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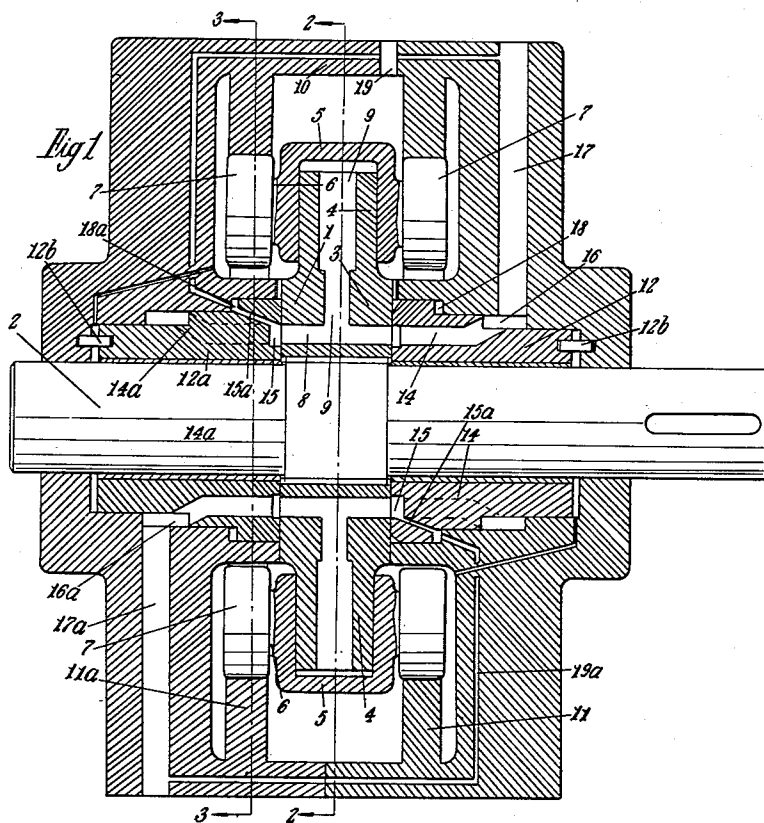
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MULTI-CYLINDER HYDRAULIC MOTORS

