Aug. 10, 1954 F. D. FUNSTON 2,685,840

VARIABLE VOLUME HYDRAULIC PUMP ASSEMBLY FOR TRACTORS

Filed Nov. 27, 1950 2 Sheets-Sheet 1

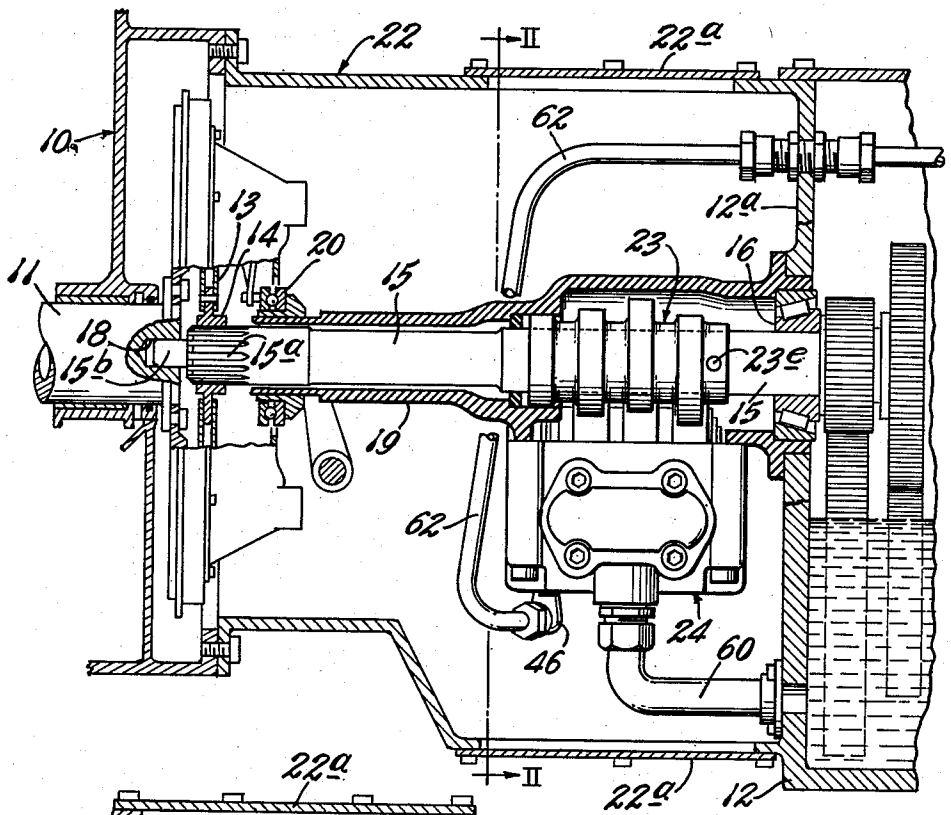


Fig. 1

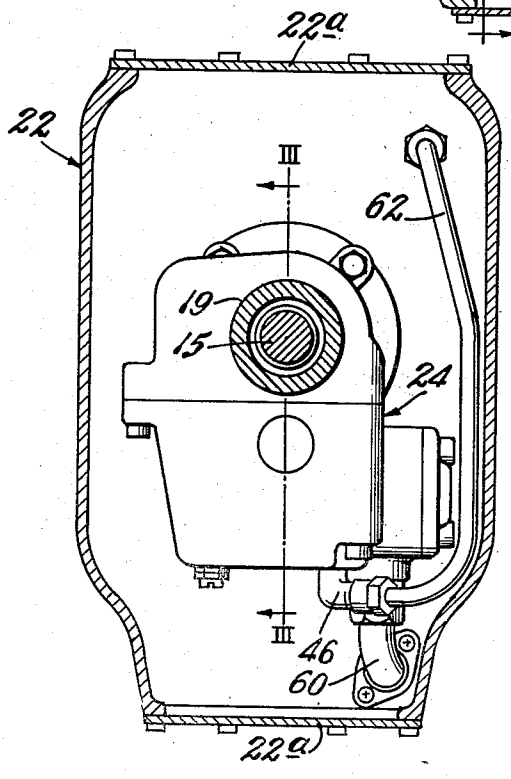


Fig. 2

INVENTOR.
F. D. FUNSTON
BY
Bloomsbury
ATTORNEY

Aug. 10, 1954 F. D. FUNSTON 2,685,840

VARIABLE VOLUME HYDRAULIC PUMP ASSEMBLY FOR TRACTORS

Filed Nov. 27, 1950 2 Sheets-Sheet 2

Fig. 3

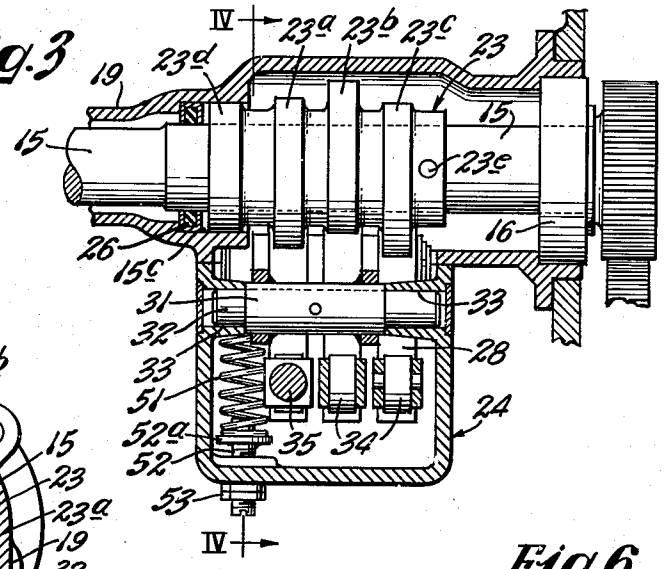


Fig. 4

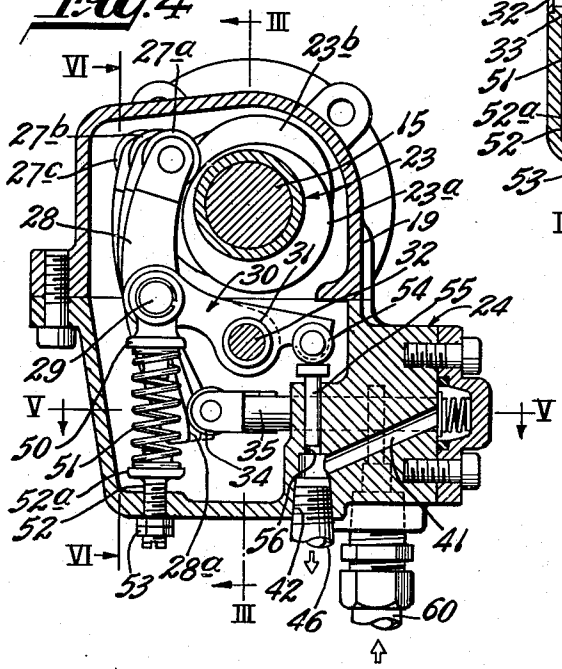


Fig. 6

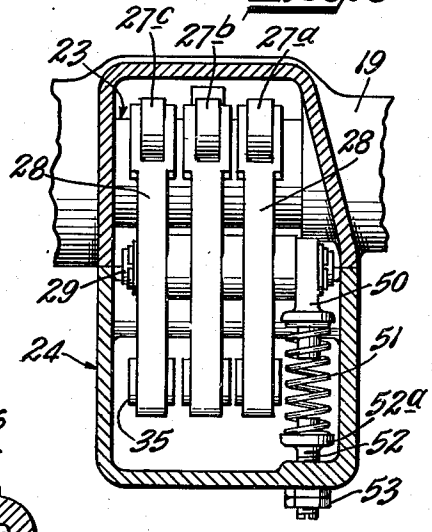
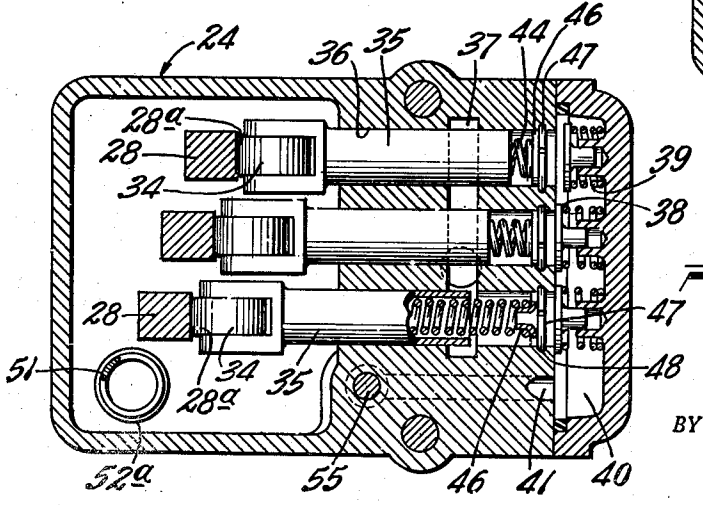


Fig. 5



INVENTOR.
F. D. FUNSTON
BY
ATTORNEY

Patented Aug. 10, 1954 2,685,840

UNITED STATES PATENT OFFICE

2,685,840

VARIABLE VOLUME HYDRAULIC PUMP ASSEMBLY FOR TRACTORS

Frederick D. Funston, Tujunga, Calif., assignor to Bendix Aviation Corporation, South Bend, Ind., a corporation of Delaware

Application November 27, 1950, Serial No. 197,800

4 Claims. (Cl. 103—54)

1

This invention relates to hydraulic systems for utilizing the power of a tractor engine to perform control operations formerly performed manually, and has to do particularly with the engine-driven pump for supplying the necessary pressure fluid.

An object of the invention is to provide an engine-driven pump assembly that is readily applicable to tractor engine-transmission units of existing design, occupies space otherwise wasted, is completely enclosed within the usual engine-transmission unit housing, and is conveniently located to utilize the transmission case oil as the hydraulic fluid.

