No. 763,131. PATENTED JUNE 21, 1904.

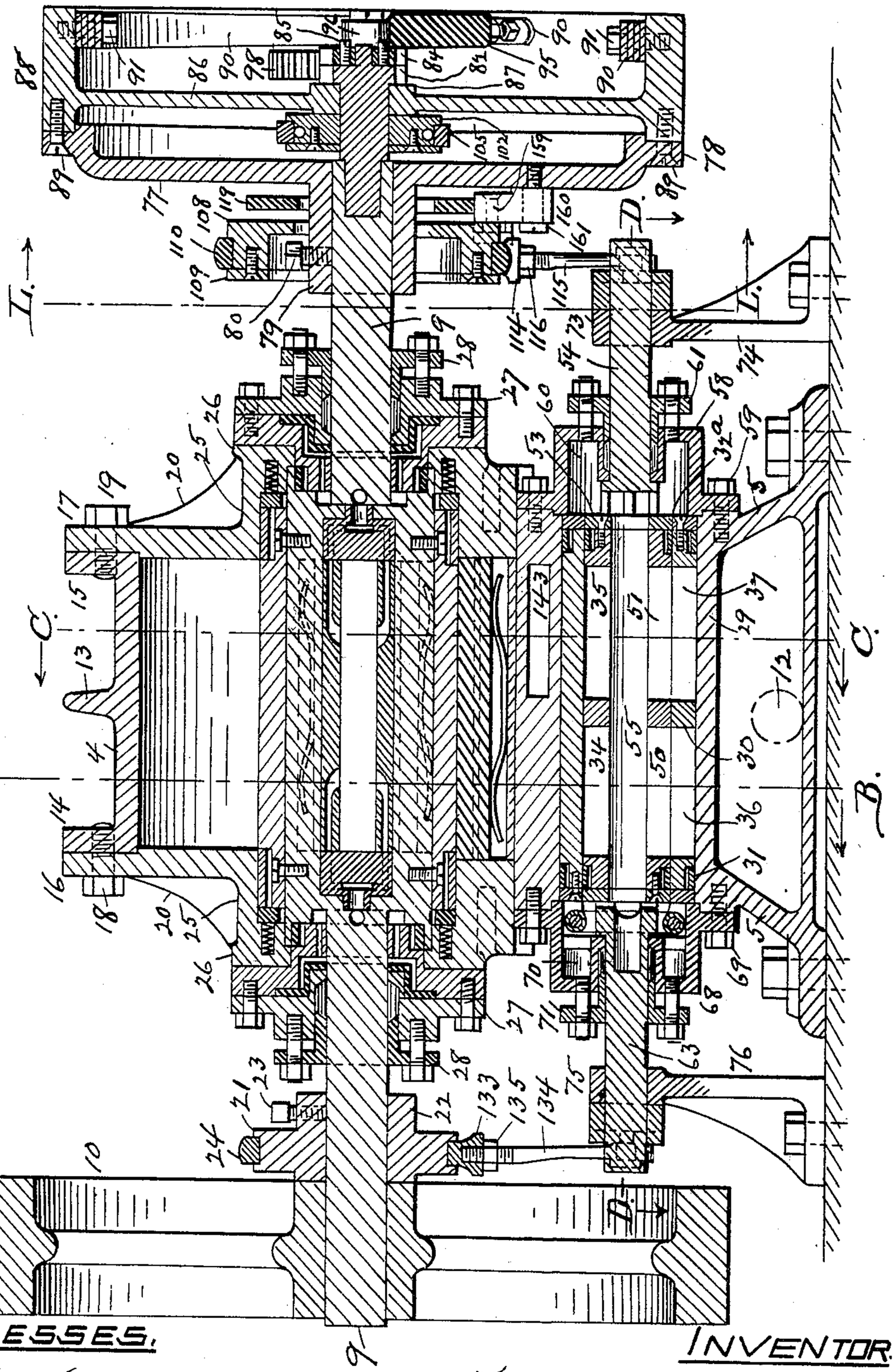
F. J. WATERS.

SHIFTING ECCENTRIC VALVE GEAR.

APPLICATION FILED AUG. 31, 1903.

NO MODEL. 3 SHEETS—SHEET 1.

FIG. 1.



WITNESSES.

C. J. Flannigan

Annie E. Perce.

INVENTOR.

Frank J. Waters

By Warren R. Perce

Attorney.

No. 763,131. PATENTED JUNE 21, 1904.

F. J. WATERS.

SHIFTING ECCENTRIC VALVE GEAR.

APPLICATION FILED AUG. 31, 1903.

NO MODEL. 3 SHEETS—SHEET 2.

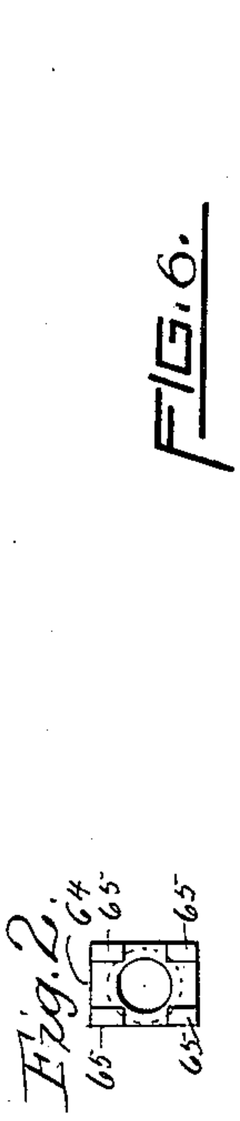


FIG. 2.

