

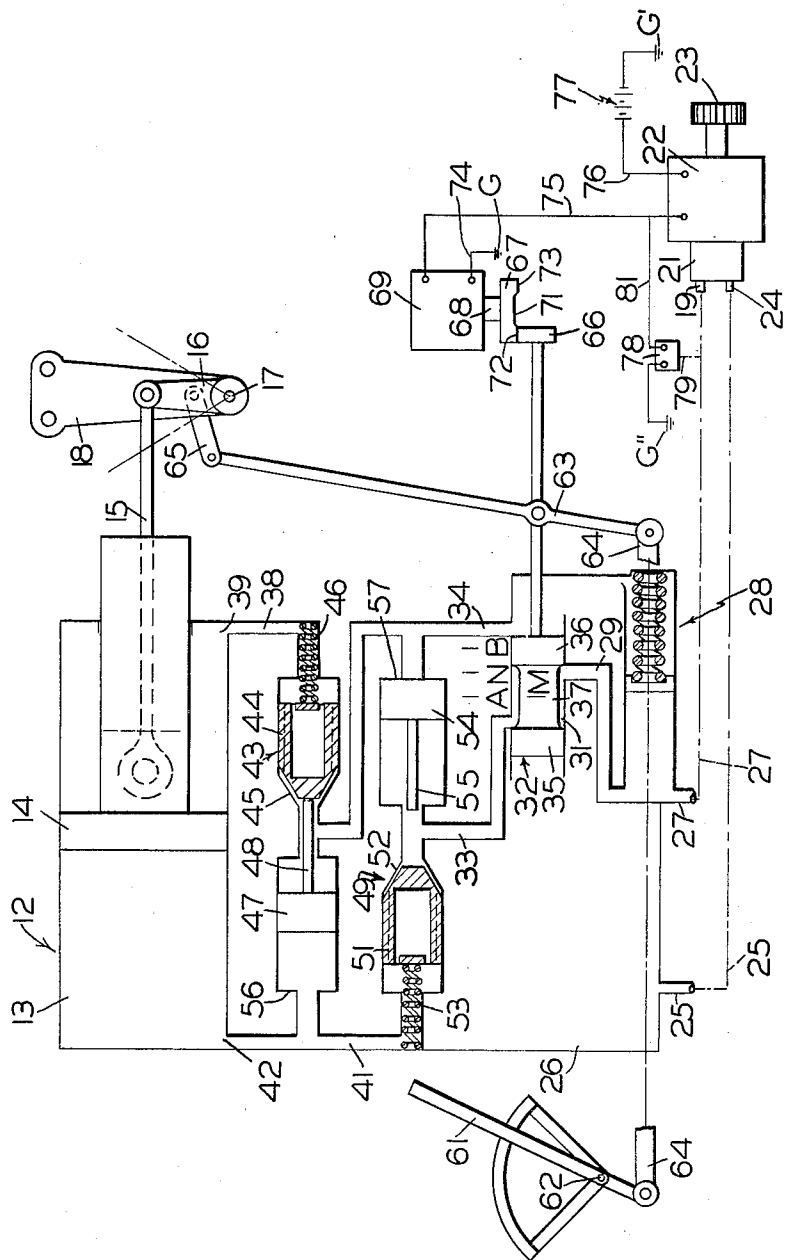
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HYDRAULIC POWER TRANSMITTING DEVICE

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HYDRAULIC POWER TRANSMITTING
DEVICE

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5 Claims. (Cl. 60—51)

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This invention relates to an hydraulic power transmitting unit of a type serviceable as a power lift for a tractor and relates more particularly to such a unit which selectively receives power from a continuously rotating member which may be a shaft or the like driven by a tractor engine.

The invention may be regarded as an improvement over the hydraulic power lift shown in co-pending U. S. patent application, Serial No. 63,482, filed December 4, 1948, now Patent No. 2,524,055, issued October 3, 1950, in the name of Clarence A. Hubert and assigned to the assignee of the present application. The power lift disclosed in said patent includes a pump continuously driven from the tractor engine. Excepting when the power lift of the patent is in operation the fluid from the pump outlet is discharged at low pressure through a section of a pressure control valve. A manually operated control valve, by virtue of opening a port of a control passage for the pressure controlling valve, is operable to terminate the low pressure bypass condition concurrently with directing the fluid from the pump to a hydraulic ram or motor of the power lift. The hydraulic ram and an operating lever for the control valve are differentially connected with such valve whereby the ram is operable to return the valve to a closed position when the ram plunger has moved a distance and direction correlated with the distance and direction of movement of the operating lever. The control valve of said patent is of the plunger type movable axially within a bore therefor and because of this valve plunger controlling communication between the pump and ram as well as controlling the control passage port, the valve plunger must be made with a high degree of precision. Manufacturing tolerances are required involving considerable care and correspondingly increase the production cost of the valve. When the various bores and passages of the ram, of the controlling valve and of the pressure controlling unit are formed within a single casting, according to common practice, there is a further production problem of dislodging all of the metal chips made by the boring operations attendant to the forming of these passages.

