

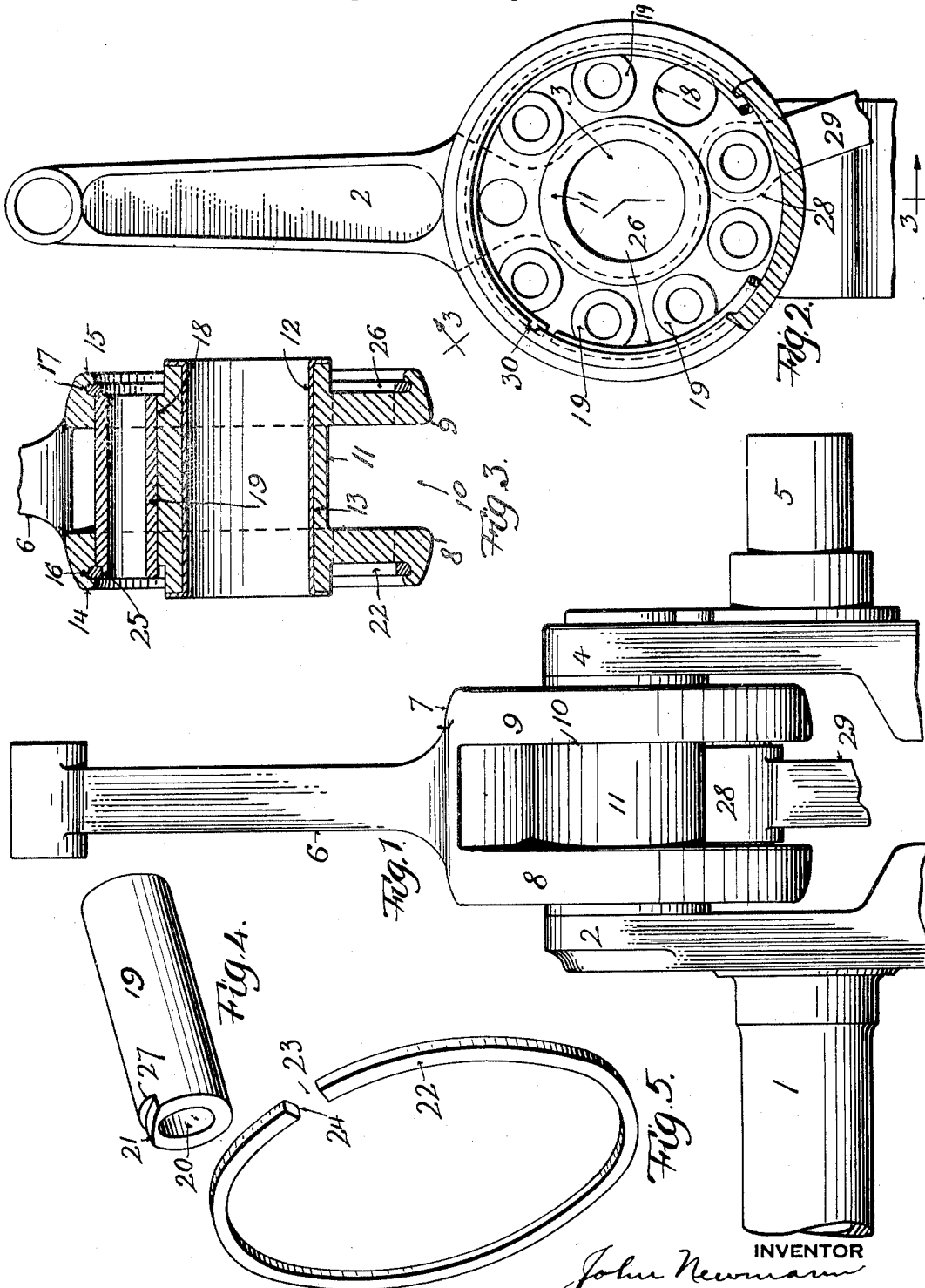
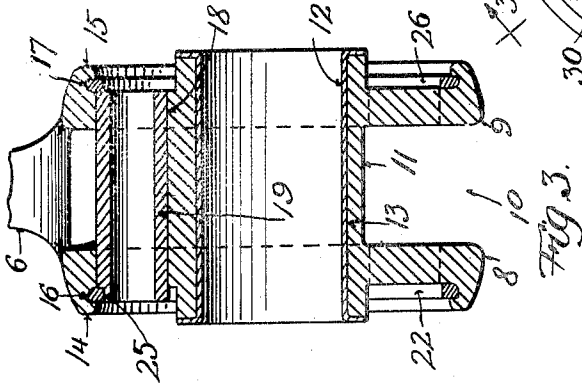
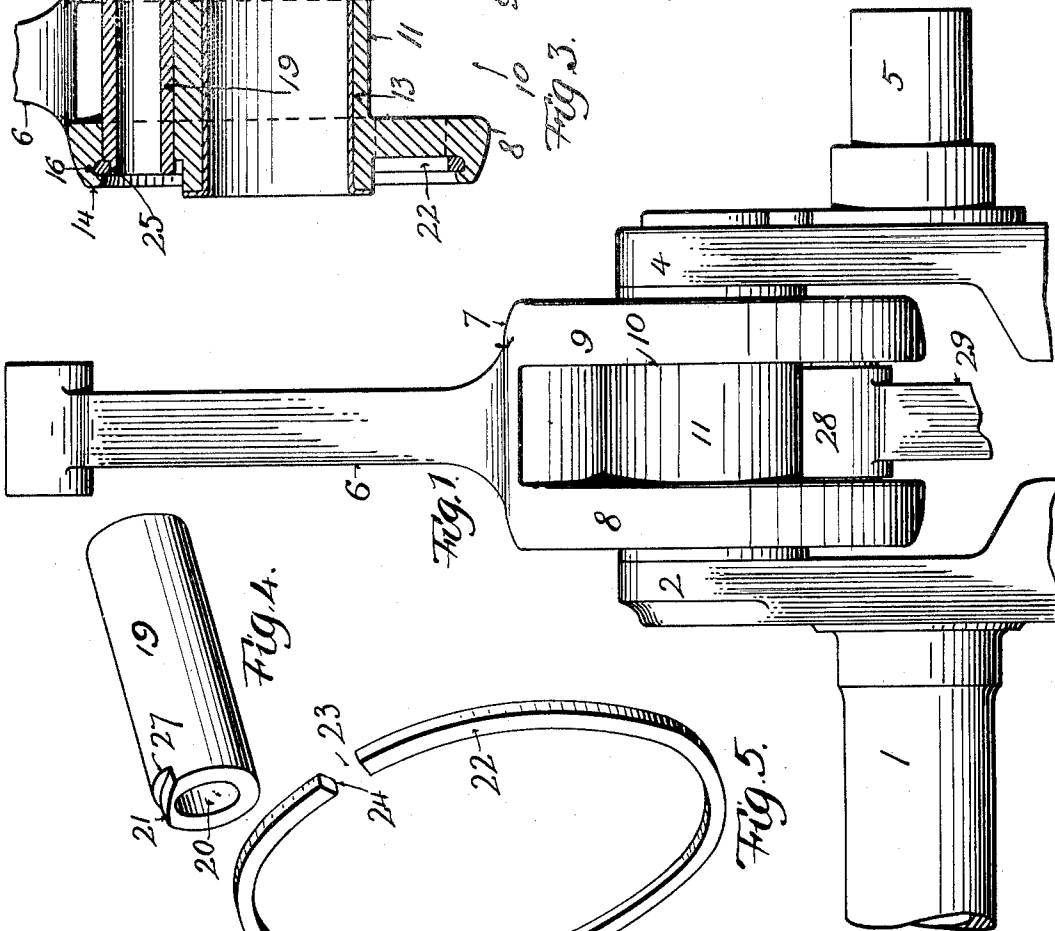
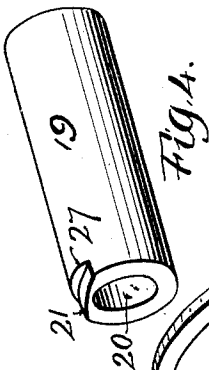
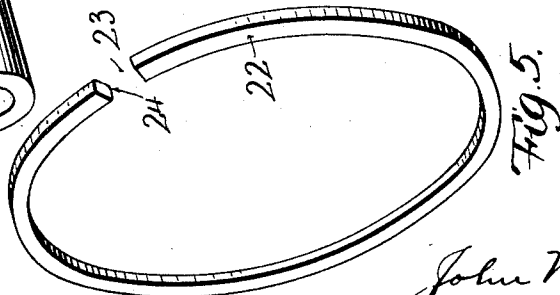
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## CRANK CONNECTION FOR RADIAL MOTORS

