

Nov. 3, 1953

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HYDRAULIC REMOTE CONTROL SYSTEM, INCLUDING TRANSMITTER
AND RECEIVER STATIONS AND MEANS FOR AUTOMATICALLY
RESYNCHRONIZING THE RECEIVER

Filed May 5, 1947

4 Sheets-Sheet 1

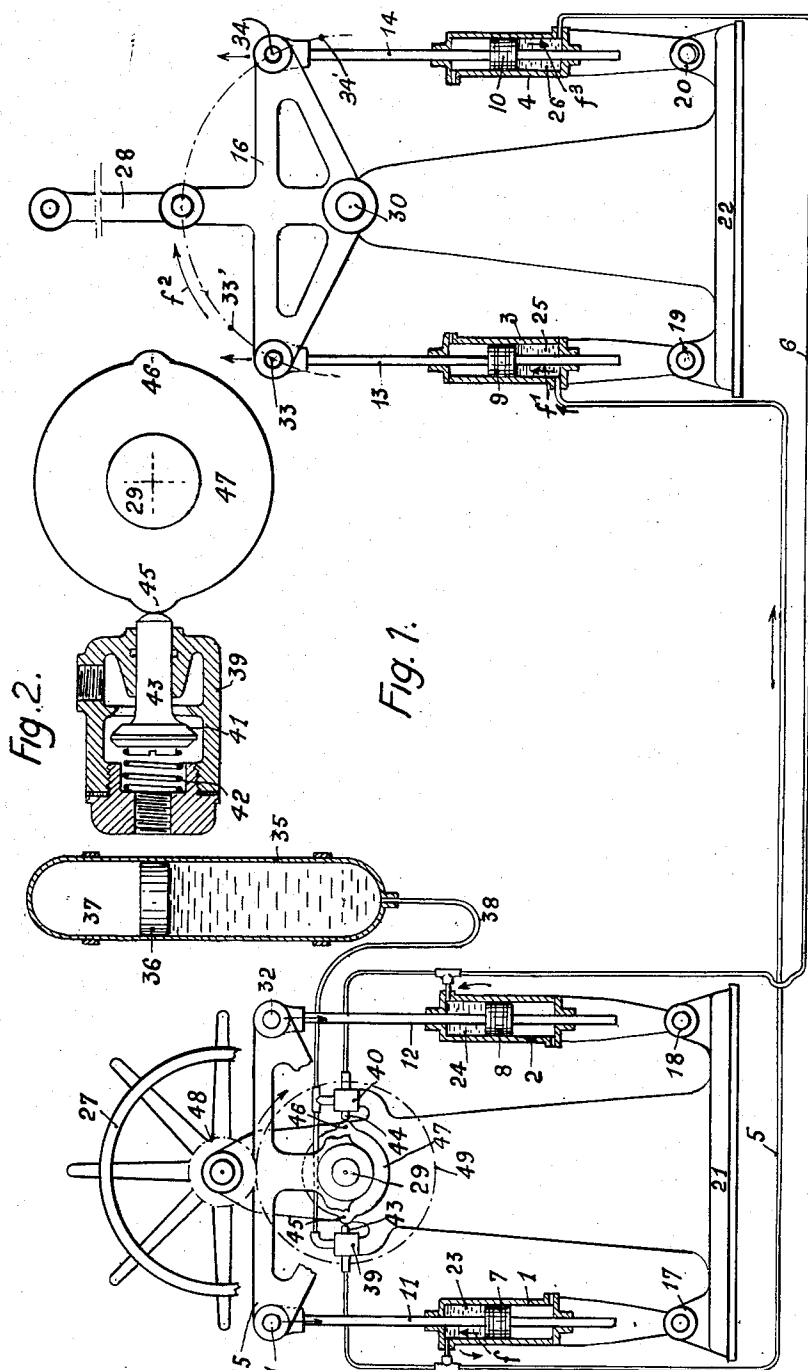


Fig. 1.

Fig. 2.