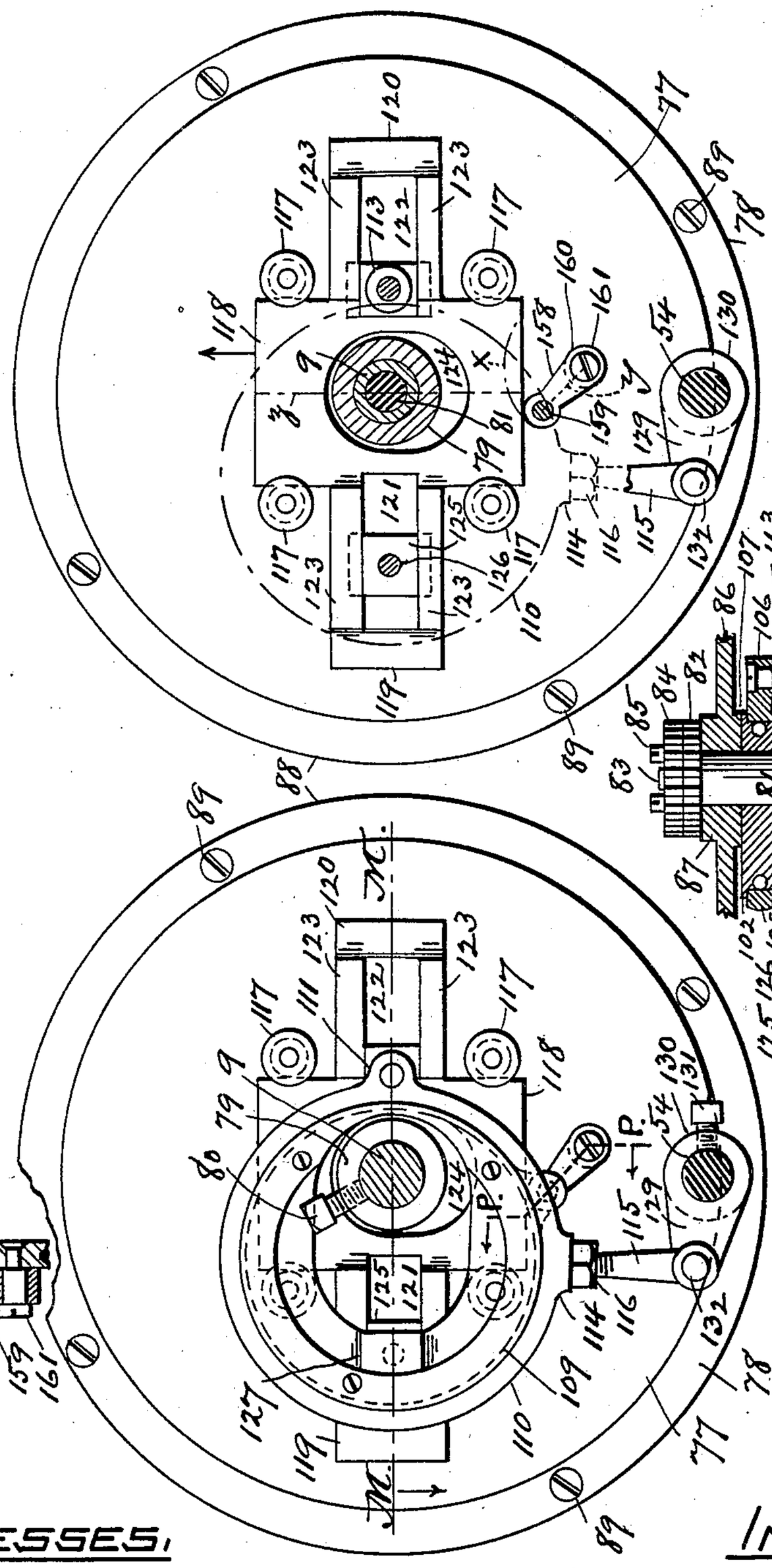


FIG. 6.

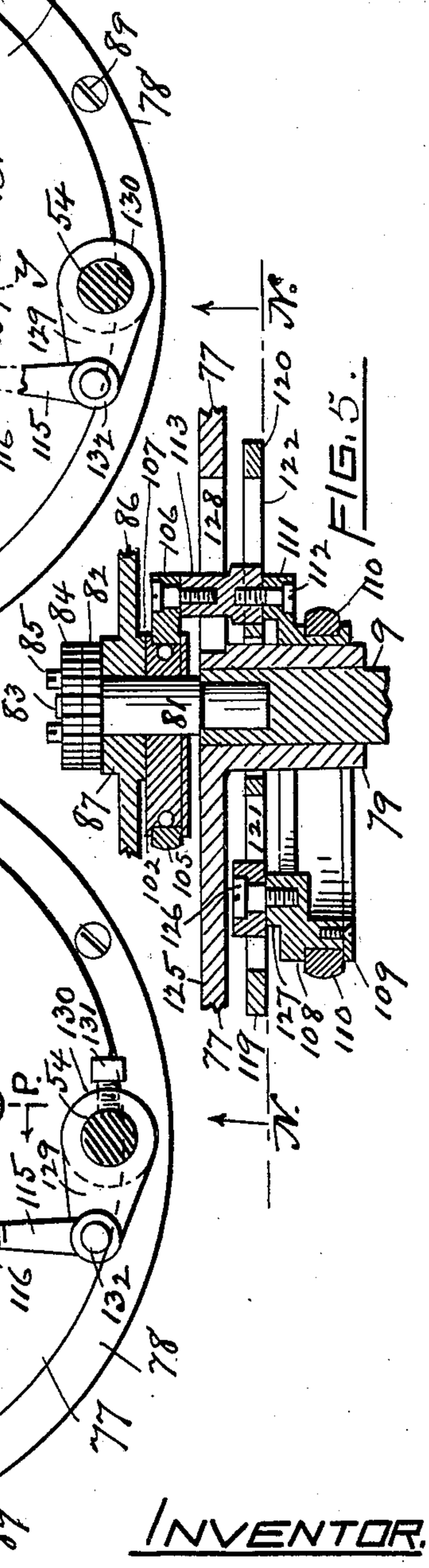


FIG. 5.

