

May 6, 1958

H. M. RUSH

2,833,116

HYDRAULIC DRIVE SYSTEM

Filed June 15, 1956

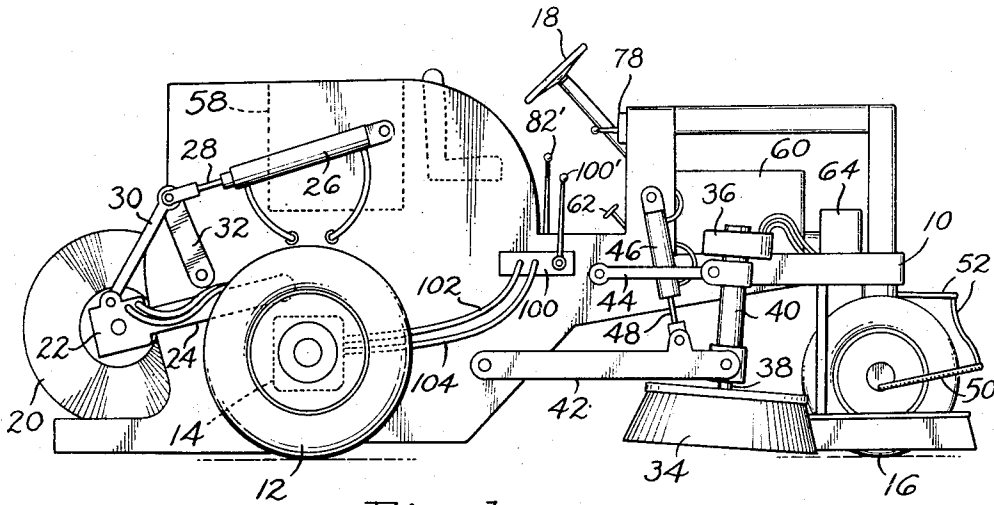


Fig. 1.

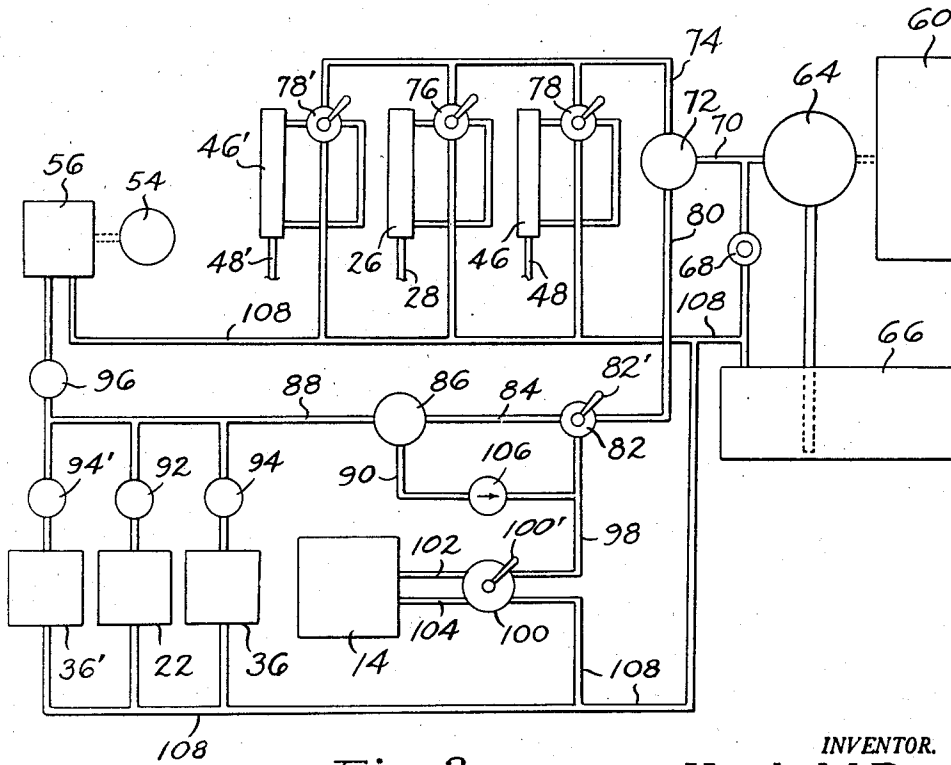


Fig. 2

INVENTOR.
Hugh M. Rush
BY *Oliver D. Olson*
Agent

1

2,833,116

HYDRAULIC DRIVE SYSTEM

Hugh M. Rush, Elkhart, Ind.

