

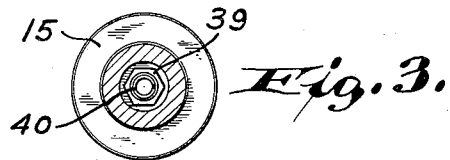
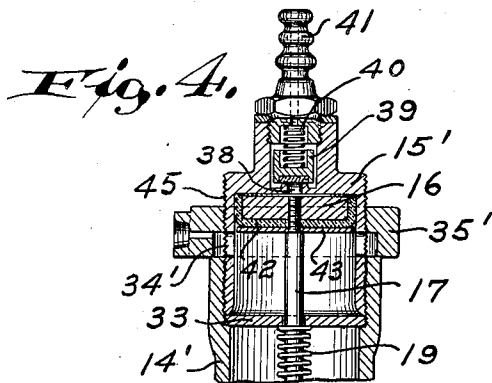
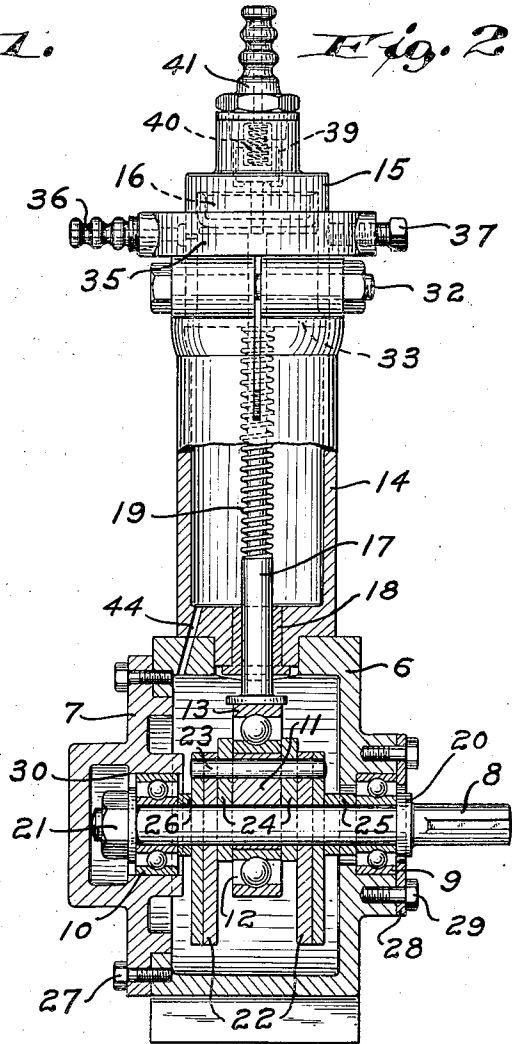
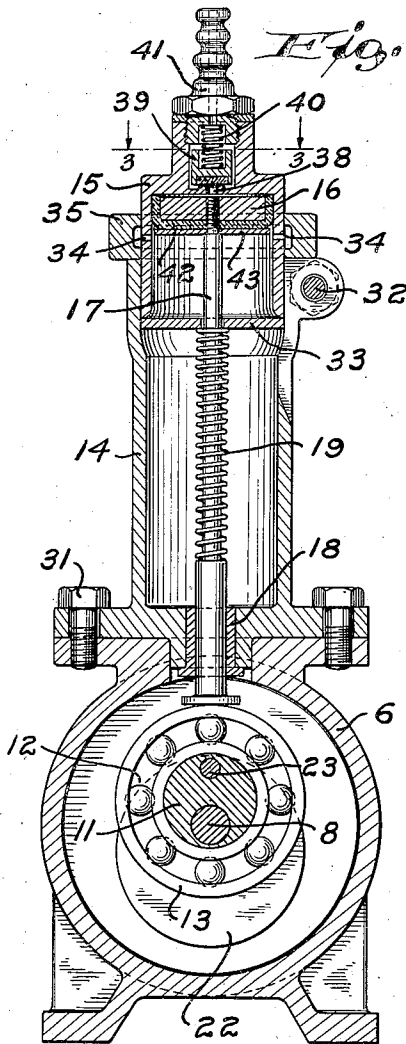
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6 Claims. (Cl. 74—55)

The present invention relates in general to improvements in the construction and operation of mechanism for converting rotary motion into reciprocating motion, and vice versa, and relates more specifically to improved motion transmission mechanism especially applicable to high speed machines such as reciprocating pumps or other similar assemblages.

