March 23, 1937. E. GÖLZ 2,074,583

HYDRAULIC POWER TRANSMITTING MECHANISM

Filed Aug. 8, 1934

Fig. 1.

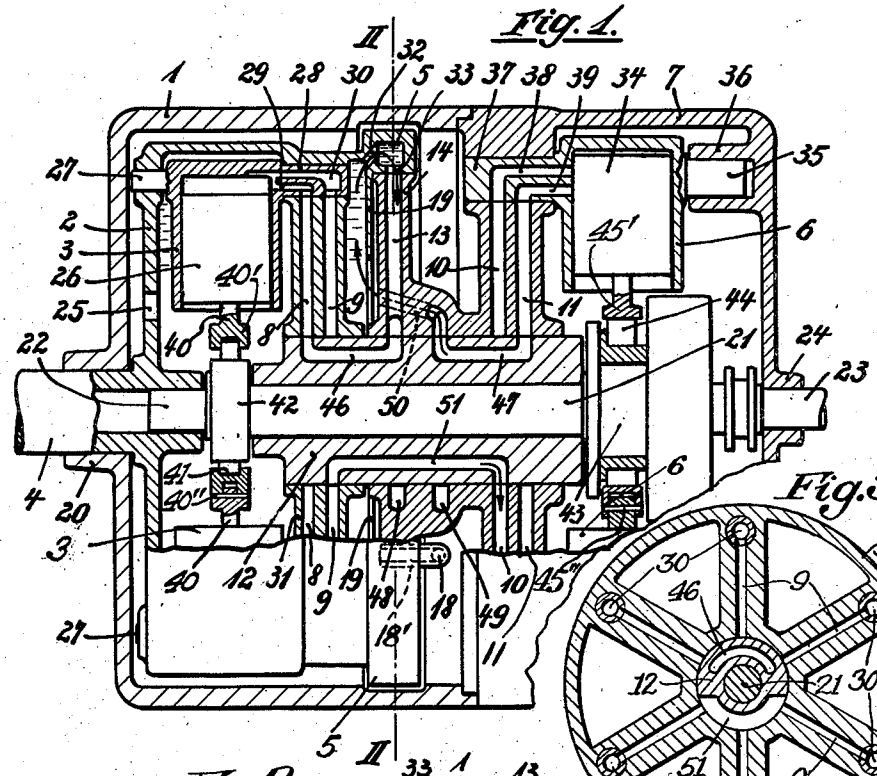
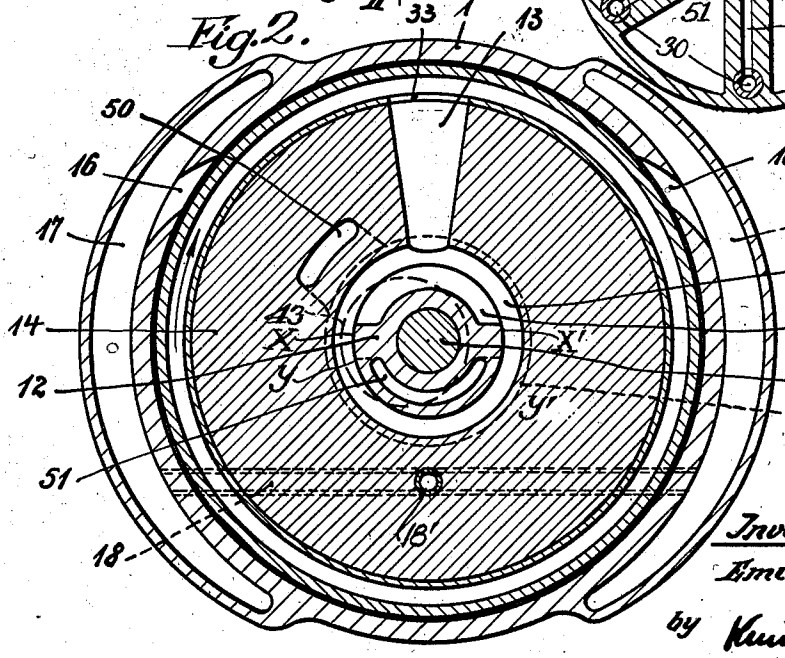


Fig. 3.

Fig. 2.