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## UNITED STATES PATENT OFFICE

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## CRANK CONNECTION FOR RADIAL MOTORS

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14 Claims. (Cl. 74-17)

The present case is a refile of applicant's abandoned application Serial No. 395,507, filed September 27, 1929.

My invention relates to radial motors and while it is especially adapted for motors to be used in aeroplanes, nevertheless it is also adapted to be used in connection with other types of motors. In my Patent No. 1,823,464 and my co-pending application Serial No. 557,427 I showed and described radial motors and the general object of the present invention is somewhat similar to those cases, but there are advantages in the present construction over those of said cases.

The present invention relates to that type of radial motor wherein an annular connecting or bearing member is integral with or connected to a master connecting rod, and wherein a plurality of connecting rods are pivotally connected with the annular member, whereby a number of motor cylinders may be arranged around a common axis and have their several piston rods operating on a common crank.

One object of the present invention is to eliminate screws, bolts and various threaded members in the crank connection and as a result a number of objects are accomplished. Primarily, the elimination of threaded members avoids the possibility of any of the parts becoming loose or disassembled during the operation of the motor, so that the device is highly efficient from the standpoint of safety.

Secondly, the bearing member referred to, by reason of the elimination of threaded members interposed between the several knuckle pins, as used in previous constructions, makes it possible to provide a stronger bearing member and to reduce its size and its weight.

The latter is an important factor when it is considered that the crank in a motor of this type may make as high as 2000 or more revolutions per minute. Another advantage of the present construction is that the number of parts in the device is reduced to the minimum. Another advantage is that the cost of manufacture of the device is considerably less than in devices now in commercial use and the device may be made without the necessity of providing expensive tools and special machines and dies. Most or all of the operations in the manufacture of the device may be performed on an ordinary lathe.

Another object of my invention is to provide a ring which is locked in a suitable groove and held by its expansion against the wall of the groove and which ring serves to hold the several knuckle pins on which the articulated connecting

rods are pivoted in assembled relation upon the bearing member. In my said copending application Serial No. 557,427 I showed a ring for locking the several knuckle pins against accidental displacement but in that case the locking ring is shown engaging the several knuckle pins in an arc adjacent the axis of the bearing member, whereas in the present case the locking ring is disposed in a groove formed in a projecting flange of the bearing member to engage the knuckle pins for locking them in place, the engagement with the knuckle pins being near their outer edges or at a greater distance from the axis of the bearing member than in my said copending application.

In the present construction the bearing member is strengthened by the additional flange which forms the socket for the locking ring, so that in a given size device the present construction of bearing member is very strong.

One important advantage of having a large ring engaging the outer portions of the knuckle pins is that the ring of larger diameter has a greater spring capacity and therefore can be removed and replaced a number of times and still retain sufficient resiliency to fit snugly in the retaining groove of the bearing member. In the fullest embodiment of my invention I employ a locking ring for each end of the knuckle pins so that the knuckle pins cannot move longitudinally from their correct position within the bearing member in either direction.

Another object of the invention is to simplify the construction of the knuckle pins by eliminating end flanges so that they are reduced to the simple form of a rod or tube with a slight groove or notch cut in one end thereof. These and other advantages which are accomplished in the present construction will be set forth more in detail in the following description of my invention.

In the drawing forming part of this application,

Figure 1 is an elevation of a crank connection for a radial motor embodying my invention, in which view only one of the articulated connecting rods is shown,

Figure 2 is an end view of the bearing member, master connecting rod and one of the articulated connecting rods,

Figure 3 is a sectional view taken on the line 3-3 of Figure 2,

Figure 4 is a perspective view of one of the knuckle pins, and

Figure 5 is a perspective view of one of the locking rings.

