Sept. 29, 1925. 1,555,165

T. L. SHERMAN

MECHANISM FOR INTERCONVERSION OF ROTARY AND RECIPROCATING MOTION

Filed May 22, 1923 3 Sheets-Sheet 1

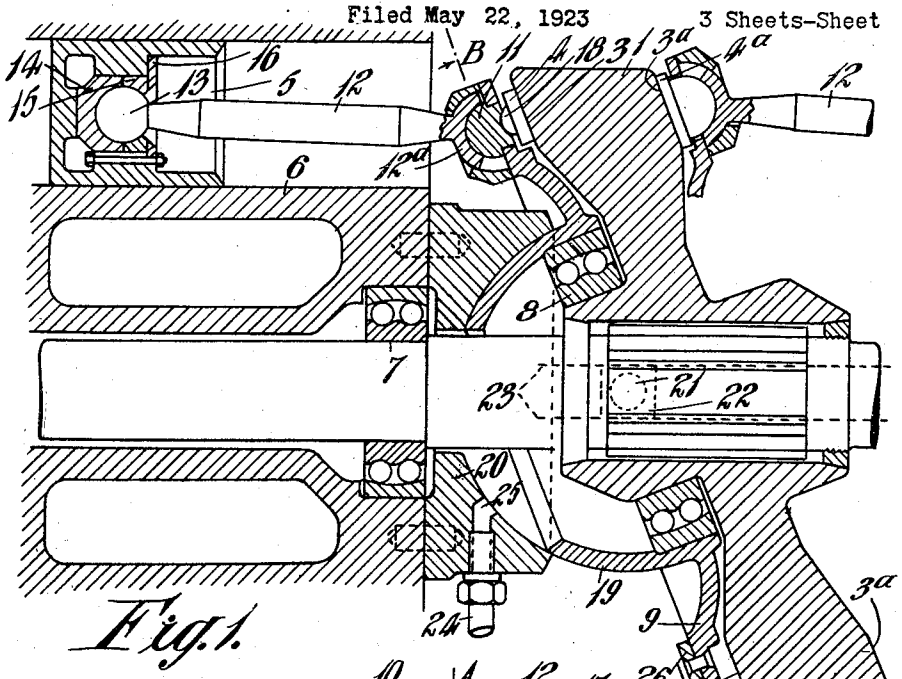


Fig. 1.