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Patented Mar. 23, 1937 2,074,583

UNITED STATES PATENT OFFICE

2,074,583

HYDRAULIC POWER TRANSMITTING MECHANISM

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Application August 8, 1934, Serial No. 738,908
In Germany September 4, 1933

10 Claims. (Cl. 60—53)

My invention relates to hydraulic power transmitting mechanisms, and more particularly to mechanisms of the kind in which a pump unit is combined with a motor unit. The pump unit is the driving member and in turn is driven by an engine of any kind. The liquid under pressure, normally oil, from the pump unit actuates the motor unit.

In mechanisms of this kind as designed heretofore, it was difficult to remove from the liquid the air or gas it had included, and the efficiency was much deteriorated by the presence of such inclusions.

It is an object of my invention to eliminate this drawback. To this end, I provide, in combination with a pump and a motor unit, a rotary centrifugal reservoir for separating the included gas or air from the liquid before the liquid is admitted to the suction side of the pump.

Preferably, the centrifugal reservoir is so connected to the pump unit that the liquid is presented to the suction side of the pump unit under the static pressure produced by the centrifugal action of the reservoir.

In a preferred embodiment of my invention, the centrifugal reservoir is operated by, or integral with, the rotary impeller of the pump unit, and a thorough scavenging of the cylinders of the pump and motor units is effected by providing separate suction and delivery passages for the pump cylinders, and separate inlet and outlet passages for the motor cylinders. If the cylinders of the two units are mounted to oscillate about trunnions, the passages are preferably connected to separate continuation passages in one of the trunnions. In this manner, the liquid flowing to the pump, and the liquid delivered by the pump, as well as the liquid supplied to the motor unit and the liquid which is returned to the pump unit from the motor unit, is conducted in separate passages and the flow in the individual passages is never reversed, so that accumulation of air or gas in the passages is effectively prevented.

The impeller of the pump unit is equipped with an annular end plate at its inner end, i. e., that end of the impeller which faces the motor unit. The plate and an intermediate partition in the pump impeller make up together a rotary centrifugal reservoir. When the impeller rotates, an annular body of liquid forms in the rotary reservoir under centrifugal action and is retained by the annular end wall. The air or gas is expelled from the liquid under centrifugal action, and the liquid is presented to the suction side of the pump under the static pressure produced by centrifugal action. The static pressure obviously is a function of the velocity at which the centrifugal means rotates.

Preferably, the liquid from the outlet passages of the motor unit is conducted to the body of liquid which is under the centrifugal action of the pump unit, so that the suction side of the pump unit is supplied with liquid, delivered by the pump unit itself, as well as with liquid returned from the motor unit, and the liquid from both sources is presented to the suction side of the pump unit free from air or gas, and under the said static pressure.

Preferably, the leakage from the pump unit is also returned to the pump unit, mixed with the other liquid, and presented to the suction side of the pump unit under the static pressure of the other liquid.

In the following detailed description, the gaseous fluid included in the liquid will be referred to as "air" for the sake of brevity but it is understood that this expression includes air, gas or vapor, and a mixture thereof.

In the drawing affixed to this specification and forming part thereof, a mechanism embodying my invention is illustrated diagrammatically by way of example.

In the drawing—

Fig. 1 is an elevation of the mechanism, partly in section in its axial plane, and

Fig. 2 is a section on the line II—II in Fig. 1.

Fig. 3 is a section of a detail of Fig. 1, showing the spoked partition 31.

Referring now to the drawing, the casing of the mechanism is divided, 1 being the casing for the pump unit, and 7 being the casing for the motor unit. The two casings are closed by end walls at their outer ends, and are connected by a spigot at their open inner ends. 4 is the driving shaft to which rotation is imparted by any suitable engine (not shown). The inner end of the driving shaft is hollow and is mounted in a suitable bearing 20 in the end wall of casing 1. 21 is the driven shaft whose journals 22 and 23 are supported, respectively, by the inner hollow end of driving shaft 4, and by a bearing 24 in the end wall of casing 7.

