June 15, 1943. F. A. LANE 2,321,828

COMPRESSOR

Filed Nov. 24, 1941 2 Sheets-Sheet 1

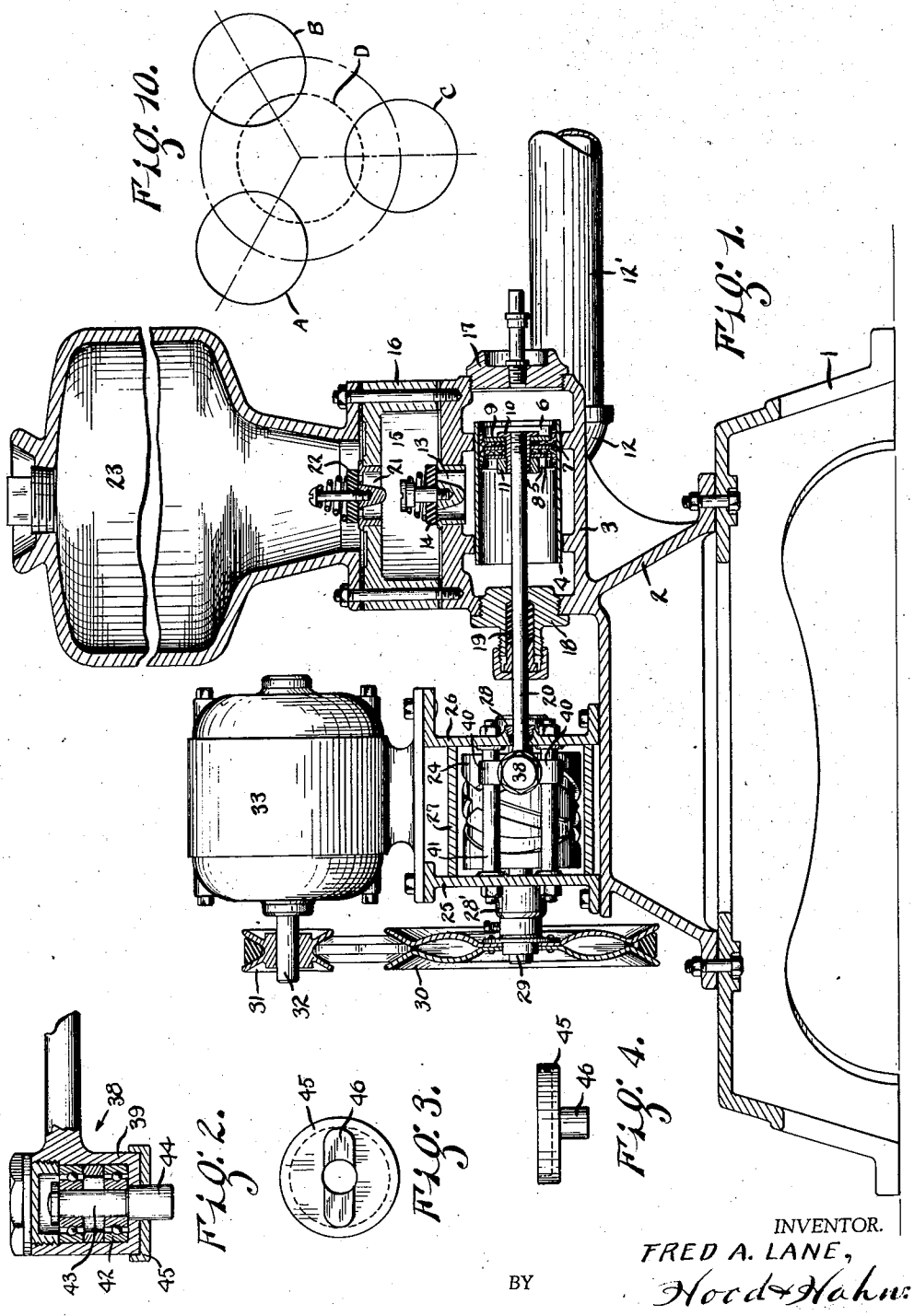

Fig. 10.

Fig. 1.

Fig. 2.

Fig. 3.

Fig. 4.