A general object of this invention is the provision of an interruptable drive between the pump and the continuously rotating driving member therefor and which is operated to establish the driving connection concurrently with movement of the control valve from the closed position, this construction being employed as an expedient for providing fluid at high pressure only during

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the establishment of communication between the pump and ram. Consequently the pressure controlling device of said co-pending application together with the various passages and bores associated therewith and with control ports of the control valve are eliminated. It is thus possible to make the control valve plunger shorter and to have fewer port-controlling enlargements upon this plunger wherefor its production is less complicated and its cost decreased. Diminishing the number of bores, passages and ports attendant to the elimination of the pressure controlling device simplifies the network of passages and the removal of metal filings and chips therefrom.

Another object is the provision of magnetic-fluid clutch between the continuously rotating driving member and the pump, this clutch having a driving characteristic when subjected to an overload permitting slippage between its driving and driven parts while transmitting a constant maximum torque irrespective of the relative speed of such parts. This clutch is energized by an electric circuit under control of the member which is manipulated for controlling the control valve plunger wherefor the clutch will establish its driving connection for the pump only while the control valve establishes communication between the pump and ram. The use of a clutch having the above described driving characteristic makes it possible to substantially instantaneously operate the pump without exerting excessive strain thereon or on the driving connections therefor. Structural details of the magnetic fluid clutch are disclosed in an article commencing on page 639 of SAE Quarterly Transactions for October 1949, vol. 3, No. 4.

Another object is the provision of a hydraulic accumulator in the fluid line between the pump and the control valve together with an energizing circuit for the magnetic-fluid clutch and which circuit includes a switch operable responsively to a predetermined minimum accumulator pressure to energize the clutch for driving the pump and to de-energize the circuit and pump upon the accumulator pressure attaining a predetermined maximum.

The above and other desirable objects inherent in and encompassed by the invention will be more fully understood from the ensuing description, the appended claims and the annexed drawing.

The single figure of drawing is a partially diagrammatic illustration of an hydraulic power

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transmission unit embodying the preferred form of the invention.

With continued reference to the drawing, an hydraulic ram or motor 12 has a cylinder 13 and a piston 14. A piston rod 15 is pivotally connected between the piston and the upper end of an arm 16 fixed to a rock shaft 17. This rock shaft has a second arm 18 constrained for rocking therewith to impart operating force to any selected tool or mechanism (not shown).

Fluid for operating the ram 12 is received from an outlet 19 of a pump 21 when this pump is connected by a magnetic-fluid clutch 22 with a continuously rotating driving member 23 in the form of a gear adapted to be driven from the engine of a tractor upon which the power-transmitting unit is mountable. Fluid is returned to the pump through an inlet 24 and a conduit 25 leading from a sump-type reservoir 26 of the power-transmitting unit.

Assuming the pump 21 to be driven, fluid under pressure flows from the outlet 19 through a conduit 27, through an accumulator 28 and an admittance port 29 into a cylindrical bore 31 of a control valve 32. This valve bore 31 has two ports 33 and 34 adapted to be simultaneously closed by enlargements or lands 35 and 36 upon a valve plunger 37 which is axially movable within the bore. A reversible flow passage 38 is communicative between the valve port 34 and a port 39 at the piston rod end of the ram cylinder 13. A second reversible flow passage 41 is communicative between the valve port 33 and a port 42 at the opposite end of the ram cylinder. Passage 38 contains a check valve 43 in series therewith. This check valve includes a valve member 44 urged upon an annular seat 45 by a spring 46. The valve member 44 is adapted to be held unseated, as illustrated, by pressure of fluid in the passage 41 upon a piston 47 which exerts a thrust through a stem 48 against the valve member 44. Resersible flow passage 41 contains a check valve 49 including a valve member 51 urged upon an annular seat 52 by a spring 53. This check valve is openable by fluid flowing from the port 33 through the passage 41, as illustrated in the drawing. This valve is also openable by the pressure of fluid in the reversible flow passage 38 against a piston 54 which is thereby operable to exert a thrust force through the stem 55 against the valve member 51 for opening the valve 49 during a phase in the operation of the device which will be later explained. During such later explained phase in the operation of the unit the fluid will be flowing from the valve port 34 and through the reversible flow passage 38 and will be operable to unseat the valve member 44 to some position as that shown in the drawing while concurrently forcing the piston 47 against a shoulder 56. This is similar to the action of the fluid under pressure in the reversible flow passage 41 in holding the piston 54 against a shoulder 57.

