

No. 720,845.

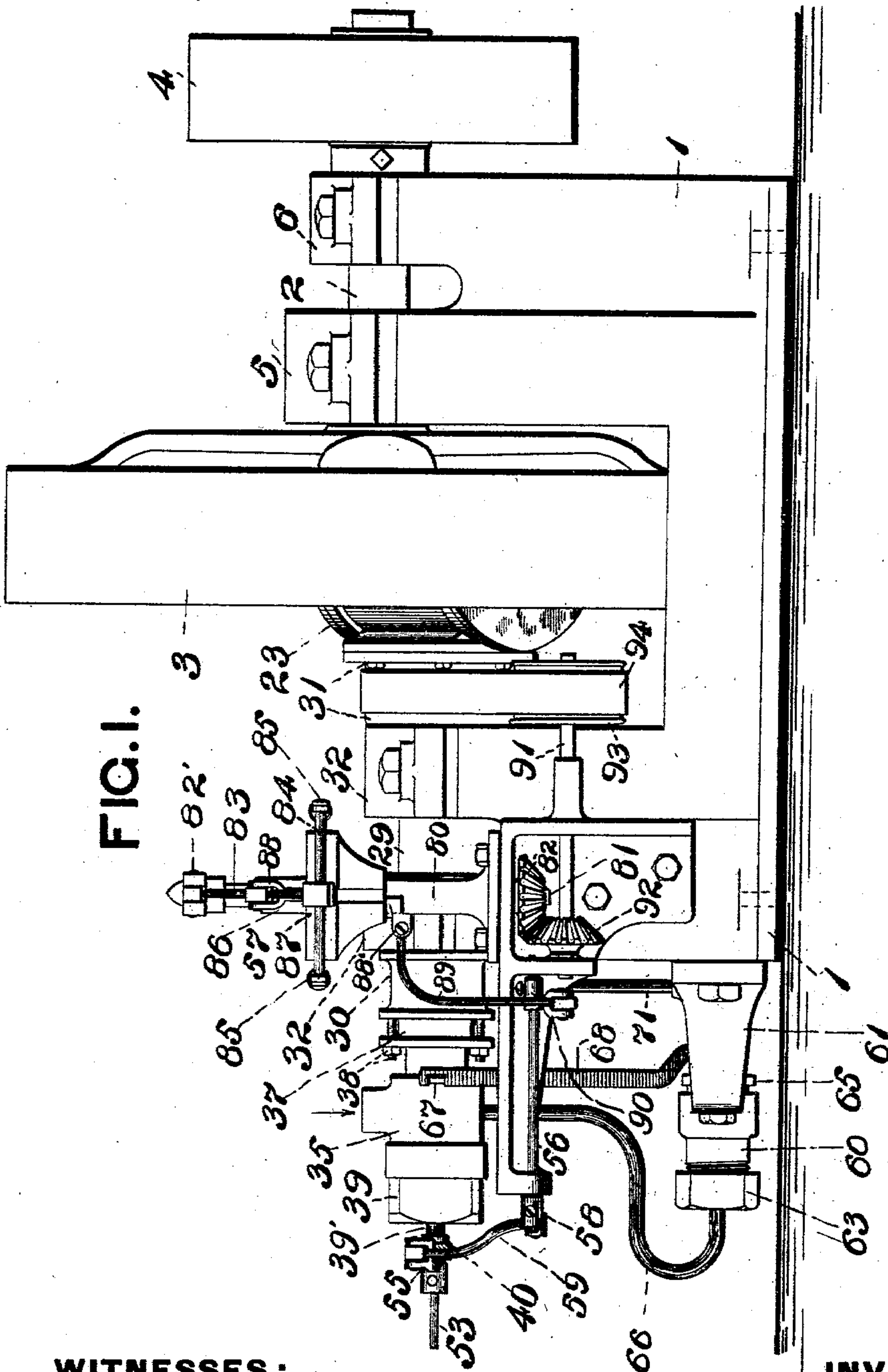
PATENTED FEB. 17, 1903.

