July 16, 1968 A. BIZIER 3,392,676

ROTARY FLUID HANDLING MACHINE

Filed June 7, 1966 3 Sheets-Sheet 1

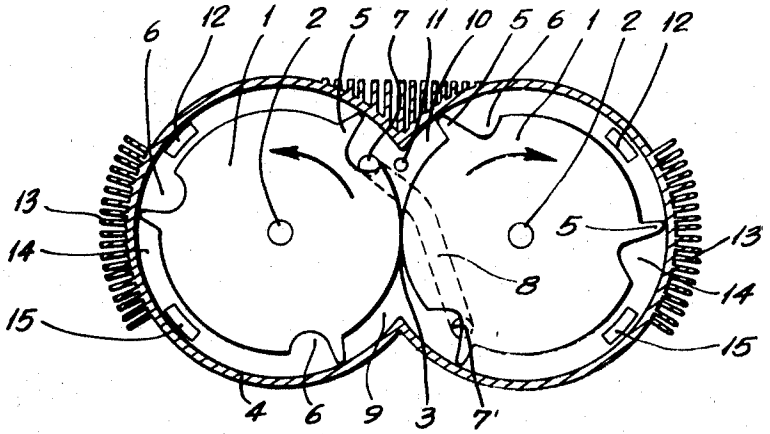


Fig. 1

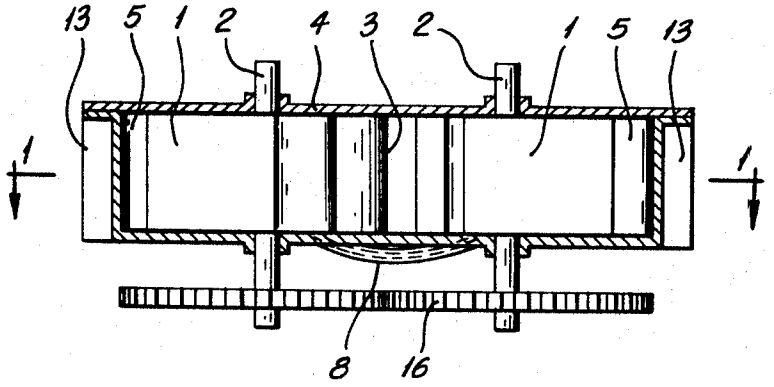


Fig. 2

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ROTARY FLUID HANDLING MACHINE

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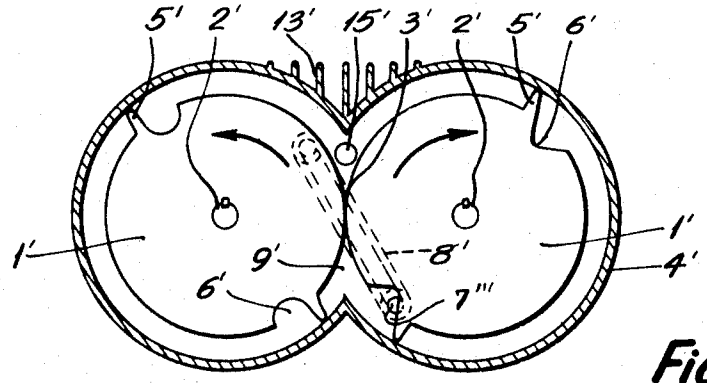


