Aug. 18, 1959 C. E. ADAMS 2,899,941

FLUID MOTOR

Original Filed Dec. 17, 1954 2 Sheets-Sheet 1

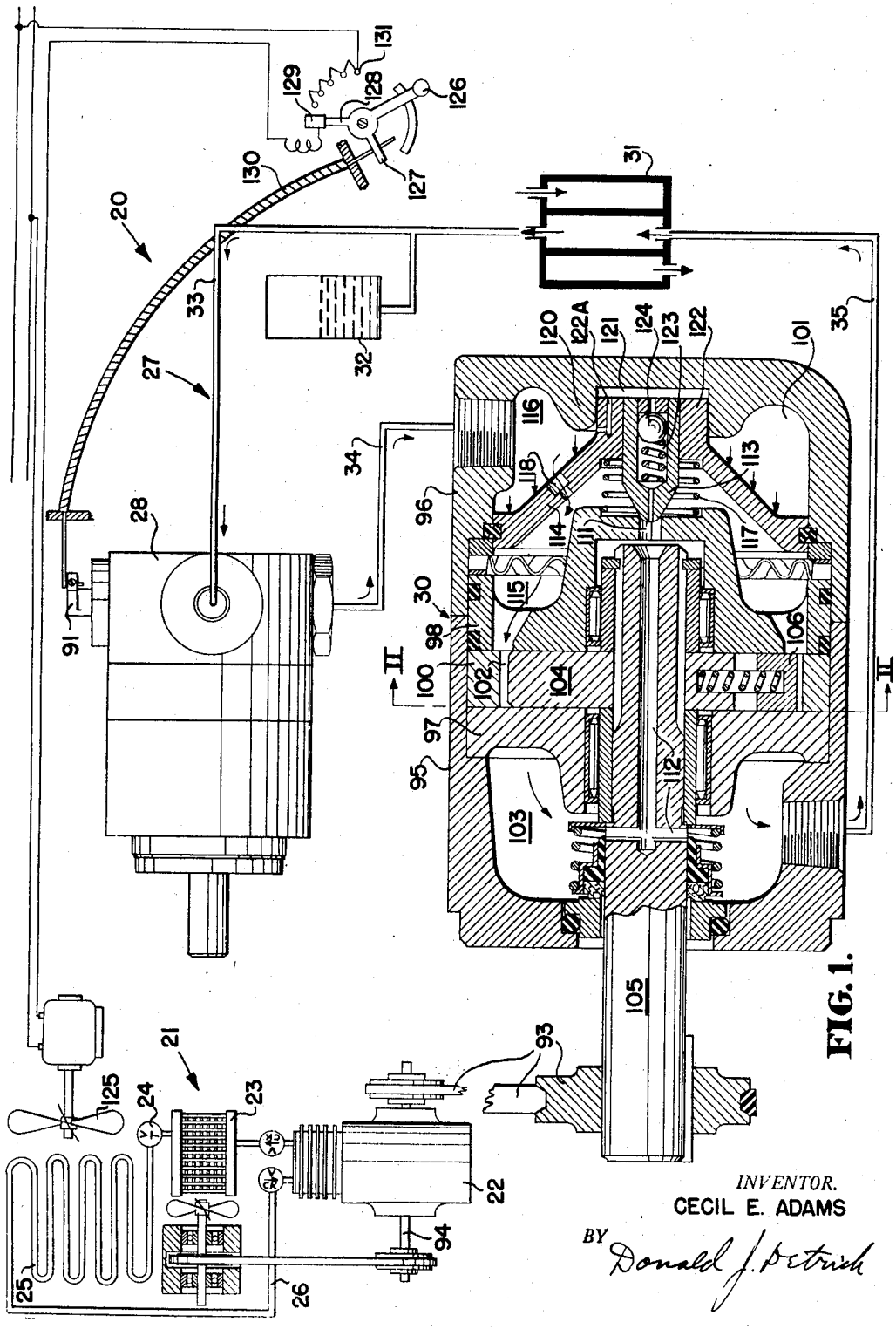


FIG. 1.

