Oct. 26, 1965 A. G. MELLINGER 3,213,759

HYDRAULIC POWER UNIT

Filed March 29, 1963 4 Sheets-Sheet 1

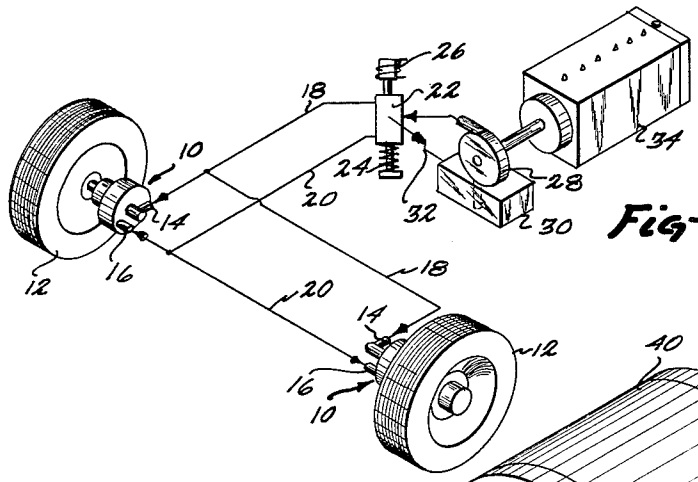
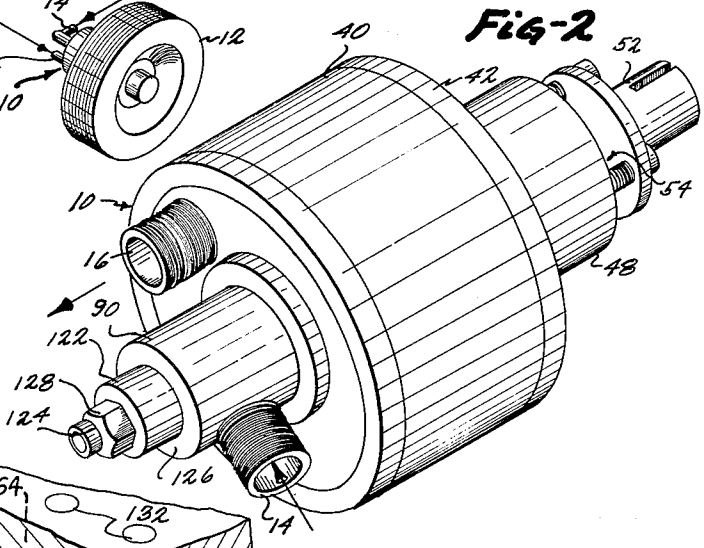