Fig. 3

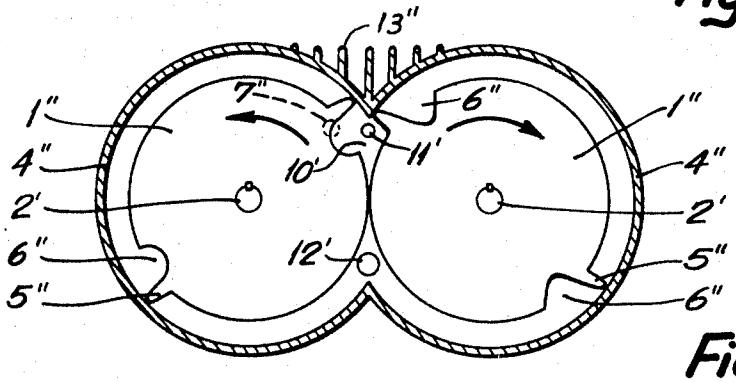


Fig. 4

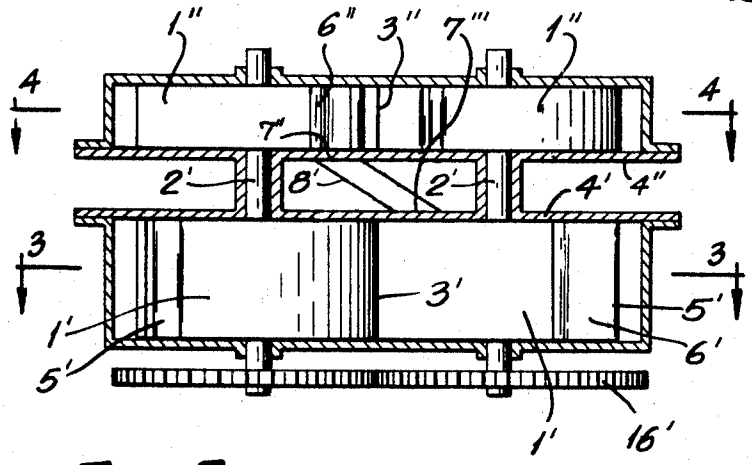


Fig. 5

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ROTARY FLUID HANDLING MACHINE

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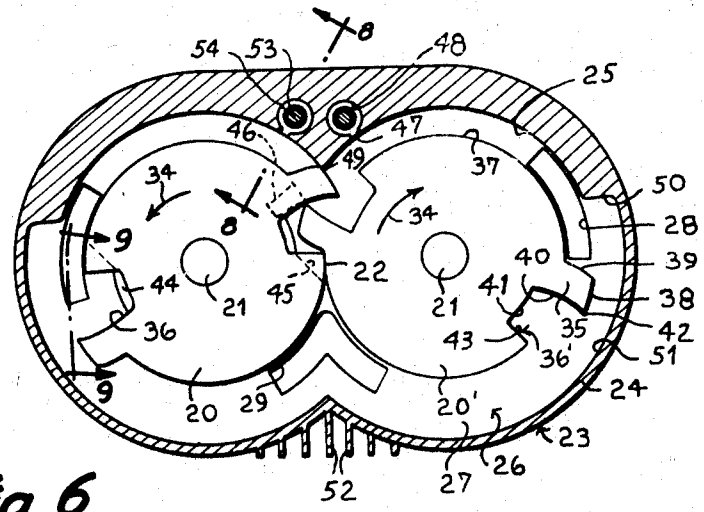


Fig. 6

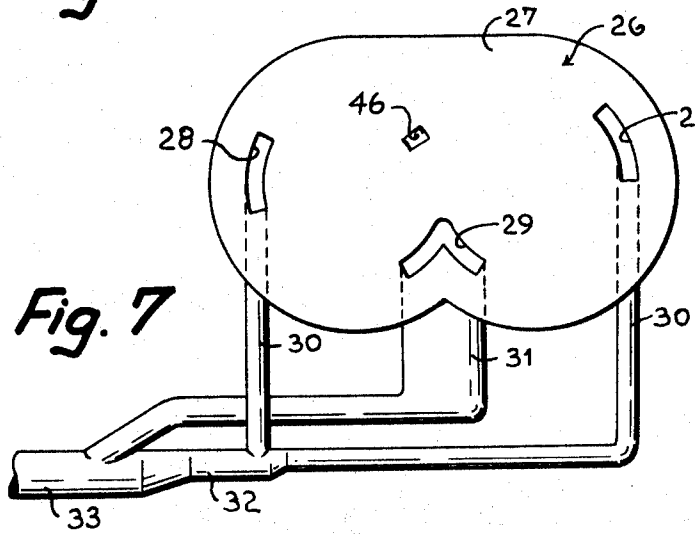


Fig. 7

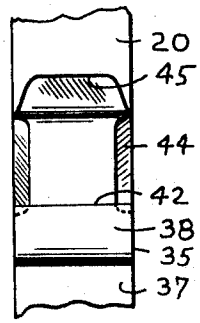


Fig. 9

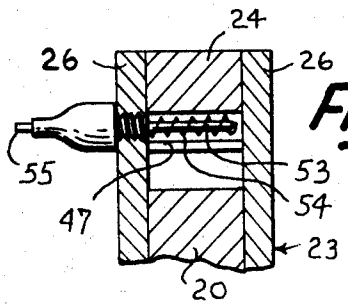


Fig. 8

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United States Patent Office 3,392,676
Patented July 16, 1968

