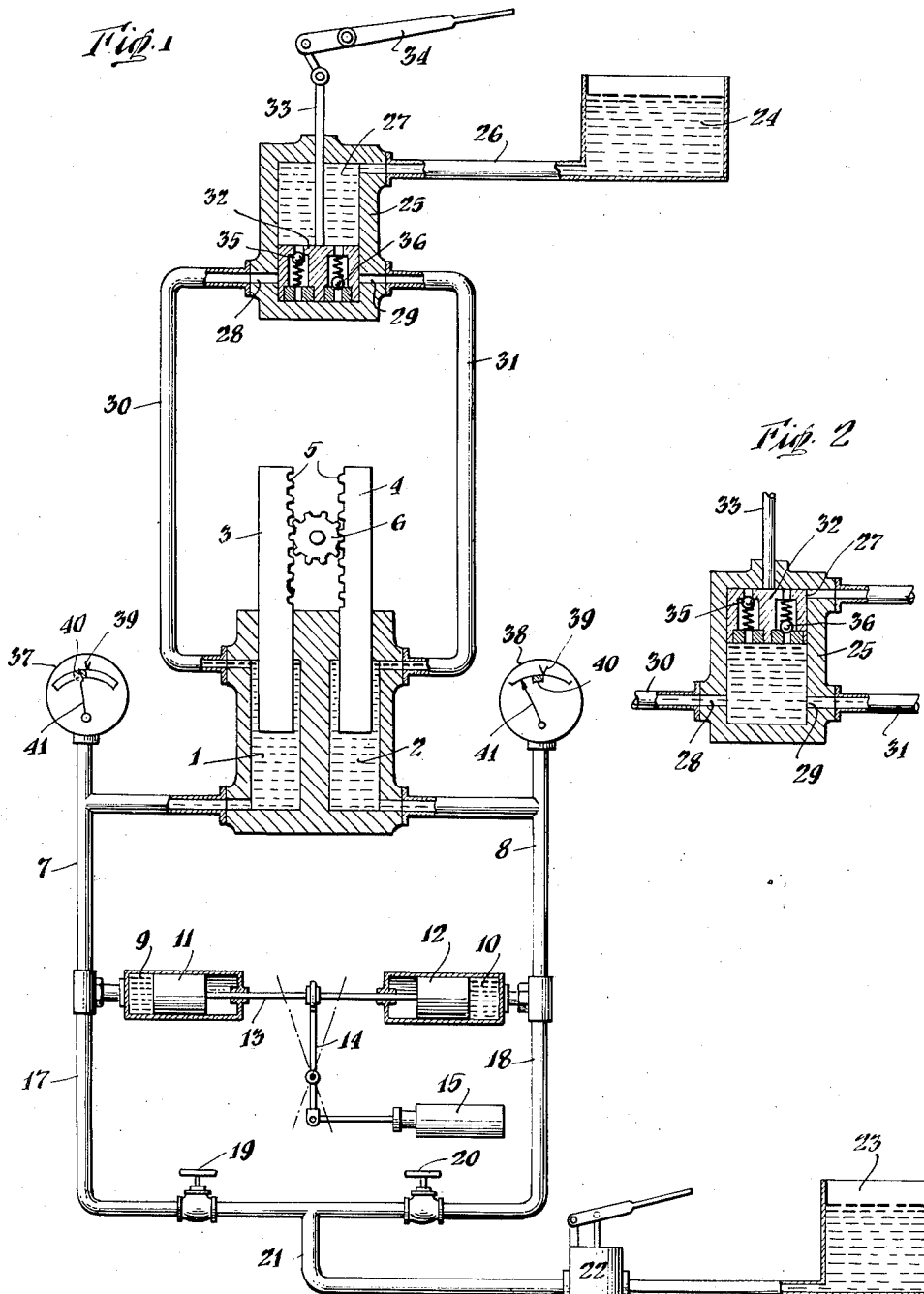


July 29, 1952

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HYDRAULIC COMPENSATING AND BALANCING DEVICE FOR
RECIPROCAL HYDRAULIC REMOTE-CONTROL CIRCUITS
Filed Oct. 8, 1949

2,604,757



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HYDRAULIC COMPENSATING AND BALANCING DEVICE FOR RECIPROCAL HYDRAULIC REMOTE-CONTROL CIRCUITS

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Application October 8, 1949, Serial No. 120,258
In France October 15, 1948

3 Claims. (Cl. 60—54.5)

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The present invention relates to hydraulic remote-control installations commonly used, especially on board ship, to operate remotely located elements. Such type of control is especially applied to the actuation of apparatus operating the rudder and removed at a distance from the pilot's station.

Such a remote control installation essentially comprises a keying or transmitting station including two juxtaposed cylinders into which penetrate plunger pistons interconnected for reciprocal motion through racks meshing with a control gear interposed therebetween, a receiving station including two cylinders in which are movable pistons connected in the first place with each other for reciprocal motion and in the second place with the element to be operated, and conduits respectively connecting a cylinder of the keying station with a cylinder of the receiver station and adapted to define with their respective cylinders two separate capacities or circuits entirely filled with an incompressible liquid such as oil. Any displacement of the keying pistons will be translated, depending on which of the plunger pistons is sinking, into a displacement of the element to be controlled in one or the other direction, from an intermediate zero position.

