

March 7, 1967

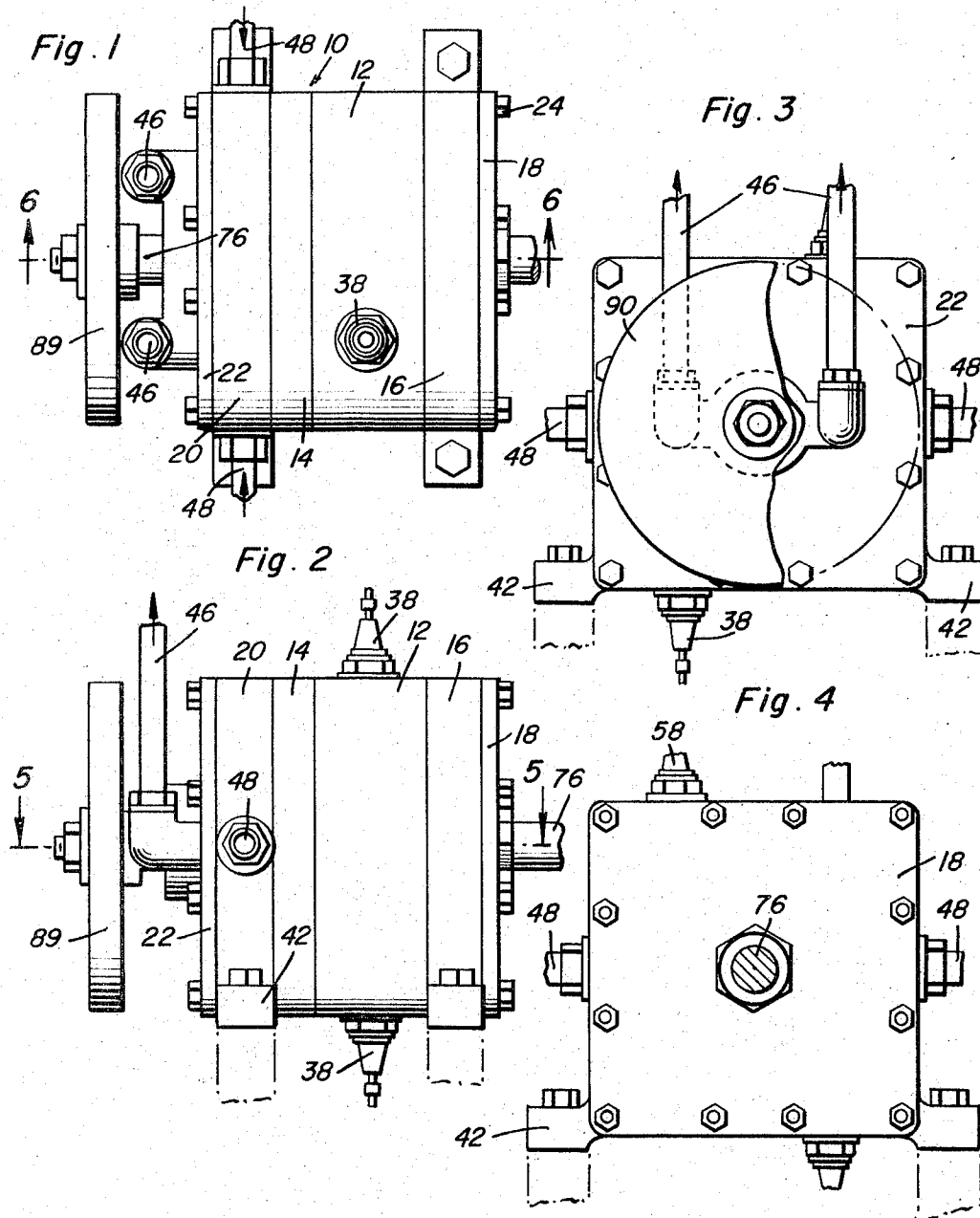
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3,307,525