3,392,676

ROTARY FLUID HANDLING MACHINE

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Filed June 7, 1966, Ser. No. 555,793
5 Claims. (Cl. 103—126)

ABSTRACT OF THE DISCLOSURE

This invention concerns a rotary fluid handling machine comprising two synchronously and oppositely rotating rotors in contact with each other, each rotor being provided with piston blades and adjacent notches so the blades of one rotor will engage notches of the other rotor, ports in the path of the notches of said rotors, the notches having bevelled corner surfaces at their bottom terminating at the lateral surfaces of the rotors along a zone radially inwardly closer to the center of rotation than the bottom of the notches, the ports being located in register with said bevelled corners, so as to facilitate the transfer of fluid between the ports and notches.

The present invention resides in rotary fluid handling machines such as air compressors, liquid pumps, fluid motors and rotary internal combustion engines.

More specifically, the rotary fluid handling machine in accordance with the present invention is of the type comprising two cylindrical rotors mounted for rotation in opposite direction on parallel axes and having a common line of contact, said rotors being provided with radially protruding piston blades and adjacent notches so arranged that during rotation, the blades of one rotor will engage the notches of the other rotor, so as to enable free rotation of the two rotors, the piston blades moving in opposite direction and defining on at least one side of the common contact line, a chamber of varying volume.

The general object of the present invention resides in the provision of a rotary fluid handling machine of the above-mentioned type, which has improved design of the piston blades and adjacent notches in the rotors, and improved location of the admission and exhaust ports, so that the rotors will provide themselves the valving means necessary for the admission and exhaust of the fluids.

Another object of the invention resides in the provision of a rotary fluid handling machine of the character described, which can be used as a four-cycle engine or a two-cycle engine.

Another object of the invention resides in the provision of a fluid handling machine of the character described, in which the piston blades of the two rotors are interengageable in a substantially fluid-tight manner immediately past the common contact line of the two rotors, in order to form immediately behind the two piston blades an admission chamber starting to fill with fluid immediately at that instant to thereby result in a much more efficient engine, pump or compressor.

The foregoing and other important objects of the present invention will become more apparent during the following disclosure and by referring to the drawings, in which:

FIGURE 1 is a section perpendicular to the rotor axes of the interior of a rotary internal combustion engine of the two-cycle type in accordance with the first embodiment of the invention, said section being taken along line 1—1 of FIGURE 2;

FIGURE 2 is a plan section of the two-cycle engine of FIGURE 1;

FIGURE 3 is a section perpendicular to the rotor axes of the first cylinder group of a four-cycle engine, said section taken on line 3—3 of FIGURE 5;

FIGURE 4 is a similar section of the second cylinder group of the same four-cycle engine and taken along line 4—4 of FIGURE 5;

FIGURE 5 is a plan section of the four-cycle engine;

FIGURE 6 is a section perpendicular to the rotor axes of another embodiment of an engine of the invention;

FIGURE 7 is an elevation of one lateral wall of the engine casing of FIGURE 6 and showing the exhaust system;

FIGURE 8 is a partial cross-section, taken along line 8—8 of FIGURE 6; and

FIGURE 9 is a partial elevation of the rotor periphery and taken along line 9—9 of FIGURE 6.

Referring now more particularly to the drawings in which like reference characters indicate like elements throughout, referring to FIGURES 1 and 2, there are shown two cylindrical rotors 1 keyed on spaced parallel shafts 2, arranged so that the rotors will have a common line of contact 3 while rotating in opposite directions, as shown by the arrows.

The assembly of the rotors is located in a casing 4 defining two cylindrical interfering chambers having their axes common with the shafts 2.

Piston blades 5 radially protrude from each rotor 1 and have their tip in sliding fluid-tight contact with the cylindrical wall of the chambers of casing 4. The piston blades are preceded or followed by notches 6 made in the peripheral surface of the rotor and enabling the passage of the blades of the other rotor without interference and also in order to control the closing and opening of ports 7 and 7' which open at the lateral face of the casing 4, opposite notches 6, radially inwardly of the peripheral surface of the rotors 1.

