March 3, 1959 R. H. GOVAN ET AL 2,875,871

HYDRAULIC SYSTEM

Filed Sept. 26, 1955 2 Sheets-Sheet 1

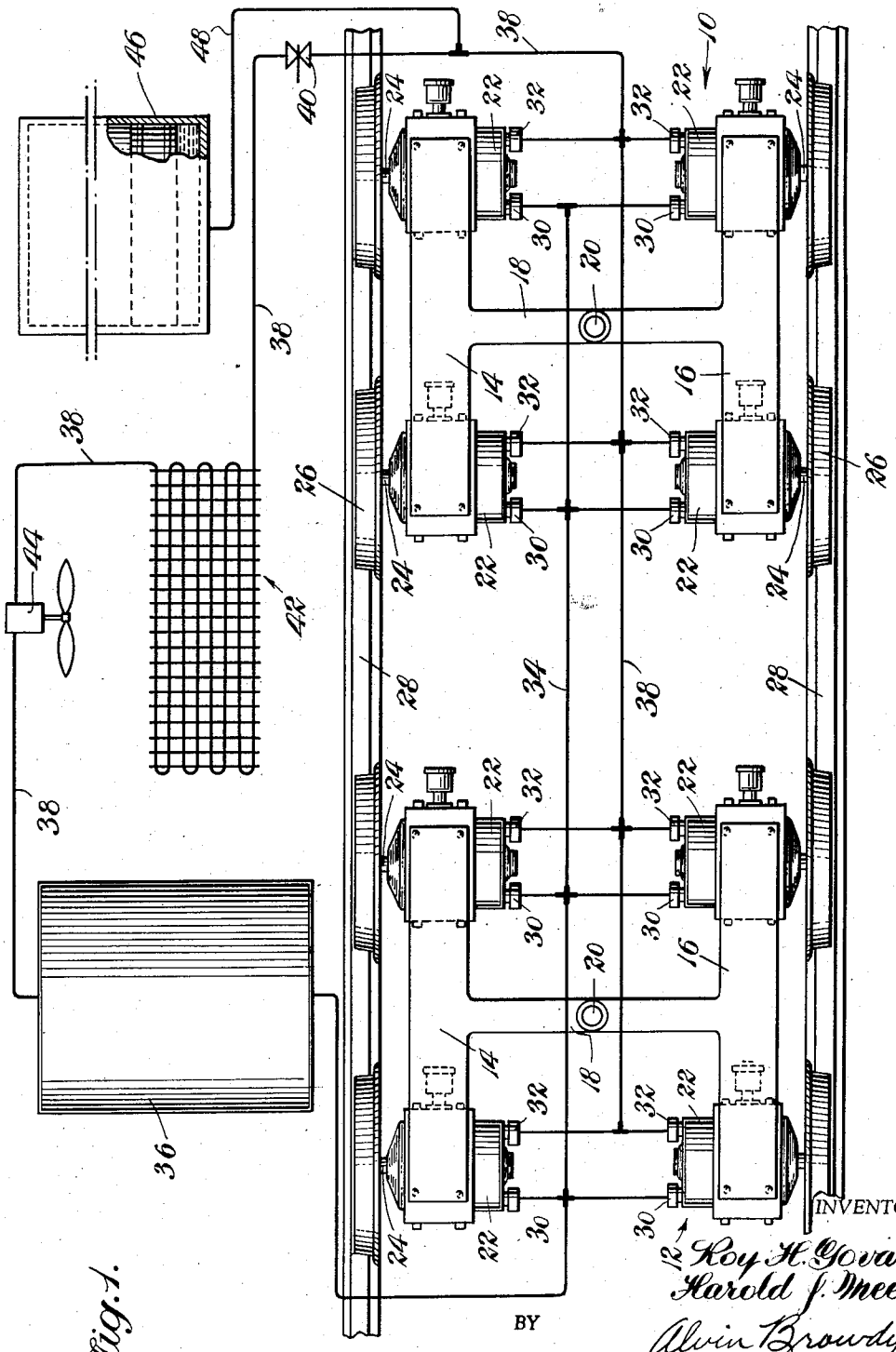


Fig. 1.

