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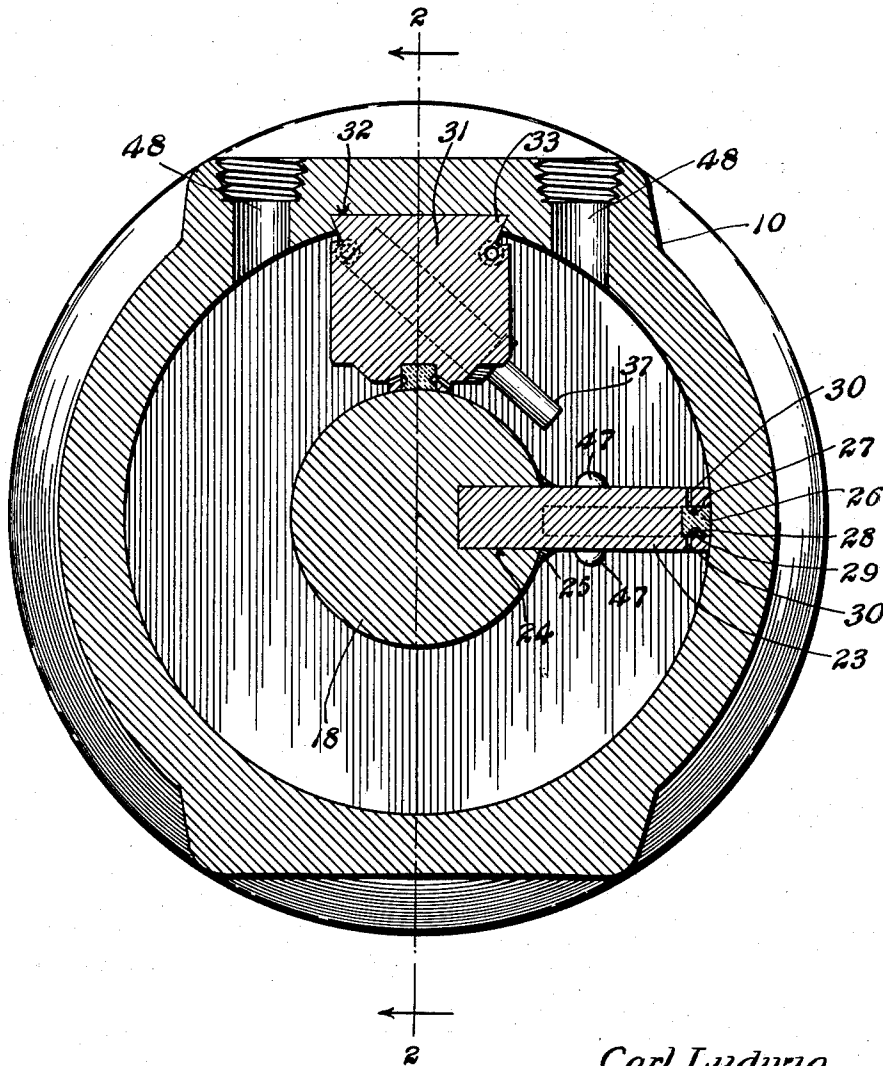
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HYDRAULIC MOTOR HAVING ADJUSTABLE CUSHIONING MEANS

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Fig. 1.