Filed March 8, 1963

3 Sheets-Sheet 1



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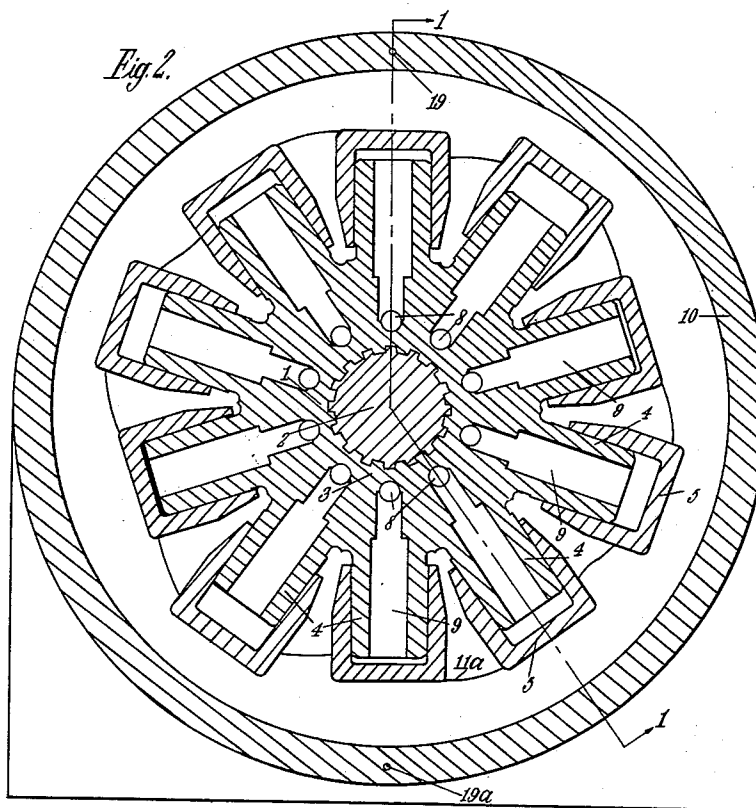
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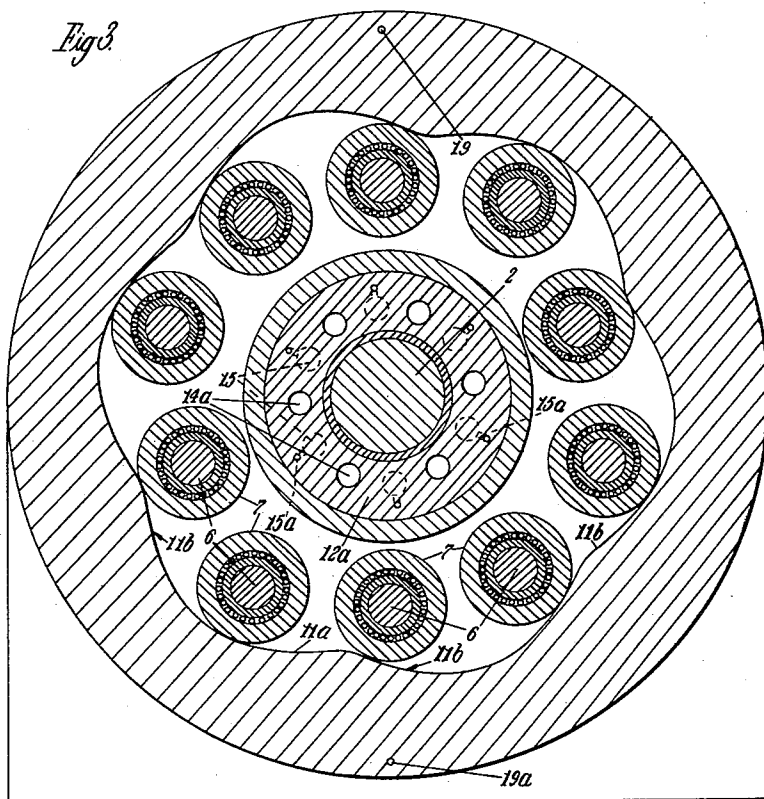
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MULTI-CYLINDER HYDRAULIC MOTORS

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1 Claim. (Cl. 91—205)

This invention has reference to multi-cylinder hydraulic motors having pairs of radially extending piston and cylinder assemblies mounted on a supporting member and carrying rollers, an outer casing having at least one cam ring with which the rollers co-operate and valve means whereby pressure fluid is admitted to and exhausted from the assemblies to cause reciprocation of the rollers and thereby relative rotation of the assemblies and casing. In such motors the assemblies may constitute the rotor and the casing the stator, or the casing may constitute the rotor and the assemblies the stator.

The present invention has for its object to provide an improved construction of hydraulic motor of this kind in which an effective seal between the rotor and stator is maintained to prevent or minimize leakage without diminishing the efficiency of the motor.

According to the present invention a multi-cylinder hydraulic motor comprises an inner member mounted on a shaft, a plurality of pairs of diametrically opposite piston and cylinder assemblies and rollers carried by said assemblies, said member having a series of axially extending through passages each of which is in communication with the interior of an assembly, a casing enclosing the central member and assemblies, at least one cam ring carried by the casing and with which the rollers co-operate, two opposed axially slidable valve members in the form of sleeves encircling the shaft and bearing on the inner member, one of said valve members constituting an inlet valve and the other an exhaust valve, said valve members being non-rotatable with respect to the casing and each having a series of ducts and intermediate balance pockets, the through passages in the inner member registering alternately with the ducts in the inlet and exhaust valve member, an annulus formed by opposed faces of each valve member and casing, one of such annuli being connected to a fluid supply and the other to the fluid exhaust, a further annulus likewise formed by opposed faces of each valve member and casing and connected to the adjacent series of balance pockets, the said faces of the four annuli having the same area, and passages by which the second mentioned annulus of the exhaust valve member is connected to the high pressure side of the motor and the corresponding annulus of the inlet valve member is connected to the exhaust side of the motor, the arrangement and construction being such that the pressure fluid supplied to the motor is admitted to and exhausted from the assemblies under the control of the two valve members and the rollers reciprocated to cause relative rotation of the inner member and casing and the two valve members are equally and oppositely biased by fluid pressure to bear on the outer sides of the inner member, the biasing being proportional to the summation of the fluid inlet and exhaust pressure.