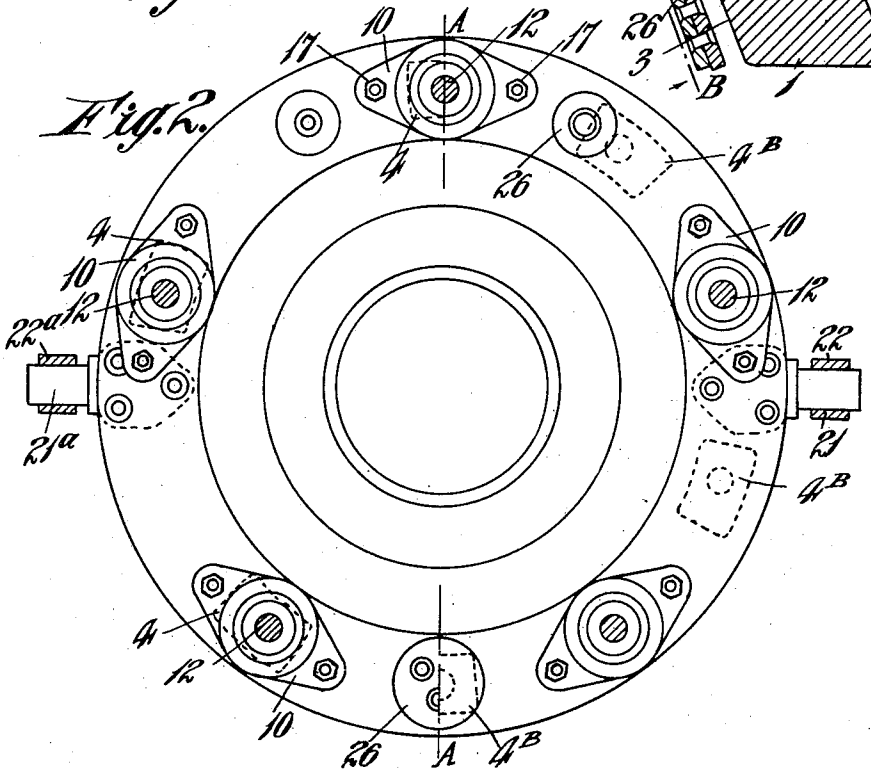


Fig. 2.

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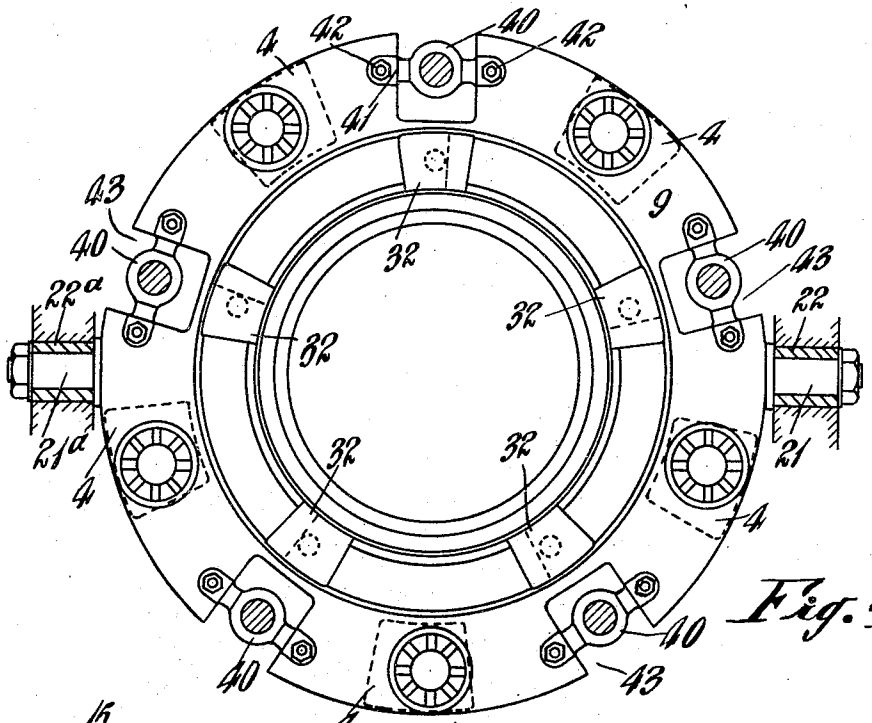


Fig. 4.