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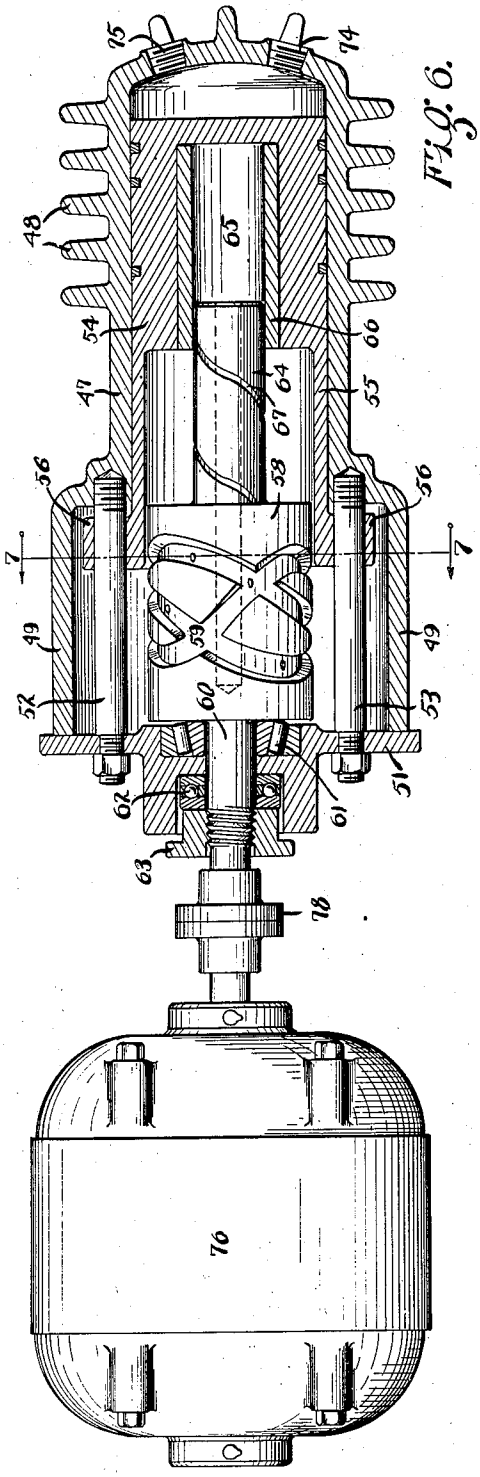

Fig. 6.

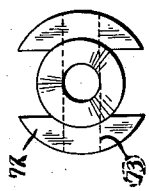

Fig. 8.

Fig. 9.

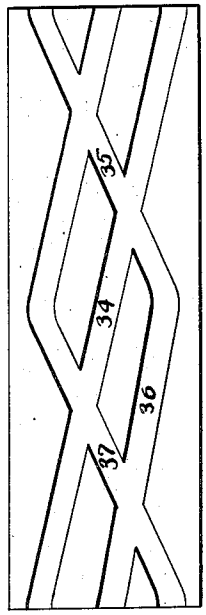

Fig. 5.

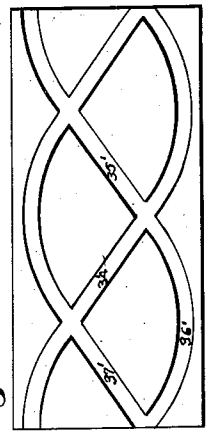

Fig. 11.

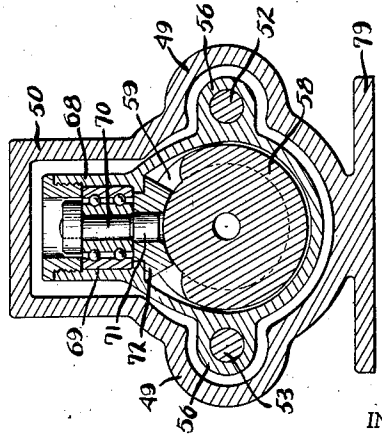

Fig. 7.

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UNITED STATES PATENT OFFICE

2,321,828

COMPRESSOR

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Application November 24, 1941, Serial No. 420,245

9 Claims. (Cl. 74—57)

The present invention relates to improvements in apparatus for converting rotary into reciprocating movement or vice versa.

