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(54) **PISTON PUMP AND PISTON PUMP AND MOTOR ASSEMBLY.**

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(73) Proprietor: **NASCIMENTO PACHECO, José, Mauricio**
**Rua Panorama, No 33**
**13050-Campinas, SP (BR)**

Proprietor: **NASCIMENTO PACHECO, Claudio**
**Rua Cel. Silva Teles, No 276**
**6. andar**
**13023-Campinas, SP (BR)**

(72) Inventor: **NASCIMENTO PACHECO, José, Mauricio**
**Rua Panorama, No 33**
**13050-Campinas, SP (BR)**
Inventor: **NASCIMENTO PACHECO, Claudio**
**Rua Cel. Silva Teles, No 276**
**6. andar**
**13023-Campinas, SP (BR)**

(74) Representative: **Everitt, Christopher James Wilders et al**
**F.J. CLEVELAND & COMPANY**
**40/43 Chancery Lane**
**London WC2A 1JO (GB)**



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## Description

### BACKGROUND OF THE INVENTION

#### Field of the Invention

The present invention relates to hydraulic systems and, more specifically, to a piston pump and to a piston pump motor assembly particularly suitable to be used in the driving of working units.

#### Prior Art

Several types and models of hydraulic pumps are widely known from the state of the art, which are used in any and all types of hydraulic systems.

Generally speaking, the pumps can be defined as being one of the basic elements of the hydraulic systems, together with valves, motors, connections, tubings and others, and their main objective is to convert electrical, mechanical or even hydraulic energy received from a motor into dynamic hydraulic energy.

The hydraulic pumps presently known can be divided or classified in five main types or groups, according to its operative principle, namely reciprocating pumps, gear pumps, blade pumps, piston pumps and centrifugal pumps.

The reciprocating or alternating movement hydraulic pumps have a major disadvantage in that the same do not produce a continuous flow of hydraulic energy, which prevents their utilization in hydraulic systems where a continuous flow is needed.

The gear type hydraulic pumps are capable of producing a continuous flow, with flow rates of approximately 280 1/min at pressures of 120 kg/cm$^2$ (~120 bar). However, the main problem with this type of pump is their low efficiency, since a major part of the received power is used to move its gears and only a small portion of that power is used to generate energy.

The blade type pumps, while being capable of producing flow rates similar to those of the gear pumps with a better efficiency, present the problem of being of complex construction, with the blades being radially displaceable within a rotor which, in turn, is eccentrically mounted in a housing, turning these pumps fragile and, therefore, more susceptible of failure.

The piston type hydraulic pumps are, up to now, the most resistant and they present the best efficiency, when the relationship between the power supplied thereto and the amount of dynamic hydraulic energy produced is considered.

These pumps can be of the axial type, where the pistons move parallel to the rotor shaft, or of the radial piston type, in which the pistons move inwardly and outwardly with regard to a piston eccentrically mounted within a housing, in an operation similar to those of the blade type pumps.

Due to their rugged construction, the piston pumps are capable of providing flow rates up to 1200 1/min of pressures in the range of 700 kg/cm$^2$ (~700 bar), without prejudice to the safety requirements.

Finally, the centrifugal pumps are mainly used in hydraulic systems where great volumes of hydraulic fluid need to be displaced at medium or low pressures, due to its low resistance to backup pressures, which makes its control more difficult.

Hydraulic motors using hydraulic energy developed by the pumps, both of the rotary and piston types, are also widely known from the state of the art.

The rotary hydraulic motors are rarely used mainly because they can be easily replaced by electric motors. The piston motors, in turn, have an operating principle similar to those of the piston pumps, that is to say, the displacement of a piston causes the displacement of a given volume of hydraulic fluid.

Both the pumps and the piston motors can be of the single action type, when the piston produces work only in a single direction of its stroke, or of the double action type, when the piston produces work in both directions of its stroke.

### SUMMARY OF THE INVENTION

The objective of the present invention is to provide a hydraulic pump and motor assembly, more particularly a piston pump and motor, connected in a closed hydraulic circuit, in which the power developed by the said pump unit is sufficient for driving the said motor, which generates an output power for driving an independent working unit.

According to the present invention, this objective is achieved by the provision of a piston pump of the type comprising at least a double action piston, the pump having driving means for receiving an input power, a first pair of crank arms rotatively driven by the driving means, a second pair of crank arms coupled to a movable driven shaft, a pair of connecting rods coupling, in an intercrossed manner, the first and second pairs of crank arms and connecting means coupling the movable driven shaft to the piston, whereby upon each revolution of the driving means the piston carries out four strokes of hydraulic fluid volumetric displacement.

Still in accordance with the present invention, this objective is achieved by the provision of a piston pump and motor assembly of the type comprising at least a double action piston, the assembly having a pump unit with driving means for

receiving an input power, a first pair of crank arms rotatively driven by the driving means, a second pair of crank arms coupled to a movable driven shaft, a pair of connecting rods coupling in an intercrossed manner the crank arms of the first and second pairs of arms, connecting means coupling the movable driven shaft to the piston of said pump, whereby upon each revolution of the driving means, the pump piston carries out four strokes of hydraulic fluid volumetric displacement, means for directing the hydraulic fluid displaced by the pump piston for driving the driving means and a motor unit having cam means integral with the driving means and cam follower means coupled to the pistons of the motor.

## BRIEF DESCRIPTION OF THE DRAWINGS

The present invention will be described in greater details in a non-limitative and exemplified manner making reference to its presently preferred embodiment, which is illustrated in the attached drawings, wherein:

Figure 1 is a cross-section view of a piston pump and motor assembly which embodies the present invention;

Figure 2 is cross-section view of the motor unit of the assembly illustrated in figure 1, taken along line II-II in figure 1;

Figure 3 is a cross-section view of the motor unit shown in figure 1, taken along line III-III of figure 1;

Figure 4 is a cross-section view of the pump unit of the assembly shown in figure 1, taken along line IV-IV of figure 1;

Figure 5 is a cross-section view of a second embodiment of the piston pump and motor assembly which embodies the invention;

Figure 6 is a cross-section view of the motor unit of the assembly shown in figure 5, taken along line VI-VI of figure 5;

Figure 7 is cross-section view of the pump unit of the assembly shown in figure 5, taken along line VII-VII of figure 5;

Figure 8 is a cross-section view of another embodiment of the pump unit shown in figure 7;

Figure 9 is a cross-section view of the pump unit shown in figure 8; and

Figure 10 is a schematic view of the basic hydraulic circuit of the piston pump and motor assembly of the present invention.

## DESCRIPTION OF THE PREFERRED EMBODIMENT

Making reference to the drawings, a piston pump and a piston pump and motor assembly which embody the present invention are illustrated in the attached drawings, which are intended to illustrate the presently preferred embodiments of the invention and are not intended to limit its scope.

Figure 1 is a cross-section view of a piston pump and motor assembly which embodies the present invention comprising a box or housing 1 having a suitable shape, driven by a pulley 2 fixed to a driving shaft 3 by means of a key 4 or the like.

The driving shaft 3 freely rotates within the box 1 supported on ball bearings 5 and a retainer 6 is placed in a housing 7 of the box 1, adjacent to the pulley 2, so as to prevent any hydraulic fluid leakage therefrom. Additionally, the shaft is also provided with a counterbalance wheel 8 near to one of its ends.

The counterbalance wheel 8 and two cams 9, 10, intended to drive the driving pistons 11, 12 of the motor unit are also secured to the driving shaft 3 by means of the keys 4, as can be seen from the cross-section illustration showing details of its connecting portions to the shaft 3 and also from figures 2 and 3.

The rotational movement of the cams 9, 10 is converted into alternate movement of the pistons 11, 12 by cam follower rollers 13 fixed to the lower ends of the pistons 11, 12, by means of U shaped fixing elements 14, which legs are formed with transpassing rolls within which are received the central shafts 16 of the ball bearings 17, around which the rollers 13 freely rotate.

The cams 9 and 10 are preferably discs having a contour defined by the Archimedes spiral curve equation, so that its rotational movement, when converted into movement of the pistons 11, 12 causes this piston movement to be uniform in both directions so as to prevent pressure peaks in the hydraulic fluid being pumped.

