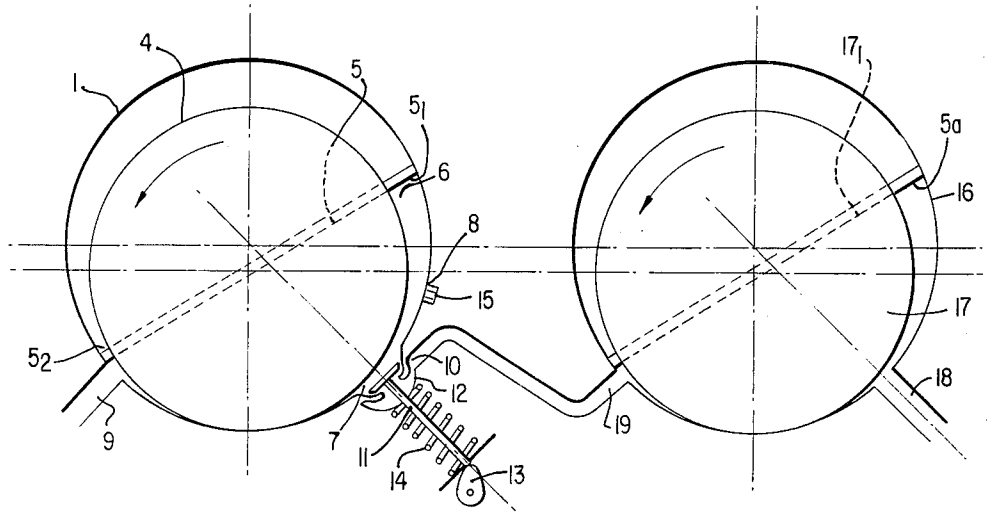
Oct. 26, 1965 E. M. DOUROUX 3,213,838

INTERNAL COMBUSTION ROTARY MOTOR

Filed Feb. 27, 1961 3 Sheets-Sheet 1

FIG. 1



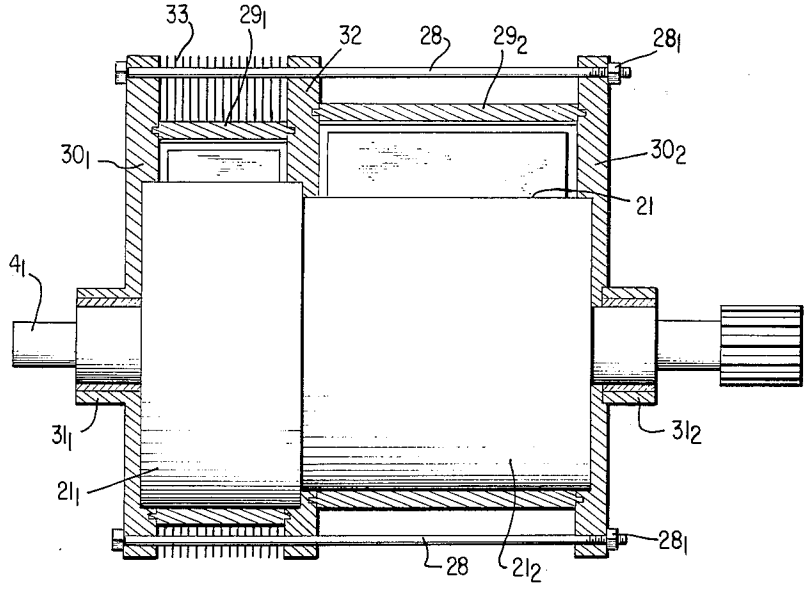


FIG. 2

INVENTOR
ETIENNE MARIUS DOUROUX

BY Smirie and Smiley

ATTORNEYS.