One of the objects of my invention is to provide a rotor in the form of a cylindrical cam preferably having a cam slot formed in its periphery adapted to cooperate with a reciprocating piston either for driving said piston from a source of power or for transmitting the power imparted to said piston to a power receiving source.

In the specific embodiment of the invention, it is one of the objects of the invention to provide a rotary cam member for transmitting power from a suitable source to a reciprocating piston and driving said piston to cause said piston to operate as a fluid compressor either of air or liquid.

I have illustrated certain embodiments of the invention in the accompanying drawings, in which:

Fig. 1 is a longitudinal sectional view of a pump embodying my invention;

Fig. 2 is a longitudinal sectional view of a follower at the end of a piston rod;

Fig. 3 is a plan view of the follower illustrated in Fig. 2;

Fig. 4 is an end elevation showing a follower rib;

Fig. 5 is a developed view of the rotor;

Fig. 6 is a horizontal section of a form of compressor embodying my invention;

Fig. 7 is a transverse sectional view on the line 7, 7 of Fig. 6;

Fig. 8 is a bottom plan view of a follower for use with the structure in Figs. 6 and 7;

Fig. 9 is an end elevation of the follower member;

Fig. 10 is a diagrammatic view showing the cylindrical grouping about the axis of the rotor where it is desired to use more than one cylinder; and

Fig. 11 is a developed view of a modified form of the type of rotor illustrated in Fig. 5.

In the embodiment illustrated in Figs. 1 to 5, I provide a base 1 on which the various parts of the assembled structure are adapted to be mounted. On this base 1, I provide a sub-base 2 which has formed as a part thereof a cylinder casting 3 having an open ended cylinder lining 4. Operating within this lining is a piston comprising the oppositely faced piston cups 5 and 6 spaced apart by a washer 7 and stiffened by oppositely disposed washers 8 and 9. This assembly is mounted upon a headed hollow thimble 10 being secured thereon by means of a threaded nut 11. The cylinder casting 3 is provided with an intake 12 connected with a suitable intake pipe 12' and with a discharge port 13 controlled by a spring seated valve 14. This discharge port discharges into a chamber 15 formed by a hollow casting 16 secured on the cylinder casting 3. One end of the cylinder casting 3 is closed by a threaded plug 17 and the opposite end by a threaded plug 18 which carries a packing 19 for the piston rod 20. The chamber 15 communicates through a port 21 controlled by a spring-pressed valve 22 with a hydraulic head 23.

A rotor 24 for imparting reciprocating motion to the piston is rotatably mounted within a housing comprising a pair of end members 25 and 26 between which is suitably clamped a cylindrical casing 27. This rotor 24 is mounted in end bearings 28 and 28' and is provided with an extension shaft 29. The extension shaft 29 carries a driven pulley 30 having a belt drive connection with the driving pulley 31 on the shaft 32 of an electric motor 33 mounted on the top of the two end members 25 and 26.

The rotor 24 is provided with a continuous groove therein extending around the periphery. This groove is so arranged as to impart a relatively slow compression stroke to the piston with a relatively fast returning stroke. To this end, the groove comprises a reach 34 which extends through 360° of rotation of the rotor. This reach merges into a reach 35 which crosses the reach 34 at an angle thereto and extends through 180° of the rotor. The reach 35 merges into a reach 36 parallel with the reach 34 and extending through 360° of the rotor. This reach 36 merges into a reach 37 crossing the reach 34 and the reach 36 and extending at an angle to these reaches and extending throughout 180° of the rotor. The reach 37, of course, eventually merges into the reach 34. Accordingly, this groove comprises a pair of reaches arranged in echelon and each extending through 360° of the rotor, which reaches are adapted to impart, what may be termed, the power stroke, to the piston; and, as a result, the angle of inclination of these reaches is comparatively low, imparting to the piston a relatively slow powerful thrust. Likewise, there is provided a pair of reaches crossing the first-mentioned reaches and each extending throughout 180° of rotor, the angle of inclination of which is accordingly comparatively sharp, giving to the piston a return stroke much more rapid than that given to the power stroke.