Fig-1

Fig-2



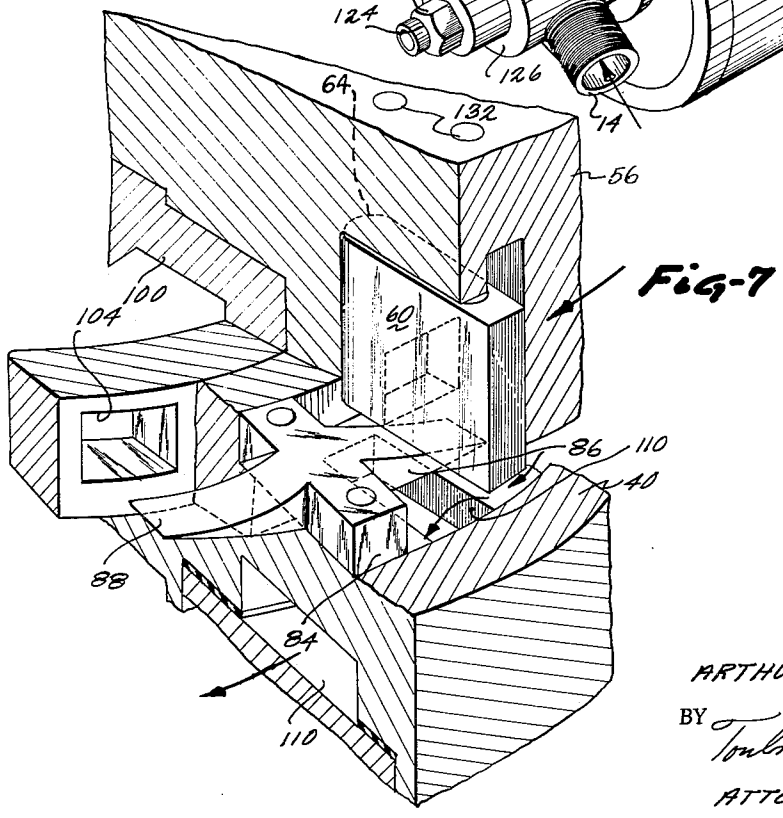


Fig-7

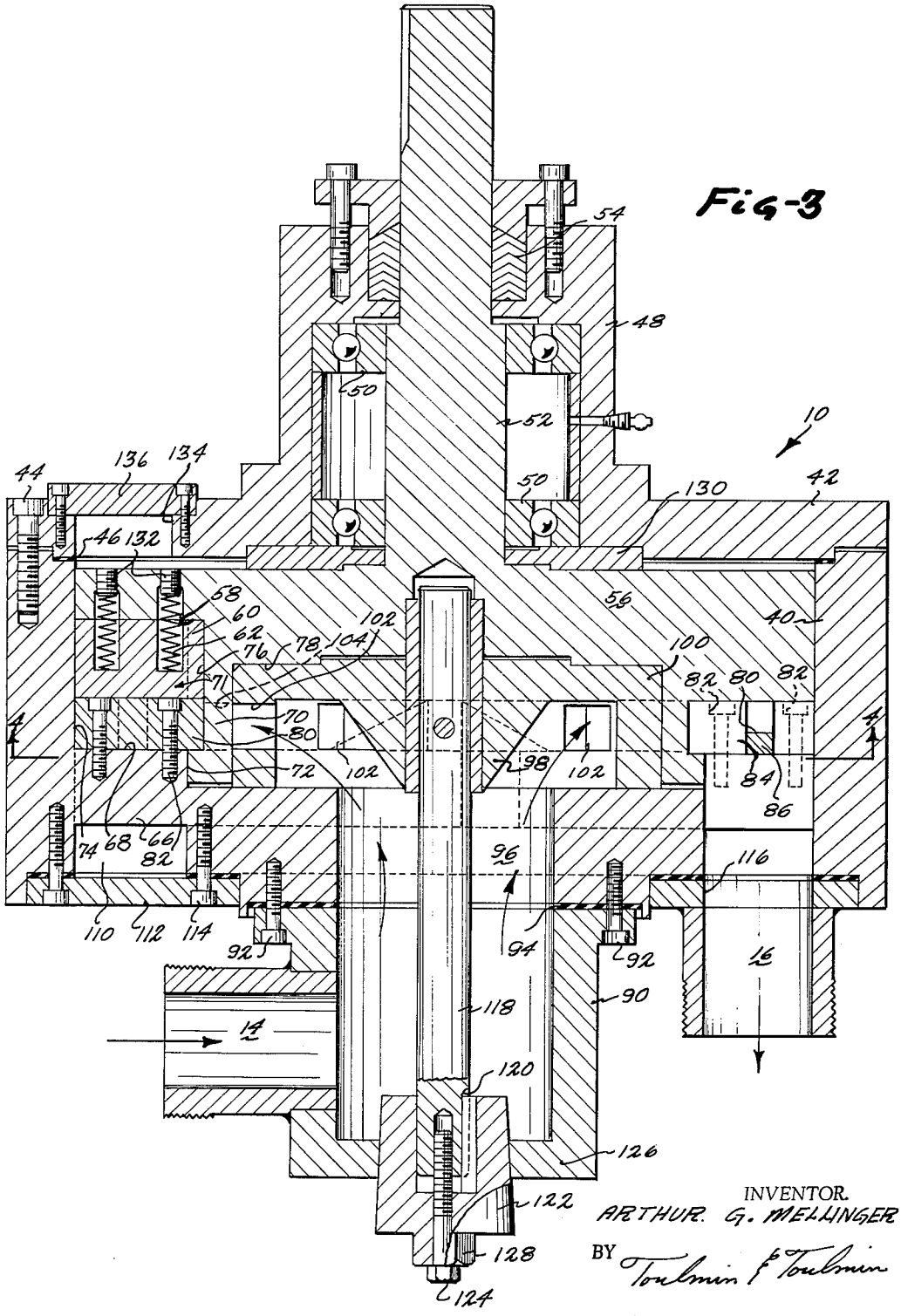
INVENTOR.
ARTHUR G. MELLINGER
BY Toulmin & Toulmin
ATTORNEYS