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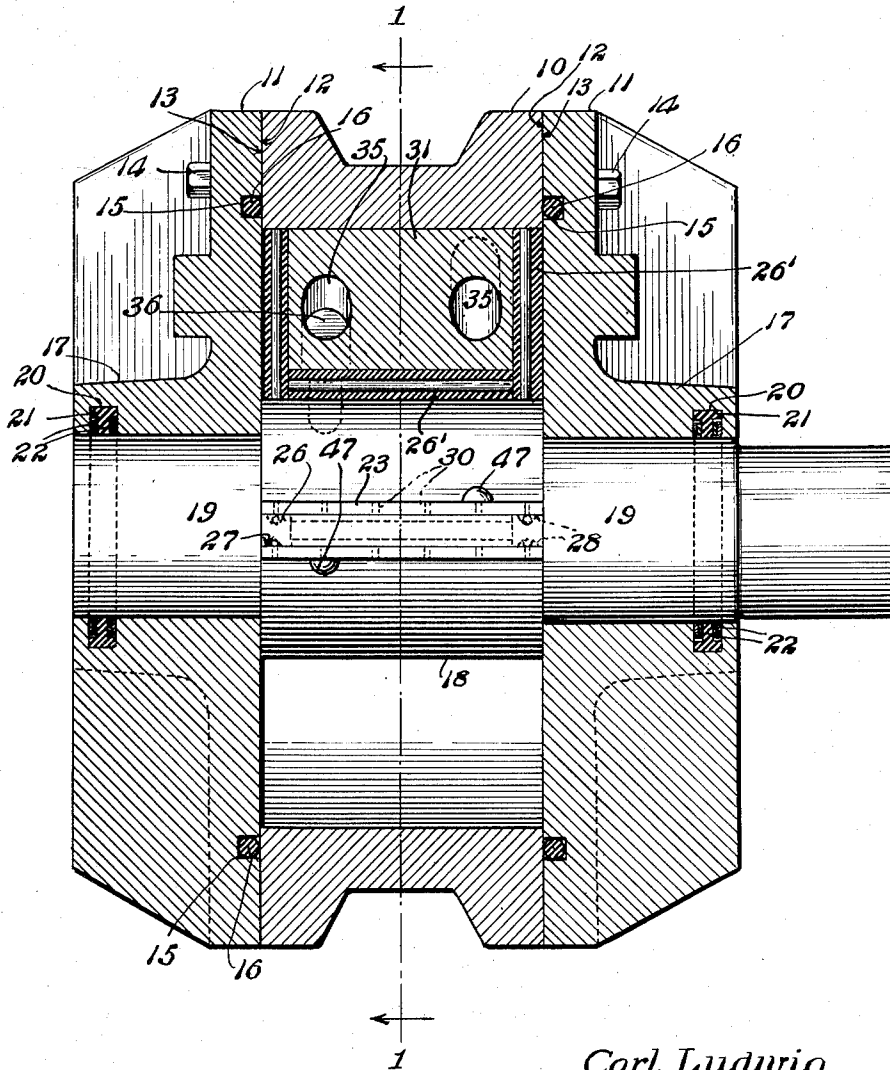
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Fig. 2.



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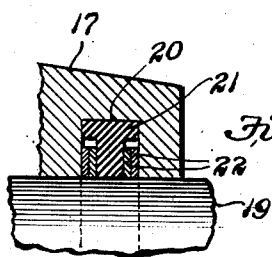
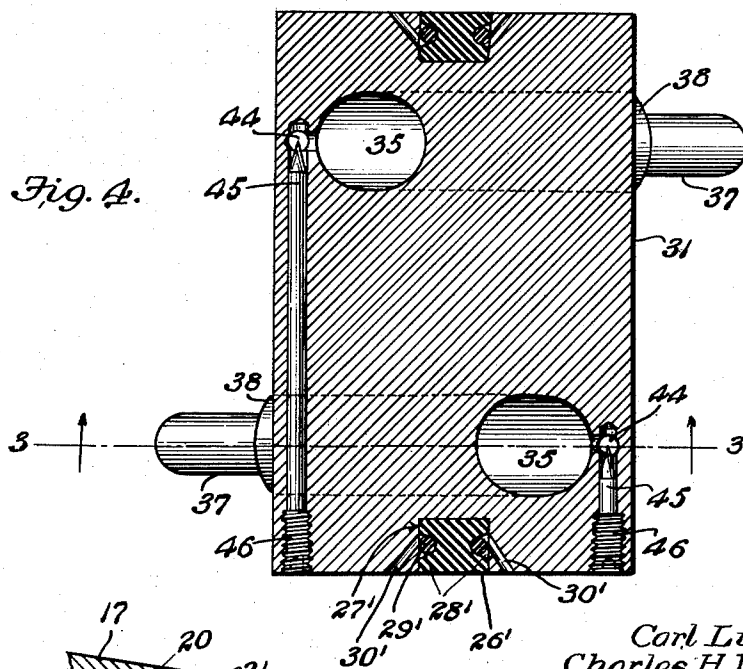
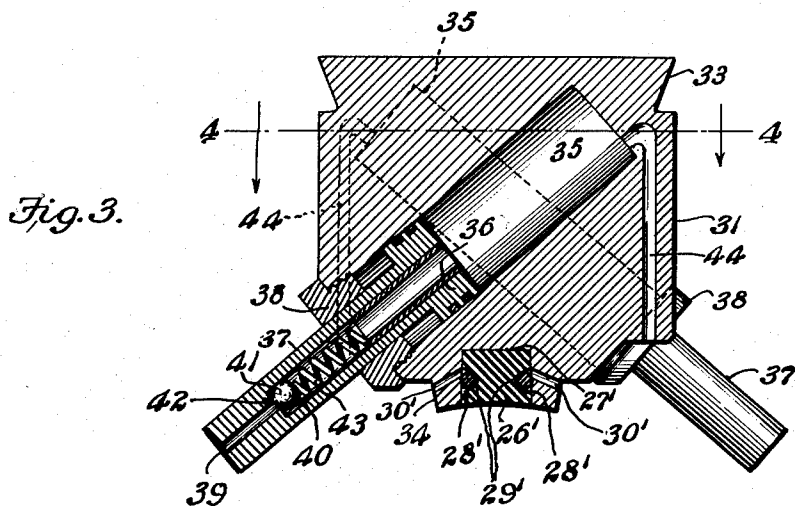
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3 Sheets-Sheet 3



