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3,068,709

ROLLER AND WRIST PIN CONSTRUCTION FOR ROTARY ENGINES

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3 Sheets-Sheet 1

Fig. 1

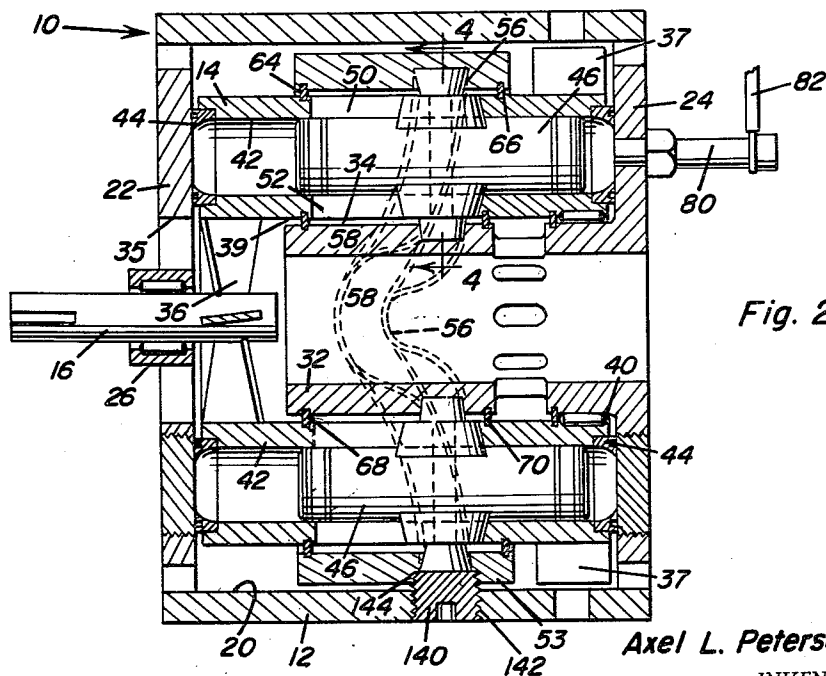
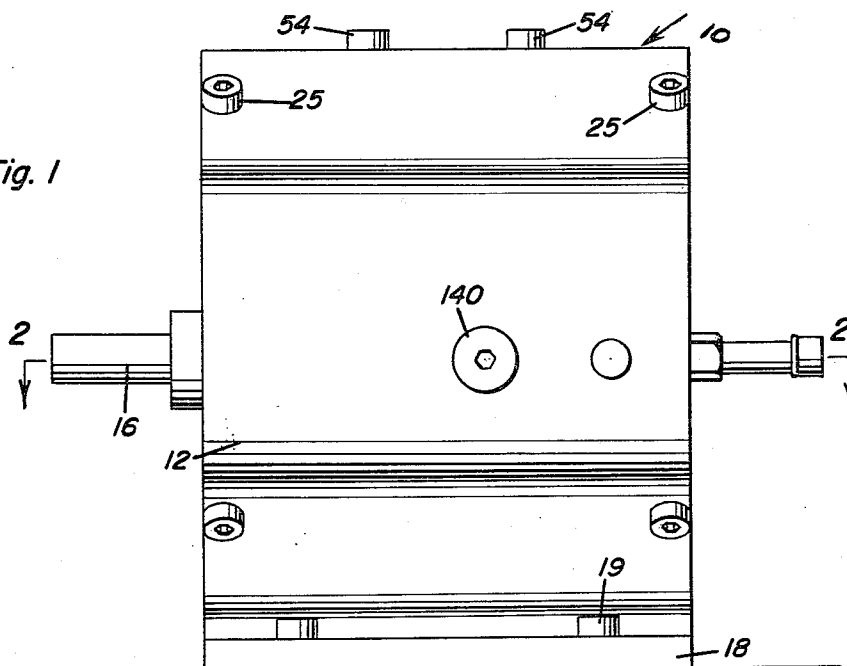


