

O. JUNGREN & F. W. BENTLEY.

CENTRIFUGAL GOVERNOR.

APPLICATION FILED JULY 29, 1907.

957,886.

Patented May 17, 1910.

2 SHEETS—SHEET 1.

Fig. 1.

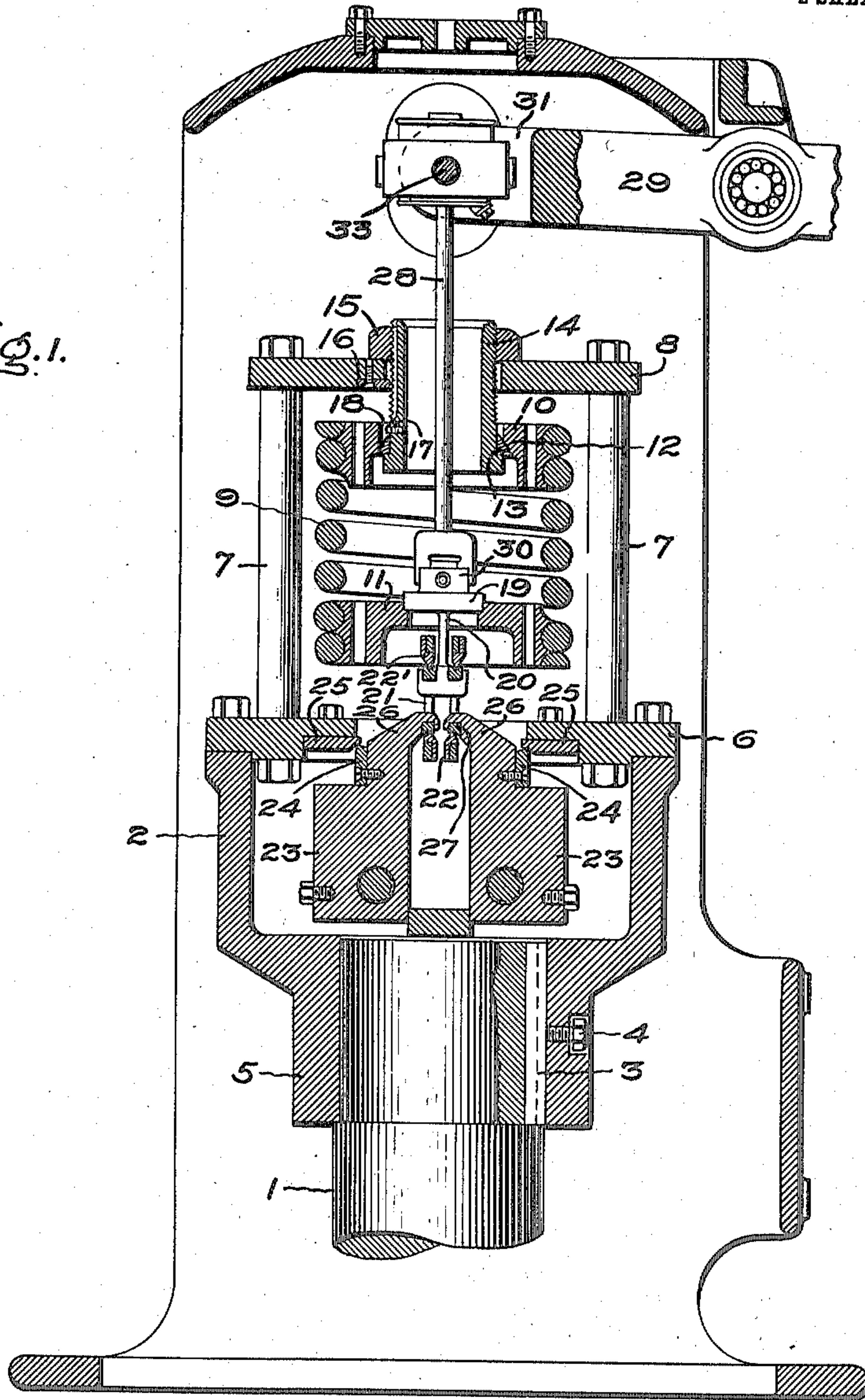
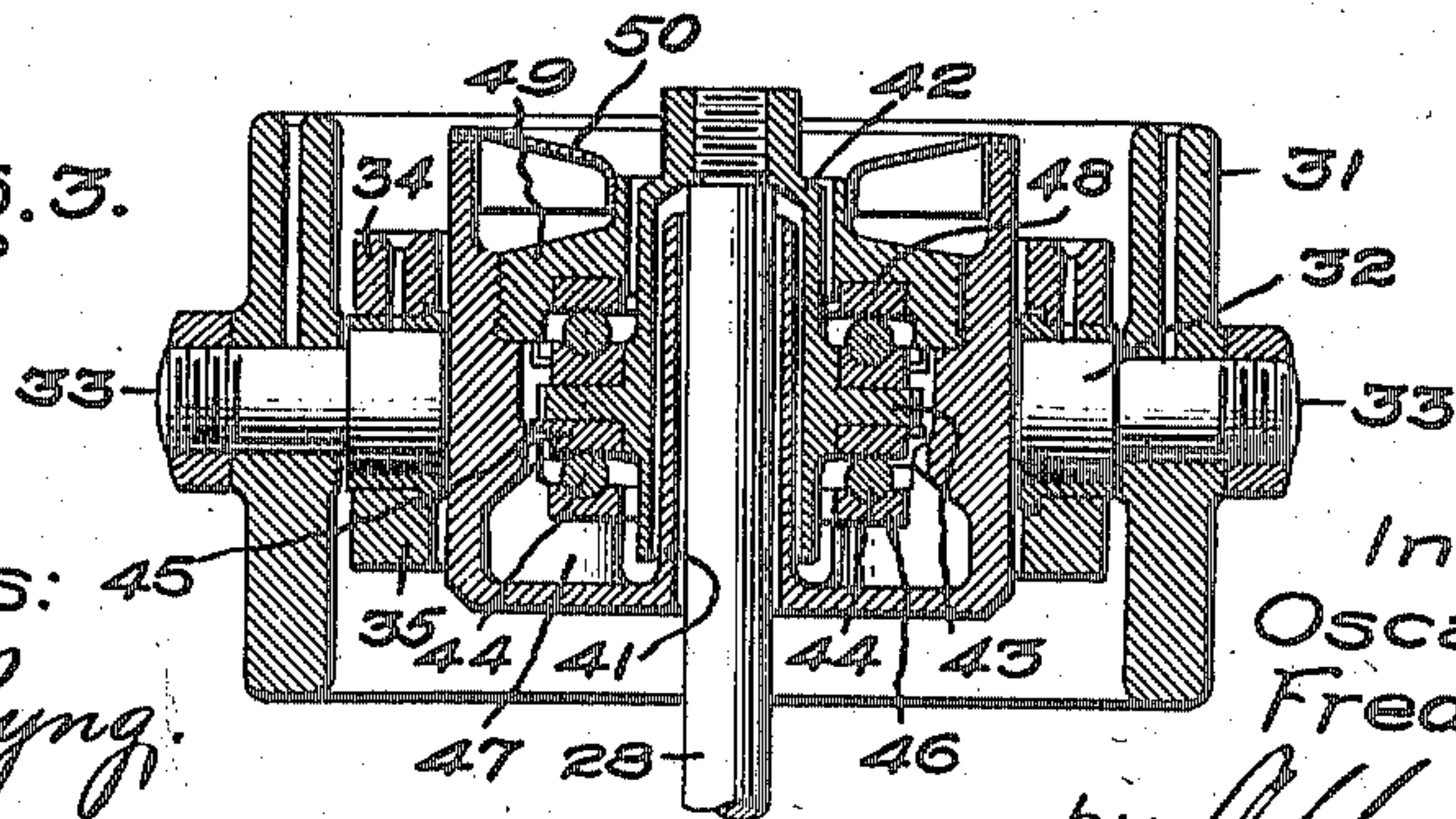


