HYDRAULIC DRIVE SPEED CHANGING AND TRANSMITTING UNIT

FIG. 4
HYDRAULIC DRIVE SPEED CHANGING AND TRANSMITTING UNIT

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This invention relates to hydraulically operated drive systems, and more particularly to a new hydraulically operated drive speed changing and transmitting system of the type including hydraulic motors driven by hydraulic fluid supplied thereto from pumps.

In hydraulic drive speed changing and transmitting system (hereinafter referred to as a hydraulic drive system) for use in vehicles, a pair of pumps and hydraulic motors are provided for driving the left and right wheels or other running gear of the vehicles, and, therefore, a pair of hydraulic fluid control means must be provided. However, in such hydraulic drive systems, the existence of a pair of hydraulic motors, pumps and control means makes the construction and piping of the system complicated with the resultant difficulty of assembly and disassembly thereof.

Accordingly, an important object of this invention is to provide a hydraulic drive system and unit, in which the hydraulic motors, pumps and hydraulic fluid control means are assembled in a unit to simplify the construction and piping of the system.

Another object of this invention is to provide a hydraulic drive system and unit, in which the hydraulic motors, pumps and hydraulic fluid control means are assembled in a compact unit to facilitate the installation, repair and inspection of the system.

Other and further objects of this invention will be obvious upon an understanding of the preferred embodiments which will be described hereinafter in connection with the accompanying drawings, in which:

FIG. 1 is a schematic illustration of a conventional hydraulic drive system including a pair of hydraulic circuits and, therefore, a pair of fluid control means;

FIG. 2 is a schematic perspective view of a hydraulic drive unit according to this invention;

FIG. 3 is a schematic diagram illustrating the piping circuits employed in the drive unit of FIG. 2; and

FIG. 4 is a disassembled perspective view of a hydraulic drive unit of practical form according to this invention.

Referring now to FIG. 1, there is illustrated a conventional hydraulic drive system including a pair of hydraulic circuits. In the figure, a pump 2 belonging to one of the circuits is suitably driven by a prime mover (not shown) and supplies hydraulic fluid through a supply line 4 to a hydraulic motor 8 to drive the same. The hydraulic fluid which has driven the hydraulic motor 8 returns through a return line 5 to the pump. Fluid flow control means 10 is interposed in the supply and return lines in order to control the fluid flow and therefore the operation of the hydraulic motor 8.

In the other hydraulic circuit, a pump 3 similar to the pump 2 is suitably driven by a prime mover (not shown) and supplies hydraulic fluid through a supply line 6 to a hydraulic motor 9. The hydraulic fluid which has been used to drive the motor 9 returns through a return line 7 to the pump 3. Fluid flow control means 11 is interposed in the supply and return lines 6 and 7 to control the fluid flow and, therefore, the operation of the hydraulic motor 9.

In the operation of the system, the hydraulic fluid flows from the pumps 2 and 3 through the control means 10 and 11 to the motors 8 and 9 and thereafter returns to the pumps 2 and 3, respectively. When it is desired to stop the hydraulic motors 8 and 9, the hydraulic fluid in both circuits is caused to flow through the control means 10 and 11 and through common lines 14 and 15 to a fluid reservoir (not shown) by operating a release valve 12.

Make-up fluid for compensating for the discharged amount of the fluid is supplied by a make-up pump 13 through the line 14 into the supply and return lines 4-7.

In the conventional system of the above type, the control means 10 and 11 are separately arranged, which results in complexity of the piping of the system and bulkiness of the same.

The hydraulic drive unit according to this invention, which eliminates this disadvantage, is schematically shown in FIG. 2 in which the same numerals as in FIG. 1 designate the same elements as in FIG. 1. The power unit shown includes a prime mover 20 such as an electric motor which rotates through a drive shaft 22 a main spur gear 24, which is in mesh with spur gears 25 and 26 and rotates the same. The spur gears 25 and 26 drive pumps 2 and 3, respectively. Reference numeral 32 designates a gear which is in mesh with the gear 24 and serves to drive a make-up pump 13 (see FIG. 1).

