

Aug. 10, 1937.

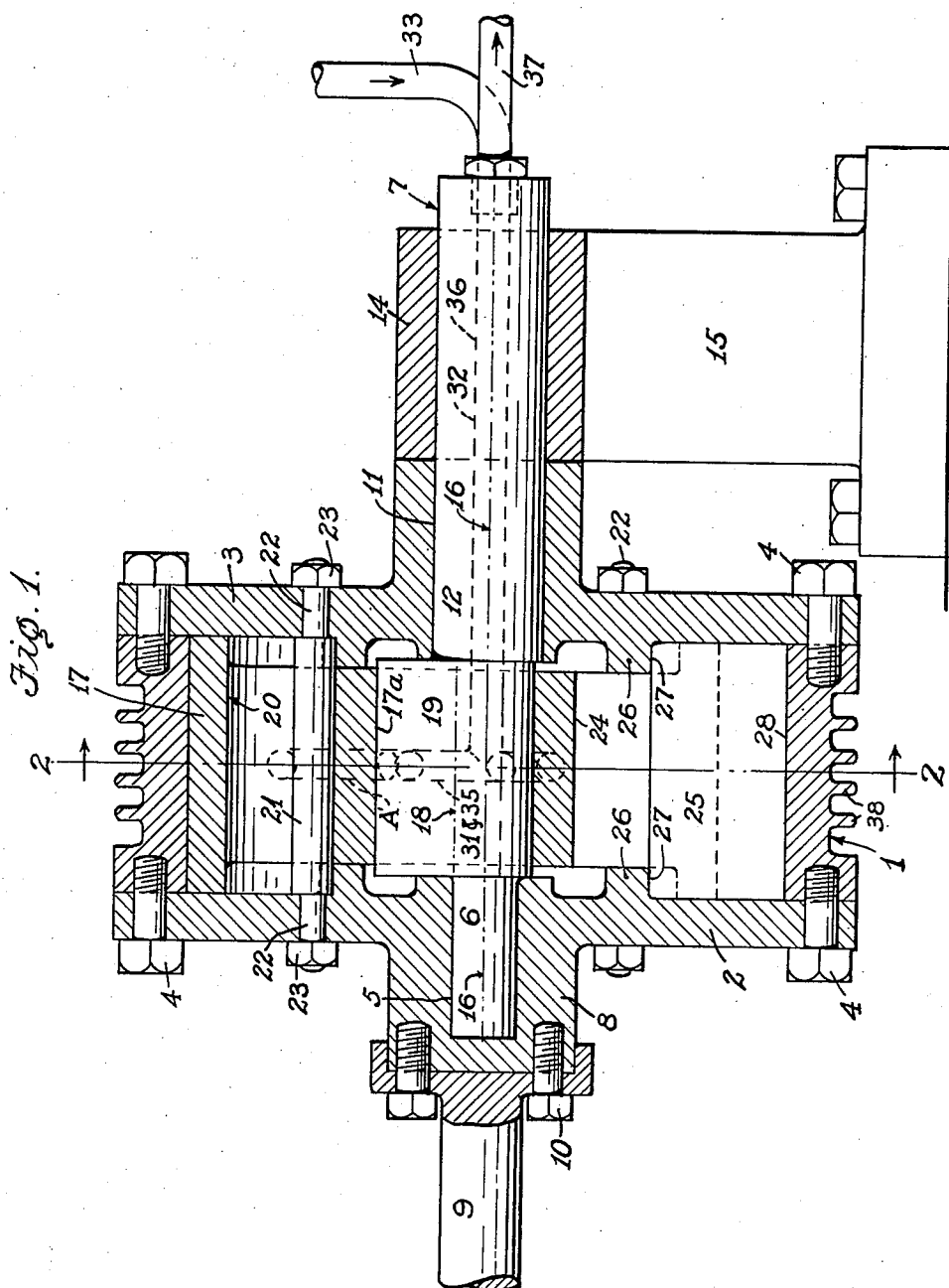
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2,089,593

ROTARY COMPRESSOR AND THE LIKE

Filed July 27, 1935

2 Sheets-Sheet 1



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2 Sheets-Sheet 2

Fig. 3.