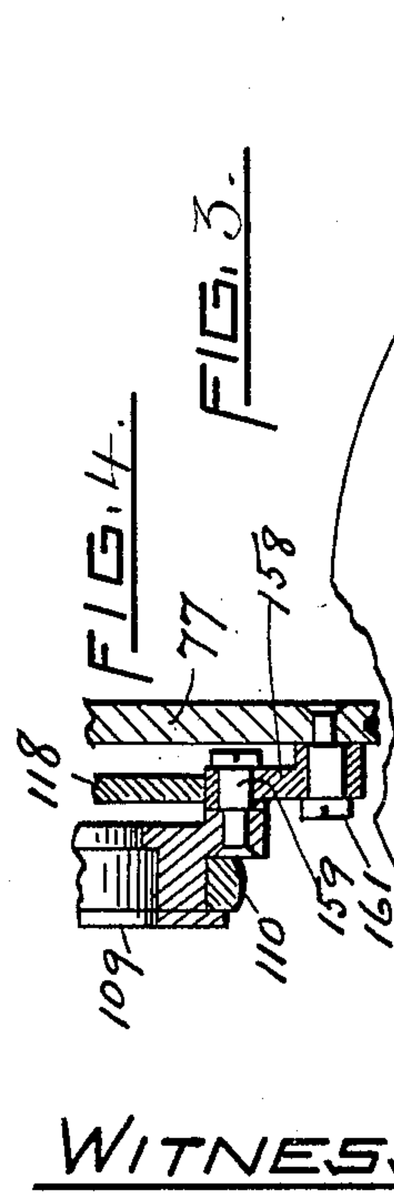


FIG. 4.

FIG. 3.

WITNESSES,

C. F. Dannigan.

Annie E. Perkins

INVENTOR.

Frank J. Waters

By Warren R. Pierce

Attorney.

No. 763,131. PATENTED JUNE 21, 1904.

F. J. WATERS.

SHIFTING ECCENTRIC VALVE GEAR.

APPLICATION FILED AUG. 31, 1903.

NO MODEL. 3 SHEETS—SHEET 3.

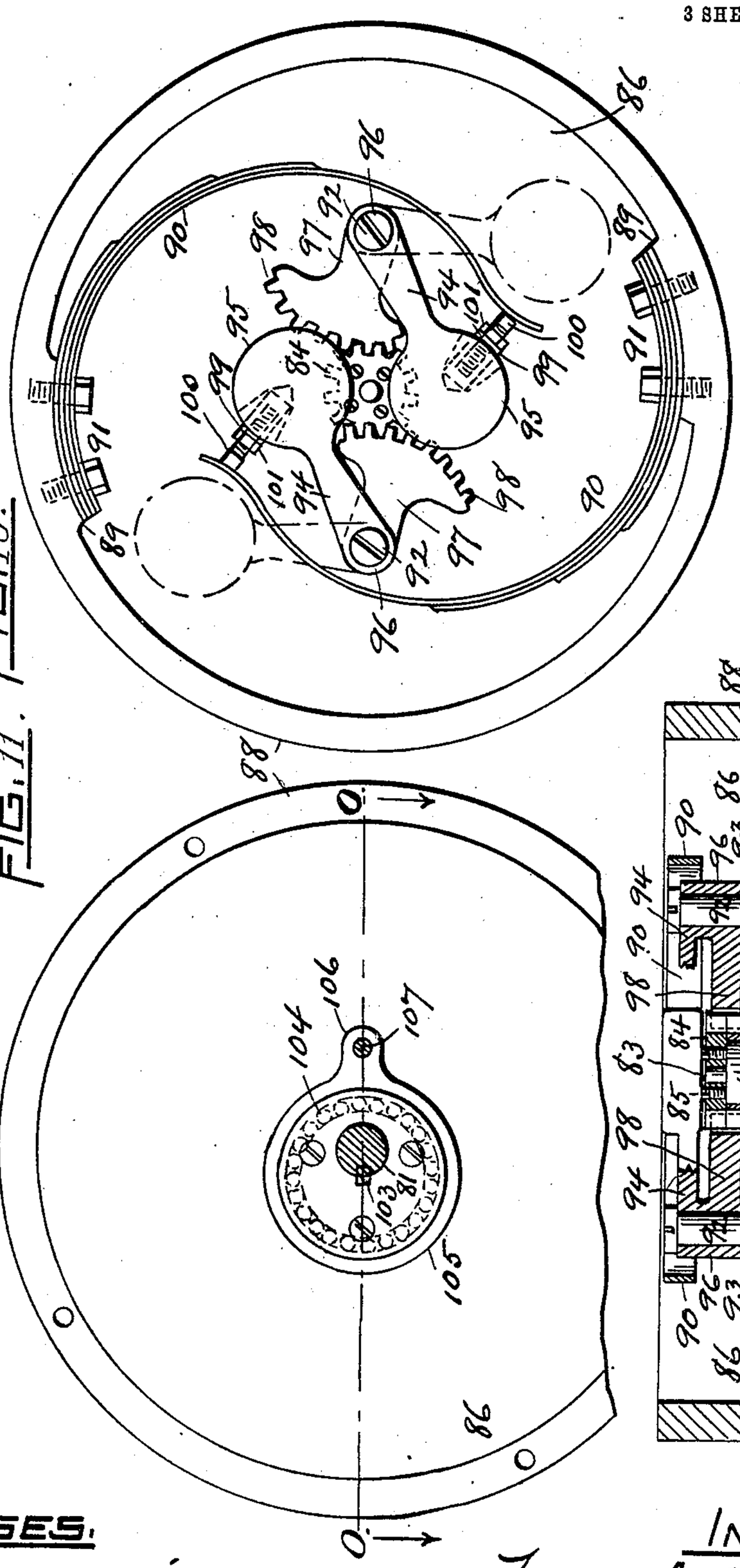


FIG. 9.