Ports 7 and 7' are in communication by a transfer tube 8 external to the casing chambers. Upstream from the contact line 3, there is formed a compression chamber 9, and downstream from said contact line 3, there is formed a combustion chamber 10.

In chamber 10, is located a spark plug 11 exposed at the lateral face of the casing 4. The casing is further provided with exhaust ports 12 opening at the lateral faces thereof, radially outwardly from the rotors.

The exhaust ports 12 are angularly spaced downstream from contact line 3 and at an equal distance.

The engine further includes admission ports 15, equally angularly spaced downstream from the exhaust port 12 and radially outwardly located with respect to the periphery of the rotors 1.

In the two-cycle engine of FIGURES 1 and 2, the transfer tube 8 enables to transfer the compressed combustible gases towards explosion chamber 10, where they are ignited by spark plug 11. The burnt gases are exhausted through exhaust ports 12.

The engine is provided with cooling blades 13 disposed in such a manner as to dissipate the excess heat and produce a depression at the dead center area 14, in order to allow sucking of new combustible gases through admission port 15. The gases are then compressed within chamber 9 upstream from contact line 3 and are transferred into the combustion chamber 10 through tube 8 and the cycle is repeated.

External gears 16 keyed to shaft 2 cause the two rotors to rotate in opposite directions, at equal speeds and at the desired angular relationship. All conventional accessories for internal combustion engines may be used in association with this engine, including, if desired, a super charger to increase the efficiency.

FIGURES 3, 4, and 5 show a four-cycle engine in accordance with the invention. This engine includes two pairs of rotors 1' and 1'' respectively, housed in separate casings 4' and 4'', but the corresponding rotors in the two casings are mounted on the common shafts 2' run-

ning through the two casings and arranged such that the pairs of rotors have a common contact line 3', 3'' respectively.

As in the first embodiment, rotors 1', 1'' have piston blades 5' and notches 6', and piston blades 5'' and notches 6'' respectively. The casings are provided with cooling blades 13', 13''. The first pair of rotors 1' serve as a compressor, the combustible mixture being admitted through admission opening 15' and the gas is compressed within chamber 9', being expelled through transfer tube 8' into the combustion chamber 10' of the other casing 1'' by port 7''. Thus, the admission port 7'' at the discharge end of transfer tube 8' is located at the same point in casing 4'' as the admission port 7 of FIGURE 1.

The spark plug 11' causes the explosion and the burnt gases are expelled through exhaust opening 12', just upstream from the line of contact of the two rotors 1''.

The two above-described engines can function with heavy fuel in a diesel cycle by substituting an injection system to the igniting system.

FIGURES 6 to 9 show another embodiment of the invention having an improved design. Two cylindrical rotors 20, 20' are keyed on their respective shaft 21, which are arranged in spaced parallel relationship and such that the rotors have a common line of contact 22. The rotors are housed in a casing 23 which defines two cylindrical interfering chambers having their axes coaxial with the axes of the shafts 21.

Casing 23 is preferably composed of a central piece 24 defining the cylindrical surfaces 25 of the casing chambers. Lateral plates 26 are secured to central piece 24 by means of bolts, or the like, not shown, and said lateral plates 26 have an internal flat surface 27 defining the lateral surfaces of the chambers.

One of the plates 26 is shown in FIGURE 7 and comprises exhaust openings 28 and 29 communicating with exhaust pipes 30 and 31 respectively.

The two exhaust pipes 30 communicate with a common pipe 32 increasing in diameter, as shown at 33, in the direction of gas flow and the exhaust pipe 31 communicates with the enlarged pipe portion 33 downstream from the communications of pipes 30 and at an acute angle, whereby the exhaust gases flowing from pipes 30, produce a venturi effect on the gases coming from exhaust pipe 31 and produce therefore a suction in pipe 31 to suck the gases in the region of port 29.

The two rotors 20 and 20' are driven in opposite directions of rotation in accordance with arrows 34, but at the same rotational speed by means of gear wheels, not shown, secured to the shafts 21 and similar to the gear wheels 16 and 16' of the first and second embodiments.

