April 21, 1964 G. STRIEGL 3,129,669

ROTARY COMPRESSORS, PUMPS AND THE LIKE

Filed July 2, 1962 2 Sheets-Sheet 1

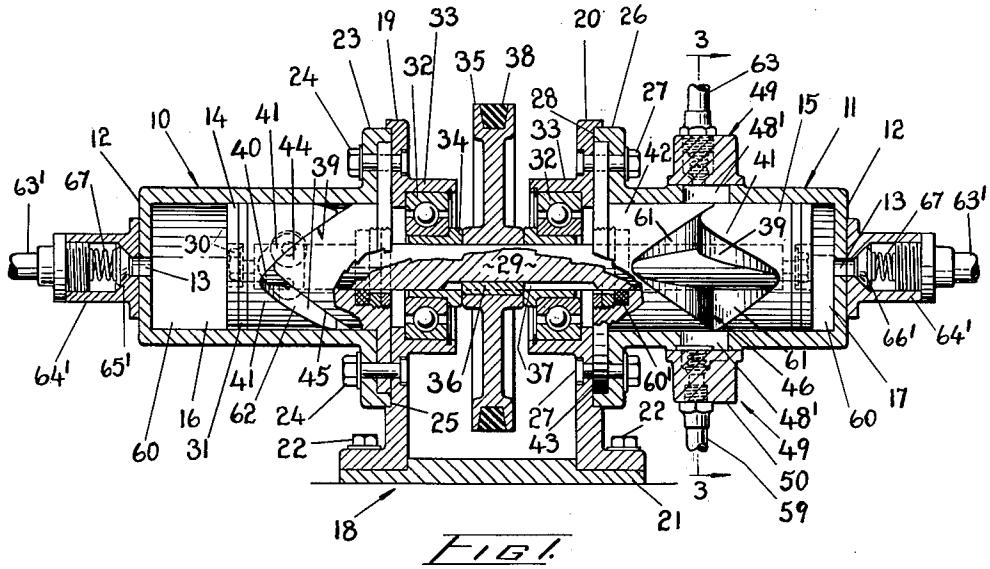


FIG 1.

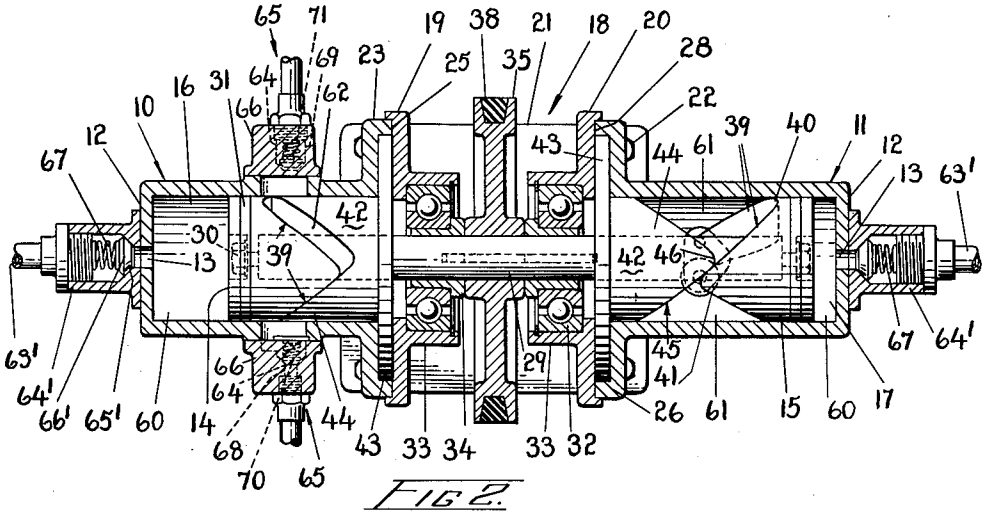


FIG 2.

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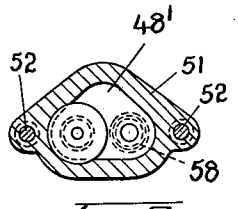


FIG 4.