Referring now more particularly to figure 4, the hydraulic pump unit for fluids of the pump and motor assembly is shown driven by the driving shaft 3 through a gear 18 connected thereto by a key 4, which engages another gear 19 fixed to a driven shaft 20 having two crank arms 21 connected thereto by means of keys 4.

The driven shaft 20 freely rotates supported by ball bearings 22 received in support columns 23 and each one of the crank arms 21 is provided with a ball bearing 24 in its distal end for rotational coupling with a pair of intercrossed connecting rods 25 which transmit the rotary movement of the driven shaft 20 to an upper driven shaft 26 movable by means of a similar assembly of ball bearings 27 provided in the distal ends of the crank arms 28 secured to the movable driven shaft 26 by means of keys 4.

The movable upper driven shaft 26 freely rotates supported by bearings 29 secured to a

fixing element 30. An anti-backup mechanism 31 such as a sprocket is coupled to the movable upper driven shaft 26, so as to prevent rotation thereof in a direction contrary to a desired one.

The inter-crossed disposition of the connecting rods 25 causes each revolution of the driving shaft 3, or of the lower driven shaft 20, to be transformed into two vertical displacements of the movable driven shaft 26, and accordingly, of the shaft 32 to which the fixing element 30 is secured and which has a piston 33 secured at its end, whereby this piston 33 moves four times within the cylinder 34 upon each revolution of the driving shaft 3, while in a normal crank arm system this piston would only move twice.

This allows the piston 33 to carry out a hydraulic fluid volumetric displacement within the cylinder 34 allowing the piston pump and motor assembly to generate an output power for a separate operating unit.

Since this piston 33 is of the double action type, unidirectional valves 35, 36, 37, 38, are disposed in the ends of the cylinder 34, connecting the fluid supply lines 39 and the fluid discharge line 40 thereto.

Referring again to figure 1, the piston pump and motor assembly has a rotary directional valve 41, of high flow rate and speed, having a box 42 provided with inlet/outlet openings for hydraulic fluid 43 within which is a conversion and distribution bushing 44 formed with four openings 45, which area corresponds to the area of each inlet/outlet opening 43, so as to prevent interruption of the hydraulic fluid flow due to clogging.

A distribution rotor 46 is disposed within the bushing 44 so as to control the distribution of the hydraulic fluid in the system, which rotor is driven by means of a gear 47 coupled thereto through a fine adjust means 48, which will not be described herein in greater details since it is not part of the present invention.

Two bearings 49 support the distribution rotor 46 within the bushing 44, so that the rotor can freely rotate when driven by the gear 47 which, in turn, is directly driven by a gear 50 secured to the driving shaft 3 by means of a key 4.

In this manner, the rotary directional valve 41 permits the circulation of the hydraulic fluid from a pressure accumulator 51 to a pressurized reservoir 52 in a closed hydraulic circuit as represented by figure 10.

Figures 5, 6 and 7 illustrate a second embodiment of the present invention, in which the piston pump and motor assembly is shown having pairs of pistons.

A box 53, having a suitable shape receives a driving shaft 54 which freely rotates on bearings 55 secured to the box, with a retainer 56 being disposed in a housing 57 of the box to prevent any hydraulic fluid leakage. Again, a pulley 58 is secured by means of a key 59 to the end of the shaft 54, for transmitting/receiving a torque.

A gear 60 and a counterbalance wheel 61 are fixed to the shaft 54 by means of a key 59, which gear 60 engages a second gear 62 connected to a second shaft 63 parallel to the driving shaft 54 by means of a key 59, which simultaneously fixes a second counterbalance wheel 64.

The second shaft 63 freely rotates within the box 53 supported on bearings 65 and projects into the pump compartment of the assembly, for driving the pump mechanism as it will be described in greater details below.

Each one of the shafts 54, 63 has a cam disc 66 attached thereto by means of keys 67.

As above mentioned, the cams 66 have profiles defined according to the Archimedes spiral curve, so that the transformation of the rotational movement of the shafts in an alternate movement of the pistons results in a uniform and constant displacement for avoiding pressure peaks of the hydraulic fluid.

Two cam follower rollers 68 interconnected by a rocker arm 69 are coupled to a first piston 70 by means of a link shaft 71 for the rocker arm, while the opposed piston 74 is also driven by two cam follower rollers 72 interconnected by a rocker arm 73 secured to the piston 74 by means of a link pin 75.

This constructive disposition of the present invention allows a perfect balance of all the force components, while still providing a greater volumetric displacement due to the utilization of pairs of pistons.

Within the pump compartment, the second shaft 63 has a gear 76 attached thereto by means of a key 59, which cooperates with a second gear 77 integral with an intermediate shaft 78 for transmitting a rotational movement to the gears 79 which cause the pumping system to rotate.

The gears 79 are fixed to shafts 80, respectively, and each shaft has a first pair of crank arms 81 attached thereto by means of keys 59. Similar to the preceding embodiment, the shafts 81 rotate on bearings 82 disposed in supports 83.

The distal ends of the crank arms 81 are connected to the distal ends of a second pair of crank arms 84 by means of intercrossed connecting rods 85, whereby the shafts 86, which freely rotate on bearings 87 having a sprocket system 88 coupled to each one thereof, are vertically displaced upon rotational movement of the shafts 81.

The vertical displacement of the shafts 86 causes a displacement of the pistons 89 coupled thereto by connecting members 90. Thus, the pistons 89 move four times upon each rotation of the

shafts 81.

Again, in order that the pistons function as double action pistons, admission 91 and discharge 92 unidirectional valves are coupled to the ends of the cylinders 93 within which the pistons move.

Figures 8 and 9 illustrate a second embodiment of the composite pump unit disclosed in figure 7, particularly suitable for direct coupling to a motor assembly. Due to the similarity between this embodiment and the embodiment shown in figure 7, similar reference numbers were given to the same component parts.

Shaft 63 having a gear 76 attached thereto by means of a key 59 within the housing 94, supported by bearings 95 and a retainer 96, received in a housing 97 of the box 94, serve to prevent any hydraulic fluid leakage out of the box.

Gear 76 directly engages gear 79, without the intermediate gear 77 and respective shaft 78, whereby the rotation of the shaft 63 is transmitted to the shafts 80 by the gears 76 and 79, with the shafts 80 rotating in opposite directions.

As already explained with regard to figures 5, 6 and 7, the shafts 80 rotate on bearings 82 in columns 83, thus defining a synchronized stationary dual assembly by means of gears.

The crank arms 81 fixed to each one of the respective shafts 80 have their distal ends connected to the distal ends of the similar crank arms 84 by means of the respective pairs of intercrossed connecting rods 85, whereby the rotational movement of the lower shafts 80 is transformed into a vertical displacement movement of the shafts 86 to which the crank arms 84 are attached.

These shafts 86, in turn, rotate on bearings 87, with a gear mechanism 88 being used for preventing its displacement in a direction contrary to the desired one, and its alternate movement is transmitted to the cylinders 89 by means of connecting members 90.

According to the present invention there are provided a piston pump and a piston pump and motor assembly which are capable of producing an output power for driving an independent separate operating unit.

Figure 10 schematically illustrates the basic hydraulic system of the present invention, comprising, besides the above-mentioned pressure accumulator 51 and pressurized reservoir 52, a pump unit B, a motor unit M, the high speed directional valve 42, the conventional hydraulic control valves V and an oil cooler R.

## Claims

**1.** A piston pump of the type comprising at least a double action piston, comprising driving means (2,3,4) for receiving an input power, characterized by a first pair of crank arms (21) rotatively actuated by said driving means (2,3,4), a second pair of crank arms (28) coupled to a movable driven shaft (26), a pair of connecting rods (25) coupling in an intercrossed manner said first (21) and second (28) pairs of crank arms, and connecting means (29,30,31) coupling said movable driving shaft (26) to said piston (33), whereby upon each revolution of said driving means said piston carries out fours strokes of hydraulic fluid volumetric displacement.

**2.** A piston pump in accordance with claim 1,wherein said driving means comprise a driving shaft (3) having a driving pulley (2) attached thereto by means of a key (4).

**3.** A piston pump in accordance with claim 2, wherein said driving shaft (3) has a gear (18) integral therewith and engaging a second gear (19) integral with a second driven shaft (20).

**4.** A piston pump in accordance with claim 3, wherein said first pair of crank arms (21) is integral with said second driven shaft (20)

**5.** A piston pump in accordance with claim 4, wherein each one of the crank arms (21) of said first pair is coupled to an end of each crank arm (25) of the said pair.

