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MACHINES AND IN PARTICULAR INTERNAL COMBUSTION ENGINES HAVING AN ECCENTRICALLY MOUNTED ROTOR WITH RADIAL BLADES SLIDABLE THEREIN

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Fig. 2.

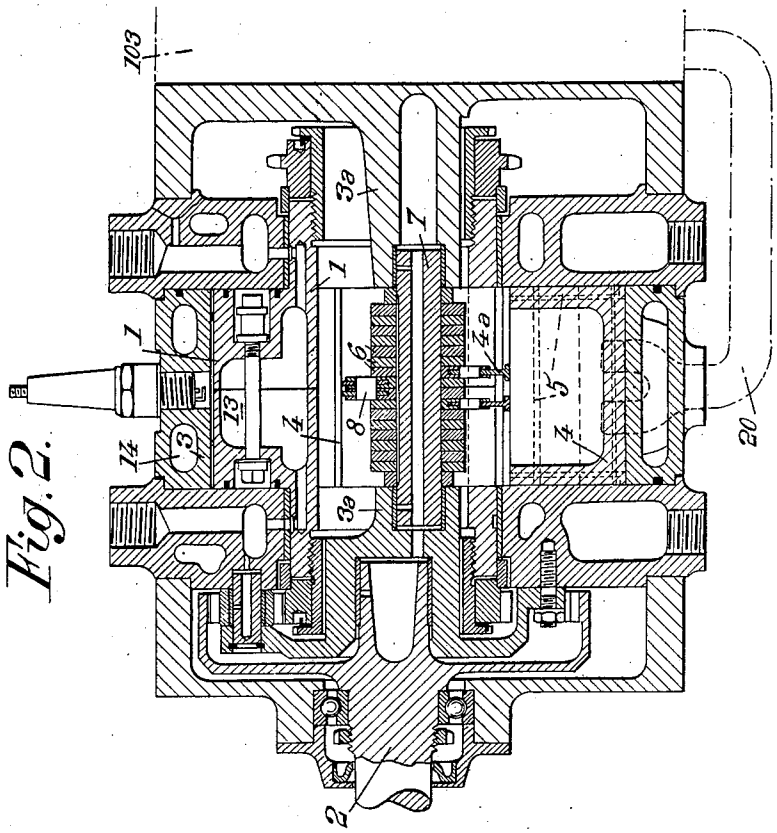


Fig. 1.

