A rotary pump and power transmission system in which multiple cam grooves are formed in a rotor and a follower engages in the grooves to form a rotary pump and a rotary motor. A secondary pump is connected in the system to increase the fluid flow to the motor. A four-way reversing valve provides means for reversing the direction of rotation of the motor while continuing to operate the pump in the original direction. A valve is provided in the system actuated by the hydraulic brakes of the vehicle to retard the flow of drive fluid to or from the motor to retard the speed of the vehicle.
ROTARY PUMP AND POWER TRANSMISSION SYSTEM

BACKGROUND OF THE INVENTION

1. Field of the Invention
The present invention relates to rotary pumps and motors formed into a drive system for motor vehicles.

SUMMARY OF THE INVENTION
The present invention is directed to a drive system for motor vehicles which includes a rotary hydraulic pump and rotary hydraulic motor connected together whereby pressure fluid from the pump causes the motor to rotate. A four-way reversing valve is provided to reverse the direction of rotation of the motor while the pump continues to operate in the same direction. Means are also provided for retarding the flow of fluid to or from the motor actuated by the hydraulic brakes of the system to use the braking effect of the rotary motor.

The primary object of the invention is to provide a hydraulic pump and transmission system which is positive in its action, inexpensive to manufacture, and relatively simple to maintain. Other objects and advantages will become apparent in the following specification when considered in the light of the attached drawings.

BRIEF DESCRIPTION OF THE DRAWINGS
FIG. 1 is a fragmentary sectional view taken through the invention;
FIG. 2 is an enlarged fragmentary horizontal section taken along the line 2—2 of FIG. 1 looking in the direction of the arrows;
FIG. 3 is an enlarged sectional view of one of the check valves;
FIG. 4 is a transverse sectional view taken along the line 4—4 of FIG. 3 looking in the direction of the arrows;
FIG. 5 is a transverse sectional view taken along the line 5—5 of FIG. 3 looking in the direction of the arrows;
FIG. 6 is a fragmentary elevational view shown partially in section of a Y connection to the motor of FIG. 2; and
FIG. 7 is a horizontal sectional view taken through the primary and secondary pumps when actuated by a single shaft.