INVENTOR.
CECIL E. ADAMS
BY Donald J. Petrich

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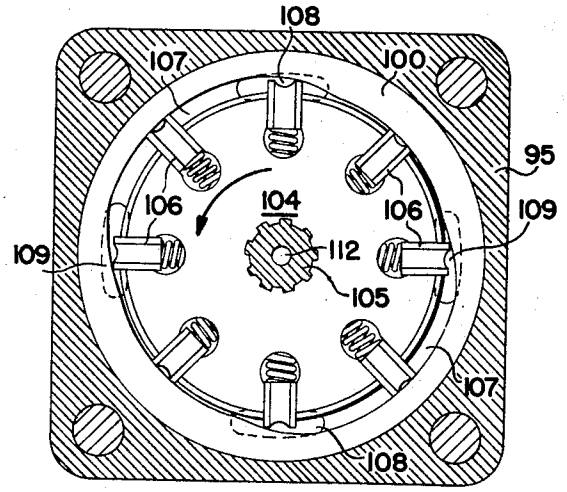


FIG. 2.

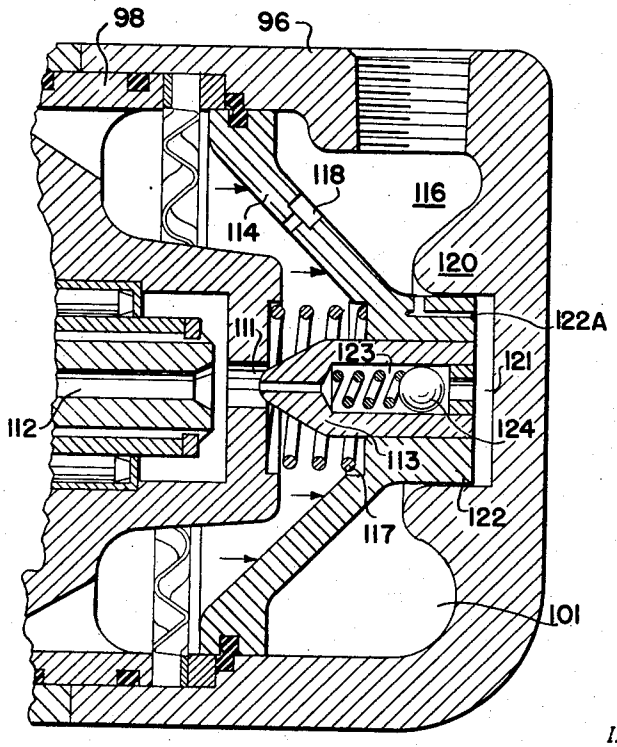


FIG. 3.

INVENTOR.
CECIL E. ADAMS

BY
Donald J. Petrick

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2,899,941

FLUID MOTOR

Cecil E. Adams, Columbus, Ohio, assignor to American Brake Shoe Company, New York, N.Y., a corporation of Delaware

Original application December 17, 1954, Serial No. 475,994. Divided and this application September 2, 1958, Serial No. 758,461

5 Claims. (Cl. 121—86)

This application is a division of my application Serial No. 475,994, filed December 17, 1954, for a "Hydraulic Transmission and Control Mechanism."

The present invention relates to fluid motors of the type which may be employed, for example, in a hydraulic transmission system of the type which is employed in automotive vehicles to drive an air conditioning apparatus thereof.

An object of this invention is to provide an improved fluid motor which may be employed in a hydraulic system of the type set forth which motor has a novel valve means incorporated therein that is responsive to the volume of fluid supplied thereto by a pump to render the motor operative or inoperative and which is also effective as a safety device to by-pass fluid around the motor and to exhaust in the event the motor is loaded unduly, whereby the motor as well as system in which it is employed are protected against injury in the event certain troubles develop therein.