ROTARY PISTON EXPANSIBLE CHAMBER MACHINE

Filed May 5, 1964

6 Sheets-Sheet 1



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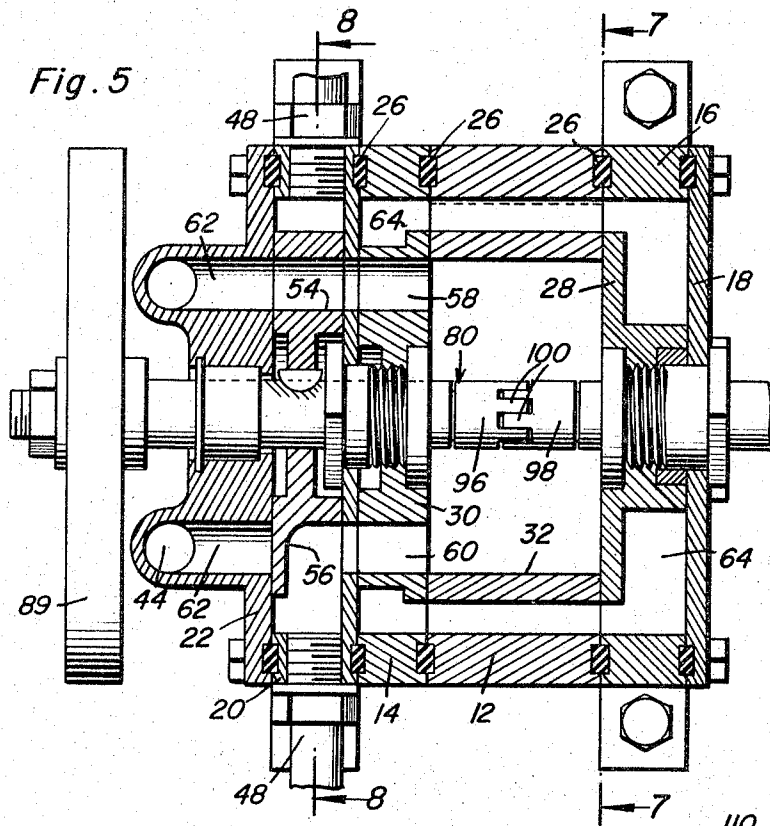
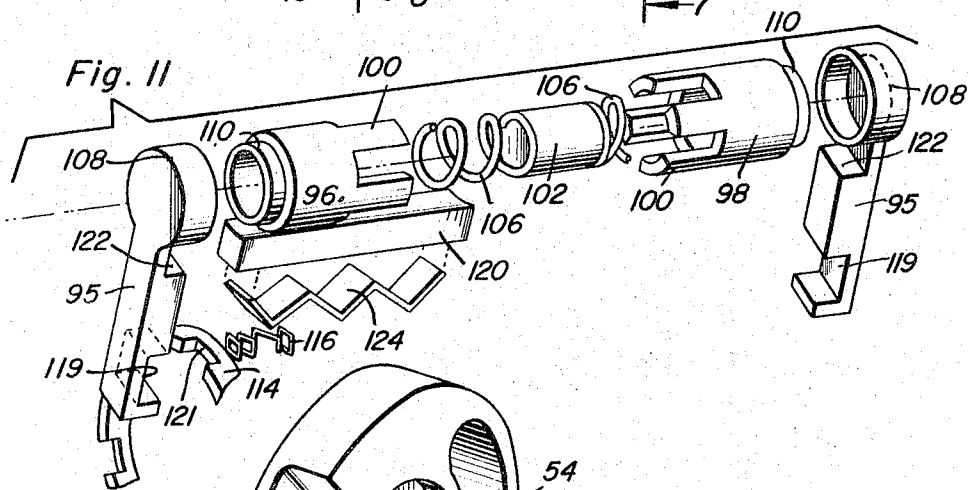
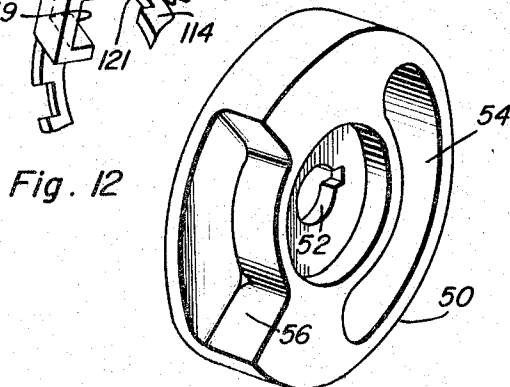
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ROTARY PISTON EXPANSIBLE CHAMBER MACHINE

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6 Sheets-Sheet 2



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ROTARY PISTON EXPANSIBLE CHAMBER MACHINE

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Fig. 6

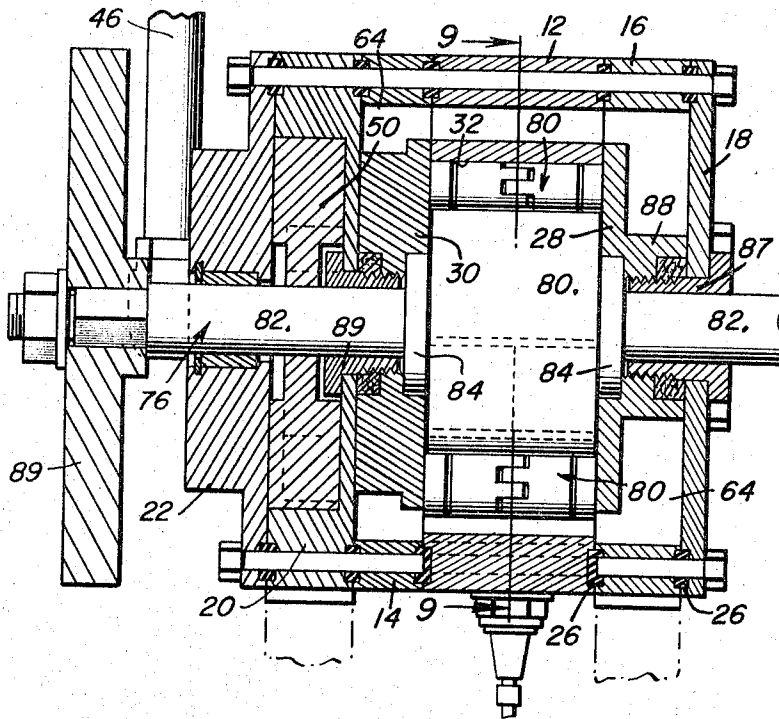
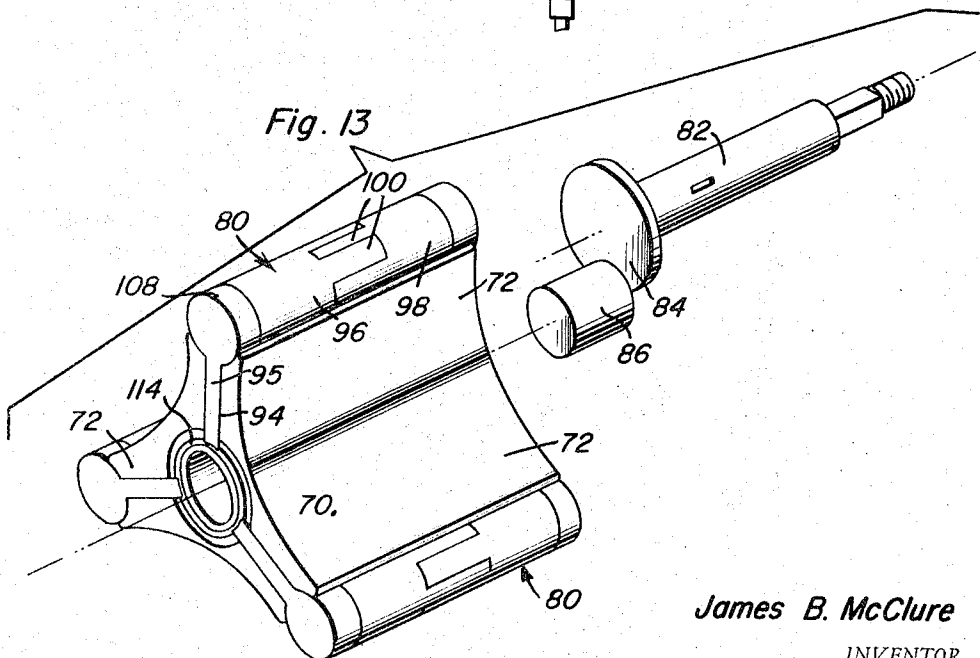