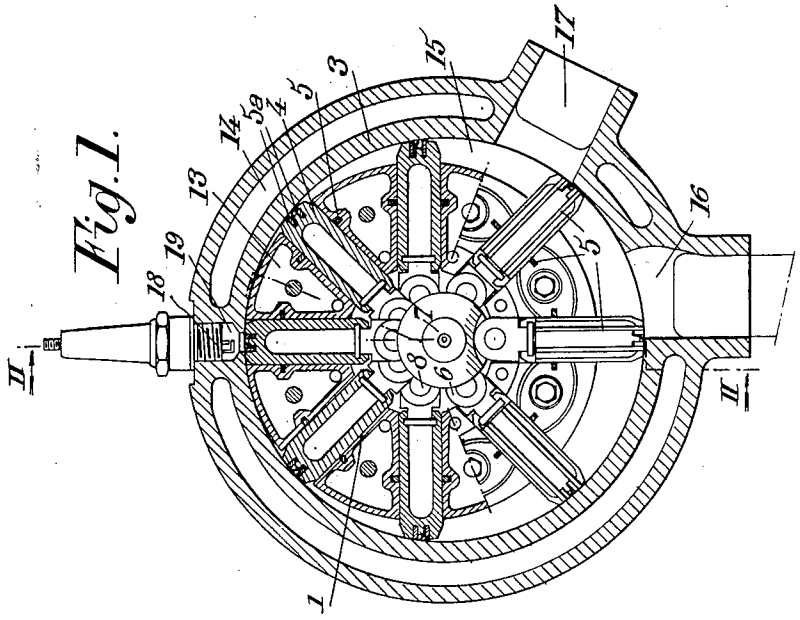


Fig. 3a

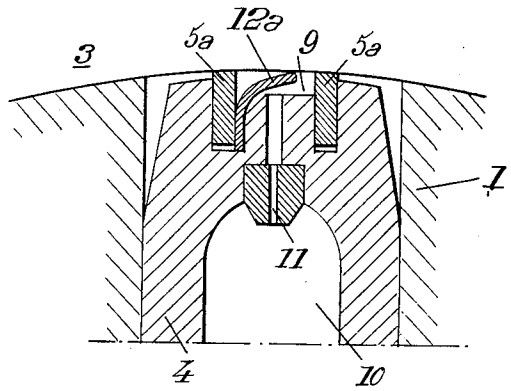
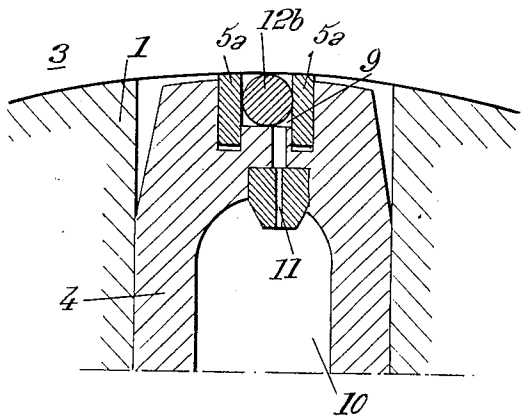


Fig. 3b.



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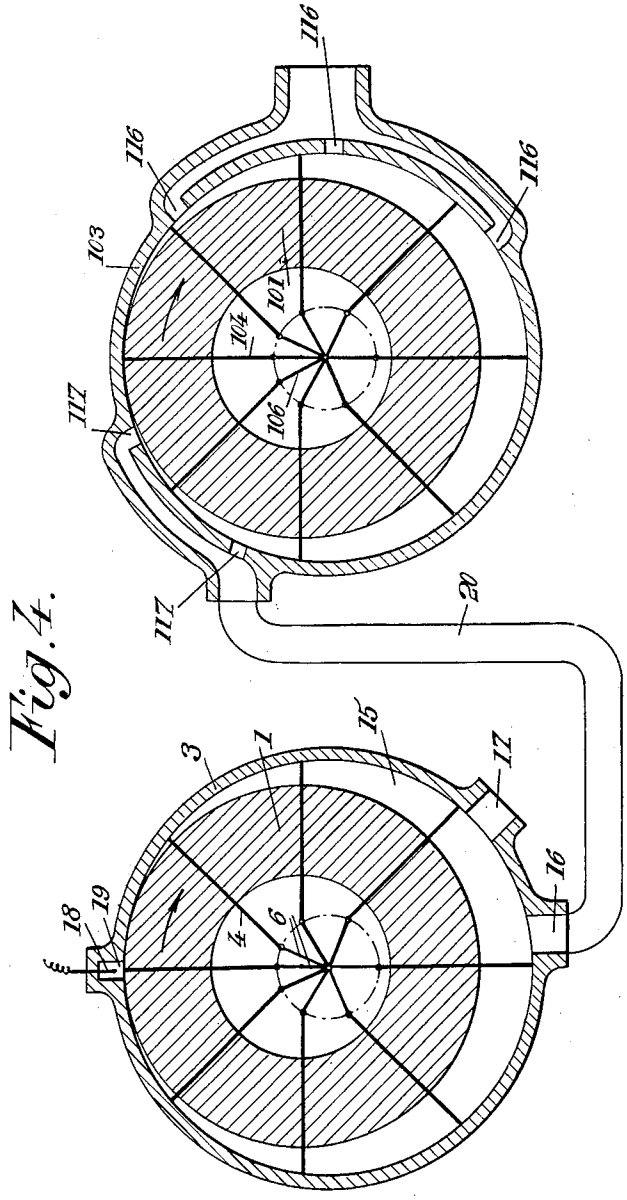