Fig. 3.



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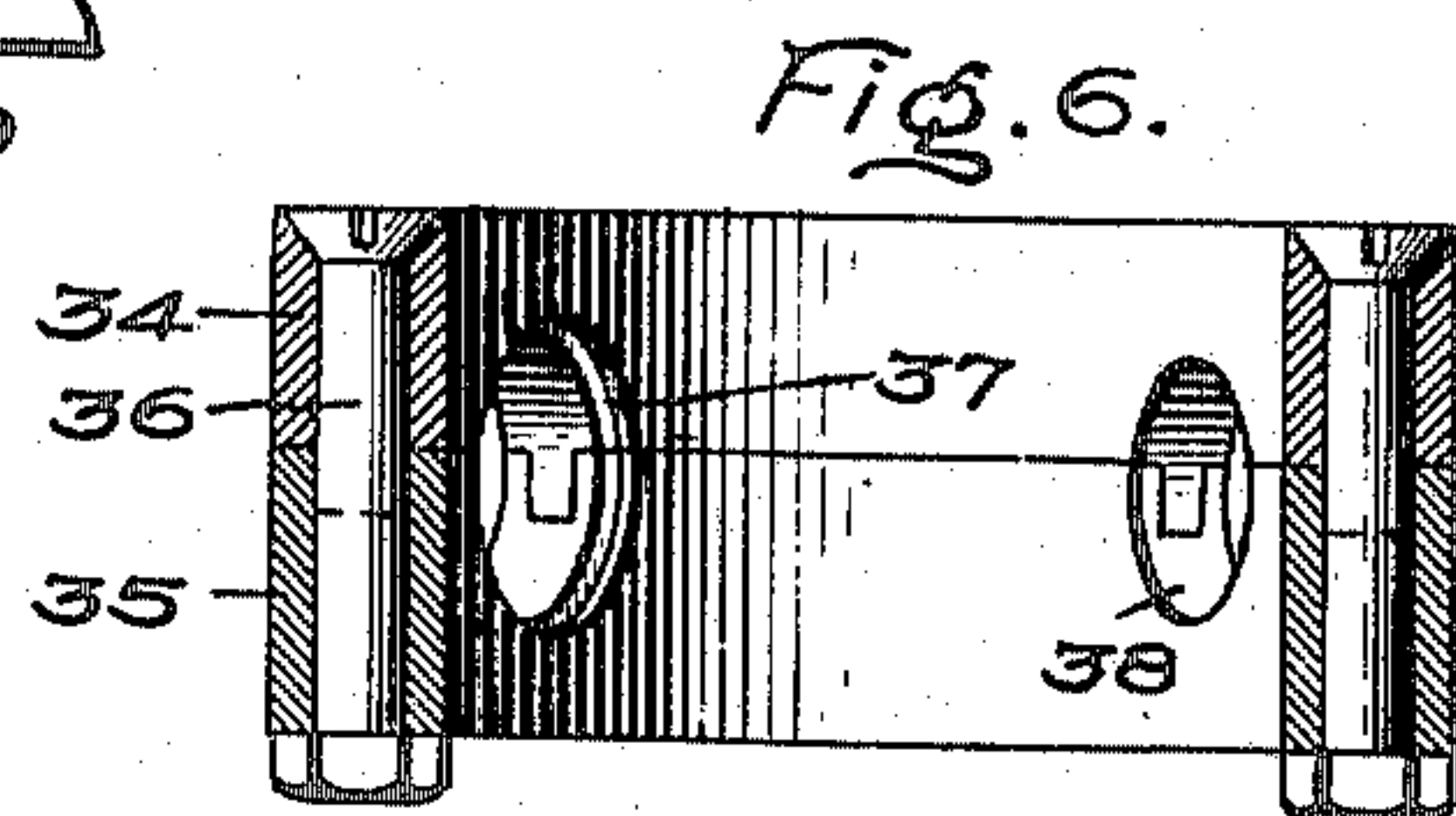