2 is the impeller of the pump unit. The impeller is a substantially cylindrical casing whose outer end plate is integral with the hollow driving shaft 4 while its inner end plate 19 is annular and its radial depth is appreciably less than that of the outer end plate. 25 is a port, or one of several ports, in the outer end plate. Pump cyl-

inders 3, with plungers 26 fitted to reciprocate therein, are mounted to oscillate in the pump impeller 2 by solid trunnions 27 at one side, and by hollow trunnions 28 at the other side, of every cylinder 3. Every hollow trunnion 28 is subdivided into a suction passage 29 and a delivery passage 30. 31 is an intermediate partition between the end plates of the pump impeller 2, 8 are suction, and 9 are delivery passages in the partition 31. The passages in the trunnions 28 are evidently made so wide that their connection to the passages 8 and 9 in the partition 31 is not cut off by the oscillation of the trunnions. At its inner end and beyond the inner end plate 19, the pump impeller 2 is equipped with a centrifugal ring 5 which is connected to the space between the annular rear end plate 19, and the intermediate partition 31, shown in Fig. 3 by ports 32 so as to form part of the rotary centrifugal reservoir. A port 33 is formed in the inner perimeter of the centrifugal ring 5, Fig. 2.

14 is an intermediate partition, of U-section, which is fixed in the motor casing 7 with one of its shanks while the other shank extends into the pump casing 1 as far as the centrifugal ring 5 of the impeller 2, and is equipped with a passage 13 into which opens the port 33 of the centrifugal ring 5. The shank with which the partition 14 is fixed to the casing 7, presents inlet passages 10 and outlet passages 11 for the cylinders 6 of the motor unit in the casing 7.

The motor cylinders 6 in which plungers 34 are fitted to reciprocate, are mounted to oscillate about solid trunnions 35 in bearings 36 at the inner side of the end wall of the motor casing, and about hollow trunnions 37 in bearings which are partly formed by an inwardly projecting rib of the motor casing 7, and by a shank of the fixed partition 14. The hollow trunnions are each subdivided into an inlet passage 38 and an outlet passage 39, which are connected, respectively, to passages 10 and 11, and are so wide that their communication with the passages 10 and 11 is not cut off by the oscillation of trunnions 37.

The connecting rods 40 of the pump plungers 26, through antifriction means 41, cooperate with a cam 42 on the driven shaft 21, and a similar arrangement, with a cam 43 on the driven shaft 21, and antifriction means 44, is provided for the connecting rods 45 of the motor plungers 34.

The eccentricities of the cams 42 and 43 are pitched at 0° or at 180° to each other. The position of cam 43 with respect to the controlling edges x and y and x' and y' at diametrically opposite sides of the control sleeve 12 is shown in Fig. 2. The highest point of the cam is positioned centrally between the edges x, y at the corresponding side of the sleeve. The other cam, 42, may be pitched like the cam 43, as shown in Fig. 1, or it may be pitched at 180° to cam 42, in which latter case its highest point is positioned centrally between the edges x' and y'.

Means not shown, but old in the art, are provided for varying the eccentricity of cam 43, and thereby the ratio of the drive. One of the connecting rods in the pump and motor units may be integral with a ring 40' for the cam 42, and 45' for the cam 43, to which the other connecting rods are pivoted at 40'' and 45'', respectively.

12 is a control sleeve which is mounted on the driven shaft 21 and inserted in axially aligned bores of the partitions 31 and 14. The sleeve on one side has a pair of U-shaped passages 46 and 47. The inner end of the passage 46 is connected to an annular groove 48 in the bore of that shank of the U-shaped partition 14 which presents the passage 13. The outer end of passage 46 is in line with the suction passages 8 of the pump cylinders 3 and is about 180° in extent, but not quite, as a certain overlap must be considered. As shown in Fig. 2, the passage 46 extends between the controlling edges x and x'. The other U-shaped passage 47 at its inner end is in line with an annular groove 49 in the web of partition 14, and an inclined passage 50 connects the groove 49 to the space between the intermediate partition 31, and the annular inner end wall 19, of the pump impeller 2. The outer end of passage 47 is in line with the delivery passages 11 of the motor cylinders 6 and extends through about 180° like the outer end of passage 46.

At the side which is opposite the passages 46 and 47, the sleeve 12 has a single passage 51 which is also U-shaped and extends through substantially 180° Fig. 2 between the controlling edges y and y'. The ends of this passage 51 are in line, respectively, with the delivery passages 9 of the pump unit, and with the inlet passages 10 of the motor unit.