INVENTORS
Roy H. Govan,
Harold J. Meek.
BY Alvin Browdy
ATTORNEY

March 3, 1959 R. H. GOVAN ET AL 2,875,871

HYDRAULIC SYSTEM

Filed Sept. 26, 1955 2 Sheets-Sheet 2

Fig. 2.

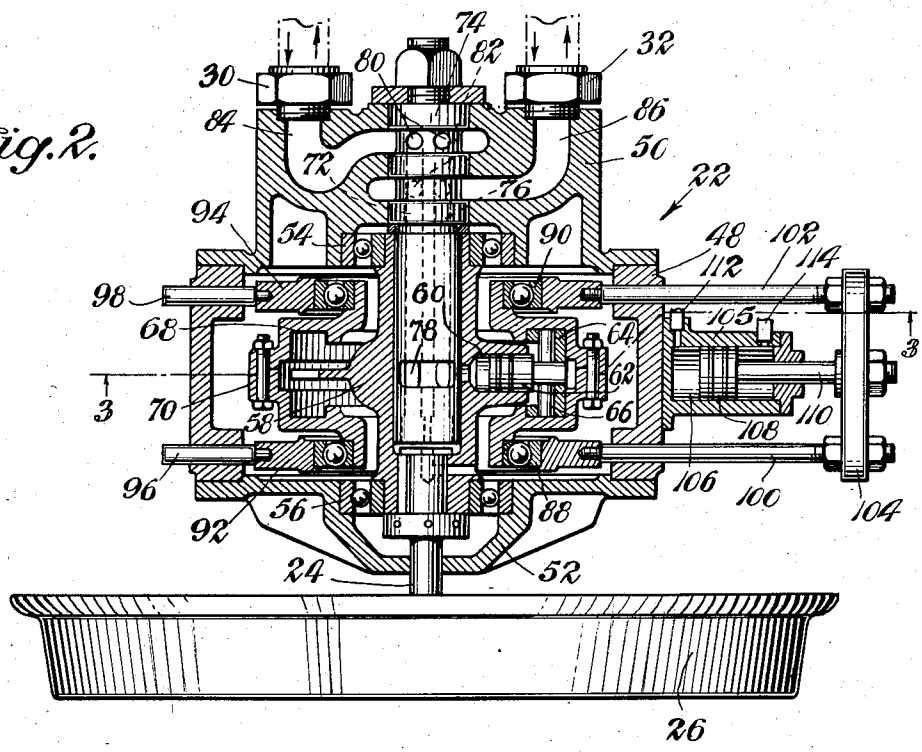
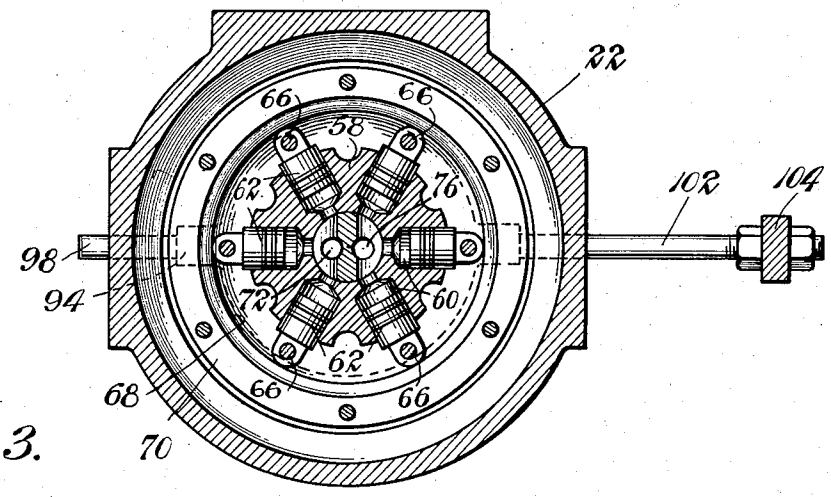


Fig. 3.



INVENTORS

Roy H. Govan,
Harold J. Meek.

BY Alvin Browdy

ATTORNEY

United States Patent Office 2,875,871 Patented Mar. 3, 1959

2,875,871

HYDRAULIC SYSTEM

Roy H. Govan, Hoboken, N. J., and Harold J. Meek, Staten Island, N. Y., assignors to Jaroco Engineering Co., Hoboken, N. J., a corporation of New Jersey

Application September 26, 1955, Serial No. 536,680

8 Claims. (Cl. 192—3)

The present invention relates to a hydraulic system for use with vehicles. More particularly, the present invention relates to a hydraulic system for use in braking and accelerating vehicles and has particular application for railway rolling stock.