Oct. 26, 1965 A. G. MELLINGER 3,213,759

HYDRAULIC POWER UNIT

Filed March 29, 1963 4 Sheets-Sheet 2

Fig-3



INVENTOR.
ARTHUR G. MELLINGER
BY Toulmin & Toulmin
ATTORNEYS

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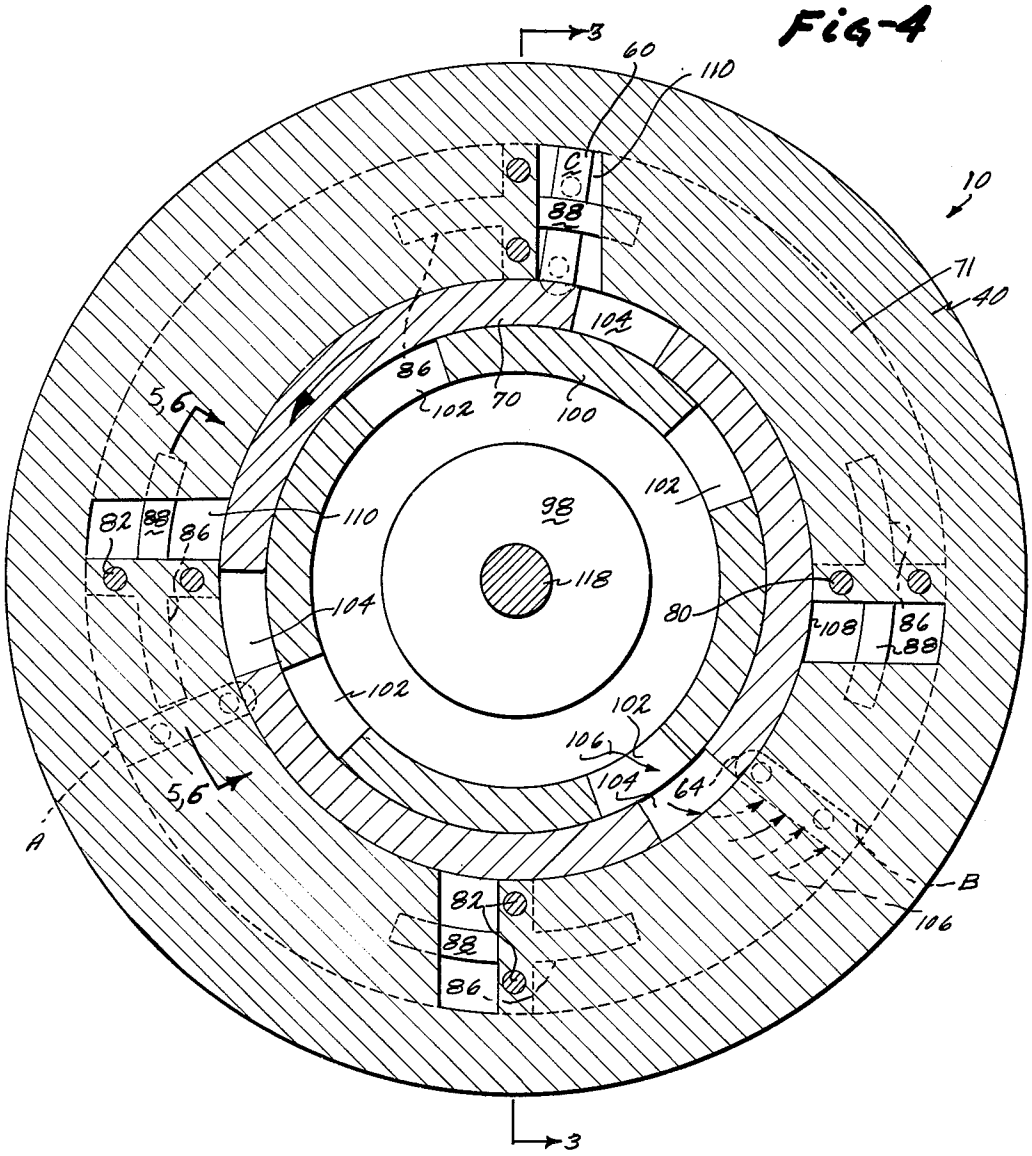
HYDRAULIC POWER UNIT