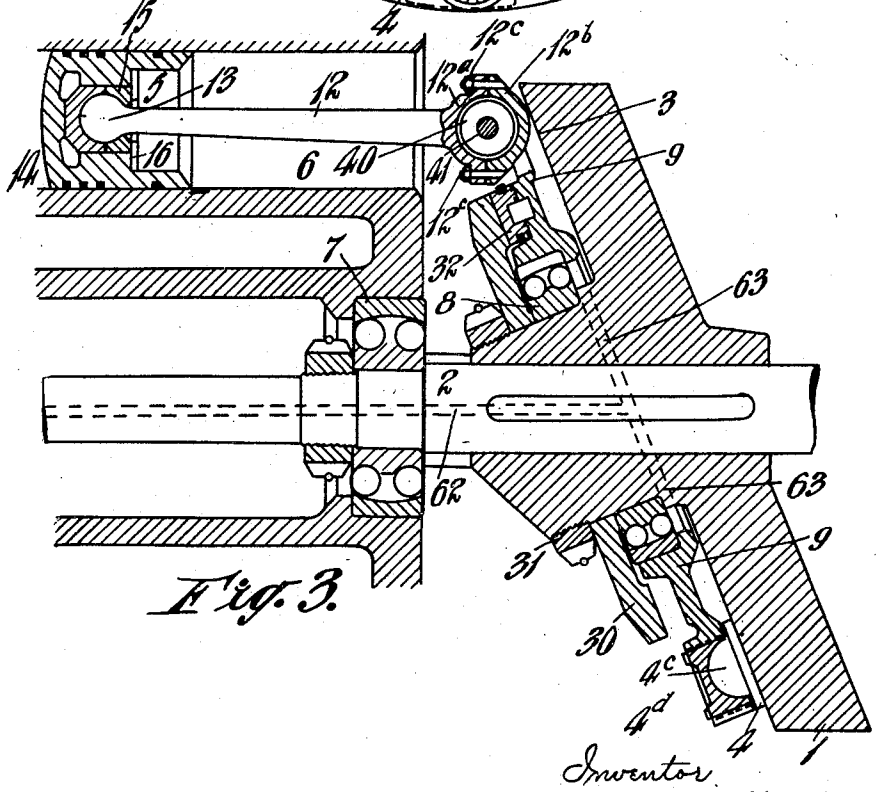


Fig. 3.

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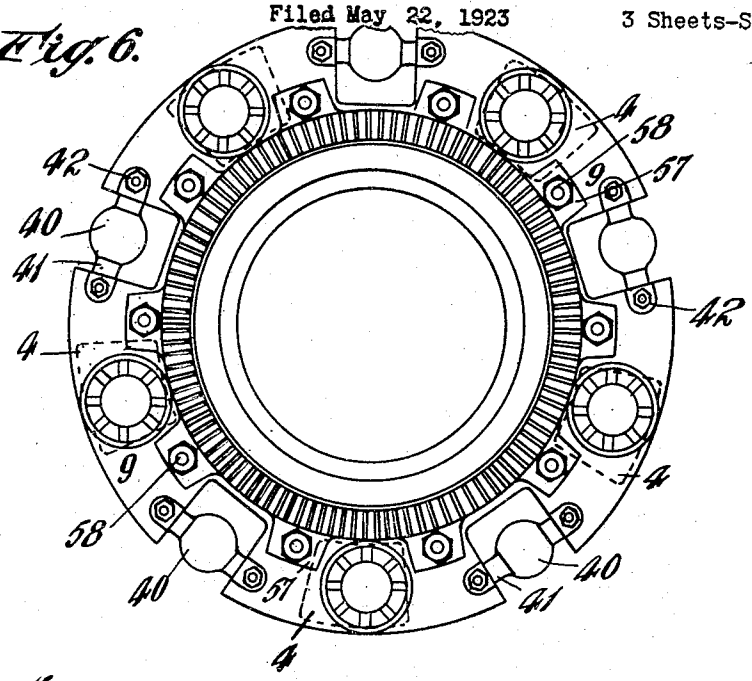
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Fig. 6.