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4 Sheets-Sheet 2

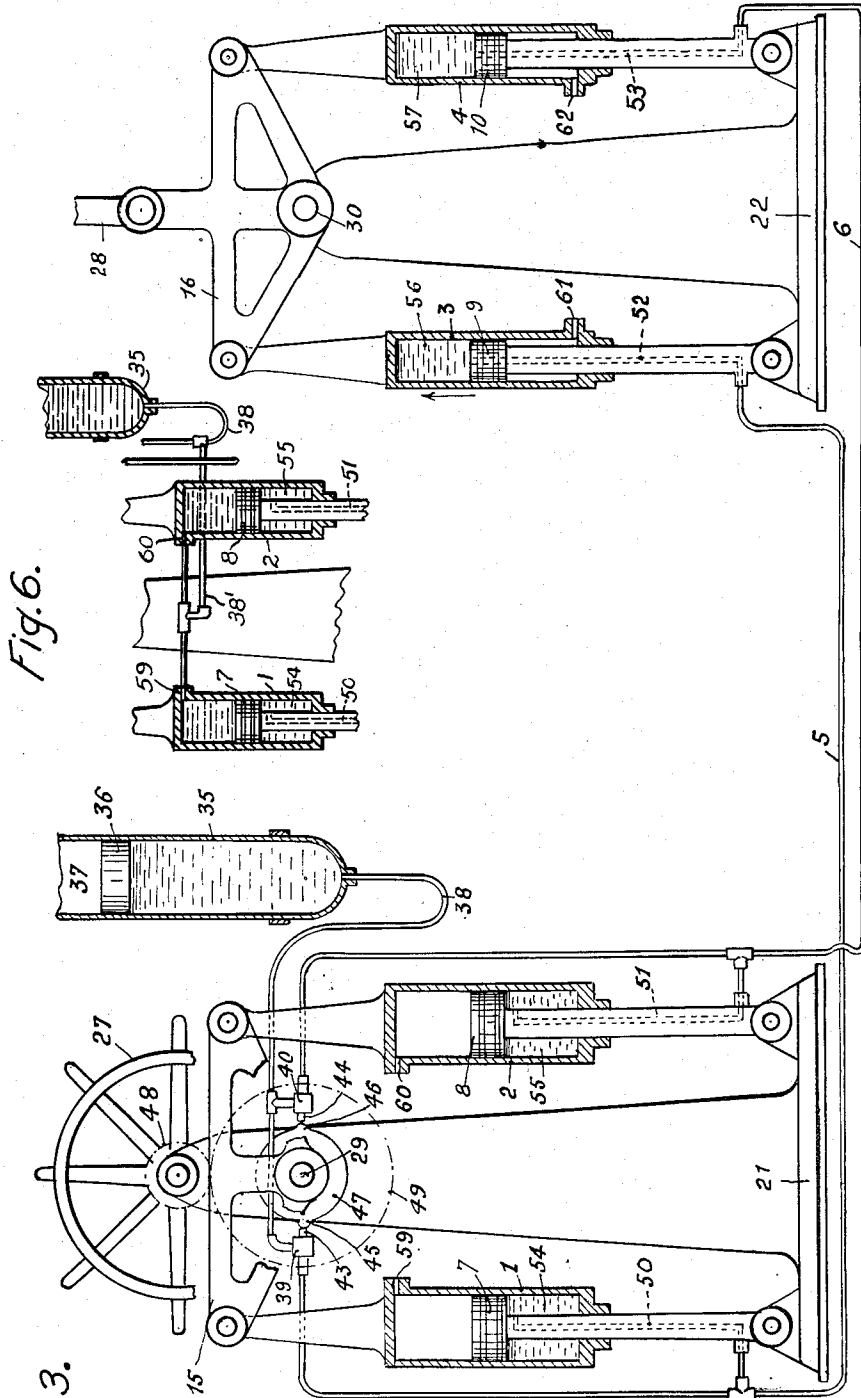


Fig. 6.

Fig. 3.

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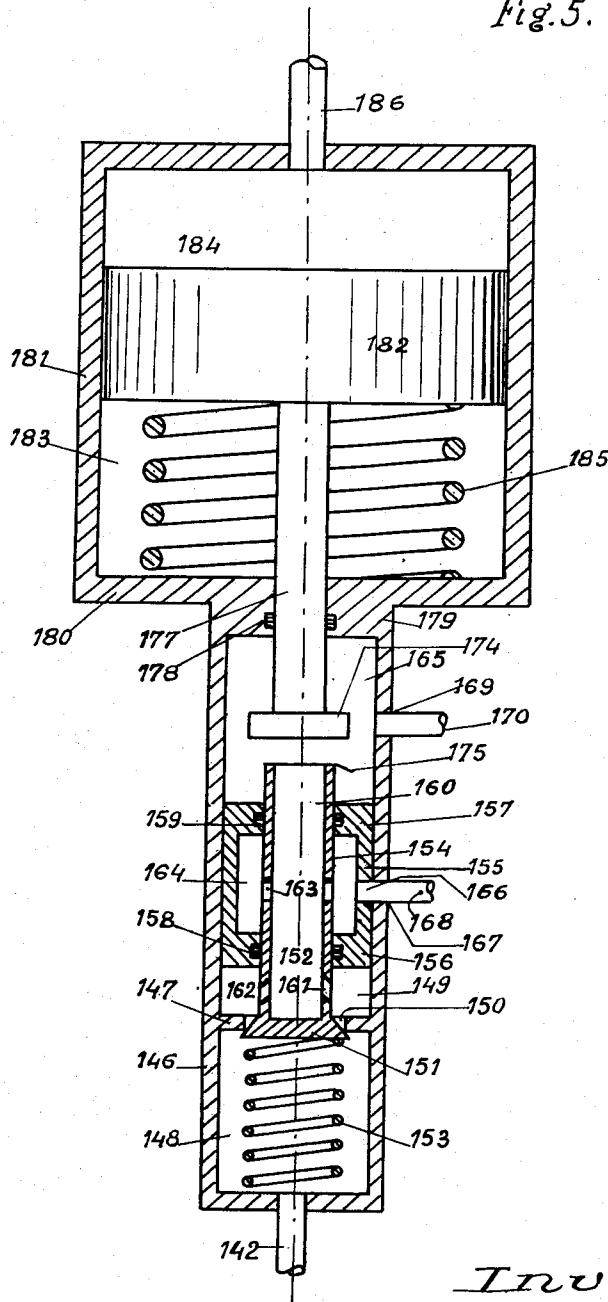
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4 Sheets-Sheet 4

Fig. 5.