Application June 15, 1956, Serial No. 591,630

4 Claims. (Cl. 60—53)

This invention pertains to multiple drive systems, and relates particularly to a novel hydraulic power distributing system by which a plurality of driven elements may be driven selectively from a single power source.

It is a principal object of the present invention to provide a fluid pressure drive system by means of which a single source of power may be utilized to drive a plurality of driven elements at selected constant speeds and another driven element at variable speeds over a selected range.

Another important object of the present invention is to provide a fluid pressure system wherein a single source of variable pressure or volumetric flow may be divided selectively into the plurality of channels each having a predetermined constant pressure or volumetric flow and another channel having a variable pressure or flow over a predetermined range.

A further important object of this invention is to provide a fluid pressure drive system for driving a plurality of driven elements from a single power source, which drive system is of simplified construction for economical manufacture, and which affords maximum facility of operation with a minimum of maintenance and repair.

A further specific object of this invention is to provide a fluid pressure drive system for street sweeping apparatus, wherein a single source of fluid pressure is utilized to drive the various work elements of the apparatus at predetermined constant speeds while affording variable drive for the traction system of the apparatus.

The foregoing and other objects and advantages of the present invention will appear from the following detailed description, taken in connection with the accompanying drawing, in which:

Figure 1 is a view in side elevation of a form of street sweeping apparatus, incorporating therein a hydraulic drive system embodying the features of the present invention; and

Figure 2 is a schematic diagram of a hydraulic system by which the several driven elements of the street sweeping apparatus of Figure 1 may be interconnected in accordance with the present invention.

The hydraulic drive system of the present invention may be utilized for many and various types of apparatus in which it is desired to drive a plurality of driven elements at predetermined constant speeds and other driven elements at variable speeds over a selected range. The street sweeping apparatus illustrated in Figure 1 of the drawing is illustrative of such types of apparatus.

The street sweeping apparatus illustrated includes a frame 10 supported by the spaced rear drive wheels 12 driven by hydraulic motor 14 and the centered front wheel 16 which is steerable by steering wheel 18.

The sweeper is equipped with a rotary rear broom 20 which is driven by hydraulic motor 22. The rear broom is mounted for vertical adjustment by means of arm 24 secured pivotally at one end to the frame 10 and at the opposite arm to the casing of motor 22. Vertical adjustment of the rear broom is achieved by means of a hydraulic motor in the form of a piston-cylinder unit 26

2

which is secured pivotally at one end to the vehicle frame. The piston rod 28 extending from the cylinder is secured pivotally to one end of a link 30, the other end of which is connected pivotally to the casing of motor 22. A supporting link 32 is mounted pivotally at one end on the frame 10 and is connected at the opposite end to the pivot connection of piston rod 28 and link 30.

The street sweeper illustrated also includes a side gutter broom 34 positioned adjacent the front wheel 16. The gutter broom is driven by a hydraulic motor 36 connected thereto by means of a drive shaft 38 which extends through the supporting sleeve 40. The lower end of the sleeve is secured pivotally to one end of a supporting link 42, the other end of which is secured pivotally to the frame 10. The upper end of the sleeve is secured pivotally to one end of a second link 44, the opposite end of which is secured pivotally to the frame 10. The gutter broom is mounted for vertical adjustment by means of the hydraulic piston-cylinder unit 46. One end of the cylinder is secured pivotally to the vehicle frame 10, while the piston rod 48 thereof is secured pivotally to the link 42.

The side gutter broom assembly 34—48 preferably is duplicated on the opposite side of the vehicle, and the corresponding elements thereof shown in Figure 2 of the drawing are identified by the same reference numerals carrying the prime superscript.

Also included in the street sweeping apparatus is a water spray system including the laterally extending spray tubes 50 which are connected through water pipes 52 to a water pump 54 (Figure 2). The water pump is driven by hydraulic motor 56 and functions to deliver water under pressure to the spray tubes from a reservoir 58.

