

No. 611,472.

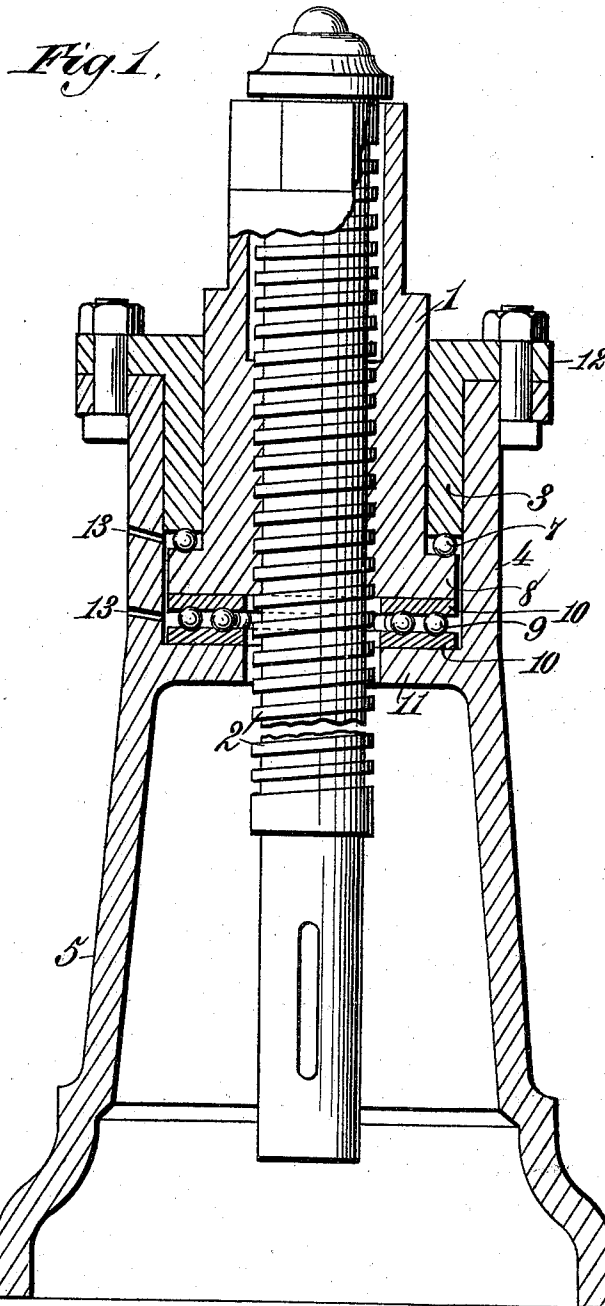
Patented Sept. 27, 1898.

R. S. GILLESPIE.
MECHANISM FOR OPERATING SLUICE GATES, &c.

(Application filed Feb. 18, 1898.)

(No Model.)