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HYDRAULIC REMOTE CONTROL SYSTEM, INCLUDING TRANSMITTER AND RE- CEIVER STATIONS AND MEANS FOR AU- TOMATICALLY RESYNCHRONIZING THE RECEIVER

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11 Claims. (Cl. 60—54.5)

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The present invention relates to a hydraulic remote control system providing for automatic setting from the mid position.

The prior art is replete with hydraulic systems for reproducing remotely by means of a receiver the movement of a transmitter in such fashion that for a particular position of the transmitter a similar position of the receiver is obtained.

In general such systems are provided with auxiliary devices or controls providing for resynchronizing of the transmitter and receiver at the conclusion of their travel. In some instances, particularly in telemotor systems, the normal position of the apparatus is the mid position of the total travel. Therefore it is necessary to provide means for synchronizing the receiver with respect to the transmitter when the transmitter is in the mid position; in other words, it is necessary to positively move the receiver into the mid position in the event it has for any reason drifted out of this position.

Accordingly it is one object of the present invention to provide in a hydraulic remote control system an arrangement which will automatically move the receiver to its mid position when the transmitter has been brought to mid position and one in which the restoring torque effecting this movement will cease as soon as the transmitter is moved away from the mid position.

A more specific object of the present invention is to provide a hydraulic remote control system in which the receiver and transmitter each include a pair of hydraulic cylinders and pistons constituting hydraulic groups and each pair of cylinders and pistons are respectively pivoted to a base and to an oscillating cross beam in turn pivoted to a post by a pivot which lies outside of the line connecting the pivoting axes of the hydraulic groups with the cross beam.

It is a further object to provide in an arrangement of this character, conduits connecting the transmitter hydraulic groups to the receiver hydraulic groups and means automatically connecting these conduits with a hydropneumatic accumulator or the like when the transmitter is in its mid position.

A further object is to provide an arrangement in which either the pistons or the cylinders of the hydraulic groups are bodily pivoted to the cross beam.

Another object is to provide, in a system of this character, rods carried by the pistons of the hydraulic groups pivoted to the cross beam at the opposite ends thereof and above the axis of

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pivotation of the cross beam with respect to the post and pivoting the cylinders with which the pistons are associated to the base of a post and extending the piston rods beyond the pistons so that they pass through the base of the respective cylinders.

It is a further object to provide in a system of this character a particular disposition of the conduits interconnecting the cylinders of the hydraulic groups respectively associated with the receiver and transmitter so that the liquid in the cylinders are on opposite sides of the pistons in the respective groups.

It is a further and more specific object to provide an arrangement in which the piston rods are each provided with a duct through which the liquid in the cylinders pass to and from the conduits connecting the respective transmitter and receiver groups and in which construction the rods are pivoted to the base of the post thereby providing that the cylinders which are pivoted to the cross beam constitute the movable members.

It is another object to provide an arrangement for use in installations where the receiver must overcome a comparatively high resistance such as in moving rudders of heavy aircraft and in which event, the movement of the receiver corresponding to that of the transmitter may be initiated by an external source of energy independent of the transmitter and which energy may constitute the pressure existing in another hydropneumatic accumulator operative as a servomotor.

Further and more specific objects will be apparent from the accompanying drawings in which:

Figure 1 is a view partly in section illustrating a first example of the remote control system;

Figure 2 is a cross sectional view on an enlarged scale through a valve chest providing automatic communication between the hydropneumatic accumulator and the connection pipes or conduits when the transmitter is in its mid position;

Figure 3 is a view partly in section illustrating a modification of the system shown in Figure 1 in which the cylinders of the hydraulic groups constitute the movable members;

Figure 4 is a diagrammatic view of a third embodiment;

Figure 5 is a view partly in section and on an enlarged scale of a distributor device embodied in the modification shown in Figure 4; and

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Figure 6 is a partial view of the embodiment of Figure 3, modified to provide for automatic restoring of the transmitter to mid position.

In the modification of Figure 1, the system includes a transmitter and receiver respectively provided with hydraulic groups comprising equal cylinders 1, 2 and 3 and 4. Conduits or piping 5 and 6 connect the upper portions of the cylinders 1 and 2 with the lower portions of the cylinders 3 and 4 respectively.

Pistons 7, 8, 9 and 10 are associated with the respective cylinders 1 to 4 and embody piston rods 11, 12, 13 and 14. The piston rods 11 and 12 are pivotally connected at 31 and 32 to the cross beam 15 which is pivoted at 29 to the upright portion of the post constituting the transmitter. The cylinders 1 and 2 are each provided with an extension including bearings 17 and 18 and by which the cylinders 1 and 2 are pivoted to the base 21 of the transmitter. As indicated in the drawings, the piston rods 11 and 12 are slidably guided and pass through apertures in the base or bottom of the respective cylinders 1 and 2. With respect to the receiver column, the piston rods 13 and 14 are pivoted at 33 and 34 to a cross beam 16 which in turn is pivoted at 30 to the post and the cylinders 3 and 4 are further provided with extensions and bearings 19 and 20 by which they are pivotally connected to the base 22 in a manner similar to the arrangement of the transmitter.

It is noted that the piston rods 11 to 14 pass through liquid chambers 23, 24, 25 and 26 and at the receiver the chambers 25 and 26 containing the liquid are below the pistons 9 and 10, that is they are on the side of the piston opposite to the location of the cross beam whereas in the constructional arrangement of the transmitter, the liquid chambers 23 and 24 are arranged between the pistons 7 and 8 and the cross beam 15.