Filed March 29, 1963 4 Sheets-Sheet 3

Fig-4



INVENTOR.
ARTHUR G. MELLINGER
BY Toulmin & Toulmin
ATTORNEYS

Oct. 26, 1965 A. G. MELLINGER 3,213,759

HYDRAULIC POWER UNIT

Filed March 29, 1963 4 Sheets-Sheet 4

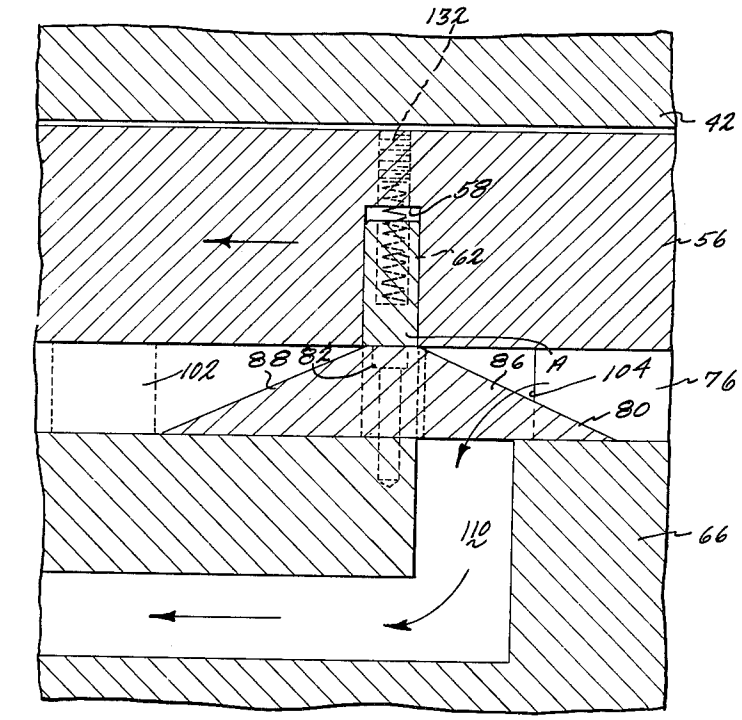


Fig-5

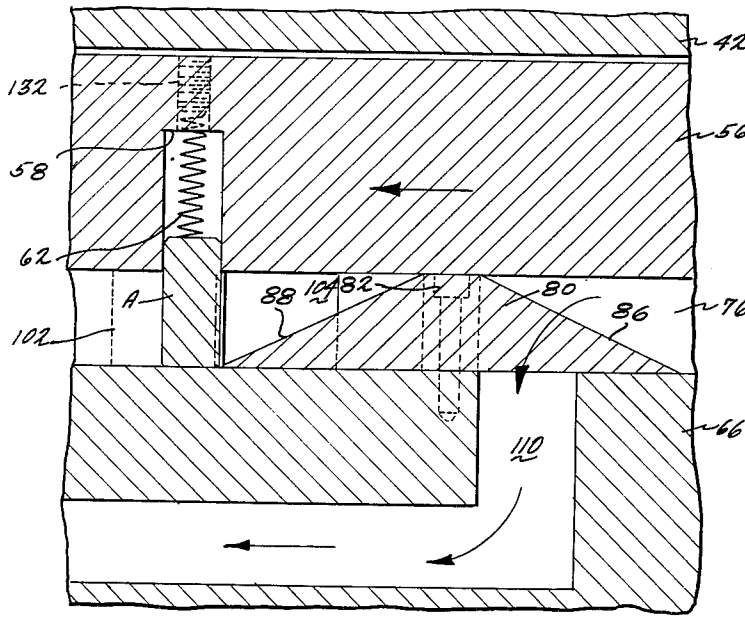


Fig-6

INVENTOR.
ARTHUR G. MELLINGER
BY
Toulmin & Toulmin
ATTORNEYS

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3,213,759

HYDRAULIC POWER UNIT

Arthur G. Mellinger, Lancaster, Pa., assignor to Arthur G. Mellinger, Inc., Lancaster, Pa., a corporation of Pennsylvania

Filed Mar. 29, 1963, Ser. No. 268,891
7 Claims. (Cl. 91—126)

This invention relates to rotating hydraulic apparatus and is particularly concerned with a rotary hydraulic unit especially adaptable for use as a motor. More particularly still, the present invention relates to a hydraulic motor arrangement particularly well adapted for driving a vehicle wheel.

Hydraulic motors are, of course, well known and take many forms, including piston type motors, gear motors and vane type motors. It is with a vane type motor that the present invention is particularly concerned.

A primary object of the present invention is the provision of a vane type hydraulic motor especially arranged and adapted for driving a load such as a vehicle wheel.