3 Sheets—Sheet 1.



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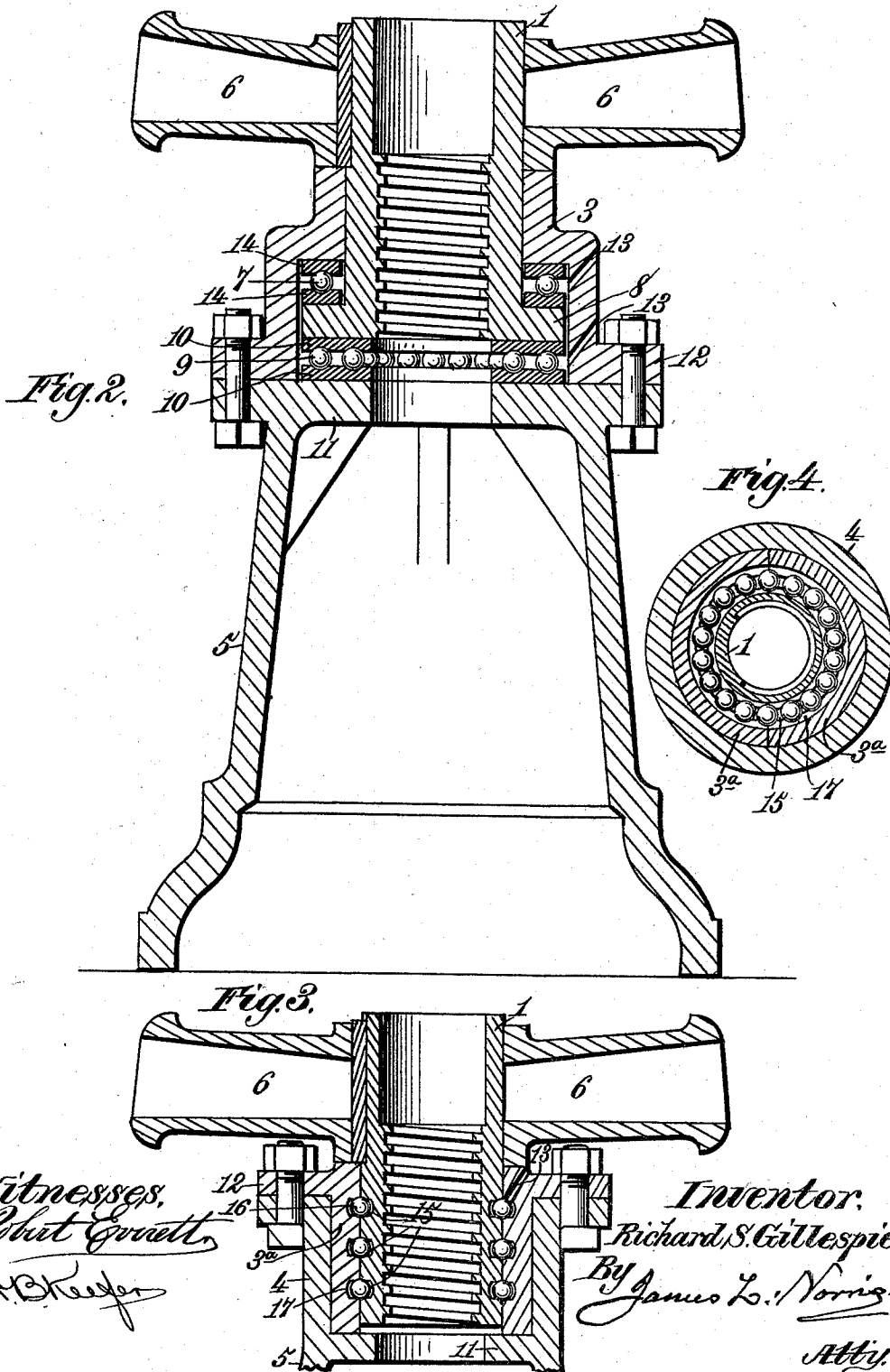
Patented Sept. 27, 1898.

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MECHANISM FOR OPERATING SLUICE GATES, &c.

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3 Sheets—Sheet 2.



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3 Sheets—Sheet 3.

Fig. 5.