Operating within the cam groove of the rotor 24 is a follower 38 which is secured upon or forms a part of the end of the piston rod 20. The piston rod 20, at its end, is extended to provide a cylindrical boss 39 having disposed on either side thereof a pair of guide bosses 40. Each of these guide bosses has a central opening therein receiving a guide rod 41 which is bolted between the heads 25 and 26, serving not only to hold the heads together but also to act as guide rods for the follower. By this arrangement, the follower head comprising the cylindrical member 39 is guided in its reciprocations. The enlarged cylinder 39 receives a pair of roller bearings 42 within which is mounted a rotary friction pin 43 having an enlarged end 44 projecting through a head 45 on the cylinder boss 39, and this head is provided with a rib 46, on its under face, which is slightly narrower in cross section than the pin portion 44. This rib, however, is of greater longitudinal extent than the width of the cam slots so that as the follower rib 46 follows through the cam slots and crosses over another cam slot, there will be no danger of the follower failing to track in its proper slot.

In the structure illustrated in Figs. 6 to 9, inclusive, I have shown an improved form of compressor which embodies my invention and which reduces the number of parts for a compressor to the minimum. In this structure, I provide a compressor cylinder 47 having peripheral heat dissipating fins 48. The rear end of this cylinder is enlarged to provide a casing or housing for the rotor. This housing is extended on either side, as at 49, to provide guide spaces and is extended at its top to provide a casing 50 for the follower. The rear end of the cylinder is closed by a head 51 bolted to the casing by guide rod bolts 52 and 53 which extend through the head and into the cylinder walls passing through the enlargements 49. Operating within the cylinder 47 is a compression piston 54 having an extension skirt 55 provided with laterally extending bosses 56 bored to receive the guide rods 52 and 53 whereby the piston will be held against rotation and will be guided in its reciprocating movement in the cylinder 47. The rotor 58 which is provided with a cam slot 59 similar to the cam slot illustrated in Fig. 5 is mounted within the housing extension of the cylinder 47 and to this end, one end of the rotor is provided with a shaft 60 operating in a roller bearing 61 mounted in a cup-like recess in the head 51 and provided with a thrust ballbearing 62 operating against an adjustable thrust nut 63 on the shaft 60. The opposite end of the rotor 58 is provided with an extension shaft 64 which is piloted in a recessed end 65 of the piston 54, this recessed end being lined with a bearing lining 66, and the pilot shaft 64 is provided with a spiral oil groove 67 to insure proper lubrication of this shaft as it operates within the recess 65.

The cylinder skirt 55 is provided with an upwardly extending cylindrical boss 68 adapted to receive ballbearing races 69 in which is mounted a pin 70 having an enlarged head 71 which head extends through a follower 72 provided on its under face with a follower rib 73. The thickness of this rib is slightly less than the diameter of the head 71 and the longitudinal extent of the rib is greater than the width of the cam slot 59 in the rotor so that the follower will track in the cam slot at the cross-over points.

The cylinder 47 is provided, at its end, with a suitable inlet valve connection 74 and an outlet valve connection 75, and the rotor shaft 60 is adapted to be connected to and driven from an electric motor 76 connected to the rotor shaft through the medium of a suitable coupling 78. The cylinder extension housing is provided with a base 79 on which the same may rest and, of course, this base would be in the same horizontal plane as the base of the driving motor 76. In this structure, as in the pump heretofore described, a relatively long angled power stroke is imparted to the piston 54 while a relatively short angled return stroke is imparted thereto by the parallel crossing cam slots.

It is obvious that, if desired, the rotor may control or be controlled by the piston of more than one cylinder. In Fig. 10, I have illustrated diagrammatically the grouping of a plurality, three, of cylinders about the axis of a rotor so that the same rotor can be connected to the piston rods of each. In this diagrammatic view, the three cylinders A, B and C will be grouped about the rotor D. In each instance, of course, the piston of each cylinder would have a follower operating in the cam slot of the rotor.

In Fig. 11, I have shown a developed view of a modification of the rotor illustrated in Fig. 5. In some instances, particularly in rotors having a relatively small diameter, it is desirable that the crossing of the different reaches of the cam slot shall more nearly approach a right angle than is shown in the structure illustrated in Fig. 5. In some instances, it is desirable that all of the reaches be of substantially the same length. As illustrated in Fig. 11, the reaches 35' and 37', corresponding to reaches 35 and 37 in the structure illustrated in Fig. 5, merge into the other reaches with a more pronounced curve and, as a result, these reaches cross reaches 34' and 36', likewise merging with a more pronounced curve more nearly at right angles. Therefore, the danger of the follower jumping out of the cam groove at the cross-over point is reduced to the minimum. Furthermore, it will be noted that each of the reaches is of the same length or extends around the cylinder the same number of degrees.