Another object of the invention is to provide a fluid motor having an inlet, a rotor chamber and an outlet and a by-pass passage directly connecting the inlet and outlet, this passage having a valve element which is normally biased to an open position to permit fluid to by-pass the rotor chamber, there being means responsive to fluid flow at a predetermined volume to the motor to close the valve and direct all the fluid through the rotor chamber, the valve biasing means being operative again to move the valve to the by-pass passage opening position in the event excessive opposition is offered to the operation of the fluid motor.

A still further object of the invention is to provide a fluid motor having inlet, rotor and outlet chambers and a movable partition dividing the inlet chamber into sections, one thereof being connected directly with the outlet chamber by a by-pass passage, the partition carrying a valve element for opening and closing the by-pass passage in response to movement of the partition, the latter being moved in response to pressure differentials caused by fluid flow through an orifice establishing restricted communication between the sections of the inlet chamber formed by the partition, means being provided to cause differentials in areas on opposite sides of the partition so that, in the event fluid pressures at opposite sides thereof are equal, forces on opposite sides will be unequal and the partition will be urged in a direction to cause the valve element to open the by-pass passage and direct fluid to exhaust without operating the motor.

Further objects and advantages of the present invention will be apparent from the following description, reference being had to the accompanying drawings wherein a preferred form of embodiment of the invention is clearly shown.

In the drawings:

Fig. 1 is a diagrammatic view of a combined hydraulic system and electrical circuit of which a motor embodying the principles of the present invention forms a part, parts

of the apparatus being shown diagrammatically and other parts being shown in longitudinal section;

Fig. 2 is a vertical sectional view taken through the fluid motor seen in Fig. 1, the plane of the section being indicated by the line 2—2 of Fig. 1, and

Fig. 3 is a fragmentary longitudinal sectional view taken through the motor and showing parts thereof in positions different from that shown in Fig. 1.

Referring more particularly to the drawings and especially Fig. 1, the numeral **20** designates one form of a combined hydraulic system and electrical circuit of which a hydraulic motor which includes the features of the invention forms a part. Apparatus **20** includes a refrigerating system **21** which is shown diagrammatically and includes a compressor **22**, a condenser **23**, an expansion valve **24**, an expansion coil or evaporator **25**, and a fluid line **26** leading from the latter to the inlet of the compressor **22**.

The apparatus also includes a hydraulic transmission system, designated generally by the numeral **27**, this system including a variable volume pump **28**, a fluid motor **30**, a cooler **31** and an accumulator or reservoir **32**, a fluid line **33** leading from the reservoir to the inlet of the pump, a second fluid line **34** leading from the outlet of the pump to the inlet of the fluid motor, and a third line **35** extending from the outlet of the fluid motor to the cooler and back to the reservoir **32**.

The pump **28** is of the type shown in the co-pending application of Cecil E. Adams et al., Serial No. 416,768, filed March 17, 1954, to which reference may be had for a detailed description. Since this pump forms no part of the present invention, it need only be pointed out here that it is a pump the output volume of which may be adjusted to deliver an infinite number of constant output volumes and a pump which is self-adjusting to maintain the output volume for which it is adjusted even though the speeds at which its shaft are driven may vary. Pump **28** is to be driven by the engine, not shown, of the vehicle to which the air conditioning system is to be applied.

The operation of the pump has been fully explained in copending application Serial No. 416,768, above-identified, and for the purposes of this application, it is sufficient to state that, as it is driven by the engine of the vehicle fluid is drawn from the conduit **33** into the pump and is expelled therefrom into the conduit **34**. The volume of fluid flowing from the pump discharge port into line **34** will be maintained as determined by the setting of an adjustable lever or knob **91**.