Other more specific objects and features of the invention will become apparent from the description to follow.

It is old practice in tractor hydraulic systems to produce the necessary pressure fluid with a pump deriving power from the tractor engine, but the pump has been usually mounted exteriorly of the engine and transmission casings, and driven from a power take-off shaft extending through the transmission casing. This is sometimes objectionable because the pump takes up space that could better be utilized for other purposes, and coupling the pump to the engine through the power take-off shaft complicates the use of that shaft for its intended purpose. It has also been common practice to employ pumps of constant volume type which delivered fluid whenever the engine was running irrespective of the demand for pressure fluid. To avoid power wastage and heating of the fluid, various known expedients have been adopted for preventing pressure in the outlet of the pump when the hydraulic system is inactive. One obvious expedient is to provide a pressure regulating valve that by-passes fluid from the outlet to the inlet at low pressure whenever the system pressure reaches a predetermined value. This method has the objection that it is relatively expensive. Another commonly used expedient is to circulate fluid at low pressure through the motor control valve when the latter is in neutral position, but this method is applicable only when the hydraulic system contains only a single motor, and wastes power with resultant overheating of the fluid when only small amounts of fluid are being used.

In accordance with the present invention, the mentioned defects of previous pump locations are avoided by placing the pump within the clutch housing immediately in front of the transmission, and driving it by a cam on the main gearshaft extending from the clutch to the transmission. This completely encloses the pump within the usual power plant structure of the tractor and utilizes space that would otherwise be wasted. Further in accordance with the invention, the pump is of the plunger type, having an inlet port covered and uncovered by the stroke of the plunger, with a cam follower linkage adjustable to vary the stroke and the average stroke position between a maximum volume setting and a minimum volume setting. In the maximum volume setting, the plunger not only has its maximum stroke but uncovers the inlet port only at the outer end of its stroke, so that it pumps throughout practically its entire stroke. In the minimum volume setting, the plunger not only has its minimum stroke but never covers the inlet port, so that it does not pump at all. The cam follower linkage is actuated automatically in response to the pressure in the system to cause the pump to develop pressure and deliver fluid to the system only when fluid is being used.