The correspondence between the zero positions of the keying device and the receiver is insured by filling both circuits with the desired amount of oil. For such a filling operation, the conduits pertaining to both these circuits are generally connected, through the medium of a valve by which they may be isolated during operation, with a common outlet conduit of a pump supplied from an oil tank at free atmospheric pressure.

Hitherto, the filling operation was effected at atmospheric pressure, a balanced condition of both circuits being a result of the fact that the said filling operation was made through a common pump, with the keyer and the receiver both at zero position.

Such a balanced state unfortunately cannot be maintained in a permanent manner because of numerous external factors. In particular, temperature variations may determine in either one or both of the circuits, expansions and contractions which will produce within the liquid vacuum or over-pressure effects. Especially in the case of over-pressures, defects in the seals may result in leakage of the liquid. The resulting depressions which are increased by such leaks cause compensating penetrations of air.

Thus there often is air entrapped within the

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circuits, either because of such air penetrations or due to the release of air emulsified during the filling operation.

Now, any difference in pressure at zero position between the two circuits or the presence of air in the circuits will bring about the fact that the receiver no longer will faithfully reproduce the displacements of the keyer, and this constitutes a major defect in operation.

To correct this defect, known installations comprise in addition to the filling device, auxiliary means making it possible to compensate for oil leaks and provide for a fresh balancing of the system. No means however have heretofore been suggested for supplying a satisfactory solution to the problem of eliminating the state of unbalance resulting from the presence of air. It is only by the use of expedients which entail the loss of valuable time that it is possible to eliminate the entrapped air, especially through draining operations by means of suitably located drain-cocks.

Now the presence of air in the circuits constitutes the most frequent and the gravest defect. For it causes a lost motion in the control, since a certain displacement of the down-moving plunger is used in compressing said air up to the necessary pressure for displacing the corresponding receiver piston. The keyer therefore is already displaced some points off zero at the time the receiver leaves the zero position.

The present invention has for its object to provide a method making it possible to reduce, in any desired proportion, the effect of entrapped volumes of air and which consists of creating in the circuits, when balancing the installation, a pressure systematically greater than atmospheric pressure.

The invention has a further object to provide a device making it possible through a single operation to achieve both compensation and balancing at a predetermined pressure in the installation as a whole. The device the provision of which forms an object of the invention is characterized in that it comprises an auxiliary tank connected with the end of a special cylinder the other end of which communicates through two conduits with the keying cylinders and in which is movable a piston connected with an operating lever adapted to seal, in its idle position, the outlets of two balancing conduits and comprising a check-valve and an intake valve spring-loaded at the pressure which it is desired to supply in the system.

The features of the invention will stand out

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from the ensuing description of an hydraulic remote-control installation for a steering apparatus comprising said device, given exclusively by way of example with reference to the accompanying drawings, in which:

Figure 1 is a diagrammatic view of the assembled system in operation;

Figure 2 is a view of the balancing cylinder alone during the balancing operation.

As shown in Figure 1, the keyer or transmitter comprises two independent juxtaposed cylinders 1 and 2 in which are inserted plunger pistons 3 and 4 interconnected for reciprocal movement through their rack bars 5 with the control gear 6. Said cylinders are respectively connected through two conduits 7 and 8 with the cylinders 9 and 10 of the receiver, shown as being arranged in alignment with each other, in which two pistons 11 and 12 are movable, interconnected together by a common piston rod 13 acting on a lever 14 actuating the apparatus to be controlled (not shown) through a servo-motor 15. Extensions 17 and 18 of the conduits 7 and 8 provided with valves 19 and 20 which enable them to be isolated, are connected by a common conduit 21 with the filling pump 22 supplied from an oil tank 23 at free atmosphere.

According to the invention, an auxiliary filling tank 24 is provided connected with a filling cylinder 25 by a conduit 26 opening at 27 into the end of said cylinder. From the opposite end as at 28 and 29 lead two symmetrical conduits 30 and 31 connecting the filling cylinder with the two cylinders 1 and 2 of the keyer. In said filling cylinder a piston 32 is moveable, the rod 33 of which is connected with a control lever 34 and which, in its idle position (Fig. 1) plugs the entrances 28 and 29 of both conduits. Within said piston there are mounted first a check-valve 35 and secondly a spring-loaded intake or relief valve 36.