A preferred embodiment of the invention will now be described with reference to the accompanying drawings wherein:

FIGURE 1 is a sectional elevation of the improved hydraulic motor, the section being on the line 1—1 of FIGURE 2;

FIGURE 2 is a section on the line 2—2 of FIGURE 1; and

FIGURE 3 is a section on the line 3—3 of FIGURE 1.

As shown in the drawings the improved hydraulic motor is provided with a rotor in the form of a yoke ring 1 fast

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on the driven shaft 2. The yoke ring 1 consists of a hub 3 from which projects radially a number of pairs of diametrically aligned pistons 4. On each piston is a relatively radially slidable cylinder 5 carrying trunnions 6 on which are mounted rollers 7, one on each side of each cylinder. The hub is provided with a series of axial through passages 8 extending from end to end thereof and from the passages 8 extend radial passages 9, each radial passage extending through a piston and communicating with the interior of the cylinder thereon.

The rotor is mounted within a casing 10 which constitutes the stator and which supports the shaft 2. The casing incorporates at twin cam track 11 and 11a having humps 11b with which said rollers co-operate to cause rotation of the rotor when the cylinders reciprocate. Fitted within the casing and encircling the shaft are two valve members 12 and 12a in the form of sleeves. The valve members are secured to the casing by dowels 12b so that they cannot rotate but are capable of relative axial movement. The inner end of each valve member makes sliding contact with the opposed face of the hub 3. The valve members 12 and 12a are provided with a series of ducts 14 and 14a respectively which terminate at the hub and also an intermediate series of balance pockets 15 of the same cross sectional area as the said ducts where they abut against the hub. The number of said ducts in each valve member corresponds with the number of humps on each track. The ducts 14 communicate at their outer ends with an annulus 16 which in turn is in communication with a passage 17 which may be a pressure fluid inlet or exhaust passage.

The ducts 14a at their outer ends communicate with an annulus 16a which in turn communicates with a passage 17a which may be an exhaust passage or pressure fluid inlet.

Each annulus is formed by stepping the valve member and the side of the casing into which it is fitted. The valve members 12 and 12a and the casing are further stepped to form two annuli 18 and 18a respectively which in turn communicate with the balance ports 15 at the same side of the rotor by short passages 15a provided in the valve members.

The annuli 18 and 18a are connected by ducts 19 and 19a with the passages 17 and 17a respectively. The sides of the four annuli formed by the stepped faces of the valve members have all the same area.

The pistons are diametrically opposed to achieve radial balance, the pistons of each pair making their working strokes simultaneously.

Further the humps on the tracks are also diametrically opposed. The motor therefore must have an even number of pistons and an even number of humps on the tracks.

Suitable numbers of pistons and humps are as follows—

Number of Humps:	Number of pistons
2	6 or 10 or 14
4	6 or 10 or 14
6	10 or 14
8	10 or 14

For size and economy of manufacture the preferred choice from the above is 6 humps with 10 pistons.

Assume that pressure fluid is supplied to the passage 17 communicating with the distributing annulus 16 at the right of the rotor as viewed in FIGURE 1. The pressure fluid passes through the ducts 14 in the adjacent valve member 12 and into the through passages 8 in the rotor which are in register therewith more or less. The pressure fluid then passes through the radial passages 9 which are in communication with such passages 8 to force the pistons outwards. The co-operation of the rollers carried by such pistons with the humps of the tracks results in

the rotation of the rotor. As rotation continues the cylinders which have been forced outwards now commence to travel radially inwards, the aforesaid through passages 8 to which pressure fluid was supplied now no longer registering with the ducts 14 in the valve member 12 to which the pressure fluid is supplied but registering with the ducts 14a in the other valve member 12a so that the spent fluid returns through said ducts, the annulus 16a connected thereto and the exhaust passage 17a in the casing.

It will be understood that each passage 8 registers alternately with a duct 14 in the valve member 12 and with a duct 14a in the valve member 12a. The fluid pressure is transmitted from the passage 17 through the ducts 19 to the annulus 18a and from there through short ducts 15a to the balance pockets 15 formed in the valve member 12a.