Fig. 13



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ROTARY PISTON EXPANSIBLE CHAMBER MACHINE

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Fig. 7

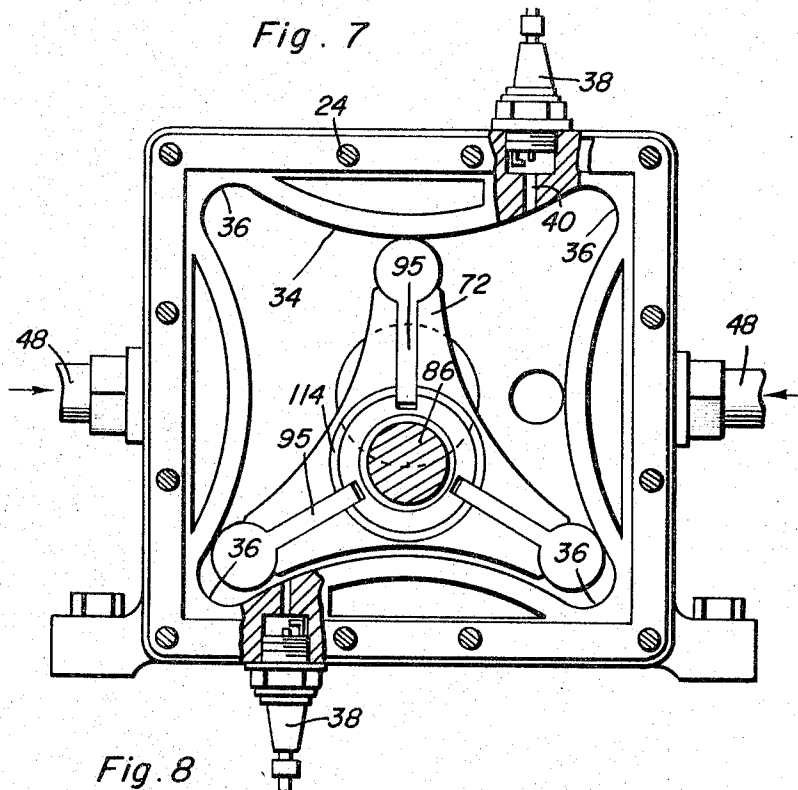
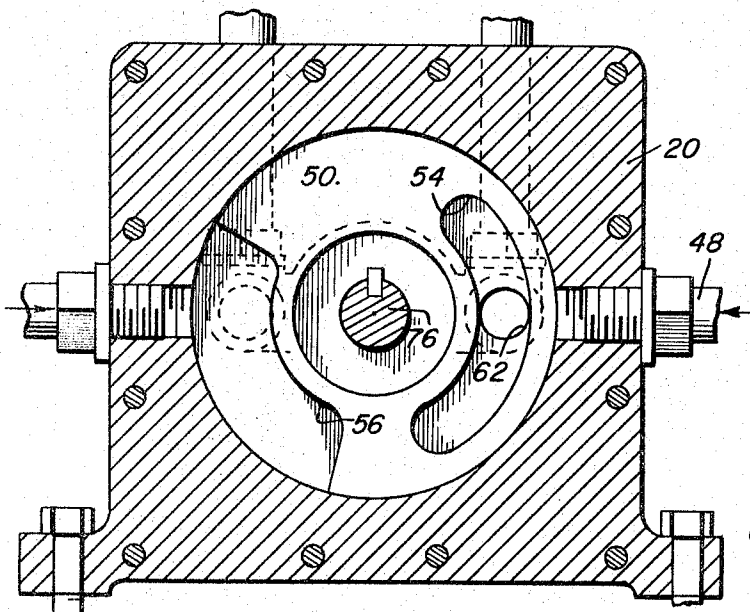


Fig. 8



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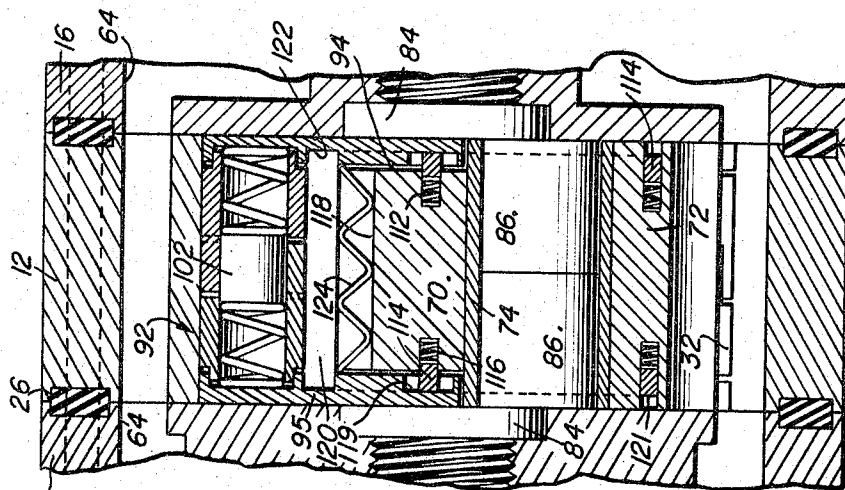