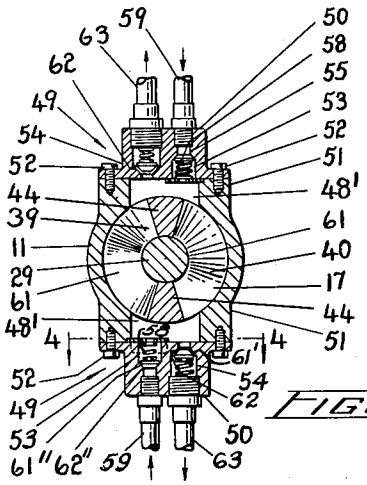
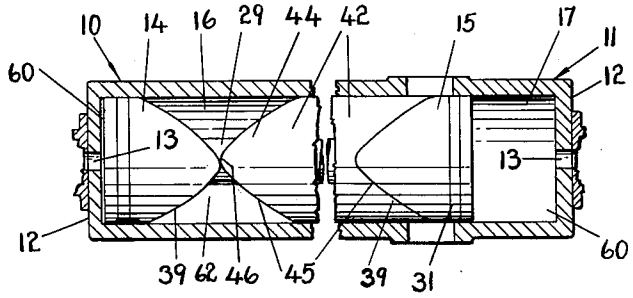


FIG 3.

FIG 6.



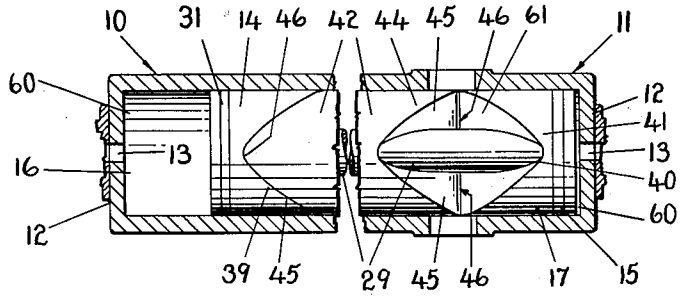


FIG 7.

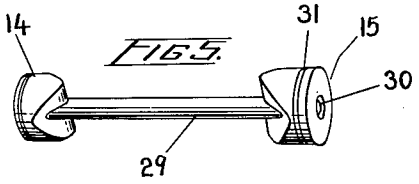


FIG 5.

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United States Patent Office 3,129,669 Patented Apr. 21, 1964

3,129,669

ROTARY COMPRESSORS, PUMPS AND THE LIKE

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Filed July 2, 1962, Ser. No. 206,733
12 Claims. (Cl. 103—157)

My invention relates to rotary power units and in particular to improvements in rotary compressors, pumps and the like, and has for its primary object the provision of a highly efficient and serviceable device of this kind which is substantially constant and positive in its action.

A further object of the invention is to provide a contrivance of the kind referred to which is uniform in output and reliable in operation, and one which may be motivated by a prime mover of comparatively small capacity and which moreover is inexpensive to manufacture.

The contrivance of my invention is possessed of a minimum of working parts, which are well balanced for smooth operation and durability.

The invention comprises the novel combination and arrangement of parts as described in the ensuing specification and shown in the accompanying drawings forming a part thereof.

In the drawings there is shown a selected embodiment of the invention in the nature of a rotary compressor, and it will be understood that various changes and modifications may be made in the details of the structure without departing from the scope of the invention.

In the drawings:

FIGURE 1 is a view in sectional elevation of the compressor;

FIGURE 2 is a sectional view of the compressor taken at right angles of FIGURE 1;

FIGURE 3 is a vertical section taken on the line 3—3 of FIGURE 1;

FIGURE 4 is a cross section on line 4—4 of FIGURE 3;

FIGURE 5 is a perspective detail of the coupled pistons on a unitary shaft;

FIGURE 6 is a fragmentary longitudinal sectional view of the work cylinders with the piston of the left hand work cylinder at the end of its outstroke position in which the cam heads thereof are aligned with the stationary cam heads at the inner end of this work cylinder; and

FIGURE 7 is a view similar to FIGURE 6 but showing the piston of the left hand working cylinder advanced to its innermost position and the piston in the other cylinder fully receded to its outstroke position in which its cam heads are aligned with the stationary cam heads.