Oct. 26, 1965 E. M. DOUROUX 3,213,838

INTERNAL COMBUSTION ROTARY MOTOR

Filed Feb. 27, 1961 3 Sheets-Sheet 2

FIG. 3

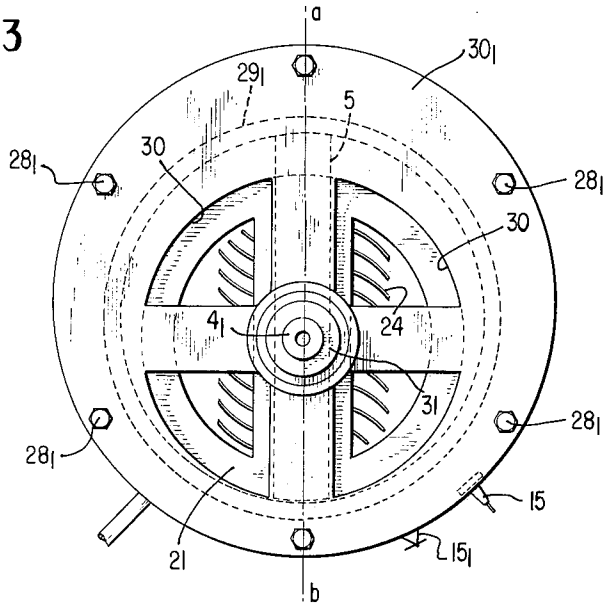
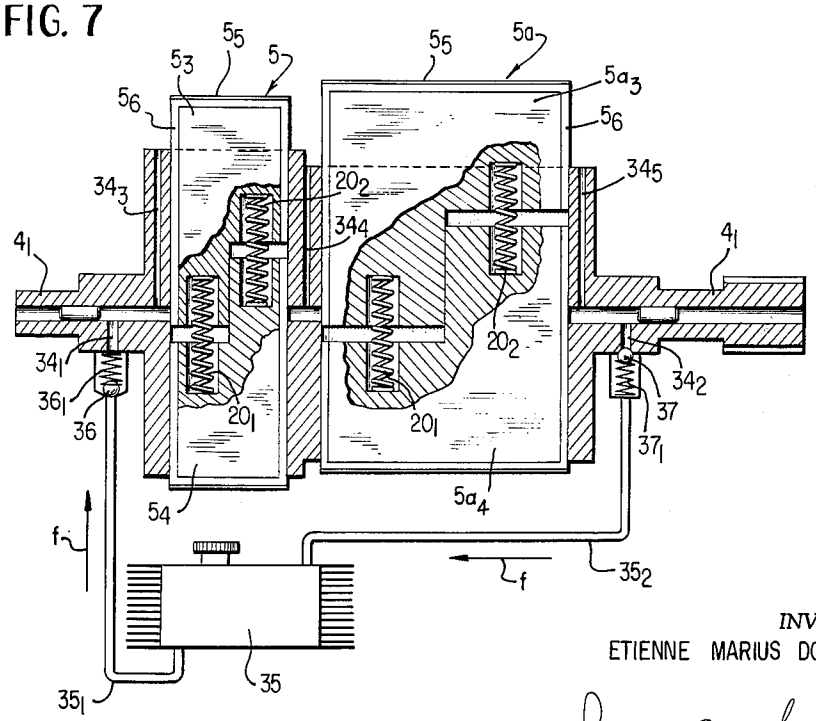


FIG. 7



INVENTOR
ETIENNE MARIUS DOUROUX

BY Imirie and Smiley

ATTORNEYS.