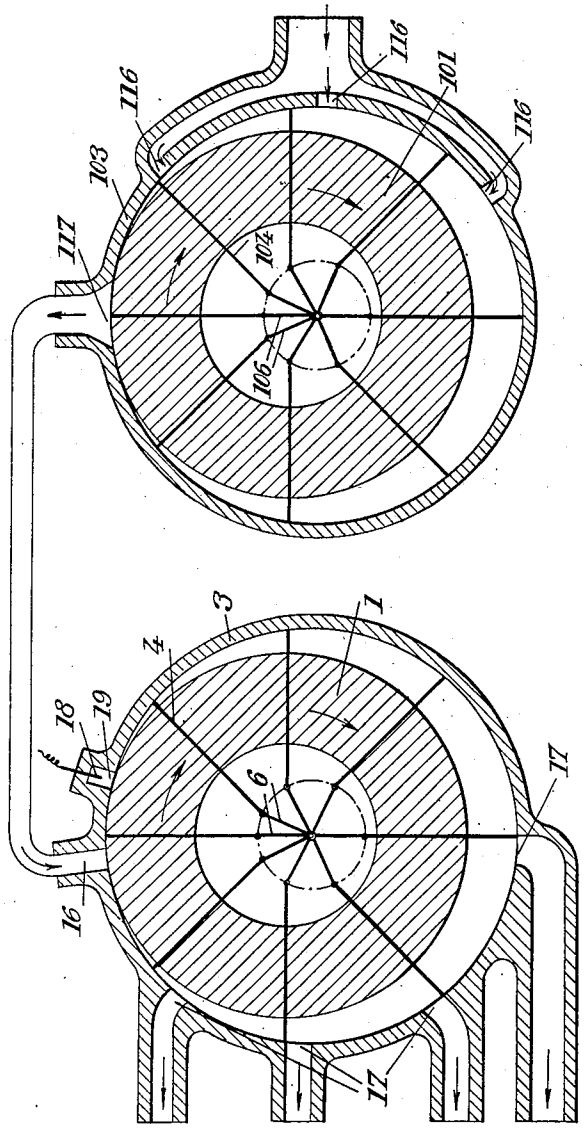
Fig. 4.

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MACHINES AND IN PARTICULAR INTERNAL COMBUSTION ENGINES HAVING AN ECCENTRICALLY MOUNTED ROTOR WITH RADIAL BLADES SLIDABLE THEREIN

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Fig. 5.



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Fig. 6.

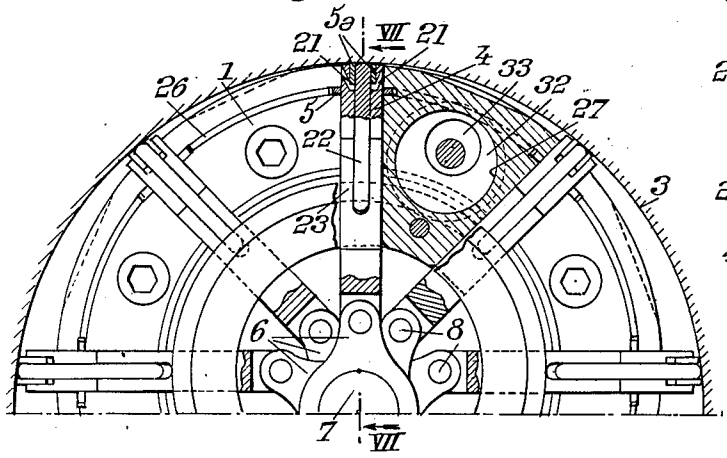


Fig. 7.

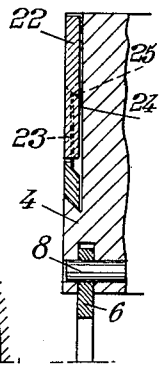


Fig. 6a

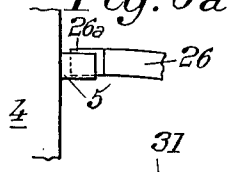


Fig. 8.

Fig. 9.

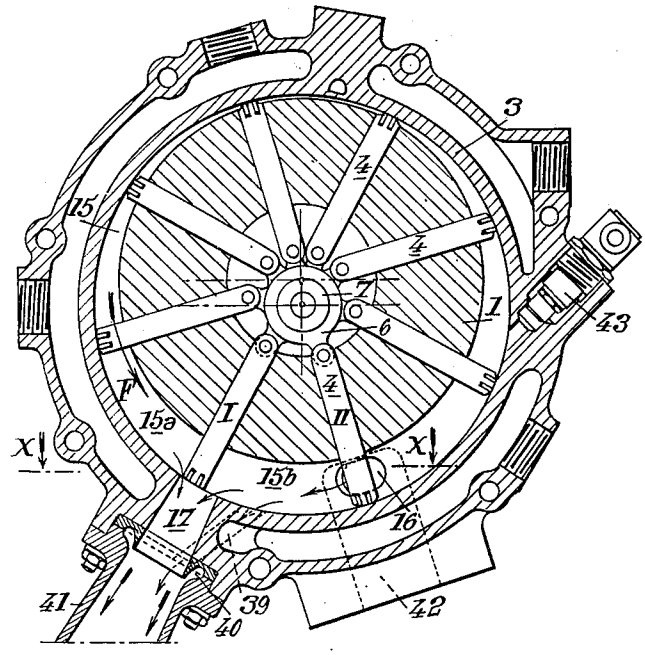
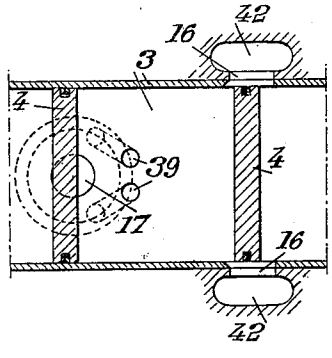

3
4
15
4
7
1
6
43
4
F
15a
I
II
X
X
15b
17
16
41
39
40
42

Fig. 10.