Motor **28** includes a pair of casing sections **95** and **96**, a pair of cheek plates **97** and **98** and a cam ring **100** disposed and clamped between the cheek plates. The casing sections, cheek plates and cam ring cooperate to provide the casing with inlet, rotor and outlet chambers **101**, **102** and **103**, respectively. The rotor chamber receives a rotor **104** which is mounted on a shaft **105** supported for rotation in bearings carried by cheek plates **97** and **98**. The rotor has radially extending slots formed therein to receive vane elements **106** which are spring urged outwardly for engagement with the internal surface of the cam ring **100**. This surface is generally of elliptical form, the ends of the ellipse being spaced a greater distance from the outer surface of the rotor **104** than the sides to form working chambers **107**, as shown in Fig. 2. Inlet and outlet ports **108** and **109** are formed at the opposite ends of the working chambers, the inlet ports communicating with the inlet chamber **101** and the outlet ports communicating with the outlet chamber **103**. Fluid supplied to the motor through line **34** will flow through the inlet chamber **101**, through the inlet ports **108** to the rotor chamber and will apply force to one side of the vanes **106** in the working chambers and tend to urge

these vanes toward the outlet ports **109**, the fluid flowing through the outlet ports to the outlet chamber **103** from which it will flow through line **35** to the cooler **31**. As the vanes move, rotary motion will be imparted to the rotor **104** and shaft **105**, this motion in turn being transmitted by the belt or other motion transmitting means **93** to the shaft of the compressor **22**.

As shown in Fig. 1, cheek plate **98** and the shaft **105** of the motor **30** are provided with openings and passages **111** and **112** which directly establish communication between the inlet chamber **101** and the outlet chamber **103**. The opening **111** in cheek plate **98** forms a seat for a valve element **113** which, in the present instance, is carried by a partition **114**, this partition being arranged in the inlet chamber **101** for limited longitudinal movement. The partition divides the chamber **101** into a pair of sections **115** and **116**, the latter of which communicates directly with the passage **34** while the other communicates with the rotor chamber. The opening **111** in cheek plate **98** and the passages **112** in shaft **105** communicate with the section **115** of the inlet chamber. Partition **114** and the valve element **113** carried thereby are urged in a direction away from the cheek plate **98** by a coil spring **117** so that, normally, when fluid is not flowing through the motor **30** or only a relatively small amount of fluid is flowing therethrough, the inlet chamber **101** will be directly connected with the outlet chamber by the opening **111** and passages **112** in cheek plate **98** and shaft **105**. Fluid may then flow from the inlet chamber to the outlet chamber without flowing through the rotor chamber and the motor will then be idle.

Sections **115** and **116** of the inlet chamber communicate with one another through an orifice **118** formed in the partition. This orifice will create a pressure differential on fluid flowing through the orifice and, when a predetermined volume of fluid is supplied to the motor, the higher pressure of the differential will be great enough to cause the partition to move toward cheek plate **98** and seat the valve element **113** against the perimeter of the port **111** formed in the cheek plate **98**. The by-pass passage formed by the port **111** and passages **112** will then be closed and fluid will be directed through the rotor chamber. Rotary movement will then be imparted to the shaft **105**. As long as a sufficient amount of fluid flows through the motor to create the necessary pressure differential, the valve element will remain seated. When the volume of fluid supplied to the motor is reduced to a predetermined quantity, however, the pressure differential will not be maintained sufficient to overcome the force of the spring **117** and the valve element will be moved away from a by-pass passage closing position, the fluid supplied to the motor then being directed to the outlet port without passing through the rotor chamber. The motor will again be idle.

The partition **114** and valve **113** carried thereby have also been designed to serve as a relief valve or safety element. This object is accomplished by forming the casing section **96** with a boss-like projection **120** having a recess **121** formed therein to receive a hub **122** formed on the partition **114**. This hub is received for sliding movement in the recess, the construction serving to create a differential in areas exposed to fluid pressure in the sections of the inlet chamber **101**.