Oct. 26, 1965 E. M. DOUROUX 3,213,838

INTERNAL COMBUSTION ROTARY MOTOR

Filed Feb. 27, 1961 3 Sheets-Sheet 3

FIG. 4

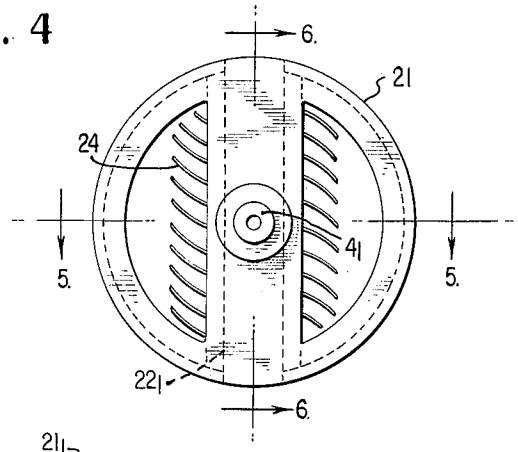


FIG. 5

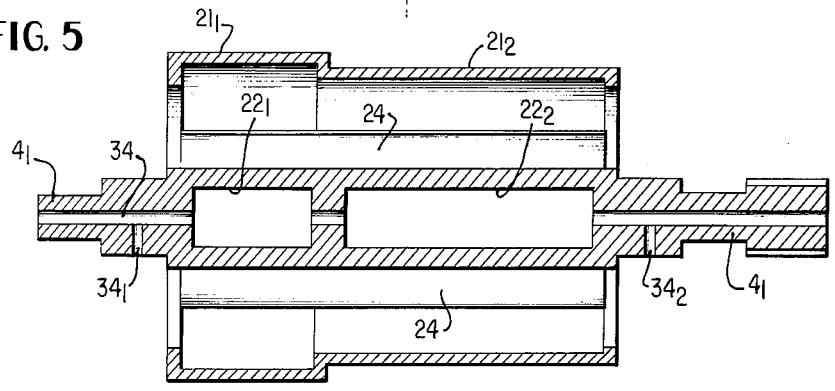
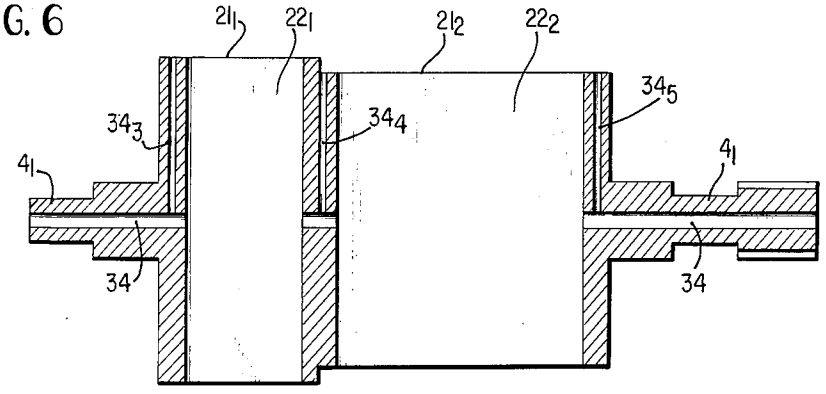


FIG. 6



INVENTOR
ETIENNE MARIUS DOUROUX

BY Inirie and Smiley

ATTORNEYS.

United States Patent Office

3,213,838

Patented Oct. 26, 1965

3,213,838

INTERNAL COMBUSTION ROTARY MOTOR

Etienne Marius Douroux, 59 Grande Rue, Gannat, France

Filed Feb. 27, 1961, Ser. No. 92,065
Claims priority, application France, Feb. 27, 1960, 822,524, Patent 1,251,954
5 Claims. (Cl. 123—16)

The object of the present invention is to realize an internal combustion rotary engine of the four cycle type having a power stroke for each half revolution of the rotor and thus being balanced in the same manner as four cylinder, four cycle piston engine.

Another object of the invention is to establish a device of oil circulation combining the lubricating action with a substantial cooling action and further combined with the cooling action of air circulation throughout the motor.

Another purpose is to establish a lubricating circuit which is at the same time a cooling circuit.

Another purpose is to establish a cooling circuit so that the oil heated during its passage in the power member is utilized for heating the combustible in the compressor.

Other purposes and advantages will be revealed by the following description and the attached drawings, in which:

FIG. 1 is a schematic view of the motor, theoretically represented as made of two distinct parts: motor and compressor;

FIG. 2 is a longitudinal sectional view of the assembled rotor and stator;

FIG. 3 is an end view of an assembled stator and rotor;

FIG. 4 is an end view of the rotor;

FIG. 5 is a sectional view taken on line 5—5 of FIG. 4;

FIG. 6 is a sectional view taken on line 6—6 of FIG. 4; and

FIG. 7 is a schematic sectional view of a possible embodiment of the lubricating and cooling circuit.