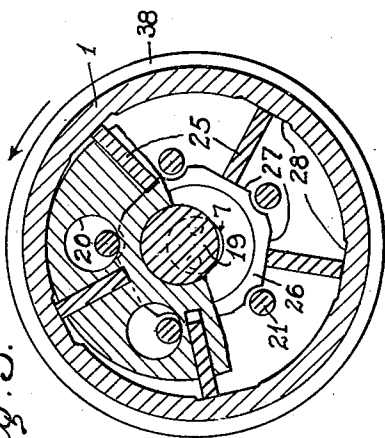


Fig. 4.

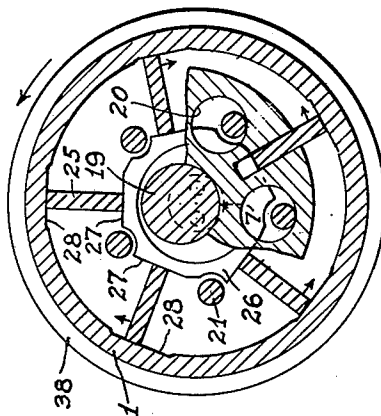
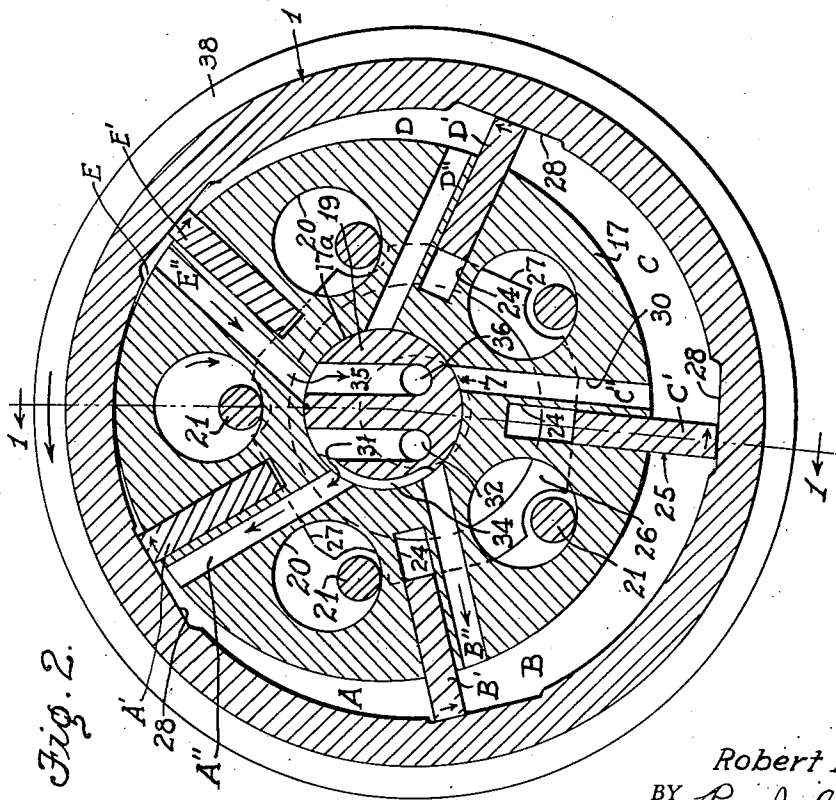


Fig. 2.

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UNITED STATES PATENT OFFICE

2,089,593

ROTARY COMPRESSOR AND THE LIKE

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Application July 27, 1935, Serial No. 33,541

3 Claims. (Cl. 230—140)

This invention relates to air or other fluid compressors and in particular, the invention relates to compressors of the rotary type.

It is an object of my invention to provide a fluid compressor which shall be nearly as possible perfectly balanced, capable of being operated at a very high speed and free from excessive friction.

A further object of my invention resides in the provision of a compressor which is capable of operating efficiently with a minimum amount of vibration and noise.

A further object of my invention resides in a device which may be directly connected to an electric motor or other source of power without provision of gears, which is free from valves, which is small in comparison with the work it can perform, which is light in weight and which may be produced at a very low cost.

Briefly stated, the compressor forming the subject of my invention comprises an external rotor and an internal rotor suitably mounted within the external rotor on an axis which is non-concentric with the axis of the external rotor. The internal rotor is operatively connected to the external rotor so as to revolve synchronously therewith and in the same direction. A plurality of vanes are movably mounted in one of the rotors and are movably engaged with the other rotor so as to divide the space between the two rotors into a plurality of non-communicating chambers. A plurality of ports are also provided in the internal rotor which communicate with the spaces or chambers divided by the vanes. An intake line is provided for the fluid to be compressed and an exhaust line is provided for the compressed fluid.