Rotors 20, 20' are each provided with at least two piston blades 35 followed or preceded by a notch 26, 26' respectively, enabling the passage of the piston blade of the other rotor without interference.

Each piston blade 35 protrudes radially outwardly from the cylindrical peripheral surface 37 of each rotor 20, 20' and defines a terminal surface 38, of generally rectangular shape when seen in top plan view, but convex when seen in side elevation, having a radius of curvature equal to that of the cylindrical surface 25 of the chambers defined by casing 23, the terminal surface 38 being in sliding contact with surface 25.

The transverse surface 39 of each piston blade 35, opposite to notch 36 or 36', is slightly convex, whereas the transverse surface 40, adjacent notch 36 or 36', is slightly concave and is extended down to the bottom 41 of said notch 36 or 36'.

Surfaces 38 and 40 of each piston blade form a relatively sharp straight edge 42 adapted to come in sliding contact with the concave surface 40 of the piston blade of the adjacent rotor.

Bottoms 41 of notches 36, 36' are preferably slightly convex and the lateral notch wall opposite the piston blade 35 is flat or straight, as indicated at 43.

In rotor 20, notches 36 have their bottom wall 41 bevelled, as shown at 44, along their side edges, the bevelled surfaces being directed radially inwardly to merge at the lateral flat surfaces of the rotor.

Moreover, wall 43 of notch 36 is notched or cut out in its central part to form a bevelled surface 45 which is inclined in a direction opposite to piston blade 35 and opens at the peripheral surface 37 of rotor 20. However, during rotation of the two rotors, piston blade 35 of rotor 20' comes into contact with the wall 43 on each side of the cavity formed by inclined wall portion 45.

Casing plates 26 are preferably each provided with an admission port 46, of generally trapezoidal shape, disposed radially inwardly of the peripheral cylindrical surface 37 of rotor 20 in order to be in register with the notches 36 of said rotor during rotation of the latter.

Preferably, admission ports 46 are located in such a manner as to start to become uncovered by notch 36 in the position of the rotor shown in FIGURE 6 and wherein the two rotors have their notch and piston blade respectively just past the line of contact 22, whereby the seal between the two rotors is just re-established at said line of contact.

The width of the admission port 46 is such that said port will be closed by rotor 20 as soon as piston blade 35 of rotor 20' engages the cylindrical surface 25 of the casing 23.

The height of the admission port 46 is such that its radially inner edge will be at the level of the radially inner edge of the bevelled surfaces 44 of the bottom of notch 36.

Central piece 24 of casing 23 is provided across its entire width with slits 47 each making communication between a bore 48 made in said central piece 24 and the cylindrical chambers containing the rotor.

There is a bore 48 with its associated slit 47 disposed on each side of the edge 49 defined by the two interfering cylindrical chambers of the casing.

Slits 47 are at a substantially equal distance from edge 49 in each cylindrical chamber, said distance being calculated with respect to the width and the location of the admission port 46 and to the width of the piston blade 35, in such a manner that the admission port 46 will be completely closed by the rotor 20 at the moment the piston blades 35 uncover the two slits 47 in accordance with the direction of rotation of the rotors indicated by arrows 34.

The exhaust ports 28 made in the lateral wall 26 are of elongated and curved shape and disposed just radially outside of the periphery of the rotors and at equal angular distances from slits 47, the start of the exhaust ports making an angle of about 90 degrees with slits 47.

At about the center of the exhaust port 28, the cylindrical chambers of the casing increase in diameter, as defined by the radial shoulder 50 and the surface 51 is cylindrical but has a greater diameter than the cylindrical surface 25, which is the only active surface.

Exhaust port 29 is in the form of an inverted V and disposed just upstream from the common contact line 22 of the two rotors and is located just radially outwardly of the peripheral surfaces of the two rotors.

The casing is provided with cooling fins 52, or can be provided with a liquid cooling system, in which case the casing itself would have passages for the circulation of the cooling liquid.

Bores 48 receive igniting elements or spark plugs, but the igniting elements are preferably in the form of a porcelain rod, or other refractory or heat-resisting material 53 around which is wound an electric heating wire 54, one end of which is connected to the ground or metal screw body of the plug and the other end of which is connected to an electric supply wire 55.