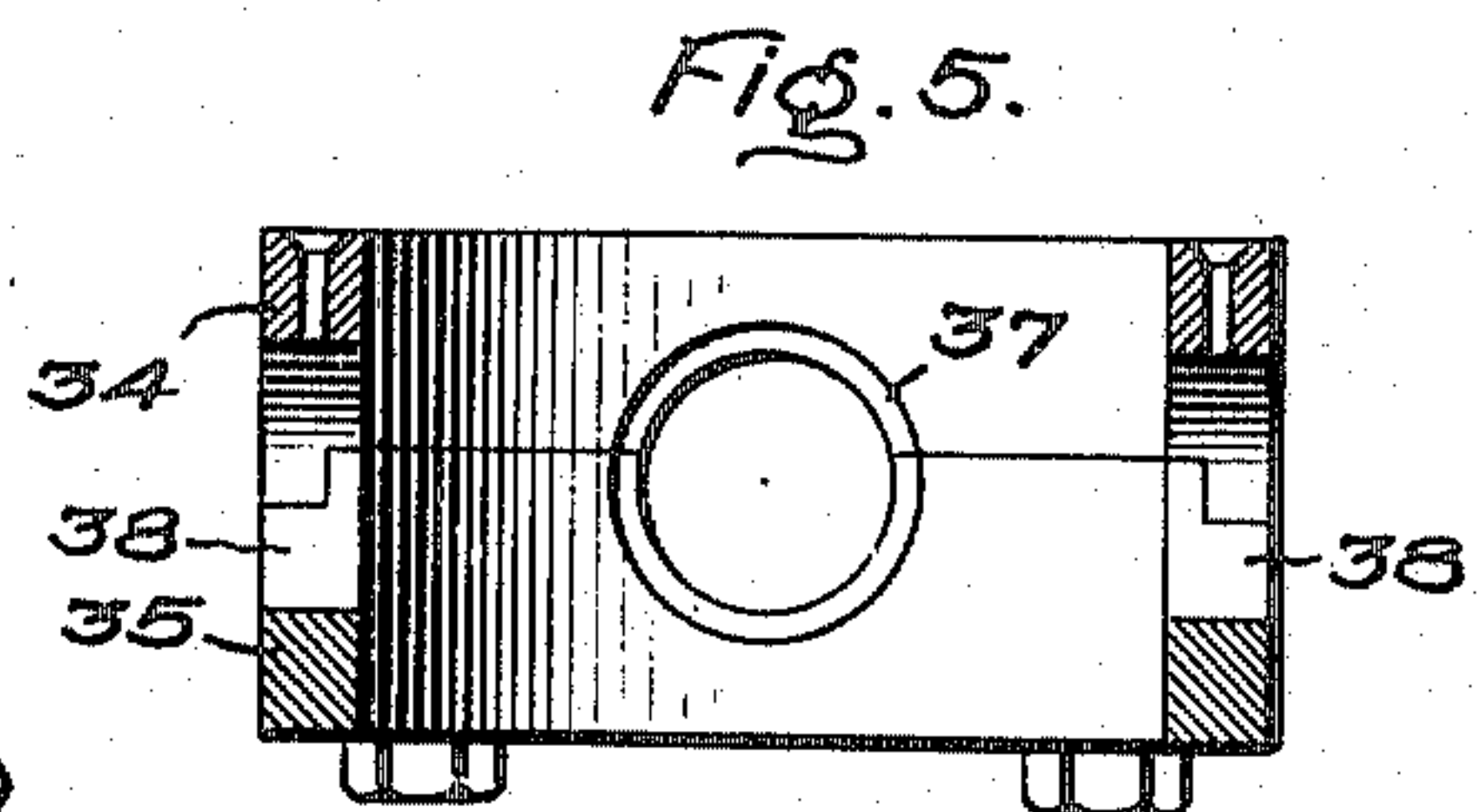
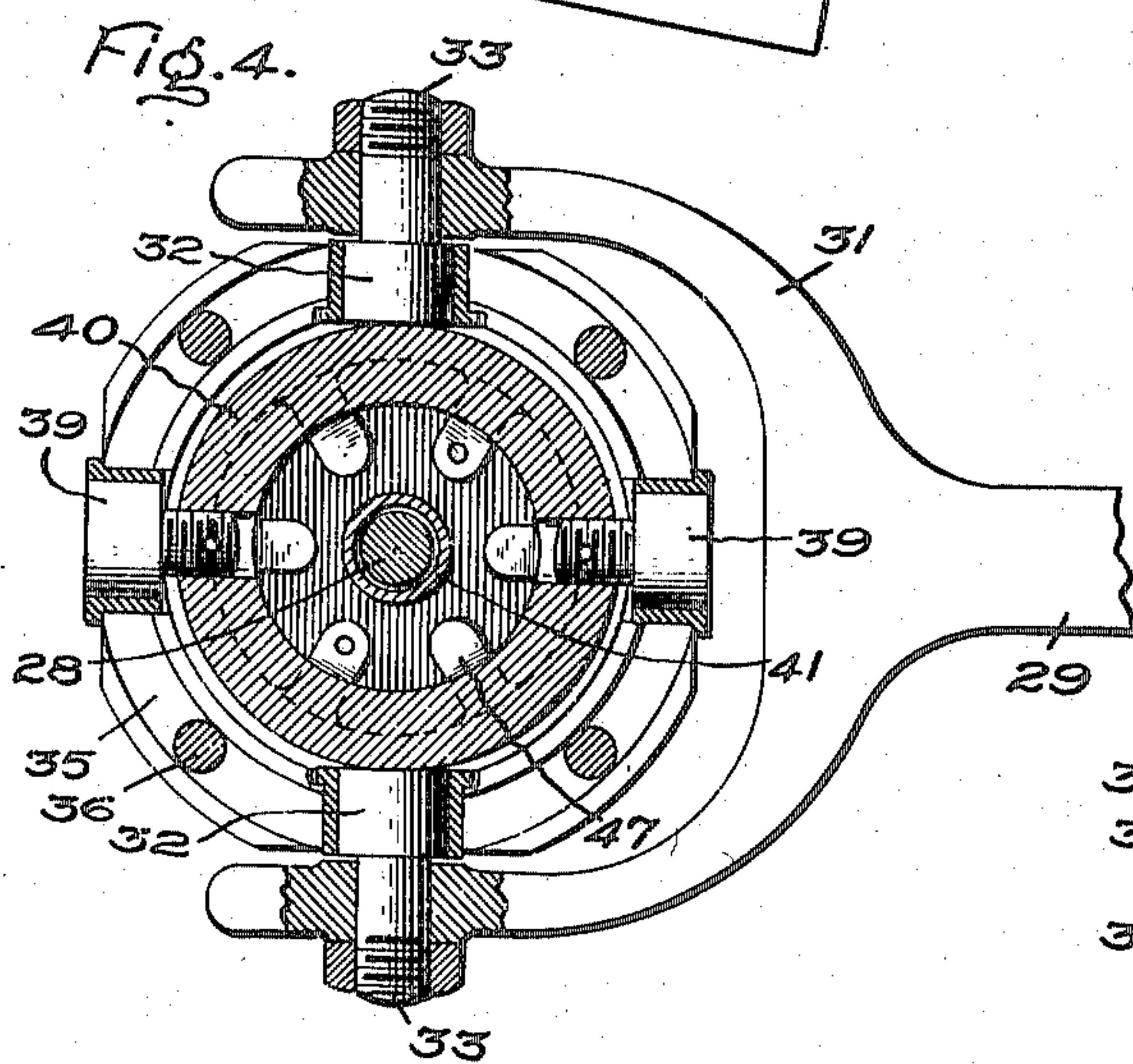