The unit shown in a diagrammatical manner in FIGURE 1 consists of a motor 1 properly so called and a compressor 16.

The motor consists of a stator 1 which is made cylindrical and inside of which is a rotor 4 which is off center in relation to the axis of the stator 1.

Inside the rotor 4 there is a slot 4_1 which traverses it from side to side. A sliding piston 5 is housed in this slot delimiting the chambers of the power member.

This sliding piston 5 is so made that its two ends 5_1 and 5_2 rub on the walls of the stator 1.

The rotation of the rotor 4 thus drives the sliding piston 5, by causing the volume of the ignition chamber 6 to vary, this chamber 6 is delimited by a segment of the rotor, a segment of the stator 1 and the sliding piston 5.

In the wall of the stator 1 there are three openings 7, 8, 9 which are respectively utilized, the first (7) to enable the combustible mixture or fuel to be introduced into the explosion chamber 6 of the motor, and the second (8) to enable the mounting of the ignition member for the combustible fuel mixture, and the third (9) to enable the burnt gases to escape.

In the opening 7 enabling the combustible mixture to be introduced into the explosion chamber 6 there is a valve seat 10 fixed by screwing on which the head of the valve 11 rests. The rod of this valve 11, after traversing the sleeve 12 acting for introducing the combustible mixture rests by its end on a cam 13. A spring 14 is also arranged around the rod of the valve 11 and bears on the sleeve 12 so as automatically to bring the valve 11 against its valve seat, as soon as the cam 13 allows it.

This cam 13 is, for example, rotatively driven by a gear device from the driving shaft.

Whatever the device used for controlling the cam 13, the valve 11 is separated from its valve seat 10 at the required moment, so as to enable the introduction of the combustible mixture into the explosion chamber 6. This valve 11 is also brought into contact with its valve seat 10 immediately before firing, so as to close the explosion chamber 6.

As soon as the explosion occurs, by means of the ignition member 15 fixed in the opening 8, the power produced by this explosion acts on the sliding piston 5 of the rotor 4, so as to displace it. Actually, it should be noted that the only movable element in this motor is the rotor 4. Consequently, as soon as the explosion occurs, the power produced acts on the sliding piston 5 so as to revolve it which drives the rotor 4 and hence the driving shaft 4_1.

The compressor is a rotary compressor and consists of a cylindrical stator 16 inside of which a rotor 17 revolves.

The combustible mixture is introduced into the explosion chamber coming from the compressor which is mounted on the same spindle as the motor and which is connected to the latter by a duct 19 emerging in the sleeve 12 for introducing the combustible mixture.

The stator 16 and rotor 17 are made cylindrical and the rotor 17 comprises a slot 17_1 which traverses it from side to side. Inside this slot there is a sliding piston 5*a* which bears by its two ends against the wall of the stator thus delimiting the compression chambers.

The lateral and end walls of the sliding piston are provided with segments 5_5 and 5_6, FIG. 7, the segment 5_5 mounted at the end of the sliding piston being enclosed at its ends by two segments 5_6 placed on the lateral walls of the sliding piston 5 and 5*a*.

Seeing that the sliding piston 5*a* traverses the rotor 17 from side to side, there are two compressions per revolution of this rotor.

On the wall of the stator 16 are two openings 18 and 19. The one (18) acting for introducing the combustible mixture which is not yet compressed, the other (19) which is connected to a sleeve 12 of the power member acting for the passage of the compressed combustible mixture to convey it into the explosion chamber 6 of the motor.

The sliding piston delimiting the chambers of the motor or compressor can be made in two elements 5_3 and 5_4, or $5a_3$ and $5a_4$ (see FIGURE 7).

In this case these two elements are separated by springs 20_1 and 20_2 which constantly tend to keep them apart from each other so as to press them against the wall of the stator.