In the normal operation of the sweeper illustrated, it is desired that the rear broom 20, the side gutter brooms 34, 34' and the water pump 54 be driven at their optimum constant speed, and that provision be made for varying the speed of the drive motor 14 for varying the speed of travel of the vehicle. This is accommodated in the present invention by the hydraulic distributing system illustrated in Figure 2. A gasoline or other variable speed engine 60, controlled by the operator from a foot throttle 62, is utilized to drive a variable hydraulic pump 64. A reservoir 66 supplies fluid to the pump, and the high pressure side of the latter is regulated by a relief valve 68 which bypasses hydraulic fluid in excess of a predetermined amount back to the reservoir.

The outlet side of pump 64 is connected through conduit 70 to a valve 72 which is constructed in such manner as to divide the volumetric flow of fluid in conduit 70 into two paths, as follows: A fixed, predetermined volumetric flow of fluid is diverted to conduit 74 for use by the broom elevating cylinders 26, 46, 46'. Each broom elevating cylinder is controlled by separate three-way valves 76, 78, 78', respectively.

All fluid volume in excess of the amount diverted to conduit 74 is diverted to conduit 80, which is connected to a two-way valve 82 operated by handle 82'. One outlet side of this valve is connected through conduit 84 to the inlet of a second valve 86, which is similar to valve 72, described hereinbefore. Valve 86 is constructed in such manner as to divide the fluid flow from conduit 84 to deliver a predetermined volumetric flow to conduit 88 and to bypass all fluid flow in excess thereof to conduit 90. Conduit 88 is connected to the rear broom motor 22 through flow regulator valve 92, to gutter broom motor 36 through flow regulator valve 94, to the opposite gutter broom motor 36' through flow regulator valve 94', and to the water pump motor 56 through flow regulator valve 96.

The second outlet of valve 82 is connected through conduit 98 to a three-way valve 100 operated by handle 100'.

Conduits 102 and 104 connect the outlets of this valve to the drive wheel motor 14 for forward and reverse operation, respectively. Conduit 90, leading from the second outlet of valve 86, is connected through check valve 106 to conduit 98 leading to the valve 100. The purpose of this connection is described more fully hereinafter.

Each of the hydraulic motors and piston-cylinder units is returned to the reservoir 66 through the exhaust conduits 108, as illustrated.

In the operation of the street sweeping apparatus illustrated, let it be assumed for purposes of the following explanation that vertical adjustment of the rear broom 20 requires delivery of hydraulic fluid to cylinder 26 at the constant rate of two gallons per minute, and that vertical adjustment of each of the gutter brooms 46, 46' requires delivery of hydraulic fluid to the cylinders 46, 46' at the constant rate of one gallon per minute. Assume further that proper operation of the rear broom drive motor 22 requires hydraulic fluid at the constant rate of five gallons per minute, that each of the gutter broom motors 36, 36' requires three gallons per minute, and that the water pump motor 56 requires two gallons per minute. Assume further that the drive wheel motor 14 requires up to 20 gallons per minute of hydraulic fluid to propel the sweeper over its normal range of speed.

Assuming further that the idling speed of engine 60 drives the main hydraulic pump 64 at a speed sufficient to produce four gallons per minute output to valve 72, said valve therefore is constructed to divert hydraulic fluid to conduit 74 at the rate of four gallons per minute, this amount of fluid being sufficient to operate the broom lift cylinders 26, 46, 46'. Thus, as the speed of engine 60 is increased, the flow of hydraulic fluid from pump 64 in excess of four gallons per minute is diverted by valve 72 to conduit 80.

With valve 82 adjusted to the position in which conduit 80 communicates with conduit 98, all of the hydraulic fluid in excess of four gallons per minute is diverted to valve 100, from which it is directed to drive motor 14 through either of conduits 102 or 104 to drive the sweeper either in the forward direction or in the reverse direction, respectively. Thus, it will be understood that the traveling speed of the sweeper may be controlled by the speed of engine 60, through proper manipulation of the foot throttle 62.