Another object of this invention is the provision of a novel type vane motor having both the inlet and outlet means on the same side of the motor and the output shaft extending from the other side of the motor.

Another object of this invention is the provision of a relatively simple vane motor construction.

Still another object of this invention is the provision of a reversible vane motor that will be substantially as efficient in one direction of rotation as in the other direction of rotation.

It is also an object of this invention to provide a vane motor in which relatively few vanes are employed but wherein there is a smooth and continuous delivery of power to the output shaft means of the motor.

These and other objects and advantages of this invention will become more apparent upon reference to the following specification taken in connection with the accompanying drawings in which:

FIGURE 1 is a more or less diagrammatic view showing the application of hydraulic motors according to my invention to a vehicle drive arrangement;

FIGURE 2 is a perspective view of an assembled motor;

FIGURE 3 is a longitudinal sectional view through the motor and is best indicated by line 3—3 on FIGURE 4;

FIGURE 4 is a transverse sectional view through the motor and is indicated by line 4—4 on FIGURE 3;

FIGURE 5 is a fragmentary sectional view indicated by line 5—5 on FIGURE 4 and shows a vane of the motor passing over a divider member that separates the pressure chambers of the motor from the exhaust chamber thereof;

FIGURE 6 is a view like FIGURE 5 and is indicated by the same section line but shows the vane after it has passed over the divider member and immediately prior to the opening of the pressure port into the region behind the vane; and,

FIGURE 7 is a perspective view showing a vane of the motor as it is commencing to move up the approach incline of the aforementioned divider member.

Referring now to the drawings somewhat more in detail, the motor of the present invention is generally indicated at **10** in FIGURES 1 and 2. In FIGURE 1 each motor **10** is connected for driving a vehicle wheel **12**. Each motor has a pair of ports of which port **14** can be designated the input port and port **16** can be designated the output port although it will be understood that for reversible operation of the motors, the function of these ports would also be reversible.

Conduit **18** leads to the input ports and conduit **20** leads to the output or exhaust ports and these conduits are connected to the service ports of a four-way reversing valve **22** which may be biased in one direction by spring **24** and moved in the other direction by a solenoid **26**. A pump **28** has its outlet connected with the inlet port of valve **22** while the suction side of the pump is connected to reservoir **30** to which reservoir the exhaust conduit **32** of valve **22** also leads.

Engine **34** drives pump **28** for supplying pressure fluid to valve **22** and therefrom to the motors **10**.

Each motor is constructed as will be seen in FIGURES 3 through 7 and wherein it will be observed that the motor comprises an outer ring-like casing part **40** on one side of which is mounted a relatively heavy cover plate **42** retained in position by cap screws **44** and sealed to casing **40** by gasket means **46**.

Cover plate **42** has a central hub portion **48** in which are mounted the antifriction bearings **50** that rotatably support the motor output shaft **52**. Outwardly of bearings **50** hub **48** includes sealings means **54** for sealing against leakage around shaft **52**.

Shaft **52** is affixed to or may be made integral with a rotor member **56** located inside casing part **40** and fitting closely within the casing. Rotor part **56** has circumferentially spaced slots **58** in an annular face in which are located the vanes **60** that are axially movable in the slots and which are biased in a direction axially outwardly of the slots by the springs **62**.

The vanes **60** at their radially outer edges slidably engage the inside of casing member **40** and at their radially inner edges vanes **60** are preferably rounded as indicated at **64** in FIGURES 4 and 7 and these rounded ends of the vanes are received in rounded grooves at the radially inner sides of the vane slots.

The casing part **40** comprises a radially inwardly extending part **66** that extends inwardly to the radially inner ends of the vanes and forms a flat annular surface **68** directly opposed to the axially outer edges of vanes **60**.

The rotor **56** on the other hand has an axially extending skirt portion **70** extending axially beyond the axially outer ends of the vanes and on down past the aforementioned surface **68** so as to be in telescopic relation with portion **66** of the casing, the said telescoping of the two parts being identified by reference numerals **72**. At this point it will be seen that the casing **40** and the inwardly extending portion **66** thereof and the rotor **56** together with its axially extending portion **70** thereof define a closed annular path **71** through which the vanes **60** sweep as the rotor turns within the casing.

The aforementioned space **71** is confined at its outer periphery by the inner wall **74** of the casing and at its inner periphery is confined by the outer wall **76** of the projection **70** of the rotor. The axially outer surface of this space is confined by the annular surface **68** of the projection **66** of casing **40** while at the other side the space is confined by the annular surface **58** of the rotor. This space is rectangular in cross section.