I claim as my invention:

1. In an apparatus of the character described, in combination, a guide, a slide reciprocable in said guide, a rotor associated with said slide and having a continuous groove in its peripheral face extending three times around the rotor and including a pair of spiral reaches each extending approximately 360° of rotation of the rotor, and a pair of spiral reaches each extending substantially at right angles to said first-mentioned reaches and approximately 180° of the rotation of the rotor, each reach of each pair merging at its opposite ends in the reaches of the other pair, and a rotor connection between said rotor and said slide operating in said groove.

2. In an apparatus of the character described, in combination, a guide and a slide reciprocable in said guide, a rotor in the nature of a cylinder having a continuous groove in its peripheral face extending three times around the rotor and including a pair of spiral reaches each extending aproximately 360° of the rotation of the rotor and disposed in echelon, and a pair of spiral reaches crossing said first-mentioned reaches disposed in echelon each extending approximately 180° of the rotation of the rotor, and a rotor connection between said rotor and slide and operating in said groove.

3. In an apparatus of the character described,

in combination, a guide, a slide reciprocable in said guide, a rotor in the nature of a cylinder having a continuous groove in its peripheral face extending a plurality of times around the rotor and including a pair of spiral reaches disposed in echelon, a second pair of reaches crossing said first-mentioned reaches and disposed in echelon and being of less peripheral extent than said first-mentioned reaches.

4. In an apparatus of the character described, in combination, a guide, a slide reciprocable in said guide, a rotor in the nature of a cylinder having a continuous groove in its peripheral face extending a plurality of times around the rotor, said groove including a pair of reaches disposed in echelon, and a pair of reaches disposed in echelon and shorter than said first-mentioned reaches, and a rotor connection between the rotor and slide and operating in said groove.

5. In an apparatus of the character described, in combination, a guide and a slide, a cylindrical cam rotor associated with said slide for imparting forward and return motion to its follower in a plurality of revolutions of said cam, the forward imparting portion of said cam including a pair of reaches disposed in echelon and the return motion part of said cam including a pair of reaches shorter than said first-mentioned reaches crossing said first-mentioned reaches and disposed in echelon, a follower cooperating with said cam, and means for connecting said follower to said slide.

6. In an apparatus of the character described, in combination, a guide having an extension thereof forming a rotor housing, a head closing the rear end of said housing, a slide operating in said guide and having an extension skirt projecting into said housing, a plurality of supporting members secured in said housing and arranged parallel to the axis of said guide and symmetrically with respect to said axis, a plurality of bosses on said skirt sleeved on said supporting members, a rotor mounted in said housing having a cylindrical cam, a follower carried by said slide skirt cooperting with said cam for imparting reciprocating movement to said slide with respect to said guide, said cam having one end journalled in the head of said housing and the other end journalled in said slide.

7. In an apparatus of the character described, in combination, a cylindrical cam rotor having a cam surface extending a plurality of times about its axis and including a pair of cam portions disposed in echelon and a second pair of cam portions crossing said first-mentioned cam portions and disposed in echelon and having less extent than said first-mentioned portions.

8. In an apparatus of the character described, in combination, a guide, a slide reciprocable in said guide, a rotor in the nature of a cylinder having a continuous groove in its peripheral face extending a plurality of times around the rotor, said groove including two pairs of reaches, the reaches of each pair being disposed in echelon, each reach of each pair merging at its opposite ends in the reaches of the other pair, and a rotor connection between said rotor and slide and operating in said groove.

9. In an apparatus of the character described, in combination, a cylindrical cam rotor having a continuous extending cam portion extending a plurality of times about the axis thereof and including a pair of spiral reaches, each having a peripheral extent of approximately 360° and disposed in echelon, and a pair of spiral reaches crossing said first-mentioned reaches, disposed in echelon and each having a peripheral extent of aproximately 180°, each reach of each pair merging at its opposite ends in the reaches of the other pair.

FRED A. LANE.