Fig. 2

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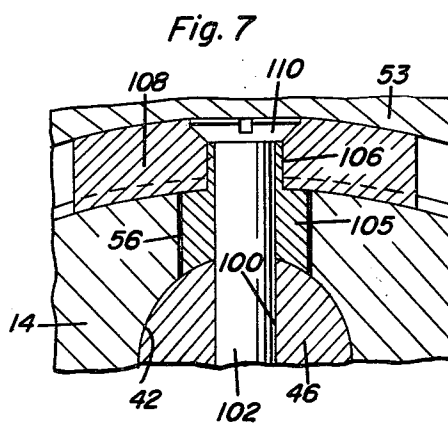
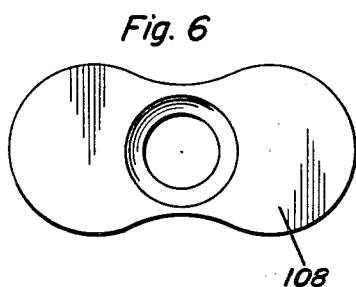
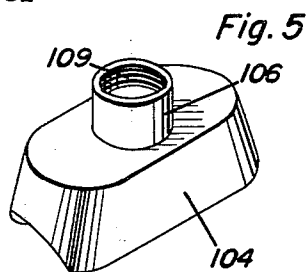
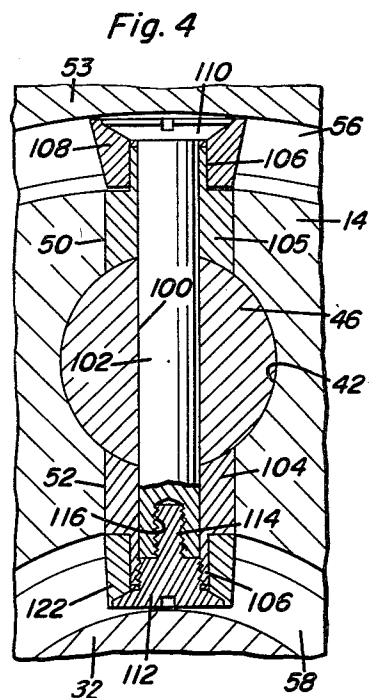
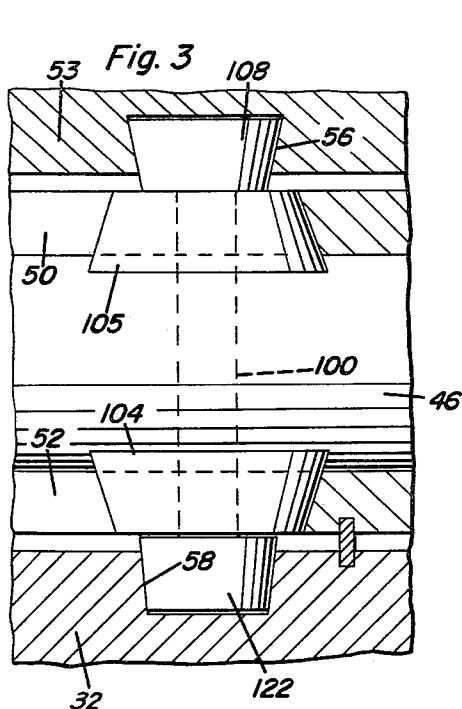
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ROLLER AND WRIST PIN CONSTRUCTION FOR ROTARY ENGINES