The driving member at the transmitter is constituted by a control wheel 27 and the member to be moved in conformity therewith constitutes a lever 28 actuated by the controlling member or receiver.

The arrangement just described will provide an exact reproduction of the movements of the transmitter at the receiver if the transmitter and receiver cylinders are equal. However, it will not provide for compensation for positive or negative variations of the volume of the working fluid or for re-setting or restoring of the receiver to the mid position.

According to the main characteristics of the present invention the cross beams 15 and 16 oscillate about axes 29 and 30 respectively which, as indicated, are positioned outside of the line joining the axes 31-32 and 33-34 which constitute the pivoting axes of the piston rods with respect to the cross beams. The importance of this physical disposition of the various pivot points will be brought out hereinafter. Suffice it to say, that in accordance with well known mechanical principles such an arrangement provides for the existence of unequal effective lever arms with respect to the vertical plane passing through the pivot points 29 and 30 and bisecting the bases 21 and 22 respectively between the pivot connections of the cylinders to the bases. In this arrangement it is clear that when the cross beam 16 is oscillated the cylinders 3 and 4 can respectively move through different angular distances and thereby provide that the pivot point 33 approaches the aforementioned vertical plane while the pivot point 34 moves further away from this

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plane, as illustrated, thus providing for the existence of unequal effective lever arm distances.

A hydropneumatic accumulator 35, consisting of a cylinder closed at its upper end, containing a piston 36 above which is provided a compressed air cushion 37, is connected by a pipe or conduit 38 to valve chests 39 and 40, respectively which insure that when the control wheel 27 is in the mid position of its total movement the conduits 5 and 6 are automatically placed in communication with the accumulator 35.

As indicated in Figure 2 the valve chests 39 and 40 are each provided with a valve 41 urged by a spring 42 to closed position. The valves are provided with stems 43 and 44 respectively passing through the casings 39 and 40 and engageable by cam surfaces 45 and 46 formed on a ring 47. As shown in this figure, the cam surfaces 45 and 46 are in alignment with one another and have their axes horizontal when the control wheel occupies its mid position. The valve chests are so disposed that the axes of the valves are horizontal.

Preferably the ring 47 is fast with the control shaft 29 which also constitutes the pivot of the cross beam 15. This shaft is driven by a pinion 48, keyed to the shaft of the wheel 27, and which pinion is in mesh with a gear 49 fixed to shaft 29.

The operation of this arrangement is such that when the transmitter wheel 27 is held by the pilot in the mid-position, the volumes of liquid contained in cylinders 1 and 2 are equal to one another, owing to the particular design of the system, and further, these cylinders, as well as the cylinders 3 and 4 of the receiver, are connected in parallel with the accumulator 35, the valves 41 of chests 39 and 40 being in the open position under the action of the cam surfaces or shoulders 45, 46.

Therefore, if at this instant the cross beam 16 of the receiver should, for any particular reason, be in a position other than the mid-position, with the axis 33 for instance disposed at 33' and thus the axis 34 at 34', the moment of the force exerted by piston 10 on the cross beam 16, with respect to the pivot axis 30, will be greater than the moment of the force exerted by piston 9 on said cross beam, owing to the greater length of the effective lever arm transmitting the force exerted by piston 10.

Consequently, and owing solely to the action of the pressure impulse provided by the accumulator, the receiver will be automatically reset into the mid-position.

This automatic resetting of the remote hydraulic control system to its mid-position therefore, provides an arrangement in which a notch, not shown, is provided on the transmitter for stopping the control member in the mid-position so as to make the system ready, at any instant, for use in case of need, since the two stations are automatically set in perfect synchronism.

If, during operation, the pilot moves the transmitter away from its normal mid-position, the valves 41 will close automatically.

If the transmitter is for instance acted upon in such a manner that the volume of liquid in chamber 23 of cylinder 1 decreases in the direction indicated by the arrow $-f-$, the pressure in pipe 5 will increase, thereby increasing the closing force exerted upon valve 41 in chest 39. At the same time, the cylinder 3 will receive liquid delivered from cylinder 1, causing the piston 9 to move in direction of arrow $-f_1-$ and

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swing the cross beam 16 into the corresponding direction indicated by arrow $-f_2-$.

At the same time, the combined action of cross beam 16 and the suction established in pipe 6 by the downward movement of piston 8, while leaving the valve 41 in chest 40 closed, will cause the piston 10 to move downward as indicated by arrow $-f_3-$.

The controlled lever 28 will consequently occupy, at any instant, a position corresponding to that given by the pilot to the control wheel 27.

It will be observed that the pistons 9, 10 of the receiver work constantly in compression in their action upon the cross beam 16, so that the cross beam is constantly in a state of stable equilibrium, while the transmitter cross beam 15 is in unstable equilibrium. These equilibrium characteristics are a direct result of the arrangement of the liquid chambers with respect to the pistons and cross beams. With respect to the equilibrium characteristics, by the particular structure embodied it is apparent that pistons 9 and 10 always exert a positive compression action on the cross beam 16 since when these pistons are stationary they are submitted to the action of the accumulator 35 and in operation they are submitted to the pressure exerted by either one or the other of the transmitter pistons 7 and 8. Therefore there can never exist an empty space between either of the pistons 9 and 10 and the liquid in the compartments 25 and 26 below these pistons. On the contrary, with respect to the transmitter arrangement an empty space may be produced above whichever of pistons 7 or 8 moves downward in its associated cylinder. For this reason cross beam 16 is in stable equilibrium and cross beam 15 is in unstable equilibrium.