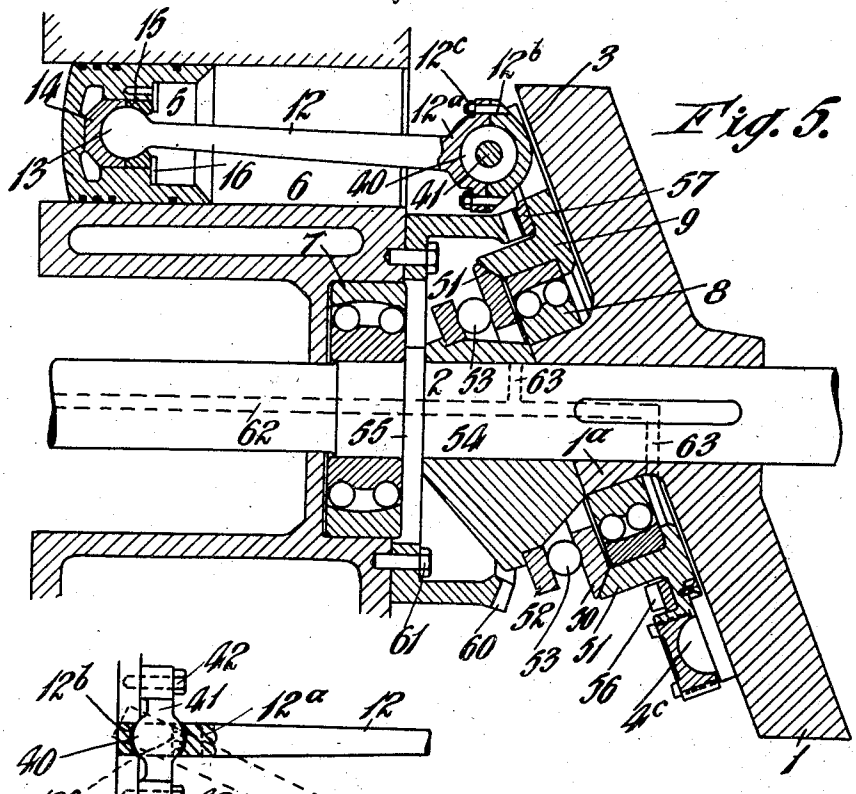


Fig. 5.

Fig. 7.

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Patented Sept. 29, 1925.

1,555,165

UNITED STATES PATENT OFFICE.

THOMAS LOUIS SHERMAN, OF CAULFIELD, VICTORIA, AUSTRALIA, ASSIGNOR TO CRANKLESS ENGINES (AUS) PROPRIETARY LIMITED, OF MELBOURNE, AUSTRALIA.

MECHANISM FOR INTERCONVERSION OF ROTARY AND RECIPROCATING MOTION.

Application filed May 22, 1923. Serial No. 640,724.

To all whom it may concern:

Be it known that I, THOMAS LOUIS SHERMAN, a subject of the King of Great Britain, residing at "Helenslea," Ontario Road, Caulfield, in the State of Victoria, Australia, have invented certain new and useful Improvements in Mechanism for Interconversion of Rotary and Reciprocating Motion, of which the following is a specification.

The present improvements are applicable to mechanism of the type described in United States Patent No. 1,409,057, wherein the relative rotary motion of an oblique swash-plate or "slant" and a reciprocating element is co-ordinated through a slipper element.

Variant structural forms of such mechanism are described in United States Patents No. 1,418,598, and No. 1,487,965 wherein the slipper elements are retained in position by a retainer-plate maintained parallel to the slant in all phases of its motion but restrained from revolving with the slant by its connection to the reciprocating elements. According to the present invention, the slipper retainer-plate, which for convenience is here-in-after designated the cage, is restrained from revolving by guides attached to the case of the machine which arrangement is of special advantage in single ended mechanism of the type mentioned or when double ended the slippers on opposite sides of the slant are not connected together or bridged in pairs across the periphery of the slant.

The accompanying drawings illustrate practical applications of the cage restrained by guides for the purpose stated and, although several forms are depicted, in each instance the restraint mentioned is effected consequent upon the engagement of the cage with the frame of the mechanism.

In the drawings, Fig. 1 is a part axial section of the rotary element, reciprocating elements and cages,

Fig. 2 is a side view of the cage, shown in Fig. 1.

Figs. 3 and 4 are respectively an axial section and side view similar to Figs. 1 and 2 of a modified construction, and

Figs. 5 and 6 are further axial section and side view also corresponding respectively to Figs. 1 and 2 of another modification.

Fig. 7 is a detail view of a part common to the construction shown in Figs. 3, 4, 5 and 6.