Stated more specifically, the compressor forming the subject of my invention may be described as comprising an outside ring substantially in the shape of a hollow cylinder with a pair of cover plates mounted on each side of the outside ring, said outside ring and cover plates comprising an external rotor. The inner circumference of the outside ring is provided with a plurality of equally spaced plane surfaces or flats. The central portion of each cover plate is recessed to provide a bearing for the non-eccentric portions of an eccentric shaft about which the external rotor may be revolved. On the interior surfaces of each cover plate, a projecting ring is provided which is positioned in a circle which is concentric with the recesses in the cover plates. Plane surfaces or flats are provided on each projecting ring which are parallel to and equidistant with the plane surfaces provided on the outside ring. A plurality of

equally spaced pins are mounted between the cover plates on a circle concentric with the recesses on projecting rings. An internal rotor having a centrally disposed recess to provide a bearing for the eccentric of the aforementioned eccentric shaft is mounted on the eccentric and within the external rotor. The internal rotor is thus mounted in an eccentric position with respect to the external rotor. The internal rotor is provided with a plurality of equally spaced recesses on a circle concentric with the central recess provided as a bearing. The circumferences of the recesses are adapted to engage with the circumferences of the pins so that when the external rotor is rotated, the internal rotor is compelled to rotate synchronously therewith and in the same direction. The internal rotor is also provided with a plurality of equally spaced and radially disposed slots to receive vanes, the ends of which lie between the plane surfaces of the projecting rings and the plane surfaces provided on the outside ring. The plane surfaces are for the purpose of allowing the vanes to slide back and forth as the rotors are rotated. The vanes divide the space between the two rotors into a plurality of non-communicating chambers. The number of such chambers will be determined by the number of vanes. Located along the side of each slot and on the center of the internal rotor, a port is provided which extends from the periphery of the internal rotor to the bearing. The ports thus communicate with the chambers at one extremity and with the eccentric at the other extremity. These ports serve as both intake and exhaust ports depending upon the position of the internal rotor with respect to the eccentric to be described. A pair of vertically disposed passageways are provided in the eccentric which communicate with longitudinally disposed passageways in the eccentric shaft. One of the passageways is connected to a line for admitting fluid to be compressed into the chambers while the other passageway is connected to a line for delivering the compressed fluid to the place of intended use. Thus when a port in the internal rotor is open to the intake passageway, fluid to be compressed will be admitted into the chamber and when a port is open to the exhaust passageway, fluid which has been compressed will be expelled from the chamber. Preferably, a groove is provided on the circumference of the eccentric which communicates with the intake passageway. The groove is of sufficient length along the circumference of the eccentric and in communication

with the intake passageway so as to allow more than one port to communicate simultaneously with the intake passageway as the rotors are rotated.

5 Other objects, features and advantages of my invention will become apparent to those skilled in the art from the following description of my invention taken from the drawings which is not to be considered as limiting my invention.

10 Fig. 1 represents a vertical cross-section of the device taken along line 1—1 of Fig. 2;

Fig. 2 represents a plan section of the device taken along line 2—2 of Fig. 1.

15 Figs. 3 and 4 are also sectional plans of the device with parts partly in section so as to show details of the device.

Referring more particularly to the drawings wherein like reference numerals refer to corresponding parts throughout the several views, 1 denotes an outside ring which is substantially in the shape of a hollow cylinder and is fastened to circular left and right cover plates 2 and 3 respectively by means of a plurality of bolts 4. The outside ring 1 and the cover plates 2 and 3 form an assembly which shall be referred to hereinafter as the external rotor.

At the center of the left cover plate 2, a recess 5 is drilled to a sufficient depth to form a bearing for left portion 6 of the eccentric shaft 7. A hub 8 is also provided which may be connected to a suitable source of power not shown which is adapted to rotate the external rotor. The right cover plate is similar in construction as the left cover plate with the exception that a larger centrally disposed recess 11 is provided to form a bearing for right portion 12 of eccentric shaft 7, which is of greater diameter than shaft 6. The remaining portion of the shaft 12 extends through the cover plate and is supported by a suitable bearing 14 which is suitably mounted on frame 15. Thus, the external rotor is so provided as to revolve about fixed axis 16 on bearings 5 and 14. It will be observed that during rotation of the external rotor and the internal rotor to be described, the eccentric shaft remains stationary while the rotors revolve about the shaft. If desired, the portion of the eccentric shaft passing through the bearing 14 may be provided with a keyway and key or a set screw to prevent the shaft from revolving when the rotors are rotated.