Fig. 10

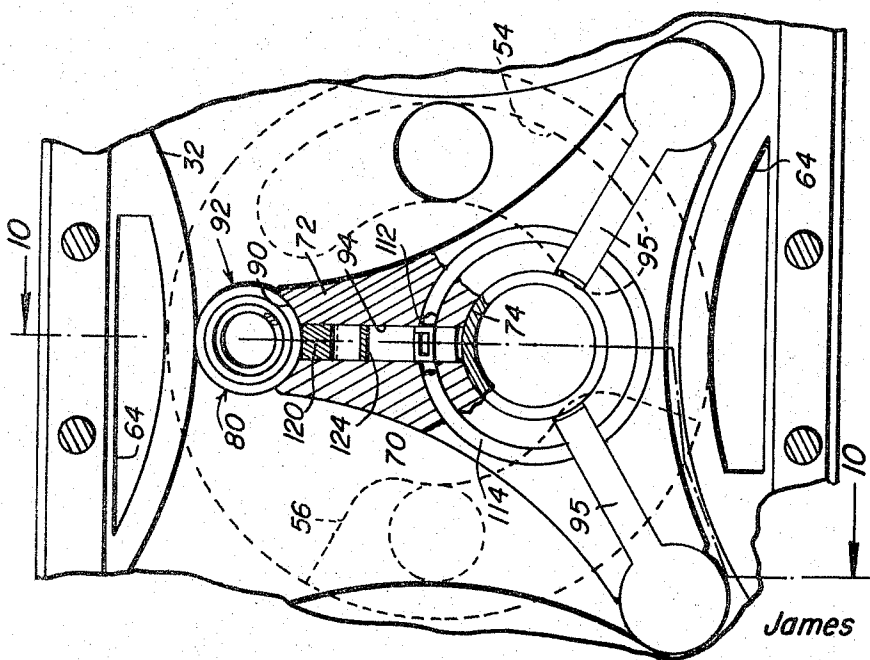


Fig. 9

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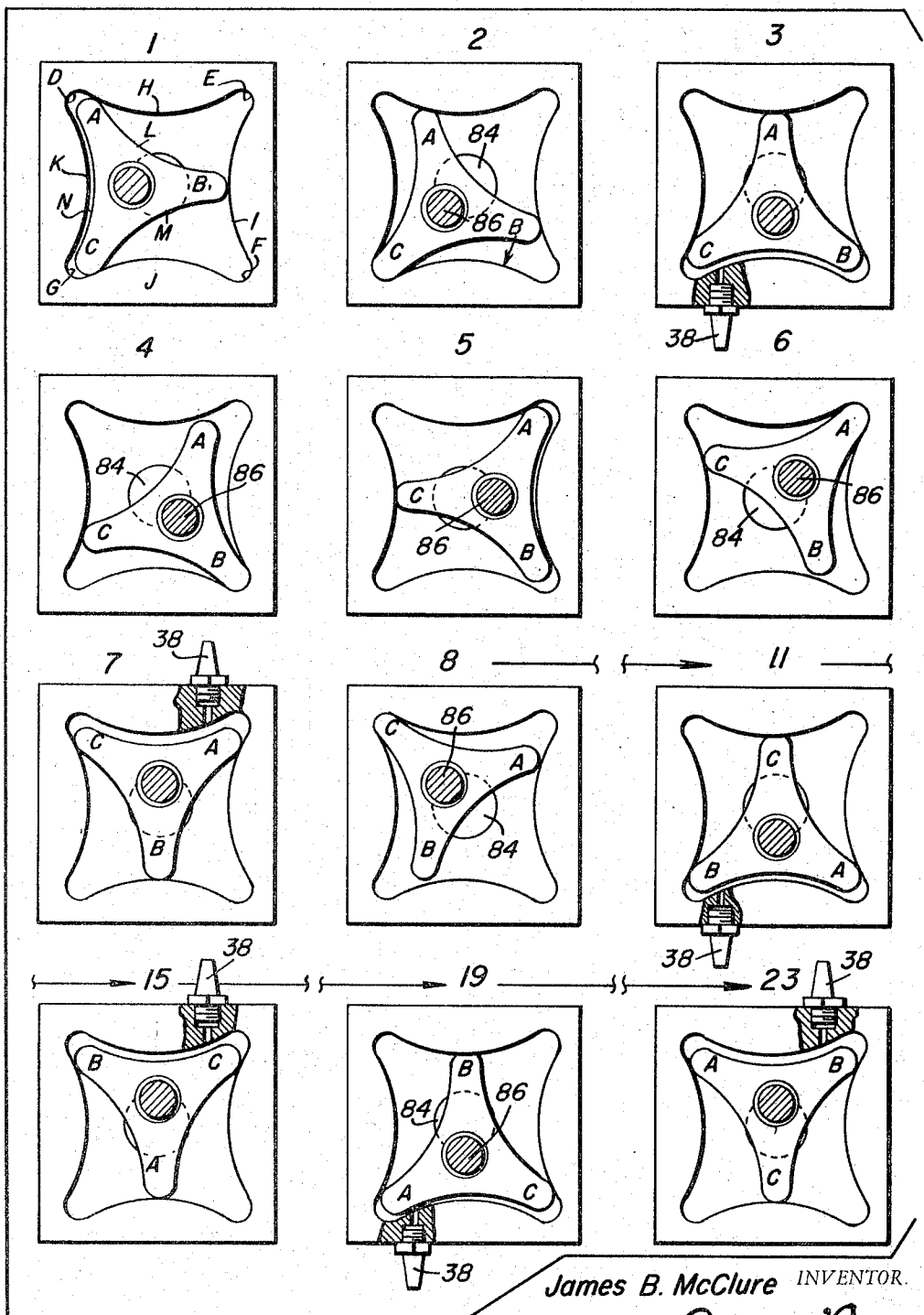
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ROTARY PISTON EXPANSIBLE CHAMBER MACHINE

Filed May 5, 1964

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3,307,525

ROTARY PISTON EXPANSIBLE CHAMBER MACHINE

James B. McClure, Mercury, Nev., assignor to McClure Corporation of America, a corporation of Nevada
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9 Claims. (Cl. 123-8)

This invention comprises a novel and useful rotary piston expansible chamber machine.

