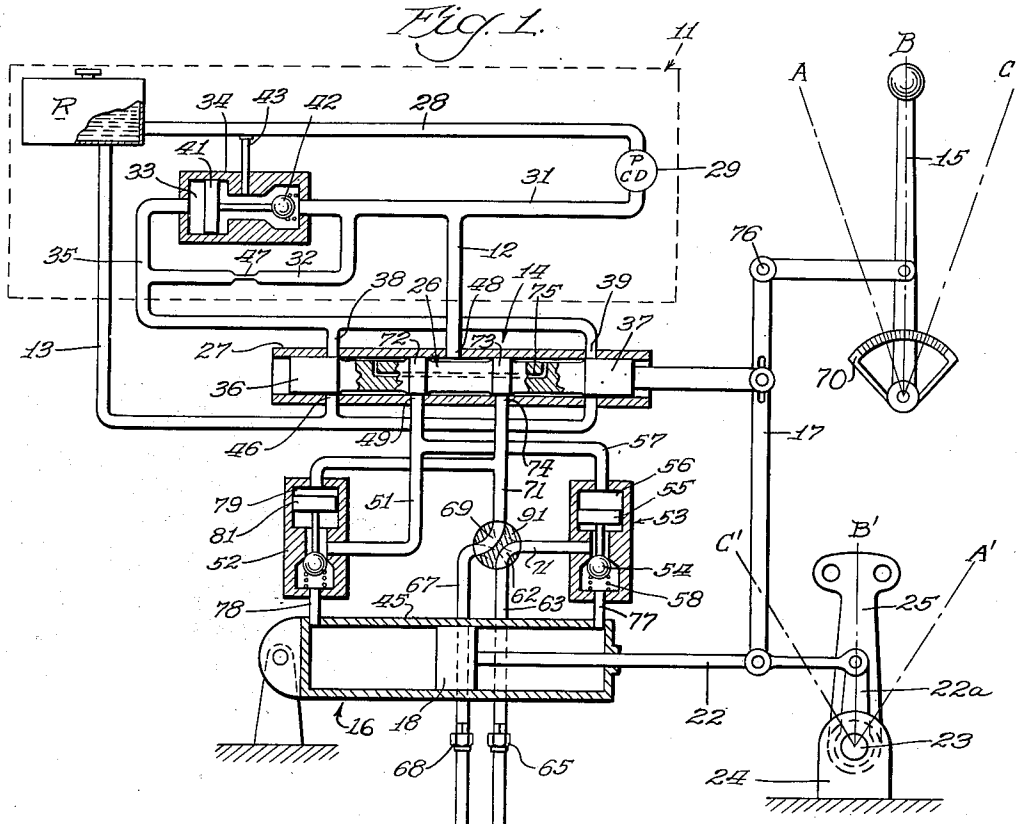
Nov. 6, 1951 J. F. ZISKAL 2,573,943

TELEMETER TYPE HYDRAULIC POWER TRANSMITTING SYSTEM

Filed April 10, 1948

Fig. 1.



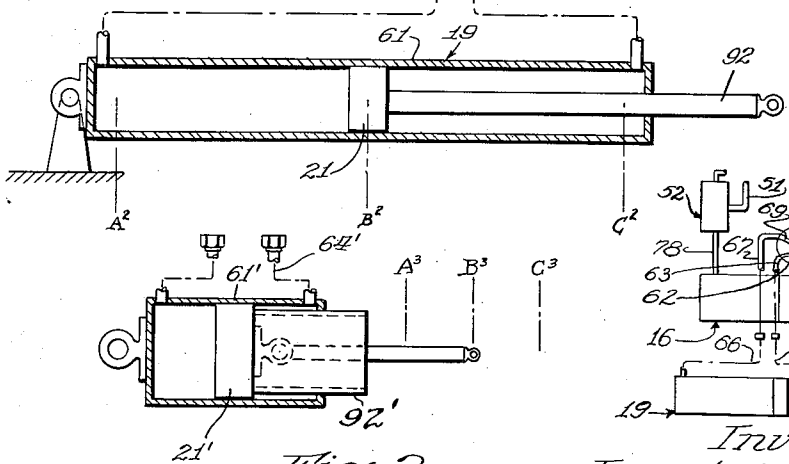
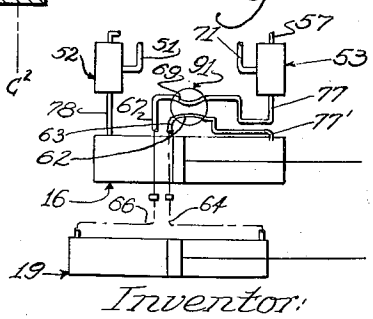


Fig. 2.