Now, referring to the drawings in detail, the rotary compressor comprises a pair of work cylinders, generally indicated at 10 and 11, arranged in confronting relation and in spaced alignment. Said cylinders have enclosing outer end walls 12 perforated to provide axially located fluid passages 13 which are valve controlled and communicate respectively with displacement chambers 60 in the outer ends of said cylinders beyond pistons 14 and 15 operably disposed in said cylinders. Said fluid passages 13 and their controlling valves will be dealt with more fully later on.

Said cylinders have bores 16 and 17 respectively of uniform diameter in which the pistons 14 and 15 reciprocate respectively, the head ends being outwardly disposed. A frame, indicated as a whole by the numeral 18, rigidly supports said cylinders and may be of any suitable construction. It is shown, by way of example, as comprising the spaced vertical plates 19 and 20 attached to a base plate 21 as by means of screw 22. Cylinder 10 is secured to the vertical plate 19 by the provision of a flange 23 and fastening elements, shown as the bolts and nut 24.

Flange 23 is checked in said vertical plate 19 by means of a recess 25.

Cylinder 11 is similarly secured to the vertical plate 20 by the flange 26 and bolts and nuts 27. Flange 26 is checked in vertical plate 20 by means of a recess 28. Both of the vertical plates 19 and 20 are supplied with apertures in register with the bores 16 and 17 of the respective cylinders which enables said vertical plates to receive the shaft 29 which is firmly secured to the pistons 14 and 15 in a detachable manner. One way of attaching said shaft to said pistons is to fit the ends of said shaft in blind holes in the pistons and to lock the pistons to said shaft by headed screws 30. The heads of the screws 30 are desirably sunk in recesses in the outer ends of the pistons. Said pistons move as a unit along with the coupling shaft 29 and are made a sliding fit in the bores 16 and 17 of said cylinders, respectively. Said pistons are equipped with standard rings 31.

Anti-friction bearings 32 are contained in bosses 33 on the said vertical plates 19 and 20 for support of shaft 29. The inner races of the anti-friction bearings 32 are press fitted on bushings 34 and the bushings slidably receive said shaft so that it may move freely endwise along with said pistons as well as being free to rotate. A suitable driving agent is employed to rotate said shaft and is shown, by way of example, as a pulley 35 shouldered between said spaced bushings 34 and fastened to said shaft by a feather key 36 slidable endwise in a keyway 37 cut in said shaft. A belt 38 is trained about said pulley and also about another pulley (not shown) which is driven by a source of power—such as a prime mover for example.

Each piston 29 is cut away to diametrically opposite sides from its inner end to provide cam heads 41 and substantially V-shaped recesses whose helical complementary faces 39 are camming faces converging to a vertex 40 adjacent to the outer end of the respective piston. The camming faces of the recess at one side of a piston are symmetrical with respect to the camming faces of the recess at the other side of the piston. Also, the recesses in one piston are angularly offset in a transverse plane with regard to the recesses in the other piston so that the vertex of each recess in a piston is brought out of alignment to some extent at least with regard to the corresponding recess vertex of the other piston, or in other words, there is an offset relation with regard to the recesses of the coupled pistons. This will be dealt with later.

A stator 42 is fixed in each of the working cylinders 10 and 11 as by an integral circumposed flange 43 clamped by the bolts and nut 24 or 27. Said stator is a generally cylindrical member having a central opening which freely receives the drive shaft 29, and this opening is sealed by a standard seal or stuffing box 60', FIGURE 1. Said stator is cut away at diametrically opposite sides from its outer end to provide cam heads 44 and intervening substantially V-shaped recesses whose helical complementary faces 45 are camming faces converging to an apex 46. Said cam heads 44 of the stator conform dimensionally with the recesses in the corresponding piston for camming action with the camming faces 39 thereof. The camming faces 45 mate with the camming faces 39 and have co-acting engagement in the effective movements of the pistons which is brought about by rotation imparted to the drive shaft 29.

The cam heads 44 on one stator are angularly offset in a transverse plane with regard to the cam heads on the other stator but there is a greater angular offset than there is between the recesses in the coupled pistons 14 and 15. This permits the proper engagement of the camming faces of the pistons and the respective stators.