42
16
3
4
39
4
17
16
42

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MACHINES AND IN PARTICULAR INTERNAL COMBUSTION ENGINES HAVING AN ECCENTRICALLY MOUNTED ROTOR WITH RADIAL BLADES SLIDABLE THEREIN

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Fig. 13.

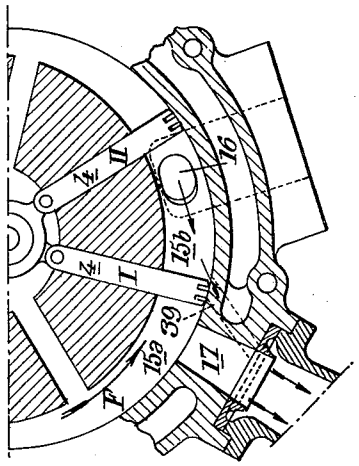


Fig. 12.

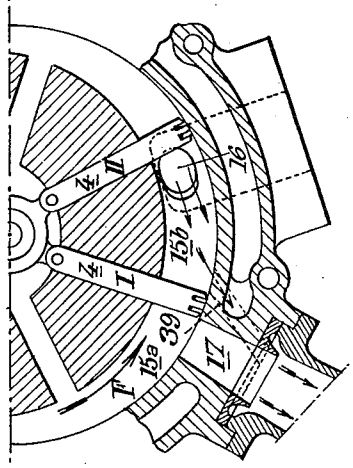
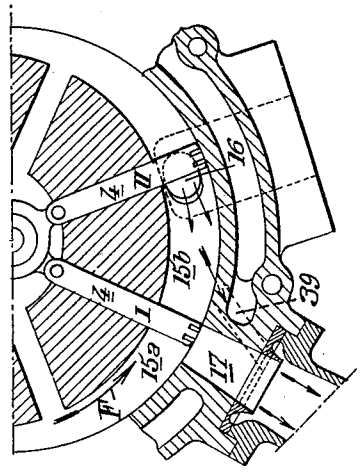


Fig. 11.



United States Patent Office 3,103,920 Patented Sept. 17, 1963

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MACHINES AND IN PARTICULAR INTERNAL COMBUSTION ENGINES HAVING AN ECCENTRICALLY MOUNTED ROTOR WITH RADIAL BLADES SLIDABLE THEREIN

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Filed July 20, 1961, Ser. No. 125,429
Claims priority, application France Aug. 4, 1960
9 Claims. (Cl. 123—16)

The present invention relates to improvements in machines, and in particular internal combustion engines, having an eccentrically mounted rotor with radial blades slidable therein so as to form, with the external wall of the rotor and the internal wall of a casing surrounding it, a plurality of chambers the respective volumes of which vary constantly during the rotation of the rotor, said chambers being provided with inlet and outlet orifices.

The object of my invention is to provide a machine of this kind which is better adapted to meet the requirements of practice than those used up to the present time.

For this purpose the machine according to my invention, which comprises a rotor in the form of a body symmetrical about an axis and rotatable about said axis, said rotor having mounted therein a plurality of radial blades each slidable in the rotor in a plane passing through said axis, said blades cooperating with a casing surrounding the rotor, is characterized in that a plurality of links are interposed between said blades, respectively, and a shaft or spindle extending along a second axis parallel to the first mentioned one to control the sliding movements of the blades in the rotor, the casing disposed about said rotor being in the form of a surface surrounding, with a very small clearance, the surface generated by the outer edges of said blades when the rotor is rotating in the fixed casing.

Other features of my invention will be hereinafter set forth in the following description with reference to the appended drawings, given merely by way of example and in which:

FIG. 1 is a cross-sectional view of an internal combustion engine made according to a first embodiment of this invention.

FIG. 2 is a longitudinal sectional view on the line II—II of FIG. 1.

FIG. 3*a* is a cross-sectional view on an enlarged scale of a particular embodiment of packing means provided on the outer edge of the blades.