2

A full understanding of the invention may be had from the following description with reference to the drawing, in which:

Fig. 1 is a longitudinal, vertical sectional view through the clutch housing of a typical tractor equipped with a pump in accordance with the invention;

Fig. 2 is a cross section taken in the plane II—II of Fig. 2;

Fig. 3 is a vertical, longitudinal, sectional view through the pump, the section being taken in the plane III—III of Fig. 2;

Fig. 4 is a cross section taken in the plane IV—IV of Fig. 3;

Fig. 5 is a horizontal section taken in the plane V—V of Fig. 4; and

Fig. 6 is a vertical section taken in the plane VI—VI of Fig. 4.

As previously indicated, Fig. 1 is a section through the clutch housing of a common type of tractor, showing the rear end portion of the engine 10 having the crankshaft 11, and the forward end of the transmission case 12, which is spaced rearwardly (to the right) an appreciable distance from the engine 10. The engine contains the usual clutch, only the driven plate 13 of which is shown, this plate having an internally splined hub 14 which slides on the splined forward end portion 15a of the usual main gearshaft 15 which extends rearwardly from the clutch plate 13 into the transmission housing 12, and serves to deliver the power of the engine into the transmission. The main gearshaft 15 is commonly supported in the forward wall of the transmission 12

by the bearing assembly 16, and has a pilot journal 15b extending from its forward end which rests in a pilot bearing 18 in the rear end of the engine crankshaft 11. That portion of the main gearshaft 15 extending between the transmission housing 12 and the clutch 13 is enclosed in a main gearshaft housing 19 which is secured at its rear end to the transmission housing 12 and extends forwardly around the shaft 15. The forward end of this housing 19 is sometimes used to support the clutch throw-out bearing 20, as shown. The structure so far described corresponds to the prior art. Heretofore there has usually been no element, other than those mentioned, positioned between the transmission housing and the engine. However, it has been customary to rigidly interconnect the engine 10 and the transmission housing 12 by a clutch housing 22 which defines a largely empty space between those elements. The housing 22 is commonly provided with a plurality of openings and cover plates 22a therefor to permit access to the interior.

In accordance with the present invention, the usual main gearshaft 15 has installed thereon a pump-actuating cam 23 which is secured to the shaft 15 for rotation therewith, as by a pin 23e. Further in accordance with the invention, the usual gearshaft housing is modified to provide the necessary space therewithin for the cam 23 and for the mounting thereon of a pump case 24. The pump case 24 may be bolted to the gearshaft housing 19 to form a unitary assembly therewith, which is fully illustrated in Figs. 3 to 6 inclusive.

Referring to Fig. 3, the cam 23 is provided with eccentric cam surfaces 23a, 23b and 23c, and a concentric surface 23d that functions as a radial bearing running in a cylindrical passage 15c in the main gearshaft housing, for supporting the cam at its forward end with respect to the housing.

The three eccentric cam surfaces 23a, 23b and 23c respectively contact follower rollers 27a, 27b and 27c respectively, each of which is mounted on the upper end of a separate rocker arm 28. All three rocker arms 28 are mounted on a common rocker arm shaft 29 which is supported on the left end (Fig. 4) of a rocker arm supporting lever 30. The lever 30 is composite in nature, actually comprising several levers alternating along the shaft 29 with the rocker arms 28, and all secured solidly as by welding to a common sleeve 31 which is pinned or otherwise secured to a shaft 32 which is rotatably supported at its opposite ends by bearings 33—33 in the pump housing 24 (Fig. 3).