As shown in Fig. 1, hub **122** is drilled as at **122A** to provide restricted communication between the inlet chamber section **116** and the recess **121**. This communication will permit fluid to escape from the recess to the chamber section **116** when the partition is moved under the influence of spring **117** to space valve **113** from its seat. The valve element **113** is formed with a central passage **123** to establish communication between the recess **121** and the port **111**, a spring pressed check valve **124** being provided in the valve element **113** to normally close this passage and interrupt flow therethrough. When the pressure in the recess increases sufficiently, however, the check valve **124** will open to permit fluid to flow from the recess to the by-pass passage and forces on opposite sides of the partition will be unbalanced. These unbalanced forces will cause the partition to move and withdraw the valve element **113** from the seat in cheek plate **98** to open the by-pass passage. This operation will occur in the event an excessive load is applied to the shaft **105** of the fluid motor **30**. When this excessive load is applied, the pressure in the sections **115** and **116** of the inlet chamber **101** will be equalized through the orifice **118** but, since there is a differential of areas on opposite sides of the partition **114** exposed to this pressure and the greater area is exposed to section **115** which communicates with the rotor chamber, the partition will be moved causing fluid to be expelled from the recess **121** and the valve element **113** to be moved to a by-pass passage opening position. Fluid then flowing to the pump will pass from the inlet chamber directly to the outlet chamber while the motor is permitted to stand idle. The partition and valve elements are shown in the position just described in Fig. 3. Arrows are employed to show the application of the greater force to the partition to move the valve away from the valve seat.

One of the features of the apparatus shown in Fig. 1 is that it includes a novel control mechanism whereby the rate of operation of the compressor **22** may be controlled simultaneously with the rate of operation of an electrically operated fan **125** employed to circulate air over the evaporator. This control mechanism is shown diagrammatically in Fig. 1. The control mechanism includes an actuating lever **126** which is mounted for pivotal movement in a location convenient for actuation by the operator of the vehicle. The lever has a pair of arms **127** and **128**, the former of which is connected by a motion transmitting device **130**, in this instance a push-pull wire, with the lever or knob **91** used to vary the output volume of the pump **28**. When the control lever is moved in one direction, the wire will transmit such motion to the knob **91** to change its position and thereby change the volume of fluid delivered by the pump and consequently the rate of operation of the motor **30**. Since motor **30** is connected with the compressor, the rate of operation of the latter will also be changed. It should be obvious that, if the control lever **126** is moved to decrease the output of pump **28** sufficiently, the operation of motor **30** and the compressor may be interrupted. If the control lever is moved in the opposite direction, the volume of fluid discharged by the pump will be increased and the rate of operation of the motor **30** and the compressor will be increased. When the compressor operating rate is increased, the evaporator will cause an increased cooling effect and consequently it is desirable to increase the volume of air flowing over the evaporator. The control lever **126** has, therefore, been provided with the second arm **128** which has a contact element **129** for cooperation with a variable resistance **131** connected in the circuit for the electric motor coupled with the fan **125**. This arrangement permits the fan to be operated at various rates depending upon the position of the control lever. If the control is moved to increase the volume of fluid supplied to the fluid motor, the supply of current to the electric motor for the fan will also be increased to cause the fan to operate at a faster rate.

While the form of embodiment of the present invention as herein disclosed constitutes a preferred form, it is to be understood that other forms might be adopted, all coming within the scope of the claims which follow:

I claim:

1. In a fluid motor, a casing forming a rotor chamber, inlet and exhaust chambers at opposite sides of said rotor chamber and inlet and outlet ports communicating with said inlet and exhaust chambers, respectively; a

shaft in said casing; a rotor in said rotor chamber driving said shaft, fluid flow through said rotor chamber imparting rotary motion to said rotor and shaft; means forming a passage establishing communication directly between said inlet and exhaust chambers and by-passing said rotor chamber; a valve element supported for movement between positions opening and closing said passage; a first means urging said valve toward the position opening said passage; a second means in said inlet chamber responsive to fluid pressure to urge said valve toward the position closing said passage; and means forming a restricted orifice through which fluid flows to said rotor chamber, said restricted orifice creating a back pressure which is applied to said second means to cause said valve to close said passage.