FIG. 10.

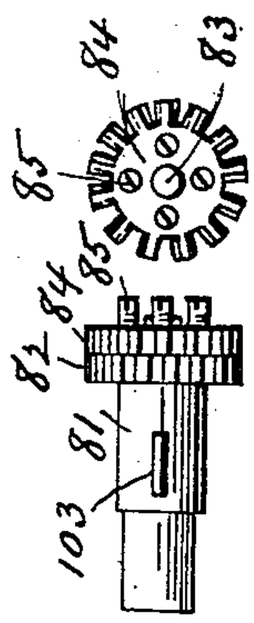


FIG. 11.

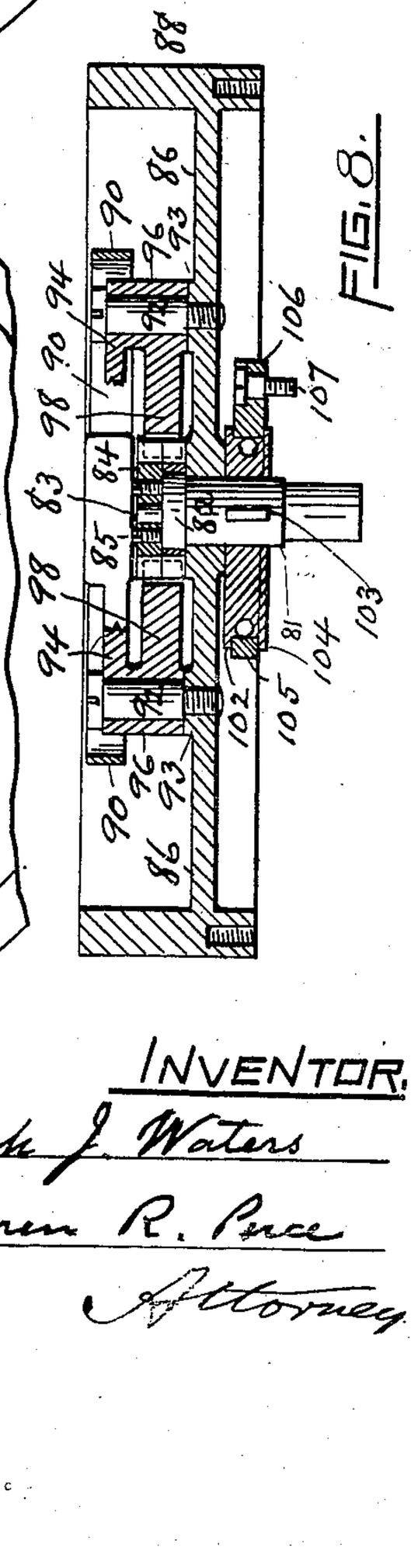


FIG. 8.

FIG. 7.

WITNESSES:

C. J. Hannigan.

Annie E. Perce.

INVENTOR.

Frank J. Waters

By Warren R. Perce

Attorney.

No. 763,131. Patented June 21, 1904.

UNITED STATES PATENT OFFICE.

FRANK J. WATERS, OF PROVIDENCE, RHODE ISLAND, ASSIGNOR OF TWO-THIRDS TO WILLIS A. DREW, FRANK E. FARNHAM, ARTHUR C. FARNHAM, AND ALFRED HARRISON, OF PROVIDENCE, RHODE ISLAND, JAMES GEE, OF CRANSTON, RHODE ISLAND, AND HENRY J. PAGE, OF WARWICK, RHODE ISLAND.

SHIFTING ECCENTRIC VALVE-GEAR.

SPECIFICATION forming part of Letters Patent No. 763,131, dated June 21, 1904.

Application filed August 31, 1903. Serial No. 171,456. (No model.)

To all whom it may concern:

Be it known that I, FRANK J. WATERS, a citizen of the United States, residing at Providence, in the county of Providence and State of Rhode Island, have invented certain new and useful Improvements in Shifting Eccentric Valve-Gears, of which the following is a specification, reference being had therein to the accompanying drawings.

Like numerals indicate like parts.

Figure 1 is a central longitudinal section of a steam-engine containing my invention. Fig. 2 is an end elevation of the head of one of the shafts of the cut-off valve. Fig. 3 is an elevation of the inner side of the regulator as seen on line L L of Fig. 1. Fig. 4 is a detail view. Fig. 5 is a sectional view of the same as seen on line M M of Fig. 3. Fig. 6 is an elevation of the same as seen on line N N of Fig. 5. Fig. 7 is an elevation of the rear of the web or central disk of the regulator and mechanism. Fig. 8 is a sectional view of the regulator as seen on line O O of Fig. 7. Fig. 9 is a view in elevation of the front side of the regulator and the mechanism thereon. Fig. 10 is a view of a gear used in the regulator mechanism. Fig. 11 is a side elevation of the same.

My invention relates to a shifting eccentric valve-gear for regulating the movements of a cut-off valve for steam-engines; and it consists of the novel construction and combination of the several parts, as hereinafter described, and specifically set forth in the claims.

This valve-gear is used in connection with a certain cut-off valve which constitutes the subject-matter of my pending application for Letters Patent of the United States, Serial No. 159,937.