Referring particularly to Fig. 1, the slant 1, which is shown keyed to the shaft 2, is formed with plane working faces 3, 3^a with which the slippers 4, 4^a make working contact.

It is to be understood that the slant 1, instead of being made with truly plane faces 3, 3^a as above described may have these surfaces slightly convex, the construction of the slippers being adapted to conform therewith and the action of both elements being in accordance with the Patent No. 1,418,598 above cited.

The reciprocating element 5 is shown as a single-acting piston, fitting in a stationary cylinder 6. In most applications a number of pistons 5 will be employed, arranged circumferentially about the shaft axis, being either all located on one side of the slant, or on both sides thereof as indicated in Fig. 1. It is to be understood that alternatively the cylinder 6 may be arranged to revolve about the axis of the shaft 2 and slant 1 the latter remaining stationary, the relative rotation in either case being effected through a bearing 7.

Referring in the first instance to the parts shown on the left hand side of the slant 1 in Fig. 1 mounted in the cage 9 opposite to the cylinder 6 are concave and convex spherical bearings 10, 11. These bearings retain between them the correspondingly shaped end 12^a of the rod 12, the opposite end 13 of which is ball shaped and articularly mounted in the piston 5 by means of the socket and cap pieces 14, 15 and 16. The concave bearing piece 10 may be attached to the cage 9 by screws 17 as shown in Fig. 2, a number of such bearings 10 and rods 12 being shown in this figure arranged circumferentially as above indicated. The slipper 4 may be furnished with a rounded projection 18 and articularly mounted in a corresponding recess in the bearing 11 as shown in Fig. 1.

Alternatively, the slippers 4 instead of being pivoted in the bearings 11, as shown in Fig. 1 and by dotted lines in the left hand half of Fig. 2 may be pivoted directly to the cage 9, in the circumferential intervals between the bearings 10 as shown

at 4^b in the right hand half of Fig. 2. According to another modification of the design first described, the projection on the slipper may itself form the convex bearing 11, the combined element serving as a single intermediary between the slant 1 and the rod 12. This modified construction is illustrated in the slipper 4^a shown on the right-hand side of the slant in Fig. 1.

The cage 9 is constructed with central spherical boss 19 which engages with the convex spherical surface of the seating 20, attached to the cylinder frame, and by this means the motion of the cage is restricted to movements of rotation about the fixed centre of such spherical surface. It will be seen that the boss 19, and seating 20 serve as a thrust bearing adapted to maintain the cage 9 at the required distance from the slant 1.

As an additional support for the cage 9 in its motion relative to the slant 1 a bearing 8 may be applied having its axis at right angles to the plane faces 3, 3^a.

It will also be observed that by means of this spherical boss 19 and seating 20 the cage 9 is enabled to move so as to be at all times parallel to and at a constant distance from the working face 3 of the slant 1 without however accompanying the latter in its rotation, free relative rotation being permitted by the bearing 8.

Attached to the periphery of the cage 9 are two trunnions 21, 21^a fitted with trunnion-blocks 22, 22^a which slide in guides parallel to the axis of the machine. These guides are indicated by dotted lines 23, in Fig. 1.

In order to effect lubrication of the working surfaces of the slant 1, and cage 9, oil may be introduced through the spherical seating piece 20, through a pipe 24 and oil port 25. Such oil immediately lubricates the working surfaces of the boss 19 of the slant, and of its spherical seat 20, and is thence distributed by centrifugal force through the ball bearing 8 to surfaces 3, 3^a of the slant 1 and other working parts.

In order to effect dynamical balance of the cage (making it dynamically symmetrical in all directions) balance pieces 26 may be attached to it so as to equilibrate the masses of the trunnion pins 21, 21^a and blocks 22, 22^a. Alternatively, where a cage is used on each side of the slant, the trunnions of one cage may be located in an axial plane at right angles to that of the trunnions of the other cage, so as to effect a mutual balance.