It will be noted that when valve 82 interconnects conduits 80 and 98, hydraulic fluid is prevented from passing to conduit 90 and the valve 86 by the provision of check valve 106. This valve functions to permit hydraulic flow from valve 86 through conduit 90 to conduit 98, but prevents flow in the opposite direction.

When valve 82 is adjusted to the position in which conduit 80 communicates with conduit 84, all hydraulic fluid in excess of four gallons per minute is directed to valve 86. Since the motors 22, 36, 36' and 56 require a total of thirteen gallons per minute for proper operation, valve 86 is constructed in such manner as to divert thirteen gallons per minute of hydraulic fluid to conduit 88, and to divert all hydraulic fluid in excess of thirteen gallons per minute to conduit 90. Thus, assuming that the engine 60 is driven at a speed sufficient to produce an output of hydraulic fluid to conduit 70 of seventeen gallons per minute, four gallons per minute are diverted to conduit 74 and thirteen gallons per minute are diverted to conduit 88. By increasing the speed of engine 60, for example to produce twenty-four gallons output from pump 64 to conduit 70, four gallons per minute are diverted to conduit 74, thirteen gallons per minute are diverted to conduit 88, and seven gallons per minute are diverted through conduit 90 to the drive motor 14. Thus, it will be seen that in this position of valve 82 all speeds of engine 60 in excess of the speed required to produce seventeen gallons per minute output from pump 64 will result in driving the sweeper forward or rearward at a rate of speed proportional to the speed of engine 60.

In the foregoing example it will be apparent that the brooms 20, 34, 34' may be adjusted vertically while the engine 60 is running at idling speed. Thus, with valve 82 interconnecting conduits 80 and 84, the sweeper may be driven forward or rearward at any desired speed while simultaneously operating the brooms and water pump, it being required merely that the engine be driven at a speed sufficient to deliver hydraulic fluid to conduit 70 in excess of seventeen gallons per minute. Thus, the speed of travel of the sweeper may be regulated simply by manipulation of foot throttle 62. The brooms and water pump need no attention or control since they are operated at constant speeds by supply thereto of the required amounts of hydraulic fluid. Vertical adjustment of the brooms may be made at any time simply by proper manipulation of the valves 76, 78, 78' positioned conveniently in front of the operator, as indicated in Figure 1.

From the foregoing, it is believed to be apparent that the hydraulic drive system of the present invention is adaptable to such apparatus as street sweeping equipment to provide advantages heretofore not available. The simplified system effects a substantial reduction in cost of the equipment and reduces to a minimum the subsequent costs of maintenance and repair. The system affords maximum flexibility of operation of the equipment with minimum effort and attention by the operator.

As stated hereinbefore, it will be apparent to those skilled in the art that the hydraulic drive system of the present invention may be utilized with equipment of various types which involve simultaneous operation of a plurality of constant speed and variable speed elements. It is adaptable, for example, to power operated lawn mowers wherein the cutting reel and traction wheels may be driven simultaneously or independently at fixed or variable speeds, as desired.

It will be further apparent to those skilled in the art that various changes in the details of construction described hereinbefore may be made without departing from the scope and spirit of this invention. For example, the drive system described and illustrated herein utilizes volumetric flow of hydraulic fluid for the source of power and thus includes valves which divide a volumetric flow of hydraulic fluid into a plurality of components, one of which is constant and the other of which is variable, depending upon the amount in excess of said constant flow. It will be apparent that other forms of fluid power may be used, such as a fluid pressure system of liquid fluid or compressed gas, and that the volumetric divider valves may be replaced with pressure divider valves. In this case a fixed portion of the total pressure is diverted to conduit 74 and the excess diverted to conduit 80 where it may again be divided into a fixed component directed to conduit 88, with the excess directed to conduit 90. It will be further apparent that the conduit 70 may be connected directly to conduit 80 in the event the apparatus does not include motors in the position of the piston-cylinder units 26, 46, 46'.

In view of the foregoing and other changes which may be made as desired, it is to be understood that the foregoing description is primarily illustrative of the invention and is not to be considered as limiting the scope thereof.