In the drawings the base of the engine is shown at 1, upon which rests an inclosed chamber or box 2. A main shaft 9 is rotatably mounted in the ends of the cylinder, and a fly-wheel 10 is splined or otherwise fastened thereon. On the main shaft 9, near the fly-wheel 10, is mounted an eccentric disk 21, which has an integral hub 22. A set-screw 23, passing through the hub 22, has its inner end in contact with the main shaft 9 and fastens the eccentric disk 21 in position. The periphery of the disk 21 is grooved, and a strap 24 is loosely mounted therein.

In the chamber 2 and integral therewith is a valve-seat 29, substantially tubular in form and shown in Fig. 1. In the ported tubular valve-seat is mounted a tubular valve 30, capable of a limited oscillation therein.

A split spring-ring 31 surrounds each reduced end of the valve 30 and constitues a packing. A solid ring is fastened by screws to one end of the valve 30 and serves to hold the split spring-ring 31 from outward lateral displacement, and another solid ring 32^a is fastened by screws to the opposite end of the valve 30 to hold the split spring-ring 31 there from outward displacement.

The valve 30 has four ports 34, 35, 36, and 37.

In the bore of the tubular valve 30 is seated the tubular cut-off valve 47, which has four diametrically arranged ports. At one end of the valve 47 is a solid ring 53, having a central circular aperture of the same diameter as the bore 55 of the cut-off valve 47. Said ring 53 is of such a diameter as to allow it to fit within the ring 32^a of the valve 30, as seen in Fig. 1. The ring 53 is integral with a valve-shaft 54, which has also an integral flange. Equispaced integral bars extend between the ring 53 and flange. The ring 53 of the valve-shaft 54 is secured to the ends of the valve 47 by screws. A sleeve or cap 58 is fastened by bolts 59 to the chamber 5, as seen in Fig. 1, and has a stuffing-box 60, through which the shaft 54 passes. A gland 61 compresses the packing 62 in the stuffing-box 60, as shown in Fig. 1. At the opposite end of the cut-off valve 47 is the valve-shaft 63, having a head 64 rectangular in cross-section. It has a concentric circular socket. It has equispaced projections at the corners of said head, and the space between said projections is cut in a semicircular shape, as seen

in Fig. 1. The ends of said projections rest against a ring which serves to keep the adjacent ring from lateral displacement and which is secured by screws 67 to the adjacent end of the valve 47, as shown in Fig. 1. A sleeve-cap 68 is fastened by bolts 69 to the chamber 5, as seen in Fig. 1, and has a stuffing-box 70, through which the valve-shaft 63 passes. A gland 71 compresses the packing 72 in the stuffing-box 70, as shown in Fig. 1.

The valve-shaft 54 is rotatably mounted in a bearing 73 upon the top of the standard 74, and the valve-shaft 63 is rotatably mounted in a bearing 75 upon the top of the standard 76.

On the end of the main shaft 9 of the engine, opposite to that end where the fly-wheel 10 is mounted, is what I comprehensively call the "regulator." This consists of a circular cupped disk 77, having a circumferential flange 78 and a hub 79, by the latter of which it is mounted on the main shaft 9, and a set-screw 80, passing through said hub, fastens it in position.

A short shaft 81, which may be called the "regulator-shaft," is concentrically reduced at its inner end and is there loosely received into an axially-directed socket in the adjacent end of the main shaft 9, as seen in Figs. 1, 5, and 8. At the outer end of the regulator-shaft 81 there is the integral pinion-gear 82 and a central integral spindle 83. A gear 84 has a central aperture, by which it is mounted on the spindle 83 of the regulator-shaft 81. The gear 84 is of the same diameter as the gear 82 and has the same number of teeth as the gear 84 and of the same size. The shaft 81 and the gears 82 and 84 are separately shown in Figs. 10 and 11. The gear 84 is fastened to the gear 82 by screws 85, which pass through slightly-elongated holes of the gear 84.

A circular disk or web 86 has a hub 87, by which it is mounted loosely on the regulator-shaft 81, and said disk or web has an integral flange 88, which constitutes the rim of the regulator. Screws 89 fasten the circumferential flange 78 of the cupped disk 77 to the inner edge of the flange or rim 88 of the web 86, as shown in Fig. 1. On the inner periphery of the rim 88 are the two integral bosses 89. (Shown in Fig. 9.) On each boss 89 is a curved leaf-spring 90, which is bolted at 91 to the boss 89.

There are two weighted arms mounted on two screws or studs 92, which pass through bosses 93 of the web or disk 86. These arms are designated as 94, and each terminates at its outer end with the ball or weight 95 and at its inner end in a hub 96, through which the screw or stud 92 is received. Integral with each hub 96 is an arm 97, on the outer end of which is a sector-gear 98. The two sector-gears 98 engage with the pinion-gears 82 and 84, as seen in Figs. 1, 8, and 9.

As shown in Fig. 9, each ball or weight 95 has a radial bore in which a screw-threaded tube 99 is inserted loosely. A screw-threaded bearing-pin 100 is engaged in said tube 99 and is held in its adjusted position therein by means of a check-nut 101. The free end of each leaf-spring 90 rests against the outer end of one of these bearing-pins 100.

An eccentric disk 102 is mounted fast on the regulator-shaft 81 by means of a key or spline 103 and abuts the hub 87 of the web or disk 86 on the rear thereof. A circular face-plate 104 is secured by screws to the eccentric disk 102 on the rear side thereof. The disk 102 has a circumferential flange, as seen in Figs. 1 and 8, and a strap 105 is loosely mounted on the rim of the eccentric disk 102 between said flange and the face-plate 104. The strap 105 has a radial projection 106 with an aperture in it, through which the screw 107 passes.

