No. 638,273.

Patented Dec. 5, 1899.

# C. C. PROTHEROE.

## BALL BEARING SLIDE.

(Application filed Feb. 14, 1899.)

(No Model.)

2 Sheets—Sheet 1.

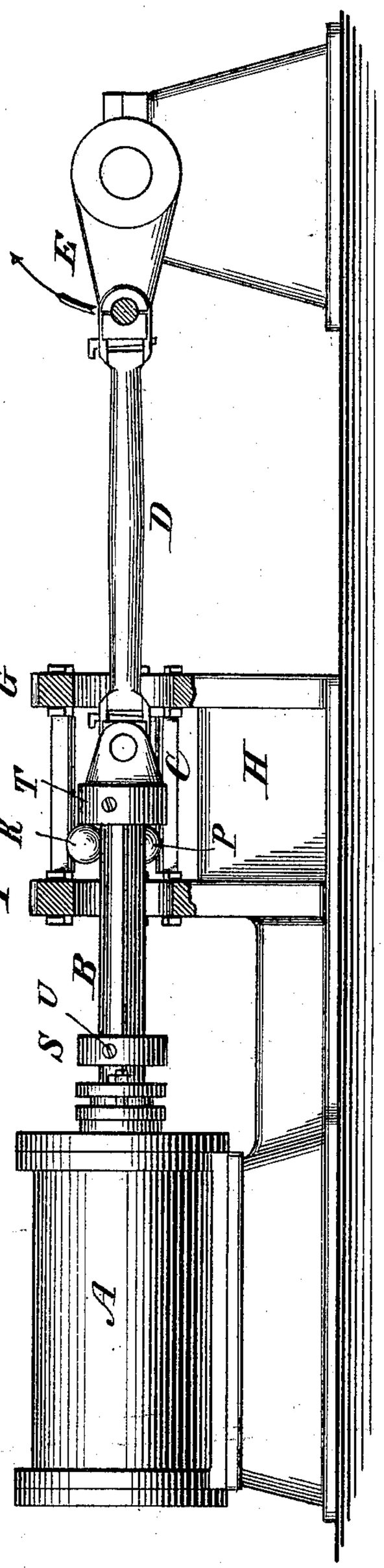


Fig. 1.

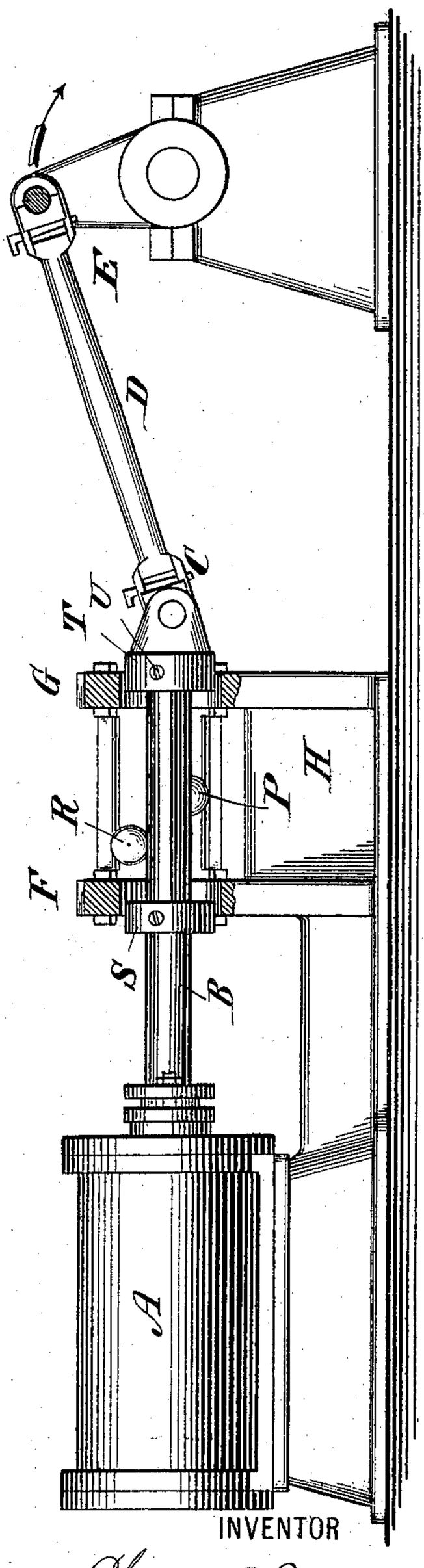


Fig. 2.