An object of the invention is to provide an improved motion transmitting mechanism which is simple and compact in construction, and which is moreover highly efficient in operation.

Another object of the invention is the provision of a durable high speed machine wherein rotary motion may be quietly and effectively converted into reciprocating motion, or vice versa.

A further object of the invention is to provide various improvements especially applicable to air pumps or the like, whereby the various parts of such structures are made conveniently accessible for adjustment, inspection and renewal of parts.

Still another object of the invention is the provision of an improved high speed pump structure which may be manufactured and sold at minimum cost, and which is operable with minimum vibration and noise.

These and other objects and advantages will be apparent from the following detailed description.

A clear conception of several specific embodiments of the improved features, and of the mode of constructing and of operating air pumps built in accordance with the invention, may be had by referring to the drawing accompanying and forming a part of this specification in which like reference characters designate the same or similar parts in the various views:

Fig. 1 is a central vertical section through a high speed air pump, taken transversely through the main driving shaft thereof;

Fig. 2 is a longitudinal vertical section through a portion of the air pump of Fig. 1;

Fig. 3 is an enlarged horizontal section through the discharge valve chamber of the pump, taken along the line 3—3 of Fig. 1; and

Fig. 4 is a central vertical section through a fragment of a modified pump structure.

While the invention is shown and described herein as being specifically applied by way of illustration, to air pumps of the reciprocating piston type, it is not intended to unnecessarily restrict the scope by such disclosure, since at least some of the features of the improvement may be more generally applicable to other classes

of machines such as positive displacement reciprocating piston engines.

Referring to Figs. 1 to 3 inclusive of the drawing, the air compressor specifically shown therein comprises in general a main casing 6 having a removable end cover 7; a shaft 8 rotatably supported in a pair of concentric anti-friction bearings 9, 10 mounted in the casing 6 and cover 7 respectively; an eccentric 11 carried by the shaft 8 between the bearings 9, 10; a relatively large anti-friction bearing 12 embracing the eccentric 11 and having an outer race or ring member 13, an auxiliary casing 14 removably attached to the main casing 6 and projecting upwardly therefrom; a cylinder 15 detachably connected to the upper end of the auxiliary casing 14; a piston 16 reciprocable within the cylinder 15; a piston rod 17 secured at its upper end to the piston 16 and slidable at its lower portion in a guide bearing 18 mounted in the casing 14; and a spring 19 for constantly urging the lower extremity of the rod 17 in contact with the bearing member 13.

The shaft 8 may be detachably connected to an electric motor or other source of rotary motion, by means of an ordinary flexible coupling associated with the protruding shaft end, and a flange 20 is rigidly attached to or formed integral with the shaft at this end and coacts directly with the inner revolving race of the ball bearing 9. The portion of the shaft 8 which is normally concealed within the casing 6 and cover 7, is devoid of key-ways, and the concealed end of the shaft is threaded and has a clamping nut 21 coacting therewith. Embracing the shaft 8 at each side of the eccentric 11, is a balancing or counter-weight 22 for the eccentric, and each of these weights 22 may be composed of several layers of sheet metal having like or different gauge selected to insure perfect counter-balancing. The counter-weights 22 are rigidly attached to the eccentric 11 by a rivet 23, and the inner race of the ball-bearing 12 is clamped to the eccentric by collars 24 interposed between the ends of the eccentric and the adjacent weights 22, these collars 24 also being penetrated by the rivets 23 as shown in Fig. 2. In order to insure such clamping of the inner bearing race, the eccentric 11 may be formed of slightly less width than the race, and the rigidly interconnected eccentric 11, weights 22 and collars 24 are all bored to snugly fit the shaft 8. The outer faces of the counter-weights 22 are engaged by collars 25, 26 snugly embracing the shaft 11, and these collars 25, 26 have end engagement with the inner races of the bearings 9, 10 respectively, so that when the nut 21 is driven

home against the adjacent lock washer, the eccentric 11, bearings 9, 10, counter-weights 22 and collars 24, 25, 26 are all simultaneously locked in position upon the shaft 8 and against the fixed 5 flange 20. The cover 7 which is detachably connected to the casing 6 by cap screws 27, obviously permits such assembly of the elements upon the shaft 11, and removal thereof, and the interior of the casing 6 is normally supplied with a bath of 10 lubricant. It should also be noted, that the outer race of the anti-friction bearing 9 is confined within an end bore in the casing 6 by a plate 28 and cap screws 29, while the outer race of the other shaft bearing 10 is slidably mounted in a 15 bore 30 of the cap 7 so as to permit free endwise removal of this cap.