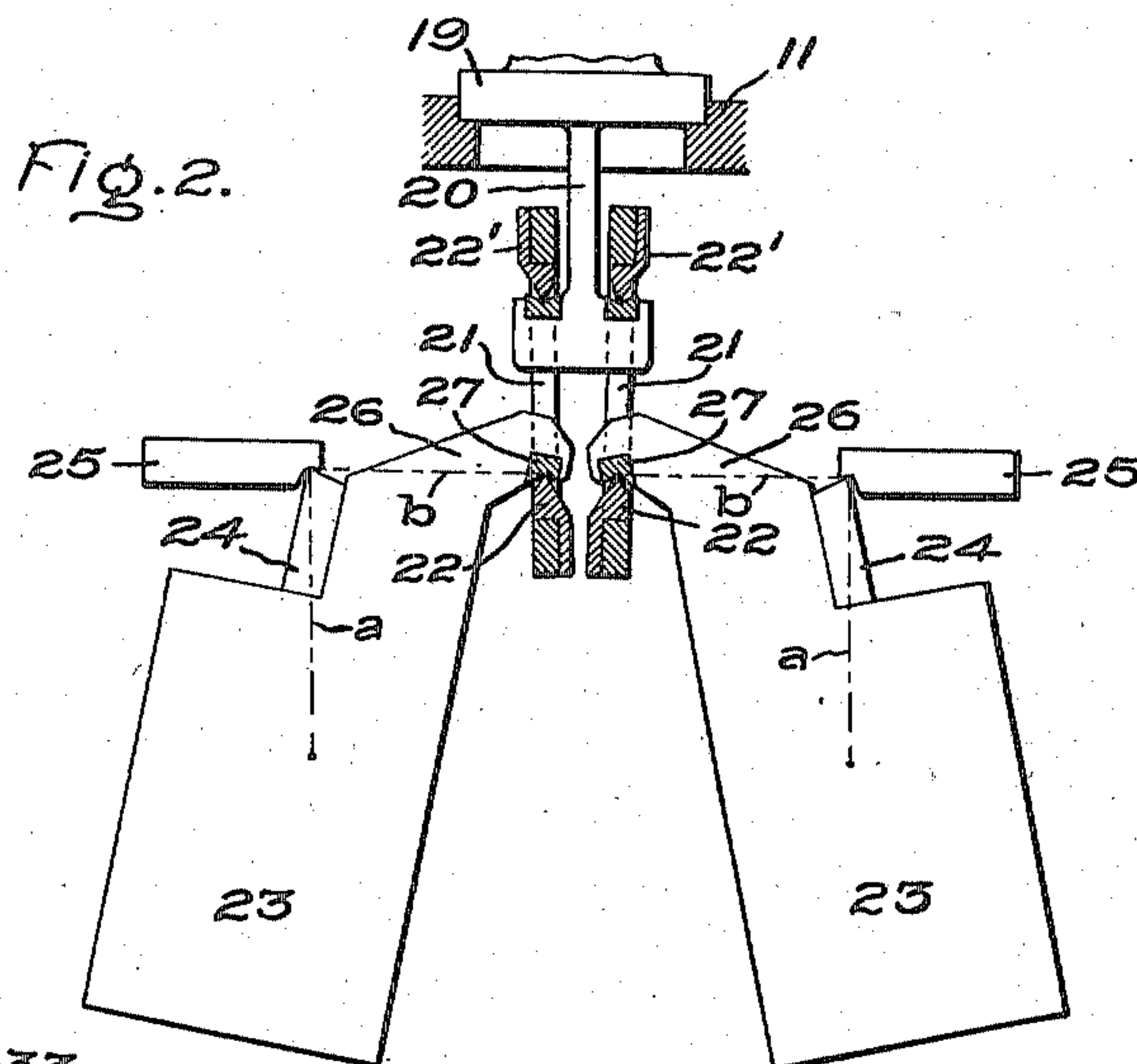
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2 SHEETS—SHEET 2.