The rod 53 and electric heating wire 54 extend over the entire width of the cylindrical chambers of the casing and, consequently, of the length of slits 47.

The motor operates in the following manner:

As soon as the rotor has reached the position shown in FIGURE 6 and starts to uncover the admission ports 46, the mixture of air and fuel under pressure is admitted behind the two piston blades 35, which are in contact with each other in the notch 36 of rotor 20 and the combustible mixture under pressure therefore fills the notch 36 uncovering the admission ports 46.

The rotor continues to rotate until admission ports 46 become closed by the peripheral portion of rotor 20. At this moment, a combustion chamber is defined behind the two piston blades and between the two rotors up to the contact line 22. At this moment, the terminal faces of the two piston blades are in sliding contact with the cylindrical surfaces 25 of casing 23.

When the piston blades uncover the slits 47, the combustible mixture under pressure comes in contact with the electric heating wires 54. An explosion and the following gas expansion are produced until the piston blades 35 uncover the exhaust ports 28. The spent burnt gases are exhausted by exhaust ports 28 and the remaining exhaust gases is sucked by exhaust port 29.

The compressed air supplied to the motor through admission port 46 can come from any source of compressed air, including, for example, the compressor part shown in FIGURE 3, which would be provided with piston blades shaped as shown in FIGURE 6.

The fuel is injected under pressure by means of jet nozzles directly within the tube supplying the compressed air, just before the admission port 46.

Experiments carried out with a motor built in accordance with FIGURE 6 have shown that this motor develops relatively high torque with respect to its size and, moreover, is vibrationless in operation and can attain relatively high speed.

This motor can be provided with a system to advance or retard the ignition time. In this case, the bores 48 are provided with a bushing or sleeve having a longitudinally extending lateral slit and housing the ignition element 53, 54 is an eccentric position.

The casing will be provided with several parallel and spaced slits 47 whereby rotation of the sleeve or bushing, together with the ignition element, will align the slit of the bushing with one or the other of the slits 47 made in the casing.

This ingnition advancing system can be made automatic and to depend on the speed of rotation of the rotors.

The device of the present invention can be used as a compressor, as a vacuum pump or as a fluid handling motor with proper modifications.

While preferred embodiments in accordance with the invention have been illustrated and described, it is understood that various modifications may be resorted to without departing from the scope of the appended claims.

What I claim is:

1. In a rotary fluid handling machine, a casing, two cylindrical rotors mounted for rotation within said casing about spaced parallel axes, gear means connected to said rotors for causing said rotors to rotate at an equal speed, but in opposite direction of rotation and in accordance with a predetermined angular relationship, the two rotors being in contact with each other along a common line of contact, said casing defining two cylindrical interfering chambers co-axial with the axes of said rotors and having lateral flat surfaces, each rotor being provided with piston blades and adjacent notches, the piston blades of one rotor engaging the notches of the other rotor and inversely during rotation of said rotors, said piston blades having their tip in sliding contact with the cylindrical surface of said chambers, at least one of said lateral flat surfaces of said chamber being provided with an admission port located in register with the notches of at least one of said rotors, whereby to be opened and closed by the rotation of said rotor, each piston blade having a terminal surface of generally rectangular shape when seen in plan view, and of convex shape when seen in lateral elevation, having the same radius of curvature as the radius of curvature of the cylindrical surface of said chambers, whereby said terminal face is in sliding contact with said cylindrical surface of said chamber, said piston blade having a transverse surface which is slightly concave and extends down to the bottom of the adjacent notch, said concave transverse face defining with said terminal face a straight relatively sharp edge adapted to make a sliding contact with the concave transverse face of the piston blade of the adjacent rotor, and wherein the notches of at least one of said rotors have bevelled corner surfaces at their bottom, said bevelled corners terminating at the lateral surface of said rotor along a zone radially inwardly closer to the center of rotation than the bottom of said notches, said admission port being located in register with said notches having bevelled corners, said admission port having a radially inner edge at the level of the external edge of said bevelled corner surfaces and a radially outer edge just radially inwardly spaced from the peripheral surface of said rotor.

2. In a rotary fluid handling machine as claimed in claim 1, wherein said notches provided with said bevelled bottom corners are further provided at their surface opposed to the adjacent piston blade with a central cavity having a bottom inclined radially outwardly in a direction opposed to said piston blade.