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HYDRAULIC MOTOR HAVING ADJUSTABLE CUSHIONING MEANS

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6 Claims. (Cl. 121—97)

The invention relates to oscillating type hydraulic motors having a shaft adapted to be oscillated within a cylindric housing or body, by fluid pressure selectively admitted to the interior of the housing on opposite sides of a vane fixed upon the shaft.

Hydraulic motors of this general character are provided with a stationary shoe or barrier located within the housing and having a running fit with the shaft, and a radial vane is fixed upon the shaft and has a running fit with the inner walls of the housing. Ports are provided in the housing on opposite sides of the shoe for alternately admitting fluid under pressure to one chamber of the housing and exhausting it from the other chamber.

The extreme pressure at which the fluid is admitted to the housing tends to cause the fluid pressure to equalize between the chambers of the housing, by leaking through the joint between the housing and the shoe, as well as through the necessary clearances between the shoe and the shaft and between the vane and the housing, and also between the journal portions of the shaft and the bearing portions of the housing.

It is also well known that, in such oscillating hydraulic motors, the shaft is abruptly stopped at the end of each stroke by impact of the vane with the shoe, and these continuous impacts can be detrimental to the motor as well as to the mechanism operated thereby.

Furthermore, since it is customary to form the housing of an annular member with heads attached to opposite ends thereof, there is a tendency for the fluid under pressure to leak out through the joints between these parts.

It is therefore an object of the present invention to provide a hydraulic motor of the oscillating type which overcomes the above-mentioned disadvantages and difficulties.

Another object is to provide such a hydraulic motor in which the shoe is provided with a dove-tail outer portion fitted into a dove-tail recess in the annular portion of the housing, so as to overcome the tendency for the fluid to leak therebetween.

A further object is to provide a low friction heat and low temperature resisting, pressure-operated seal between the shoe and the shaft and heads of the housing, and between the vane and the inner walls of the housing.

A still further object is to provide such a seal comprising a molded plastic member with grooves in opposite sides thereof and plastic rods in said grooves, with means for admitting oil pressure from the housing thereto.

Another and important object of the invention is to provide adjustable cushioning means for the shaft at the end of each stroke.

A further object is to provide such cushioning means comprising oppositely disposed oil cylinders in the shoe with pistons therein adapted to be pushed into the cylinders by the movement of the vane toward the end of each stroke, and means for adjusting the discharge rate of oil from the cylinders.

A still further object is to provide spring loaded ball

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valves in the pistons for preventing oil from being discharged from either cylinder through the piston thereof, but permitting oil to be discharged from the housing through each piston.

Another object is to provide a novel sealing means around the journal portions of the shaft.

A further object is to provide such sealing means for the journals of the shaft, comprising a T-shaped rubber ring backed up on each side by flat metal rings.

The above objects together with others which will be apparent from the drawings and following description, or which may be later referred to, may be attained by constructing the improved hydraulic motor in the manner illustrated in the drawings and hereinafter described in detail.

In general terms, the invention may be described as comprising a cylindric housing or body formed of an annular member with heads attached to the ends thereof, and sealing means therebetween. The annular member of the housing has a dove-tail groove therein, within which is located the dove-tail outer portion of a stationary shoe or barrier, the inner end of which has a running fit with a shaft located axially through the housing and journaled in the heads thereof.

A longitudinal groove is formed in the central portion of the shaft, and a radially disposed vane is set in said groove and welded to the shaft, the outer and side edges of the vane having a running fit with the inner walls of the cylindric housing.

Ports are located through the housing on opposite sides of the shoe for alternately admitting oil under pressure to the housing on one side of the shoe and exhausting oil therefrom on the other side.