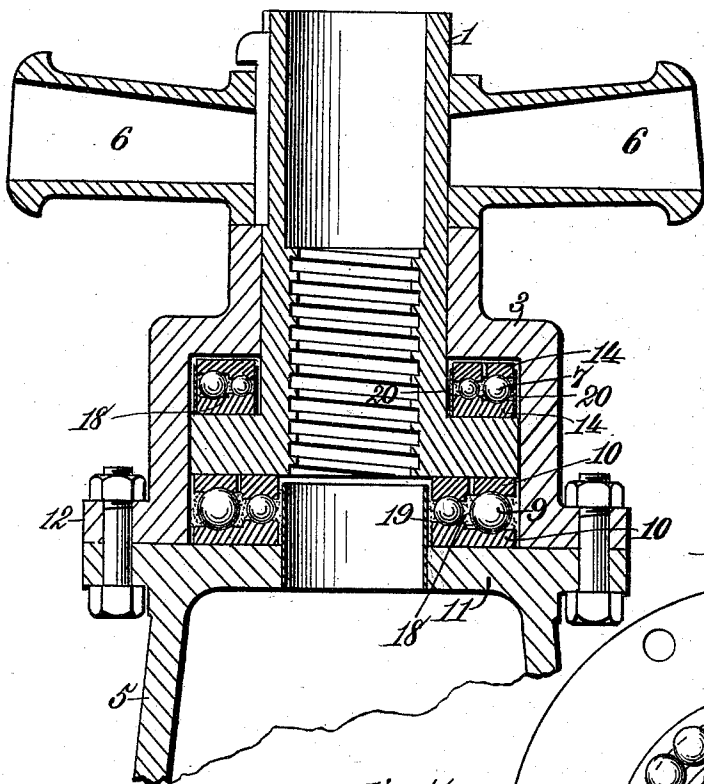


Fig. 6.

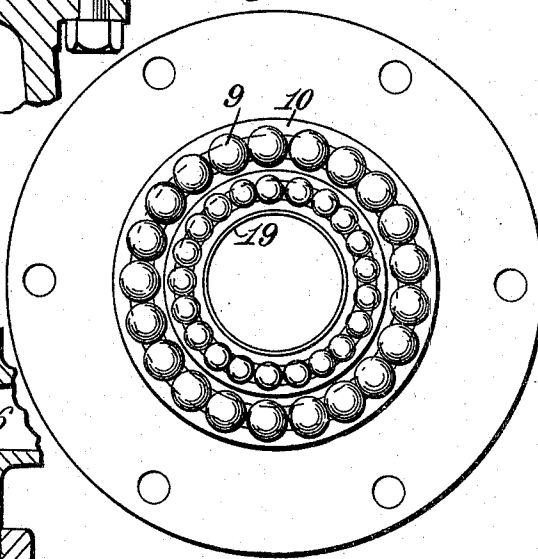
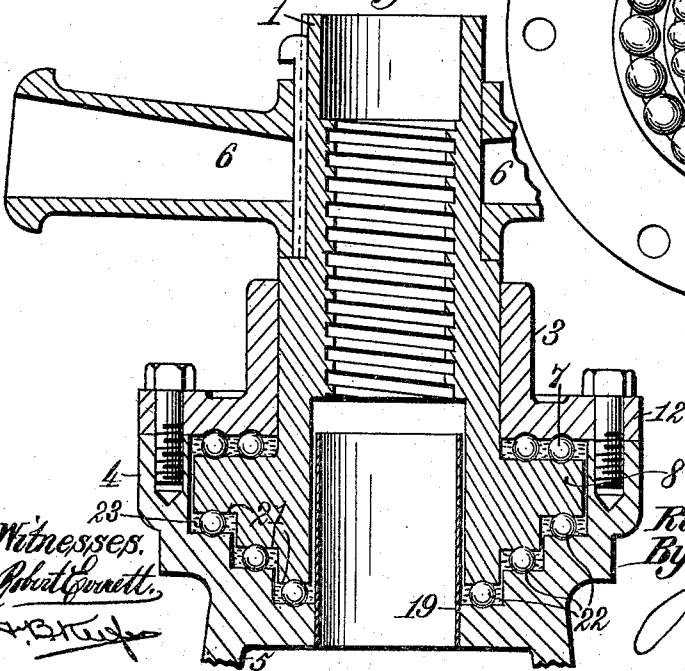


Fig. 7.



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UNITED STATES PATENT OFFICE.

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MECHANISM FOR OPERATING SLUICE-GATES, &c.

SPECIFICATION forming part of Letters Patent No. 611,472, dated September 27, 1898.