Between the eccentric disk 102 and the strap 105, in a circumferential channel of the peripheral groove of said disk, are placed ball-bearings. (Indicated by solid lines in Figs. 1, 5, and 8, and by dotted lines in Fig. 7.)

On the exposed side of the cupped disk 77, on the hub 79 thereof, is fastened and mounted eccentrically the flanged ring 108. A ring 109 is secured to the ring 108 by screws, and a strap 110 is mounted loosely on the eccentric ring 108 between the flange of the latter and the ring 109. An arm 111 extends at a right angle from one side of the eccentric ring 108, as best shown in Fig. 5, and has a longitudinal tap in which the screw 112 is engaged. A bar 113 has a screw-hole tapped in each end, one of which holes receives the screw 107 and the other of which holes receives the screw 112. The ring 108 has also a boss 114, which is tapped to receive the link bar 115, (see Fig. 3,) the latter being held in position by the check-nut 116.

On the disk 77 are rotatably mounted four friction-rollers 117, arranged as shown in Fig. 6. A rectangular sliding plate 118 is mounted on the disk 77 with its edges in contact with said friction-rollers and is capable of a slight reciprocating movement. The sliding plate 118 has two oppositely-directed extension-pieces 119 120. The extension-piece 119 has a rectangular opening or aperture 121 therein, and the extension-piece 120 has a rectangular opening or aperture 122 therein, and on two opposite sides of said openings 121 122 are the guides or ways 123, parallel to and slightly distant from the plane of the sliding plate 118. The plate has also an elliptical or oblong opening or aperture 124, as seen in Figs. 3 and 6. The hub 79 of the disk 77 extends through this aperture 124.

A sliding block 125 moves in the aperture 121 of the extension-piece 119 of the plate 118 and has flanges which extend under the guides 123 of said extension piece 119. This block 125 is mounted on a screw-pivot 126,

which extends through a boss 127 into the ring 108, as seen in Figs. 3, 5, and 6. The bar 113 extends through the opening 122 of the extension-piece 120 of the sliding plate 118 and is provided with flanges which project under the guides 123 of the extension-piece 120 of the sliding plate 118. As seen in Fig. 5, the bar 113 also extends through an aperture 128 in the disk 77.

On the outer end of the valve-shaft 54 is a crank-arm 129, having a hub 130. A set-screw 131, passing through the hub 130, fastens the crank-arm 129 to said shaft 54. The end of the crank-arm 129 is connected with the link bar 115 by the screw-pivot 132.

From a projection 133 of the strap 24 (see Fig. 1) extends a link bar 134, which is secured by screw-threads therein and held in place by a check-nut 135. The lower end of the link bar 134 is pivotally connected with a crank-arm, which is fastened by a hub thereof on the outer end of the valve-shaft 63 and held in place by a check-nut, as seen in Fig. 1.

The means of imparting a transverse reciprocating movement to the sliding plate 118 between the friction-rollers 117 are shown in Figs. 1 and 6 and are as follows: On the eccentric ring 108, near the edge thereof, is mounted a short bar 158 on a stud or pivot 159. Said bar 158 extends from a hub 160, and through the hub 160 a screw or stud 161 extends through the disk 77. (See Fig. 4.) The steam passes into the cap 68 and thence through the semicircular steam passage-ways between the projections of the head of the valve-shaft 63. Steam also passes into the cap 58 and thence through the rectangular steam passage-ways between the bars of the flanges 53 of the valve-shaft 54, as seen in Fig. 1. Thence the steam passes into the bore of the cut-off valve 47 and thence through the ports thereof whenever allowed. The cut-off valve 47 is rotatably mounted in the bore of the tubular valve 30, and when the port of the valve 47 opens into the port 34 of the valve 30 the steam can pass into said port 34, and when the other port of the valve 47 opens into the port 35 of the valve 30 the steam can pass into said port 35. In this manner the steam can pass into the cylinder 4 and move the piston therein, as is apparent from an inspection of Fig. 1.

When the regulator is in its normal position, as in Fig. 9, the ports of the cut-off valve 47 and the tubular valve 30 oscillate into and out of registration with the ports of the cylinder alternately. As the main shaft 9 is rotated with power and the momentum of the fly-wheel 10 increases the balls or weights 95 swing outwardly from the position shown in solid lines in Fig. 9 to the position shown in said figure in dotted lines. This movement of the balls or weights 95 forces the springs 90 outwardly and increases their tension. As the balls or weights 95 thus swing outwardly they communicate motion to the sector-gears 98, with which they respectively are integral, causing said gears to move inwardly. The two sector-gears 98 thus actuated give a partial rotation to the pinion 82 84 and its connected shaft 81. The shaft 81 is loosely mounted in the hub 87 of the web 86 and is also loosely mounted in the socket in the end of the main shaft 9, Fig. 5. The eccentric disk 102, however, is fast on the shaft 81 and moves with it. As the eccentric disk 102 partially rotates when the shaft 81 is partially rotated by the centrifugal power of the balls or weights 95, the motion of said disk 102 is communicated by the strap 105 on said disk 102 to the arm 113, which is pivotally connected at 107 to the projection 106 of said strap, and thus a corresponding motion is communicated to the eccentric ring 108. As the eccentric ring 108 thus partially rotates the block 125, pivotally connected at 126 to the eccentric ring 108, slides in the ways or guides 123 and slot 121 of the extension-piece 119 of the sliding plate 118, and at the same time the bar 113, which is pivotally connected at 112 to said eccentric ring 108, equally slides in the slot 122 and ways or guides 123 of the extension-piece 120 of the sliding plate 118. The movement communicated by the partial rotation of the eccentric ring 108 to the strap 110, which is upon said ring, results, by means of the link-bar 115, in oscillating the crank 129, Fig. 3, and thus partially rocks the valve-shaft 54 and the connected cut-off valve 47. At the same time the rotation of the main shaft of the engine causes a regular and constant rotation of the eccentric disk 21 thereon, and said disk in its rotation communicates, by means of the strap 24 thereon and the link 134, a reciprocating oscillating movement to the crank 137, thus regularly rocking back and forth the valve-shaft 63. The rectangular head of said shaft loosely entering the rectangular opening which is between the bars and tubes on the end or ring of the tubular valve 30, as shown in Fig. 1, gives an oscillating movement to said tubular valve. The shafts 54 and 63 are thus rotated in the same direction until a high speed is developed; but after the high speed has been developed the shaft 54 is rotated in a direction opposite to that of the rotation of the shaft 63. The oscillation of the valve 30 is always at a rate synchronous with the rotation of the main shaft, and there is one reciprocation of said valve movement in each rotation of the main shaft, and said oscillation of the valve 30 is always to the same degree and extent; but the oscillation of the cut-off valve 47 is variable in the extent of its oscillation and synchronous with the expansive movements of the weights or balls of the regulator. It is thus seen that the cut-off valve is automatically controlled