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UNITED STATES PATENT OFFICE.

OSCAR JUNGREN AND FRED W. BENTLEY, OF SCHENECTADY, NEW YORK, ASSIGNORS
TO GENERAL ELECTRIC COMPANY, A CORPORATION OF NEW YORK.

CENTRIFUGAL GOVERNOR.

957,886.

Specification of Letters Patent.

Patented May 17, 1910.

Application filed July 29, 1907. Serial No. 385,961.

To all whom it may concern:

Be it known that we, OSCAR JUNGREN and FRED W. BENTLEY, citizens of the United States, residing at Schenectady, county of Schenectady, State of New York, have invented certain new and useful Improvements in Centrifugal Governors, of which the following is a specification.

This invention relates to devices for regulating the speed of a steam turbine or other elastic fluid engine by automatically controlling the supply of such elastic fluid.

The invention is an improvement upon the governor previously patented to Oscar Junggren, Patent No. 778,249, and consists in certain modified details of construction which tend to give a more sensitive response to speed changes, and a greater freedom of movement of the parts; besides insuring safety from accident in case of breakage.

The novel features are hereinafter set forth at length and are particularly pointed out in the claims.

In the accompanying drawings, Figure 1 is a vertical sectional view of a governor embodying our invention; Fig. 2 is a detail view illustrating the action of the weights; Fig. 3 is a cross section of the combined swivel and universal joint between the connection rod and the governor beam; Fig. 4 is a sectional plan view of the same with the ball bearings removed; Figs. 5 and 6 are cross sections of the gimbal ring.