Application filed February 16, 1898. Serial No. 670,569. (No model.)

To all whom it may concern:

Be it known that I, RICHARD S. GILLESPIE, a citizen of the United States, residing at New York, in the county of New York and State of New York, have invented new and useful Improvements in Mechanism for Operating Sluice-Gates and for other Purposes, of which the following is a specification.

This invention relates to that class of mechanism for operating sluice-gates and for other purposes in which the rotation of a nut is caused to give longitudinal movement to a screw-shaft with which is connected the gate or other object to be moved. In the raising and lowering of sluice-gates it is usual to effect rotation of the nut or internally-threaded cylinder through the medium of worm-gearing actuated by means of a crank on the worm-shaft, and the laborious exertions of several men are required to lift the gate, owing to the great pressure of water against it. The size of sluice-gates is often considerable and many of them are under from sixty-five to one hundred feet head of water or more, so that in order to open the gate the united labor of about four men is required on the worm-shaft crank or on a capstan-bar connected with the nut or internally-threaded cylinder which actuates the screw-shaft of the gate. All the weight of the gate and its appurtenances and the strain due to the pressure of water upon the gate will be received by the nut and its bearings, and thus the opening or lifting of the gate is usually a slow, difficult, and laborious operation.

It is the purpose of my invention to facilitate the turning of the screw-operating nut by providing series of antifriction-balls to take the thrust of said nut and sustained mechanism; also, to provide reservoirs for immersing the balls in a liquid, or preferably in mercury when there is no liability of its amalgamating with contiguous metal parts; also, to provide for arranging the balls and their bearings in such manner as to distribute and equalize the strain, and generally to improve the construction of mechanism for the operation of sluice-gates or stop-valves and for other purposes, as hereinafter described.

My invention is illustrated in the annexed drawings, in which—

Figure 1 is a vertical section of a pedestal in which is supported a rotatable nut provided with a fixed bushing or guide and with upper and lower annular series of steel antifriction-balls which may be immersed in some heavy liquid that will not readily freeze. Fig. 2 is a sectional view showing both the upper and lower series of balls placed between hardened-steel plates. Fig. 3 shows several series of balls arranged in grooves around the nut, intermediate the same and its bushing, which is preferably split or formed in halves. Fig. 4 is a horizontal section of the same through the nut and split bushing. Fig. 5 shows both the upper and lower sets of balls in concentric annular series and proportioned in size to the radius of the paths in which they travel, showing also a preferred construction of reservoirs for the fluid in which the balls are immersed. Fig. 6 is a part plan of the contacting arrangement of balls included in the construction shown in Fig. 5. Fig. 7 shows a construction in which the lower balls are placed in steps formed in the nut and supporting-pedestal and in which a common reservoir is provided for the immersing fluid of both the upper and lower balls.

Referring to the drawings, the numeral 1 designates a rotatable nut or internally-threaded cylinder to engage a longitudinally-movable screw-shaft 2, with which is to be connected a sluice-gate or other object to be moved. This nut or cylinder 1 is arranged to be capable of turning in a fixed bushing 3, that may be supported in the chambered portion 4 of a pedestal 5 and to which the said bushing may also serve as a cover, as shown in Figs. 1, 3, and 7. In Figs. 2 and 5 the bushing 3 constitutes the whole of the chamber that receives the nut and its ball-bearings. The nut is preferably provided with sockets 6 for insertion of capstan-bars as a means of rotating the nut, thus doing away with the usual expensive gearing generally employed in the operation of sluice-gates and affording an increased facility in the application of manual power.

To provide for easily turning the nut or cylinder 1 and to equably distribute the strain thereon due to weight of the parts to be moved, as well as to the pressure of water

against a sluice-gate, I arrange about the nut one or more annular series of steel antifric-tion-balls in at least two sets, upper and lower.