The lateral faces of the three rocker arms 28 adjacent the lower ends thereof below the shaft 29 contact rollers on the outer ends of pump plungers 35, there being three plungers corresponding to the three respective rocker arms 28. Each plunger 35 is reciprocable in a cylinder 36 formed in the pump housing 24. As best shown in Fig. 5, each cylinder 36 is intercepted intermediate its ends by a common intake port 37, and each cylinder has at its outer end an outlet or discharge valve 38 that is urged against the open end of the cylinder by a helical compression spring 39. The three outlet valves 38 communicate the three cylinders with a common discharge manifold passage 40 that is connected by a passage 41 with an outlet port 42 to which pipe connection can be made to the system to be supplied with pressure fluid by the pump.

It will be apparent from the description so far that in response to rotation of the cam 23 the rocker arms 28 will be successively rocked back and forth to reciprocate their respective associated plungers 35 in their respective cylinders. Referring to Fig. 5, the lowermost plunger 35 is shown near its outermost stroke position in which its inner end clears port 37 to permit fluid to flow from the inlet port 37 into the cylinder; the intermediate plunger 35 is in an intermediate position in which it covers the port 37 and is moving to the left on its suction stroke. The uppermost plunger 35 is near its innermost stroke position, and is moving to the right and discharging fluid into the manifold 40 as evidenced by the open position of its valve.

Each of the plungers 35 is hollow and open at its inner end to accommodate a coiled compression spring 44 which serves to return the plunger and maintain the rollers 27a at the upper ends of the rocker arms 28 in contact with their associated cam surfaces. The inner end of each spring 44 bears against a retainer 46 which in turn bears against a split ring 47 expanded into a groove 48 in the associated cylinder wall.

The amount of fluid delivered by the pump can be varied from a maximum to a minimum value by rocking the rocker arm shaft supporting lever 30 from its extreme clockwise position, as shown in Fig. 4, into a counterclockwise position in which the rollers 34 on the plungers 35 contact the upper end portions of the roller-contacting lateral faces 28a provided on the rocker arms 28. Obviously, when the rocker arms are in the position shown in Fig. 4, and the plunger rollers 34 contact the surfaces 28a near their lower ends, a relatively long lever arm is provided between this point of contact and the shaft 29, so that maximum stroke of the plungers is produced. On the other hand, when the rocker arm supporting shaft 29 is lowered to cause the rollers 34 to contact the surfaces 28 nearer the shaft 29, the lever arm is reduced and the stroke of the plungers is correspondingly reduced. This alone will substantially reduce the volume of fluid pumped.

To further reduce the output of the pump as the shaft 29 is moved toward lowermost position, the surfaces 28a are extended at an angle to the path of movement of the rocker arm shaft 29 so that the average positions of the plungers 35 are moved outwardly in their cylinders. This is preferably carried to such extent that the inner ends of the plungers do not cover the inlet port 37 when the rocker arms 28 are in their extreme lower position of adjustment, thereby causing the pump to cease pumping entirely.

The lever shaft 32 could be extended exteriorly of the pump and controlled manually to vary the output of the pump. However, for the purpose of a tractor pump it is desirable to effect this operation automatically in response to variations in pressure in the delivery line from the pump, so that the pump delivers a quantity of fluid dependent upon the amount used, and ceases to pump when no fluid is being withdrawn and the pressure in the system rises to a predetermined maximum. To this end, the shaft 29 is spring-urged into position for maximum delivery, and is pressure-urged in the opposite direction. Thus there is mounted on the rocker arm shaft 29, at one end, a spring-contacting element 50 that fits into one end of a helical compression spring 51, the other end of which is supported by a head 52a on an adjusting screw 52 which extends through the wall of the pump housing and is

locked in a desired position of adjustment by a lock nut 53. The other end of the lever 30 carries a roller 54 which bears against the outer end of a plunger 55 which is reciprocable in a cylinder 56, the lower end of which is connected to the output or pressure line 41. Therefore, the pressure in the exhaust manifold of the pump and in the passage 41 is applied at all times to the lower end of the plunger 55 and urges it upward in opposition to the force exerted on the lever arm 30 by the spring 51. When the pressure becomes sufficiently great, the plunger 55 moves upwardly, compressing the spring 51 in so doing, and rocks the rocker arm shaft 29 into the position in which no pumping takes place.