As will be seen in drawings and particularly in FIGURE 4, the space **71** through which the vanes sweep is interrupted at circumferentially spaced points by cam members **80** that are secured to portions **66** of casing **40** by cap screws **82**. Each of these cam members comprise a central radially extending bar-like portion **84** which extends from side to side and top to bottom of the space **71** so that the said bar-like portion of each cam member forms a dividing element in space **71** that prevents fluid movement past the cam members.

Each cam member is also provided with an incline **86** on one side and an incline **88** on the other side which form approach and exit ramps for lifting and lowering

the vanes as they move across the cam members. Each cam member could, of course, have at least the exit ramps thereof extending the full width of the space through which the vanes sweep but I have found it practical to form these cam members as illustrated in the drawings.

The fluid supply to the vanes when the motor is running in the normally forward direction is accomplished by supplying pressure fluid to the inlet **14**. Inlet **14** opens into the interior of a hollow hub member **90** mounted on the casing **40** on the side thereof opposite output shaft **52**. Inlet hub member **90** is held in place by cap screws **92** and is sealed to the casing by a gasket **94**. The interior of the hub member **90** communicates with an opening **96** in the middle of the adjacent wall of casing **40** and this opening leads to the interior of a cylindrical valve member **98**.

Valve member **98** is stationarily mounted within the motor and comprises a peripheral cylindrical valve part or sleeve **100** that slidingly fits inside cylindrical projection **70** of the rotor.

As will be seen in FIGURE 4, valve portion **100** is provided with spaced radial ports **102** for admitting fluid to the vanes of the motor. Ports **102** cooperate with ports **104** formed in cylindrical portion **70** of the rotor.

As will be seen in FIGURE 4 there are four of the cam members **80** while there are three of the vanes **60**. There is a port **102** for each of the cam members, namely four ports **102**; while there is one of ports **104** for each of the vanes **60**, namely, three of the ports **104**.

The ports **104** are located immediately behind their pertaining vanes when the motor is turning in its normally forward direction and the effect that will be had with regard to the supply of pressure to the vanes will be seen in FIGURE 4.

With respect to the vane at the left side, marked "A," this vane has just finished its movement down the exit ramp of the pertaining cam member so that the space between vane "A" and the cam member immediately behind is now ready to receive pressure fluid for driving the vane in the direction of the arrow in FIGURE 4 which indicates normal forward rotation of the motor.

It will be seen that the ports **102** and **104** pertaining to vane "A" are at the point of opening so that there will be a supply of pressure fluid to the region behind vane "A" which will drive it in the direction of the arrow.

The position which vane "A" will occupy after a predetermined amount of movement is represented by vane "B" which is about intermediate its movement between two cam members and it will be observed that the ports **102** and **104** pertaining to vane "B" are in free communication and there is thus a supply of pressure fluid into the space behind vane "B" as indicated by arrow **106**.

As a vane approaches the approach ramp of a cam member the ports **102** and **104** pertaining thereto will gradually close off their communication and communication therebetween will be interrupted at about the time the vane reaches the said approach ramp.

The conditions that obtain when a vane is moving up the approach ramp will be seen in connection with vane "C" in FIGURE 4 wherein it will be observed that the ports **102** and **104** pertaining to vane "C" are completely out of communication with each other.

It is, of course, understood that each vane in moving from cam member to the next will sweep oil out of the space **71** in front of the vane and this oil leaves the motor through the exhaust ports **108** provided on the leading side of each cam member and leading into annular space **110** which will be best seen in FIGURE 3.

Annular space **110** is closed by an annular cover plate **112** held in place by cap screws **114**. This annular cover plate has an aperture **116** that communicates with outlet port **16** that is carried by the annular member.

The valve member **98** is adjustable angularly within the motor for adjusting the valving conditions by mounting the valve member on a shaft **118** that extends through the inlet hub **90**.

This shaft is keyed by key **120** to tapered plug member **122**. A screw **124** connects the plug member to the shaft. Tightening of screw **124** will pull the plug member into tapered seat **126** provided therefor in hub **90** whereas, by loosening screw **124**, the wrench portion **128** of plug **122** can be availed of for turning the plug thereby to adjust valve member **98** angularly.

Inasmuch as there is a substantial amount of axial thrust on rotor **56** on account of the pressure fluid standing on only one side thereof, the rotor arrangement preferably includes an annular thrust bearing **130** disposed between the rotor and cover plate **42**.