In the alternative construction shown in Figs. 3 and 4 the slant 1, shaft 2, pistons 5 in cylinders 6, bearings 7 and 8, cage 9, rods 12, trunnions 21, 21^a and blocks 22, 22^a are generally similar to the corresponding parts shown in Figs. 1 and 2. The slippers 4 between the slant and cage are mounted circumferentially in the spaces between the ends of the rods 12, as in the alternative construction shown at 4^b in Fig. 2. These slippers are pivoted, as by a half-ball 4^c attached to the slipper 4, in adjustable seats 4^d, which are screwed into the cage 9.

The slant 1 revolves relatively to the cage 9 in the bearing 8 and is also supported relatively thereto by the disc 30 fixed on the slant and secured thereto by the nut 31, thrust slippers 32 being interposed between the cage 9 and disc 30, making working contact therewith so as to maintain the cage 9 always parallel to, and the slippers 4 in contact with, the face 3 of the slant 1 during its rotation. The ends of the rods 12 may be articularly attached to the cage 9 by spherical bearings as shown at 10, 11, in Figs. 1 and 2 or the alternative construction illustrated in Figs. 3, 4 and 7 may be used. In this latter construction a ball 40, formed on a bar 41, is attached as by screws 42 in Figs. 4 and 6 to the cage 9 a gap 43 formed in the periphery of the cage to provide space all round the ball 40. The rod 12 is formed with a head 12^a and with a cap 12^b attached to it as by screws 12^c, both the head 12^a and cap 12^b being fitted to make working engagement on the ball 40. In the operation of the machanism, as the plane of the cage rotates the rod 12 takes various angular positions relatively to the ball 40, both in the plane of Fig. 3 and in that of Fig. 7 which is at right angles to the plane of Fig. 3. The extreme angular positions of the rod 12 in the latter plane are indicated by dotted lines in Fig. 7.

In the further modified construction shown in Figs. 5 and 6 all the parts are respectively like those described in connection with Figs. 3 and 4 except the means for retaining the cage 9 in working relation to the slant 1 and for preventing its rotation.

For the former of these purposes the cage is furnished with an annular race 50, fitting on a cylindrical seat 51, and forming with a second annular race 52 and the balls 53, a ball thrust bearing which retains the cage 9 in working contact with the slant 1 while allowing rotation relative thereto. For convenience the ball race 52 is mounted on a separate block 54, held on the shaft between shaft-collar 55 and the boss 1^a of the slant 1.

To restrain the cage 9 from rotating with the slant 1, it is provided, in this alternative, with bevel teeth 56, preferably formed on a separate ring 57 attached to the cage 9 by bolts 58. This bevel wheel gears with a stationary wheel 60 having the same number of teeth, which is fixed by bolts 61 to the casting in which the cylinders 6 are formed. It will be understood that as the

slant 1 revolves, each tooth of the gear wheel 56 engages in succession with the corresponding tooth of the wheel 60, and the ring 57 and cage 9 are thereby restrained from rotation around the axis of the shaft 2, while remaining always in working contact with and parallel to, the slant 1.

It will be seen that the main point of distinction between the construction shown in Figs. 3 to 7 and that shown in Figs. 1 and 2, is that in the former, the cage is maintained in working contact with the slant by means of the disc 30 or race 52, mounted upon a member rotating with the slant, and in the latter by means of a spherical seating 20 fixed to the member in which the cylinders are formed.

It will also be noted as regards the restraint of the cage 9 against rotation with the slant 1 that the arrangement shown in Figs. 1 to 4 does not differ in function from that in Figs. 5 and 6 although in sliding and partial rotary engagement with the frame of the mechanism while in the latter the gear wheel 57 on the cage 9 engages with the fixed gear wheel 60 concentric with the axis of the shaft 2 of the mechanism and in the latter case the engaging tooth on the wheel 56 performs the same purpose as the pin 21 or 21^a in Figs. 2 and 4.