An internal rotor 17 provided with a centrally disposed recess or bearing 17a is mounted in the interior of the external rotor so as to revolve about fixed axis 18 on eccentric 19 of the eccentric shaft 7. Shafts 6, 12 and 19 form the eccentric shaft 7. Shafts 6 and 12 have a common fixed axis 16 while the fixed axis 18 is eccentrically positioned with reference to the axis 16 of the external rotor. By the arrangement shown in the drawings, the internal rotor revolves inside of the external rotor but nearer to one side than to the other due to the eccentric positioning of eccentric 19 with respect to shafts 6 and 12. Preferably, the internal rotor is so positioned eccentrically in the external rotor so that one end substantially contacts the inner surface of the external rotor and to provide an oil seal. This will cause substantially all of the compressed fluid to be forced out of the chamber. The internal and external rotors revolve synchronously. This effect may be produced in various ways without departing from the spirit of my invention. In the method illustrated in the drawings, a plurality of equally spaced circular recesses 20 are provided in the internal rotor about a circle

concentric with the recess 17a and an equal number of pins 21 extending through the recesses are mounted between the left and right cover plates about a circle concentric with recesses 5 and 11. The ends 22 of the pins extending through the cover plates are smaller in diameter than the body of the pins so as to form shoulders at the ends of the body of the pins to abut against the interior surface of the cover plates. The pins are mounted to the cover plates by screws 23. The pins are provided in such position as to engage the internal circumferences of the recesses 20. Thus, by this means, when the external rotor is revolved on shafts 6 and 12 or in other words, about fixed axis 16, by the power connected to stub shaft 9, the internal rotor 17 is also compelled to revolve in the same direction due to engagement with pins 21. However, the rotor 17 revolves freely about eccentric 19 or in other words about its own fixed axis 18. The recesses 20 may be of any diameter but in order to obtain the synchronized rotation of the internal and external rotors, the radius of the recesses 20 is made equal to the sum of the distances between axes 16 and 18 of the two rotors and the radius of the pins 21.

Throughout the thickness of the internal rotor 17, a plurality of equally spaced and radially disposed slots 24 are provided to receive vanes 25 which are rectangular in shape and of a thickness substantially equal to the width of the slots. This is for the purpose of dividing the space between the two rotors into as many non-communicating chambers as there are vanes as will be more fully explained hereinafter.

Projecting rings 26 are provided on the inner surfaces of both cover plates and are formed around the center thereof. These rings are provided with as many plane surfaces or flats 27 as there are numbers of vanes. The edges of the plane surfaces of the projecting ring on one cover plate are parallel to those on the other cover plate. Correlated plane surfaces 28 are formed on the inner surfaces of the outside ring 1. The vanes 25 are positioned in the slots 24 between the plane surfaces 27 and 28 so that the inner end of each vane is continuously in contact with the two corresponding plane surfaces 27 of the projecting rings while the outer end of each vane is in continuous contact with the corresponding plane surfaces 28 of the outside ring. Thus with the vanes positioned as described when the external rotor is revolved, which also causes the internal rotor to revolve in the same direction, the ends of vanes 25 slide along plane surfaces 27 and 28 while the upper and lower ends of the vanes slide along the inside surfaces of the cover plates. The vanes also slide backward and forward in the slots as will be more fully described. While preferably, I provide two projecting rings in the device, it is to be understood that I may dispense with one of said projecting rings and thus provide one only with the desired number of plane surfaces for carrying the vanes. This will be understood to those skilled in the art.