Railway braking systems are necessarily designed for use in rapidly decelerating the railway vehicles during various phases of operation and for this purpose utilize either mechanical frictional type braking or some form of an electrical or pneumatic braking system. A most important function of the braking system is to gradually decelerate the railway cars when bringing the railway cars to a rest position and to brake the cars at a constant rate, for example, when the cars are moving down grade. Prior to the instant invention, the heretofore known braking systems were subject to considerable wear during the braking operation and the wheels of the railway cars were particularly subject to wear during long braking periods such as on down grade runs.

Railway rolling stock in addition to having braking problems are considerably difficult to start from a position of rest due to the excessive loads involved. Much effort must be expended by the prime mover to accelerate the railway cars from a position of rest to normal operating speed and it is seen that this acceleration period is extremely inefficient from the point of view of fuel consumption. Moreover, if the train is moving freight, then considerably long periods of acceleration are required to bring the train up to the normal operating speed.

It is therefore an object of the present invention to provide a braking and accelerating system for use with railway rolling stock that is adapted to effectively brake the railway cars and, in addition, to rapidly accelerate the cars from a position of rest.

Still another object of the present invention is to provide a hydraulic braking system for use with vehicles.

Still another object of the present invention is to provide a hydraulic system for use with vehicles wherein the vehicles are adapted to be rapidly accelerated from a position of rest.

Still another object of the present invention is to provide a hydraulic system for use with vehicles wherein a remotely controlled hydraulic unit that is directly connected to the wheels of the vehicle is operated to brake or accelerate the vehicle, as desired.

Still another object of the present invention is to provide a pump unit for use with a hydraulic system for vehicles wherein said pump is directly connected to the ground wheel shaft of the vehicle and is utilized as a bearing therefor.

Still another object of the present invention is to provide a hydraulic system for braking or accelerating a land vehicle wherein the hydraulic fluid utilized to operate the system is effectively cooled.

Other objects and the nature and advantages of the instant invention will be apparent from the following

description taken in conjunction with the accompanying drawings, wherein:

Fig. 1 is a diagrammatic illustration of the hydraulic system embodied herein and as shown has particular use with railway rolling stock;

Fig. 2 is a horizontal sectional view of one of the hydraulic units shown in Fig. 1 and is illustrated being connected directly to a wheel of a railway car; and

Fig. 3 is a view taken along the line 3—3 in Fig. 2.

Referring now to the drawings, and particularly Fig. 1, the hydraulic system embodied in the present invention is illustrated diagrammatically therein. The hydraulic system illustrated in Fig. 1 is intended for use as a braking and accelerating device and is intended to be employed in connection with land vehicles such as, for example, railway rolling stock. It is understood, however, that the hydraulic system disclosed herein may be utilized in connection with other land vehicles whenever braking and accelerating needs are required. The apparatus illustrated in Fig. 1 is specifically designed for use with a railway car which is represented by front and rear wheel trucks generally indicated at 10 and 12, respectively. The front and rear wheel trucks 10, 12 are identical in structure and include frame members 14 and 16 to which is joined a brace 18, the brace 18 being pivotally secured to the underside of the railway car body at the pivot connection 20. Secured to the outer ends of the frame members 14 and 16 are hydraulic units 22, each of which has a shaft 24 extending therein. The hydraulic units are normally designed to operate as pumps but, for purposes of accelerating the railway car, may operate as a motor. The construction of the hydraulic units 22 will be described in detail hereinbelow.

A conventional railway wheel 26 is secured to the outer end of the shaft 24 and engages a rail 28 for movement thereover. It is seen that the conventional axle upon which the wheels 26 are normally mounted is eliminated by the present invention, thereby eliminating the conventional wheel bearings. As shown in Figs. 2 and 3, the shafts 24 are mounted for rotation in the hydraulic units 22 and, as such, each hydraulic unit 22 defines supporting means for its shaft 24 and the associated wheel 26.

