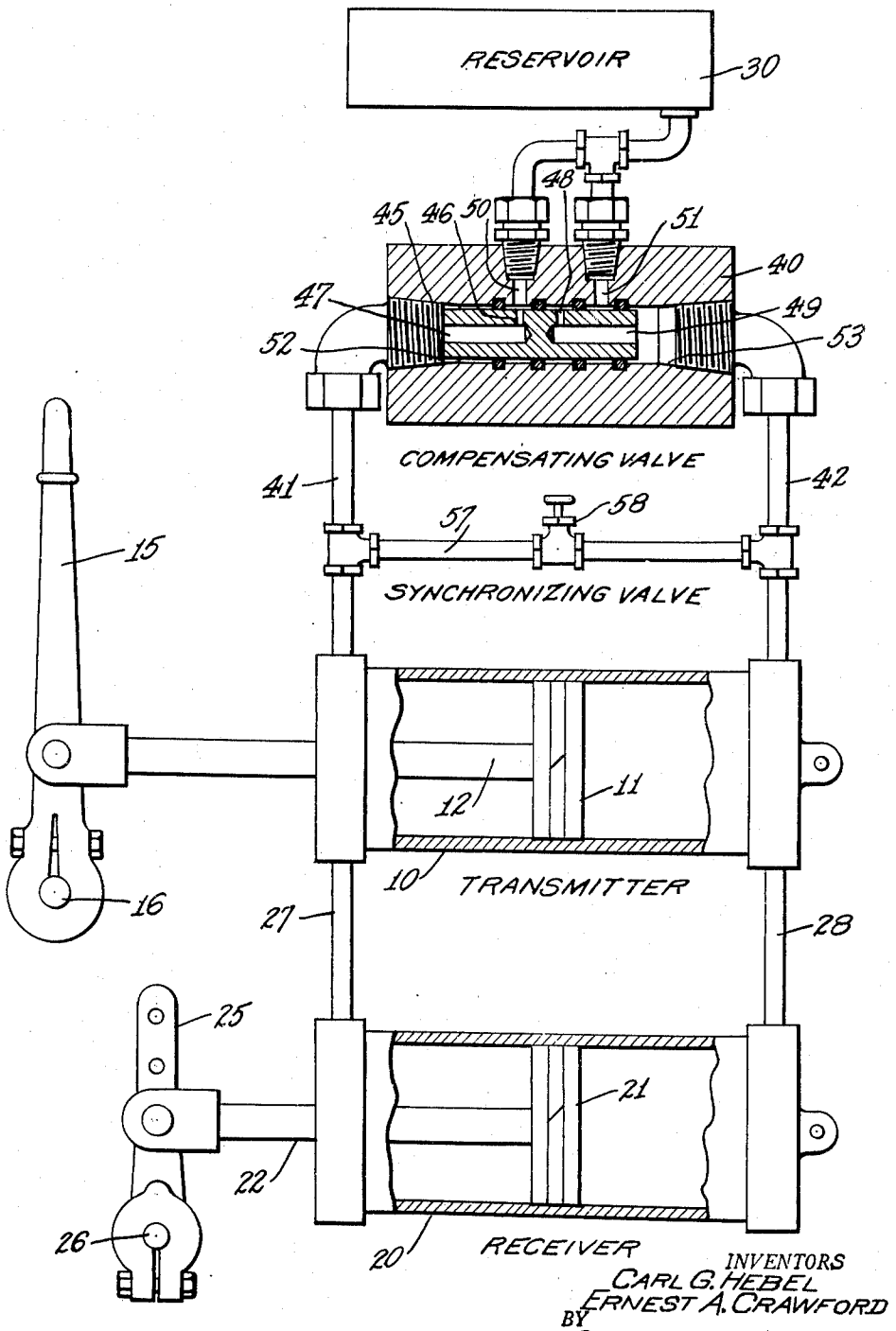

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MEANS FOR COMPENSATING FOR FLUID LOSS IN HYDRAULIC TRANSMISSION SYSTEMS