The control valve plunger 37 is differentially controlled by a manual control lever 61 and the ram 12. The lever 61 is pivotal about a fixed pivot 62 and has its lower end connected with the lower end of a walking beam lever 63 by a link 64. The ram piston is operably connected with the upper end of the walking beam lever through the connecting rod 15, arm 16, and a link 65.

A cam head 66 on the right-hand of the plunger 37 cooperates with a cam follower 67 on an endwise reciprocal stem 68 of a switch 69.

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This switch is open when the cam 66 registers with a notch 71 in the cam follower head thereby permitting the stem 68 to project a short distance endwise downwardly. While the cam 66 registers with either of the lobes 72 or 73 on the follower 67, the switch will be closed. The switch 69 constitutes part of an electrical circuit commencing with ground G and leading through a conductor 74, switch 69, a conductor 75, magnetic-fluid clutch 22, a conductor 76, and the tractor storage battery 77 to ground at G'.

An auxiliary electrical circuit for controlling energization of the magnetic-fluid clutch 22 includes a fluid pressure responsive switch 78 communicative with the accumulator 28 through the conduit 27 and a conduit 79. The auxiliary circuit starts with the ground at G' and leads through the switch 78, a conductor 81, a portion of conductor 75, the magnetic-fluid clutch 22, conductor 76 and battery to ground at G'. The switch 78 closes responsively to the accumulator pressure dropping below a predetermined minimum to energize the clutch 22 for connecting the pump 21 with the continuously rotating driving member 23, thereby causing the pump to periodically replace any leakage from the accumulator past the enlargements 35 and 36 of the valve plunger while this plunger is in position closing both ports 33 and 34.

Operation of the apparatus

While all parts of the apparatus are at rest, with the exception of the continuously rotating driving member 23, the control valve plunger 37 will be in the closed or neutral position N, that is with the index mark M of the plunger in alignment with the scale mark N. At that time the plunger enlargement 35 will register with the port 33 and enlargement 36 will register with the port 34, closing these two ports. The cam 66 on the right end of the plunger will be centered in the cam follower recess 71 causing the switch 69 to be open. Assuming the fluid pressure in the accumulator 28 to be above the minimum pressure to be maintained therein, the pressure responsive switch 78 will also be open and the magnetic-fluid clutch 22 de-energized.

The drawing illustrates the apparatus in the status it assumes immediately following movement of the control lever 61 clockwise about the pivot 62 for incurring clockwise movement of the rock shaft 17. When the operator pivoted the control lever 61 clockwise, this lever was operable through the link 64 to swing the lower end of the walking beam lever 63 to the left for moving the plunger 37 endwise into the open position A. Concurrently with this endwise movement of the valve plunger, the cam 66 passed under the cam follower profile 72 for closing the switch 69 and consequently engaging the magnetic-fluid clutch. Thereupon the continuously rotating member 23 is drivingly connected with the pump 21 whereby fluid is discharged through the pump outlet 19, conduit 27, accumulator 28, valve port 29, valve port 33, reversible flow passage 41 and the check valve 49 therein into the left end of the ram cylinder 13. The pressure of fluid in the reversible flow passage 41 is exerted against the left end of the valve operating piston 47 which moves to the right for unseating the valve member 44 wherefor the ram piston 14 can move to the right under the influence of the pressure fluid in the left end of the cylinder 13 incident to exhausting the fluid from the piston rod end of the cylinder through the reversible flow passage 38, past the

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check valve 43 therein and into the reservoir 26 through port 34. Fluid flows from the reservoir 26 through the conduit 25 and thus through the pump inlet 24. As soon as the rock shaft 17 has rocked clockwise a distance correlated with the pivotal movement of the manually-operated lever 61, the walking beam lever 63 will have been pivoted sufficiently far clockwise about its pivotal connection with the link 64 for returning the valve plunger to the neutral position N. Thereupon the switch 69 is opened and the valve ports 33 and 34 closed. The springs 46 and 53 close the check valves 43 and 49 and thereby hydraulically lock the ram piston 14 against movement in either direction.

When it is desired to rock the rock shaft counter-clockwise the lever 61 will be manually moved counter-clockwise to swing the lower end of the walking beam lever 63 to the right for carrying the valve plunger 37 to position B wherein communication is established between the ports 29 and 34, and to establish communication between the port 33 and the reservoir 26. The cam 66 will have been moved into registry with the cam lobe 73 for closing the switch 69 whereupon the clutch 22 operably connects the pump with the continuously rotating driving member 23. Fluid under pressure will then flow from the accumulator through the ports 29 and 34, through the reversible flow passage 38 and the check valve 43 therein into the piston rod end of the ram cylinder 13. The fluid in the reversible flow passage 38 will press against the right end of the valve operating piston 54 for shifting the stem 55 against the valve member 51 to hold the latter unseated from the seat 52. Consequently the plunger 14 can move to the left under the influence of the fluid under pressure in the right end of the cylinder 13 incident to exhausting fluid through the reversible flow passage 41 and the opened check valve 49, and thence through the port 33 into the reservoir 26. When the ram plunger 14 has moved to the left a distance correlated with the distance of movement of the hand lever 61 counter-clockwise the valve plunger will disconnect the switch 69 and close the valve ports 33 and 34 to re-establish the quiescent condition of the apparatus while it is disconnected from the continuously driving member 23.