The auxiliary or guide casing 14 is rigidly but removably connected to the main casing 6, by means of cap screws 31, and the cylinder 15 of 20 Figs. 1, 2 and 3, is fitted within a bore formed in the longitudinally split upper end of the casing 14 and may be clamped firmly therein by means of a clamping bolt 32. While the cylinder 15 is susceptible of slight vertical adjustment, the 25 lower end of this cylinder would ordinarily rest upon a transverse plate 33 which is mounted within the casing 14 and provides an upper guide for the rod 17 as well as a limit stop for the cylinder. The wall of the cylinder 15 is pierced by 30 a series of suction ports 34 disposed above the upper extremity of the guide casing 14, and these ports may be surrounded by a suction casing 35 having a hose attaching nipple 36 and a clamping screw 37 as shown in Fig. 2. The upper end 35 of the displacement chamber of the cylinder has therein a central discharge port 38 controlled by a hexagonal discharge valve 39 normally pressed to its seat by means of a spring 40 the upper end of which reacts against a removable plug 41 hav- 40 ing a discharge hose attaching nipple formed integral therewith. The discharge valve 39 is formed hexagonal as shown in Fig. 3, or of some other polygonal cross-section, in order to permit free escape of the fluid being pumped, and the 45 plug 41 permits free insertion, inspection, or removal of this valve.

The piston 16 is detachably connected to the upper end of the rod 17, and has a cup-leather or other suitable packing 42 held in place by a fol- 50 lower plate 43 as shown in Fig. 1. The lower portion of the rod 17 which slides within the guide bearing 18, is of enlarged diameter so as to permit the spring 19 which embraces the thin rod portion and which is of approximately the same external diameter as the thick rod portion, to be 55 inserted and removed with the piston rod through the bore of the bearing 18. The upper end of the spring 19 reacts against the plate 33, while the lower end engages the rod shoulder, and the lower 60 extremity of the rod 17 is enlarged for extended contact with the peripheral surface of the outer race or ring member 13 of the eccentric bearing 12. The casings 6, 14 may be provided with one or more lubricant drainage holes 44 for returning 65 oil escaping past the guide bearing 18 to the main casing 6, and it is to be noted that by removing the casing 14 from the casing 6, and utilizing the lower enlarged end of the piston rod 17 to unscrew this rod from the piston 16, the rod 17 70 and spring 19 may be withdrawn through the guide bearing 18. This guide bearing may also be inserted or removed from the casing 14 from the exterior thereof when removed from the casing 6.

75 During normal operation of the improved com-

pressor, the shaft 8 is being rotated at relatively high speed within the ball bearings 9, 10, thereby causing the eccentric 11 and counter-weights 22 to revolve within the casing 6 and to splash the lubricant from the bath in the bottom of the 5 casing upon the bearings 9, 10, 11 and 12. The concealed elements are thus abundantly lubricated and any oil which escapes into the interior of the casing 14 will be returned through the 10 holes 44 to the interior of the casing 6. As the eccentric 11 and the anti-friction bearing 12 associated therewith, revolve, the ring member 13 of the ball bearing engages the enlarged end of the piston rod 17 and moves this rod longitudinally to thereby cause the piston 16 to approach 15 the discharge port 38. The spring 19 functions to move the rod 17 in opposition to the motion imparted thereto by the eccentric, thus causing the piston 16 to reciprocate and to constantly contact with the ring member 13 of the large eccentric ball bearing. The receding movement of the piston 16 is sufficient to cause the piston in its down- 20 ward motion to uncover the suction ports 34, and when this is done, air is withdrawn through these ports into the displacement chamber of the cylinder 15 and this air after being compressed is delivered through the discharge port 38 past the 25 discharge valve 39. As the reciprocation of the piston 16 and rod 17 is continued by the constant revolution of the eccentric 11 and bearing 12, a substantially constant stream of compressed air is discharged through the plug 41 and this air may be delivered to a storage tank and subsequently utilized as desired. By virtue of the fact 30 that the ring member 13 is rotatable with respect to the balls and inner race of the bearing 12, the sliding action between the member 13 and the rod 17 is reduced to a minimum. The counter-weights 22 effectively counter-balance the eccentric 13 and the collars 24, thereby reducing the 35 vibration and the noise to a minimum, while effectively converting the rotary motion of the shaft 8 into reciprocatory motion of the rod 17.