As will be described in more detail hereinafter, each of the hydraulic units 22 is provided with a fluid inlet port 30 and a fluid outlet port 32, the inlet port 30 communicating with a fluid conduit 34 that directs hydraulic fluid thereto from a fluid reservoir 36. All of the hydraulic units 22 are connected in parallel relation and are thus adapted to function concurrently when operating as a braking or accelerating device. The hydraulic fluid is adapted to be recirculated and for this purpose each of the outlet ports 32 is connected to a fluid conduit 38 that communicates with the reservoir 36 through a relief valve 40, a heat exchange unit generally indicated at 42 and a fluid operated pump-fan unit 44 that directs cooling air to the heat exchange unit 42. For purposes of acceleration, a hydraulic accumulator 46 communicates with the fluid conduit 38 through a conduit 48 and the function of the accumulator will be described in detail below.

During normal operation of the railway car, the wheels 26 will always rotate in a specific direction, depending on the direction of travel of the locomotive. As the shaft 24 of each hydraulic unit is rotated, the rotor secured thereto is rotated. However, the hydraulic units will not function to deliver fluid unless a suitable control device is actuated to move the operating elements of the units to an operating position.

Referring now to Figs. 2 and 3 of the drawings, one of the hydraulic units 22 is illustrated in section therein and comprises a casing 48 which includes an end cover 50 and a shaft cover 52. It is understood that all of

the hydraulic units 22 are similar in construction and will operate concurrently during a braking or accelerating of the vehicle to which they are attached. Mounted in the end cover 50 and shaft cover 52, respectively, are body bearings 54 and 56 which receive for rotation therein a cylinder body 58. The cylinder body 58 is connected to the shaft 24 and is rotatable therewith when the railway car wheel 26 is rotating on the track 28. Formed in the cylinder body 58 are a plurality of radially extending cylinders 60, each of which receives a grooved piston 62 therein. Secured to the outer end of the pistons 62 are pairs of slippers or rollers 64 which are mounted on a pin 66, the rollers engaging an annular groove 68 formed in a floating ring assembly 70. Positioned in the end cover 50 is a central cylindrical valve 72 that is formed with axial parallel passages 74 and 76 that communicate with central ports, one of which is indicated at 78, the central ports communicating with the radial cylinders 60 formed in the cylinder body 58. Formed in the valve 72 adjacent the outer end thereof are openings 80 and 82 that communicate with an inlet passage 84 and an outlet passage 86, respectively. The inlet passage 84 extends into the inlet port 30 and similarly the outlet passage extends into the outlet port 32. In order to vary the stroke of the pistons 62 and thereby control the direction of discharge of the fluid being pumped, the floating ring assembly 70 is movable with respect to the cylinder body 58. The floating ring assembly 70 is mounted on bearings 88 and 90 secured in guide blocks 92 and 94, respectively, the guide blocks 92, 94 being supported by guide pins 96 and 98, respectively, which extend through guides cast on the casing 48. To provide for movement of the floating ring assembly 70 with respect to the cylinder body 58, guide rods 100 and 102 are secured to the guide blocks 92 and 94, respectively, and have joined to the outer end thereof a cross head 104. Since the hydraulic unit 22 must be controlled remotely, a servo motor 105 is provided and is operatively connected to the cross head 104 for causing movement thereof. The servo motor 105 comprises a cylinder 106 which receives a piston 108 for sliding movement therein, the pitson 108 having a piston rod 110 secured thereto. The piston rod 110 is secured to the cross head 104 and is adapted to move the cross head therewith in response to pressure exerted by a pressure fluid that is directed into the cylinder 106 through fluid conduits 112 and 114.

It is understood that the means for controlling the supply of the operating fluid to the servo motor 105 is located at a conveniently positioned control station. It is also understood that all of the hydraulic units 22 may be controlled independently or as a unit, depending upon the needs required. However, in the normal operation of the device, for either braking or accelerating, all of the hydraulic units 22 would be concurrently controlled to operate together.