Having thus described a single preferred form of the invention with the view of clearly and concisely illustrating same, I claim.

1. In an hydraulic power transmitting unit receivable of driving force from a continuously rotating driving member; a hydraulic motor operable responsively to admittance of fluid under pressure into an inlet thereof; a pump having a fluid outlet; fluid conducting means including a control valve interposed between said motor inlet and the pump outlet, the control valve being adjustable from a closed condition wherein it is effective for blocking communication through the fluid conducting means from the pump outlet to the motor inlet to an open condition establishing such communication through the fluid conducting means; a control member manipulatable for adjusting the valve from the closed condition to the open condition; means operable by the motor pursuant to operation thereof for resetting the valve to the closed condition; an electro-magnetic clutch interposed between said continuously rotating member and the pump and energizable for transmitting driving force from such rotating member to the pump, said electro-magnetic clutch having a driving characteristic when sub-

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jected to an overload of permitting slippage between its driving and driven parts while transmitting a constant maximum torque irrespective of the relative speed of such parts; and an electric energizing circuit operable in timed relation with said valve to energize the clutch pursuant to opening of the control valve and to de-energize the clutch pursuant to closing of the valve.

2. The combination set forth in claim 1 wherein said control valve includes port means in series with the fluid conducting means and a valve member occupying a position covering the port means when the valve is closed and movable into a position uncovering the port means when the valve is open; and wherein the electric energizing circuit includes a switch controlling the energization status of said circuit and operated by said valve member.

3. The combination set forth in claim 1 wherein said fluid conducting means includes a hydraulic accumulator having a chamber through which fluid flows en route from the pump outlet to the motor inlet; and wherein there is a second electric energizing circuit for the electro-magnetic clutch and including a pressure-responsive switch unit subjected to the fluid pressure in said accumulator and operable attendant to a predetermined diminution of the pressure in the accumulator to energize such second circuit and the electro-magnetic clutch and operable attendant to the attainment of a predetermined maximum pressure of the fluid in the accumulator to de-energize such second circuit and the electro-magnetic clutch.

4. The combination set forth in claim 3 wherein said control valve includes port means in series with the fluid conducting means and a valve member occupying a position covering the port means when the valve is closed and movable into a position uncovering the port means when the valve is open; and wherein the electric energizing circuit includes a switch controlling the energization status of said circuit and operated by said valve member.

5. In an hydraulic power transmitting unit receivable of driving force from a continuously rotating driving member; an hydraulic motor alternatively drivable in opposite directions; passages communicative with said motor for causing operation thereof in respective of such opposite directions when fluid is delivered to such motor respectively therethrough, each of said passages also being for the exhaust of fluid from the motor attendant to delivery through the other passage; check valves in said passages and operable when closed to preclude exhaust of fluid therethrough; fluid-operated devices respectively associated with said check valves and operable when subjected to a status of pressure differential to open their associated check valve to accommodate exhaust of fluid from the motor; a pump having a fluid outlet; a control valve having a cylindrical bore with axially-spaced ports from which said passages respectively lead, a fluid admittance port between the axially-spaced ports and a plunger reciprocally in said bore; a low pressure reservoir communicating with said bore axially outwardly from the ends of the plunger; said plunger having a pair of axially spaced lands respectively registered with the axially spaced ports when the plunger is in a valve-closing position from which it is movable in opposite axial directions for alternatively establishing communication between said ports and the fluid admittance port while the other of said axial spaced ports is uncov-

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ered by its associated land to communicate with the reservoir, each of said fluid-operated devices being communicative with the passage of the non-associated check valve for being subjected to the pressure of fluid admitted through such passage and operable thereby to open the associated check valve; a pump having an inlet communicative with said reservoir and an outlet communicative with said admittance port; means operable by said motor pursuant to operation thereof for resetting the valve plunger to the valve-closing position; an electro-magnetic clutch interposed between said continuously rotating member and the pump and energizable for transmitting driving force from such rotating member to the pump, said electro-magnetic clutch having a driving characteristic when subjected to an overload of permitting slippage between its driving and driven parts while transmitting a constant maximum torque irrespective of the relative speed of such parts; and an electric energizing circuit operable

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in timed relation with said valve plunger to energize the clutch pursuant to movement of the plunger in either axial direction from the closed position and for de-energizing the clutch pursuant to return of the valve plunger to the valve closing position.

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