Now, assuming that the piston **14** is at the inner end of its stroke in which position its cam heads **41** will be fully engaged in the mating recesses of the adjacent stator **42** and the cam heads **44** of this stator will be similarly engaged with the recesses in this piston. In this phase however, the piston **15** will be at the end of its out stroke with the apexes of the cam heads **41** thereof engaged with those of the cam heads **44** belonging to the mating stator and with the respective recesses forming two fully open and diametrically opposite displacement chambers **61** as will be best understood from an inspection of FIGURE 1. Rotation of shaft **29**, as by power transmitted through the medium of pulley **35** and belt **38**, induces a camming effect in which the piston **14** has an attendant outward movement as it turns with shaft **29**, and this out stroke creates gradually enlarging displacement chambers due to spreading action between the inter-engaged cam head **41** of piston **14** and the adjoining stator. Said rotation of shaft **29** induces a concurrent camming effect in which the piston **15** has an attendant inward movement as it turns with this shaft, and this instroke gradually decreases the aforesaid fully open, diametrically opposite displacement chambers **61** due to the closing in of the inter-engaged cam heads **41** of the piston **15** and the adjoining stator, see FIGURES 1 and 2. It will be evident there are two sets of displacement chambers, one set within the confines of the working cylinder **10**, indicated at **62**, and the other set within the confines of the working cylinder **11**. Each set is utilized for the compressing or pumping of fluids, namely, gases or liquids.

Valve facilities are combined with the sets of displacement chambers **61**, **62**, for control of fluid passages communicating with the respective cylinders **10** and **11**. The fluid passages are diametrically disposed and extend through said cylinders to form a communicating with the bores thereof. The fluid passages for cylinder **11** are indicated at **48'** and are located at an intersecting disposition with regard to the apexes **46** of the cam heads **44** belonging to the internally located stator **42**.

The said valve facilities for cylinder **11** comprise a valve assembly **49** for each of the two passages **48'** therein. Said valve assemblies are of identical construction and each is shown, by way of example but not of limitation, as including a housing **50** mounted on a boss **51** on the cylinder as by headed screws **52**. Said housing is supplied with an ingress passage **53** and an egress passage **54**. The ingress passage **53** has a port **55** controlled by a valve **62''** which is urged to a seat **61''** by a spring **58**. Passage **53** is connected with a supply pipe **59**.

The egress passage **54** has a valve seat **61'** normally engaged by a valve **62** biased by spring pressure. The egress passage has a delivery pipe **63** which may lead to and be connected to a suitable receiver (not shown).

Now, from the foregoing it will be understood that as the piston **15** recedes from its instroke position a compression chamber is formed by the recesses intervening the cam heads **41** and **44**, and this chamber gradually enlarges as said piston continues to move outwardly. The enlarging chamber creates a suction and draws in fluid through the ingress valve which automatically closes at the end of the suction stroke of the piston. When the piston reverses its travel and moves inwardly in a compressive stroke the chamber is gradually reduced in volume and consequently the fluid therein is subjected to a compressive action which forces it past the egress valve and through the delivery pipe.

The fluid passages for cylinder **10** are denoted at **64** and are also located at an intersecting disposition with regard to the apexes **46** of the cam heads **44** belonging to the stator **42**.

The said valve facilities for cylinder **10** comprise a valve assembly **65** for each of the two fluid passages **64** therein and these valve assemblies are identical in construction to those previously recounted, and include a

housing **66**. The ingress passage is denoted at **68** and the egress passage at **69**.

The valve in the ingress passage is denoted at **70**, and the valve of the egress passage is represented at **71**. The valves **70** and **71** function similarly to the valves in the valve assemblies **49**.

It has been said that the recesses in the cam heads of the pistons constitute displacement chambers due to relative reciprocation of the pistons within the respective cylinders. Additionally to the described fluid displacement chambers, this invention contemplates using the free space between the outer ends of the pistons and the outer ends of the cylinders, respectively, as displacement chambers in order to increment the displacement capacity of the compressor in its entirety. This provides for increase of output for a given size of compressor.