Fig. 3.



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TELEMETER TYPE HYDRAULIC POWER TRANSMITTING SYSTEM

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4 Claims. (Cl. 121—41)

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This invention concerns a hydraulic power transmitting system including a valve-closing servo-motor operable to close a control valve for terminating operation of such motor when a work member thereof has moved an amount correlated with the distance of valve-opening movement of a control member for such valve, and relates more particularly to such a system capable of employing a plurality of hydraulic rams interchangeably connectable in series with the motor and differing in bore and/or stroke but so related in fluid displacement capacity to that of the servo-motor that the position of the plunger of each ram throughout the range of its stroke is similarly correlated with the position of the valve control member within its adjusting range.

Heretofore, so far as I am aware, hydraulic power transmitting systems comprising a valve-closing servo-motor in series with an hydraulic ram have utilized a ram of the same fluid capacity and structural proportions as the motor when it was desired to cause the ram plunger to occupy positions in its range of movement respectively corresponding to positions of a control member for the valve closable by the motor. According to this invention it is possible for a system of such character to utilize an hydraulic ram of any desired bore and stroke and retain the operating feature that the ram piston will be caused to advance to positions located within its range of movement that correspond to positions of the valve control member within its range of movement. This constitutes an important general object of the invention and is accomplished by making the displacement capacity of the piston-rod end of the ram equal to the displacement capacity of one end of a motor chamber which receives a vibratory work member of the motor, and communicatively connecting these two equal displacement spaces when connecting the motor and ram in series in the system. With such a design and arrangement of the ram with respect to the motor, the magnitude of the displacement capacity of the other two ends of the motor chamber and of the ram cylinder is immaterial.

Thus the invention further contemplates, and has as one of its objects, a plurality of rams of various bore and/or stroke but constructed with their piston rods of a diameter to make the displacement capacity of their cylinders at their piston-rod ends equal to the displacement capacity of the motor chamber with which such cylinder ends are to be communicatively connected, wherefore the rams are interchangeably disposable in the system where the position of their plunger can be correlated with the position of the valve control member. The improved system therefore embodies a basic counterpart including a valve control member and with which any of various rams may be combined to attain the desired length of operating stroke, speed of plunger movement, and magnitude of force exertable by the plunger. The system has particular utility when the basic part is installed upon and energized from a tractor, making it possible to use and accurately control rams having proper operating characteristics for the manipulation of sundry equipment mounted upon or coupled to the tractor.

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A further object is the provision of an hydraulic power transmitting system employing a servo-motor energized by fluid flowing under control of a control valve when such valve is manipulated from a neutral setting, and the energized motor being operable to reset the control valve to neutral, together with check valves in respective fluid lines leading from the control valve to the motor, and valve means interposed between one of the check valves and the motor to selectively place a ram in or out of series connection with the motor.

These and other desirable objects inherent in and encompassed by the invention will be better understood upon reading the ensuing description with reference to the annexed drawings, wherein:

Fig. 1 is a partially diagrammatic view showing the elements of an hydraulic power transmitting system constituting a preferred embodiment of this invention.

Fig. 2 is a sectional view taken axially through an hydraulic ram substitutable for the hydraulic ram shown in the lower part of Fig. 1 but having a different bore and stroke than the ram of Fig. 1.

Fig. 3 is a fragmentary view showing an alternative arrangement of a valve which controls communication of a part of the hydraulic circuit with fluid conducting power-take-off conduits.

Referring now particularly to Fig. 1, there will be seen a liquid source 11 having a high pressure outlet 12 and a low pressure inlet 13. There are also shown a control valve 14, a manually operated control member 15 for the valve 14, a servo-motor 16 operable through a link 17 for resetting the valve 14 into a closed position for stopping operation of the motor 16 after the piston 18 therein has moved a distance correlated with the distance of movement of the manually

settable member 15 in opening the valve for initiating energization of such motor. An hydraulic ram 19 is connected in series with the servo-motor 16, wherefore the plunger 21 of this ram is caused to move concurrently with the movement of the piston 18. The servo-motor is operable through a piston rod 22 and an arm 22a for operating a rock-shaft 23 journaled in bearings 24, of which one is shown. An arm 25, which is constrained for oscillation with the rock-shaft 23, is adapted to transmit power to equipment (not shown) to be controlled by the apparatus.