This invention comprises a novel and useful rotary piston expansible chamber machine and while pertaining generally to expansible chamber devices of the rotary piston positive displacement type, it is particularly concerned with an internal combustion engine of that general type.

The primary object of this invention is to provide a positive displacement expansible chamber device which, although not limited thereto, is especially adapted to function as an internal combustion engine and wherein a plurality of expansible chambers are provided within a stator in which a single rotor providing a plurality of pistons moves progressively about the series of chambers in the stator thus providing a plurality of complete cycles of operation for a single rotation of the drive shaft and rotor.

A further object of the invention is to provide a device in which a unidirectional rotation of the piston is substituted for the conventional reciprocating piston usually employed in internal combustion engines.

A further object of the invention is to provide a device in accordance with the foregoing objects in which the pistons have a relative sliding and sealed engagement with the walls of the chambers and move progressively into and out of a series of chambers during a single revolution of the drive shaft.

A still further object of the invention is to provide a device having an improved fluid inlet and exhaust system controlled by a very simple rotary valve element.

Yet another purpose of the invention is to provide a device in compliance with the preceding objects which shall utilize a two-piece crankshaft thus enabling easy assembly and disassembly of the engine with the ends of the crankshaft being in juxtaposition and in alignment with each other and journaled in the hub of the rotor.

Still another purpose of the invention is to provide a device as set forth in the foregoing objects which shall have an improved sealing means on the piston element of the rotor and one which will yieldingly elongate itself axially of the device for taking up wear and clearance in the working chamber of the device.

These together with other objects and advantages which will become subsequently apparent reside in the details of construction and operation as more fully hereinafter described and claimed, reference being had to the accompanying drawings forming a part hereof, wherein like numerals refer to like parts throughout, and in which:

FIGURE 1 is a top plan view of a preferred embodiment of the invention which as illustrated in the accompanying drawings and described in the accompanying specification is an internal combustion engine;

FIGURE 2 is a side elevational view of the arrangement of FIGURE 1;

FIGURE 3 is an end elevational view from the left end of FIGURES 1 and 2, parts being broken away and other parts being shown in dotted lines;

FIGURE 4 is an end elevational view from the right end of FIGURES 1 and 2, certain concealed parts being shown in dotted lines;

FIGURE 5 is a central horizontal sectional view taken upon an enlarged scale substantially upon the plane in-

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dicated by the section line 5-5 of FIGURE 2 and showing the fluid passage system and one of the sealing means of the invention;

FIGURE 6 is a further view in central vertical section taken upon an enlarged scale substantially upon the plane indicated by the section line 6-6 of FIGURE 1 and showing more clearly the rotor of the engine;

FIGURE 7 is a view in vertical transverse section taken substantially upon the plane indicated by the section line 7-7 of FIGURE 5 with parts broken away and shown in section and showing more clearly the location and disposition of the working chambers of the device;

FIGURE 8 is a view in vertical transverse section taken substantially upon the plane indicated by the section line 8-8 of FIGURE 5 and showing in particular the intake and exhaust port arrangement of the invention and the rotary valve element thereof;

FIGURE 9 is a fragmentary view in vertical transverse section taken substantially upon the plane indicated by the section line 9-9 of FIGURE 6 and showing certain details of the sealing means of the rotor unit of the engine;

FIGURE 10 is a view in vertical longitudinal section, parts being broken away and omitted, taken substantially upon the plane indicated by the section line 10-10 of FIGURE 9 and showing further details of the sealing means for the piston blades;

FIGURE 11 is an exposed perspective view of one of the rotor piston blade sealing assemblies;

FIGURE 12 is a perspective view of the rotary valve disk which controls the intake and exhaust of the engine;

FIGURE 13 is an exploded perspective view of the rotor and a portion of the two-piece engine crankshaft associated therewith; and

FIGURE 14 is a composite view showing diagrammatically the sequence of movements of the rotor pistons in the working chambers at successive positions during a complete cycle of the operation of the engine.

Although the principles of the invention are applicable to fluid motors, external combustion engines and pumps and compressors, there is disclosed specifically herein as a manner of applying the principles of the invention an internal combustion engine construction.

Stator

The internal combustion engine illustrated in the drawings is indicated generally by the numeral 10 and may be of any suitable shape and size being illustrated as of square cross-section. The engine includes a stator together with a rotor movably mounted therein.

The stator as may be best seen from FIGURES 1, 2, 5 and 6, consists of a central casing section 12 having open ends to which are secured a pair of axially aligned manifold sections 14 and 16. The section 16 in turn is provided with an end plate 18 while the section 14 has a valve casing 20 together with an end plate 22. These sections are axially aligned with each other and are of the same external cross-sectional shape and are detachably secured together as by through bolts 24, suitable sealing rings such as those shown at 26 in FIGURE 5 being positioned between the mating surfaces of the various sections.