As shown in Fig. 1, the upper annular series of balls 7 is placed between the lower end of the fixed bushing 3 and a laterally-projecting annular flange or collar 8, that is formed on the lower end of the nut. Each of these parts between which the upper balls 7 are placed—namely, the lower end of the bushing 3 and the upper surface of the nut flange or collar 8—is provided with a concaved annular groove, as shown, to obviate cutting and reduce frictional wear, and, if desired, the said parts may be appropriately hardened for the same purpose. The lower balls 9 are arranged in a plurality of concentric annular series and are placed between two hardened-steel plates 10, provided with concaved annular grooves in which the balls travel. These hardened and grooved steel plates 10 and intermediate balls 9 are placed beneath the flanged nut 1 and are supported by an internal annular flange 11 of the pedestal or frame. Such bearing-plates are not always required for the upper balls except when the balls are subjected to excessive pressure, and they may therefore be omitted, as in Fig. 1. The upper balls 7 are, however, just as important to receive the thrust when lowering the gate under pressure as the lower balls are when raising the gate. The bushing or cap 3 acts as a guide for the nut as well as to receive the effort of thrust. This bushing or cap, as shown in Fig. 1, has at its upper end a flange 12, through which it is bolted to the supporting-pedestal. For the purpose of supplying the upper and lower sets of balls with a lubricating fluid there are provided inlet-passages 13, that are arranged to communicate with the ball-containing chamber or chambers at suitable points. I have successfully applied the construction shown in Fig. 1 to gates under eighty-five feet head of water and one man can raise or lower them with a capstan-bar having a radius of five feet and a half.

In Fig. 2 I have shown the bushing or cap 3 as having its flange 12 at the lower end and bolted therethrough to the pedestal or frame 5. This fixed bushing or cap 3 is chambered to receive the flange 8 of the rotary nut 1 and the balls 7 and 9 above and below said nut-flange or collar, together with the bearing-plates for said upper and lower balls, the upper balls 7 being in this case provided with grooved and hardened-steel plates 14, similar to the plates for the lower balls, as already described.

Although I have shown the described mechanism in vertical position, it will be obvious that it can be readily arranged for operation in any position desired. Without the pedestal 5 the construction shown in Fig. 2 is complete for operating the screw-shaft of a horizontally-movable sluice-gate, and I have so employed it with success in the operation of a horizontally-movable gate four feet in

diameter and under one hundred and fifteen feet head of water, with the labor of one man only, whereas the united efforts of at least four men have heretofore been required for the same work unaided by the advantages afforded in my improved gate-operating mechanism. Under a pressure such as named, added to the weight of the gate and its appurtenances, it is preferable that all the balls should work in between steel plates, as shown.

The arrangement of balls shown in Fig. 3 is more particularly designed for application to gate-operating mechanism already in use and where the diameter of the nut or internally-threaded cylinder 1 is too small to allow the use of a sufficient number of balls of the proper diameter under the nut. It will be seen that in this case the vertical exterior of the nut or cylinder 1 is provided with a series of concaved annular grooves 15, Figs. 3 and 4, corresponding with similar grooves in the interior of a fixed bushing 3^a, that is preferably split or formed in halves, as more clearly shown in Fig. 4. In these coinciding annular grooves of the nut and its bushing are placed the several annular series of steel balls 16, that take the thrust. Each annular ball-groove has a countersunk channel 17 for circulation of oil supplied through an inlet 13. The bushing 3^a is preferably made in two pieces, as shown, for easy insertion of the balls 16, but it can be made in one piece and have a hole drilled through it into each groove for entrance of the balls, each hole being subsequently closed by a screw-plug. Although the construction shown in Fig. 3 is not so excellent, ball for ball, as compared with the arrangement shown in Fig. 1 or 2, it is nevertheless very effective, owing to the large number of balls that can be used. The bushing 3^a being held rigid, the thrust is taken by the balls when the nut is turned in either direction.