On the upper end of an upright shaft 1, driven by the turbine or other engine, is mounted a frame 2 secured in place by a key 3 which is fastened by a set-screw 4 tapped into the hub 5 of said frame. We prefer to make this frame in the shape of a pot having cylindrical walls and partially closed by an annular lid 6, on which are erected a plurality of columns 7 which support an annular top plate 8.

Between the columns is located a strong tension spring 9 concentric with the axis of the shaft 1. Screw-threaded plugs 10, 11 are screwed into its upper and lower ends. The upper plug 10 is counter-bored from below, and the resulting shoulder 12 has a spherical surface to cooperate with a hardened steel spherical-faced collar 13 suitably mounted on a screw-threaded sleeve 14 which extends up through the annular top-plate 8 and meshes with the tension-adjust-

ing nut 15 resting on said plate. A key 16 is attached to said top-plate and engages with a longitudinal groove in said sleeve to prevent it from rotating relatively to the frame. A stud 17 in said sleeve engages with a longitudinal groove 18 in the spring plug 10 to prevent relative rotation between said sleeve and plug. The lower spring-plug 11 supports a centrally disposed block 19 from which a T-shaped hanger 20 depends through a hole in said plug. On the arms of the hanger are suspended links 21, which are provided at each end with knife-edge bearings. For convenience of repair and removal, these knife-edges are made removable from the links, as shown at 22, 22' in Fig. 1.

The governor weights 23 have knife-edge fulcrum blocks 24 which rest against the under side of fulcrum plates 25 secured to the pot-lid 6. The weights have upwardly projecting hooks or arms 26 provided with bearing blocks 27 which engage the knife-edges 22 at the lower ends of the links 21.

The bearing blocks 27 are located at such a distance above the fulcrum blocks 24 that when the weights have swung out to their normal running angles, as shown in Fig. 2, the knife-edges 24 on the fulcrum blocks and the knife-edges 22 on the lower ends of the links are all in a horizontal line. In this position also the centers of gravity of the weights stand in the same vertical planes as the knife-edges 24. Under these conditions any movement of the weights in either direction causes a shortening of the vertical distance a of the centers of gravity below the knife-edges 24, and at the same time there occurs a shortening of the horizontal distance b of the knife-edges 22 from the knife-edges 24. Since these distances a b are at right angles to each other, the shortening of one of them bears a constant ratio to the shortening of the other, irrespective of the degree of angular movement of the weights and their arms: *i. e.* $\frac{a}{b} = \text{constant}$. In other words, the leverage through which the weights act upon the spring is constant, and as the tension of the spring is constant the movement of the lower spring plug is exactly proportional to the changes in the centrifugal force exerted by the weights, due to changes in speed. These movements of

the spring plug are communicated by means of a connection rod 28 to the governor beam 29. The lower end of the rod is connected by a universal joint 30 to the block 19. The rod passes up through the sleeve 14 and its upper end is swiveled to the beam by means of a device which also includes a universal joint, so that perfect freedom of movement is insured. The construction which we prefer to use is shown in Figs. 3 to 6 inclusive.

The governor-beam has a fork 31 in which are secured pivots 32 preferably made with small shanks 33 inserted through the arms of the fork from the inside to prevent their working loose and falling out. On said pivots is hung a gimbal ring, which is preferably made in upper and lower halves 34, 35 rabbeted together and secured by screws 36. The ring has diametrically opposite bearings 37 for the pivots 32, and at right angles thereto the diametrically opposite bearings 38 for the trunnions 39 which are attached to the swivel casing 40. The gimbal ring is made in halves to enable it to be applied to the pivots and trunnions after they have been put in place in the fork and the casing. Said casing is a cylindrical cup-shaped receptacle having a central hole to permit the rod 28 to pass up through it. The casing has an upwardly projecting sleeve 41 concentric with the rod to prevent the escape of lubricant from said casing.

On the upper end of the rod 28 is secured a petticoat 42 which drops down over the sleeve 41 and has a circumferential flange 43 in the plane of the pivots 32 and trunnions 39. Above and below said flange are ball bearings comprising balls 44 running in raceways consisting of rings 45 located on the upper and lower sides of said flange, a bottom ring 46 resting on supporting lugs 47 in the casing 40, and a top ring 48 held in an annular plug 49 screwed into the top of the casing. A cover 50 keeps out dust and other foreign matter. These ball bearings enable the rod to rotate easily while the gimbal ring insures freedom of movement of the governor beam without danger of binding.