F. W. REEVES.  
RECIPROCATING ROTARY ENGINE.

APPLICATION FILED JUNE 28, 1902.

NO MODEL.

5 SHEETS—SHEET 1.



WITNESSES:

*W. H. Adams*  
*J. E. Krepps*

INVENTOR

*Frederick W. Reeves*  
BY his ATTORNEY  
*Richard D. Harrison*

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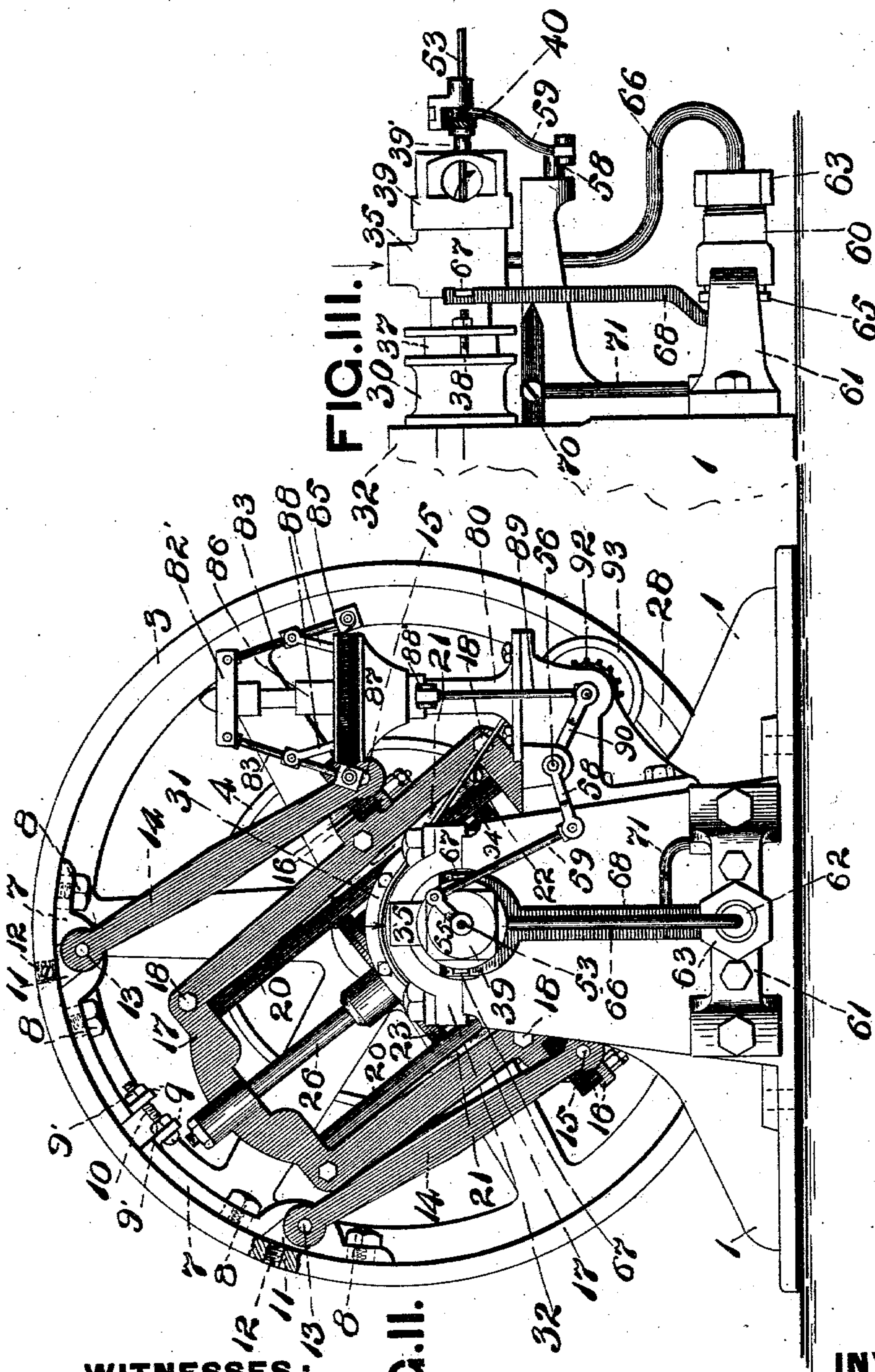
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5 SHEETS—SHEET 2.