To one side of each slot 24, ports 30 are drilled substantially radially through the center of the internal rotor which extend into the recess 17a. These ports function as both intake and exhaust ports for the fluid to be compressed as will be hereinafter described more fully. Thus, the ports communicate at their outer ends with the space between the internal and external rotors. The eccentric 19 of the eccentric shaft 7 is provided with a vertical passageway 31 which communi-

cates with a longitudinally disposed passageway 32 drilled through the center of the eccentric shaft which in turn is connected with a line 33. A groove 34 is provided for a suitable distance along the circumference of the eccentric 19 which communicates with passageway 31. Line 33, passageways 32 and 31 and groove 34 serve to admit the fluid to be compressed through ports 30 into the space between the internal and external rotors. Adjacent and parallel to passageways 31 and 32, similar passageways 35 and 36 are provided in the eccentric shaft, the latter connecting with line 37. Passageways 35 and 36 and line 37 serve as the exhaust for the compressed fluid. It will be observed that during the rotation of the rotors at least two chambers communicate at all times through their respective ports with the groove 34 and thus with the intake line whereas only one chamber is subjected to exhaust at a time and this occurs only when the inner end of the port communicates with the passageway 35. If desired a groove similar to the one shown at 34 for intake passageway 31 may be provided for exhaust passageway 35. This will provide a longer exhaust passageway. However, this groove must not be sufficiently long as to uncover two ports simultaneously. The ports of other chambers not in communication with either the exhaust or intake passageways are sealed off by eccentric 19. In this position the fluid undergoes compression.

While I have described the essential features of the device forming the subject matter of my invention, there will be apparent to those skilled in the art, many improvements which will result in a smooth and efficient operation of the device. I have shown the outside ring 1 as being provided with a plurality of fins 38 in order to radiate the heat resulting from the friction produced by the operation of the various parts of the mechanism. Obviously, this feature for radiating heat produced by friction may be improved upon by those skilled in the art. If desired, the fins may be placed in a position perpendicular to those shown, i. e., across the periphery of the outside ring. Also, radially extending fins may be provided on the cover plates. Also various improvements may be made to minimize the wear of working parts and to reduce the amount of friction to a minimum. Thus, the recesses 5 and 11 in the cover plates and the recess 17a in the internal rotor may be lined with bronze or other metallic bushings or with ball bearings in order to reduce the wear of the surfaces. Provision may be made for lubricating the various working parts such as the bearings, vanes and pins. While I have shown the space between the internal and external rotors as being divided into five chambers, it is obvious that this space may be divided into a greater or smaller number of chambers by providing the necessary number of vanes, etc. I have described a device with five chambers but there is no reason why the device cannot be made to operate satisfactorily with a different number of chambers.

For convenience in describing the operation of the device, I have indicated the various chambers shown in Fig. 2 as A, B, C, D and E, the vanes as A', B', C', D', and E', and the ports as A'', B'', C'', D'', and E''. Referring more particularly to Fig. 2 of the drawings, the chamber A is in a position where the compressed fluid has been exhausted from the chamber and the chamber has passed a certain number of degrees of intake, air or other fluid to be compressed being drawn into the chamber via line 33, passageways 32, 31, groove 34 and port A''. Rotation of

the rotors in a counterclockwise direction indicated by the arrow is accomplished as stated above by connecting the stub shaft 9 to a suitable source of power such as an electric motor. As the rotors continue to revolve in the direction of the arrow, the capacity of the chamber is gradually increased and further quantities of fluid are drawn into the chamber until the chamber shall have revolved 180° from the position where fluid is first drawn into the chamber after which the port A'' is sealed off from further intake of fluid by the surface of the eccentric 19. The chamber is then ready to start the compression cycle. During the rotation of the rotors, the chambers assume the various positions A, B, C, D and E. Each of said positions represents 72° of rotation, this figure being arrived at by dividing the number of chambers into 360°. Thus at position B, the chamber is still connected to the groove 34 which is connected to the intake line. In other words, in the positions shown in the drawings, both chambers A and B are connected through their respective ports A'' and B'' to the intake line. When the chamber A shall have revolved about the circle another 72° it assumes the position shown at C. Thus the port C'' of chamber C is sealed off from both the intake and exhaust lines by eccentric 19. At this position, the chamber A would have passed 180° from the beginning of the cycle or from top dead center which is the position when the port is sealed off by the eccentric 19 at a point between the intake and exhaust passageways 31 and 35 respectively. At the 180° position, the chamber would have reached its maximum capacity and further rotation of the rotor will seal off the intake port and decrease the capacity of the chamber which effects compression of the fluid. At the position shown at C, the fluid has been partially compressed. Another 72° revolution of the rotors brings the chamber A to position D. Thus in chamber D, the port D'' is still sealed off by the surface of the eccentric 19 but the size of the chamber D is smaller than that shown at C indicating that the fluid in the chamber is under greater compression than at C. The compression of the fluid in chamber A continues by the revolution of the rotors and thus by the decrease in the capacity of the chamber until the port is opened to the exhaust passageway 35 after which the compressed fluid is forced through passageways 35 and 36 to line 37 where the compressed fluid may be utilized for the purposes intended. The exhausting of the fluid continues aided by further constriction in the capacity of the chamber during its continued revolution until the port of the exhausting chamber is sealed off by the eccentric at the position between the two passageways 31 and 35. At E, I have indicated that the port E'' has been opened to the exhaust passageway 35 for a certain number of degrees. At top dead center, the chamber is ready for another cycle of intake of fluid to be compressed followed by a compression of said fluid and exhausting through line 37.