Reference numeral 27 designates a fluid flow control block which contains therein the fluid flow control means 10 and 11 as mentioned in connection with FIG. 1. The control block 27 is in the form of a T-shaped piece and has a head portion 27' thereof rigidly supporting the pumps 2 and 3. A leg portion 27" of the block 27 supports on both sides thereof hydraulic motors 8 and 9.

The control block 27, of course, contains therein the piping 4-7 or corresponding passages. Reference numerals 28 and 29 designate control levers for controlling the deliveries of the pumps 2 and 3, respectively, and numerals 30 and 31 designate control levers for controlling the discharges of the hydraulic motors 8 and 9, respectively.

A connection diagram of the control circuit for the unit of FIG. 2 is illustrated in FIG. 3, in which the same numerals as in FIGS. 1 and 2 designate the same elements as in FIGS. 1 and 2. In FIG. 3, the elements enclosed by the dot and dash line are those which are contained within the control block 27.

In the lower hydraulic circuit shown in FIG. 3, branch lines 33 and 34 branch off from the supply and return lines 4 and 5, respectively. The branch line 33 branches into branch lines 33' and 33", and the branch line 34 branches into branch lines 34' and 34". The branch lines 33' and 33" include check valves 37 and 39 inserted therein, respectively, and the branch lines 34' and 34" include check valves 38 and 40 inserted therein respectively.

The check valve 37 allows the fluid flow from the supply line 4 to pass therethrough but prevents the fluid flow toward the line 4, and the check valve 39 allows the fluid flow toward the supply line 4 but prevents the flow from the line 4. Similarly, the check valve 38 permits the fluid flow from the return line 5 to pass therethrough but prevents the fluid flow toward the line 5, and the check valve 40 allows the fluid flow toward the return line 5 but prevents the flow from the line 5.

The branch lines 33' and 34' meet together at 53, and likewise the branch lines 33" and 34" meet together at 54. A line 45 extends between the points 53 and 54 and has a relief valve 47 inserted therein. This relief valve 47, when operated, permits the fluid flow to pass from the point 53 to the point 54. The details of this relief valve 47 are out
of the scope of this invention and will not be described further.

There is provided a fluid reservoir tank 52 which is connected through a strainer 55 to the suction side of the fluid make-up pump 13. The delivery side of the pump 13 leads through a filter 56 and through a line 49 to the point 54. From the line 49, a discharge line 50 extends to a fluid reservoir tank 51, the line 50 having there-in the release valve 12 (see FIG. 1).

The upper hydraulic circuit shown in FIG. 3 has the same arrangement as the lower hydraulic circuit which has been described above, and includes branch lines 35 and 36, check valves 41, 42, 43 and 44, a relief valve 48, and a line 46 having the relief valve 48. The line 46 is also connected to the common line 49 and communicates with the reservoir tanks 51 and 52.

The hydraulic drive system shown in FIG. 3 operates as follows. When the prime mover 20 is driven, the pumps 2 and 3 are operated through the gearing 24–26 to feed the pressurized hydraulic fluid through the supply lines 4 and 6 to the hydraulic motors 8 and 9, respective-ly, so as to drive the same. The fluid after leaving the motors returns through the return lines 5 and 7 to the suction side of the pumps 2 and 3.

The above described operation occurs only when the relief valves 47 and 48 are not operated and are not permitting the communication between both sides thereof. However, when the relief valves 47 and 48 are oper-ated to permit the communication therethrough, the hy-draulic fluid flows through the supply lines 4 and 6, the branch lines 33 and 35, the check valves 37 and 41, the relief valves 47 and 48, the lines 45 and 46, the common line 49, the relief valve 12, and the line 50 into the reservoir 11. When the relief valves 47 and 48 are oper-ated as described above, the flows of fluid through the components 4, 8, and 9 on one hand, and the compo-nents 6, 9, and 7 on the other hand, becomes very small because the resistances at the hydraulic motors 8 and 9 respectively, are greater than those of the pas-sages leading the relief valves 47 and 48, respectively. Accordingly, the flow of fluid through motors 8 and 9 becomes too small to operate these motors, so that the motors come to a stop.