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FIG. II.

INVENTOR

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5 SHEETS—SHEET 3.

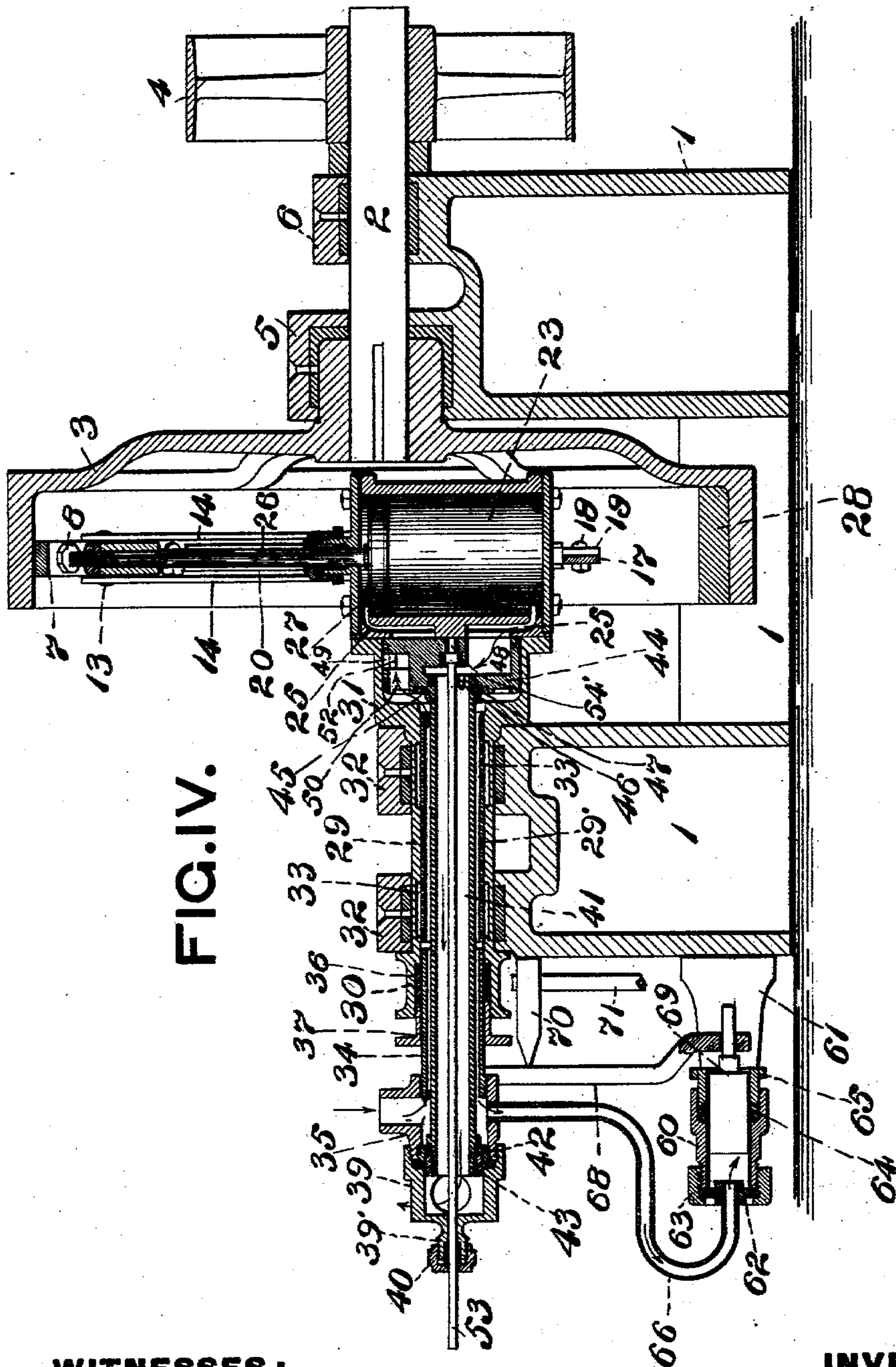


FIG. IV.

