Oct. 18, 1966 YOSHITO KUDO ET AL 3,279,172

HYDRAULIC DRIVE SPEED CHANGING AND TRANSMITTING UNIT

Filed March 17, 1965

2 Sheets-Sheet 1

FIG. 1

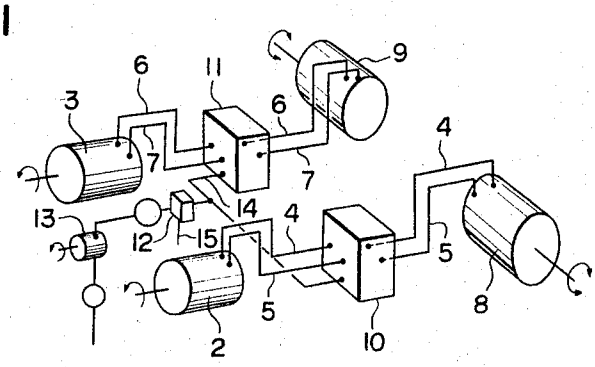
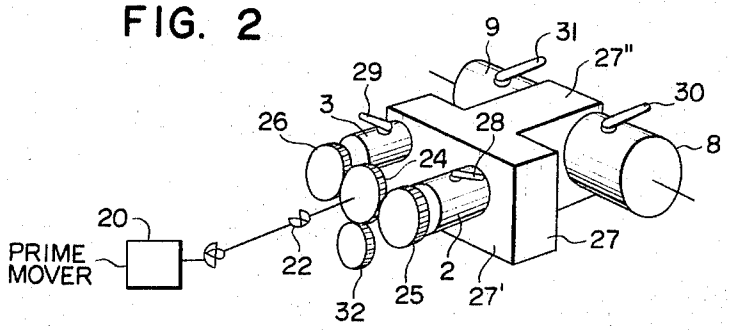


FIG. 2



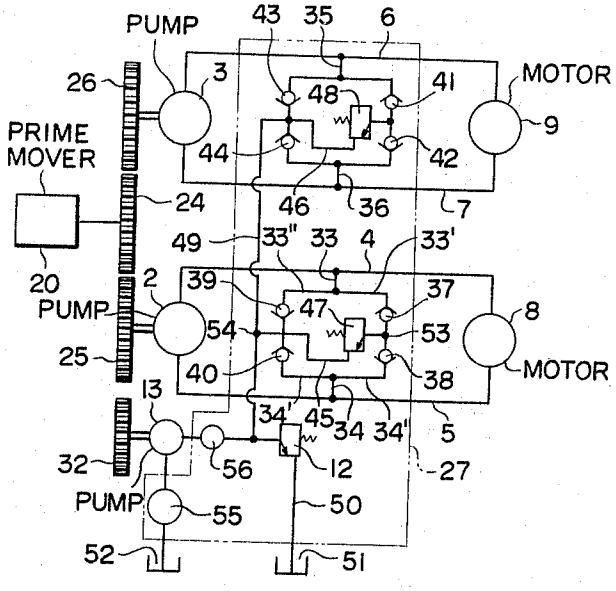


FIG. 3

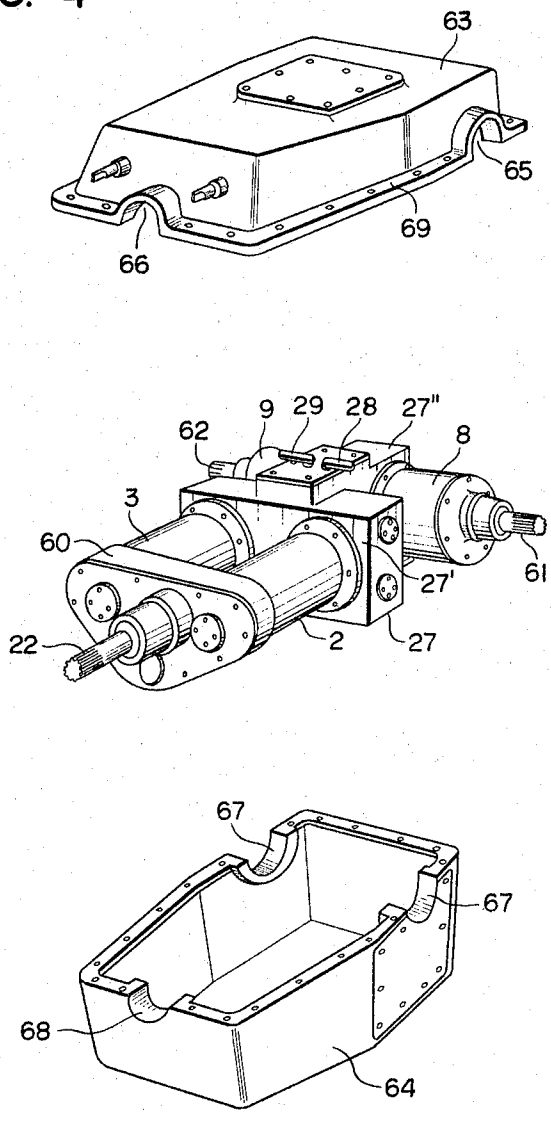
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FIG. 4



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HYDRAULIC DRIVE SPEED CHANGING AND TRANSMITTING UNIT

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4 Claims. (Cl. 60—53)

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 having a pair of hydraulic circuits, in which a pair of fluid flow 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 in perspective 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 this 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** similar to the motor **8**. 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 main 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 pipings **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 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 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 therein 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**, respectively, 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 operated to permit the communication therethrough, the hydraulic 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 tank **51**. When the relief valves **47** and **48** are operated as described above, the flows of fluid through the components **4**, **8** and **5**, on one hand, and the components **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 passages including 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 hydraulic 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 illustrated in detail. In this figure, the same numerals as in FIGS. 2 and 3 designate the same components or elements 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 understood 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 including 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, hydraulic motors and unit body and have openings providing for an input shaft of said pumps and the ouput 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.

References Cited by the Examiner

UNITED STATES PATENTS

2,446,242	8/1948	Orshansky	60—53
2,941,609	6/1960	Bowers et al.	60—53
3,052,098	9/1962	Ebert	60—53
3,123,975	3/1964	Ebert	60—53

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