2. In a fluid motor, a casing forming a rotor chamber, inlet and exhaust chambers at opposite sides of said rotor chamber and inlet and outlet ports communicating with said inlet and exhaust chambers, respectively; a shaft in said casing; a rotor in said rotor chamber driving said shaft, fluid flow through said rotor chamber imparting rotary motion to said rotor and shaft; means forming a passage establishing communication directly between said inlet and exhaust chambers and by-passing said rotor chamber; a partition supported in said inlet chamber for limited movement; a valve element carried by said partition for movement toward and away from a position closing said passage; means urging said partition and valve away from a passage closing position; and means forming a restricted orifice establishing communication between spaces in said inlet chamber at opposite sides of said partition, said orifice creating a back pressure which tends to urge said partition and valve toward a passage closing position.

3. In a fluid motor, a casing forming a rotor chamber, inlet and exhaust chambers at opposite sides of said rotor chamber and inlet and outlet ports communicating with said inlet and exhaust chambers, respectively; a shaft in said casing; rotor means in said rotor chamber driving said shaft, fluid flow through said rotor chamber imparting rotary motion to said rotor means and shaft; a partition supported in said inlet chamber for limited movement and dividing said inlet chamber into high and low pressure sections and having surface areas exposed to each of said sections; means forming a passage establishing communication between said low pressure section and said exhaust chamber and by-passing said rotor chamber; a valve element carried by said partition for movement toward and away from a position closing said passage means; means urging said partition and valve away from said passage closing position; said partition forming an orifice establishing restricted communication between said high and low pressure sections in said inlet chamber through which fluid flows to create different pressures in said high and low pressure sections the difference between which urges said partition and valve to said passage closing position upon a predetermined flow of fluid through said orifice.

4. In a fluid motor, a casing forming a rotor chamber, inlet and exhaust chambers at opposite sides of said rotor chamber and inlet and outlet ports communicating with said inlet and exhaust chambers, respectively; a shaft in said casing; rotor means in said rotor chamber driving said shaft, fluid flow through said rotor chamber imparting rotary motion to said rotor means and shaft; a partition supported in said inlet chamber for limited movement and dividing said inlet chamber into high and low pressure sections and having surface areas exposed to each of said sections; means forming a passage establishing communication between said low pressure section and said exhaust chamber and by-passing said rotor chamber; a valve element carried by said partition for movement toward and away from a position closing said passage means; means urging said partition and valve away from said passage closing position; means establishing restricted communication between said high and low pressure sections in said inlet chamber through which fluid flows to create different pressures in said high and low pressure sections the difference between which urges said partition and valve to said passage closing position upon a predetermined flow of fluid through said orifice.

5. In a fluid motor, a casing forming a rotor chamber, inlet and exhaust chambers at opposite sides of said rotor chamber and inlet and outlet ports communicating with said inlet and exhaust chambers, respectively; a shaft in said casing; rotor means in said rotor chamber driving said shaft, fluid flow through said rotor chamber imparting rotary motion to said rotor means and shaft; a partition supported in said inlet chamber for limited movement and dividing said inlet chamber into high and low pressure sections and having surface areas exposed to each of said sections; means forming an exhaust passage for said low pressure section; a valve element carried by said partition for movement toward and away from a position closing said passage means; means urging said partition and valve away from said passage closing position; means establishing restricted communication between said high and low pressure sections in said inlet chamber through which fluid flows to create different pressures in said high and low pressure sections the difference between which urges said partition and valve to said passage closing position upon a predetermined flow of fluid through said orifice.

References Cited in the file of this patent

UNITED STATES PATENTS

2,375,076	Caserta	May 1, 1945
2,808,812	Shaw	Oct. 8, 1957