While the control member 15 and the piston 18 of the servo-motor 16 occupy correlated positions as illustrated in Fig. 1, the valve plunger 26 will be in a neutral position closing all ports in the valve casing 27. Consequently fluid drawn from the reservoir R through a conduit 28 by a constant delivery pump 29 will be discharged by that pump through a conduit 31 and thence through a conduit 32 into a chamber 33 of a valve 34. The pressure of this fluid is imposed through a conduit 35, but since enlarged portions 36 and 37 of the movable valve element 26 then block valve ports 38 and 39, fluid cannot escape from the conduit 35 and the full pressure of the fluid is imposed upon a valve piston 41 for unseating the valve ball 42. Fluid from the discharge side of the pump 29 can then by-pass past the valve 34 and through conduits 43 and 28 back to the reservoir or to the inlet side of the pump.

Manual movement of the control member 15 toward the limit A of its range of movement will manipulate the valve 26 for causing movement of the motor piston 18 toward the right or toward the piston rod end of the motor cylinder 45, whereas movement of the member 15 toward the limit C of its range of movement will adjust the control valve for causing movement of the motor piston 18 toward the opposite end of the motor cylinder. Concurrently with movement of the control member 15, the movable valve element 26 is adjusted from its neutral position for causing termination of the low pressure by-pass condition of the fluid source 11 and creation of a high pressure condition. When, for instance the control member 15 is moved to the left toward position A, the enlargement 36 of the valve element 26 will be moved out of registry with ports 38 and 46, whereby fluid from the conduit 35 can escape through the ports 38 and 46 and the conduit 13 back to the reservoir R. Because of the restriction 47 in the conduit 32, the fluid can escape through the ports 38 and 46 sufficiently fast to diminish the pressure in the valve chamber 33 so that this pressure will be insufficient to hold the by-pass valve ball 42 unseated. As a consequence this ball 42 will seat and close the by-pass valve and terminate low pressure by-pass. The fluid at high pressure will then be delivered through the conduit 12 and control valve ports 48 and 49 into a reversible flow conduit 51 which leads through a check valve 52 to the left end of the motor cylinder 45. Fluid thus introduced into the left end of the motor cylinder 45 will force the piston 18 to the right, displacing fluid from the piston rod end of said cylinder through a check valve 53 of which the ball 54 is then held open by the pressure of fluid above a piston 55. This fluid reaches the piston receiving chamber 56 through a conduit 57 from the conduit 51. Because of the end area of the piston 55 exceeding the area of the seat for the ball 54, a pressure in the chamber 56 above the

piston 55 not necessarily exceeding the pressure in the spring chamber 58 will prevail over the pressure upon the ball 54 and cause this ball to be unseated. Fluid discharged from the piston rod end of the motor cylinder 45 past the check valve 53 and through a conduit 71' will be discharged into the piston rod end of the ram cylinder 61 through a valve passage 62, a fluid-conducting power take-off conduit 63, and a conduit 64 detachably connected with the conduit 63 through a coupling 65. Introduction of fluid into the piston rod end of the ram cylinder 61 will cause displacement of the ram plunger 21 to the left and the displacement of fluid from the left end of this ram cylinder through a conduit 66 which is detachably connected with a fluid conducting power take-off conduit 67 through a coupling device 68. Fluid discharged through the conduit 66 flows through the conduit 67, a valve passage 69 and a second reversible flow conduit 71. Inasmuch as at this time the control valve member 26 is moved to the left from the position shown in Fig. 1, and the valve member enlargements 72 and 73 are to the left of their respectively associated ports 49 and 74, the fluid discharged through the conduit 71 will flow through the port 74 and thence into the right end of a channel 75 extending axially of such element. Fluid is discharged from the left end of this channel 75 through the port 46 and the conduit 13 back to the reservoir.

Movement of the motor piston 18 toward the right end of the motor cylinder 45 will continue until it is sufficient to move the control valve element 26 back to neutral, this movement of the valve element being effected through the piston rod 22. The walking beam element 17 at that time pivots about a pivot pin 76 which is held fixed by frictional engagement of the control member 15 with its associated quadrant 70. Consequently the distance that the motor piston 18 moves in resetting the control valve 14 to neutral for stopping operation of the motor is correlated with the distance of manual setting of the member 15 for initiating the operation.