In accordance with the provisions of the patent statutes, we have described the principle of operation of our invention, together with the apparatus which we now consider to represent the best embodiment thereof; but we desire to have it understood that the apparatus shown is only illustrative, and that the invention can be carried out by other means.

What we claim as new and desire to secure by Letters Patent of the United States, is,—

1. A weight for a centrifugal governor in which the line joining the fulcrum with the center of gravity is at right angles to the line joining the fulcrum with the point at which the weight exerts its effort.

2. A weight for a centrifugal governor in which there is a constant ratio between the vertical distance of the center of gravity from the fulcrum and the horizontal distance from said fulcrum of the point at which the weight exerts its effort.

3. A centrifugal governor comprising a spring and weights and means whereby said weights exert a constant leverage on said spring at all points in their movement so that the effective movement of the governor is exactly proportional to changes in centrifugal force due to changes in speed.

4. A centrifugal governor which rotates about a given axis, comprising a frame, an axially arranged spring, pivoted weights located on opposite sides of the axis, knife-edge pivots between the weights and the frame, and means connecting the weights with the spring, there being knife-edge pivots between the weights and said means, and said pivots and weights being so constructed and arranged that the line joining a frame pivot with the center of gravity of the adjacent weight is at right angles to the line joining said frame pivot and the pivot between the weight and said means.

5. A centrifugal governor comprising a rotatable shaft, a frame fixed on said shaft, a spring, an annular plug screwed into the end of the spring, a supporting member projecting from the frame into the opening in the plug, and a spherical joint between the plug and the supporting member.

6. A centrifugal governor comprising a spring, an annular plug screwed into said spring and having an internal spherical shoulder, a sleeve passing through said plug, a spherical faced collar on said sleeve co-operating with the shoulder on the plug and a connection extending outwardly from the spring through said sleeve and plug.

7. The combination with a governor beam, of a rotatable rod, and a combined swivel and universal joint connecting the rod and beam, said joint including a member universally mounted in the beam, and a second member carried by the rod that is rotatably mounted in the first member.

8. The combination with a governor beam, of a rotatable rod, a gimbal joint supported by said beam, and a ball-bearing swivel for the rod in the same plane as the pivots of the gimbal.

9. The combination with a governor beam, of a gimbal ring pivoted to said beam, a swivel casing pivoted in said ring, a rotatable rod concentric with the ring and casing, and ball-bearings in said casing supporting the rod.

10. The combination with a forked governor beam, of a gimbal ring made in upper and lower halves, pivots for said ring having small shanks inserted into the arms of the fork from the inside, and a swivel casing

having trunnions, said pivots and trunnions being received in bearings in the halves of said ring.

11. The combination with a governor beam, of a rotatable rod, a casing having an upright sleeve concentric with said rod, a petticoat on said rod dropping over said sleeve, a flange on said petticoat, ball-races on said flange, ball-races supported in said casing, and balls in said races.

12. A centrifugal governor comprising a frame, a spring, a plug screwed into one end of the spring, a member on the frame by which the plug and the attached end of the spring are supported, a spherical joint between the plug and the supporting member, weights pivoted on the frame, and means connecting the weights with the other end of the spring, said weights and connections being so constructed and arranged that the line joining the fulcrum or pivot of a weight with its center of gravity is at right angles to the line joining said fulcrum with the point at which the weight exerts its effect on said means.

13. A centrifugal governor comprising a rotatable shaft, a frame mounted on the shaft, an axially arranged helical spring, a plug mounted in one end of the spring and provided with a central opening, a sleeve mounted on the frame and projecting into said opening, there being a spherical joint between the plug and the sleeve, a second plug mounted in the other end of the spring, weights pivoted on the frame, means connecting the weights with the second plug, a governor beam, an axially arranged rod connecting the second plug and the beam, that passes outwardly through the sleeve to said beam, a universal joint between one end of the rod and the plug, and a combined universal and swivel joint between the other end of the rod and the beam.

In witness whereof, we have hereunto set our hands this 26th day of July, 1907.

OSCAR JUNGREN.
FRED W. BENTLEY.

Witnesses:

BENJAMIN B. HULL,
HELEN ORFORD.