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3 Sheets-Sheet 2



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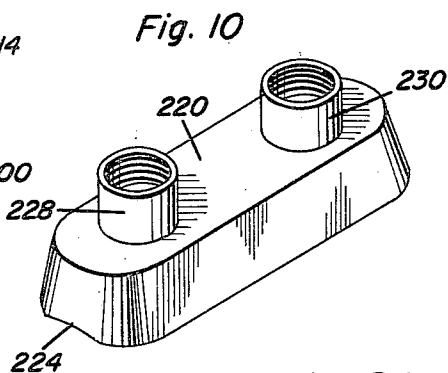
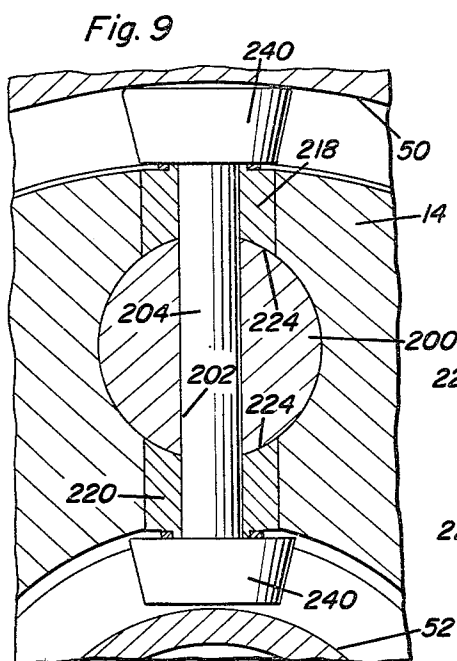
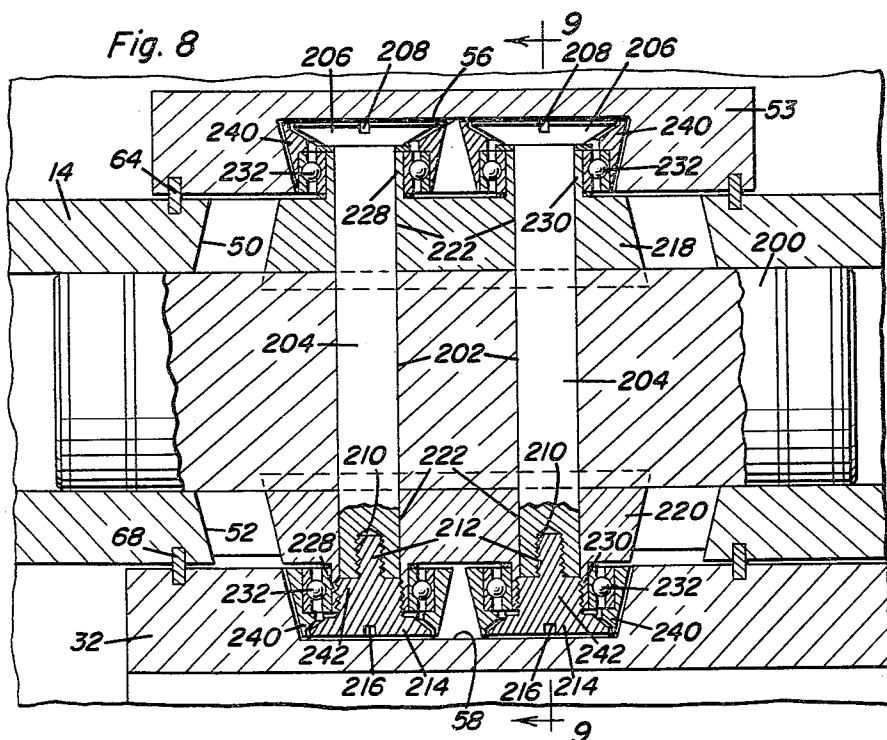
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ROLLER AND WRIST PIN CONSTRUCTION FOR ROTARY ENGINES

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3 Sheets-Sheet 3



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ROLLER AND WRIST PIN CONSTRUCTION FOR ROTARY ENGINES

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10 Claims. (Cl. 74-57)

This invention comprises a novel and useful roller and wrist pin construction for rotary engines, and more particularly relates to an internal combustion engine of the rotating cylinder type wherein pistons reciprocating in the cylinders convert their reciprocatory movement into rotary motion of a drive shaft through a cam mechanism connecting the pistons to the drive shaft.

A primary object of this invention is to provide a rotary internal combustion engine wherein a plurality of pistons disposed in parallel relation may be operatively connected to a power take-off shaft in an improved manner such that each piston may impart the power produced by a plurality of reciprocations to the power take-off shaft during one rotation of the latter.

A further important object of the invention is to provide a rotary internal combustion engine of the cam mechanism type which shall have a cam mechanism connecting the rotating and reciprocating pistons to a power shaft in such a manner as to provide for a greatly increased life of the cam connecting mechanism and a greatly increased efficiency transmitting reciprocatory motion of the pistons to rotating motion of the cam shaft.