The pressure of the spent fluid is transmitted through ducts 19a to the annulus 18 and to the balance pocket 15 provided in the valve member 12.

It will be appreciated that the pressure fluid transmitted to the passages 8 creates a separating force acting on the valve member 12 tending to separate it from the adjacent face of the hub. Further the separating force varies as the passages 8 are covered and uncovered by the valve members 12 during the rotation of the rotor.

A separating force is also applied to the valve member 12a by reason of the balance pockets 15 in said member being covered and uncovered in synchronism with the covering and uncovering of the ducts 14. The pressure fluid in the ducts 14 also acts on the face of the hub adjacent thereto, the area of the face submitted thereto varying as the rotor rotates. An exactly similar separating force acts on the valve members 12a due to the pressure transmitted to the balance pockets therein. The two valve members are thereby submitted to forces tending to force them from the hub, the forces being equal and proportional to the pressure of the fluid supplied to the motor.

The force tending to separate the valve member 12 from the hub is more than counteracted by the pressure fluid in the annulus 16, said fluid acting on the stepped face of this valve member forming said annulus.

The pressure fluid in annulus 18a acts on the stepped face of valve member 12a forming said annulus. As said stepped faces have the same area the said forces forcing the valve members on the hub are equal and opposite.

As the rotor rotates each cylinder 5 in turn is forced radially inwardly by the co-operation of its rollers with the cam tracks and the fluid therein is forced through the passages 9 and 8 to the ducts 14a in valve member 12a. Said fluid then passes to annulus 16a and through the exhaust duct 17a. As each duct 14a is covered and uncovered the fluid exerts a separating force on the said valve member. A similar but opposite separating force exists in the balance pockets of the valve member 12, but the fluid in annulus 16a acts on the stepped face of valve member 12a to force said member against the hub. The same fluid transmits pressure through ducts 19a to annulus 18 and exerts pressure on the stepped face of valve member 12 forming said annulus. As the said two stepped faces have the same area the exhaust fluid exerts equal and opposite forces on the two valve members to hold them against the hub, the forces being proportional to the exhaust pressure.

Thus the two valve members are held against the hub

by equal and opposite forces which are proportional to the summation of the pressure of the hydraulic fluid supplied to the motor and the pressure of the fluid exhausted therefrom.

The operation of the motor has been described on the assumption that the pressure fluid is supplied to the passage 17 but it will be understood that the pressure fluid could be supplied through the passage 17a, the direction of rotation of the rotor being then reversed. By providing means whereby the pressure fluid can be supplied selectively to either of said passages the motor is reversible.

In a modification of the hydraulic motor as above described the shaft is non-rotatable and constitutes the stator while the casing is rotated and constitutes the rotor. In such arrangement the inlet and outlet passages for the hydraulic fluid are located within the shaft.

What I claim is:

A multi-cylinder hydraulic motor comprising an inner member mounted on a shaft, a plurality of pairs of diametrically opposite piston and cylinder assemblies and rollers carried by said assemblies, said member having a series of axially extending through passages each of which is in communication with the interior of an assembly, a casing enclosing the inner member and assemblies, at least one cam ring carried by the casing and with which the rollers co-operate, two opposed axially slidable valve members in the form of sleeves encircling the shaft and bearing on the inner member, one of said valve members constituting an inlet valve and the other an exhaust valve, said valve members being non-rotatable with respect to the casing and each having a series of ducts and intermediate balance pockets, the through passages in the inner member registering alternately with the ducts in the inlet and exhaust valve members, an annulus formed by opposed faces of each valve member and casing, one of such annuli being connected to a fluid supply and the other to the fluid exhaust, a further annulus likewise formed by opposed faces of each valve member and casing and connected to the adjacent series of balance pockets, the said faces of the four annuli having the same area, and passages by which the second mentioned annulus of the exhaust valve member is connected to the high pressure side of the motor and the corresponding annulus of the inlet valve member is connected to the exhaust side of the motor, the arrangement and construction being such that the pressure fluid supplied to the motor is admitted to and exhausted from the assemblies under the control of the two valve members and the rollers reciprocated to cause relative rotation of the inner member and casing and the two valve members are equally and oppositely biased by fluid pressure to bear on the outer sides of the inner member, the biasing being proportional to the summation of the fluid inlet and exhaust pressure.

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