Upon movement of the valve element 26 back to neutral, the ports 38 and 46 will be closed again, preventing the escape of fluid from the conduit 35 so that the fluid passing through the restriction 47 can again build up the pressure in the valve chamber 33 causing movement of the piston 41 for unseating the valve ball 42 and recreating the low pressure by-pass condition.

Presuming now that the control member 15 has been moved from position B toward position C, the control valve element 26 will have been shifted to the right uncovering the valve ports 49, 74, 39, and 77. The uncovering of the valve ports 39 and 77 again permits fluid to escape from conduit 35 and the diminution of pressure in the valve chamber 33 so that the by-pass valve ball 42 will again seat and create a high pressure condition. High pressure fluid will then flow through the conduit 12 and through ports 48 and 74 into the reversible flow conduit 71, the direction of fluid through the conduit 71 having been in the opposite direction in the operation initiated by movement of the control member 15 toward the position A. The fluid continues from the conduit 71 through the valve passage 69 and conduits 67 and 66 into the left end of the ram cylinder 61. Movement of the ram plunger 21 to the right ensues and displaces fluid from the piston rod end of the cylinder through the conduits 64, 63, 59, check valve 53, and con-

duit 77 into the piston rod end of the motor cylinder 45. This displaces the motor piston 18 to the left and forces fluid outwardly through the conduit 78 and past the check valve 52 into the conduit 51. At this time the check valve 52 is forced open by the pressure of fluid from the conduit 71 into the chamber 79 above a piston 81 to force this piston downwardly. Conduit 51 communicates with the left end of the valve element passage 75 through the valve port 49 so that the fluid exhausted from the left end of the motor cylinder passes through the passage 75 and thence through port 39 into the conduit 13 for return to the reservoir. In this phase of the operation, the motor piston 18 in moving to the left will cause the walking beam link 17 to swing in the opposite direction about the then fixed pivot 76 for shifting the control valve element 26 toward neutral. The distance that the piston 18 moves is correlated with the distance that the control member 15 had been moved in displacing the valve element 26 from neutral. Again when the valve element 26 is returned to neutral both ports 38 and 39 will be closed to prevent escape of fluid from the conduit 35 so that the fluid introduced through the passage restriction 47 into the valve chamber 33 will be effective for opening the by-pass valve 34 and recreating the low pressure by-pass condition.

Conduit means interconnecting the control valve 14 with the servo-motor 16 includes the two reversible flow conduits 51 and 71. When the valve is operated for causing movement of the motor piston 18 in one direction, fluid is caused to flow from the valve through one of these two conduits and back to the valve through the other of such conduits, and when the valve is adjusted for causing movement of the motor piston 18 in the opposite direction, the direction of flow of fluid through the conduits 51 and 71 is reversed.

It will also be observed that the hydraulic ram 19 is connected in series with the servo-motor 16. This is more easily comprehended when the conduits 77, 71', and 63 are regarded as a single conduit leading from the piston rod end of the motor cylinder 45 and when the conduits 71 and 67 are regarded as a single conduit leading from the valve 14. For the motor 16 to be caused to operate, these fabricated conduits 77—71'—63 and 71—67 leading respectively from the valve and from the piston rod end of the motor must be connected in series. When a rotatable valve element 91 is in the position shown, the serial connection of these two fabricated conduits 77—71'—63 and 71—67 are connected in series through the conduits 64 and 66 and the hydraulic ram 19. In other words, the hydraulic ram is interposed in series with the series conduits 77—71'—63 and 71—67.