and is adapted to act under a variable load, causing the engine to run at a uniform speed notwithstanding a variation in load.

As seen in Fig. 6, the sliding plate 118 has an oblong aperture 124 to allow a reciprocating movement of the sliding plate 118 between the friction-rollers 117. This reciprocation of the sliding plate 118 is caused by the oscillation of the bar 158. The normal position of the sliding plate 118 is that which is shown in Fig. 6; but when by the centrifugal force of the outwardly-swinging weights or balls 95 of the regulator the eccentric ring 108 has moved to a position to the right of that which is represented in Fig. 6 the bar 158 moves in the arc marked *x* in said figure and swings upon the stud or pivot 161. The consequence is that as the axial line of said bar (designated as *y* in said figure) comes into alinement with the axial line of the plate 118, marked *z* in said figure, the inner end of said bar forces the sliding plate 118 to move between the friction-rollers 117 in the direction of the arrow in said figure. When the said lines *y* and *z* come into alinement and the oscillation of said bar proceeds further, the result is that the valve-shaft 54 oscillates in a direction opposite to the direction of the oscillation of the valve-shaft 63, and such continues to be the movement as long as the axial line *y* is to the right of the axial line *z*. Hence as the ports of the cut-off valve 47 approach the ports of the tubular valve 30 the cut-off action is rapid. The return movements caused when the steam has thus been cut off or diminished in volume are as follows: The springs 90, overcoming the centrifugal force of the balls or weights 95, bring back said balls or weights toward or to the position indicated in Fig. 9 by solid lines, whereupon the sector-gears 98 turn outwardly and reverse the rotation of the pinions 82 84, and inconsequence the eccentrics 102 and 108 resume their former positions, and the valve 47 comes back to its original position in relation to the valve 30 as the engine slows down.

I claim as a novel and useful invention and desire to secure by Letters Patent—

1. In a steam-engine, the combination of a main shaft, an oscillating cut-off valve and having a valve-shaft an oscillating tubular valve in which said cut-off valve is loosely mounted, a regulator-shaft mounted loosely in an axial socket in one end of the main shaft, a regulator comprising a disk rotating with said main shaft but loosely mounted on the regulator-shaft, a pinion on the regulator-shaft, two **V**-shaped levers pivotally mounted on said disk diametrically opposite to each other, on one arm of each of which levers is a ball or weight and on the other arm of which levers is a sector-gear engageable with said pinion, two springs each of which is mounted at one end to said disk and adapted to press by its free end against said balls or weights, and means intermediate said regulator-shaft and said valve-shaft adapted to communicate movement from the former to the latter, substantially as described.

2. In a steam-engine, the combination of a main shaft, a ported tubular valve mounted in a valve-seat, a valve-shaft loosely connected at its inner end to one end of said valve, an eccentric disk fastened on and rotatable with the main shaft, a strap on said eccentric disk, a crank on the outer end of said valve-shaft, a link connection between said strap and said crank, a ported cut-off valve mounted in the first-named valve, a valve-shaft fastened on the end of said cut-off valve, a disk having a hub which is fastened on the main shaft, a strap on the last-named eccentric disk, a crank on the last-named valve-shaft, a link connection between said last-named strap and said last-named crank, a regulator-shaft loosely mounted in the end of the main shaft, a regulator rotatable with said main shaft but loosely mounted on said regulator-shaft and comprising pivotally-mounted weighted arms capable of swinging outwardly by centrifugal force, and means intermediate said weighted arms and the last-named eccentric disk, adapted to communicate motion from the former to the latter, substantially as described.

3. In a steam-engine, having a cut-off valve, the combination therewith of a regulator-shaft having a pinion on said shaft, a disk loosely mounted on said shaft, two **V**-shaped lever-arms mounted on diametrically opposite studs which project from the outer side of said disk, a ball or weight on one end of each lever-arm, a sector-gear on the other end of each lever-arm both of which gears engage with said pinion, an eccentric disk fastened on said shaft, two springs fastened on the first-named disk and having their free ends resting against projections from each of said balls or weights respectively, a strap upon said eccentric disk, and means intermediate said strap and the cut-off valve and adapted to operate said valve, substantially as specified.

4. In a steam-engine having a cut-off valve, the combination therewith of a regulator-shaft, a main shaft having at its end an axially-directed socket in which the inner end of the regulator-shaft is loosely mounted, a regulator having a disk rotatable with said main shaft but loosely mounted on the regulator-shaft, means adapted to rock said regulator-shaft, an eccentric disk fastened on said regulator-shaft, a second disk having a hub which is loosely mounted on the main shaft, a properly-mounted eccentric ring having a boss on one side thereof, a strap on said eccentric disk, a bar connecting said strap and the boss of said eccentric ring and passing through an aperture of said hubbed disk, a strap on said eccentric ring, and means intermediate said last-named strap and said cut-off valve to operate the latter, substantially as specified.