When the wheel is brought back into the mid-position, the two valves 41 will open and permit fluid under pressure to return, if necessary, the lever 28 to its mid-position.

Figure 3 shows an alternative embodiment in which the pistons 7, 8, 9 and 10 are provided with simple rods instead of the double rods of the preceding embodiment. Ducts 50, 51 and 52, 53 provided in these rods and in the pistons 9 and 10 respectively connect the cylinder chambers 54, 55 and 56, 57 respectively to pipes 5 and 6. In this embodiment the cylinders constitute the movable parts of the system with respect to movement toward or away from the bases 21 and 22. Apertures 59 to 62 connect with the atmosphere the other cylinder chambers, that is, those chambers containing no liquid.

The resynchronization is obtained, in case of misadjustment, by the presence of accumulator 35, as before.

For permitting the receiver to exactly follow the movements of the transmitter, it is merely necessary that when the apparatus is at rest, in its mid-position, the volumes of chambers 54 and 55 be equal to those of chambers 56 and 57 and that the relation

$$R^2 - t^2 = P^2$$

be verified, where

R is the radius of cylinders 1 and 2,
 t the radius of the corresponding piston rods, and
 P the radius of cylinders 3 and 4.

It is of course possible, without altering the principle of the invention, to replace the cushion of compressed air 37 by any other elastic force, such as a spring, acting upon the column of liq-

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uid in the accumulator 35 and the pipe 38, this action being also controlled by the operation of the valve chests.

In case it should be desired, for convenience or by habit, that the transmitter be reset automatically to the mid-position when or if the pilot releases wheel 27, then the arrangement shown in Figure 6 is employed. In this modification the apertures 59 and 60, that communicate with atmosphere in the zone shown in Figure 3, are in communication with a branched conduit 38 so that fluid under pressure constantly flows into the upper cylinder chambers above pistons 7 and 8. Under these conditions, when the transmitter occupies a position other than the mid-position, the pressure from the accumulator will exert upon the cross beam 15 a restoring torque similar to that exerted upon the cross beam 16, as previously described, when the transmitter is in its mid-position.

In the alternative embodiment of Figures 4 and 5, the transmitter T comprises two hydraulic groups 63 and 64. Group 63 is constituted by a cylinder 65 in which is arranged a liquid-tight piston 66 dividing the cylinder into two chambers 67 and 68. The piston rod 69, extends from both faces of piston 66, passes through the upper and lower end plates 70 and 71 of cylinder 65. The cylinder has embodied therewith an upper cap 72 pivoted at 73 to the end of the arm 74 of a beam 75 in turn pivoted on the pin 76. The end of piston rod 69, opposite the beam 75, is pivoted at 77 to a fixed support or base.

The construction of the hydraulic group 64 is similar to that of group 63. It is constituted by a cylinder 78 in which is arranged a liquid-tight piston 79 dividing the same into two chambers 80 and 81. The piston rod 82 extends from both faces of piston 79 and passes through the upper and lower end plates 83 and 84 of cylinder 78. The latter also has embodied therewith an upper cap 85 pivoted at 86 to the end of an arm 87, of length equal to the length of arm 74, of beam 75. The end of the piston rod 82, opposite the beam 75, is pivoted at 88 to a fixed support. On two other arms 89 and 90 of beam 75 is mounted the hand-wheel 91 of the transmitter.

The construction of the receiver R is similar, as concerns its hydraulic groups 92 and 93, to that of the transmitter T. Group 92 is constituted by a cylinder 94 in which is arranged a liquid-tight piston 95 dividing the cylinder into two chambers 96 and 97. The piston rod 98 extends from both faces of piston 95 and passes through upper and lower end plates 99 and 100 of cylinder 94. The latter has embodied therewith an upper cap 101 pivoted at 102 to the end of an arm 103 of a beam 104 pivoted on pin 105. The end of piston rod 98, opposite the beam 104, is pivoted at 106 to a fixed support.

The hydraulic group 93 is constituted by a cylinder 107 in which is arranged a liquid-tight piston 108 dividing the cylinder into two chambers 109 and 110. The piston rod 111 extends from both faces of piston 108 and passes through the upper and lower end plates 112 and 113 of cylinder 107. The latter has embodied therewith an upper cap 114 pivoted to the end 115 of an arm 116 of the beam 104, and the length of arm 116 is equal to the length of arm 103. The end of the piston rod 111, opposite the beam 104, is pivoted at 117 to a fixed support. A lever 118, integral with beam 104, is connected to the controlled member.

The transmitter cylinder chambers 68 and 81 and the receiver cylinder chambers 96 and 109 are filled with liquid. Chamber 68 is hydraulically connected to chamber 96 through a pipe or conduit 119, and chamber 81 is connected to chamber 109 through pipe or conduit 120.

The transmitter T includes a hydropneumatic accumulator 121 from which branch pipes 122 and 123 lead to the valve chests 124 and 125. The valves 126 and 127 of these chests are controlled by a shouldered disc or cam 128, the spindle 129 of which is fast with a lever 130 pivoted to a rod 131 pivoted in turn to an arm 132 of beam 75. Pipes 133 and 134 lead respectively from the valve chests 124 and 125 to the pipes 119 and 120.