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*W. H. H. H.*  
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5 SHEETS—SHEET 4.

FIG.VII.

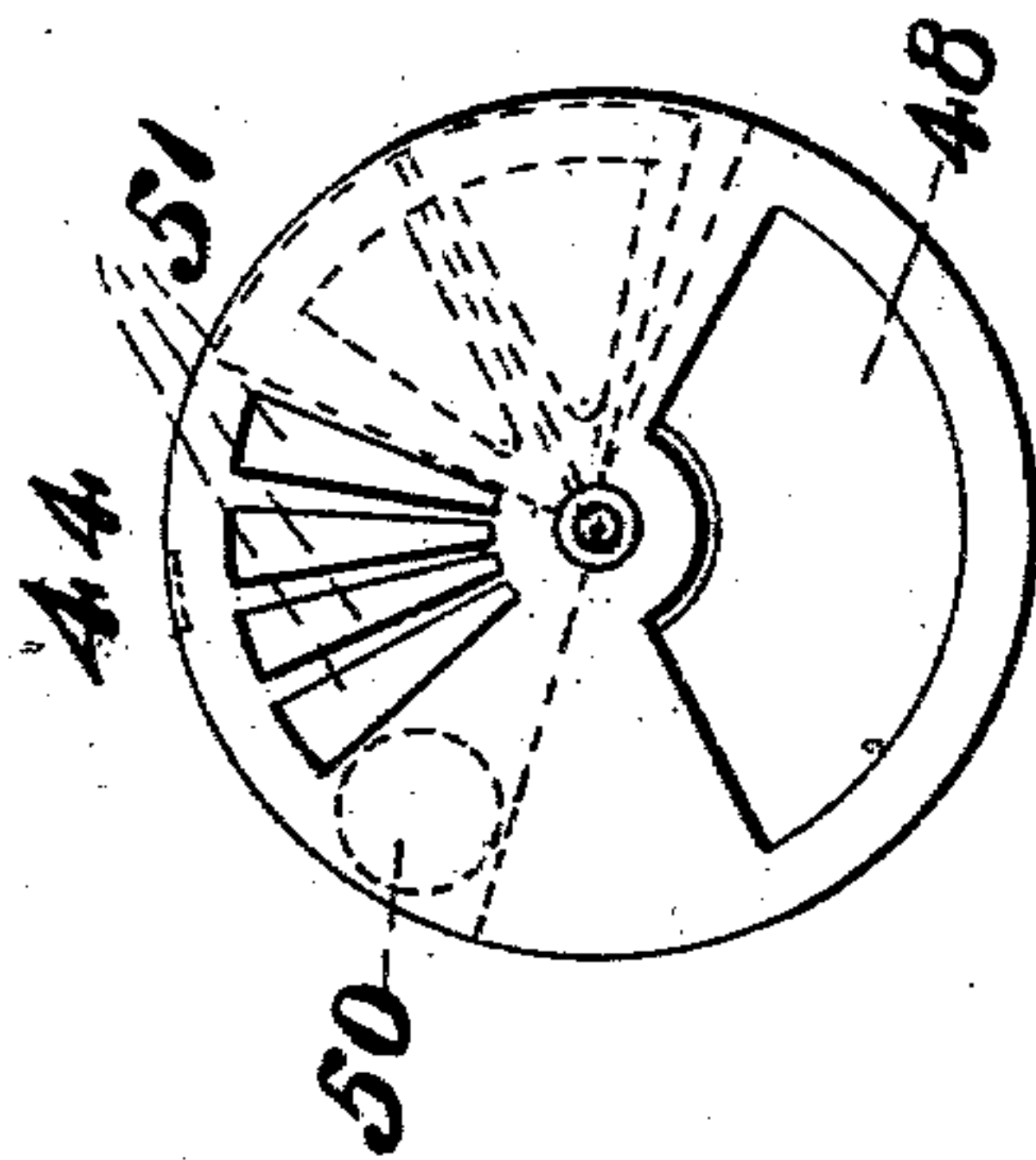


FIG.VIII.