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1 Claim. (Cl. 60—54.5)

1

This invention relates to hydraulic controls of the type wherein movements of a transmitter are reproduced by a receiver through the medium of a fluid connection. More particularly, the invention relates to 2-pipe hydraulic systems wherein fluid is moved in one direction between transmitter and receiver, and in the opposite direction between receiver and transmitter. In such systems, both the transmitter and the receiver are of the double-acting variety in which two mechanically separate but functionally inter-related hydraulic systems are present, each system including one of said pipes and so arranged that movement of fluid in one pipe in a given direction causes movement of the fluid in the other pipe in the opposite direction.

In closed systems of the above type, the problem arises of relieving the pressure in the system upon rise in temperature, and of compensating for the variable volume of liquid due to temperature variation and leakage. Heretofore, the method employed to solve this problem consisted in proving each separate hydraulic system (each of the two sides of a double-acting, closed system) with a reservoir under pressure, and the transmission of power was effected against the higher pressure existing in the respective reservoirs. Several undesirable results followed from the use of this arrangement. In the first place, since each side was provided with its own reservoir, leakage or temperature variation in one side, different from the leakage or temperature variation in the other side, caused loss of synchronism between the transmitter and the receiver. In the second place, since the pressure in the reservoir determined the force which could be transmitted and received, any leakage or temperature variation which varied the pressure in the respective reservoir also varied the output from the transmitter.

It is, therefore, one of the principal objects of this invention to provide pressure release and volume compensation in a 2-way hydraulic control of the type described wherein the necessary correction will be made automatically without affecting the capacity of the transmitter and the receiver and independent of the pressure in the reservoir.

It is a further object of this invention to provide pressure release and fluid volume compensating means in which a single reservoir may be employed for both sides of the 2-way, 2-pipe hydraulic control.

2

It is a further object to provide pressure release and fluid volume compensating means for a plurality of 2-pipe hydraulic controls in combination with a single reservoir.

It is a further object of this invention to provide compensating means wherein slow leaks on either side of a 2-pipe hydraulic control will not cause loss of synchronism between transmitter and receiver.

Still other objects and advantages of this invention will become apparent in the following detailed description thereof.

In the accompanying drawing,

The figure is a front elevation of an assembly, partly sectioned vertically, of one embodiment of this invention.

Referring to the drawing, the invention is shown as applied to a 2-pipe hydraulic control comprising a transmitter cylinder 10 within which operates a piston 11 connected by rod 12 to a transmitter handle 15 pivoted for movement at 16. The control also comprises receiver cylinder 20 within which operates a piston 21 connected by rod 22 to a receiver, or operated, member 25 pivoted for movement at 26. The pistons 11 and 21 divide the cylinders into two separate chambers, and corresponding chambers of the cylinders are connected by pipes 27 and 28 so that two separate hydraulic systems are formed on opposite sides of the pistons. The systems are, however, functionally interrelated whereby movement of fluid in one system in one direction causes movement of fluid in the other system in the opposite direction.

The two separate hydraulic systems are filled with liquid, giving rise to the problem set forth in the introduction hereto of providing pressure release and of compensating for changes in volume of liquid due to temperature variations and leakage. One solution which avoids the objections present in systems heretofore employed is shown in the drawing. In this form of the invention, a single reservoir 30 is employed and this reservoir is adapted to be connected to both hydraulic systems (i. e., both sides of the 2-way, 2-pipe hydraulic control) by way of a compensating valve member 40 and connections 41 and 42 to the respective hydraulic systems at opposite sides of the control. The reservoir 30 is at atmospheric pressure, if vented, or at higher than atmospheric pressure, if pressurized. Within the valve member 40 is a sliding valve 45 having ports 46, 47 cooperating with connection 41, and having ports 48, 49 cooperating with