A still further object of the invention is to provide an internal combustion engine in accordance with the preceding objects which shall be relatively simple in construction, mechanically easy to assemble or disassemble, and shall be highly efficient for the purposes intended.

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 side elevational view of a suitable embodiment of an internal combustion engine incorporating therein the principles of this invention;

FIGURE 2 is a horizontal central sectional view taken substantially upon the plane indicated by the section line 2-2 of FIGURE 1 and showing the internal construction of the engine and a portion of the cam track appearing in dotted lines therein;

FIGURE 3 is a fragmentary view taken upon an enlarged scale at the mid-portion of a cylinder and piston as shown in FIGURE 2;

FIGURE 4 is a view in vertical transverse section taken substantially upon the plane indicated by the section line 4-4 of FIGURE 2 and at right angles to FIGURE 3 and showing further details of the piston pin and the cam follower mechanism of the invention;

FIGURE 5 is a perspective view of one of the elements of the cam mechanism;

FIGURE 6 is a top plan view of the top cam follower;

FIGURE 7 is a detail view taken at right angles to FIGURE 4 and showing the upper cam follower;

FIGURE 8 is a view similar to FIGURE 2 but showing a modified construction;

FIGURE 9 is a transverse vertical sectional view taken substantially upon the plane indicated by the section line 9-9 of FIGURE 8; and

FIGURE 10 is a perspective view of the cam slide employed in the construction of FIGURE 8.

In the accompanying drawings, for simplicity of illustration in understanding the principles of this invention, there has been disclosed an internal combustion engine.

It will be understood, however, that various features of this invention, particularly the means used for operatively transmitting the power derived from the various fluids and gases to the power shaft attached to the rotor of the engine, have utility and may be successfully employed with other devices than internal combustion engines, as, for example, with air motors, pumps, steam engines and the like.

Referring first to FIGURES 1-5, it will be seen that the engine, designated generally by the numeral 10, consists of a stator or outside casing 12, a rotor in the form of a cylindrical drum 14 therein, and a power shaft 16 which is directly connected with the rotor.

The stator comprises a preferably cylindrical casing which at its bottom portion is laterally enlarged to provide a base or mounting flange 18 which, by means of bolts 19, constitutes a mounting means for securing the device upon any suitable support.

The stator 12 which forms the outer casing previously mentioned has a cylindrical inner surface 20 which bounds a cylindrical opening extending horizontally through the casing and within which the rotor 14 and the transmission mechanism are received. The casing includes a pair of removable end walls 22 and 24, the former having a journal and bearing assembly 26 through which power shaft 16 extends. The casing end walls 22 and 24 are separably secured together as by suitable bolts 25 extending therethrough as suggested in FIGURE 1.

The other end wall 24, at its central portion, is provided with an integral inwardly projecting cylindrical sleeve 32 which is re-entered into the casing and which communicates with the exterior of the casing at its outer end as shown in FIGURE 2. This sleeve has an outer surface 34 which is concentric with the inner surface 20 of the stator casing and with the axis of the power shaft 16, the sleeve constituting a stationary core about which the rotor 14 is caused to revolve. The inner extremity of the sleeve 32 terminates in spaced relation from the other end wall 22 to provide a chamber or space therebetween which is occupied by a fan 36 which serves the dual functions of inducing a circulation of air through the hollow sleeve of the stator to the inside of the rotor through the central opening 35 in the end wall 22 and also serves to support and connect the rotor 14 to the shaft 16. Other fan blades, as at 37, induct air around the outside of the rotor and through the stator 12.

The rotor 14 consists of a cylindrical body or annulus which has a cylindrical opening extending axially therethrough as shown by the numeral 39, so that the sleeve 32 is received within this opening and the rotor is received between the sleeve and the casing. A bearing assembly 40 carried by the sleeve 32 adjacent the wall 24 serves to rotatably journal and support the end of the rotor, the other end of the latter being carried by the journaling of the shaft 16 in the bearing assembly 26. The rotor is thus mounted for rotation about the horizontal axis which is the center of the sleeve 32 and of the stator.