In the drawing I have shown the principal parts of a crank connection for radial motors and I have illustrated the same in connection with a shaft 1 having a crank throw similar in construction to those shown in my said copending applications.

It is preferable to use the present invention in connection with a crank construction similar to those disclosed in said cases, although the present invention is not limited to use with a particular type of crank construction. The present invention relates more particularly to the connecting rods, the annular bearing member connected with the master rod and to the means for securing the knuckle pins in assembled relation upon the bearing member. The shaft 1 in the drawing is provided with one arm 2 forming part of the crank throw and this is provided with a wrist pin 3 to which is detachably secured at one end another crank arm 4 which is integral with the shaft section 5 so that the shaft members 1, 5, together with the crank arms and the wrist pin form a crank throw with which the annular bearing member is associated.

In the drawing the member 6 forms what is called the master connecting rod which is the rod with which the annular bearing member is either rigidly connected or made integral, preferably the latter. This master rod is shown as formed integral with the annular bearing member 7 which consists of the two circular bearing members or plates 8, 9 spaced laterally from each other to provide a pocket 10 for the reception of the heads of the articulated connecting rods. The inner hub or cylindrical portion 11 is an integral part of this bearing member and it is centrally located in relation the members 8, 9 and it is adapted to fit over the wrist pin 3 of the crank throw.

Any form of bearing may be used where this hub fits the wrist pin, but by way of example I have shown a true bearing 12 of bearing metal lining the inner bore 13 of the member 11 to form the bearing.

I will describe the construction as shown in the drawing, in which a locking ring is used at each end of the knuckle pins although not intending to limit the invention to the use of both locking rings except insofar as both are included in certain of the claims herein. There is projecting from the member 8 the flange 14 and from the parallel and opposite member 9 there is a flange 15 also projecting laterally or parallel with the axis of the wrist pin. Each of these flanges or projections is provided with an annular recess or groove, the groove in the flange 14 being indicated by the numeral 16 and the groove in the flange 15 being indicated by the numeral 17, and preferably these grooves are similar to each other. In the walls 8, 9 and between the hub member 11 and the flanges 14, 15 the bearing member is provided with bores 18 to receive longitudinally therein by close, sliding fit, the several knuckle pins 19, there being one such knuckle pin for each articulated connecting rod.

In the example shown in the drawing there are eight such knuckle pins arranged equal distances apart and equally spaced from the axis of the master connecting rod, making a total of nine connecting rods counting the master rod and the articulated rods. In Figure 4 I have shown one of the knuckle pins detached. It consists of a cylindrical body 19 preferably made hollow by having a central bore 20 therein for lightness and at one end I have shown an arcuate slot or notch 21 extending inwardly from the edge of the

knuckle pin and adapted for locking purposes, as will be hereinafter set forth.

In Figure 5 I have shown one of the locking rings of which there are two in the fullest embodiment of my invention, both of which may be alike. It consists of an annular member 22 having a split or opening 23 to permit the ring to be compressed for insertion into the locking groove and one of the inner edges of the ring is rounded, as shown at 24 to facilitate the snapping of the ring into its groove.

As shown in Figure 3 one of these locking rings is inserted into the groove 16 in the flange 14 and this one may be inserted before the knuckle pins have been placed in the bores 18 if desired. The thickness or depth of this locking ring is such that when its outer edge is seated in the groove 16 its inner edge or perimeter projects inwardly, as shown at 25 so that its diameter is less than the diameter of a circle passing through the outer portions of the several knuckle pin bores 18. The ring, therefore, projects inwardly from the groove to form a shoulder or abutment for the ends of all of the knuckle pins, as shown in Figure 3, so that the ring prevents the knuckle pins from moving lengthwise to the left in this view. The other locking ring 26 is adapted to seat in the groove 17 of the flange 15 and it is also of sufficient depth so that the inner side or perimeter of this ring extends inwardly of the diameter of a circle passing through the outer portions of the several knuckle pins.