The operation of the described remote control system is quite similar to that of the various embodiments of this system, set forth above. It ensures the reproduction, at a distance, by the receiver, of the movement given the transmitter, while the receiver is automatically restored into its mid-position when the transmitter is itself set in this position and the resetting torque ceases to be effective as soon as the transmitter is swung out of the mid-position.

According to the present embodiment, the chambers 97 and 110 of receiver R, are utilized for receiving the pressure from a hydropneumatic accumulator 135, which in effect constitutes a servo-motor. The latter is supplied by a pump 136 drawing liquid through a pipe 137 from a tank 138 and delivering it under pressure into a pipe 139 leading to the lower side of the hydropneumatic accumulator 135. A check valve 140 prevents back flow through pipe 139.

The pipe 141, extending from the hydropneumatic accumulator 135, is branched into two pipes 142 and 143 leading respectively to two distributors 144 and 145. Such a distributor is shown on a larger scale in Figure 5.

This distributor, for instance 144, comprises a casing 146 divided by a transverse partition or wall 147 into a lower chamber 148 and an upper chamber 149. The wall 147 is provided with an aperture 150, the opening and closing of which is controlled by the head 151 of a valve 152. A spring 153 arranged in chamber 148 urges the valve 152 towards closed position. The valve 154 slides in a sleeve 155 embodied within casing 146 and provided with bearings 156 and 157 provided with stuffing rings 158 and 159. The stem 153 of valve 152 is provided with a channel 160 in permanent communication with the three chambers limited by the sleeve 155, namely, by means of an aperture 161 with the lower chamber 162, by an aperture 163 with the middle chamber 164 and directly with the upper chamber 165.

The sleeve 155 and casing 146 are provided with two aligned apertures 166 and 167, from which a pipe 168 leads to chamber 110 of the hydraulic group 93. The casing 146 is also provided with an aperture 169 in communication with chamber 165 and from which a branch pipe 170 extends which after merging with a corresponding branch pipe 171 extending from distributor 145, continues as return pipe 172 leading fluid back to the tank 138. The distributor 145 communicates via a pipe 173, similar to pipe 168, with chamber 97 of the hydraulic group 92.

In chamber 165 is arranged a valve head 174 which may cooperate with the end portion 175 of the hollow stem 154 so as to close the channel 160. The stem 177, on which is mounted the head 174, passes through the bottom 179 of

casing 146, the passage being provided with a stuffing ring 178. The stem 177 further passes through the bottom 180 of a cylinder 181 arranged next to casing 146 and integral with the latter. The stem 177 constitutes the rod of a piston 182 arranged in liquid-tight relationship within cylinder 181 and forming in the latter a lower chamber 183 and an upper chamber 184. In the lower chamber 183 is arranged a calibrated spring 185 bearing on the one hand against the cylinder bottom 180 and on the other hand against the under side of piston 182. From the upper chamber 184, a pipe 186 extends and communicates with pipe 119. A corresponding pipe 187, extends from distributor 145 and communicates with pipe 120.

The operation of this remote control system, fitted with an effective servo-motor, is as follows:

When the pilot moves the hand-wheel 91, for instance, in the direction shown by arrow 188, thus setting up in chamber 68, and consequently in the piping 119, a pressure above a predetermined value, depending upon the force exerted by the spring 185, the piston 182 of distributor 144 will be depressed under the action of this pressure and overcome the force of spring 185. In the first phase of its downward motion, the valve head 174 closes fluid flow through the channel 160, thus interrupting the communication between chamber 110 and tank 138. During the subsequent descending movement of piston 182, the valve 152 is moved and its head 151 is moved clear from its seat. The chamber 148, subjected to the pressure of the hydropneumatic accumulator 135, is thus connected, through the aperture 159, apertures 161, channel 160, apertures 163 and pipe 168, with chamber 110. The pressure set up in this chamber causes the hydraulic group 93 to move downward, thus rotating the beam 104 in the direction of arrow 189. When the force exerted by the pilot falls below the said predetermined value, the distributor 144 will operate in the opposite direction, disconnecting chamber 110 from the hydropneumatic accumulator 135 and connecting it to the tank.

The receiver, connected to lever 118, is thus brought to a position corresponding to that of the handwheel 91 of the transmitter without it being necessary for the force exerted by the pilot to exceed at any moment, a predetermined value. When the resistance encountered by the controlled member becomes such that it requires that an excessive force be exerted by the pilot, this resistance will be overcome by the pressure of accumulator 135 acting as the servo-motor applied according to the invention.

When the pilot moves the wheel 91 in the direction opposite to arrow 188, it is the distributor 145 which will now connect, when the force exceeds a predetermined value, chamber 97 of the hydraulic group 92 with the hydropneumatic accumulator 135.

The chambers 67 and 80 of transmitter T may be used, if desired, for obtaining the automatic resetting of the transmitter to its mid-position when the pilot releases the wheel 91, as set forth at the beginning of the specification with reference to the embodiment of Figure 6, by connecting chambers 67 and 80 to hydropneumatic accumulator 121.

In all cases where the pilot exerts a force which is less than the predetermined value, the remote control system operates as described further above, without the intervention of the servo-motor device.