FIG. 3*b* is a view similar to 3*a* showing a modification.

FIG. 4 is a diagrammatical view of an internal combustion engine according to this invention provided with a feeding pump.

FIG. 5 is a view similar to FIG. 4 relating to a modification.

FIG. 6 is a cross-sectional view of an internal combustion engine made according to a second embodiment of the invention.

FIG. 6*a* is an enlarged view of a portion of FIG. 6.

FIG. 7 is a detailed view in section on the line VII—VII of FIG. 6.

FIG. 8 is a longitudinal sectional view of the engine of FIG. 6.

FIG. 9 is a cross-sectional view of an internal combustion engine made according to another embodiment of the invention.

FIG. 10 is a sectional view on the line X—X of FIG. 9.

FIG. 11 to 13 inclusive are sectional views showing three successive relative positions of the parts of the engine of FIG. 9.

The internal combustion engine shown by FIGS. 1 and 2 comprises a rotor 1 coupled through suitable

gear means (shown on the left hand side of FIG. 2) with a shaft 2 which is the output or driven shaft of the engine. Rotor 1 is mounted eccentrically in a casing 3 the exact shape of the inner wall of which will be hereinafter defined but which may be considered approximately as belonging to a circular cylinder. The eccentricity of the rotor is for example equal to one half of the difference between the diameter of the inner wall of the casing and the diameter of the outer wall of the rotor, said rotor being substantially tangent to the inner wall of the casing.

Rotor 1 is provided with radial housings the number of which is eight in the example of FIG. 1 and a blade 4 is slidably mounted in each of these housings with the interposition of packing members 5 between said blade and the walls of the corresponding housings.

According to the present invention each of these sliding blades 4 is connected through a link, or rather through a pair of links, 6 with a spindle 7 coaxial with casing 3, which means that the axis of this spindle 7 is at a distance from the axis of rotor 1, said spindle 7 being journalled in inner projections 3*a* rigid with casing 3.

The inner wall of casing 3 is in the form of a surface surrounding with a very small clearance the surface generated by the outer edge of blades 4.

Thus blades 4, which are subjected to the action of the centrifugal force when the rotor is being driven in rotation, are prevented from scraping against the inner wall of casing 3, which avoids any risk of deterioration of said inner wall.

It will be noted that links 6 may be made of relatively light weight since they have to support only the outwardly pulling forces of blades 4 but do not serve to transmit the power developed by the engine.

Preferably, as shown by FIG. 2, the pairs of links 6 of blades 4 are arranged in such manner that the two links of one blade fit between the two links of the diametrally opposed blade, all the annular heads of the links adjoining one another along spindle 7 as shown by FIG. 2.

It should be noted that the relative movement of two adjoining link heads connected to different blades is a mere movement of oscillation of relatively small amplitude so that heating and rapid wear of adjoining surfaces cannot take place.

Every annular link 6 is pivotally connected with the extension 4*a* of the corresponding blade by a pin 8 of a length such that the ends thereof are flush with the flat sides of said link 6. Furthermore the inner portion of said spindle is at a distance from the axis of spindle 7 smaller than the outer diameter of annular links 6 so that this pin 8, once mounted in position, is prevented from moving in its axial direction by the side walls of the annular links 6 between which it is mounted.

In order to make fluid-tight the variable volume chambers limited by blades 4, I provide the edges of said blades with small packing members 5*a* adapted to slide radially in guiding grooves provided in said blade edges.

Advantageously, as shown by FIG. 3*a*, the edge of every blade 4 is provided with two packing members 5*a* parallel to each other and limiting between them a fluid-tight chamber 9. This chamber 9 is fed with a lubricating liquid fed, under the action of the centrifugal force, through a passage 10 extending radially in the body of the blade and communicating with said chamber 9 through at least one calibrated hole 11. Between these two packing members 5*a* there is mounted a resilient plate 12*a* housed for instance in the groove of one of the packing members 5*a* (that located rearwardly with respect to the direction of rotation of rotor 1) said plate being bent

toward the front so as to bear resiliently against the inner wall of casing **3**.

This plate **12***a* improves the fluid tightness of chamber **9**, which achieves a permanent lubrication without substantial leakage of the portion of the inner wall of casing **3** against which packing members **5***a* are bearing.

In a modification illustrated by FIG. 3*b* I make use, instead of such a plate **12***a*, of a cylindrical element **12***b* (roller or needle for instance) disposed freely between packing members **5***a* and of a diameter substantially equal to the distance between said members.