The leakage which escapes into the pump casing 1, is entrained by the impeller 2 as the impeller rotates, and is ejected into a collector 17, Fig. 2, through ports 16 from which it is returned to the cycle by a pipe 18, whose outer ends are connected to the collector 17. A central branch pipe 18' extends into the space defined by the annular rear end plate 19 and the partition 31, so that the leakage is finally delivered to the ring 5.

In the position illustrated in Fig. 1, the plunger 26 in the cylinder 3 which is shown in section, is about to start for its suction stroke. Passage 46 connects the suction passage 8 of the cylinder to the passage 13 to which the centrifugal ring 5 delivers driving liquid through passage 33. At the same time, passage 47 connects the outlet passage 11 of the corresponding motor cylinder 6 to the space between the intermediate partition 31 and the annular end wall 19.

The corresponding pump and motor cylinders at the opposite side of sleeve 12 are controlled by passage 51. The passage 51 connects the delivery passage 9 of the pump cylinder to the inlet passage 10 of the corresponding motor cylinder.

As the impeller 2 rotates, the liquid under centrifugal action, rotates with the impeller in the shape of an annular body which is retained by the annular inner end wall 19 of the impeller 2. The liquid in the body fills the space between the pump cylinders 3 and penetrates into the centrifugal ring 5 from which the liquid, under the static pressure due to centrifugal force, is expelled through port 33 and delivered to passage 13. From this passage, it is conducted to the suction passage 8 of the corresponding pump cylinder 3 through passage 46. The delivery passage 9 of this cylinder is closed by the solid portion of the sleeve 12 which bridges the passage 46. At the other side of sleeve 12, the pump cylinder 3 performs its delivery stroke, supplying the corresponding motor cylinder with liquid under pressure through 9, 51 and 10. From the motor unit, the liquid is returned to the pump unit through passages 11, 47 and 50. The flow of the liquid is indicated by the arrows in Fig. 1, and it will appear that the liquid from passage 50 enters the impeller 2 in the vicinity of its inner end and is forced outwards in radial direction whereby the air in the liquid is effectively separated therefrom. In this manner, the air which the liquid has included in the motor unit, is expelled from

the liquid before it is returned to the pump unit. By providing separate suction and delivery passages 8 and 9 for the pump cylinders 3, and separate inlet and outlet passages 10 and 11 for the motor cylinders 6, and corresponding continuation passages in the hollow trunnions 28 and 37 of the pump and motor cylinders, respectively, the air is also removed very thoroughly from the cylinders so that the separation of the air is complete throughout the mechanism and the efficiency of the mechanism is improved in proportion. The air which has been separated in the pump impeller 2, collects in the impeller and flows into the casing 1 through port, or ports, 25, as shown in Fig. 3 past the partition 31 which does not occupy the entire cross-section of the impeller 2 but is designed like arms or spokes so that the air can pass freely. From the casing, it escapes into the open air through the bearing of shaft 4, or through any other means of escape.

I wish it to be understood that I do not desire to be limited to the exact details of construction shown and described for obvious modifications will occur to a person skilled in the art.

I claim:—

1. In a hydraulic power transmitting mechanism, a casing, a driving pump unit and a driven motor unit, and a rotary centrifugal reservoir for separating included gas from the liquid circulating in the mechanism, and for admitting the liquid from which the gas has been separated, to the suction side of said pump unit under the static pressure resulting from the centrifugal action on the liquid, means provided on the circumference of said reservoir for discharging gas into said pump unit, and valveless means for discharging gas therefrom into said casing.

2. In a hydraulic power transmitting mechanism, a casing, a driving pump unit and a driven motor unit, and a rotary centrifugal reservoir operatively connected to said pump unit for separating included gas from the liquid circulating in the mechanism before the liquid is admitted to the suction side of said pump unit, means provided on the circumference of said reservoir for discharging gas into said pump unit, and valveless means for discharging gas therefrom into said casing.

3. In a hydraulic power transmitting mechanism, a casing, a driving pump unit and a driven motor unit, means for returning to said pump unit the liquid which has operated said motor unit, and a rotary centrifugal reservoir operatively connected to said pump unit for separating included gas from the liquid returned from said motor unit, and for admitting both bodies of liquid to the suction side of said pump unit under the static pressure resulting from the centrifugal action on the liquid, means provided on the inner circumference of said reservoir for discharging gas into said pump unit, and valveless means for discharging gas therefrom into said casing.