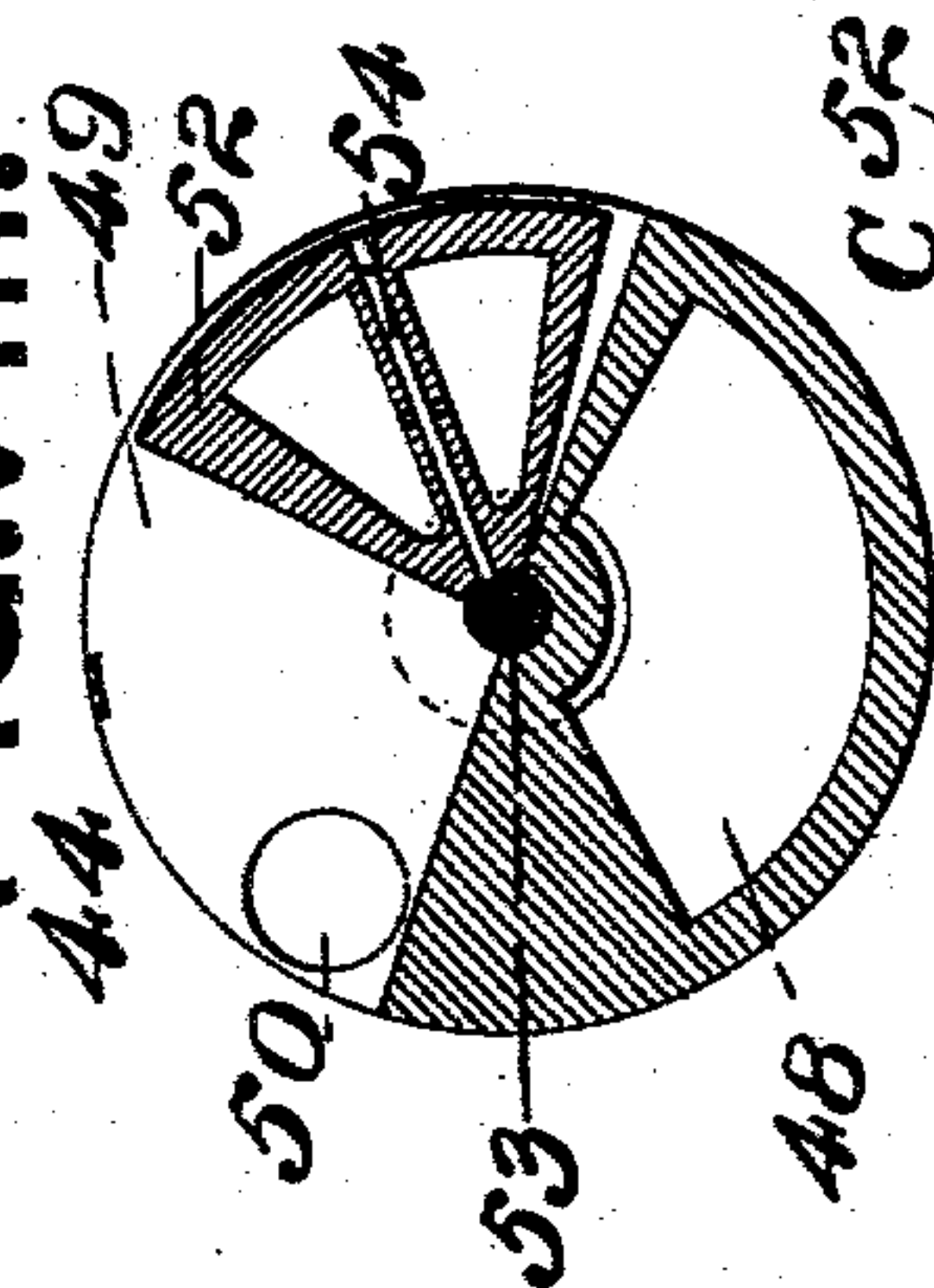


FIG.VI.