The lubricating means above described serve also as cooling means. Cooling of the engine may be further improved by providing respectively in rotor **1** and in casing **3**, passages **13** and **14** for circulation of a cooling fluid such for instance as oil for rotor **1** and water for casing **3**.

The periphery of casing **3** must be provided with ports for the feed of an air (and fuel) to the variable volume chamber **15** provided between blades **4** and for the exhaust of the burnt gases from said chambers.

These orifices or ports are disposed in accordance with the cycle of operation of the engine and in particular with the rate of feed thereof.

Anyway, it is necessary to provide at least one inlet orifice **16** and one exhaust orifice **17**, igniting means such for instance as a burner or a sparking plug **18** being provided in a recess **19** formed in casing **3** between orifices **16** and **17**, at the place where rotor **1** is closest to the inner wall of casing **3**.

I will describe by way of example two constructions according to my invention where the internal combustion engine such as above described is fed with fuel from a pump which is preferably of the same type as the engine itself, that is to say including an eccentrically mounted rotor and sliding radial blades.

FIG. 4 shows the first construction, wherein the engine is fed at low pressure for scavenging and filling purposes, the engine proper then producing the supplementary compression, the expansion after ignition and the exhaust. The internal combustion engine proper, shown on the left hand side of FIG. 4, is similar to that of FIGS. 1 and 2, the inlet orifice **16** being mounted at a point substantially diametrally opposed to the igniting means **18** and the exhaust orifice **17** being located at the rear of said inlet orifice (the terms rear and front being taken in relation to the direction of rotation of the rotor), the distance between the exhaust and inlet orifices **17** and **16** respectively being smaller than the distance between two consecutive blades so as to ensure scavenging of the burnt gases.

The pump for feeding for instance a fuel and air mixture is shown on the right hand side of FIG. 4. It comprises an eccentrically mounted rotor **101**, sliding radial blades **104**, a casing **103**, a plurality of inlet orifices **116** distributed over an arc substantially located in the middle part of the periphery of the casing where the volume of the chambers limited by the blades increases and several delivery orifices **117** located in the portion where the volume of these chambers is close to its minimum value. These orifices **117** open into a conduit **20** leading to the inlet orifice **16** of the internal combustion engine proper.

According to the second construction, illustrated by FIG. 5, a fuel and air mixture is fed under high pressure to the inlet orifice **16**, which is located at a short distance before igniting device **18**, where the volume of the variable volume chamber **15** is nearly minimum. Several exhaust orifices **17** preferably independent are provided over an arc of more than 90°, for instance of 135°, starting from the point where the volume of the variable volume chamber begins to decrease. The pump for feeding the air and fuel mixture, shown on the right hand side of FIG. 5, is similar to that of FIG. 4 with

the only difference that it has a single delivery orifice located close to the point where rotor **101** is tangent to the inner wall of casing **103**.

It is pointed out that in both of these constructions super-charging of the engine may be obtained by increasing the speed of rotation of the pump with respect to that of the engine.

In both cases, the pump may be mounted side by side with the engine proper, for instance as shown by FIG. 2.

FIGS. 6 to 8 show a second embodiment of an internal combustion engine according to this invention. The reference numerals on FIGS. 6 to 8 are the same as for FIGS. 1 and 2 to designate the same parts.

In the construction of FIGS. 6 to 8, packing members **5***a* have curved edges so that they bear against the inner wall of casing **3** along generatices of said wall; furthermore, the bottoms of the grooves in which these members **5***a* are housed communicate, in the construction of FIGS. 6 to 8, each with the adjoining variable volume chamber for instance through one or several conduits **21** provided in the blade.

This arrangement ensures some compensation between the pressures exerted by the gases respectively on the external edge of the packing member and on the internal edge thereof, said members **5***a* being constantly urged outwardly, that is to say against the inner wall of casing **3**, by the action of the centrifugal force produced by the rotation of blades **4**.

It should be noted that this compensation between the pressures exerted upon the external and internal edges of packing members **5***a* is obtained without risk of passage of gas from one variable volume chamber to the next one, since there are two packing members **5***a* on every blade and the grooves containing said members **5***a* each communicate only with one of the two chambers located on opposite sides of the radial blade that is considered.

According to another feature of this invention, each of the two side walls of every radial blade **4** is provided with two overlapping packing members, to wit a rectilinear packing member **22** to provide fluid-tightness between two adjacent variable volume chambers and a U-shaped packing member **23**, the branches of which extend along said rectilinear packing members **22** on either side thereof and the opening of which is directed toward the outer periphery of the rotor.