4. In a hydraulic power transmitting mechanism, a casing, a driving pump unit and a driven motor unit, means for returning to said pump unit the liquid which has operated said motor unit, and the leakage, and a rotary centrifugal reservoir operatively connected to said pump unit for separating included gas from the liquid returned from said motor unit, and for admitting the bodies of liquid to the suction side of said pump unit under the static pressure resulting from the centrifugal action on the liquid, means provided on the inner circumference of said reservoir for discharging gas into said pump unit, and valveless means for discharging gas therefrom into said casing.

5. In a hydraulic power transmitting mechanism, a casing, a driving pump unit and a driven motor unit, a rotary impeller forming part of said pump unit, and an annular inner end wall on said impeller for retaining in said impeller an annular body of liquid formed by centrifugal action, a rotary centrifugal reservoir for separating included gas from said body before the liquid from the body is presented to the suction side of said pump unit, means provided on the inner circumference of said reservoir for discharging gas into said pump unit, and valveless means for discharging gas therefrom into said casing, and means integral with said casing for discharging liquid from said reservoir, a passage for said liquid connected with said motor unit, and a passage connected with said pump unit for delivering liquid thereto.

6. In a hydraulic power transmitting mechanism, a casing, a driving pump unit and a driven motor unit, a rotary impeller forming part of said pump unit, and an annular inner end wall on said impeller for retaining in said impeller an annular body of liquid formed by centrifugal action, means for conducting to said body the liquid returned from said motor unit, and a rotary centrifugal reservoir for separating included gas from said body before the liquid from the body is presented to the suction side of said pump unit, means provided on the inner circumference of said reservoir for discharging gas into said pump unit, and valveless means for discharging gas therefrom into said casing.

7. In a hydraulic power transmitting mechanism a casing, a driving pump and a driven motor unit in said casing, partitions in said casing defining single-purpose suction and delivery passages for said pump unit, and single-purpose inlet and outlet passages for said motor unit; and a rotary centrifugal reservoir operatively connected to said pump unit for admitting to said suction passages the liquid from said outlet passages, and for separating included gas from the liquid before it is admitted to said suction passages, means provided on the inner circumference of said reservoir for discharging gas into said pump unit, and valveless means for discharging gas therefrom into said casing.

8. In a hydraulic power transmitting mechanism a casing, a driving pump and a driven motor unit in said casing, cylinders in said units, trunnions about which said cylinders are mounted to oscillate, partitions in said casing defining single-purpose suction and delivery passages for said pump unit, and single-purpose inlet and outlet passages for said motor unit; and said trunnions defining single-purpose continuation passages for said suction, delivery, inlet and outlet passages; and a rotary centrifugal reservoir operatively connected to said pump unit for admitting to said suction passages the liquid from said outlet passages, and for separating included gas from the liquid before it is admitted to said suction passages, means provided on the inner circumference of said reservoir for discharging gas into said pump unit, and valveless means for discharging gas therefrom into said casing.

9. In a hydraulic power transmitting mechanism a casing, a driving pump and a driven motor unit in said casing, a collector for the leakage on said casing, a rotary centrifugal reservoir for separating included gas from the liquid circulating in the mechanism before the liquid

is admitted to the suction side of said pump unit, means provided on the inner circumference of said reservoir for discharging gas into said pump unit, and valveless means for discharging gas therefrom into said casing and means controlled by said pump unit for delivering to said collector the leakage liquid, and for returning it to the liquid circulating in the mechanism before the liquid is admitted to the suction side of said pump unit.

10. In a hydraulic power transmitting mechanism a casing, a driving pump and a driven motor unit in said casing, a collector for the leakage on said casing, the wall of said casing defining a port through which the leakage is forced into said collector by said pump unit under centrifugal action, a rotary centrifugal reservoir for separating included gas from the liquid circulating in the mechanism before the liquid is admitted to the suction side of said pump unit, and a pipe line for returning the leakage to the liquid circulating in the mechanism before the liquid is admitted to the suction side of said pump unit.

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