The compensation for the released amount of the hy-draulic fluid is effected by feeding the fluid from the reservoir tank 52 through the strainer 55, the filter 56, the common line 49, the check valves 39, 43 and 40, 44, and the branch lines 33, 35 and 34, 36 to the supply and return lines 4, 6 and 5, 7, by means of the make-up pump 13.

In order to control the speed of the hydraulic motors 8 and 9, the control levers 28 and 29 or 30 and 31 may be manipulated.

Referring to FIG. 4, a practical construction of the hydraulic power unit according to this invention is illus-trated in detail. In this figure, the same numerals as in FIGS. 2 and 3 designate the same components or ele-ments as in FIGS. 2 and 3.

The power unit shown includes the fluid flow control block 27 of T-shaped configuration, to the head portion 27 of which are rigidly secured the pair of pumps 2 and 3. A triangular cover 60 is secured onto the ends of the pumps 2 and 3 and encloses the gearing 24–26 and 32. The drive shaft 22 extending through the cover 60. The T-shaped control block 27 has thereon the control levers 28 and 29 for controlling the deliveries of the pumps 2 and 3, respectively. The hydraulic motors 8 and 9 are secured on respective opposite sides of the leg portion 27.

of the block 27, and have their rotor shafts 61 and 62 projecting therefrom in opposite directions.

There are provided a pair of upper and lower casing elements 63 and 64 which are adapted to enclose the power unit. The upper casing element 63 includes a pair of semi-circular recesses 65 and another semi-circular recess 66, and the lower casing element 64 includes a pair of semi-circular recesses 67 and another semi-circular recess 68, the recesses 67 being adapted to align with the recesses 65 to form a pair of bearing covers for receiving the bearing parts of the rotor shafts 61 and 62 and the recess 68 being adapted to align with the recess 66 to form a bearing cover for receiving the bearing part of the drive shaft 22. The upper casing element 63 has a flange 69 for fastening the element 63 to the lower element 64.

When the casing elements are fitted about the drive unit, only the pair of rotor shafts 61 and 62 and the drive shaft 22 project beyond the side surface of the assembled casing. This affords a compact form of the hydraulic drive unit and thereby makes possible easy installation of the drive unit onto vehicles. Moreover, repair and inspection of the drive unit can be easily carried out.

While preferred embodiments of this invention have been shown and described hereinabove, it is to be under-stood that this invention is not intended to be limited thereto but may be modified or changed without departing from the spirit and scope of this invention as set forth in the appended claims.

What we claim is:

1. In a hydraulic drive speed changing and transmitting unit comprising a pair of hydraulic circuits each in-cluding a pump, a hydraulic motor driven by hydraulic fluid supplied thereto from said pump and control means for controlling the hydraulic fluid flow to said hydraulic motor, the improvement in which the control means of both said hydraulic circuits are arranged within a unitary T-shape body having a head portion and a leg portion, said head portion rigidly supporting said pumps and said leg portion rigidly supporting, on respective opposite sides thereof, said hydraulic motors.

2. The hydraulic drive speed changing and transmitting unit according to claim 1, which further comprises a pair of casing elements which fully enclose said pumps, hy-draulic motors and unit body and have openings providing for an input shaft of said pumps and the output shafts of said hydraulic motors to extend through said casing elements to the outside.

3. A hydraulic drive speed changing and transmitting unit, according to claim 1, which further comprises a gear box in driving connection with said pumps and having said input shaft extending therefrom for coupling with a driving shaft of an exterior prime mover.

4. A hydraulic speed changing and transmitting unit, according to claim 3, which further comprises a pair of casing elements fully enclosing said pumps, hydraulic motors and unitary body, said casing elements being formed conjointly to provide openings for extension of said output shafts and the input shaft of said gear box through said casing elements to the exterior thereof.

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