The linkage interconnecting the piston rod 22, the valve element 26, the rock-shaft 23, and the manually operated control member 15 is so designed in proportion that the full range movement of the control member 15 will cause full range movement of the piston 18 and will also cause full range rocking movement of the rock-shaft arm 25 between its limits A^1 and C^1. For example, when the control member 15 occupies an intermediate position as B, the piston 18 will occupy a correlated mid-position between the two ends of its stroke and the rock-shaft arm 25 will occupy an intermediate position B^1 correlated with position B of the lever 15. By connecting the piston rod end of the ram cylinder 61 with the piston rod end of the motor cylinder 45 by the series conduit 77—71'—63, and by connecting the opposite end of the ram cylinder with the control valve through the other series conduit 71—67 as illustrated in Fig. 1, and by making the displacement capacity of the piston rod end of the ram cylinder equal to that of the piston rod end of the motor cylinder, the motor piston can be caused to occupy positions witihn the range of its stroke correlated with the positions into which the manually controlled member 15 is moved. Assuming that fluid is being introduced into the left end of the ram cylinder 61, movement of the ram plunger 21 to the right will cause displacement of the motor piston 18 to the leftmost end of the motor cylinder 45 only after the ram plunger 21 has been moved to the piston rod end of the cylinder 61. This is because the displacement capacities of the piston rod ends of the two cylinders are the same, wherefore a full stroke of the plunger 21 is necessary to displace enough fluid for satisfying the displacement capacity of the piston rod end of the cylinder 45. Therefore, when the control member 15 is moved into position C and the control valve 14 is thereby set for causing delivery of fluid through the series conduit 71—67 to the left end of the ram cylinder 61, the valve will not be reset to neutral until the motor piston 18 has been displaced to the left end of the cylinder 45 to move the rock-shaft arm 25 to position C^1, and this does not occur until the ram plunger 21 has been moved to position C^2. The fact that the displacement capacity of the left end of the ram cylinder 61 is greater than the piston rod end thereof and is also greater than either end of the motor cylinder, is immaterial; the pump will continue to deliver fluid from the reservoir into the left end of the ram cylinder until the plunger has been moved to position C^2, coincidentally with which incident the motor 16 will be operated sufficiently for returning the control valve to neutral.

When the control member 15 is moved to the limit A of its range of movement, the control valve 14 will be set for causing introduction of fluid into the left end of the motor cylinder 45 and the valve will not be reset into neutral until the motor piston 18 has moved to the piston rod end of the cylinder, placing the rock-shaft arm 25 in position A^1. Incident to this movement of the motor piston, fluid displaced from the piston rod end of the cylinder 45 will enter the piston rod end of the ram cylinder 61 and will thus cause movement of the ram plunger 21 to the left end of the ram cylinder, placing the plunger in position A^2.

Despite the ram cylinder having a bore and stroke in excess of that of the motor cylinder, both the extreme and intermediate positions of the ram piston are correlated with the extreme and intermediate positions of the control member 15. This is also true of a ram as that shown in Fig. 2 which has a much shorter stroke than the ram of Fig. 1 but a considerably larger bore. The parts of the ram shown in Fig. 2 respectively corresponding to the parts of the ram in Fig. 1 are designated by the same reference characters with the addition of a prime. However, the tubular piston rod 92' of the ram shown in Fig. 2 is also made of large diameter so the displacement capacity of the piston rod end of the ram cylinder 61 will be the same as the displacement capacity of the piston rod end of the motor cylinder 45. When the conduits 66' and 64' of the second ram are coupled onto the conduits 67 and

63 interchangeably with the conduit members shown in Fig. 1 and the system is filled with fluid, manipulation of the manually controlled member 15 will cause the ram plunger 21' to occupy the position B^3 when the member 15 is in position B and will cause the ram 21' to be in extreme positions A^3 or C^3 when the member 15 is in positions A or C respectively. The positions of the plunger 21 and the control member 15 are correlated throughout their range of movement. The substitution of either ram for the other entails no adjustment of the system other than such substitution.

When the valve 91 is rotated 90° from the position shown in Fig. 1, one of the passages 62 or 69 will connect the conduits 71 and 71' in direct series while the other of such passages communicates between the fluid conducting power-take-off conduits 63 and 67. Conduits 71 and 71' are then, in effect, serially connected sections of a fluid line 71—71' having valve means 91 interposed therebetween, and the fluid conducting power-take-off conduits are isolated from such fluid line sections. Operation of the servo-motor 16 is not disturbed by this alternative setting of the valve 91.

In the modification of Fig. 3 the conduit 71 connects directly with the check valve 53 and the valve 91 is interposed between fluid line sections 71 and 77' which, when directly connected through one of the valve passages 62 or 69, function similarly to the passage 77 in Fig. 1. When the valve 91 is in the position shown in Fig. 3, it connects the fluid line sections 77 and 77' respectively with the power-take-off conduits 63 and 67 and causes any of the rams as 19 to operate in concert with the motor 45. With this Fig. 3 arrangement the check valves hydraulically lock both the motor and the remote ram while the valve 91 is in the position shown and while the control valve 14 is in neutral. A more positive hydraulic lock is attainable with the poppet type check valve than if the slidable plunger type control valve were relied on for this function.