Whenever operation of the remote control apparatus reveals the necessity of effecting a balancing or compensating operation, it is only necessary to perform a single operation to restore the circuits to their normal operative condition. Such operation is effected at the zero point. It consists of actuating the lever 34. The piston 32 starting from its lowermost idle position uncovers the entrances 28 and 29 of both balancing conduits, which restores the pressure balance in both circuits. The liquid contained in the cylinder, under the effect of the vacuum underneath the piston, flows through the latter by means of the check-valve 35 into the portion of the cylinder which communicates with the balancing ducts (Fig. 2). The downward return movement of the piston causes closure of the check-valve 35 and the liquid is forced into both circuits as a whole, so long as the pressure has not reached a value corresponding with the spring-loading of the intake or relief valve 36. At the same time the top portion of the cylinder is supplied by the tank. Upon the pressure in the circuits reaching such value, said valve 36 will open, allowing the excess liquid to return into the top of the cylinder. At the end of its stroke, the piston will again seal the entrances 28 and 29 of both balancing ducts and both circuits will again be isolated, both at a common pressure as corresponding to the spring-loading of the intake or relief valve.

Placing under pressure the oil in the circuits of the system at zero point results in reducing the lost motion which may arise due to the pres-

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ence of air. To prove this, assuming a is the volume of entrapped air, at atmospheric pressure, the preliminary placing of the circuits under the pressure p atmospheres will reduce such volume to

$$\frac{a}{p}$$

During operation, if P atmospheres is the pressure necessary to start the receiver in operation from its position of balance, the volume of entrapped air on starting is

$$\frac{a}{P}$$

In the event of filling at atmospheric pressure, the lost motion is measured by the travel necessary to reduce a to

$$\frac{a}{P}$$

In other words, the lost motion may be measured by

$$a - \frac{a}{P}$$

When the circuits are filled at a preliminary pressure p atmospheres, the lost motion is measured by

$$\frac{a}{p} - \frac{a}{P}$$

It will thus be seen that the closer the initial pressure p to the pressure P necessary for starting, the smaller will the lost motion be, and that said lost motion will equal zero for $p=P$.

It thus is possible, by filling the conduits according to the invention at a suitable preliminary pressure, to reduce to any desired extent and even quite suppress the idle period at starting. Moreover, the presence in the system of a pressure at all times greater than atmospheric pressure will tend to prevent penetration of air, and states of unbalance will be less frequent. Where, due to a leak for instance, a condition of unbalance is found to exist between the pressure values in both circuits at zero position, as shown by the reading of pressure gauges 37 and 38 mounted on both circuits at the keying station, a single operation effected at the keying station will insure compensation and balancing at the selected preliminary pressure. Such an operation may be effected by unskilled operators; it is merely necessary for example to give oneself an upper limit for the permissible deviations from the initial pressure level shown by the indices 39 on the gauges 37 and 38 and provide on each pressure-gauge dial a coloured sector 40 into which the pointer is to return in the condition of balance. Each time the gauge pointer will move out of said sector at zero position, it will only be necessary to actuate once in each direction the balancing piston lever 34 while the control gear 6 is at the zero point in order to reestablish normal conditions of operation.

There is thus obtained, as a result of the means described, a remote control which is ideally rigid or faithful, offering but little danger of air penetration and easy to maintain in good working order.

It will be understood that the invention is not restricted to the form of embodiment illustrated and described and to the application contemplated, given by way of example. Thus in particular, the sealing of the balancing conduits may

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be obtained rather than by the piston itself, by check-valves linked with the displacement of said piston.

What I claim is:

1. A hydraulic remote control system comprising a transmitter, a receiver, two separate and reciprocally controlled hydraulic circuits between the transmitter and the receiver, a source of liquid, valve means, a supply conduit connected between said source of said valve means, a pair of branch conduits each connected between said valve means and one of said circuits, said valve means being movable between a normal position wherein it blocks fluid communication between any of said conduits and a filling position wherein said branch conduits are in fluid communication with each other and with said supply conduit.

2. A hydraulic remote control system as defined in claim 1, including means operable only when said valve means is in its filling position to force liquid into said branch conduits at a predetermined pressure at least equal to the pressure which must be developed in the circuits to start the receiver moving in response to operation of the transmitter.

3. A hydraulic remote control system comprising in combination a transmitter, a receiver, two separate and reciprocally controlled hydraulic circuits between the transmitter and the receiver, a cylinder, a pair of conduits, each connected at one end to one of said circuits, and opening at its opposite end through a side wall of said cylinder adjacent one end thereof, a piston in said cyl-

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inder, said piston being effective to close said conduits when it is at said one end of the cylinder, a source of liquid, means providing fluid communication between the other end of the cylinder and said source, said piston having two passages therethrough connecting the ends of said cylinder, a check valve in one of said passages biased to closed position and arranged to open when said piston moves toward said other cylinder end so as to transfer liquid from said source to said circuits, a relief valve in the other of said passages, a spring biasing said relief valve closed against the pressure in said one end of the cylinder, so that said relief valve opens only when the pressure in said one cylinder end exceeds a value determined by said spring, and means for reciprocating said piston.

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REFERENCES CITED

The following references are of record in the file of this patent:

UNITED STATES PATENTS

Number	Name	Date
404,472	Dunn	June 4, 1889
2,348,323	Binder	May 9, 1944

FOREIGN PATENTS

Number	Country	Date
757,282	France	Oct. 9, 1933
895,284	France	Mar. 27, 1944
517,314	Great Britain	Jan. 26, 1940