The portion of the ring 22 which projects inwardly is adapted to engage or lie in the arcuate grooves or notches 21 of the several knuckle pins when they are in assembled position, so that the shoulder 27 of each knuckle pin abuts against one side of this locking ring and the knuckle pins are, therefore, prevented from moving lengthwise to the left in Figure 3. The ring 26 overlaps a portion of the rim of each knuckle pin at the right hand end in Figure 3, so that these pins cannot shift to the right.

In this manner the knuckle pins are held from shifting lengthwise in either direction and they are also prevented from revolving within their bores 18 by reason of the surface 21 of each of the notches of the knuckle pins engaging the inner surface or perimeter of the locking ring 22, no other means being required to prevent the turning of the knuckle pins within the bearing member.

One method of assembling the device is to slide the master connecting rod and bearing member along the wrist pin, the latter passing through the bore of the hub 11 until the end of the hub 11 rests against the cheek of the crank arm 2, it being understood that this operation is performed before the crank arm 4 is attached to the projecting end of the wrist pin. The crank arm 4 may now be assembled on the projecting end of the wrist pin so that one of its cheeks lies close to or against one end of the hub 11.

The locking ring 22 may now be applied to the groove 16 by compressing it sufficiently to allow it to be passed over the flange 14 until it registers with the groove 16, whereupon it will spring outwardly and seat snugly into this groove, due to the resiliency of the ring. The several knuckle pins may now be assembled by inserting them into the bores 18 of the bearing member at the same time passing through the heads 28 of the articulated connecting rods 29, which heads lie in the space 10 between the plates 8, 9. When the knuckle pins are thus inserted into the bores 18 they are pressed inwardly until the locking ring 22 lies in

the notch 21 of each of the knuckle pins so that the ring will prevent longitudinal movement of the knuckle pins in one direction and prevent the rings from turning within their respective bores 18.

The second locking ring 26 may now be applied by compressing it to permit it to be pressed over the flange 15 and when it registers with the groove 17 it will expand under its own resiliency and seat tightly in this groove. The inwardly projecting portion of this ring, that is, the portion which projects inwardly from the groove 17 overlies a portion of the end of each knuckle pin so that it locks all of the knuckle pins against longitudinal movement in one direction. When the assembly has been completed, the rings serve to lock all of the knuckle pins against longitudinal movement in either direction and the ring 22 also serves to prevent the knuckle pins from revolving in their bores 18. The assembly of the device is very simple and may be quickly performed.

The knuckle pins are all securely locked in place and cannot be dislodged by any vibration of the motor so that the device is safer than those heretofore used. As no holes have to be drilled between the bores 18 in the plates 8, 9, the construction is much stronger than in previous devices and the bearing member may be made smaller, lighter and more compact for a given type of motor.

The elimination of threaded members in the crank assembly not only avoids the danger of parts becoming disassembled in operation but it reduces the construction to the simplest form and to the minimum of parts. Where the knuckle pins are held at opposite ends by locking rings, and the knuckle pins are provided with notches 21 to co-operate with one of the rings to prevent them from revolving with relation to the bearing member, it is unnecessary to form flanges on the ends of the knuckle pins and this simplifies their construction and cheapens the cost of manufacture.

Any or all of the knuckle pins may be removed and replaced by simply removing the locking ring 26. For this purpose any suitable instrument such as a screw driver or pointed tool may be inserted into the notch 30 of the flange 15 to pry inwardly one end of the locking ring in order to permit the end to be grasped or forced by a tool whereupon the ring may be sprung out of the groove 17. When the ring has been removed any one or all of the knuckle pins may be slid out of their bores 18 by moving them to the right in Figure 3.

Other knuckle pins to replace those worn and removed may be inserted into the bores 18 and after replacement of the knuckle pins the locking ring 26 may be again returned to the groove 17 to lock the several knuckle pins in place. Both locking rings are provided with rounded edges 24 at one side to facilitate the springing of the rings over the flanges 14, 15 and into their respective grooves. These flanges 14, 15 which are provided to receive and hold the locking rings increase the strength of the bearing member.