It is seen that if the floating ring assembly 70 of each hydraulic unit 22 is maintained in concentric relation with the cylinder body 58, the hydraulic unit 22 will not perform any work, and the unit will be maintained in a static condition. However, if it is desired to move the hydraulic fluid through the unit, the unit thereby effecting a pumping action, the floating ring assembly 70 is moved inwardly by the cross head 104 through remote control of the servo motor 105. When the floating ring assembly 70 moves inwardly to a position such that it is eccentric with respect to the cylinder body 58, a stroke of the pistons 62 is effected upon rotation of the shaft 24 and a pumping action takes place. The hydraulic fluid is then pumped through the inlet port 30, through the passage 76 and into the cylinder 60, from where it is directed by relative movement of the cylinder 60 and the piston 62 into the passage 74 for discharge through passage 86 and port 32. An increase in the eccentricity of the floating ring assembly 70 with respect to the cylinder body 58 increases the quantity of fluid pumped by the unit and thereby increases the load on the shaft 24. It is seen, therefore, that by sufficiently loading the shaft 24 of each hydraulic unit 22, a braking effect is created that will tend to decrease the speed of the vehicle.

In the operation of the device, if it is desired to brake the vehicle, for example, when the train is proceeding down a relatively long grade, the operator of the train actuates the servo motor controls to cause the cross head 104 of each hydraulic unit to move the floating ring assembly 70 in eccentric relation with respect to the cylinder body 58. The load on the shafts 24 created by the pumping of the hydraulic fluid through the units then sufficiently brakes the train. A greater or lesser braking action may be obtained by varying the eccentricity of the floating ring assembly 70, thereby increasing or decreasing the stroke of the pistons 62.

It is understood that the braking system just described is utilized primarily for initiating the braking action of the vehicle and in most instances will be used in conjunction with conventional frictional braking systems. Thus, when the vehicle has been sufficiently braked by the present system, the conventional braking system may then be employed to hold the vehicle at a rest position.

Since the hydraulic system operates in a closed circuit, the heat generated by the fluid passing through the relief valve 40 during the braking operation must be dissipated and, for this purpose, the heat exchange unit 42 is provided. The hydraulic fluid exhausted from the ports 32 enters the fluid conduit 38 and is then pumped through the relief valve 40 to the heat exchange unit 42. Cooling fins of any convenient construction are provided in the heat exchange unit in contact with the conduit 38 and are adapted to reduce the temperature of the hydraulic fluid as it circuates through the conduit 38. Cooling air is directed to the heat exchange unit 42 by the hydraulic motor 44 which is interposed in the fluid conduit 38 and is driven by the hydraulic fluid being pumped therethrough. A fan of any suitable design is rotated by the motor 44 and directs air into the heat exchange unit 42. The cooled hydraulic fluid is then pumped into the reservoir 36 for recirculation through the system.

Although the hydraulic accumulator 46 is illustrated in the drawings and has been described above, it is apparent that in the braking operation just described, the accumulator is not utilized. However, when the vehicle is to be accelerated from a position of rest, the accumulator is employed and the operation of the system using the accumulator follows:

During the braking operation described above, the hydraulic fluid is directed through the conduit 48 and into the accumulator 46, which has a piston located therein. A gas precharge introduced into the accumulator loads the piston and determines the pressure limit of the hydraulic fluid. When the pressure limit determined by the precharged gas is reached during the braking operation, the relief valve 40 adjusted to the predetermined pressure opens and the hydraulic fluid is then pumped through the heat exchange unit 42, motor 44 and back into the reservoir 36, as described above. Assuming now that the vehicle has been brought to a position of rest, and it is desired to begin forward movement, then the operator of the vehicle moves the floating ring assembly 70 of each unit outwardly to an eccentric position, whereby each of the previously designated exhaust ports 32 functions to introduce hydraulic fluid from the accumulator 46 into the hydraulic unit 22. Since the hydraulic fluid introduced into the units 22 from the accumulator 46 is under pressure, it acts as a motive fluid and will cause the shaft 24 of each unit 22 to be rapidly accelerated. The hydraulic fluid then exhausts through the ports 30 and is directed into the reservoir 36. As soon as the vehicle is brought

up to normal speed or the supply of fluid in the accumulator is exhausted, the floating ring assembly **70** of each unit **22** is moved into concentric relation to the cylinder body **58**, the stroke of the pistons **62** is reduced to zero, and the units then float on the line, that is, they do not deliver fluid since pump delivery has been reduced to zero. When it is necesary to again brake the vehicle, the cycle of operation is repeated.