The construction with spherical seating 20 as shown in Figs. 1 and 2 is a suitable form in cases where the pressures as such applied or transmitted to the reciprocating element, maintain the boss 19 in operative contact with the seating 20.

Of the remaining forms shown in Figs. 3 to 7 that in Figs. 3 and 4 is suitable where abundant lubrication is available to effect efficient operation of the slippers 32 and the trunnion guides 22 and 22^a. The construction in Figs. 5 and 6 does not, however, require such complete lubrication in the corresponding parts viz:—53, 57 and 60.

In the use of the mechanism shown in Figs. 3 to 7 lubrication may be effected by introducing oil in the first instance to the ball bearing 8, as through holes 62, 63 drilled in the shaft 2. From the bearing 8, the oil will be distributed by centrifugal force to supply the slippers 4, and (in the case of the construction shown in Figs. 3 and 4) also the slippers 32 as well as the balls 40.

I claim:

1. In mechanism for the interconversion of rotary and reciprocating motion, a rotary slant, a reciprocating element, a slipper through which the relative rotary motion and the reciprocating element is co-ordinated, a cage retaining the slipper in constant operative position to the rotary slant, a rod articularly connecting the cage and the reciprocating element, and guiding means associated with said cage for restraining rotation of the cage with the slant.

2. In mechanism of the character described, a frame, a shaft therein, a slant mounted on the shaft, a cage located about the shaft, a plurality of reciprocating elements, rods articularly connecting the cage with the reciprocating elements, slippers supported by the cage in working contact with the slant, and mutually engaging means on the cage and on the frame for restraining rotation of the cage relatively to the frame.

3. In mechanism of the character described, a frame, a shaft therein, a slant on the shaft, a cage located about the shaft, a central bearing for the cage, a plurality of slippers, means backing the cage for retaining the latter in operative position and maintaining the slippers in working contact with the slant, and means on the cage and frame for restraining rotation of the cage with the slant.

4. In motion conversion mechanism of the type specified, a frame, reciprocating members mounted in the frame, a slant, slippers in contact with the slant, a cage backing the slippers, rods articularly connected to the reciprocating members and to the cage, a central bearing for the latter, means supporting the cage to maintain it in operative position, and engaging means on the cage and frame for restraining rotation of said cage with the slant.

5. In motion conversion mechanism of the type specified, a frame, a slant supported by the frame, slippers on the slant, a cage backing the slippers, a central bearing for the cage, an annular race bearing backing the latter, and interengaging gear wheels on the cage and frame to restrain rotation of the cage with the slant.

6. A motion conversion mechanism of the type specified, comprising a slant, a cage mounted adjacent and parallel thereto, spherical bearing members on the cage, and slippers supported by said bearing members in contact with the slant.

7. A motion conversion mechanism of the type specified, comprising a slant, a cage mounted adjacent thereto, spherical bearing members on the cage, slippers supported by said bearing members in contact with the slant, reciprocating members, and rods articularly connected with the latter and with said bearing members.

8. A motion conversion mechanism of the type specified comprising a frame, reciprocating elements mounted therein, a shaft mounted in the frame, a slant on the shaft, a cage mounted between the slant and reciprocating members, spherical bearings on the cage, slippers movably connected with said bearings and rods articularly connected to the reciprocating members and with said bearings.

9. A motion conversion mechanism of the type specified comprising a frame, reciprocating elements mounted therein, a shaft mounted in the frame, a slant on the shaft, a cage connected with the frame between the slant and reciprocating members, a plurality of spherical supports mounted on the cage, rods articularly connected to the reciprocating elements at one end and having sockets on their other ends engaging the spherical bearings and slippers bearing on the slant connected with the spherical bearings.

Dated this 28th day of March 1923.

THOMAS LOUIS SHERMAN.