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Fig. 3,

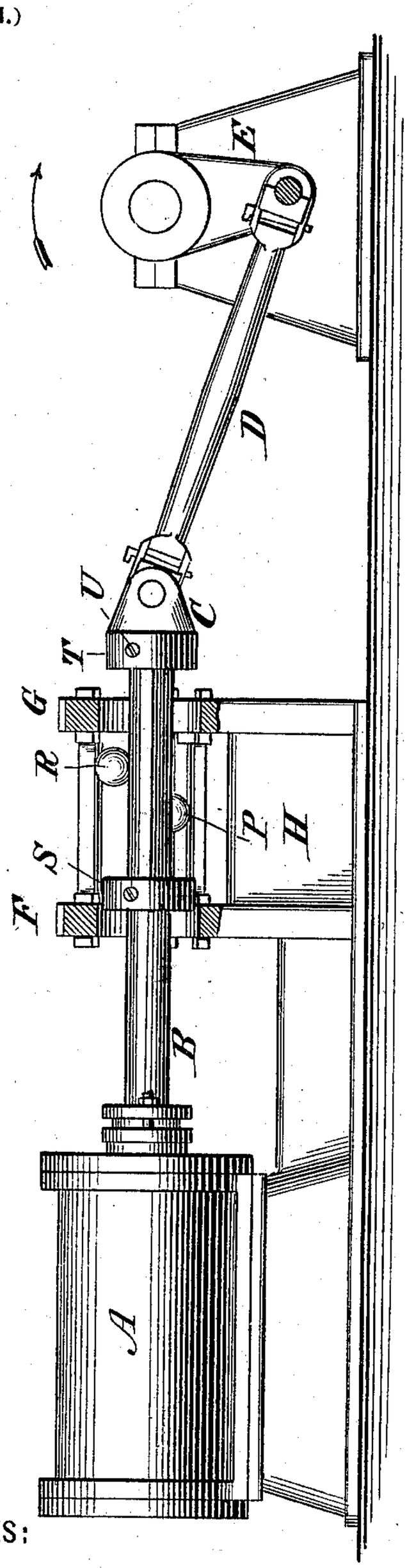



Fig. 5,

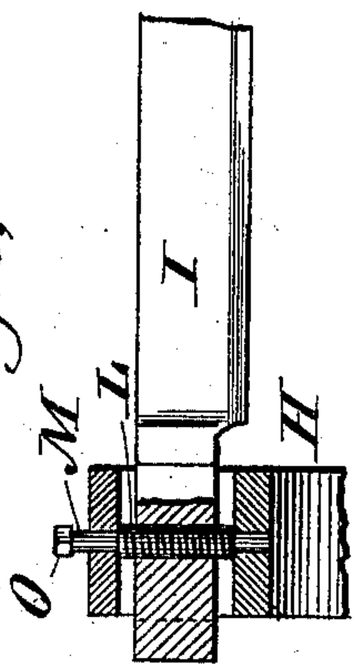
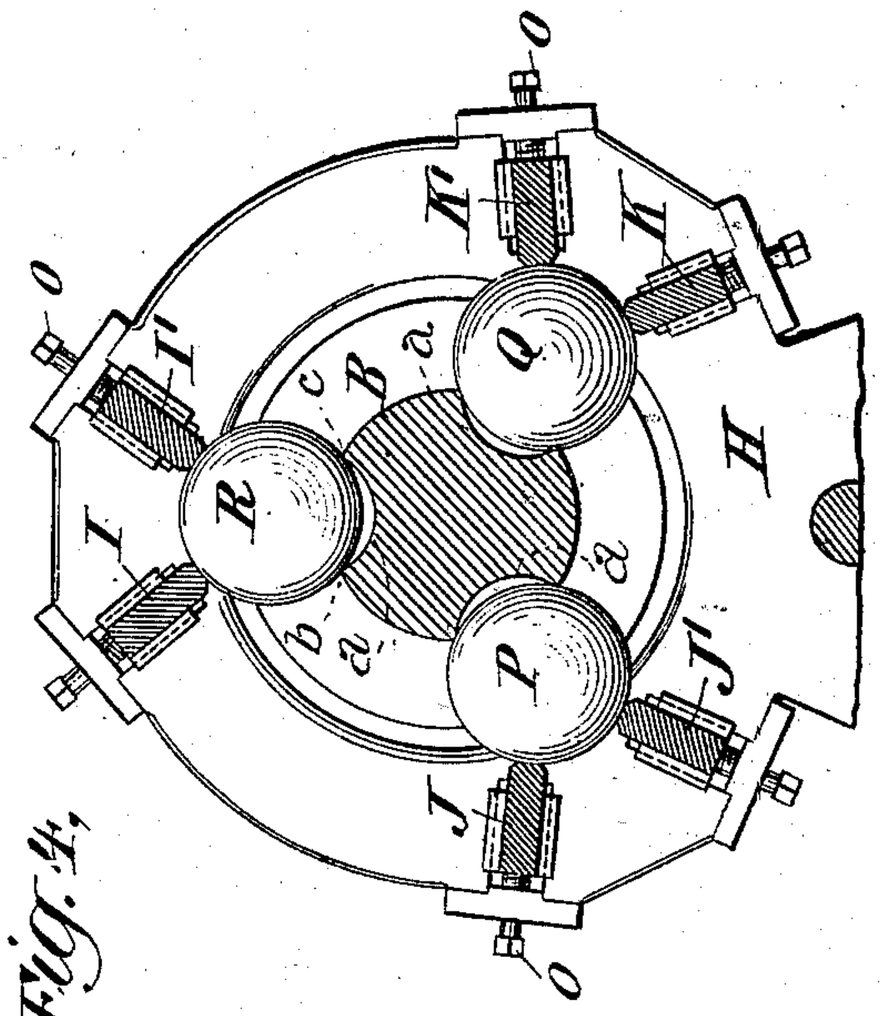



Fig. 4,

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# UNITED STATES PATENT OFFICE.

CHARLES C. PROTHEROE, OF NEW YORK, N. Y.

## BALL-BEARING SLIDE.

SPECIFICATION forming part of Letters Patent No. 638,273, dated December 5, 1899.

Application filed February 14, 1899. Serial No. 705,496. (No model.)

*To all whom it may concern:*

Be it known that I, CHARLES C. PROTHEROE, of New York, (Richmond Hill,) borough of Queens, State of New York, have invented a new and useful Improvement in Ball-Bearing Slides, of which the following is a specification.

My invention is a ball-bearing slide for the reciprocating member of any mechanism.

My invention consists in the combination, in a ball-bearing, of a ball which is rolled by the reciprocating member borne thereby to and fro over a definite path corresponding to the path of reciprocation of said member, of two or more balls similarly actuated over parallel paths, of means for bringing said balls into substantially the same plane transversely said reciprocating member at the ends of their path of movement, of means for adjusting the position of said balls with reference to the longitudinal axis of said transverse reciprocating member, and in the various other combinations set forth in the claims.

In the accompanying drawings, Figures 1, 2, and 3 are vertical sections of my ball-bearing slide shown in combination with a horizontal reciprocating engine and respectively showing the position of the parts at three different stages of the stroke. Fig. 4 is a transverse section of my ball-slide, showing the device for adjusting the guides or ways in a direction radial to the axial line of the piston-rod. Fig. 5 is a transverse section showing in detail the device for adjusting one of said guides or ways.