It should be noted that the rectilinear packing member **22** is applied against the side wall of the casing by the gaseous pressure existing in the groove **24** where said packing member **22** is housed.

The pressure with which packing members **22** are applied against the side walls of the casing may be increased by providing each of said packing members **22** with a bevelled edge bearing against the packing members **5***a* provided on the edges of the blades, so that the centrifugal force which urges packing members **22** outwardly gives rise, through said bevelled edge, to a lateral reaction applying said members **22** against the side walls of the casing.

As for U-shaped packing member **23**, it is also subjected to a gaseous pressure tending to apply it against the cooperating side wall of the casing. This action may be increased by giving a bevelled shape to the ends of the branches of each member **23**, the ends **25** of the housing provided in blade **4** to accommodate each packing member **23** being correspondingly bevelled.

According to still another feature of this invention, I provide on the side walls of rotor **1** arcuate packing members **26** extending along circular arcs and the ends **26***a* of which project over the ends of the grooves where are housed the rectilinear packing members **5** cooperating with blades **4**, as shown by FIG. 6*a*, whereby said rectilinear packing members **5** are held in their respective grooves by the projecting ends **26***a* of arcuate packing members **26**.

According to still another feature of this invention, an efficient cooling of rotor **1** is obtained by providing in said

rotor recesses 27 through which is circulated a cooling fluid coming from a fixed conduit 28, this fluid entering the rotor through passages 29 and leaving it through passages 30, the outer ends of which are at a greater distance from the axis of rotation than the outer ends of passages 29, the fluid being finally evacuated through a fixed conduit 31.

With such an arrangement, rotor 1 acts, concerning the cooling liquid, as a centrifugal pump, which ensures circulation of said liquid.

It should be noted that there may be provided in every recess 27 a deflecting member arranged to compel the cooling fluid to flow along the hottest portion of rotor 1. Such a deflecting member is shown at 32 and is provided with a transfer passage 33 for the flow of the cooling fluid.

According to still another feature of this invention, the links 6 cooperating with blades 4 and said blades themselves are lubricated as follows:

Lubricant is fed to the inside of shaft 7 which carries the annular links 6, the row formed by these links being held in position by rings 34 located at the ends of this row.

Shaft 7 is provided with one or several holes 36 through which lubricant passes from the inside of shaft 7 to the space between said shaft and annular links 6.

Rotor 1 is provided with rotating rings 37 one of the walls of which, and preferably both of said walls, comprises helical grooves 38 arranged so that a suction is exerted when said rings are rotating to produce the circulation of lubricant which is thus forced through shaft 7.

FIGS. 9 to 13 illustrate another feature of the invention relative to an internal combustion engine of the kind of that of FIGS. 1 and 2, that is to say an engine wherein the angular offsetting between the inlet orifice 16 and the exhaust passage 17 corresponds at least approximately to the angle made by two successful radial blades 4. In these figures rotor 1 rotates in the direction of the arrow F.

In this construction, there is provided a connecting conduit 39 extending between exhaust passage 17 and a point of the inner wall of casing 3 located between the orifice of exhaust passage 17 and inlet orifice 16.

This connecting passage 39 is arranged in such manner that the gases escaping through exhaust passage 17 produce a suction in said conduit and therefore in the chamber 15*b* which is then in communication with said conduit. Thus I obtain an improved scavenging and filling of the variable volume chambers 15 that come successively into communication with connecting conduit 39 so that it may become possible to dispense with a feed of air under pressure to said chambers.

When exhaust passage 17 is in the form of a surface of revolution, for instance of a conical divergent nozzle, I advantageously provide, as shown by the drawings, an annular groove 40 coaxial with said passage 17 and opening thereinto in the direction of the outlet nozzle 41 in line with passage 17. The above mentioned connecting conduit 39 (and preferably two such conduits disposed side by side as shown on FIG. 10) opens into said annular groove 40. When there are two such conduits 39 they advantageously diverge from each other toward groove 40, as shown by FIG. 10. As for inlet 16, it is advantageously constituted by two ports or orifices provided opposite each other in the side walls of casing 3 and fed with air through conduit 42.

The operation of such a device will now be described with reference to FIGS. 9 to 13.