**6.** A piston pump in accordance with claim 5, wherein the opposite ends of each crank arm (25) are coupled in an intercrossed manner to said crank arms (28) of said second pair.

**7.** A piston pump in accordance with claim 6, wherein the coupling between said crank arms (21,28) and said connecting rods (25) comprises bearings (24) therein, integral with a common shaft.

**8.** A piston pump in accordance with claim 7, wherein said movable driven shaft (26) is coupled to said piston (33) by means of a support member (30) having a pair of bearings (39) on which said shaft (26) freely rotates.

**9.** A piston pump in accordance with claim 8, wherein said support member (30) comprises an anti-backup means (31) for securing rotation of the shaft in a single direction.

**10.** A piston pump in accordance with claim 9, wherein said anti-backup means (31) comprises a sprocket.

**11.** A piston pump and motor assembly, of the type comprising a piston pump unit and a piston motor unit coupled in a closed hydraulic circuit, said pump unit having at least one double action piston, comprising driving means (2,3,4,54,58,63) for receiving an input power, characterized by at least a first pair of crank arms (21,81) rotatively driven by said driving means (2,3,4,54,58,63), at least a second pair of crank arms (28,84) coupled to at least one movable driven shaft (26,86), at least a pair of connecting rods (25,85) coupling in a intercrossed manner said first and second pairs of crank arms (21,28,81,84), connecting means (29,30,32,90) coupling said movable driven shaft (26,86) to at least one piston (33,89) of said pump unit, whereby upon each revolution of said driving means said pistons carry out four strokes of hydraulic fluid volumetric displacement, means (42) for directioning said displaced hydraulic fluid for actuating said driving means, cam means (9,10,66) integral with said driving means (3,54,58,63) and cam follower means (13,68,72) coupled to each piston of said motor unit.

**12.** A piston pump and motor assembly in accordance with claim 11, wherein said driving means comprise a driving shaft (3,54) having a pulley (2,58) attached thereto by means of a key (4,59).

**13.** A piston pump and motor assembly in accordance with claim 12, wherein said driving shaft (3, 54) has a gear (18,60) integral therewith engaging a second gear (19,62,76) integral with a second driven shaft (20,63,80).

**14.** A piston pump and motor assembly in accordance with claim 13, wherein said at least one first pair of crank arms (21,81) is integral with said second shaft (20,80).

**15.** A piston pump and motor assembly in accordance with claim 14, wherein each one of said crank arms (21,81) of said at least one first pair is coupled to an end of each said crank arm (25,85) of said at least one pair.

**16.** A piston pump and motor assembly in accordance with claim 15, wherein the opposite ends of each crank arm (25,85) are coupled in an intercrossed manner to said crank arms (28,84) of said at least one second pair.

**17.** A piston pump and motor assembly in accordance with claim 16, wherein said at least one movable shaft (26,86) is coupled to said at least one piston (33,89) by means of a support member (30,90) having a pair of bearings (29,87) on which said shaft (26,86) freely rotates.

**18.** A piston pump and motor assembly in accordance with claim 17, wherein said support member (30,90) comprises an anti-backup means (31,88) for securing the rotation of the shaft in a single direction.

**19.** A piston pump and motor assembly in accordance with claim 11, wherein said means for directioning the hydraulic fluid comprises high speed directional valve (42).

**20.** A piston pump and motor assembly in accordance with claim 11, wherein said cam means comprise cam discs (10,66).

**21.** A piston pump and motor assembly in accordance with claim 20, wherein said cam discs (9,10,66) have a contour defined in accordance with the Archimedes spiral curve.

**22.** A piston pump and motor assembly in accordance with claim 11, wherein said cam follower means comprise rollers (13,68,72).

**Patentansprüche**

**1.** Kolbenpumpe in einer zumindest einen doppeltwirkenden Kolben umfassenden Ausführung, die Antriebsmittel (2, 3, 4) zur Aufnahme einer Eingangsleistung umfaßt, gekennzeichnet durch ein erstes Paar Kurbelarme (21), die in drehbarer Weise durch die genannten Antriebsmittel (2, 3, 4) betätigt werden, ein zweites Paar Kurbelarme (28), die mit einer bewegbaren angetriebenen Welle (26) verbunden sind, ein Paar Verbindungsstangen (25), die in sich kreuzender Weise die genannten ersten (21) und zweiten (28) Paare Kurbelarme verbinden, sowie Verbindungsmittel (29, 30, 31), die die genannte bewegbare antreibende Welle (26) mit dem genannten Kolben (33) verbinden, so daß bei jeder Drehung der genannten Antriebsmittel der genannte Kolben vier Hübe zur Volumenverdrängung von Hydraulikmedium durchführt.

**2.** Kolbenpumpe nach Anspruch 1, wobei die genannten Antriebsmittel eine antreibende Welle (3) umfassen, die eine mit Hilfe eines Keiles (4) daran befestigte Antriebsscheibe (2) aufweist.

**3.** Kolbenpumpe nach Anspruch 2, wobei die genannte antreibende Welle (3) ein damit integral verbundenes Zahnrad (18) aufweist, das in ein mit einer zweiten angetriebenen Welle (20) integral verbundenes zweites Zahnrad (19) eingreift.

**4.** Kolbenpumpe nach Anspruch 3, wobei das genannte erste Paar Kurbelarme (21) mit der genannten zweiten angetriebenen Welle (20) integral verbunden ist.

**5.** Kolbenpumpe nach Anspruch 4, wobei jeder einzelne der Kurbelarme (21) des genannten ersten Paares mit einem Ende eines jeden Kurbelarmes (25) des genannten Paares verbunden ist.

**6.** Kolbenpumpe nach Anspruch 5, wobei die gegenüberliegenden Enden eines jeden Kurbelarmes (25) in sich kreuzender Weise mit den genannten Kurbelarmen (28) des genannten zweiten Paares verbunden sind.

**7.** Kolbenpumpe nach Anspruch 6, wobei die Verbindung zwischen den genannten Kurbelarmen (21, 28) und den genannten Verbindungsstangen (25) darin vorgesehene Lager (24) umfaßt, die mit einer gemeinsamen Welle integral verbunden sind.

**8.** Kolbenpumpe nach Anspruch 7, wobei die genannte bewegbare angetriebene Welle (26) mit dem genannten Kolben (33) über ein Stützelement (30) verbunden ist, das ein Paar Lager (39) umfaßt, auf denen die genannte Welle (26) sich frei dreht.

**9.** Kolbenpumpe nach Anspruch 8, wobei das genannte Stützelement (30) ein Antirücklaufmittel (31) umfaßt, um eine Drehung der Welle in nur einer Richtung sicherzustellen.

**10.** Kolbenpumpe nach Anspruch 9, wobei das genannte Antirücklaufmittel (31) einen Zahnkranz umfaßt.

**11.** Kolbenpumpen- und -motoraggregat in einer Ausführung, die eine Kolbenpumpeneinheit und eine Kolbenmotoreinheit umfaßt, die in einem geschlossenen Hydraulikkreis miteinander verbunden sind, wobei die genannte Pumpeneinheit mit zumindest einem doppeltwirkenden Kolben Antriebsmittel (2, 3, 4, 54, 58, 63) zur Aufnahme einer Eingangsleistung umfaßt, gekennzeichnet durch zumindest ein erstes Paar Kurbelarme (21, 81), die in drehbarer Weise durch die genannten Antriebsmittel (2, 3, 4, 54, 58, 63) angetrieben werden, zumindest ein zweites Paar Kurbelarme (28, 84), die mit zumindest einer bewegbaren angetriebenen Welle (26, 86) verbunden sind, zumindest ein Paar Verbindungsstangen (25, 85), die in sich kreuzender Weise die genannten ersten und zweiten Paare Kurbelarme (21, 28, 81, 84) verbinden, Verbindungsmittel (29, 30, 32, 90), die die genannte bewegbare angetriebene Welle (26, 86) mit zumindest einem Kolben (33, 89) der genannten Pumpeneinheit verbinden, so daß bei jeder Drehung der genannten Antriebsmittel die genannten Kolben vier Hübe zur Volumenverdrängung von Hydraulikmedium durchführen, Mittel (42) zur Zuführung des genannten verdrängten Hydraulikmediums, um die genannten Antriebsmittel zu betätigen, Nockenmittel (9, 10, 66), die mit den genannten Antriebsmitteln (3, 54, 58, 63) integral verbunden sind, sowie Nockenstößelmittel (13, 68, 72), die mit jedem Kolben der genannten Motoreinheit verbunden sind.