What I claim is:

1. A hydraulic remote control system; including a transmitter and a receiving station each including two similar cylinders, stationary pivots for securing same at their outer ends, pistons adapted to reciprocate therein, piston rods therefor, a cross-beam the ends of which are pivotally secured to said piston rods and a pivot for said cross-beam located at equal distances from and outside the line connecting the connection points of said cross-beams with the piston rods, pipes connecting each cylinder of the transmitter with the corresponding cylinder of the receiver, said pipes opening inside the transmitter cylinder compartment on one side of the piston with reference to the cross-beam and inside the receiver cylinder compartment on the other side of the piston with reference to the cross-beam of the receiver, a mass of liquid filling said pipes and the cylinder compartment communicating therewith, a hydraulic accumulator, a valve box including valves for connecting said accumulator with each of said two pipes respectively at a point in proximity with the corresponding transmitter cylinders and control means for the valve boxes responsive to the movement of the transmitter cross beam and operative upon the rocking of the transmitter cross-beam round its pivot to its medial position of symmetry for opening the valves to automatically restore the receiver into its medial corresponding position through the balancing action of the pressure impulse from the accumulator on the fluid in the pipes.

2. A hydraulic remote control system, including a transmitter and a receiving station each including a system embodying two similar cylinders, pistons adapted to reciprocate therein, piston rods for said pistons pivotally secured to a stationary point, a cross beam having opposite ends pivotally secured to the cylinders of each system and a pivot for said cross-beam located at equal distances from and outside the line connecting the connection points of each said cross-beam with the cylinders, pipes connecting each cylinder of the transmitter with the corresponding cylinder of the receiver and including conduit means passing at least through the piston rods and opening into the compartment defined by the cylinder and the piston lying to one side of said piston with reference to the cross-beam at the transmitter station and to the other side thereof for the receiver station; a hydro-pneumatic accumulator, a valve box including valves for connecting said accumulator with each of said two pipes respectively at a point in proximity with the corresponding transmitter cylinders and control means for the valve boxes responsive to the movement of the transmitter cross beam and operative upon the rocking of the transmitter cross-beam round its pivot to its medial position of symmetry for opening the valves to automatically restore the receiver into its medial corresponding position through the balancing action of the pressure impulse from the accumulator on the fluid in the pipes.

3. A hydraulic remote control system, including a transmitter and a receiving station each including a system embodying two similar cylinders and pistons slidable therein, a cross beam pivotally connected to each said cylinder and piston system and a pivot for each said cross-beam located at equal distances from and outside the line connecting the connection points of said cross-beam with the cylinder and piston systems, pipes connecting each cylinder of the transmit-

ter with the corresponding cylinder of the receiver, a hydraulic accumulator, a double valve box including valves for connecting said accumulator with said two pipes respectively at a point in proximity with the corresponding transmitter cylinder and means whereby the rocking of the transmitter cross-beam round its pivot opens both valves when in its medial position of symmetry for restoring the receiver to its medial corresponding position through the balancing action of the accumulator on the fluid in the pipes, a second hydro-pneumatic accumulator at the receiver station, ducts adapted to provide for selective communication of the side of the receiver cylinders which does not communicate with the pipes from the transmitter, with the atmosphere and with said second accumulator, a distributing system including distributors controlling said ducts, branch pipes communicating with the said first mentioned pipes and controlling the distributors for closing at increasing pressures the communication between the ducts and the atmosphere and then connecting the ducts with the second accumulator for thereby furthering the movement of the receiver piston.

4. A hydraulic remote control system, including a transmitter and a receiving station each including a system embodying two similar cylinders and pistons slidable therein, a cross beam pivotally connected to each said two cylinder and piston systems and a pivot for said cross-beam located at equal distances from and outside the line connecting the connection points of said cross-beam with the cylinder and piston systems, pipes connecting each cylinder of the transmitter with the corresponding cylinder of the receiver, a hydraulic accumulator, a double valve box including valves for connecting said accumulator with said two pipes respectively at a point in proximity with the corresponding transmitter cylinder, means whereby the rocking of the transmitter cross-beam round its pivot opens both valves when in its medial position of symmetry for restoring the receiver into its medial corresponding position through the balancing action of the accumulator on the fluid in the pipes, a second hydropneumatic accumulator at the receiver station, branch pipes communicating with each receiver cylinder on the side thereof which is not fed by the pipe from the transmitter, a distributor for each receiver cylinder adapted to make the corresponding branch pipe communicate selectively with the atmosphere and with the second accumulator, and means whereby said distributors are submitted to the action of the transmitter station for controlling the connections of said branch pipes and amplifying thereby the effort transmitted by the main pipes.

5. A hydraulic remote control system, including a transmitter and a receiving station each including a system embodying two similar cylinders and pistons slidable therein, a cross beam pivotally connected to said two cylinder and piston systems and a pivot for said cross-beam located at equal distances from and outside the line connecting the connection points of said cross-beam with the cylinder and piston systems, pipes connecting each cylinder of the transmitter with the corresponding cylinder of the receiver, a hydraulic accumulator, a double valve box including valves for connecting said accumulator with said two pipes respectively at a point in proximity with the corresponding transmitter cylinder, means whereby the rocking of the transmitter

cross-beam round its pivot opens both valves when in its medial position of symmetry for restoring the receiver into its medial corresponding position through the balancing action of the accumulator on the fluid in the pipes, a second hydro-pneumatic accumulator at the receiver station, branch pipes communicating with each receiver cylinder on the side thereof which is not fed by the pipe from the transmitter, a distributor for each receiver cylinder, adapted to make the corresponding branch pipe communicate selectively with the atmosphere and with the second accumulator, and a further branch pipe connecting the main pipe communicating with one cylinder at the receiver station with the distributor corresponding to the other for urging same in the direction closing communication between its first mentioned branch pipe and the atmosphere and opening it into the second accumulator.