Extending axially through the rotor are a plurality of cylindrical bores 42 which are disposed parallel to each other and to the axis of rotation of the rotor and are equidistant from the latter. These bores comprise the working cylinders of the engine. The bores open at the opposite ends of the rotor and suitable annular packing or sealing rings 44 are provided for the opposite ends of these bores, these packing rings having sliding engagement with the inner faces of the end plates 22 and 24 to establish a fluid-tight sealed engagement therewith. Inasmuch as the invention set forth and claimed herein does not require any particular construction of packing or sealing rings, a further description and explanation of the same is deemed to be unnecessary.

Slidable in each of the cylinders 42 is a double ended or double headed reciprocating piston 46 which likewise could be of any suitable construction. Disposed medially and diametrically of each of the double ended pistons is a piston pin and cam follower assembly to be more specifically described and claimed hereinafter and which also projects through the diametrically disposed longitudinally extending slots 50 formed in the outer circumference of the rotor 14 and the corresponding slots 52 formed in the inner circumference thereof. The opposite ends of piston pins are received in concentric outer and inner cam tracks to be hereinafter described and which are carried by the stator so that in response to the application of propulsion fluid to the opposite ends of the pistons, the reciprocation of the latter in the cylinders will in turn reciprocate the piston pins in the slots 50 and 52 of each cylinder causing the pins to react against an annular stationary cam member 53 attached to the stator 12 and the stationary cam track 58 formed in the reentrant sleeve 32 of the end wall 24 to effect rotation of the rotor.

The mechanism by which the reciprocating pins have their reciprocatory movement converted into rotation of the shaft 16 consists of a cam transmission comprising a pair of cam members. The outer cam member comprises an annulus or ring 53 which is disposed within the inner surface 20 of the stator and is detachably secured thereto and mounted thereon as by fastening bolts 54, see FIGURE 1. A sinuous cam groove or track 56, see also FIGURE 3, is formed in that surface of the ring 53 which is adjacent to the rotor and surrounds the latter. A similar and complementary cam surface or cam track 58 is formed in the outer surface of the stationary sleeve 32 and is complementary to the track 56.

It will be understood that the two stationary cam tracks 56 and 58 are necessarily identical and are of a wavy contour, having a series of reaches of maximum axial extent in one direction interspersed with other reaches of maximum axial extent in the other direction, there being any desired number of these reaches along the circumference of the cam members. It will thus be apparent that the cam followers, to be hereinafter described, carried by the extremities of the piston pins, when riding in these stationary cam tracks, will cause the pistons to be moved in a reciprocating manner longitudinally of their respective cylinders when the rotor is caused to rotate. Conversely, when the pistons are reciprocated, the reciprocating cam followers, by their engagement in the stationary cam tracks, will cause the rotor to turn, thus giving power to the shaft 16. Obviously any desired number of cylinders and any desired number of pairs of cam reaches can be provided to give the desired number of impulses to the shaft 16 during one revolution of the latter.

Annular sealing rings as at 64 and 66 are provided at the opposite sides of the outer cam track 56, being received in circumferentially extending channels or slots in the concave surface of the ring 53 and in the convex surface of the rotor 14 adjacent thereto. Similarly, a second set of annular sealing rings as at 68 and 70 are provided between the sleeve 32 and the adjacent surface of the rotor for the same purpose. These rings serve to retain lubricants applied in any desired manner to the piston and to the transmission mechanism at the areas which it is desired to lubricate, as will be apparent from FIGURE 2.

Any desired means is provided for delivering propulsive fluid in timed relation into the opposite ends of the cylinders and for educting the same therefrom, whereby to impart reciprocation to the pistons. Inasmuch as the present invention is not limited to any particular means for this purpose, a further description of the same is deemed to be unnecessary.

When the engine is to be used as an internal combustion engine, it is obvious that explosive charges will be introduced into the cylinder, and that products of combustion will be educted therefrom. Similarly, any desired means

will be provided for igniting the combustible charges supplied to the engine. For that purpose, there are provided spark plugs, such as indicated at 80, and to which an ignition current is supplied as by a conductor 82 from any suitable source of ignition, not shown.