The locking rings in the present construction are of larger diameter than the locking rings of my said co-pending application Serial No. 551,427 for a given type of motor, and therefore they have a greater capacity for being sprung or deformed to permit them to be inserted into their grooves than where the smaller rings are employed. The grooves 16, 17 do not have to be deeper than the grooves of my said co-pending application but the capacity for bending of the locking rings or the

ability to be sprung into and out of their locking grooves without changing the normal diameter of the rings is greater in the present case, owing to the fact that the locking rings are of larger diameter.

From the above it will be apparent that I have provided a simple, compact and dependable crank connection for radial motors which is of light construction and has fewer parts than the devices heretofore used, and it will also be apparent that I have eliminated threaded members in the crank connection and in so doing I have eliminated the danger incident to the use of threaded members. Having described my invention, what I claim is:

1. In a crank construction for motors, the combination of a shaft, a crank throw, a wrist pin thereon, a bearing member journaled on said wrist pin, a plurality of knuckle pins mounted in said bearing member, and connecting rods pivoted on said knuckle pins, said bearing member having a groove, a split locking ring engaging in said groove and held between the shoulders of the groove, said ring being disposed around the outer portions of said knuckle pins and arranged to prevent longitudinal movement of said knuckle pins in one direction, and means for preventing longitudinal movement of said knuckle pins in the other direction.

2. In a crank construction for motors, the combination of a shaft, a crank throw thereon, including a wrist pin, a bearing member journaled on said wrist pin, a plurality of knuckle pins mounted in said bearing member, connecting rods pivoted on said knuckle pins, said bearing member having grooves, split locking rings engaging in said grooves and held therein by the expansive action of said rings, said rings being disposed adjacent opposite ends of said knuckle pins around the outer portions of said pins, to prevent longitudinal movement of said knuckle pins in either direction.

3. In a crank construction for motors, the combination of a shaft, a crank throw thereon, including a wrist pin, a bearing member journaled on said wrist pin, said bearing member having bores, a plurality of knuckle pins mounted in said bores in said bearing member, connecting rods pivoted on said knuckle pins, said bearing member having a groove disposed outside of and around the several knuckle pin bores, a split locking ring engaging in said groove and disposed between the shoulders thereof, the ring projecting inwardly of the outer portions of the bores in which said knuckle pins are mounted to engage the ends of said knuckle pins to prevent longitudinal movement thereof in one direction, and means to prevent longitudinal movement of said knuckle pins in the other direction.

4. In a crank construction for motors, the combination of a shaft, a crank throw thereon having a wrist pin, a bearing member journaled on said wrist pin, said bearing member having lateral bores circularly disposed therein, knuckle pins mounted in said bores, connecting rods pivoted on said knuckle pins, said bearing member having grooves adjacent opposite ends of the knuckle pins and circularly disposed beyond the outer edges of said knuckle pin bores, a split locking ring held in each groove by the expansive action of said ring, said rings projecting inwardly to engage opposite ends of said knuckle pins to prevent longitudinal movement thereof in either direction.