It will be observed from the foregoing description and the drawing that the present invention provides for a convenient location of the pump on a tractor in a place where there is ample room and where it can be conveniently driven by a cam conveniently located on an existing shaft. It will also be apparent that the construction provides a variable volume pump responsive to the pressure in the output or delivery line, for causing the pump to operate only when fluid is being withdrawn from the system. When no fluid is withdrawn, the pump operates only to a sufficient extent to maintain the desired pressure in the lines. This permits any number of different motors to be operated from the pump, each under the control of a separate, independent valve.

It is desirable in some instances, in a tractor hydraulic system, to use the transmission oil as the hydraulic fluid, and use the transmission case as the reservoir for the fluid supply. Such an arrangement is shown in Fig. 1 in which the inlet pipe 60 of the pump is connected to the transmission housing 12 near the lower end thereof. In this instance, the pump discharge port 46 is shown connected to a tube 62 that extends through the front wall 12a of the transmission case and into the casing. Such an arrangement is sometimes used where a hydraulic cylinder to be actuated is positioned within the transmission case so that any leakage therefrom will return to the reservoir.

Although for the purpose of explaining the invention, a particular embodiment thereof has been shown and described, obvious modifications will occur to a person skilled in the art, and I do not desire to be limited to the exact details shown and described.

I claim:

1. A hydraulic pump assembly for a tractor having an engine with a drive clutch on its rear end, a transmission supported in fixed relation with respect to said engine spaced rearwardly of said clutch and having a main gear shaft extending forwardly from said transmission to said clutch in driven relation with the clutch, and a gearshaft housing mounted on said transmission and projecting forwardly therefrom, said pump assembly comprising: a cam on said gearshaft, a pump casing mounted on said gearshaft housing in sealing relation therewith, a cylinder in said casing, a pump plunger in said cylinder, a cam follower mechanism oscillatably supported in said casing and bearing on said cam for reciprocating said plunger in response to rotation of said gearshaft, and means for admitting fluid to and conveying it from said cylinder in response to reciprocation of said plunger.

2. An assembly according to claim 1 in which said cam comprises a sleeve secured on said gearshaft for rotation therewith, said sleeve having an eccentric cam surface thereon cooperating with said follower mechanism, and having bearing means radially rotatably supporting the forward end of said sleeve with respect to said housing.

3. A hydraulic pump assembly for a tractor having an engine with a drive clutch on its rear end, a transmission supported in fixed relation with respect to said engine spaced rearwardly of said clutch, and adapted to have a main gearshaft extending forwardly from said transmission to said clutch in driven relation with the clutch, and adapted to have a gearshaft housing mounted on said transmission and projecting forwardly therefrom, said pump assembly comprising: a main gearshaft having an eccentric driving member thereon, a main gearshaft housing having an opening in its side, a pump casing mounted on said gearshaft housing and having an opening registering with said housing opening in sealing relation therewith, a cylinder in said casing, a pump plunger in said cylinder, a coupling mechanism coupling said eccentric driving member to said plunger for reciprocating said plunger in response to rotation of said gearshaft, and means for admitting fluid to and conveying it from said cylinder in response to reciprocation of said plunger.

4. An assembly according to claim 3 in which said eccentric driving member comprises a sleeve on said gearshaft for rotation therewith, and bearing means radially rotatably supporting the forward end of said sleeve from said gearshaft housing.

References Cited in the file of this patent

UNITED STATES PATENTS

Number	Name	Date
1,190,804	Scaife	July 11, 1916
1,363,621	Sharp	Dec. 28, 1920
1,976,642	Walker	Oct. 9, 1934
2,294,454	Hathaway et al.	Sept. 1, 1942
2,475,703	Granberg	July 12, 1949
2,507,879	Beaudoin	May 16, 1950
2,559,952	Edwards	July 10, 1951