**12.** Kolbenpumpen- und -motoraggregat nach Anspruch 11, wobei die genannten Antriebsmittel eine antreibende Welle (3, 54) umfassen, die eine mit Hilfe eines Keiles (4, 59) daran befestigte Antriebsscheibe (2, 58) aufweist.

**13.** Kolbenpumpen- und -motoraggregat nach Anspruch 12, wobei die genannte antreibende Welle (3, 54) ein damit integral verbundenes Zahnrad (18, 60) aufweist, das in ein mit einer zweiten angetriebenen Welle (20, 63, 80) integral verbundenes zweites Zahnrad (19, 62, 76) eingreift.

**14.** Kolbenpumpen- und -motoraggregat nach Anspruch 13, wobei das genannte zumindest eine erste Paar Kurbelarme (21, 81) mit der genannten zweiten Welle (20, 80) integral verbunden ist.

**15.** Kolbenpumpen- und -motoraggregat nach Anspruch 14, wobei jeder einzelne der genannten Kurbelarme (21, 81) des genannten zumindest einen ersten Paares mit einem Ende eines jeden der genannten Kurbelarme (25, 85) des genannten zumindest einen Paares verbunden ist.

**16.** Kolbenpumpen- und -motoraggregat nach Anspruch 15, wobei die gegenüberliegenden Enden eines jeden Kurbelarmes (25, 85) in sich kreuzender Weise mit den genannten Kurbelarmen (28, 84) des genannten zumindest einen zweiten Paares verbunden sind.

**17.** Kolbenpumpen- und -motoraggregat nach Anspruch 16, wobei die genannte zumindest eine bewegbare Welle (26, 86) mit dem genannten zumindest einen Kolben (33, 89) über ein Stützelement (30, 90) verbunden ist, das ein Paar Lager (29, 87) umfaßt, auf denen die genannte Welle (26, 86) sich frei dreht.

**18.** Kolbenpumpen- und -motoraggregat nach Anspruch 17, wobei das genannte Stützelement (30, 90) ein Antirücklaufmittel (31, 88) umfaßt, um eine Drehung der Welle in nur einer Richtung sicherzustellen.

**19.** Kolbenpumpen- und -motoraggregat nach Anspruch 11, wobei die genannten Mittel zur Zuführung des Hydraulikmediums ein Hochgeschwindigkeitswegeventil (42) umfassen.

**20.** Kolbenpumpen- und -motoraggregat nach Anspruch 11, wobei die genannten Nockenmittel Nockenscheiben (10, 66) umfassen.

**21.** Kolbenpumpen- und -motoraggregat nach Anspruch 20, wobei die genannten Nockenscheiben (9, 10, 66) eine nach der Archimedischen Spirale definierte Kontur aufweisen.

**22.** Kolbenpumpen- und -motoraggregat nach Anspruch 11, wobei die genannten Nockenstößelmittel Rollen (13, 68, 72) umfassen.

**Revendications**

**1.** Une pompe à piston du type comprenant au moins un piston à double action, comprenant des moyens de commande (2, 3, 4) pour recevoir une puissance d'entrée, caractérisée par une première paire de bras de manivelle (21) entraînée de façon rotative par lesdits moyens de commande (2, 3, 4), une deuxième paire de bras de manivelle (28) couplée à un arbre mené mobile (26), une paire de bielles (25) accouplant d'une manière entrecroisée lesdites première (21) et deuxième (28) paires de bras de manivelle, et des moyens de raccordement (29, 30, 31) accouplant ledit arbre mené mobile (26) audit piston (33), ledit piston effectuant quatre courses de déplacement volumétrique de fluide hydraulique pour chaque révolution desdits moyens de commande.

**2.** Une pompe à piston suivant la revendication 1, dans laquelle lesdits moyens de commande comprennent un arbre d'entraînement (3) ayant une poulie de commande (2) attachée à celui-ci au moyen d'une clavette (4).

**3.** Une pompe à piston suivant la revendication 2, dans laquelle ledit arbre d'entraînement (3) a un engrenage (18) intégré à celui-ci et engageant un deuxième engrenage (19) intégré à un deuxième arbre mené (20).

**4.** Une pompe à piston suivant la revendication 3, dans laquelle ladite première paire de bras de manivelle (21) est intégrée audit deuxième arbre mené (20).

**5.** Une pompe à piston suivant la revendication 4, dans laquelle chacun des bras de manivelle (21) de ladite première paire est couplé à une extrémité de chaque bras de manivelle (25) de ladite paire.

**6.** Une pompe à piston suivant la revendication 5, dans laquelle les extrémités opposées de chaque bras de manivelle (25) sont couplées d'une manière entrecroisée auxdits bras de manivelle (28) de ladite deuxième paire.

**7.** Une pompe à piston suivant la revendication 6, dans laquelle le couplage entre lesdits bras de manivelle (21, 28) et lesdites bielles (25) comprennent des paliers (24) dans celles-ci, intégrés à un arbre commun.

**8.** Une pompe à piston suivant la revendication 7, dans laquelle ledit arbre mené mobile (26) est couplé audit piston (33) au moyen d'un élément de support (30) ayant une paire de paliers (39) sur laquelle ledit arbre (26) tourne librement.

**9.** Une pompe à piston suivant la revendication 8, dans laquelle ledit élément de support (30) comprend des moyens (31) anti-recul pour assurer la rotation de l'arbre dans une seule direction.

**10.** Une pompe à piston suivant la revendication 9, dans laquelle lesdits moyens anti-recul (31) comprennent une dent.

**11.** Une pompe à piston et un assemblage de moteur, du type comprenant une unité de pompe à piston et une unité de moteur à piston couplées dans un circuit hydraulique fermé, ladite unité de pompe ayant au moins un piston à double action, comprenant des moyens de commande (2, 3, 4, 54, 58, 63) pour recevoir une puissance d'entrée, caractérisé par au moins une première paire de bras de manivelle (21, 81) entraînée de façon rotative par lesdits moyens de commande (2, 3, 4, 54, 58, 63), au moins une deuxième paire de

bras de manivelle (28, 84) couplée à au moins un arbre mené mobile (26, 86), au moins une paire de bielles (25, 85) accouplant d'une manière entrecroisée lesdites première et deuxième paires de bras de manivelle (21, 28, 81, 84), des moyens de raccordement (29, 30, 32, 90) accouplant ledit arbre mené mobile (26, 86) à au moins un piston (33, 89) de ladite unité de pompe, ledit piston effectuant quatre courses de déplacement volumétrique de fluide hydraulique pour chaque révolution desdits moyens de commande, des moyens (42) pour diriger ledit fluide hydraulique déplacé pour entraîner lesdits moyens de commande, des moyens de came (9, 10, 66) intégrés auxdits moyens de commande (3, 54, 58, 63) et des moyens suiveurs de came (13, 68, 72) couplés à chaque piston de ladite unité de moteur.

**12.** Une pompe à piston et un assemblage de moteur suivant la revendication 11, dans lesquels lesdits moyens de commande comprennent un arbre d'entraînement (3, 54) ayant une poulie (2, 58) attachée à celui-ci au moyen d'une clavette (4, 59).

**13.** Une pompe à piston et un assemblage de moteur suivant la revendication 12, dans lesquels ledit arbre d'entraînement (3, 54) a un engrenage (18, 60) intégré à celui-ci engageant un deuxième engrenage (19, 62, 76) intégré à un deuxième arbre mené (20, 63, 80).

**14.** Une pompe à piston et un assemblage de moteur suivant la revendication 13, dans lesquels ladite au moins une première paire de bras de manivelle (21, 81) est intégrée audit deuxième arbre (20, 80).

**15.** Une pompe à piston et un assemblage de moteur suivant la revendication 14, dans lesquels chacun desdits bras de manivelle (21, 81) de ladite au moins une première paire est couplé à une extrémité de chacun desdits bras de manivelle (25, 85) de ladite au moins une paire.