5. In a crank construction for motors, the

- combination of a shaft, a crank throw thereon, including a wrist pin, a bearing member journaled on said wrist pin, said bearing member having lateral bores, knuckle pins mounted in said bores, connecting rods pivoted on said knuckle pins, said bearing member having grooves, split locking rings detachably engaging in said grooves and held therein by the expansive action of said rings, said rings being disposed adjacent opposite ends of said knuckle pins and around the outer portions thereof, said locking rings being arranged to prevent longitudinal movement of said knuckle pins in either direction.
6. In a crank construction for motors, the combination of a shaft, a crank throw thereon, including a wrist pin, a bearing member journaled on said wrist pin, said bearing member having lateral bores, a plurality of knuckle pins mounted in said bores in said bearing member, connecting rods pivoted on said knuckle pins, said bearing member having grooves disposed outside of and around said several knuckle pin bores, split locking rings detachably engaging in said grooves and held therein by the expansive action of said rings, said rings projecting inwardly of the outer portions of said bores in which said knuckle pins are mounted to engage the ends of said knuckle pins and prevent longitudinal movement thereof.
7. In a crank construction for motors, the combination of a shaft, a crank throw thereon, including a wrist pin, a bearing member journaled on said wrist pin, said bearing member having lateral bores, a plurality of knuckle pins mounted in said bores in said bearing member, connecting rods pivoted on said knuckle pins, said bearing member having a groove, a split locking ring engaging in said groove and held therein by the expansive action of said ring, said ring being disposed around the outer portions of said knuckle pins and engaging the ends of said pins to prevent longitudinal movement thereof, in one direction, and means for preventing longitudinal movement of said pins in the other direction.
8. In a crank construction for motors, the combination of a shaft, a crank throw thereon, including a wrist pin, a bearing member journaled on said wrist pin and having lateral bores, a plurality of knuckle pins mounted in said bores, connecting rods pivoted on said knuckle pins, said bearing member having an annular flange projecting laterally therefrom, said flange having an annular groove on its inner side, a split locking ring held in said groove by the expansive action of said ring, said ring being disposed around the outer portions of said knuckle pins and engaging said knuckle pins to prevent longitudinal movement thereof in one direction, and means for preventing longitudinal movement of said knuckle pins in the other direction.
9. In a crank construction for motors, the combination of a shaft, a crank throw thereon, including a wrist pin, a bearing member journaled on said wrist pin, said bearing member comprising a hub portion and spaced parallel annular walls provided with lateral bores, knuckle pins mounted in said lateral bores, connecting rods pivoted on said knuckle pins between said parallel walls of the bearing member, said bearing member having flanges projecting in opposite directions from the sides of said parallel walls, said flanges provided with annular grooves around the interior of said flanges, split locking rings detachably held in said grooves by the expansion action of said rings, said rings engaging the ends of the several knuckle pins for the purpose of preventing longitudinal movement of said pins.
10. In a crank construction for motors the combination of a shaft, a crank throw thereon, including a wrist pin, a bearing member journaled on said wrist pin, said bearing member having lateral bores, knuckle pins having unobstructed cylindrical outer surfaces and mounted in said lateral bores, connecting rods pivoted on said knuckle pins, said bearing member having flanges projecting in opposite directions and said flanges provided with annular grooves around the interior thereof and split locking rings detachably engaging in said grooves and engaging opposite ends of said knuckle pins for the purpose of preventing longitudinal movement thereof.
11. In a crank construction for motors, the combination of a shaft, a crank throw thereon, including a wrist pin, a bearing member journaled on said wrist pin and having lateral bores, knuckle pins mounted in said bores and having notches adjacent the ends thereof, connecting rods pivoted on said knuckle pins, said bearing member having a groove, a locking ring detachably engaging in said groove and disposed around the outer portions of said knuckle pins and projecting into the notches of said knuckle pins to prevent longitudinal movement thereof in one direction and to prevent said pins from rotating in said bores, and means for preventing longitudinal movement of said knuckle pins in the other direction.
12. In a crank construction for motors, the combination of a shaft, a crank throw thereon, including a wrist pin, a bearing member journaled on said wrist pin and having lateral bores, knuckle pins mounted in said bores and having notches in the ends thereof, connecting rods pivoted on said knuckle pins, said bearing member having annular grooves adjacent opposite ends of said knuckle pins and a locking ring detachably engaging in each of said grooves, one of said rings engaging in the notches of said knuckle pins and the other of said rings abutting against the opposite ends of said knuckle pins.
13. In a connecting rod assembly for radial engines, a master rod hub having circularly arranged pin bores therethrough, said hub having a circular recess at one end intersecting the pin bores, a ring seated in the circular recess in the hub end, said ring underlying the hub end intermediate the pin bores, connecting rod knuckle pins in the bores, said pins having a recessed end complementary to the intersecting portions of the ring, and retaining means for the end of the pins opposite the ring.
14. In a connecting rod assembly, a master rod hub having a main bore and circularly arranged pin bores therethrough, said hub having a circular recess in one end adjacent the main bore and intersecting a portion of the pin bores, the outer portion of the recess intermediate the pin bores being undercut, a ring in the recess having portions extending into the undercut portion thereof, means securing the ring in the recess, connecting rod pins in the pin bores having one end engaging the ring to prevent rotation and axial displacement thereof relative to the hub, and retaining means for the other ends of the pins.
- JOHN NEWMANN.