Seals are provided around the journal portions of the shaft, comprising annular grooves in the heads surrounding the journals of the shaft, a T-shaped ring of rubber or the like located in each groove and soft metal or plastic back-up rings located in the groove on each side of the T-shaped ring.

The shoe and seal are sealed by providing grooves therein, in which are located molded plastic sealing members of polytetrafluoroethylene, hereinafter referred to as Teflon, having grooves therein in which are located rods of the same material, oil pressure from the interior of the housing being admitted to said grooves to hold the sealing members in sealing contact with the walls of the cylinder and the periphery of the shaft.

Cushioning means for cushioning the shaft at the end of each stroke, comprise oppositely disposed cylinders located within the shoe, hollow pistons being slidably mounted within these cylinders, a spring-loaded ball valve being located in each piston to prevent discharge of oil through the piston from the corresponding cylinder into the housing, while permitting oil to be discharged from the housing through the piston to the cylinder.

Projections are formed upon the sides of the vane for contact with the piston to push it into the corresponding cylinder at the end of each stroke so as to cushion the shaft at these points. Adjustable needle valves or the like are provided for controlling discharge ports from the cylinders back to the interior of the housing, so as to adjust the cushioning effect.

Having thus briefly described the invention, reference is now made to the accompanying drawings illustrating a preferred embodiment of the invention, in which:

Fig. 1 is a transverse sectional view through a hydraulic motor embodying the invention, taken as on the line 1—1, Fig. 2;

Fig. 2 is a longitudinal sectional view through the motor, taken as on the line 2—2, Fig. 1;

Fig. 3 is an enlarged, detached, transverse sectional view through the shoe, showing the cylinders and pistons

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therein for cushioning the shaft, taken as on the line 3—3, Fig. 4;

Fig. 4 is a horizontal sectional view through the shoe, taken as on the line 4—4, Fig. 3; and,

Fig. 5 is an enlarged fragmentary sectional view of the seal for the journal portions of the shaft.

Referring now more particularly to the embodiment of the invention illustrated, in which similar numerals refer to similar parts throughout, a cylindric housing or body of the motor comprises the annular member, indicated generally at 10, and the substantially similar heads, each of which is indicated generally at 11.

The opposed faces 12 and 13, of the members 10 and 11 respectively, are machined flat and smooth so as to fit tightly together, and the heads 11 are attached to the annular member 10 of the housing as by cap screws 14.

An annular groove 15 is formed in each head member and receives a rubber O-ring 16 or the like for sealing the joint between the members 10 and 11 of the housing so as to prevent oil under pressure from being forced out of the interior of the housing at these points.

An outwardly disposed bearing portion 17 is formed upon each head 11, and the shaft 18 is axially located therethrough, the journal portions 19 of the shaft being journaled in said bearing portions 17 of the heads.

For the purpose of sealing these journals of the shaft so as to prevent oil under pressure from within the housing being forced out around the journals, an annular groove 20 is formed in the bearing portions 17 of each head and a palmetto-type packing is provided therein.

A T-shaped, flexible sealing ring of rubber or the like is located within the groove, as indicated at 21, and a pair of flat back-up rings 22 are located in the groove on each side of the T-shaped ring. These rings 22 may be of soft metal such as brass, or of plastic material such as Teflon or the like.

A radial vane 23 is fixed upon the shaft, and for this purpose a longitudinal groove 24 is formed in the shaft to receive the inner portion of the vane, which is rigidly connected to the shaft by weld metal as indicated at 25 in Fig. 1.

The outer and side edges of the vane 23 have a running fit within the annular member 10 and heads 11 respectively. For the purpose of providing a seal around these edges of the vane so as to prevent oil under pressure from passing between the edges of the vane and the inner walls of the housing, from one side of the vane to the other, a seal is provided comprising molded Teflon members 26 located in grooves 27 in the outer and side edges of the vane. Each of these molded members 26 is provided on each side with a substantially V-shaped groove 28, within which is located a solid Teflon rod 29.

Apertures 30 are located through opposite side portions of the vane, communicating with the grooves 28 so as to admit oil pressure from within the housing to move the rods 29 laterally under pressure and force the outer edge of the sealing member 26 into sealing contact with the inner walls of the housing.

For the purpose of rigidly mounting a shoe or barrier, indicated generally at 31, within the housing, a longitudinally disposed dove-tail groove 32 is formed in the annular member 10 of the housing, and the shoe 31 is provided with the dove-tail outer end portion 33 fitted tightly within this dove-tail groove.