DESCRIPTION OF THE PREFERRED EMBODIMENT
Referring now to the drawings in detail wherein like reference characters indicate like parts throughout the several figures the reference numeral 10 indicates generally a rotary pump and power transmission system constructed in accordance with the invention.
The system 10 includes a primary rotary pump indicated generally at 11, a rotary motor indicated generally at 12, a secondary rotary pump indicated generally at 13, a reverse valve indicated generally at 14' and a brake valve indicated generally at 15'.
The rotary pump 11, rotary motor 12, and rotary pump 13 are each identical in construction.
The pumps 11, 13 and motor 12 each include a shaft 14 positioned axially of a cylinder 15. A cylindrical rotor 16 is machined to closely fit inside the cylinder 15 and is mounted on the shaft 14 for rotation therewith. An end wall 17 closes the cylinder 15 and carries a seal 18 to seal the shaft 14 to prevent leakage thereabout.
The rotor 16 is provided with a pair of cam shaped displacement grooves 19, 20 formed in the periphery thereof in spaced apart parallel relation with the deepest portion of the groove 19 positioned opposite the shallowest portion of the groove 20 and vice versa. The cam shaped grooves 19, 20 are each ar ranged in aligned relation to a stub cylinder 21, 22 respectively by having caps 23, 24 closing their outer ends. A follower piston 25 is mounted for reciprocation in the cylinder 21 and carries a pair of rollers 26 on its inner end which engage in the groove 19 to form a moving barrier therein. A coil spring 27 in the cylinder 21 engages against the piston 25 and maintains it in contact with the base of the groove 19. A piston 28 is mounted for reciprocation in the cylinder 22 and has a pair of rollers 29 journaled on its inner end for engagement in the groove 20 to serve as a moving barrier therein. A coil spring 30 is positioned in the cylinder 22 and normally urges the piston 28 into the groove 20. The cylinder 15 is provided with a port 31 which aligns with the groove 19 and a port 32 which aligns with the groove 20. A Y shaped conduit 33 connects to the ports 31, 32 and to another conduit as described below.
The rotor 16 is provided with a plurality of ports 34 to permit passage of fluid between the opposite ends thereof to maintain a balance of fluids within the system 10. A filter plug 35 opens into the cylinder 15 from the end thereof opposite the shaft 14 to permit the system to be completely filled with fluid.
A vent pipe 36 extends from one of the Y connectors 33 to each of the stub cylinders 21, 22 to prevent pressure binding of the pistons 25, 28.
A conduit 37 extends from one of the Y conduits 33 on the pump 11 to a rotary four-way plug valve 38. A conduit 39 extends from the four-way rotary plug valve 38 to one of the Y conduits 33 on the motor 12. The conduits 37, 39 are aligned and are adapted to be connected by the rotary plug valve 38 in one position of the plug 40. A conduit 41 extends from a second Y shaped conduit 33 on the pump 11 to the plug valve 38. A conduit 42 extends from the Y shaped conduit 33 on the motor 12 to the plug valve 38. The conduits 41, 42 are aligned and are arranged to be communicated when the plug 40 is turned into the same position that communicates the conduit 37 and 39.
A brake cylinder 43 is mounted in the conduit 42 and has a valve piston 44 mounted for reciprocation therein. An annular groove 45 in the valve piston 44 is arranged to align with the conduit 42 to permit the flow of fluid therethrough. A port 46 on the upper end of the cylinder 43 is adapted to be connected to the hydraulic brake system of a motor vehicle.
The piston 44 is adapted to be forced downwardly in the cylinder 43 upon application of the brakes of the motor vehicle with the coil spring 47 arranged to provide the necessary resistance to the movement of the piston 44 and to return the piston 44 when the brakes are released. A vent pipe 48 extends from a conduit 42 to the underside of the piston 44 in the cylinder 43 to permit the escape of pressure from beneath the piston 44 so that it may move freely in the cylinder 43.
A conduit 49 extends from the conduit 37 to the valve 38. A conduit 50 extends from the valve 38 to the conduit 42. The conduits 49 and 50 are arranged in aligned relation so that they may be communicated when the plug 40 has been rotated to the position illustrated in FIG. 1. A conduit 51 extends from the conduit 41 to the plug valve 38 and a conduit 52 extends from the conduit 39 to the plug valve 38. The conduits 51, 52 are arranged in aligned relation so that they communicate when the plug 40 is in a position to communicate the conduits 49 and 50.
An automatic flow and check valve 53 is connected between the conduit 37 and the conduit 41 as a by-pass when the velocity of the fluid is low. The valve V in the check valve 53 is held open by a calibrated spring 54 until the velocity of the fluid exceeds the pressure of the spring 54 whereupon the valve V closes so that the fluid then moves through the rest of the system.
A conduit 54 extends from the conduit 41 to a reservoir (not shown). When it is desired to use the secondary pump 13 a conduit 54 extends from one of the Y shaped conduits 33 of the pump 13 to the conduit 41. A conduit 55 extends from the other Y shaped conduit 33 of the pump 13 to a check valve 56. A conduit 57 connects the valve 56 with the conduit 37. An automatic flow and check valve 53 is connected between the conduit 55 and the conduit 54 to serve as a by-pass until the fluid velocity overcomes the force of the calibrated spring 54 to close the valve V, to permit flow of fluid through the check valve 56 to the conduit 57 and to conduit 37.
In FIG. 7 a modified form of the invention is illustrated wherein the primary pump 11 and secondary pump 13 are combined into a single unit indicated generally at 58. The pump 58 has an elongate cylinder 59 closed at its lower end by a cover 60 through which a shaft 61 extends. A cylindrical rotor 62 machined to closely fit the cylinder 59 is positioned therein and is connected to the shaft 61. A pair of cam shaped displacement grooves 63, 64 are formed in the upper end of the rotor 62 in spaced apart parallel relation with the deepest part of the groove 63 being aligned with the shallowest part of the groove 64 and vice versa. Stub cylinders 21, 22 are arranged in aligned relation with the grooves 63, 64 respectively and carry the follower pistons 25, 28 as in the preferred form of the invention.