6. A hydraulic remote control system including a transmitter station and a receiving station, each station including hydraulic groups respectively comprising cylinders and pistons associated therewith, a cross beam at each station, means pivotally connecting the hydraulic groups at each station to the respective ends of the cross beam and means pivotally supporting the cross beams about an axis outside the line intersecting the axes of pivotation of the groups with respect to the ends of the beams, conduits connecting the cylinders of the respective groups, a hydropneumatic accumulator, valve controlled conduits providing for controlled communication between the accumulator and the hydraulic groups, valves in said conduits, and valve control means movable in response to the movement of the transmitter cross beam for opening the valves to permit fluid to pass from said accumulator to said hydraulic groups when the transmitter cross beam is in its median position thereby automatically restoring the receiver cross beam to a corresponding median position.

7. A hydraulic remote control system including a transmitter station and a receiver station, each station including a pair of associated cylinders and pistons and a cross beam, the pistons and cylinders being bodily pivoted to opposite ends of the cross beams at one end of the associated cylinders and pistons and means at the opposite ends of the associated cylinders and pistons fixedly pivotally supporting the same, means fixedly pivotally supporting each cross beam for oscillation about an axis equidistant from and outside a line intersecting the pivotal connections between the respective associated pistons and cylinders and the said opposite ends of the cross beams, the cross beams having a neutral position where the opposite ends thereof lie in a horizontal plane and the disposition of the axes of pivotation between the cross beam ends and the associated pistons and cylinders and the axis of pivotation of the cross beams being such that when the cross beam is oscillated in either direction with respect to its neutral position an unbalanced effective lever arm length exists as between the opposite ends of the cross beam and the axis of pivotation of the cross beam, conduits connecting the cylinders of the respective groups, said conduits communicating with the cylinders at the transmitter station between the pistons and the cross beam and with the cylinders at the receiver station on the side of the piston remote from the cross beam, a hydropneumatic accumulator, additional conduits providing communication between said accumulator and said first-

mentioned conduits, valves controlling fluid flow through said second-mentioned conduits, means urging said valves to closed position and means movable in response to the movement of said transmitter cross beam for opening said valves to provide fluid flow from said accumulator to said first-mentioned conduits, said last-mentioned means being operable when said cross beam is in its neutral position to permit the fluid flow from said accumulator into said first-mentioned conduits to restore the cross beam at said receiver station to its neutral position corresponding to the neutral position of said transmitter cross beam and said last-mentioned means being operative when said transmitter cross beam is moved from neutral position to permit said valves to close whereby said receiver cross beam is moved in conformity with the movement of said transmitter cross beam through fluid flow from the cylinders at the transmitter station to the cylinders at the receiver station.

8. A hydraulic remote control system as defined in and by claim 7 in which the means for opening said valves includes a cam ring having oppositely arranged cam surfaces thereon disposed in alignment with one another and in parallelism with the line intersecting the axes of pivotation of the associated pistons and cylinders of the transmitter station with respect to the cross beam ends and in which said valves include stems fixedly supported for sliding movement along a line parallel to said first mentioned line when the cross beam is in its neutral position, and said cam ring being movable with said cross beam and operative to open said valves only when said cross beam is in its neutral position.

9. A hydraulic remote control system as defined in and by claim 6 in which said valve control means includes a cam ring having oppositely arranged cam surfaces thereon disposed in alignment with one another and in parallelism with the line intersecting the axes of pivotation of the associated pistons and cylinders of the transmitter station with respect to the cross beam ends and in which said valves include stems fixedly supported for sliding movement along a line parallel to said first mentioned line when the cross beam is in its neutral position, and said cam ring being movable with said cross beam and operative to open said valves only when said cross beam is in its neutral position.

10. A hydraulic remote control system as defined in and by claim 9 and additional conduits providing communication between said accumulator and the cylinders at said transmitter station on the side of said pistons opposite to the side communicating with said first-mentioned conduits whereby fluid flow from said accumulator automatically resets said transmitter cross beam to neutral position.

11. A hydraulic remote control system as defined in and by claim 6 in which said cylinders are pivotally connected to the opposite ends of the cross beams and in which each piston of the respective groups includes a rod projecting through said cylinders, means fixedly pivotally supporting the projecting end of said rods, a second hydropneumatic accumulator, branch conduits extending from said first-mentioned conduits, a distributor device in respective communication with each cylinder of the receiver group and said second accumulator, said branch conduits communicating with said distributor device, movable valve means in each distributor de-

vice and conduits providing communication through said valve means between the cylinders of the receiver groups and atmosphere and between the cylinders of the receiver groups and said second accumulator whereby movement of said transmitter cross beam applies a fluid impulse through the hydraulic groups at the transmitter station to the distributor devices to move the valves therein to provide fluid flow from said second accumulator to the cylinders of the groups at the receiver station in dependence upon the direction of oscillation of the transmitter cross beam whereby fluid flow from said second accumulator effects movement of said receiver cross beam corresponding to the movement of said transmitter cross beam.

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