Similar letters of reference indicate like parts.

I illustrate my invention herein applied to the purposes of the slide-bearing for the piston-rod of a simple horizontal engine.

A represents the engine-cylinder.

B is the piston-rod; C, the cross-head; D, the pitman, and E the crank, which may be of the usual and ordinary construction, the crank being rotated in the direction of the arrow, Figs. 1, 2, and 3, through the reciprocation of the piston-rod.

I provide two annular heads F G, which may be supported in any suitable way upon the engine-bed H or upon any other fixed base. The piston-rod B extends through the heads F G, and its longitudinal axis is substantially concentric therewith. Extending between the heads F G are three pairs of guides or ways I I′ J J′ K K′. The ends of each guide, as I, Fig. 5, extend through an opening in the head F and receive a central threaded portion L of an adjusting-screw M. The unthreaded part of the adjusting-screw turns freely in the head, as shown in Fig. 5. It will be seen, therefore, that by turning the screw by means of any suitable instrument, as a wrench applied to the nut O, the guide I may be moved in a radial direction toward or from the piston-rod B.

Interposed between piston-rod B and the respective pairs of guides and supported by said guides in contact with the said rod are three balls P Q R, which are preferably of hard steel. The ball R, for example, is held between the piston-rod B and the guides I I′. Upon the piston-rod are two flanges or collars S T, held by set-screws U. The piston-rod between the collars S T has three longitudinal grooves *a*, Fig. 4, the curvature of each of which is less in radius than the ball which rests in it. The ball therefore bears upon the edges *b c* of the groove. The transverse distance between their edges is preferably equal to that between each pair of guides, as I I′, so that the ball is retained at four points on its circumference. This construction insures the rolling of the balls between guides and piston-rod when said rod is reciprocated. The pressure with which the ball bears against the rod and against the guides may be regulated by suitably turning the adjusting-screws M in the manner already described, and in the same way any wear upon these parts may be taken up.

It is obvious that with a horizontal engine such as here shown the piston-rod B rests directly upon the lower balls P Q and that the upper ball serves chiefly as a means of retaining the piston-rod in place upon the lower balls.

Referring now to Figs. 1, 2, and 3, the operation of the device is as follows: In Fig. 1 the crank, pitman, and connecting-rod are in line and the engine is about to begin its stroke. The collar T on the shaft B is in close proximity to all of the balls, which are at the left-hand end of the guides on which they move. The piston-rod now goes for-

ward, bringing the parts into the position shown in Fig. 2. The line of forward push of the piston-rod is obviously at an angle to the line of resistance, which coincides with the direction of the pitman D, and therefore there is a downward component of force at the cross-head C, and this force acts, through the piston-rod, downward upon the balls P Q. These balls are thus rolled forward on their guides J J′ K K′, and with the crank placed as indicated in Fig. 2 they will occupy about the position shown in that figure. On the upper ball R, however, there is not this downward pressure, and therefore this ball will be found to be loose and to lag behind the others, while freely turning. When the crank has been turned over to a position one hundred and eighty degrees distant from that shown in Fig. 1, the lower balls P Q will have reached the right-hand end of their guides. Meanwhile the collar S on the shaft will have met the upper ball R, or, as I shall hereinafter term it for convenience, the "loose ball," and will have rolled that ball ahead of it also to the right-hand end of its guides. Consequently when the crank shall have taken the position one hundred and eighty degrees from that shown in Fig. 1 the relation of the parts will be substantially similar to what is shown in that figure, except that the balls will all be at the right-hand end of the guides and the collar S will be in close proximity to them. Assuming now the crank to pass to the position shown in Fig. 3, having completed three quadrants of its revolution, the resultant pressure of the piston-rod will still be downward and the balls P Q will have moved to the left and into the same position as they are shown in Fig. 2, while the loose ball R will now lag at the right-hand end of the guides until it is met by the collar T and rolled to the left, so that as the last quadrant of the revolution of the crank is completed all of the parts come back exactly to the positions shown in Fig. 1. The collars S T are to be adjusted on the shaft so as to effect the foregoing, and it is preferable to place them so that they will not exert any push upon the lower balls P Q, but will come up into close proximity with those balls just after said balls have reached the extremities of their paths. As the upper ball R is practically loose, it may be rolled along by the collar pushing it with inconsiderable friction. It is also to be observed that the length of the guides over which the balls travel, measured between the heads F and G, is to be greater than the length of the path over which the balls are caused to roll by the piston-rod, so that in no case will the balls be carried against either head before the piston-rod shall have completed its motion in a given direction. This of course applies particularly to the lower balls P Q. The special advantage of the collars S T is that they insure that the loose ball R shall be brought into substantially the same transverse vertical plane as the lower balls P Q at each end of the guides alternately, so that when the piston-rod begins either its forward or backward movement all of the balls are in proper definite position. Unless such special provision as this is made it may happen that the loose ball might remain, for example, at the right-hand end of its guides or might reach the right-hand end of its guides while the piston-rod is making its right-hand movement. The ball in that case would simply be jammed by the piston-rod into the angle between the heads and the right-hand end of the guides and there would be obvious friction between the ball and rod.