It will be observed that the manifold sections 14 and 16 are hollow or provided with passages therein and these sections provide side walls 28 for the section 16 and 30 for the section 14, see FIGURE 6 in particular, while the section 12 has an inner peripheral wall 32 of an undulating configuration with successive portions being at varying distances from the center of the stator. The peripheral and side walls define therebetween a generally polygonal-shaped compartment within the stator which as

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shown best in FIGURE 7 is bounded by four convex walls with radially outwardly projecting recesses being provided between adjacent convex wall portions. Each of the convex wall portions is indicated by the numeral 34 while the interposed radially projecting recesses are indicated at 36 and as will be apparent comprise pockets.

Ignition means of any suitable type such as the spark plugs 38 are provided upon opposite sides of the stator central section and communicate as by ignition passages 40 extending through the convex walls 34 into opposite sides of the central compartment and adjacent opposite pockets or recesses 36. Any suitable ignition system is connected to these spark plugs, but inasmuch as the details of the ignition system are well understood by those skilled in the art and form no part of the invention set forth in the claims hereinafter a further description thereof is deemed to be unnecessary. It will of course be appreciated that when the device is to function as a fluid motor, a compressor or the like, that the spark plugs and their ignition system and ignition passages may be omitted.

As will be further observed from FIGURE 3, suitable supporting brackets as at 42 may be provided upon any desired portion of the stator and its section to constitute a means for mounting the device upon any suitable foundation or support structure.

As will be best observed from FIGURE 5, the end plate 22 which is engaged upon and forms a closure for the valve casing 20 is provided with an annular exhaust collection chamber 44 therein which discharges, as for example by the exhaust conduit 46, see FIGURE 2, to the atmosphere or any other suitable place of discharge. A combustible mixture from any suitable source, not shown, is supplied to the valve casing 22 as by means of the conduit 48 and thus discharging to the annular internal chamber of the valve casing.

Referring now to FIGURE 12 in conjunction with FIGURES 5, 6 and 8, it will be observed that there is provided a disk valve 50 having a central opening 52 by which it is secured upon the drive shaft of the rotor in a manner to be subsequently set forth. This valve is in the form of a disk or plate having an arcuately extending slot 54 therethrough constituting the exhaust port of the valve together with an arcuately extending recess 56 in its periphery opposite the slot 54 which constitutes the combustible mixture inlet port of the valve. It will be observed that the manifold section 14 has appropriately disposed axially extending exhaust and intake ports 58 and 60, respectively, whose opposite ends communicate with the compartment within the stator and in proper sequence with the exhaust and intake ports 54 and 56 in the valve disk. Similarly, the intake 22 includes exhaust ports 62 which are positioned to likewise register with the manifold collection chamber 44 and the exhaust port 54 of the valve disk member.

A water jacketing cooling system may be conveniently employed with this invention. A portion of this water jacket is shown in FIGURES 5, 6, 9 and 10 at 64, including chambers formed in the manifold sections 14 and 16 and connected by passages through the central casing section 12. Since the cooling system forms no part of the invention claimed herein, a further description is deemed to be unnecessary.

Rotor assembly

Cooperating with the stator is a rotor assembly. This includes a rotor in the form of a central portion or hub 70 having a plurality of radially outwardly extending blades or vanes each indicated by the numeral 72 which comprise the pistons of the apparatus. As shown, the rotor for the four-sided compartment is of triangular configuration having three blades 72. A bearing bushing or sleeve 74, see FIGURE 10, is disposed in an axial bore through the rotor and serves to journal the latter upon a drive shaft indicated generally by the numeral 76.

The rotor which is designated in its entirety by the

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numeral 80 is rotatably mounted upon the drive shaft but eccentrically of the drive shaft axis. It will be observed that the drive shaft 76 is disposed axially or centrally of the compartment within the stator while the rotor 80 is positioned eccentrically of or to one side of the compartment as the rotor moves progressively about the compartment.

The drive shaft 76 is preferably composed of two sections each comprising a crankshaft consisting of the main crankshaft portion 82, see FIGURE 13, carrying a crank throw in the form of a disk 84 upon which is carried an eccentrically disposed cylindrical crank pin 86. The two crankshaft sections extend in axial alignment with each other through suitable bearing bushings 87 and 89 which are engaged in the end wall 18 and in an axially extending internally threaded projection 88 of the manifold section 16 and in the inner wall of the valve casing 20 and the other manifold section 14.

If desired one of the crankshaft sections may terminate in its bearing assembly but at least one of the sections projects axially through the end wall of the device to receive thereon a flywheel 89. Power may be taken off from either of the crankshaft portions when the device functions as an internal combustion engine or the fluid motor, or by which power may be supplied to the rotor when the device functions as a pump or compressor.

Observing now FIGURE 10 in particular, it will be seen that the two crankpins 86 are in axial alignment with each other and are received within the bushing 74 within the rotor hub 70. In this manner, the triangular-shaped rotor is eccentrically mounted with and rotatably supported upon the drive shaft 76 by the two sections 82 thereof. The proportions of the parts are such that as the drive shaft rotates, the outer radial edges of the blades 72 will be caused to maintain a sliding contact with the convex walls 34 of the compartment except as they move into the recesses or pockets 36. Suitable sealing means are provided for insuring a fluid-tight engagement of the blades with the peripheral and side walls of the compartment in order that working chambers may be defined between the blades, the side walls and the peripheral wall in a manner to be subsequently set forth. For this purpose, the throw 84 of the crankshaft is such that as the crankshaft rotates and the rotor hub moves in an orbital path about the axis of the crankshaft, the eccentrically positioned blades will have an epicyclic motion whereby they move while continuously in contact with the convex walls 34 and progressively travel about the inner peripheral wall while rotating in a reverse direction upon rotation of the crankshaft.

Consequently, as will be noted from FIGURE 2 in conjunction with the diagrammatic views of FIGURE 14, each adjacent pair of blades defines therebetween and with the peripheral wall portions 34 of the compartment a working chamber in which the volume is progressively expanded and then contracted to thus perform the cyclic working strokes of the device.