The fan 36 previously mentioned can advantageously function to supply cooling air through the interior of the rotor and sleeve while fan blades 37 on the rotor cause a flow of cooling air between the rotor and stator. Its simple and rapid mode of assembly and disassembly is illustrated in FIGURE 2.

The cam transmission of this invention, which constitutes the improvement claimed herein, will be more readily apparent from a consideration of FIGURE 2 in conjunction with FIGURES 3-5. It will be observed that each piston 46 has a diametrically extending bore 100 there-through in which is received the piston pin 102. The opposite ends of the pin extend outwardly beyond the piston into the slots 50 and 52 and are provided with slides or shoes 105 and 104, respectively, having diametrically reduced exterior cylindrical bushings or bearings 106. Elongated cam followers 108, see FIGURE 6, are journaled upon the bearings 106 of the slide 105. The bearings of the slide 104 are internally threaded, as at 109, and having circular cam portions 122 journaled thereon. The pins 102 have an integral retaining head 110 at one end thereof, which, as shown in FIGURE 4, is seated into a recessed portion of the follower 108, while the other end of the pin has a removable, similarly headed extremity 112 provided with an externally threaded stem 114 received in the internally threaded bore 116 of the piston pin and a threaded portion which engages within the internally threaded bushing 109, see FIGURE 5.

It will be further observed by a comparison of FIGURES 3, 4 and 5 that the outer surfaces of the cam followers 108 are reversely tapered so that they will fit in and be slidably received in and be retained in the cam tracks 56. From FIGURE 3, it will be seen that the cam track 56 has its sides inwardly convergent, while the cam track 58 has its sides outwardly convergent, the followers being accordingly appropriately tapered or inclined. The elongated cam followers 108 will ride in the outer cam track 56 and the circular followers 122 will ride in the inner cam track 58.

It will be further observed that the bushings 104 will ride in the slots 52, while the bushings 105, similar to the bushings 104 except that they have no threads 109, see FIGURES 4 and 5, will ride in the slots 50, while the elongated cam followers 108 and the circular cam followers 122 will ride in the cam tracks 56 and 58, respectively.

Owing to their elongated shape, the followers 108 will have a much greater bearing area with the walls of their cam tracks, thus greatly strengthening the construction and minimizing the effects of wear thereon.

Referring again to FIGURES 1 and 2, it will be observed that the stator has a removable plug 140 in its side wall, which plug is engaged in registering screw-threaded apertures 142 in the stator and 144 in the cam ring 53. This plug is disposed so that upon proper rotation of the rotor 14, the successive piston pins will be caused to align with these registering bores whereby, when the plug is removed, the piston pins can be unscrewed and withdrawn through this opening and the elongated cam follower can likewise be removed here.

In assembling, the circular inner cam followers 122 are positioned upon their bushings 106 of the shoes 104, being locked thereon by the large headed screws 112 engaged in threads 109. The assembly is then slipped into an empty cylinder in such a manner that the cam follower 122 drops into the inner cam track 58 and the shoe 104 fits in the cylinder slot 52. The upper shoe is likewise placed in the piston cylinder, then into the outer cam track before the piston is inserted into the cylinder. The elongated cam follower is then inserted through the opening 140. The piston pin 102 is then inserted through the

opening 140 and is inserted through the two shoes 105 and 104 and the followers 108, 122, being secured by the threads 116.

In this manner, easy assembly and disassembly of the piston pin, cam follower and pistons of the engine are possible.

In the preceding embodiment, it will be observed that the cam followers have a sliding frictional engagement with both side wall of their cam tracks. In the modifications of FIGURES 8-10, there is disclosed an arrangement in which this sliding frictional engagement is replaced with the rolling contact. For this purpose each cam follower has a pair of rollers, each roller engaging one side wall only of the associated cam track.

The cylinder block, cylinder and the cam track construction is identical with that previously described and the same reference numerals are applied to identical elements. However, the double-ended pistons 200 are each provided with a pair of parallel, longitudinally spaced diametrical bores 202 therethrough which receive a pair of piston pins 204.