A pair of aligned cam shaped displacement grooves 65, 66 are formed in the lower end of the rotor 62 in spaced apart parallel relation and they too are arranged with the deepest part of the grooves 65 adjacent the shallowest part of the grooves 66 and vice versa. Stub cylinders 21, 22 are arranged in aligned relation with the grooves 65, 66 respectively and carry the follower pistons 25, 28 as in the preferred form of the invention.

The external connections of the unit 58 are identical to the external connections of the pumps 11, 13 and the operation of the modification of FIG. 7 is identical to that of the preferred form of the invention illustrated in FIG. 1.

In the use and operation of the invention the pump 11 is rotated by applying power to the shaft 14 with all conduits and spaces within the system 10 being filled with fluid. As the rotor 16 rotates within the cylinder 15 fluid is drawn into the displacement grooves 19, 20 from the conduit 41 and forced out through the conduit 37. Initially at low velocity the fluid moves through automatic flow and check valve 53 to the conduit 33 and back to the pump 11. As the velocity increases and the valve V closes the fluid flows through conduit 37 to plug valve 38. The fluid flows through the plug valve 38 through the conduit 29 and into the displacement grooves 19, 20 of the motor 12. The rotor 16 is thus forced to rotate in the cylinder 15 and the shaft 14 can be coupled to any desired device to be driven such as the wheels of a motor vehicle. The fluid exhausting from the motor 12 passes into the conduit 42 through the brake valve 15 through the plug valve 38 and back into the conduit 41 to complete the cycle. When it is desired to reverse the direction of rotation of the motor 12 the plug valve 38 is turned 90° so as to align the conduit 37 with the conduit 42 and the conduit 39 with the conduit 41 so that the fluid then flows oppositely to the motor 12 and it will then rotate oppositely.

The brake valve 15 is adapted to shut off the flow of fluid either to or from the motor 12 and hence either lock the motor 12 or slow its rotation depending upon the extent of closing of the valve 15.

The secondary pump 13 is provided for increasing the fluid flow in the system 10 to gain additional speed for the motor 12 when required. The secondary pump 13 operates identical to the pump 11 and the check valve 56 prevents the flow of fluid rearwardly through the conduit 37.

Having thus described the preferred embodiment of the invention it should be understood that numerous structural modifications and adaptations may be resorted to without departing from the spirit of the invention.

What is claimed is:

1. A rotary displacement pump comprising a housing, a rotor mounted in said housing, a pair of spaced apart parallel cam shaped displacement grooves formed in the peripheral surface of said rotor arranged with the deepest portion of each groove aligned with the shallowest portion of the adjacent groove, and a spring pressed piston follower on said housing engaging in each of said grooves, said housing having inlet and outlet ports for each groove on opposite sides of the piston engaging in each groove.

2. A hydraulic power transmission system comprising a rotary displacement pump, a rotary displacement motor, means communicating said pump and said motor for conducting fluid from said pump to said motor and from said motor back to said pump, means for reversing the direction of flow of fluid from said pump to said motor to effect a reversal of rotation of said motor, a valve in the means connecting said pump and said motor, brake means for actuating said valve for controlling the flow of fluid to and from said motor, a cylinder in each said pump and said motor, a cylindrical rotor mounted for rotation in each said cylinder, a pair of spaced apart parallel cam shaped displacement grooves formed in each of said rotors, and a spring pressed piston follower mounted on each of said cylinders and engaged in each of said grooves to form a moving barrier therein.

3. A device as claimed in claim 2 wherein said pair of displacement grooves are arranged with the deepest portions of each groove in each rotor being aligned with the shallowest portion of the adjacent groove in the same rotor.

4. A device as claimed in claim 3 wherein a pair of rollers are mounted on each of said piston followers for rolling engagement in the bottom of each of said grooves.

5. A device as claimed in claim 2 wherein two pair of cam shaped displacement grooves are formed in the peripheral face of said rotor with each of said grooves having a piston follower engaged therein.