Under the conditions already explained the upper or loose ball, as I have stated, acts as a retaining device for the piston-rod, like an ordinary slide-cap, and differs therefrom, of course, in its own peculiar characteristics, already described. If, however, the engine be reversed or if the power in the machine should be transferred not from piston to fly-wheel or crank, but from crank or fly-wheel to piston, as in the case of a pump, or where there is a heavy fly-wheel and the load has been taken off and steam also shut off from the engine, then there may be conditions when the resultant pressure of the piston-rod in the ball-slide does not come upon the lower balls, but upon the upper ball. In such case the operation will be precisely the same as already described, with the difference, however, that the balls P Q will be relatively loose and be brought into proper position at the ends of the guides alternately by the collars S T, while the ball R will receive the upward transverse pressure of the piston-rod.

The particular advantage of the device is the reduction of friction, its simplicity, cheapness of construction, and its self-adaptability to any conditions regardless of the relations of power and load.

The term "reciprocating member" herein means any body actuated by any means to and fro over a rectilinear path. The term "extent" herein applied to "path," means the linear length of said path from one end of it to the other. The term "longitudinal axis" of the reciprocating member means herein that axis of the member which corresponds in direction to the path of reciprocation. A plane "transversely" the reciprocating member means a plane at right angles to a plane passing through the longitudinal axis. "Different points on the cross-sectional periphery" of the reciprocating member means points angularly distant from one another, the apex of the angle being in the longitudinal axis of the member.

I claim—

1. The combination of a reciprocating member, a ball-bearing therefor, means actuated by said member and constructed and operating to positively move said balls in said bearing over a path of definite extent corresponding to that of the path of reciprocation of said member, and means for independently

regulating the pressure between each of said balls and said member, substantially as described.

2. The combination of a reciprocating member, balls in contact therewith, ways or guides respectively supporting said balls in said contact, and means for adjusting said ways or guides nearer to or farther from said member, substantially as described.

3. The combination of a reciprocating member, balls in contact with said member, pairs of ways or guides, each pair respectively supporting said balls in said contact, and means for independently adjusting each pair of said ways or guides nearer to or farther from said member, substantially as described.

4. The combination of a reciprocating member, balls in contact with said member, pairs of ways or guides each pair respectively supporting said balls in said contact, and means for independently adjusting each part of each pair of said ways or guides nearer to or farther from said member, substantially as described.

5. The combination of the reciprocating rod B having the collars S, T with the heads F, G, pairs of ways I, I′, J, J′, and K, K′ and balls R, P, Q respectively received by said ways; the said rod passing through said heads and between said balls, substantially as described.

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