One end of each piston pin 204 is headed at 206 and provided with a kerf of notch 208 for engagement by a screwdriver or other suitable tool. The other end of each pin is bored and internally threaded at 210 for the reception of the shank 212 of a headed screw 214 which is likewise notched at 216.

Slidable in the cylinder slots 50, 52 are elongated slides 218 and 220, respectively, see FIGURE 10, having each a pair of bores 222 through which are slidably received the pins 204. As will be apparent from FIGURE 9, one face of each slide 218 and 220 is provided with an elongated groove 224 which is concave in cross-section for snugly receiving the side of the piston 200.

The slides 218 and 220 have each a pair of sleeves or collars 228 and 230 rising therefrom on the face opposite the groove 224, which collars serve as journals for the bearing assemblies, carrying cam rollers 240. It will be noted that the rollers 240 on the slide 218 engage opposite undercut side walls of the cam track 56 while those of the slide 220 engage correspondingly the side walls of the cam track 58. Thus, each roller engages only one side wall of a cam track, thereby reducing friction and wear therebetween and permitting the use of roller bearings which move continuously in only one direction.

It will be seen that each roller 240 of the slide 218 is retained against axial movement upon its pin 204 by endwise abutting engagement of its bearing assembly 232 with the enlarged pin head 206 and with the slide 218. The rollers of the slide 220 are similarly retained between the slide 220 and the headed screw 214. It will be observed that the collars 228 and 230 of the slide 220 are internally threaded for detachably receiving therein the externally threaded portion 242 of the headed screw 214. The screws 214 thereby operate to retain the inner cam followers or rollers 240 on the slides 220 and the slides 218 and 220 with their rollers 240 against the sides of the piston.

The operation of this form of the invention, except for the provision of a separate cam roller to engage each side wall of the cam tracks 56 and 58, is identical with that of the preceding embodiment and the manner of assembly is likewise the same.

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 apparatus for converting reciprocity to rotary motion comprising a pair of concentric inner and outer cylindrical members disposed about a common axis, com-

plementary cam tracks comprising channels disposed in the adjacent surfaces of said members, a plurality of reciprocating elements disposed in side by side relation and equidistantly spaced from said axis and positioned between said members, a body having cylinders in each of which one of said elements is guidably and slidably received, means mounting said body for rotation about said axis, said body having pairs of oppositely disposed axially extending guide slots disposed in said body and opening each pair with a cylinder, said elements having diametrically disposed pins guidingly and slidably extended through said slots, cam followers on the ends of each pin slidably received in said complementary cam tracks, bushings on said pins journaling the latter in said slots, said cam followers being journaled on said bushings.

2. The combination of claim 1 wherein said followers of each pin are disposed respectively outwardly and inwardly of said body.

3. The combination of claim 1 wherein said pins each have a head seated in one follower for retaining the latter and a screw-threaded nut seated in and retaining the other follower.

4. The combination of claim 1 wherein said bushings have diametrically reduced extremities extending into said tracks, said followers being journaled upon said extremities.

5. The combination of claim 1 wherein the followers received in the outer cam track are elongated in the direction of their movement in said track.

6. The combination of claim 5 wherein the follower received in the inner cam track is circular and both of said followers and their associated tracks have their opposite side walls complementary and tapered.

7. The combination of claim 1 wherein each cam follower includes a pair of rollers, each roller having rolling engagement with one side wall only of a cam track.

8. The combination of claim 1 including a pair of axially spaced diametrically disposed pins in each element, a slide disposed on each of the opposite ends of said pair of pins and slidably received in one of said slots, a pair of rollers journaled on said slide and each roller engaging one only of the opposite side walls of a cam track.

9. The combination of claim 1 wherein the inner and outer cam tracks have their walls reversely inclined.

10. The combination of claim 1 wherein the followers received in the outer cam track are elongated in the direction of their movement in said outer track, said inner and outer cam tracks having their side walls reversely inclined said followers having inclined side surfaces complementary to the side walls of the associated cam tracks.

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