Tight-sealing washers formed by metal segments or the like are provided on the periphery of the two elements 5_3 and 5_4 of the sliding piston 5 and corresponding parts of piston 5*a* so as to ensure good gas-tightness of the explosion or compression chambers.

In this rotary motor the combustible mixture utilized can be an air-gasoline mixture in the proportions of 1 gram of gasoline for 16 to 20 grams of air.

This motor operates in the following manner:

When starting up the driving shaft 4_1 is driven by the starter or crank and drives the rotor of the compressor. The compressor sucks the combustible mixture through a carburetor fixed at 18 and compresses it, the valve 11 being closed by the spring 14 and the cam 13. When the rotation of the rotor 17 of the compressor has determined a sufficient compression of the mixture the cam 13 acts on the valve so as to allow the mixture to enter the motor cylinder. When the sliding piston 5 is in the axis of the spark plug, the valve 11 drops on to its seating 10 and the mixture is fired by the spark plug 15. The explosion then expels the sliding piston 5 by driving the rotor 4 which produces a power stroke. After the

explosion, the burnt gases are exhausted through the exhaust manifold connected at 9.

The sliding piston 5 in continuing its rotation penetrates into the rotor 4 to become lubricated and cooled; at this moment, it is the other end of the sliding piston 5 which comes out of the rotor for ensuring the second power stroke.

This motor thus gives two power strokes per revolution. However, it is possible to obtain 4-stroke motors or more by associating two or more cylinders.

The motor-compressor unit according to the invention is made in actual practice in the manner shown in FIGURES 2–7.

In this example of a preferred embodiment the rotor 21 of the motor and the compressor is made in a single part.

This embodiment enables cooling gills 24 to be placed inside the rotor, which, turned in a suitable direction, enable an air current to be set up with the outside of the motor. In this case the cheeks 30_1 and 30_2 maintaining the rotor have cavities enabling the passage of air from one end to the other of the motor-compressor unit. Water cooling can also be effected, in which case the gills 24 of the motor cylinder are replaced by a jacket which is supplied by a water pump, with a radiator in the circuit.

The stator able to be used for this kind of rotor is shown in FIGURES 9 and 10.

The stator in the case of the rotor common to the motor and compressor may be made in the manner shown in FIGURE 2.

In this embodiment, the stator is made in separate elements which are assembled to each other by fitting in and by means of threaded rods 28 and nuts 28_1. We thus have two cylindrical elements 29_1 and 29_2 respectively forming the parts of the stator reserved for the motor and compressor, two cheeks 30_1 and 30_2 placed at the ends of the motor-compressor unit and on which the shaft 4_1 of the rotor revolves through bearings and journals 31_1 and 31_2, and an intermediate partition 32, placed between the cylinders 29_1 and 29_2 of the motor and compressor. The partition 32 separates the chambers of the motor and compressor. Cooling gills 33 are also placed around the cylinder 29_1 of the power member, so as to facilitate heat exchange with the ambient air.

All these separate elements: cylinders 29_1 and 29_2, cheeks 30_1 and 30_2, intermediate element 32 are provided on their lateral walls with annular grooves for some of them and annular flanges for the others so that all these elements can be inserted into one another, to ensure their position and obtain a good seal-tightness.

The rotor that may be used in this type of motor arrangement is shown in FIGS. 4–6. Rotor 21 comprises two parts of different diameter and width, part 21_1 is reserved for the power function and has a larger diameter and a smaller width than the part 21_2 which is reserved for the compressor function. In the parts 21_1 and 21_2 there are two slots 22_1 and 22_2 respectively which receive the sliding pistons delimiting the explosion and compression chambers. Cooling gills 24 are placed within the rotor and enable an air current to be set up with the outside of the motor.

The shaft 4_1 of the rotor comprises an axial duct 34 in which a flow of oil circulates enabling both cooling to be effected and the movable sliding piston 5 to be lubricated.