Bearing sleeves and the like could be provided elsewhere between rotating parts of the motor if desired and seal rings and the like could also be provided between relatively movable parts of the motor if desired or necessary.

The aforementioned springs **62** are arranged so as to be removable or adjustable in rotor **56** by having the bottom ends of the holes therefor in the rotor closed by the set screws **132**. These set screws are accessible through a hole **134** in cover plate **42** which holes can be sealingly closed by a plate **136**. By turning the rotor the screws **132** for the several vanes can be made accessible.

While the rotor has been illustrated as having three vanes and four cam members it will be understood that there could be a greater number of cam members and vanes if so desired. It is preferred for the cam members to always be one more than the vanes because this provides for making the vanes successively effective and provides for a smooth and uniform flow of power to the output shaft of the motor and likewise contributes to a relatively steady flow of fluid to and from the motor ports.

It will be appreciated that, while a certain direction of rotation has been indicated for the motor as a normally forward direction of rotation, in practice the motor is reversible and efficient operating conditions in both directions of rotation will be had.

It will further be appreciated that the arrangement of both of the ports for the motor in one end thereof and with the output shaft extending from the other end, adapts the motor extremely well to the work of driving vehicle wheels and the like or for installations where it might be desired to insert the motor in a cavity or to mount it in a wall member or in any other place where limited access would be had to the peripheral portion of the motor casing.

It will be understood that this invention is susceptible to modification in order to adapt it to different usages and conditions; and accordingly, it is desired to comprehend such modifications within this invention as may fall within the scope of the appended claims.

I claim:

1. In a rotary hydraulic device; a stator having a cylindrical cavity therein, a rotor rotatable in said cavity and defining with said stator an annular space, on one side of said rotor, vanes axially slidably mounted in said rotor for sweeping through said space as the rotor rotates, partition members carried by the stator in said space dividing said space into a plurality of chambers and each partition member having inclined ramp means on opposite sides for guiding the vanes over the partition members, a first port in the stator on one side of each partition member, a second port in the stator intermediate each two adjacent members, and third ports carried by the rotor opening into said space immediately adjacent each vane and adapted for registration with said second ports as the rotor rotates, said first, second and third ports being located in said device on the same said one side of said rotor.

2. In a rotary hydraulic device; a stator having a cylindrical cavity therein, a rotor rotatable in said cavity and defining with said stator an annular space rectangular in cross section on one side of said rotor, axially slidable vanes carried by said rotor for sweeping through said

space as the rotor rotates, circumferentially spaced partition members carried by the stator dividing said space into a plurality of chambers and each partition member having inclined ramps on opposite sides thereof for guiding the vanes over the partition members, first ports in said stator opening into said space immediately adjacent said partition members on one side thereof, second ports in said stator intermediate said partition members, a sleeve portion on said rotor positioned between said space and said second ports, and third ports in said sleeve member immediately adjacent said vanes and arranged for registration with said second ports as the rotor rotates in said cavity, said first and second ports being adapted for connection to hydraulic pressure and exhaust lines for the supply and discharge of hydraulic fluid to and from said device, said first, second and third ports being located in said device on the same said one side of said rotor.

3. In a rotary hydraulic device; a stator having a cylindrical cavity therein, a rotor rotatable in said cavity and fitted therein to define with the stator an annular space rectangular in cross section and located on one side of said rotor, axially slidable vanes carried by the rotor for sweeping through said space as the rotor rotates, circumferentially spaced partition members carried by the stator and dividing said space into a plurality of chambers and each partition member having inclined ramps on opposite sides thereof for guiding the vanes over the partition members, a first port in the stator leading into said space on one side of each partition member, a second port in said stator located intermediate each adjacent pair of partition members, a skirt portion on said rotor disposed between said second ports and said space, and a third port in said skirt portion immediately adjacent each said vane and operable for successively connecting said second ports with said space via said third ports as the rotor rotates in said cavity, said vanes being uniformly circumferentially spaced about said rotor and number of vanes exceeding the number of partition members by one, said first, second and third ports being located in said device on the same said one side of said rotor.