Having thus described a limited number of embodiments of the invention with the view of clearly and concisely illustrating the same, I claim:

1. In an hydraulic power transmitting system energized from a liquid source having a low pressure inlet and a high pressure outlet, valve means having reversible flow passages for selective communication with said source and settable in opposite directions from a neutral setting wherein communication of each passage with said source is precluded, said valve means effecting communication of one of the passages with the source outlet and the other passage with the source inlet while set in one direction from neutral and reversing such communications of the passages while set in the opposite direction from neutral, a two-way servo-motor operable by fluid controlled by said valve means and for returning the valve means to neutral, said servo-motor including a fluid-receiving chamber and a work member reversibly movable therein between opposite ends thereof by differential of fluid pressure in the two ends of such chamber, means for selectively setting the valve means away from neutral, means operably connecting the servo-motor work member with the valve means, one of the reversible flow passages being communicative with one end of the servo-motor chamber, conduits leading respectively from the other reversible flow passage and from the other end of the servo-motor

chamber, and a plurality of two-way hydraulic rams each having a cylinder, a piston in each cylinder and a piston rod projecting from each piston through an end of the associated cylinder, said rams being interchangeably connectable in series with said conduits so the piston rod end of their cylinder is communicative with the conduit leading from the other end of the servo-motor chamber and the opposite end of their cylinder is communicative with the other conduit, such opposite ends of the ram cylinders being of different displacement capacity, and the piston rods of said rams being different in diameter for causing the displacement capacity of the piston rod end of each ram cylinder to equal the displacement capacity of said other end of the servo-motor chamber.

2. In an hydraulic power transmitting system; a source of pressure fluid; control valve means connected with said source; a servo-motor comprising a cylinder, a piston in such cylinder, and a piston rod projecting through a piston-rod end of the cylinder into connection with said valve means to close the same pursuant to energization of such motor; conduit means comprising a conduit connected between the valve and the opposite end of the motor cylinder, and series conduits respectively leading from the piston-rod end of the cylinder and from the valve means; said valve means being openable to accommodate flow of fluid through said conduit means for energizing the motor; and a plurality of rams each comprising a cylinder having a head end and a piston rod end, a piston in such cylinder, and a piston rod extending from the piston through the piston rod end of the cylinder, said rams being interchangeably connectable in series with said series conduits with the piston-rod ends of the ram cylinders connected with the conduit leading from the piston-rod end of the motor cylinder and the opposite ends of the ram cylinders connected with the other series conduit, the displacement capacity of the piston-rod end of each ram cylinder being equal to the displacement capacity of the piston-rod end of the motor cylinder, and the displacement capacity of the opposite ends of the ram cylinders being different.

3. In an hydraulic power transmitting system; a source of pressure fluid; control valve means connected with said source; a servo-motor comprising a cylinder, a piston in such cylinder, and a piston rod projecting through a piston-rod end of the cylinder into connection with said valve means to close the same pursuant to energization of such motor; conduit means comprising a conduit connected between the valve and the opposite end of the motor cylinder, and series conduits respectively leading from the piston-rod end of the cylinder and from the valve means; said valve means being openable to accommodate flow of fluid through said conduit means for energizing the motor; and an hydraulic ram comprising a cylinder having a head end and a piston rod end, a piston in such cylinder, and a piston rod extending from the piston through the piston rod end of the cylinder, said ram being connected in series with said series conduits in such fashion that the piston-rod end of the ram cylinder is connected with the series conduit leading from the piston-rod end of the motor cylinder and the opposite end of such ram cylinder is connected with the other series conduit, the displacement capacity of the piston-rod end of the ram cylinder being equal to the displacement capacity of the piston-rod end of the motor cylinder, and the

stroke of the ram being different from that of the motor.

4. A hydraulic power transmitting system comprising a control valve manipulatable from a neutral setting to accommodate flow of fluid therethrough and resettable to neutral to preclude such flow of fluid, a fluid motor operably connected with said valve and energizable by fluid flowable under control of said valve to reset the valve to neutral, fluid lines communicative between the valve and motor for conducting such energizing fluid, check valves respectively in said lines for hydraulically locking the motor while the control valve is in neutral, one of said lines in a portion thereof between its check valve and the motor including serially connectable sections, a pair of fluid conducting power-take-off conduits, and valve means interposed between said

serially connectable sections and manipulatable to connect said sections in direct series while isolating them from said conduits and manipulatable to alternatively terminate the direct series connection and connect said sections respectively communicatively with said conduits.

JOSEPH F. ZISKAL.

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