The inner side of the shoe 31 is reduced, as indicated at 34, and shaped to have a running fit upon the shaft 18. Sealing means is provided between the inner side of the shoe and the shaft 18, and between opposite ends of the shoe and the inner walls of the heads 11.

This sealing means may be the same as shown upon the vane and above described, and comprises the molded Teflon members 26', located in grooves 27' in the shoe. Each member 26' is provided with the grooves 28' within which are located the solid Teflon rods 29', oil pressure being admitted to the grooves from the interior of

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the housing through the apertures 30' in opposite sides of the shoe.

Cushioning means, for cushioning the shaft at the end of each stroke, comprises a pair of oppositely disposed, angularly located cylinders 35, formed within the shoe 31. A piston 36 is slidably mounted in each cylinder and provided with the reduced cylindrical portion 37 slidably located through the cylinder head 38.

A reduced axial passage 39 extends through the outer end of the piston to the enlarged axial passage 40 which extends through the inner end of the piston. A ball 41 is normally seated upon the seat 42 by means of the coil spring 43, closing the inner end of the reduced passage 39.

A port 44 communicates with the inner end of each cylinder 35 and extends through the adjacent side of the shoe 31. Each of the ports 44 is controlled by a needle valve 45 located through a suitable passage in the shoe and being adjustable as by the screw threads 46 so as to control the ports 44.

Projections 47 are formed upon opposite sides of the vane 23 for contact with the ends of the piston rods 37 when the vane approaches the end of either stroke.

For the purpose of operating the motor, a port 48 is located through the housing on each side of the shoe 31 for alternately admitting oil under pressure through one port to the interior of the housing and discharging oil from the housing through the other port.

In operation, the ball valves 41 normally close the reduced passages 39 of the pistons so as to prevent oil from passing from either cylinder 35 through the corresponding hollow piston back to the interior of the housing.

As the shaft is rotated in either direction by the oil pressure within the housing, when it reaches the end of each stroke the corresponding projection 47 on the vane will contact the end of the adjacent piston rod 37 and further movement of the shaft in this direction will cause the piston to be pushed backward or upward into the corresponding cylinder 35.

This will immediately slow down the movement of the shaft, as the inward movement of the piston is controlled by the rate at which oil is discharged from the corresponding cylinder 35 through the corresponding port 44. The corresponding needle valve 45 may be adjusted to control the speed as desired. The shaft will thus be cushioned at the end of each stroke so as to eliminate the usual impact of the vane against the adjacent side of the shoe.

From the above it will be obvious that the hydraulic motor thus produced is provided with adequate cushioning means for cushioning the shaft at the end of each stroke so as to eliminate impact and jar upon the parts.

Furthermore, it will be seen that the novel sealing means illustrated and described forms an efficient seal between all parts of the motor, preventing oil under pressure from being forced out of the housing between the heads and the annular member of the housing, or around the journal portions of the shaft.

Furthermore, it will be seen that the shoe is completely sealed so as to prevent oil under pressure from passing from one chamber of the housing to the other, between the shoe and the shaft, or between either end of the shoe and the heads.

Also, it will be obvious that oil under pressure cannot pass around the edges of the vane from one chamber to the other, as a perfect seal is provided between the outer and side edges of the vane and the inner walls of the housing.

In the foregoing description, certain terms have been used for brevity, clearness and understanding, but no unnecessary limitations are to be implied therefrom beyond the requirements of the prior art, because such words are used for descriptive purposes herein and are intended to be broadly construed.

Moreover, the embodiments of the improved construction illustrated and described herein are by way of ex-

ample, and the scope of the present invention is not limited to the exact details of construction.

Having now described the invention or discovery, the construction, the operation, and use of preferred embodiments thereof, and the advantageous new and useful results obtained thereby; the new and useful construction, and reasonable mechanical equivalents thereof obvious to those skilled in the art, are set forth in the appended claims.

We claim:

1. A hydraulic motor comprising a cylindric housing, a shaft located axially through the housing and journaled therein, a shoe fixed in the housing and having a running fit with the shaft, a vane fixed upon the shaft and having a running fit with the inner walls of the housing, oppositely disposed cylinders in the shoe, restricted passages in the shoe communicating with the inner ends of the cylinders and open through the adjacent sides of the shoe, a piston in each cylinder extending outwardly into the path of the vane, there being a central bore in each piston restricted at its outer end, check valves in said bores normally closing the restricted outer ends thereof, and a port in the housing on each side of the shoe for alternately admitting fluid to the housing through one port and discharging fluid from the housing through the other port.