This is carried out by the provision of fluid passages **13** and controlling valves therefor which have been briefly referred to earlier. There are two such fluid passages for each of the cylinders **10** and **11**, one serving as an ingress and the other as an egress. Only the egress passage for each of the cylinders **10** and **11** is shown in the drawings, the passages, however, lead to ports in valve assemblies which are similar in construction to the valve assemblies **49** and **65** recounted above. Therefore it is believed the construction and arrangement will be clearly understood. The valve assembly for each of the cylinders **10** and **11**, includes a delivery pipe **63'** connected to the valve housing **64'** and extended to a receiver (not shown). This delivery pipe communicates with the port of egress passage which is controlled by a check valve comprising the seat **65'**, valve element **66'** and biasing spring **67**. In a compression stroke the valve **66'** opens under pressure of fluid compression in the displacement chamber **60** and is expelled through the outlet passage **13** for delivery by the pipe **63'** to the associated receiver.

From the preceding description it will be understood that my invention is well suited for use as an air compressor and that it may also be used as a pump for liquids. Moreover by equipping it with a suitable valve and ignition system it may be employed as a rotary engine. Additionally, various changes and modifications may be resorted to as fairly come within the spirit and scope of the invention as herein after more specifically defined by the ensuing claims.

What I claim is:

1. A rotary apparatus comprising a cylinder fixedly supported and having an open end, a drive shaft disposed co-axially of said cylinder and extending into said open end thereof, supporting means for said shaft permitting it to rotate with an attendant endwise motion, means for driving said shaft and permitting it to have an attendant endwise motion, a fluid impinging piston operably disposed in said cylinder and rigid with said shaft, said piston provided with V-shaped recesses extending inwardly from an end thereof and provided with alternate V-shaped cam heads, said recesses having helical camming faces, a stator fixed in said cylinder and having cam heads and intervening substantially V-shaped recesses with helical complementary camming faces converging to an apex and conforming dimensionally with said recesses in said piston for camming engagement therewith in the rotation of said piston, whereby to produce displacement chambers, fluid passages for said chambers, valve means for said fluid passages, and means for effecting interengagement of the camming faces of said piston with those of the said stator.

2. The structure of claim 1, said means for effecting inter-engagement of the camming faces of said piston with those of the said stator comprising cam heads on said shaft with intervening V-shaped recesses having helical camming faces converging to an apex, and a relatively fixed stator having cam heads and intervening substantially V-shaped recesses with helical camming faces conforming to and engaged with said last-mentioned camming faces.

3. A rotary apparatus comprising a pair of relatively fixedly-supported work cylinders arranged in co-axial alignment and having bores therein terminating in open inner ends, a drive shaft longitudinally disposed between said cylinders and extending co-axially into the cylinders, supporting means for said shaft for permitting it to rotate with an attendant endwise movement, means for driving said shaft and permitting it to have an attendant endwise motion, a fluid impinging piston in each of said cylinders and having sealing engagement with the respective bores thereof and fixed on said drive shaft for movement therewith, said pistons having correspondingly recessed ends formed with V-shaped recesses and similarly shaped intervening cam heads, said recesses having camming faces converging to a vertex, a generally cylindrical stator fixed in each of the said cylinders and having cam heads and intervening substantially V-shaped recesses with helical complementary camming faces converging to an apex and conforming dimensionally with said recesses in the corresponding pistons for camming action with said camming faces thereof in the rotation of said drive shaft whereby to induce reciprocation of said pistons and produce displacement chambers, fluid passages provided in said cylinders for communicating with said displacement chambers, and valve means for controlling said fluid passages.

4. A rotary apparatus comprising a pair of relatively fixedly-supported work cylinders arranged in coaxial alignment and having bores therein terminating in open inner ends, a drive shaft longitudinally disposed between said cylinders and extending co-axially into the cylinders, supporting means for said shaft for permitting it to rotate with an attendant endwise movement, a rotary power transmitting device rigid with said shaft and having a connection with a motivating agent, a fluid-impinging piston in each of said cylinders and having sealing engagement with the respective bores thereof and fixed on said drive shaft for movement therewith, said pistons having correspondingly recessed ends formed with V-shaped recesses and similarly shaped intervening cam heads, said recesses having camming faces converging to a vertex, a generally cylindrical stator fixed in each of the said cylinders and having cam heads and intervening substantially V-shaped recesses with helical complementary camming faces converging to an apex and conforming dimensionally with said recesses in the corresponding pistons for camming action with said camming faces thereof in the rotation of said drive shaft whereby to induce reciprocation of said pistons and produce displacement chambers, fluid passages provided in said cylinders for communicating with said displacement chambers, and valve means for controlling said fluid passages.