In the modified construction specifically illustrated in Fig. 4, the construction of the piston 45 16, discharge valve 39 and plug 41 is substantially the same as that previously described. The mode of attaching the cylinder 15' to the auxiliary casing 14', is, however, different. In this modification the external surface of the cylinder 15' is 50 provided with screw threads 45 and the cylinder has screw thread coaction with the upper extremity of the casing 14' which is not split as in the pump of Figs. 1 and 2. The discharge casing 35' also has screw thread coaction with the external threads 45 of the cylinder 15', and this 55 casing 35' serves as a lock nut to clamp the cylinder 15' in adjusted position relative to the casing 14'. The suction ports 34' of the cylinder 15' are formed of greater length than in the 60 pump previously described, so as to take care of the adjustment of the cylinder, and the casing 35' will provide fixed upper limits for the suction openings. With this modified construction, it will be apparent that the cylinder 15' may be adjusted 65 vertically to vary the volume of the compression chamber, and if so desired, such adjustment can be utilized to vary the degree of compression. If the compression chamber is enlarged, lower discharge pressure will be attained than if this 70 chamber is reduced to a minimum, and such adjustment may be desirable in connection with certain classes of service.

From the foregoing description it will be apparent that the invention provides a simple, com- 75

pact, durable and highly efficient mechanism for
 converting rotary into reciprocatory motion, and
 vice versa. All portions of the structure are read-
 ily accessible for assembly, inspection or disman-
 5 tling, and the clamping nut 21 and flange 20 serve
 as simple and highly effective means for attach-
 ing the eccentric 11 and the counter-weights 22
 to the shaft 8, without the use of keys or set
 10 screws. These elements are, however, readily ac-
 cessible upon removal of the cap 7, and the piston
 16 and rod 17 are likewise readily accessible by
 virtue of the removability of the cylinder and of
 the auxiliary guide casing. The device may be
 15 operated at comparatively high speed with mini-
 mum vibration and noise, and has proven highly
 successful in commercial operation for air com-
 pressing purposes. The noise and vibration are
 obviously minimized by mounting the anti-fric-
 20 tion bearing 12 directly upon the eccentric and by
 counterbalancing the weight of this bearing as
 well as that of the eccentric with the counter-
 weights 22, and the additional anti-friction bear-
 ings 9, 10 assure smooth running of the unit
 25 which is abundantly lubricated by the splash sys-
 tem. While the modification of Fig. 4 provides
 for vertical adjustment of the cylinder, with the
 aid of screw threads, it will be apparent that
 such adjustment is also possible with the con-
 struction specifically shown in Figs. 1 and 2.

30 It should be understood that it is not desired
 to limit the invention to the exact details of con-
 struction herein shown and described, for various
 modifications within the scope of the claims may
 occur to persons skilled in the art.

35 It is claimed and desired to secure by Letters
 Patent:

1. In combination, a main casing, a horizontal
 rotary shaft having an eccentric portion provided
 with an annular surface disposed within said cas-
 40 ing, a ring member surrounding and spaced from
 said surface within said casing, a series of roll-
 able elements interposed between said member
 and said surface, an upright rod having an en-
 larged lower end contacting with the periphery
 45 of said member within said casing, said casing
 having an upper opening through which said rod
 end is removable, a guide casing removably at-
 tached to said main casing and having a lower
 rod guiding portion normally closing said open-
 50 ing, a transverse plate carried by said guide cas-
 ing and having an upper rod guiding portion dis-
 posed within said casing, a spring coacting with
 said plate and with said rod to urge said rod end
 in contact with said member, a cylinder carried
 55 by said guide casing above said plate, and a piston
 secured to the upper portion of said rod and re-
 ciprocable within said cylinder.