2. A hydraulic motor comprising a cylindric housing, a shaft located axially through the housing and journaled therein, a shoe fixed in the housing and having a running fit with the shaft, a vane fixed upon the shaft and having a running fit with the inner walls of the housing, oppositely disposed cylinders in the shoe, restricted passages in the shoe communicating with the inner ends of the cylinders and open through the adjacent sides of the shoe, a piston in each cylinder extending outwardly into the path of the vane, there being a central bore in each piston restricted at its outer end, check valves in said bores normally closing the restricted outer ends thereof, projections upon opposite sides of the vane for contact with the outer ends of said pistons, and a port in the housing on each side of the shoe for alternately admitting fluid to the housing through one port and discharging fluid from the housing through the other port.

3. A hydraulic motor comprising a cylindric housing, a shaft located axially through the housing and journaled therein, a shoe fixed in the housing and having a running fit with the shaft, a vane fixed upon the shaft and having a running fit with the inner walls of the housing, oppositely disposed cylinders in the shoe, restricted passages in the shoe communicating with the inner ends of the cylinders and open through the adjacent sides of the shoe, adjustable valves controlling said restricted passages, a piston in each cylinder extending outwardly into the path of the vane, there being a central bore in each piston restricted at its outer end, check valves in said bores normally closing the restricted outer ends thereof, and a port in the housing on each side of the shoe for alternately admitting fluid to the housing through one port and discharging fluid from the housing through the other port.

4. A hydraulic motor comprising a cylindric housing, a shaft located axially through the housing and journaled therein, a shoe fixed in the housing and having a running fit with the shaft, a vane fixed upon the shaft and having a running fit with the inner walls of the housing, oppo-

sitely disposed cylinders in the shoe, restricted passages in the shoe communicating with the inner ends of the cylinders and open through the adjacent sides of the shoe, needle valves controlling said restricted passages, a piston in each cylinder extending outwardly into the path of the vane, there being a central bore in each piston restricted at its outer end, check valves in said bores normally closing the restricted outer ends thereof, and a port in the housing on each side of the shoe for alternately admitting fluid to the housing through one port and discharging fluid from the housing through the other port.

5. A hydraulic motor comprising a cylindric housing, a shaft located axially through the housing and journaled therein, a shoe fixed in the housing and having a running fit with the shaft, a vane fixed upon the shaft and having a running fit with the inner walls of the housing, oppositely disposed cylinders in the shoe, restricted passages in the shoe communicating with the inner ends of the cylinders and open through the adjacent sides of the shoe, a piston in each cylinder extending outwardly into the path of the vane, there being a central bore in each piston restricted at its outer end, spring-loaded ball valves in said bores normally closing the restricted outer ends thereof, and a port in the housing on each side of the shoe for alternately admitting fluid to the housing through one port and discharging fluid from the housing through the other port.

6. A hydraulic motor comprising a cylindric housing, a shaft located axially through the housing and journaled therein, a shoe fixed in the housing and having a running fit with the shaft, a vane fixed upon the shaft and having a running fit with the inner walls of the housing, oppositely disposed cylinders in the shoe, restricted passages in the shoe communicating with the inner ends of the cylinders and open through the adjacent sides of the shoe, needle valves controlling said restricted passages, a piston in each cylinder extending outwardly into the path of the vane, there being a central bore in each piston restricted at its outer end, spring-loaded ball valves in said bores normally closing the restricted outer ends thereof, projections upon opposite sides of the vane for contact with the outer ends of said pistons, and a port in the housing on each side of the shoe for alternately admitting fluid to the housing through one port and discharging fluid from the housing through the other port.

References Cited in the file of this patent

UNITED STATES PATENTS

188,752	Pasquale et al. -----	Mar. 27, 1877
514,295	Wennberg -----	Feb. 6, 1894
937,060	Fawkes -----	Oct. 19, 1909
1,566,355	Sunnes -----	Dec. 22, 1925
1,974,775	Gorsuch et al. -----	Sept. 25, 1934
2,339,042	Anderson -----	Jan. 11, 1944
2,420,040	Frisby et al. -----	May 6, 1947
2,465,761	Staudé -----	Mar. 29, 1949
2,540,903	Mousney et al. -----	Feb. 6, 1951
2,588,183	Kosatka -----	June 26, 1951
2,633,105	Lasater -----	Mar. 31, 1953
2,701,448	Johnson -----	Feb. 8, 1955

FOREIGN PATENTS

152,565	Great Britain -----	Oct. 21, 1920
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