connection 42. The ports 46 and 48 selectively are connected to the reservoir by way of ports 50 and 51 which are so positioned that only one port 46 or 48 can cooperate with its respective port 50 or 51 at a time. The higher pressure in one side of the hydraulic control will cause the sliding valve 45 to be moved toward the lower pressure side until it strikes stop 52 or 53. In this position the reservoir is connected to the low pressure side. Thus, if the handle 15 is operated to move piston 11 to the right, pressure will be increased in the pressure system at the right of pistons 11 and 21 and connecting pipe 23. Pressure will be increased in pipe 42 and the right hand end of valve member 40, to move the valve 45 to the left until port 46 registers with port 50 to connect the reservoir to the low pressure side through pipe 41 and the pressure system to the left of pistons 11 and 21 and pipe 27. Similarly, movement of handle 15 to the left, will move piston 11 to the left and move sliding valve 45 to the right, to cause ports 48 and 51 to register, to connect the reservoir to the low pressure (now the right hand) system of the control.

It will be observed that the passages 50 and 51 are positioned further apart than ports 46 and 48. This means that only one of these ports can register with its respective passage at any one time. Furthermore, the distance between passages 50 and 51 is sufficiently greater than the distance between the seals forming the inner boundaries of ports 46 and 48 so that when one of these ports moves out of registry with its respective passage a certain degree of movement of the valve body will take place during which neither port registers with its respective passageway. In this manner it is impossible for both ports to be even partially in register with their respective passageways at any one time, and therefore it is impossible to transfer liquid from the hydraulic system at one side to the hydraulic system at the other side. This is an extremely important feature in such applications as contemplated here where precise synchronism between the transmitter and the receiver elements is essential. If at any time even momentary connection were made between the hydraulic systems at the two sides, then obviously, there would be a greater or less loss of synchronism which in those applications dependent upon exact synchronism would be so undesirable as to render the device inoperative.

Since there is normally a connection between one side (or pressure system) and the reservoir, pressure release and volume compensation are thus assured. A connection 57 directly between the pressure systems which short circuits the valve member 40 permits synchronization by means of valve 58.

Changes in temperature will result in a displacement in the relative positions of handle 15 and lever 25 dependent upon the position of the movable valve body. The position of the movable valve body is at any time dependent upon the direction of force last applied to the handle 15. If the number of times that the handle 15 is moved from right to left is equivalent to the number of times it is moved in the reverse direction, which is essential, and there are several such movements during the period of temperature change, then deviatons in one direction will compensate for those in the other direction and thus maintain the system in substantial synchronization. For unusual conditions when the system may be left in one position for an extended period of time during which temperature changes occur the synchronizing valve 58 is provided which may be used for synchronizing the handle and lever at either end of the stroke or at any intermediate position if the position of lever 25 is known. This would be of considerable advantage in aircraft where it is desirable to synchronize at full throttle in flight and at closed throttle on the ground and in power boats where it would be desirable to synchronize at full throttle under pursuit conditions and closed throttle when maneuvering in harbors or controlling gears, clutches, etc.

The foregoing description of the invention is merely illustrative and changes may be made within the scope of the appended claim.

Having described our invention, what we claim and desire to secure by Letters Patent is:

In a hydraulic control, a double-acting transmitter, a double-acting receiver, fluid transferring connections between the respective sides of the transmitter and the receiver whereby separate hydraulic systems are formed on opposite sides of the control, a reservoir, means including a valve whereby said hydraulic systems may be selectively connected to and disconnected from the reservoir when the transmitter is actuated, said last named means comprising a stationary valve casing and a movable valve body, fluid connections between the pressure systems and opposite sides of the valve body whereby the valve body will be moved in response to the pressure in the higher pressure hydraulic system, said casing having a plurality of passages communicating with the reservoir, said valve body having a plurality of ports adapted to cooperate with the passages in said casing, the distance between ports being different from the distance between passages by an amount such that only one port can register with its respective passage at any time, the difference in distances between ports and passages being also sufficient so that the second port cannot register with its respective passage until the first port has passed a predetermined distance out of register with its respective passage, whereby no fluid can pass between the hydraulic systems.

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