5. In a steam-engine having a cut-off valve,

the combination therewith of a valve-shaft, a crank on said valve-shaft, a regulator-shaft, a main shaft having at its end an axially-directed socket in which the inner end of the regulator-shaft is loosely mounted, a regulator having a disk rotatable with said main shaft but loosely mounted on the regulator-shaft, an eccentric disk fastened on the regulator-shaft, a second disk having a hub which is loosely mounted on the main shaft, a properly-supported eccentric ring having a boss on one side thereof, a strap on said eccentric disk, a bar connecting said strap and the boss of said eccentric ring and passing through an aperture of said hubbed disk, a strap on said eccentric ring, and a link connection from the last-named strap and said crank, substantially as described.

6. In a steam-engine having a cut-off valve, the combination therewith of a valve-shaft, a crank on said valve-shaft, a regulator-shaft, a main shaft having at its end an axially-directed socket in which the inner end of the regulator-shaft is loosely mounted, a regulator having a disk rotatable with said main shaft but loosely mounted on the regulator-shaft, an eccentric disk fastened on the regulator-shaft, a second disk having a hub which is loosely mounted on the main shaft, a properly-supported eccentric ring having a boss on one side thereof, a strap on said eccentric disk, a bar connecting said strap and the boss of said eccentric ring and passing through an aperture of said hubbed disk, a strap on said eccentric ring, and a link connection between the last-named strap and said crank, substantially as described.

7. In a steam-engine, the combination of a cut-off valve, a valve-shaft, a crank on said valve-shaft, a regulator-shaft, a main shaft having at its end an axially-directed socket in which the inner end of the regulator-shaft is loosely mounted, a regulator having a disk rotatable with the main shaft but loosely mounted on the regulator-shaft, an eccentric disk fastened on the regulator-shaft, a second disk having a hub which is loosely mounted on the main shaft, an eccentric ring having a boss on one side thereof, a strap on said eccentric disk, a flanged bar connecting said strap and the boss of said eccentric ring and passing through an aperture of said hubbed disk, a strap on said eccentric ring, a link connection between the last-named strap and said crank, a sliding plate having two oppositely-arranged slotted extension-pieces each having elevated guideways, under the guideways of one of which extension-pieces the flange of said connecting-bar projects, and a sliding block pivotally connected with said eccentric ring and provided with a flange which extends beneath the guideways of the other of said extension-pieces, substantially as described.

8. In a steam-engine, the combination of a cut-off valve, a valve-shaft, a crank on said valve-shaft, a regulator-shaft, a main shaft having at its end an axially-directed socket in which the inner end of the regulator-shaft is loosely mounted, a regulator having a disk rotatable with the main shaft but loosely mounted on the regulator-shaft, an eccentric disk fastened on the regulator-shaft, a second disk having a hub which is loosely mounted on the main shaft, an eccentric ring having a boss on one side thereof, a strap on said eccentric disk, a flanged bar connecting said strap and the boss of said eccentric ring and passing through an aperture of said hubbed disk, a strap on said eccentric ring, a link connection between the last-named strap and said crank, a sliding plate having an oblong central aperture and also two oppositely-arranged slotted extension-pieces each having elevated guideways, under the guideways of one of which extension-pieces the flange of said connecting-bar projects, a sliding block pivotally connected with said eccentric ring and provided with a flange which extends beneath the guideways of the other of said extension-pieces, friction-rollers properly mounted between which said sliding plate is movable, and means adapted to move said sliding plate, all arranged and operating substantially as shown and for the purpose specified.

9. In a steam-engine, the combination of a cut-off valve, a valve-shaft, a crank on said valve-shaft, a regulator-shaft, a main shaft having at its end an axially-directed socket in which the inner end of the regulator-shaft is loosely mounted, a regulator having a disk rotatable with the main shaft but loosely mounted on the regulator-shaft, an eccentric disk fastened on the regulator-shaft, a second disk having a hub which is loosely mounted on the main shaft, an eccentric ring having a boss on one side thereof, a strap on said eccentric disk, a flanged bar connecting said strap and the boss of said eccentric ring and passing through an aperture of said hubbed disk, a strap on said eccentric ring, a link connection between the last-named strap and said crank, a sliding plate having an oblong central aperture and also two oppositely-arranged slotted extension-pieces each having elevated guideways, under the guideways of one of which extension-pieces the flange of said connecting-bar projects, a sliding block pivotally connected with said eccentric ring and provided with a flange which extends beneath the guideways of the other of said extension-pieces, friction-rollers mounted on said hubbed disk between which said sliding plate is movable, and a bar mounted at one end upon a stud of said hubbed disk and at its opposite end pivotally connected with the last-named strap, said last-mentioned end of which bar is in working contact with one edge of said sliding plate, all arranged and operating substantially as shown and for the purpose specified.

10. In a steam-engine having a cut-off valve,

the combination therewith of a main shaft, a disk rotatable therewith, a regulator-shaft rotatably mounted in an axial socket of the main shaft, two V-shaped levers pivotally mounted on said disk each having a weight or ball at one end and a sector-gear on the other end, a pinion on said regulator-shaft with which said sector-gears are engageable, and means intermediate said regulator-shaft and the cut-off valve to operate the latter from the former, substantially as described.

In testimony whereof I affix my signature in presence of two witnesses.

FRANK J. WATERS.

Witnesses:
WILLIS A. DREW,
HOWARD A. LAMPREY.