As shown in Fig. 5, both the upper and lower sets of balls are arranged in a plurality of concentric annular series and may be proportioned in size to the radius of the path in which a series of balls travel. This affords means for using these balls at high velocities and under heavy pressures, and by arranging the balls of each series in close contact, as shown in Fig. 6, all portions of the annularly-grooved thrust bearings or hardened-steel plates between which the balls are placed will have an equably-distributed pressure that will greatly diminish the effects of wear and add largely to the efficiency of the mechanism.

In Fig. 5 both sets of balls, upper and lower, are shown as immersed in a fluid 18, preferably mercury, contained in suitable reservoirs. The lower reservoir is located in the chambered portion of the bushing 3, at its bottom, and its inner annular wall is constituted by a pipe 19, expanded into tight contact with the inner edge of the annular inter-

nally-projecting flange 11 of the pedestal. The upper reservoir is formed by securing inner and outer concentric rings 20 to the lower one of the annular plates 14, between which the upper balls 7 are placed. When these reservoirs are filled with liquid, the balls are completely immersed.

It is of the utmost importance in exposed places and where it is very wet that the balls and grooved plates be thoroughly protected from damp and small particles of sand, metal, or grit. To accomplish this, I fill the reservoirs or ball-chambers with some heavy fluid, one that will not readily freeze in our climate, and for this purpose I prefer to make use of mercury. This will float small particles of metal and sand or similar substances and will not be displaced by dripping water. When the balls are immersed in mercury and rotated at high velocities and under a pressure that would generate sufficient heat to cause evaporation, they must be kept cool with water. Of course when mercury is used to immerse the balls the contiguous metal parts should be of such character that the mercury will not amalgamate therewith. When the nut and screw are composed of metal that would be attacked by mercury, the reservoir-walls 19 and 20 can be covered with amalgam or be made of such material as will afford the required protection. The mercury-chamber would be very useful for the step of a turbine-wheel shaft and for turn-table centers when fitted with ball bearing or rollers, and would also be very efficient for protection of the expansion-rollers of bridges.

If it is desired to arrange more than two concentric annular series of balls under a nut of large diameter, the lower end of the flanged nut and the bottom of the pedestal-chamber can be each provided with corresponding steps 21, between which the lower balls will be arranged in preferably three concentric annular series 22, as shown in Fig. 7. This construction gives great strength to the nut when more than two annular series of balls are used under it. The annular steel plates, as 10 and 14, may be dispensed with, and in this event the steps of the nut and pedestal will be provided with concaved annular grooves to receive the lower balls, while the top of the nut-flange and the under side of the bushing or cap will be similarly grooved for reception of the upper balls.

In Fig. 7 the pipe 19 is arranged to form the inner annular wall of a single reservoir for the immersing fluid of both the upper and lower sets of balls; but if the nut, pedestal, and bushing are composed of metal that would be attacked by mercury some heavy oil 23 must be supplied to the reservoir or ball-chambers. Care must be taken that the internal diameter of the pipe 19 is large enough to allow the screw 2 to pass freely through it.

A clearance should be provided between the bushing or cap 3 and the top of the upper annular steel plate 14, as shown in Fig. 5, and

a clearance is also necessary between the upper line of balls and the cap or bushing, as shown in Fig. 7. This is necessary in all cases where there might otherwise be a tendency to bind.

In raising and lowering sluice-gates under pressure thereon it is important that the balls should run in concaved annular grooves and that about one-third to one-half the circumference of the balls be in contact with the concavity of said grooves. A steel ball three-quarters of an inch in diameter can be continually worked under one thousand pounds pressure under the above-named conditions with a minimum wear of balls and grooves, whereas balls worked at a pressure of even seven hundred pounds or less between hardened-steel plates having no grooves or only grooves that are V-shaped in cross-section will speedily cut the plates or bearings and subject them to such injury that they soon become worthless.

It will be obvious that the mechanism described and shown can be employed to great advantage for very many purposes other than the operation of sluice-gates, and therefore my invention is not restricted to that specific object.