As indicated above, the rotation of the rotors cause the vanes to slide along the plane surfaces 27 and 28 and in the slots 24. As the rotors are revolved, the vanes 25 are at all times substantially radial to the inner rotor. The vanes are furthest in the slots when the chambers are substantially at top dead center, that is, at the position when all of the fluid has been forced from the chamber and the chamber is ready to draw in fresh fluid to be compressed. At this

position, the vanes are also centrally disposed in the plane surfaces. The uppermost vane in Fig. 4 is shown at substantially top dead center. As the rotors revolve in the direction indicated by the arrow from the aforesaid position, the vanes slide in a clockwise direction towards one end of the plane surfaces. Due to the eccentricity of the internal rotor with respect to the external rotor, the vane will have risen in the slot with reference to the external rotor thus enlarging the capacity of space A. When the device has rotated 90° from the start, the vane will have traveled to the furthestmost clockwise position. Continued rotation of the rotors causes the vane to slide along the plane surfaces in a counter-clockwise direction or in the same direction as that of the rotors. When 180° is reached, the position of the vane in the plane surfaces is precisely the same as it was at the beginning of the revolution. At this point, the vane will have risen to its outermost position in the slot. As the revolution continues, when 270° is reached, the vane has traveled along its plane surfaces to the farthest point in the opposite direction and is ready to return. Further rotation causes the vane to travel in a clockwise direction to the center of the plane surfaces when the rotors have been revolved 360° and are ready to start a new revolution.

In Fig. 2 of the drawings, I have indicated by arrows on the vanes the direction of travel of the vanes at their various positions. Thus, vane A' is shown as moving in a clockwise direction and will continue to do so until the 90° point is reached, after which its direction is reversed as shown by vane B'. Vane C' shows the position and direction of travel of the vane prior to its reaching the 180° point. At 180°, the vane will have been centrally located in the plane surface 28. Vane D' indicates the position of the vane prior to its reaching the 270° point. At 270°, the vane will have moved to the extreme opposite position after which further rotation resumes the clockwise direction of travel of the vane until the revolution has been completed. Vane E' indicates the direction of travel after the vane has passed the 270° point. Fig. 4 also shows the direction that the vanes slide in their respective plane surfaces as the rotors are revolved, the uppermost vane, however, being at top dead center.

It does not seem necessary to describe the action of the recesses 20 and pins 21 at any considerable length. It is evident that as the rotors revolve, the effect of the distance between the radii of the two rotors is continually keeping the pins 21 pressed against the internal surfaces of the recesses 20 as shown in the drawings. The rotors will therefore, be held continually in the same relation to each other while each chamber will move about the axis of the external rotor.

It will be observed that when a device of the character described above is directly connected to an electric motor having an R. P. M. of about 1800 and the device is employed to compress air, for example, there will be approximately 9000 exhaust or pulsations of compressed air per minute which represents a substantially continuous stream of compressed air. This feature is particularly important and desirable for spraying purposes such as for example, for spraying paints, insecticides and other liquids.

The amount of air compressed and the pressure of the air delivered will, of course, depend upon the size of the compressor. I have constructed a device having an internal rotor of 4.25 inches

in diameter and 2 inches thick mounted in an external rotor having an internal diameter of 4.75 inches. The internal rotor was placed eccentrically in the external rotor so that the circumference of the internal rotor substantially contacted the inner circumference of the external rotor. When this device was connected to a 5 H. P. motor having an R. P. M. of 1800 it was capable of compressing air to a 100 lbs. per sq. in. in a single stage of compression. The device filled a tank of about 10 gallons with compressed air to a 100 lbs. in about two minutes. A device of this size is sufficiently large to serve most of the purposes for which compressors are now in use since it will deliver about 10 cu. ft. of air per minute at 100 lbs. per sq. in.