3. In a rotary fluid handling machine, a casing, two cylindrical rotors mounted for rotation within said casing about spaced parallel axes, gear means connected to said rotors for causing said rotors to rotate at an equal speed, but in opposite direction of rotation and in accordance with a predetermined angular relationship, the two rotors being in contact with each other along a common line of contact, said casing defining two cylindrical interfering chambers co-axial with the axes of said rotors and having lateral flat surfaces, each rotor being provided with piston blades and adjacent notches, the piston blades of one rotor engaging the notches of the other rotor and inversely during rotation of said rotors, said piston blades having their tip in sliding contact with the cylindrical surface of said chambers, at least one of said lateral flat surfaces of said chamber being provided with an admission port located in register with the notches of at least one of said rotors, whereby to be opened and closed by the rotation of said rotor, each piston blade having a terminal surface of generally rectangular shape when seen in plan view, and of convex shape when seen in lateral elevation having the same radius of curvature as the radius of curvature of the cylindrical surface of said chambers, whereby said terminal face is in sliding contact with said cylindrical surface of said chamber, said piston blade having a transverse surface which is slightly concave and extends down to the bottom of the adjacent notch, said concave transverse face defining with said terminal face a straight relatively sharp edge adapted to make a sliding contact with the concave transverse face of the piston blade of the adjacent rotor, further including an ignition system comprising heat producing devices located in transverse bores made in said casing, said transverse bores being in communication with the cylindrical chambers of said casing by means of slits made in the cylindrical surface of said chambers and disposed transversely of the same and having a length substantially equal to the width of said chambers, said slits being disposed in the vicinity of the edge produced by the interference of said two cylindrical chambers and downstream from the common line of contact of the two rotors with respect to their direction of rotation, and further including an exhaust system comprising primary exhaust ports made in the lateral walls of said casing, downstream from said slits and making an angle therewith of at least 90 degrees, and a secondary exhaust port common to the two chambers and located just upstream from said common

line of contact of the two rotors, first exhaust pipes in communication with said two primary exhaust ports, a second exhaust pipe connected to said secondary exhaust port, a common enlarged exhaust pipe, said second exhaust pipe connected to said common exhaust pipe downstream from the connections of said first exhaust pipes to said common exhaust pipe.

4. In a rotary fluid handling machine as claimed in claim 3, wherein said cylindrical chambers in the region from said exhaust ports are enlarged and their cylindrical surface is out of contact with the terminal faces of said piston blades.

5. In a rotary fluid handling machine, a casing, two cylindrical rotors mounted for rotation within said casing about spaced parallel axes, gear means connected to said rotors for causing said rotors to rotate at an equal speed, but in opposite direction of rotation and in accordance with a predetermined angular relationship, the two rotors being in contact with each other along a common line of contact, said casing defining two cylindrical interfering chambers co-axial with the axes of said rotors and having lateral flat surfaces, each rotor being provided with piston blades and adjacent notches, the piston blades of one rotor engaging the notches of the other rotor and inversely during rotation of said rotors, said piston blades having their tip in sliding contact with the cylindrical surface of said chambers, at least one of said lateral flat surfaces of said chamber being provided with an admission port located in register with the notches of at least one of said rotors, whereby to be open and closed by the rotation of said rotor, each piston blade having a terminal surface of generally rectangular shape when seen in plan view, and of convex shape when seen in lateral elevation having the same radius of curvature as the radius

of curvature of the cylindrical surface of said chambers, whereby said terminal face is in sliding contact with said cylindrical surface of said chamber, said piston blade having a transverse surface which is slightly concave and extends down to the bottom of the adjacent notch, said concave transverse face defining with said terminal face a straight relatively sharp edge adapted to make a sliding contact with the concave transverse face of the piston blade of the adjacent rotor, wherein each rotor has at least three piston blades equally angularly spaced, each piston blade having an adjacent notch and said casing defining a compression chamber having an inlet port for non-pressurized gases, and an outlet port for pressurized gases, said outlet port being adjacent and upstream from said common line of contact of the two rotors and further including a transfer tube external to said casing and establishing communicatoin between said outlet port and said admission port.

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