What I claim is—

1. The combination of a longitudinally-movable screw-shaft, a rotatable nut or internally-threaded cylinder engaged with said screw-shaft to actuate the same, a fixed bushing placed around said nut, antifriction-balls in annular series intermediate the said nut and bushing to take the thrust of the nut, the said balls having their bearings in concaved annular grooves, and means for rotating the nut, substantially as described.

2. The combination of a longitudinally-movable screw-shaft, a rotatable nut or internally-threaded cylinder engaged with said screw-shaft to actuate the same and provided with an external annular flange or collar, a fixed bushing placed around said nut, a pedestal or frame for supporting the said nut and bushing, and antifriction-balls arranged in one or more annular series on opposite sides of the nut flange or collar and working in concaved annular grooves, substantially as described.

3. The combination of a longitudinally-movable screw-shaft, a rotatable nut or internally-threaded cylinder engaged with said screw-shaft to actuate the same and provided with an external annular flange or collar, a fixed bushing placed around said nut, an annular series of antifriction-balls intermediate said bushing and one side of the said nut collar or flange, and antifriction-balls in a plurality of annular series on the opposite side of said nut collar or flange, all the balls being arranged to work in concaved annular grooves, substantially as described.

4. The combination of a longitudinally-movable screw-shaft, a rotatable nut or internally-threaded cylinder engaged with said screw-shaft to actuate the same and provided with

an external annular flange or collar, a fixed bushing placed around said nut, an annular series of antifriction-balls intermediate said bushing and one side of the said nut collar or flange, antifriction-balls in a plurality of annular series on the opposite side of said nut flange or collar, and annular hardened-steel plates between which the last-named balls are placed, all the balls being arranged to work in concaved annular grooves, substantially as described.

5. The combination of a longitudinally-movable screw-shaft, a rotatable nut or internally-threaded cylinder engaged with said screw-shaft to actuate the same and provided with an external annular flange or collar, an annular series of antifriction-balls above the said collar, antifriction-balls in a plurality of annular series below the said collar, annular hardened-steel plates between which the balls are placed and having concaved annular grooves for the balls to travel in, and a fixed bushing or cap placed around said nut and balls, substantially as described.

6. The combination of a longitudinally-movable screw-shaft, a rotatable nut or internally-threaded cylinder engaged with said screw-shaft to actuate the same and provided with an external annular flange or collar, a fixed bushing placed around said nut, and antifriction-balls in a plurality of annular series on opposite sides of said nut flange or collar and the said balls being proportioned in size to the radius of the path in which a series of said balls is to travel, substantially as described.

7. The combination of a longitudinally-mov-

able screw-shaft, a rotatable nut or internally-threaded cylinder engaged with said screw-shaft to actuate the same and provided with an external annular flange or collar, a fixed bushing placed around said nut, antifriction-balls in annular series on opposite sides of said nut flange or collar, and reservoirs for mercury to immerse said balls, substantially as described.

8. The combination of a longitudinally-movable screw-shaft, a nut or internally-threaded cylinder engaged with said screw-shaft to actuate the same, a fixed bushing placed around said nut, and antifriction-balls immersed in mercury and arranged to take the thrust of said nut, substantially as described.

9. The combination of a longitudinally-movable screw-shaft, a nut or internally-threaded cylinder engaged with said screw-shaft to actuate the same and provided with an external annular flange or collar, antifriction-balls in a plurality of annular series on each side of said nut flange or collar, a fixed bushing placed around the nut, a pedestal supporting the said nut and bushing and provided with an internal annular flange below the nut, and a pipe secured in contact with the said pedestal-flange to form a reservoir for a heavy fluid to immerse the balls, substantially as described.

In testimony whereof I have hereunto set my hand in presence of two subscribing witnesses.

RICHARD S. GILLESPIE.

Witnesses:

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JAS. T. SENTELTON.