**16.** Une pompe à piston et un assemblage de moteur suivant la revendication 15, dans lesquels les extrémités opposées de chaque bras de manivelle (25, 85) sont couplées d'une manière entrecroisée auxdits bras de manivelle (28, 84) de ladite au moins une deuxième paire.

**17.** Une pompe à piston et un assemblage de moteur suivant la revendication 16, dans lesquels ledit au moins un arbre mobile (26, 86) est couplé audit au moins un piston (33, 89) au moyen d'un élément de support (30, 90) ayant une paire de paliers (29, 87) sur laquelle ledit arbre (26, 86) tourne librement.

**18.** Une pompe à piston et un assemblage de moteur suivant la revendication 17, dans lesquels ledit élément de support (30, 90) comprend des moyens anti-recul (31, 88) pour assurer la rotation de l'arbre dans une seule direction.

**19.** Une pompe à piston et un assemblage de moteur suivant la revendication 11, dans lesquels lesdits moyens pour diriger le fluide hydraulique comprennent une vanne directionnelle à grande vitesse (42).

**20.** Une pompe à piston et un assemblage de moteur suivant la revendication 11, dans lesquels lesdits moyens de came comprennent des disques de came (10, 66).

**21.** Une pompe à piston et un assemblage de moteur suivant la revendication 20, dans lesquels lesdits disques de came (9, 10, 66) ont un profil défini en conformité avec la courbe de la spirale d'Archimède.

**22.** Une pompe à piston et un assemblage de moteur suivant la revendication 11, dans lesquels lesdits moyens suiveurs de came comprennent des galets (13, 68, 72).

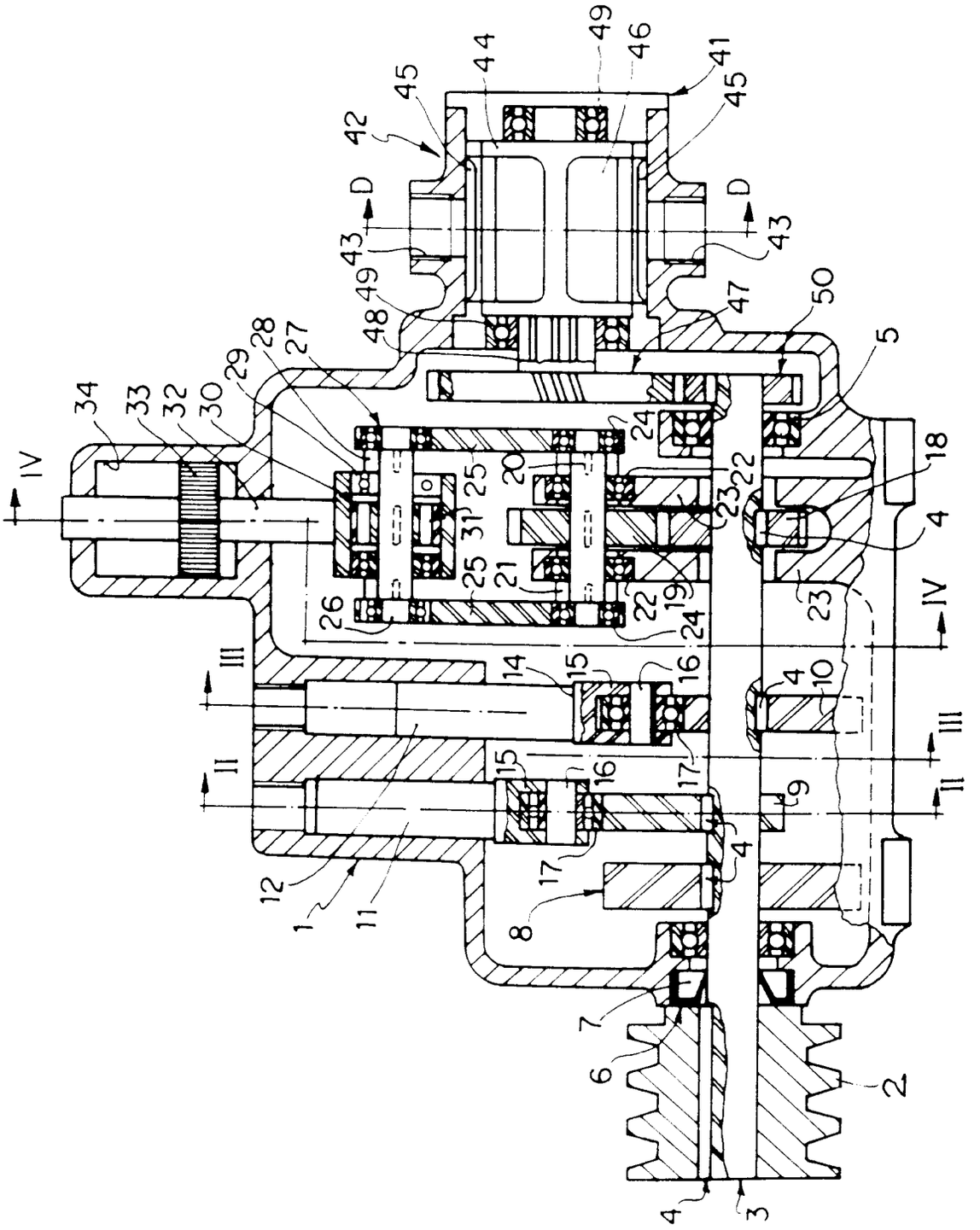
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FIG. 3

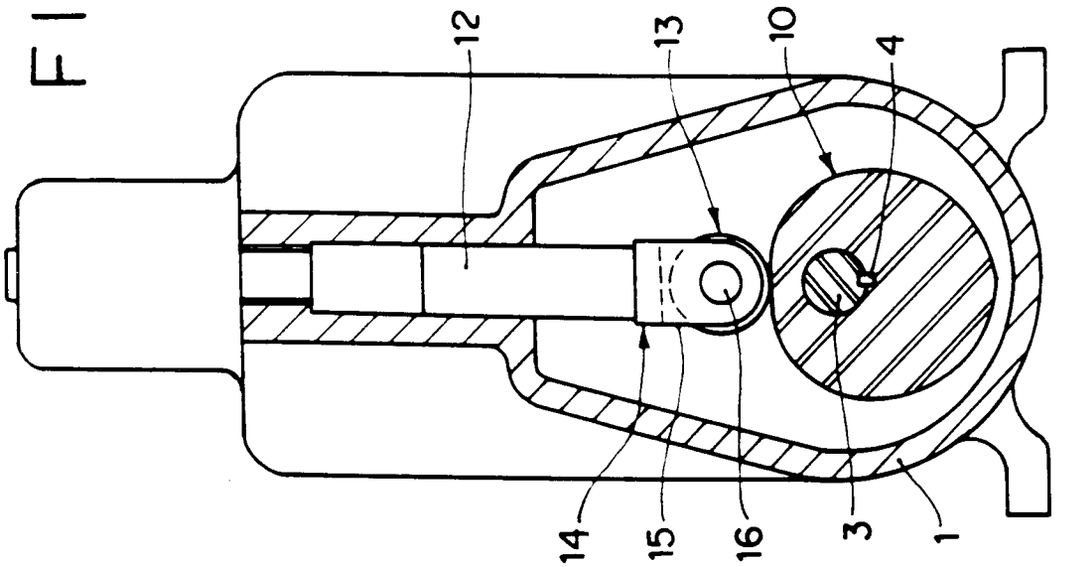
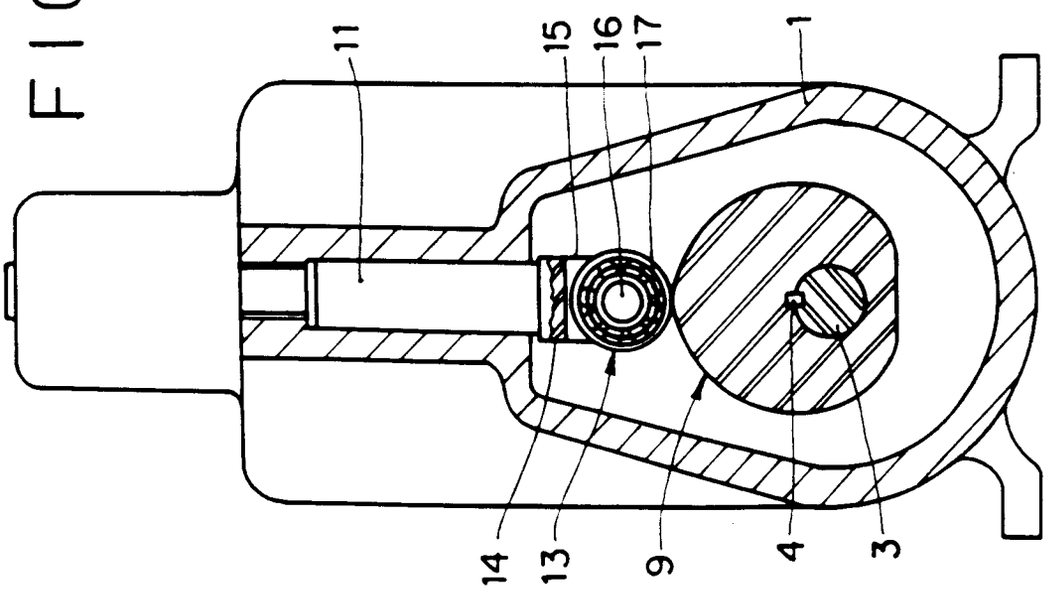