For this purpose it is desirable that the rotor shall have a different number of blades than the number of the recesses and compartments, there being shown three blades cooperating with the four recesses.

Blade sealing means

As previously mentioned, a sealing means is provided for each of the blades to establish and maintain a fluid-tight seal of the latter with the peripheral and side walls of the compartment during the orbital travel of the blades therein and a rotation of the blades during such travel.

Referring first to FIGURE 9 it will be noted that the radial outer ends of each of the blades 72 has a semi-cylindrical recess 90 therein and a cylindrical sealing element designated generally by the numeral 92 is received in this recess which constitutes a seat therefor. Moreover, as will be best apparent from FIGURE 10, in con-

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junction with FIGURE 13, the end walls of the rotor are provided with radial grooves or recesses 94 for the reception of sealing strips 95, see FIGURES 10 and 11 in particular, whereby the piston blades are sealed to the peripheral wall and to the two side walls of the compartment in which they move.

Referring now especially to FIGURES 10 and 11 it will be observed that the cylindrical sealing element 92 consists of a pair of axially aligned cylindrical sections 96 and 98, having upon their adjacent ends axially extending fingers 100. As best seen in FIGURES 5 and 13, the fingers 100 of the sections 96 and 98 are interengaged or digitated with respect to each other while being capable of a limited axial relative movement therebetween. A guide member in the form of a bushing or sleeve 102 is slidably received within the interior of the sections 96 and 98 and underlies the interengaged fingers 100 as best shown in FIGURE 10. This sleeve is primarily a sealing means preventing the leakage of fluid pressure from the working chambers of the apparatus through the openings between the interdigitated fingers 100 of the movable sections 96 and 98. It also serves the dual functions of stiffening and reinforcing the interdigitated connection of the cylindrical sections 96 and 98 as well as constituting an inner abutment for a pair of springs 106, each of which abuts against the guide member 102 and projects outwardly therefrom and through the open ends at the outer sides of the sections 96 and 98.

The sealing strips 95 previously mentioned include cylindrical caps 108 upon their extremities which embrace diametrically reduced cylindrical end portions 110 of the two sections 96 and 98. The springs thus abut against the caps and urge them axially outwardly thereby pressing the strips against the side walls 28 and 30. If desired, the caps may be fixedly secured to the portions 110 of the sections and the springs also serve to resiliently urge the sections apart and thus tend to axially elongate or extend the cylindrical sealing elements 92.

Referring now particularly to FIGURES 7, 9-11, 13, it will be appreciated that the opposite ends of the rotor hub are provided with annular sealing ring grooves or channels 112 concentric with the bushing 74 and which intersect the radial slots 94 of the sealing strips 95. Seated in each channel 112 is an annular sealing ring 114 urged by a spring 116 into resilient sealing engagement with the end walls 28 and 30. The crossing portions of the strips 95 and rings 112 are notched or gained as at 119 and 121 so that their outer surfaces are flush while they establish a fluid-tight seal with each other.

Each of the rotor vanes or blades 72 has a radially extending and transversely disposed pocket or clearance 118 which is rectangular in cross-section and opens into the bottom of the recess 90 and receives a sealing blade 120 therein. The ends of this blade are slidably and guidingly retained in the notches of the strips 95. The adjacent edge of the blade 122 is concaved for sealing engagement with the sealing element 92. A spring 124 in the pocket 118 urges the blade 122 radially outwardly against the sealing element 92 and the latter against the peripheral wall 34 of the working chamber.

Operation

The operation of the internal combustion engine illustrated herein is as follows. A combustible mixture of any suitable source is delivered by the intake conduits 48 into the radially outer portion of the valve casing 22. From thence it is distributed by the inlet arcuate recess 56 of the valve member 50 through registering ports in the valve casing and the inlet passage 60 of the manifold section 14 and into the compartment of the device. The valve is so timed that as the associated working chamber of the compartment is expanding from its minimum volume toward its maximum volume, the combustion mixture is supplied thereto. When the chamber reaches

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its maximum volume, and begins to contract, the valve disk 50 closes the inlet port and the mixture is then compressed to its maximum as the working chamber decreases toward its minimum volume. After sufficient compression has occurred, the igniting means 38 ignites the charge and the working stroke of the engine begins, at which time the igniting combustible mixture within the expanding working chamber imparts rotation to the rotor and the drive shaft connected thereto. As the working chamber approaches its maximum volume the valve disk opens the exhaust port 58 of the working chamber to the exhaust collection chamber 44 through the port 62 and the exhaust port while discharging therefrom. During this period the working chamber is decreasing in volume thereby expelling the exhaust products, after which the cycle repeats itself.

The sequence of operations will be more readily apparent from a consideration of the diagrammatic views of FIGURE 14. Shown in that figure are 12 successive positions of the rotor in the compartment during one complete revolution of the drive shaft. It will be noted that certain intermediate positions have been omitted to simplify the drawings in which each figure represents one of the 24 circumferentially spaced positions of the rotor during its travel. Considering a single blade A comprising one of the pistons of the rotor, it will be noted that this blade in the 23 different positions has moved through one complete revolution within the compartment. It will be seen that simultaneously the same movement is occurring for the other two blades or pistons B and C. Each of the four recesses or pockets is designated by the letters D, E, F and G, while the successive convex portions of the combustion chamber periphery inner wall are indicated at H, I, J and K, respectively. The section of the rotor surface lying between the blades A and B is identified as L, while that lying between B and C is indicated at M and that between C and A is identified at N.