4. In a rotary hydraulic device; a stator having a cylindrical cavity therein, a rotor rotatable in said cavity and fitted therein to define with the stator an annular space rectangular in cross section and located on one side of said rotor, axially slidable vanes carried by the rotor for sweeping through said space as the rotor rotates, circumferentially spaced partition members carried by the stator and dividing said space into a plurality of chambers and each partition member having inclined ramps on opposite sides thereof for guiding the vanes over the partition members, a first port in the stator leading into said space on one side of each partition member, a second port in said stator located intermediate each adjacent pair of partition members, a skirt portion on said rotor disposed between said second portion immediately adjacent each said vane and operable for successively connecting said second ports with said space via said third ports as the rotor rotates in said cavity, said rotor being axially slotted for receiving said vanes, the radially inner edges of said vanes being rounded, spring means carried by the rotor urging the vanes in the axial direction of the rotor in the direction of the said space, and rounded grooves in the rotor receiving the rounded ends of said vanes, said first, second and third ports being located in said device on the same said one side of said rotor.

5. In a rotary hydraulic device; a stator having a cylindrical cavity therein, a rotor rotatable in said cavity and fitted therein to define with the stator an annular space rectangular in cross section and located on one side of said rotor, axially slidable vanes carried by the rotor for sweeping through said space as the rotor rotates, circumferentially spaced partition members lying in a common plane and carried by the stator and dividing said space into a plurality of chambers and each partition member having inclined ramps on opposite sides thereof for guiding the vanes over the partition members, a first port in the stator leading into said space on one side of each partition member, a second port in said stator located intermediate each adjacent pair of partition members, a skirt portion on said rotor disposed between said second ports and said space, and a third port in said skirt portion immediately adjacent each said vane and operable for successively connecting said second ports with said space via said third ports as the rotor rotates in said cavity, a valve member carried by the stator and including a cylindrical portion and engaging the said skirt portion of the said rotor on the side thereof opposite said space, said cylindrical portion of said valve member having the said second ports formed therein, and means for supplying fluid to the interior of said valve member, said valve member being angularly adjustable with respect to said stator, said first, second and third ports being located in said device on the same said one side of said rotor.

6. In a rotary hydraulic device; a stator having a cylindrical cavity therein, a rotor rotatable in said cavity and fitted therein to define with the stator an annular space rectangular in cross section and located on one side of said rotor, axially slidable vanes carried by the rotor for sweeping through said space as the rotor rotates, circumferentially spaced partition members lying in a common plane and carried by the stator and dividing said space into a plurality of chambers and each partition member having inclined ramps on opposite sides thereof for guiding the vanes over the partition members, a first port in the stator leading into said space on one side of each partition member, a second port in said stator located intermediate each adjacent pair of partition members, a skirt portion on said rotor disposed between said second ports and said space, and a third port in said skirt portion immediately adjacent each said vane and operable for successively connecting said second ports with said space via said third ports as the rotor rotates in said cavity, an annular chamber in the stator with which said first ports communicate, a fluid connection leading to said annular chamber, a cylindrical valve sleeve inside said skirt portion of said rotor connected with said stator and in which said second ports are formed, a hollow hub on said stator communicating with the inside of said valve sleeve, a fluid connection leading into said hub, said valve sleeve being angularly adjustable relative to said stator, and a drive shaft connected to said rotor and extending out the stator on the other side thereof.

7. In a rotary hydraulic device, a stator having a cylindrical cavity therein, a rotor rotatable in said cavity and fitted therein to define with said stator an annular space on one side of said rotor, said rotor having an annular face and a skirt depending from the top and the inner side wall of said space, said stator forming the outer side wall and the bottom of said space, said rotor having a plurality of circumferentially equally spaced slots in said annular face, axially slidable vanes carried by said rotor in said slots and biased towards the bottom of said space, circumferentially spaced partition members lying in a common plane and secured to said stator at the bottom of said space and dividing said space into a plurality of chambers with each partition member having inclined ramps on opposed sides thereof for guiding the vanes over the partition members, said stator having a first port leading into said space on one side of each partition member, a sleeve shaped valve member slidingly fitted within the skirt of said rotor and augularly adjustably secured to said stator, said valve member having spaced radial second ports therein located intermediate each adjacent pair of said partition members, said skirt on said rotor having a third port immediately adjacent each said vane and operable for successively connecting said second ports with said annular space via said third ports as the rotor rotates in said cavity, the top and bottom of said annular

space lying in spaced parallel planes, conduit means for supplying fluid to the interior of said valve member, and a drive shaft connected to said rotor extending out of said stator, said conduit means and said first port means being located in said stator on the same side of said rotor which is also opposite to the side of the rotor having the driving shaft extending therefrom.

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KARL J. ALBRECHT, *Primary Examiner.*

JOSEPH H. BRANSON, JR., *Examiner.*