It is seen that the hydraulic system described herein will greatly reduce wear on the conventional braking systems and furthermore when the accumulator is employed will aid considerably in accelerating the vehicle from a position of rest. Thus, the load on the vehicle engine is reduced, resulting in more effective control and economy of operation.

It will be obvious to those skilled in the art that various changes may be made without departing from the spirit of the invention and therefore the invention is not limited to what is shown in the drawings and described in the specification but only as indicated in the appended claims.

What is claimed is:

1. In a hydraulic braking system for a vehicle, a plurality of wheels mounted for rotation on said vehicle, each of said wheels having a shaft secured for rotation therewith, each of said shafts having a hydraulically operated unit operatively connected thereto and responsive to the rotation thereof, said shafts being mounted independent of each other and responsive solely to the rotation of the associated wheel, a fluid reservoir communicating with said units and adapted to supply hydraulic fluid thereto and receive hydraulic fluid therefrom, and means for controlling the operation of said units to cause said unit to operate as a pump for pumping fluid from said reservoir, the pumping action of said units loading said shaft and thereby braking said wheels.

2. In a hydraulic braking system for a vehicle, a plurality of wheels mounted for rotation on said vehicle, each of said wheels having a shaft secured for rotation therewith said shafts being mounted independent of each other and responsive solely to the rotation of the associated wheel, each of said wheels having a hydraulic pump unit connected thereto and responsive to the rotation thereof independent of the rotation of the other units, a fluid reservoir communicating with said pump units for supplying hydraulic fluid thereto, and individual control means associated with each of said pump units for controlling the operation thereof, said control means being operatively connected to the rotor of a unit for moving said rotor to an eccentric position with respect to said shaft, said units thereby acting to pump fluid from said reservoir, the pumping action of said units loading the shaft thereof and thereby braking said vehicle wheels.

3. In a hydraulic braking system for a vehicle, a plurality of wheels secured to said vehicle, each of said wheels having a shaft secured for rotation therewith independent of the rotation of the other shafts and wheels, a hydraulic pump unit connected to each of said shafts, each said shaft being responsive solely to the rotation of its associated unit, a fluid reservoir communicating with said pump unit for supplying fluid thereto and receiving hydraulic fluid therefrom, a heat exchange system interposed between the discharge of said pump unit and said reservoir, said heat exchange system including a fan operated by the pressure of the fluid being pumped through said unit to cool said fluid prior to being introduced into said reservoir, and means for controlling the operation of said pump unit for causing said pump unit to draw fluid from said reservoir, the pumping action of said pump unit loading said shaft and thereby braking said vehicle wheel means.

4. In a hydraulic system for braking and accelerating a land vehicle, wheel means secured to said vehicle and rotated thereby, a shaft secured to said wheel means for

rotation therewith, a hydraulic unit operatively connected to said shaft and responsive to rotation thereof to pump a hydraulic fluid through a fluid conduit communicating with said unit, a fluid reservoir communicating with said unit for supplying hydraulic fluid thereto, an accumulator communicating with said unit and adapted to receive said fluid therein during the pumping operation until a predetermined pressure is reached therein, means for regulating the pressure in said accumulator, and means operatively connected to said unit for controlling said unit to cause said unit to operate as a pump for pumping said fluid and thereby loading said shaft to brake said vehicle, said control means being further operated to cause said fluid under pressure to enter said unit and thereby operate said unit as a motor when said vehicle is in a position of rest, said vehicle thereby being accelerated during a starting operation, said control means including a servo motor and a control member operatively connected to said servo motor and said unit, said control member being responsive to said servo motor to control the operation of said unit.

5. In a hydraulic system for use with a vehicle, wheel means having a shaft secured for rotation therewith, a hydraulic unit operatively connected to said shaft, a control device operatively connected to said unit and adapted to be controlled at a station remote therefrom for controlling the operation of said fluid unit, said control device being actuated to cause said unit to operate as a pump for pumping hydraulic fluid therethrough, the pumping action of said unit loading said shaft and thereby braking said wheel means, a hydraulic accumulator communicating with said unit through a fluid conduit, said unit directing hydraulic fluid to said accumulator during the braking operation until a predetermined pressure is reached therein, the hydraulic fluid under pressure being introduced into said unit when said vehicle is in a position of rest to cause said unit to operate as a motor and thereby accelerate said shaft, means for controlling the pressure on said accumulator and a hydraulic motor communicating with said unit through a conduit and being driven by the hydraulic fluid pumped through said unit, said hydraulic motor having a fan operatively connected thereto for directing a stream of cooling air into contact with said conduit, thereby cooling said hydraulic fluid.