In the position indicated by 1 in FIGURE 14, it will be noted that the chamber bounded by the walls N and K is at its minimum. Consequently, this chamber has just completed its exhaust stroke. In the position shown at 2 this chamber lying between A and C is increasing its volume and is thus on its intake or suction stroke, drawing in a combustible charge. This action continues through position 3, until it reaches its maximum volume in position 4. Thereafter, this chamber begins to compress through the position of FIGURES 5 and 6 until it reaches maximum compression in 7 at which time ignition occurs. Moving to the position of FIGURE 7, this chamber increases in volume and is moving upon its expansion or working stroke as shown in 8. When it reaches the position 11, the working stroke is completed, the exhaust port opens and the exhaust is now beginning. This continues until the exhaust is completed, a new charge is taken in and in the position 19 the second charge is compressed and fired. The chamber then moves upon its working stroke and then upon its exhaust stroke until as shown in 23 it approaches its initial position. Thus, each chamber underlies two complete explosions during one revolution. This action is occurring while the other three chambers simultaneously but at spaced intervals as will be apparent from the diagrammatic views.

When the device is employed as a fluid motor or external combustion engine, the ignition system is unnecessary and pressure is supplied to the inlet port and exhausted through the discharge ports upon the same cycle of operation. When the device is employed as a compressor, the same cycle of operation is also effected.

The foregoing is considered as illustrative only of the principles of the invention. Further, since numerous modifications and changes will readily occur to those skilled in the art, it is not desired to limit the invention to the exact construction and operation shown and described, and accordingly all suitable modifications and

equivalents may be resorted to, falling within the scope of the invention as claimed.

What is claimed as new is as follows:

1. An expansible chamber device of the positive displacement rotary piston type comprising a stator and rotor, said stator having therein a generally polygonal-shaped compartment bounded by a pair of side walls and an undulating peripheral wall, a drive shaft journaled in said stator and disposed centrally of said compartment, said rotor being disposed in said compartment and mounted eccentrically and rotatably upon said drive shaft, said rotor having a central hub with a plurality of radially extending blades comprising pistons, sealing means carried by said blades and having a sliding and sealing engagement with said peripheral and side walls, said blades, side walls and peripheral wall defining successive working chambers which expand and contract successively upon movement of said pistons about said compartment, and fluid inlet and outlet means communicating with said chamber, said sealing means comprising, a cylindrical sealing element in a semi-cylindrical, axially extending channel at the outer ends of each blade, each sealing element comprising sealing strips on opposite ends, a pair of aligned, spaced cylindrical sections having interdigitated, axially extending fingers on adjacent ends, a cylindrical guide member disposed within said cylindrical sections overlapping the interdigitated fingers, a pair of springs disposed on opposite sides of and abutting the guide member to yieldingly urge the sections apart for axially and resiliently extending the sealing strips into sealing engagement with said side walls, each of said strips having a cap portion embracing the outer end of a cylindrical section and engaging one of said springs.

2. The combination of claim 1 including resilient means in said rotor but engaging said strips and yieldingly biasing them against said side walls.

3. An expansible chamber device of the positive displacement rotary piston type comprising a stator and a rotor, said stator having therein a generally polygonal-shaped compartment bounded by a pair of side walls and an undulating peripheral wall, a drive shaft journaled in said stator and disposed centrally of said compartment, said rotor being disposed in said compartment and mounted eccentrically and rotatably upon said drive shaft, said rotor having a central hub with a plurality of radially extending blades comprising pistons, sealing means carried by said blades, and having a sliding and sealing engagement with said peripheral and side walls, said blades, side walls and peripheral wall defining successive working chambers which expand and contract successively upon movement of said pistons about said compartment, fluid inlet and outlet means communicating with said working chamber, said stator comprising a central section having said compartment therein, a pair of hollow manifold sections axially aligned with and engaging opposite open ends of said central section to form said side walls, a valve casing section axially aligned with and secured to one of said manifold sections, a pair of end plates secured respectively to and closing the ends of said valve casing section and a disk valve in said valve casing independently driven by said drive shaft and controlling flow through said ports.

4. The combination of claim 3 wherein said disk valve has an arcuate slot and an arcuate peripheral recess respectively registrable with said outlet and inlet ports.

5. The combination of claim 4 including an exhaust gas collector chamber in said end plate secured to said valve casing section and combustible mixture inlet ports in said valve casing.

6. An expansible fluid chamber device comprising, a stator having side walls and a peripheral wall enclosing a fluid compartment, a rotor eccentrically mounted for rotation within said compartment and a plurality of blades slidably mounted by said rotor, each of said blades including sealing means having a pair of elements slidably mounted by the rotor in sliding contact with said side walls, axially extensible means supported by said pair of elements in sliding contact with the peripheral wall, and spring means mounted within the axially extensible means biasing said pair of elements into sealing engagement with the side walls.

7. An expansible fluid chamber device comprising, a stator having a housing section peripherally enclosing a fluid compartment and manifold sections forming axially spaced side walls closing said fluid compartment, a power shaft rotatably mounted by the stator and extending through the fluid compartment, a rotor eccentrically mounted by the shaft within the fluid compartment, a plurality of blades mounted by the rotor dividing the fluid compartment into expansible working chambers, valve means independently driven by said power shaft for conducting fluid to and from said working chambers through one of the manifold sections of the stator, and axially biased sealing means supported by each of the blades in sealing engagement with both the side walls of the manifold sections and the housing section of the stator.

8. The combination of claim 7 wherein said valve means includes a disc member having an arcuate exhaust port extending therethrough for axial discharge of fluid from said working chambers, and an arcuate recess establishing fluid communication between a radial inlet port in the stator and the working chambers.

9. The combination of claim 8 wherein said sealing means includes a pair elements slidably mounted by the rotor in sliding contact with said side walls, axially extensible means supported by said pair of elements in sliding contact with the housing section, and spring means mounted within the axially extensible means biasing said pair of elements into sealing engagement with the side walls.

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