FIG. 2



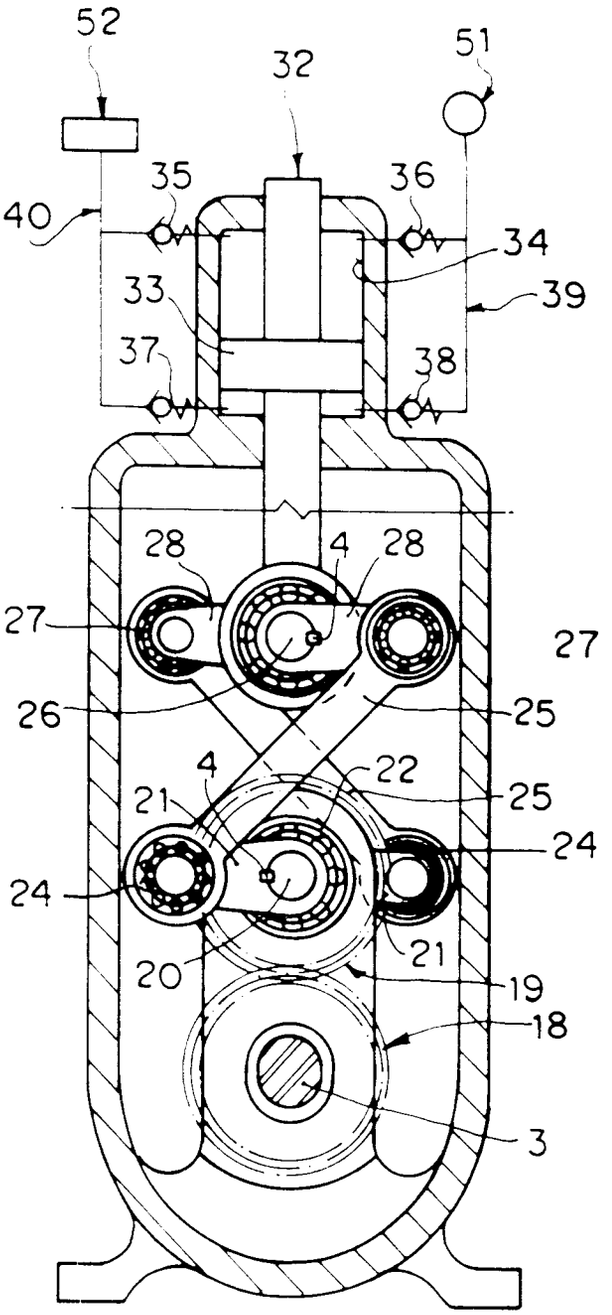

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FIG. 4

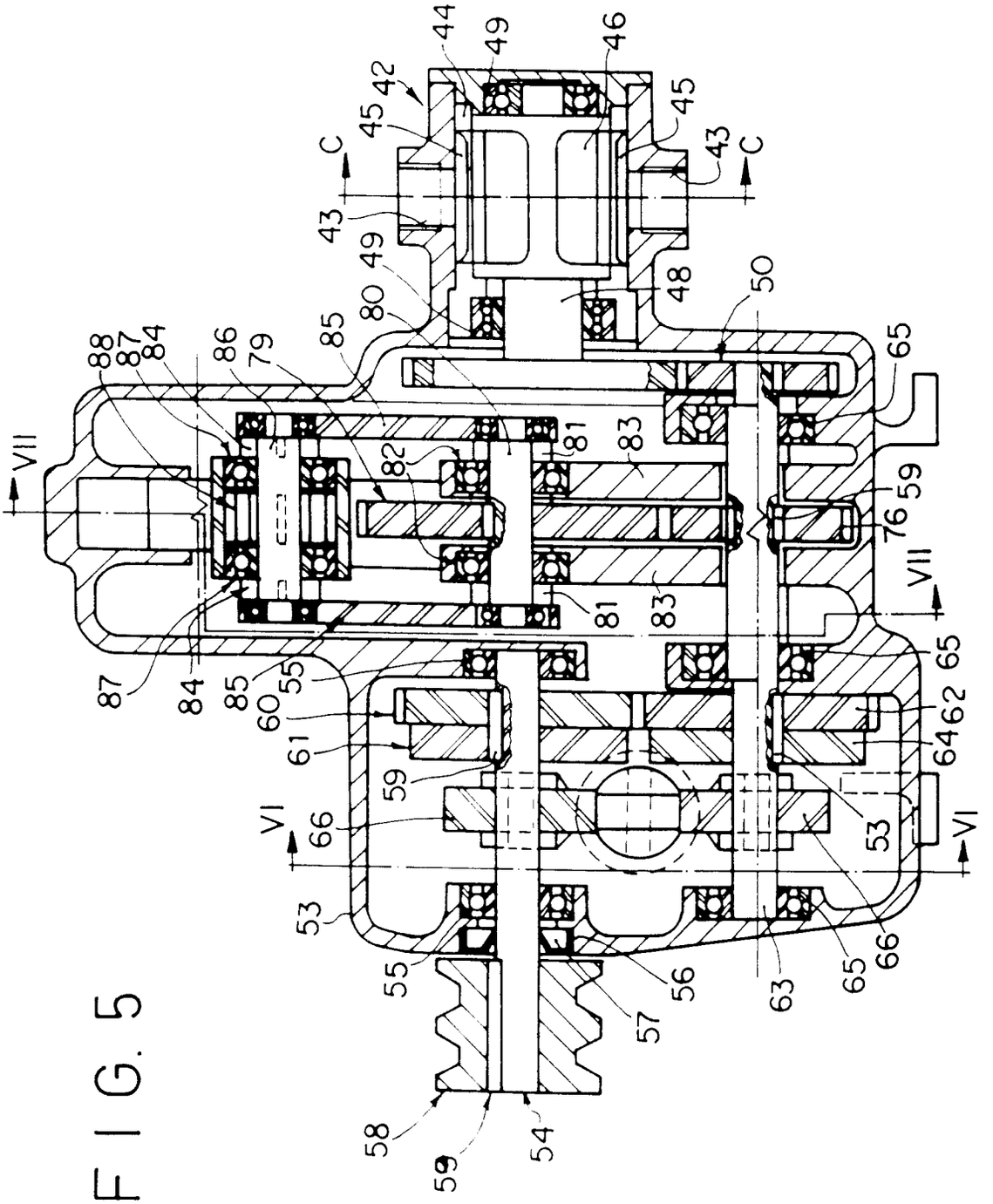
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FIG. 5