On axial ducts 34 there are also several connections 34_1, 34_2, 34_3, 34_4, 34_5 which emerge on the wall of the rotor and enable the oil to lubricate the parts in sliding contact between the rotor and stator.

Thus, the two ducts 34_1 and 34_2 emerge in the bearings 31 and 32 of the cheeks 30_1 and 30_2 whereas the ducts 34_3, and 34_4 and 34_5 emerge on the periphery of the rotor in contact with the stator.

In FIGURE 7 a rotor is shown provided with its sliding piston 5 and 5*a* made in two hollow parts 5_3 and 5_4, and a complete oil cooling and lubricating circuit.

The oil circuit is a closed circuit and comprises a tank 35 from which the oil is distributed. The movement of the oil is effected by a pumping device formed by the sliding piston 5 of the motor and compressor and ball flap-valves 36 and 37 and springs 36_1 and 37_1.

Actually, the elements 5_3 and 5_4 of the sliding piston when they are rotatively driven move with a to-and-fro movement which sucks in and then delivers a certain quantity of oil at each revolution of the rotor. It is then only necesary to place the flap-valves 36 and 37 in the inlet and outlet ducts for the fluid to give a circulation in the direction *f* of the oil. The flap-valves 36 and 37 are placed in such a manner that the fluid first passes into the part of the rotor reserved for the motor before passing into the part of the rotor reserved for the compressor. For that purpose the spring 36_1 of the flap valve 36 is arranged between the latter and the conduit 34_1 in such a manner that the said flap valve 36 under pressure by oil in the direction *f* cannot block up the conduit 34_1 and if the oil is moved in the opposite direction it would block the conduit 35_1 connected with reservoir 35. In a similar manner the spring 37_1 of the flap valve 37 is arranged between the latter and the conduit 35_2 connected with the reservoir 35 in such manner that the said flap valve 37 under pressure of oil in the direction *f* cannot block up the conduit 35_2 and if the oil is moved in the opposite direction it would block up conduit 34_2. In each rotor part the oil passes along and across the axis of the rotor, then penetrates between the basic parts of each sliding piston and into the piston interior. The oil is divided to pass into two directions by the friction contact surfaces of the pistons. This arrangement thus enables the power member to be cooled by the cold oil then to heat the compressors by the oil heated in the power member; we may thus prevent the motor from reaching too high a temperature while ensuring the lubrication of friction parts.

In order to obtain a better output, the exhaust gases of the motor can also be utilized for heating the air-gasoline mixture compressed and heated in the compressor.

Pressure conditions and temperatures in this motor unit are appreciably as follows:

(1) Entry of air into the compressor=1 atmosphere abs. 20° C.
(2) Exit from the compressor=6 atmospheres abs. 200° C.
(3) Exit from reheater=6 atmospheres abs. 290° C.
(4) Combustion chamber=6 atmospheres abs. 720° C.
(5) Exit from motor=1 atmosphere abs. 400° C.

These conditions appreciably respected will enable us to obtain an output of about 32 to 36%.

The advantages of this motor are more particularly the following:

(1) Simple construction, very low cost price.
(2) Very high power-to-weight ratio, there being no free forces, it can attain high speeds.
(3) The output may be kept almost constant, even with a partial load.
(4) Possibility of employing a cheap fuel.

What I claim is:

1. An internal combustion rotary device comprising a motor and a compressor, a cylindrical stator common to said motor and compressor, end plates covering the ends of said stator and having openings for passage of cooling air, an axially hollow, cylindrical rotor common to said motor and compressor, said rotor comprising a pair of axially disposed cylindrical rings, one of said rings for said motor and the other of said rings for said compressor, shaft means extending along the axis of said cylindrical rings and spaced therefrom, and support means transverse to said shaft means, one of said support means supporting the axially adjacent ends of both said cylindri-