6. In a hydraulic braking system for a vehicle, wheel means secured to said vehicle and having a shaft secured for rotation therewith, a hydraulic pump unit connected to said shaft and responsive to the rotation thereof, a fluid reservoir communicating with said pump unit for supplying fluid thereto and receiving hydraulic fluid therefrom, a heat exchange system interposed between the discharge of said pump unit and said reservoir, said heat exchange system including a fan operated by the pressure of the fluid being pumped through said unit to cool said fluid prior to being introduced into said reservoir, means for controlling the operation of said pump unit for causing said pump unit to draw fluid from said reservoir, the pumping action of said pump unit loading said shaft and thereby braking said vehicle wheel means, and a hydraulic accumulator operatively connected to said pump unit, said accumulator receiving said fluid from said pump unit during the braking action and accumulating said fluid therein until a predetermined pressure has been reached, said control means controlling the operation of said pump unit to direct fluid under pressure through said pump unit after said vehicle has been braked to a stationary position to operate said unit as a motor, thereby accelerating said wheel means from the stationary position, and means associated with said accumulator for controlling the pressure therein.

7. In a hydraulic system for use with a land vehicle, wheel means adapted to be rotated by said vehicle and having a shaft secured thereto for rotation therewith, a hydraulic unit including a cylinder body secured to said

shaft for rotation therewith, said cylinder body including a plurality of radial cylinders, each of said cylinders receiving a piston therein, a floating ring assembly engaging said pistons, and control means secured to said floating ring assembly for moving said floating ring assembly in eccentric relation with respect to said cylinder body for defining a stroke for said pistons and causing said unit to operate as a pump for pumping hydraulic fluid therethrough, the pumping action of said unit loading said shaft and thereby braking said wheel means, said control means including a servo motor and a cross bar operatively connected to said servo motor, said cross bar being secured to said floating ring assembly and responsive to movement of said servo motor for moving said floating ring assembly, a hydraulic accumulator communicating with said unit through a fluid conduit, said unit directing hydraulic fluid to said accumulator during the braking operation until a predetermined pressure is reached therein, said control means controlling said hydraulic unit for introducing the hydraulic fluid under pressure therein when said vehicle is in a position of rest to cause said unit to operate as a motor and thereby accelerate said shaft, and means associated with said accumulator for controlling the pressure therein.

8. In a hydraulic system for use with a land vehicle, wheel means adapted to be rotated by said vehicle and having a shaft secured thereto for rotation therewith, a hydraulic unit including a cylinder body secured to said shaft for rotation therewith, said cylinder body including a plurality of radial cylinders, each of said cylinders receiving a piston therein, a floating ring assembly engaging said pistons, and control means secured to said floating ring assembly for moving said floating ring assembly in eccentric relation with respect to said cylinder body for defining a stroke for said pistons and causing said unit to operate as a pump for pumping hydraulic fluid therethrough, the pumping action of said unit loading said shaft and thereby braking said wheel means, said control means including a servo motor and a cross bar operatively connected to said servo motor, said cross bar being secured to said floating ring assembly and responsive to movement of said servo motor for moving said floating ring assembly, a hydraulic motor communicating with said unit through a conduit and being driven by the hydraulic fluid pumped through said unit, a fan operatively connected to said hydraulic motor for directing a stream of cooling air into contact with said conduit thereby cooling said hydraulic fluid.

References Cited in the file of this patent

UNITED STATES PATENTS

1,649,347	Hardt	Nov. 15, 1927
2,255,292	Lincoln	Sept. 9, 1941
2,290,932	Aikman	July 28, 1942
2,355,604	Rupp	Aug. 5, 1944
2,416,638	Morton	Feb. 25, 1947
2,548,919	Stevens et al.	Apr. 17, 1951
2,692,759	Swenson et al.	Oct. 26, 1954
2,772,755	Nallinger et al.	Dec. 4, 1956