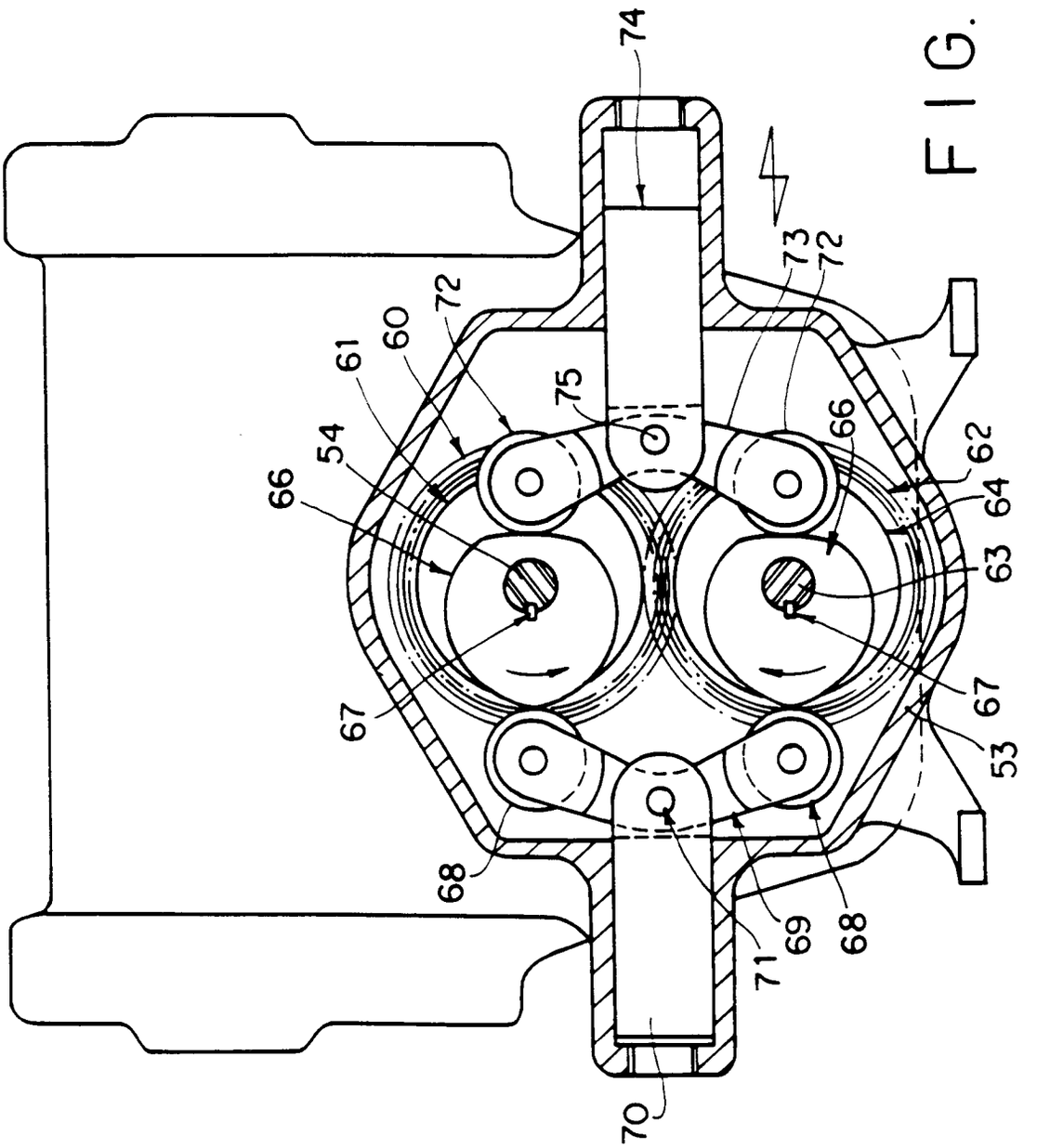


FIG. 6

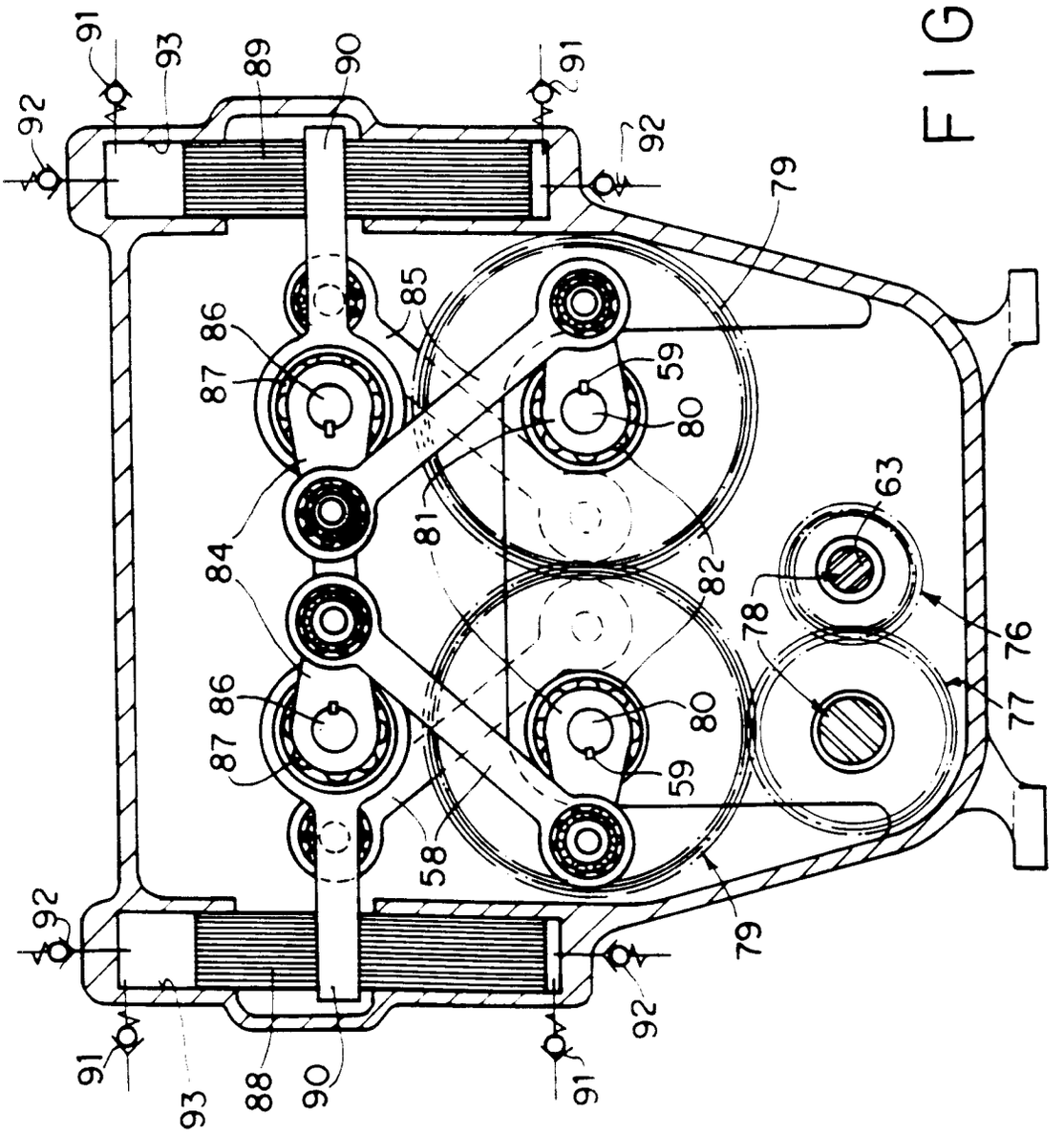


FIG. 7

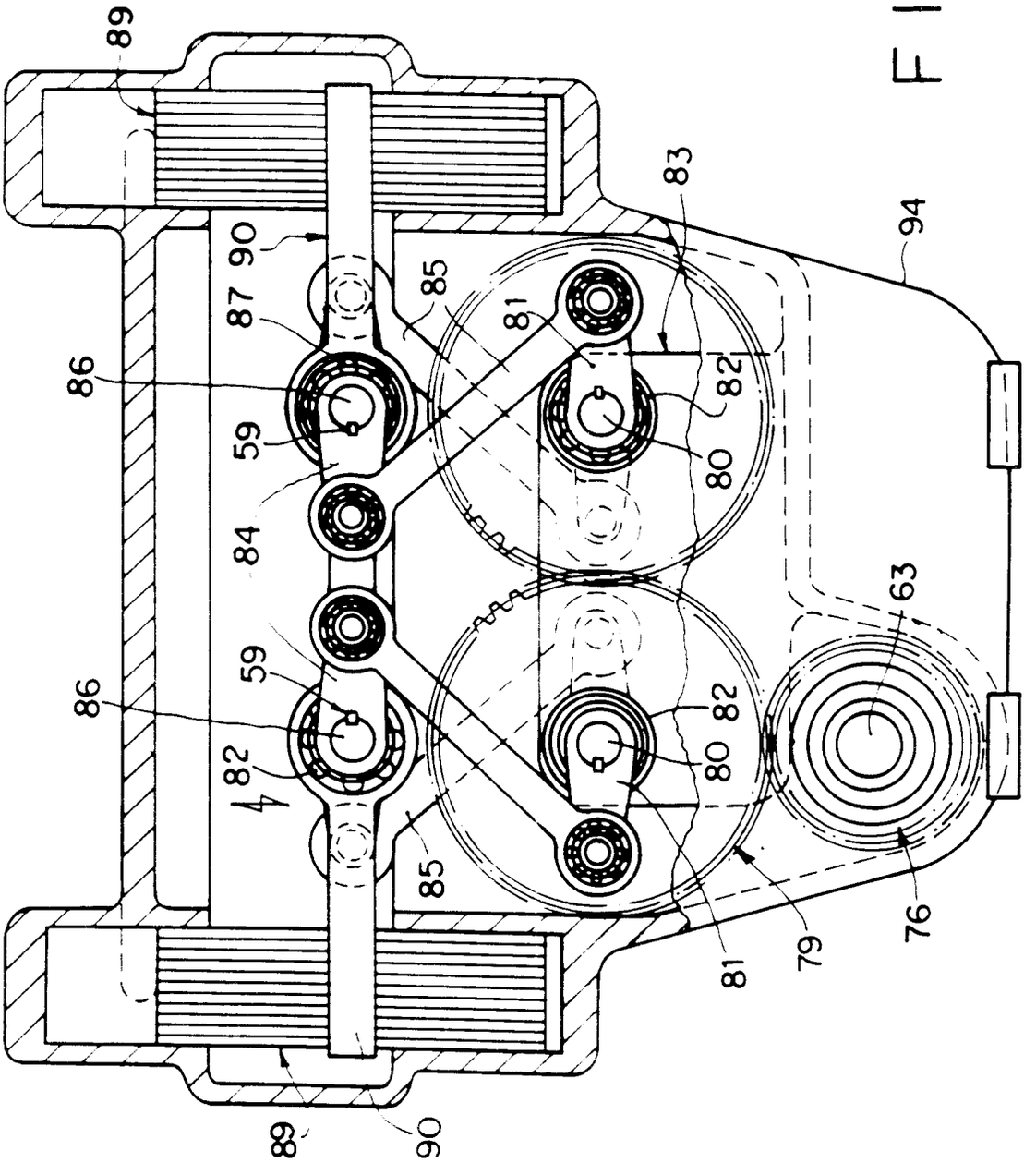