5. A rotary apparatus comprising a pair of relatively fixedly-supported work cylinders arranged in coaxial alignment and having bores therein terminating in open inner ends, a drive shaft longitudinally disposed between said cylinders and extending coaxially into the cylinders, supporting means for said shaft for permitting it to rotate with an attendant endwise movement, a rotary power transmitting device rigid with said shaft and having a connection with a motivating agent, a fluid-impinging piston in each of said cylinders and having sealing engagement with the respective bores thereof and fixed on said drive shaft for movement therewith, said pistons having correspondingly recessed ends formed with V-shaped recesses and similarly shaped intervening cam heads, said recesses having camming faces converging to a vertex, a generally cylindrical stator fixed in each of the said cylinders and having a central opening receiving said drive shaft, said stator further having cam heads and intervening substantially V-shaped recesses with helical complementary camming faces converging to an apex and conforming dimensionally with said recesses in the corresponding pistons for camming action with said camming faces thereof in the rotation of said drive shaft whereby to induce reciprocation of said pistons and produce displacement chambers, fluid passages provided in said cylinders for communicating with said displacement chambers, and valve means for controlling said fluid passages.

6. A rotary apparatus comprising a frame, a pair of spaced, coaxial cylinders mounted on said frame and having bores therein terminating in open inner ends, a drive shaft longitudinally disposed between said cylinders and extending co-axially into the cylinders, supporting means for said shaft for permitting it to rotate with an attendant endwise movement, a rotary power transmitting device rigid with said shaft and having a connection with a motivating agent, closure means for the said inner ends of the cylinders and having encompassing sealing relation with said drive shaft, a fluid-impinging piston in each of said cylinders and having sealing engagement with the respective bores thereof and fixed on said drive shaft for movement therewith, said pistons each having outer ends and recessed inner ends with V-shaped recesses and similarly shaped intervening cam heads, said recesses having camming faces converging to a vertex adjacent to the outer end of the respective piston, a generally cylindrical stator fixed in each of the said cylinders and having a central opening receiving said drive shaft, said stator further having cam heads and intervening substantially V-shaped recesses with helical complementary camming faces converging to an apex and conforming dimensionally with said recesses in the corresponding pistons for camming action with said camming faces thereof in the rotation of said drive shaft whereby to induce reciprocation of said pistons and produce displacement chambers, fluid passages provided in said cylinders for communicating with said displacement chambers, and valve means for controlling said fluid passages.

7. The apparatus of claim 6, said frame comprising plates arranged parallel to each other and having openings through which said shaft extends, said plates providing the said closure means for the inner ends of the cylinders, sealing means for said openings, and fastening devices securing said cylinders to said plates whereby to mount the cylinders on said frame.

8. The apparatus of claim 7, said plates having bearings thereon which support said shaft.

9. The apparatus of claim 6, said rotary power transmitting device comprising a rotary member keyed to said shaft intermediate of said cylinders and shouldered against endwise movement, said rotary member mounted on said shaft with a slide fit permitting said shaft to have endwise movement.

10. The apparatus of claim 6, wherein the said camming faces of the recesses of said pistons are helical and conform with the helical camming faces of the recesses in said stator.

11. The apparatus of claim 6, in which there are ingress and egress passages in said cylinders, and in which said valve means comprise valve assemblies on said cylinders for control of said passages.

12. The structure of claim 1, wherein said fluid impinging piston has a head end adjacent to an enclosing end wall on said cylinder with an intervening displacement chamber for displacement of fluid induced by reciprocation of said fluid impinging piston, and wherein said enclosing end wall is supplied with a valve-controlled fluid passage for fluid displaced from said displacement chamber by said piston.

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