The device is particularly adapted to be employed in mechanical refrigerators now in use wherein such gases as sulfur dioxide, methyl chloride, ammonia and the like are employed as refrigerants and which must be compressed, cooled and expanded to effect the desired refrigeration. Due to the high efficiency of the device, it is not necessary to operate the device for not much longer than about three minutes every hour as compared with about fifteen or twenty minutes of every hour with other compressors now in use. Obviously the size of the compressor when submitted to this use need not be as large as the one described above.

If desired, the device may be operated as an air or other gas motor or as a steam engine by reversing the intake and exhaust passageways, by providing a longer groove 34 and also by properly timing the intake passageway. The device may be employed as a pump for liquids. Other uses to which the device may be put will become apparent to those skilled in the art.

It is to be understood that the above description is merely illustrative of a preferred embodiment of my invention of which many variations thereof may be made within the scope of the following claims by those skilled in the art without departing from the spirit thereof.

Having now described my invention, what I claim as new and desire to secure by Letters Patent is:

1. In a fluid compressor, an external rotor provided with a plurality of plane surfaces and mounted on a shaft, projecting rings in said external rotor provided with plane surfaces parallel to said first mentioned plane surfaces, an internal rotor mounted within said external rotor on a shaft integral with said first mentioned shaft and non-concentric therewith, there being provided a plurality of slots in said internal rotor, vanes in said slots and resting between said first and second mentioned plane surfaces, said vanes being adapted to divide the space between said rotors into a plurality of non-communicating chambers, there being provided also a plurality of recesses in said internal rotor, a plurality of pins fixed to said external rotor and engaging said recesses, said recesses and pins being adapted to revolve said internal rotor synchronously with said external rotor, ports in said internal rotor communicating with each of said chambers, a passageway in said shafts communicating with fluid to be compressed and adapted to admit fluid to be compressed into said chambers when the ports in said internal rotor are in communication with said passageway, a second passageway in said shafts adapted to carry compressed fluid when the ports in said internal rotor are in communication with said second passageway.

2. In a fluid compressor, an external rotor comprising an outside ring and a pair of cover plates mounted on each side of said ring, the inner circumference of said ring being provided with a plurality of equally spaced plane surfaces, and the central portions of each cover plate being recessed, an eccentric shaft, the non-eccentric portions of said shaft being mounted within the recesses of said cover plates, projecting rings on the interior surfaces of said cover plates and concentric with said recesses of said cover plates, said projecting rings being provided with a plurality of plane surfaces parallel with the plane surfaces on said outside ring, a plurality of equally spaced pins mounted between said cover plates and on a circle concentric with said projecting rings, an internal rotor provided with a centrally disposed recess and mounted on the eccentric of said eccentric shaft and provided with a plurality of equally spaced recesses, the circumferences thereof being adapted to engage the circumferences of said pins, whereby rotation of said external rotor will cause said internal rotor to revolve synchronously therewith, said internal rotor being provided also with a plurality of equally spaced slots therein, vanes in said slots the ends of which vanes resting between the plane

surfaces of said projecting rings and the plane surfaces of said outside ring, said vanes being adapted to slide along said plane surfaces when said rotors are rotated, said vanes dividing the space between said rotors into as many noncommunicating chambers as there are vanes, radially extending ports in said internal rotor terminating at one extremity in said chambers and at the other extremity in the centrally disposed recess of said internal rotor, a passageway in said eccentric communicating with fluid to be compressed and adapted to admit fluid to be compressed into said chambers when the ports in said internal rotor are in communication with said passageway, a second passageway in said eccentric adapted to carry compressed fluid when the ports in said internal rotor are in communication with said second passageway.

3. An apparatus as claimed in claim 2 in which a transverse circumferential groove is provided along the periphery of said eccentric and which communicates with said passageway for admitting fluid to be compressed into said chambers, said groove being of sufficient length so as to permit admission of fluid to be compressed into a plurality of chambers simultaneously.

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