FIG. 8

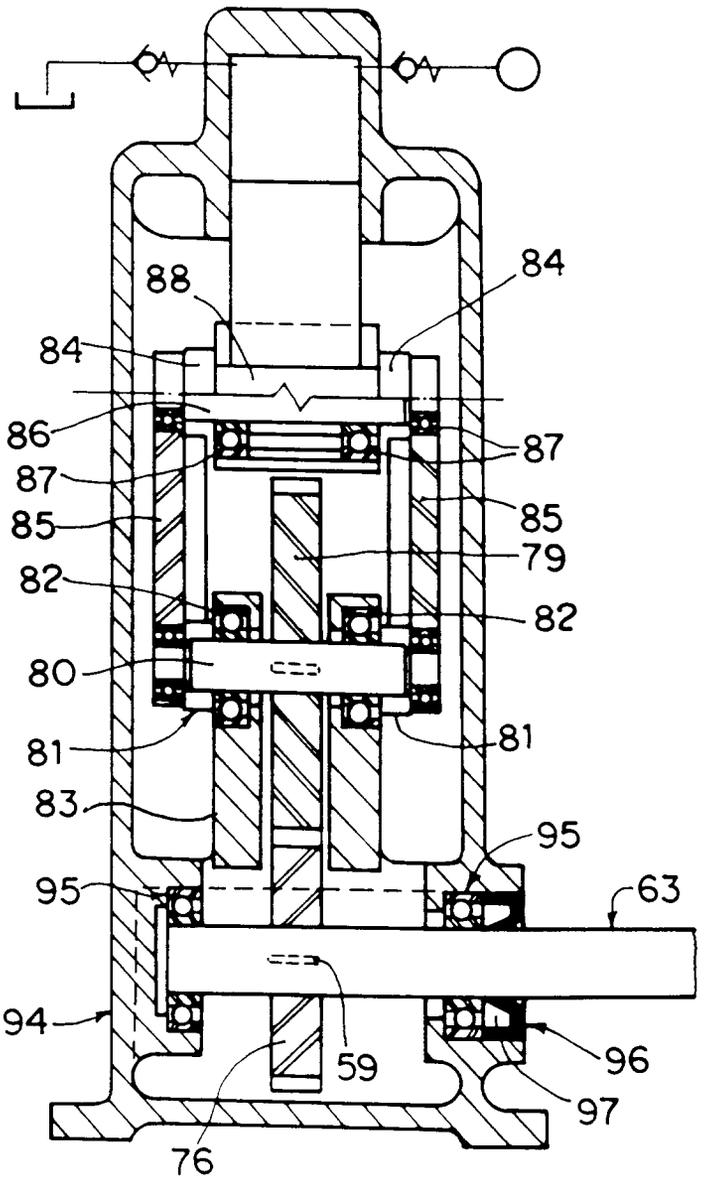


FIG. 9

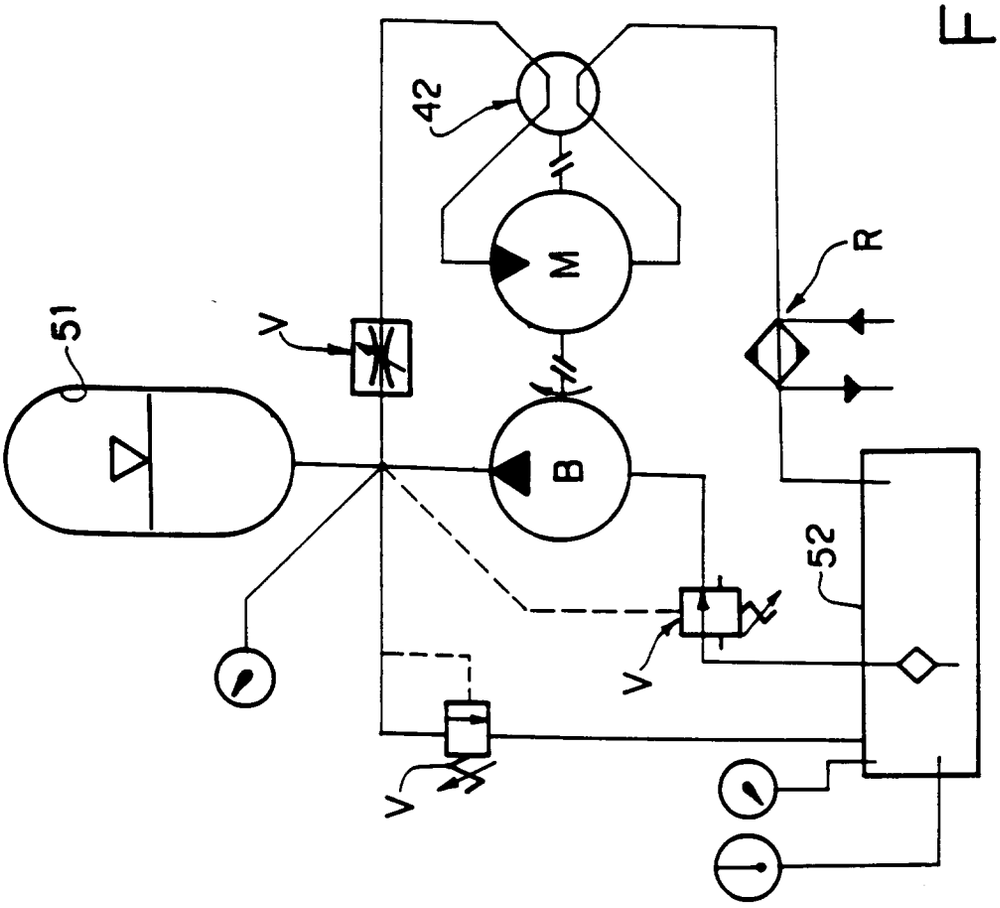


FIG. 10