cal rings and separate support means supporting the axially remote ends of said cylindrical rings, all said support means having passages for the passage of cooling air axially through said rotor, a channel in each ring extending diametrically thereof and through said shaft, said shaft means being journaled in said end plates with the rotor axis displaced from the stator axis, a pair of hollow sliding pistons in each channel, said pistons extending beyond the periphery of said rotor, resilient means intermediate each said pair of pistons retaining the radially outer ends of said pistons in contact with the inner cylindrical surface of said stator, said openings in said end plates, said passages through said support means and the space intermediate said rotor rings and shaft means being in alignment during rotor rotation to provide a circulation of cooling air through said hollow rotor, a closed circuit in said device for cooling and lubricating oil moved by said sliding pistons, said circuit including axial passage means in said shaft means communicating with said channels intermediate the pair of pistons therein to permit penetration of oil between the pairs of said pistons and radial passages in each said support means communicating said axial passage means with the surface of the stator surrounding the periphery of the rotor, inlet passage means communicating with said axial shaft passage at the motor end of said shaft means, outlet passage means communicating with said shaft passage at the compressor end of said shaft means, a sump tank communicating with said inlet and outlet passage means, cooling means on said sump tank, and check valves arranged in said oil circuit to force oil successively first across the motor and then across the compressor, inlet means supplying a combustible mixture to said compressor, exhaust means from said motor, outlet means from said compressor communicating with inlet means to said motor, and ignition means in said motor.

2. An internal combustion rotary device comprising a motor and a compressor, a cylindrical stator common to said motor and compressor, end plates provided with openings for passage of cooling air covering the ends of said stator, a rotor common to said motor and compressor, said rotor comprising a cylindrical ring having axially disposed motor and compressor sections, shaft means extending along the axis of said cylindrical ring, and support means transverse to said shaft means supporting said ring spaced from the shaft means, said support means having passages for the passage of cooling air axially through said rotor, a pair of axially aligned channels one in each of said ring sections extending diametrically thereof and through said shaft means, said shaft means being journaled in said end plates with the rotor axis displaced from the stator axis, a pair of hollow sliding pistons in each channel, said pistons extending beyond the

periphery of said rotor, resilient means intermediate each said pair of pistons retaining the radially outer ends of said pistons in contact with the inner cylindrical surface of said stator, a closed circuit in said device for cooling and lubricating oil moved by said sliding pistons, said circuit including axial passage means in said shaft means communicating with said channels intermediate the pair of pistons therein to permit penetration of oil between the pairs of pistons and radial passages in said support means communicating said axial passage means with the surface of the stator surrounding the periphery of the rotor in each of said motor and compressor sections, a pair of conduits communicating with said axial passage means at the motor and compressor ends of said shaft means, a sump tank connected to said pair of conduits, and check valves arranged in said oil circuit to force oil in one direction through said closed circuit.

3. An internal combustion rotary device as claimed in claim 2 wherein at least a pair of check valves is arranged in said oil circuit to force oil successively first across the motor and then across the compressor.

4. An internal combustion rotary device as claimed in claim 2 wherein said pair of channels are formed in said ring support means of said rotor.

5. An internal combustion rotary device as claimed in claim 2 wherein said sump tank is spaced from the stator and rotor and is provided with cooling means.

References Cited by the Examiner

UNITED STATES PATENTS

763,773	6/04	Marlitt	123—16
851,962	4/07	Prossen	123—8
969,957	9/10	Jacobs.	
972,071	10/10	Fitch	123—8
990,742	4/11	Jacobs	123—8
1,769,822	7/30	Blackman	123—16
1,839,275	1/32	Sweningson	123—8
2,013,916	9/35	Jackson	123—16
2,162,851	6/39	Lister	123—8
2,174,664	10/39	Korany	123—16
2,175,265	10/39	Johnson	123—8
2,345,561	4/44	Allen	123—16
2,367,326	1/45	Beckman	230—153

FOREIGN PATENTS

71,998	10/59	France—
		(Addition to No. 1,145,461, 5/6/57)
421,292	5/47	Italy.

SAMUEL LEVINE, *Primary Examiner.*

KARL J. ALBRECHT, RALPH H. BRAUNER, JOSEPH H. BRANSON JR., *Examiners.*