Having now described my invention and the manner in which the same may be used, what I claim as new and desire to secure by Letters Patent is:

1. In combination with a plurality of fluid power motors wherein at least one of said motors is driven at constant speed and another of said motors is driven at variable speeds, a drive system comprising a source of variable fluid power, a valve having a fluid inlet and a plurality of fluid outlets and constructed to divide an inlet fluid power into one constant outlet component and a second outlet component of the excess above said one constant outlet component, first conduit means connecting the fluid source to the inlet of the valve, second conduit means connecting the one constant outlet component to

5

a constant speed motor, third conduit means connecting the second outlet excess component to the inlet of the variable speed motor, fourth conduit means for interconnecting the first conduit means and the inlet of the variable speed motor, control bypass valve means in the first conduit means for selectively connecting the fluid source to the valve inlet and to the fourth conduit means, respectively, and check valve means in the third conduit means for preventing fluid flow toward said second outlet of the valve.

2. In combination with a plurality of fluid power motors wherein at least one of said motors is driven at constant speed and another of said motors is driven reversibly at variable speeds, a fluid power drive system comprising a source of variable fluid power, a valve having a fluid inlet and a plurality of fluid outlets and constructed to divide an inlet fluid power into one constant outlet component and a second outlet component of the excess above said one constant outlet component, first conduit means connecting the fluid source to the inlet of the valve, second conduit means connecting the one constant outlet component to a constant speed motor, third conduit means connecting the second outlet excess component to the inlet of the variable speed motor, fourth conduit means for interconnecting the first conduit means and the inlet of the variable speed motor, control bypass valve means in the first conduit means for selectively connecting the fluid source to the valve inlet and to the fourth conduit means, respectively, check valve means in the third conduit means for preventing fluid flow toward said second outlet of the valve, and motor operating valve means in the third and fourth conduit means on the motor side of the bypass valve means and check valve means for controlling the reversible operation of the variable speed motor.

3. In combination with a plurality of fluid power motors wherein at least one of the said motors is driven at constant speed and another of said motors is driven at variable speeds, a fluid power drive system comprising a source of variable fluid power, first and second valves each having a fluid inlet and a plurality of fluid outlets and constructed to divide an inlet fluid power into one constant outlet component and a second outlet component of the excess above said one constant outlet component, first conduit means connecting the fluid source to the inlet of the first valve, second conduit means connecting the one constant outlet component of the first valve to a constant speed motor, third conduit means connecting the second outlet excess component of the first valve to the inlet of the second valve, fourth con-

6

duit means connecting the one constant outlet component of the second valve to a constant speed motor, fifth conduit means connecting the second outlet excess component of the second valve to the inlet of the variable speed motor, sixth conduit means for interconnecting the third conduit means and the inlet of the variable speed motor, control bypass valve means in the third conduit means for selectively connecting the second outlet excess component of the first valve to the second valve inlet and to the sixth conduit means, respectively, and check valve means in the fifth conduit means for preventing fluid flow toward said second outlet of the second valve.

4. In combination with a plurality of fluid power motors wherein at least one of said motors is driven at constant speed and another of said motors is driven reversibly at variable speeds, a fluid power drive system comprising a source of variable fluid power, first and second valves each having a fluid inlet and a plurality of fluid outlets and constructed to divide an inlet fluid power into one constant outlet component and a second outlet component of the excess above said one constant outlet component, first conduit means connecting the fluid source to the inlet of the first valve, second conduit means connecting the one constant outlet component of the first valve to a constant speed motor, third conduit means connecting the second outlet excess component of the first valve to the inlet of the second valve, fourth conduit means connecting the one constant outlet component of the second valve to a constant speed motor, fifth conduit means connecting the second outlet excess component of the second valve to the inlet of the variable speed motor, sixth conduit means for interconnecting the third conduit means and the inlet of the variable speed motor, control bypass valve means in the third conduit means for selectively connecting the second outlet excess component of the first valve to the second valve inlet and to the sixth conduit means, respectively, check valve means in the fifth conduit means for preventing fluid flow toward said second outlet of the second valve, and motor operating valve means in the fifth and sixth conduit means on the motor side of the bypass valve means and check valve means for controlling the reversible operation of the variable speed motor.

References Cited in the file of this patent

UNITED STATES PATENTS

1,999,834	Ernst	Apr. 30, 1935
2,320,600	Howell	June 1, 1943
2,737,196	Eames	Mar. 6, 1956