2. In combination, a main casing, a shaft sup-
 porting eccentric mechanism for revolution with-
 60 in said casing, an upright rod having an enlarged
 lower end contacting with said mechanism with-
 in said casing, said casing having an upper open-
 ing through which said rod end is removable, a
 guide casing removably attached to said main
 65 casing and having a lower rod guiding portion
 normally filling and closing said opening, a trans-
 verse plate attached to said guide casing and hav-
 ing an upper rod guiding portion disposed within
 said casing in alinement with said lower rod guid-
 70 ing portion, a spring confined within said guide
 casing below said plate and coacting with said
 rod to urge said rod end in contact with said
 mechanism, a cylinder detachably connected to
 75 said guide casing above said plate, and a piston

detachably secured to said rod above said plate
 and reciprocable within said cylinder.

3. In combination, a main casing, a shaft sup-
 porting eccentric mechanism for revolution with-
 5 in said casing, a vertically movable rod having an
 enlarged lower end coacting with said mechanism
 within said casing, said casing having an upper
 opening through which said rod end is removable
 and also having a side opening through which said
 mechanism is removable from within said casing
 10 and from said shaft, a detachable cap forming
 a closure for said side opening and providing a
 bearing exposed only to the interior of said casing
 for supporting the end of said shaft, a guide cas-
 15 ing removably attached to the top of said main
 casing and having a lower rod guiding portion
 normally filling and closing said upper opening,
 a guide plate associated with said guide casing
 and having an upper rod guiding portion dis-
 20 posed within said casing and in vertical alinement
 with said lower rod guiding portion, spring means
 confined within said guide casing and coacting
 with said rod to urge the same downwardly to
 cause said enlarged end to contact with said
 25 mechanism, a cylinder carried by said guide cas-
 ing above said upper rod guiding portion, and a
 piston carried by said rod and reciprocable with-
 in said cylinder.

4. In combination, a main casing, a horizontal
 rotary shaft penetrating one side of said casing
 30 and having a removable eccentric portion provided
 with an annular surface disposed within said
 casing, a ring member surrounding an spaced
 from said surface within said casing, a series
 of rollable elements interposed between said
 35 member and said surface, a vertically re-
 ciprocable rod having an enlarged lower end co-
 acting with the periphery of said member within
 said casing, said casing having an upper opening
 through which said rod end is removable and also
 40 having a side opening through which said eccen-
 tric, ring member, and rollable elements are re-
 movable from within said casing and from the
 end of said shaft, a cap forming a closure for
 said side opening and providing an enclosed bear-
 45 ing for said shaft and exposed only to the in-
 terior of said casing, a guide casing removably at-
 tached to said main casing and having a lower
 rod guiding portion normally filling and closing
 said upper opening, means forming an upper rod
 50 guiding portion disposed within said casing in
 vertical alinement with said lower rod guiding
 portion, a cylinder carried by said guide casing
 above said means, and a piston carried by said
 rod above said means and reciprocable within
 55 said cylinder.

5. In combination, a main casing, a horizontal
 rotary shaft carrying an eccentric portion pro-
 vided with an annular surface disposed within
 said casing, a ring member surrounding and
 60 spaced from said surface within said casing, a se-
 ries of rollable elements interposed between said
 member and said surface, an upwardly extend-
 ing rod having an enlarged lower end contacting
 with the periphery of said ring member within
 65 said casing, said casing having an upper open-
 ing through which said rod end is removable, a guide
 casing removably attached to said main casing
 and having a lower rod guiding portion normally
 closing said opening, a transverse plate disposed
 70 within said guide casing, a spring coacting with
 said plate and with said rod to urge said rod end
 in contact with said ring member, a cylinder car-
 ried by said guide casing, and a piston carried by
 75

the upper portion of said rod and reciprocable within said cylinder.

6. In combination, a main casing, a horizontal rotary shaft penetrating one side of said casing and having a removable eccentric portion provided with an annular surface disposed within said casing, a ring member surrounding and spaced from said surface within said casing, a series of rollable elements interposed between said member and said surface, an upwardly extending reciprocable rod having an enlarged lower end contacting with the periphery of said member within said casing, said casing having an upper opening through which said rod end is removable and also having a side opening through which said

eccentric, ring member, and rollable elements are removable from within said casing, a cap forming a closure for said side opening and providing a bearing for said shaft, a guide casing removably attached to said main casing and having a lower rod guiding portion normally filling and closing said upper opening, means forming an upper rod guiding portion disposed within said casing in alinement with said lower rod guiding portion, a cylinder carried by said guide casing, and a piston carried by said rod and reciprocable within said cylinder.

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