In the position of FIG. 9, a blade 4 designated by reference character I is beginning to move across exhaust passage 17 whereas the preceding blade 4 (designated by reference character II) is beginning to pass across inlet port 16. The variable volume chamber 15*a* which is located at the rear of blade I is at the end of its expansion period and the exhaust period is beginning (through passage 17). The variable volume chamber 15, located between blades 1 and 2 is at the end of its exhaust period (through passages 17 and 39) and air begins to flow thereinto, this effect being accelerated by the suction due to the gaseous circulation through exhaust passage 17.

In the position of FIG. 11, blade I is going to pass beyond exhaust passage 17, whereas blade II is fully clearing inlet port 16. The suction effect is increased due to the fact that the exhaust gases are free to escape through the whole cross-section area of 17, from chamber 15*a*. The end of the scavenging period and the filling of chamber 15*b* with fresh air therefore takes place in excellent conditions.

In the position of FIG. 12, blade I has not yet moved past the opening of connecting conduit 39. As the gases are escaping at high speed from chamber 15*a* the suction effect is still being exerted in chamber 15*b*.

Finally, in the position of FIG. 13, blade I closes the opening of connecting conduit 30 and chamber 15*b* finishes to be filled with fresh air, without any special suction effect, fuel injection taking place during the next step, for instance by means of a fuel injector 43.

In a general manner, while I have, in the above description, disclosed what I deem to be a practical and efficient embodiment of my invention, it should be well understood that I do not wish to be limited thereto as there might be changes made in the arrangement, disposition and form of the parts without departing from the principle of the present invention as comprehended within the scope of the accompanying claims.

What I claim is:

1. An internal combustion engine which comprises, in combination, a stationary casing having an axis of symmetry extending therethrough, a rotor in said casing in the form of a body symmetrical about a second axis parallel to the first one, and fixed with respect thereto, said rotor being rotatable about said second axis, said rotor being provided with radial housings located in respective radial planes passing through said second axis, a plurality of radial blades slidable in said radial housings respectively, a plurality of links each pivoted at one end to said casing about said first mentioned axis, a pin for pivotally connecting the other end of each of said links to one of said blades about an axis parallel to said first and second mentioned axes and located in the plane of said last mentioned blade in fixed position with respect to said blade, each of said pins being sufficiently close to said first mentioned axis to be prevented from moving axially by the links adjoining it, said blades dividing the space between said casing and said rotor into a plurality of variable volume chambers when said rotor is rotating in said casing, the inner wall of said casing that faces said blades being in the form of a surface surrounding, with a very small clearance, the surface generated by the outer edges of said blades when said rotor is rotating in said casing, and packing means slidably carried by the outer edges of said blades to ensure a fluid-tight contact with said casing inner wall.

2. A machine according to claim 1 wherein said packing means comprise two sliding packing members slidably carried by the outer edge of each of said blades to ensure a fluid-tight contact with said casing inner wall, said packing members being parallel to each other and to said edge so as to limit, between them a chamber and means extending through the corresponding blade for feeding a lubricating liquid to said chamber.

3. A machine according to claim 1 wherein the number of said blades is even and they are regularly distributed about the axis of said rotor, a pair of links being provided between each blade and said casing, the two links corresponding to every blade adjoining the two links of the blade diametrally opposed to said first mentioned blade.

4. A machine according to claim 2 further including,

between said packing members, means for preventing leakage of said lubricating liquid.

5. A machine according to claim 2 wherein the edges of said packing members in contact with said casing inner wall are of rounded form, the outer portion of every blade being provided with two parallel grooves to accommodate said packing members, and with passages for connecting the bottoms of said grooves with the variable volume chamber nearest thereto.

6. A machine according to claim 1, said casing being provided, in the portion thereof where said rotor is at a great distance from said casing inner wall, with an air inlet orifice and an exhaust gas orifice, said inlet orifice being ahead of said exhaust orifice, in the direction of rotation of said rotor, said orifices being angularly offset by an amount at least approximately equal to the angle made by two consecutive blades, an exhaust nozzle starting from said exhaust orifice, a connecting conduit extending between said exhaust nozzle and a point of said casing inner wall located between said two orifices, whereby the exhaust gases escaping through said exhaust nozzle exert through said connecting conduit a suction in the variable volume chamber which is at the same time in communication with said inlet orifice.

7. A machine according to claim 6 wherein said exhaust nozzle has circular cross sections and includes an annular groove formed in its wall, coaxially therewith and opening toward the outlet of said exhaust nozzle, said connecting conduit opening into said annular groove.

8. A machine according to claim 6 comprising two such connecting conduits disposed side by side.

9. A machine according to claim 6 comprising two such inlet orifices located opposite each other, in the respective side faces of said casing.

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