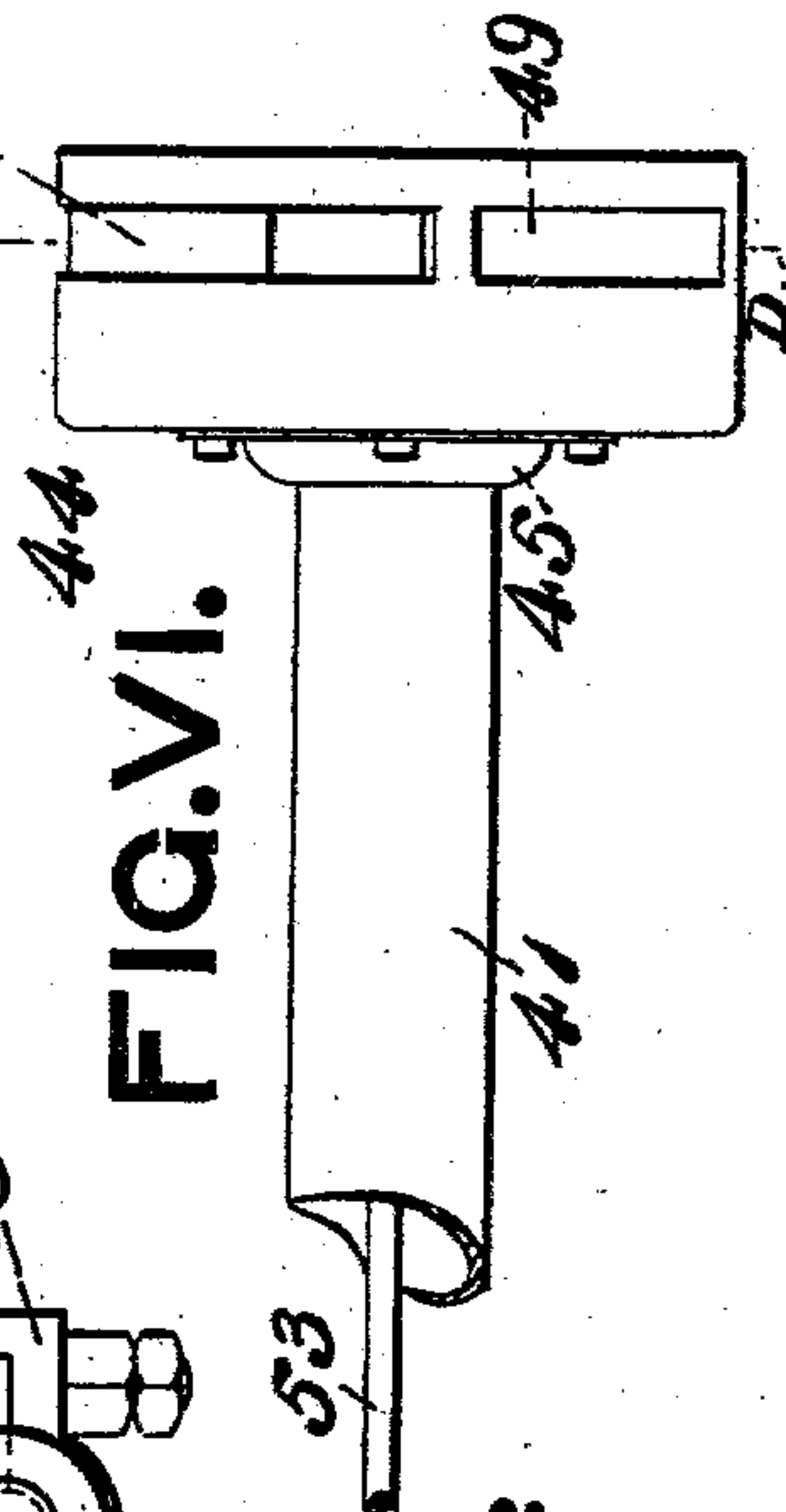
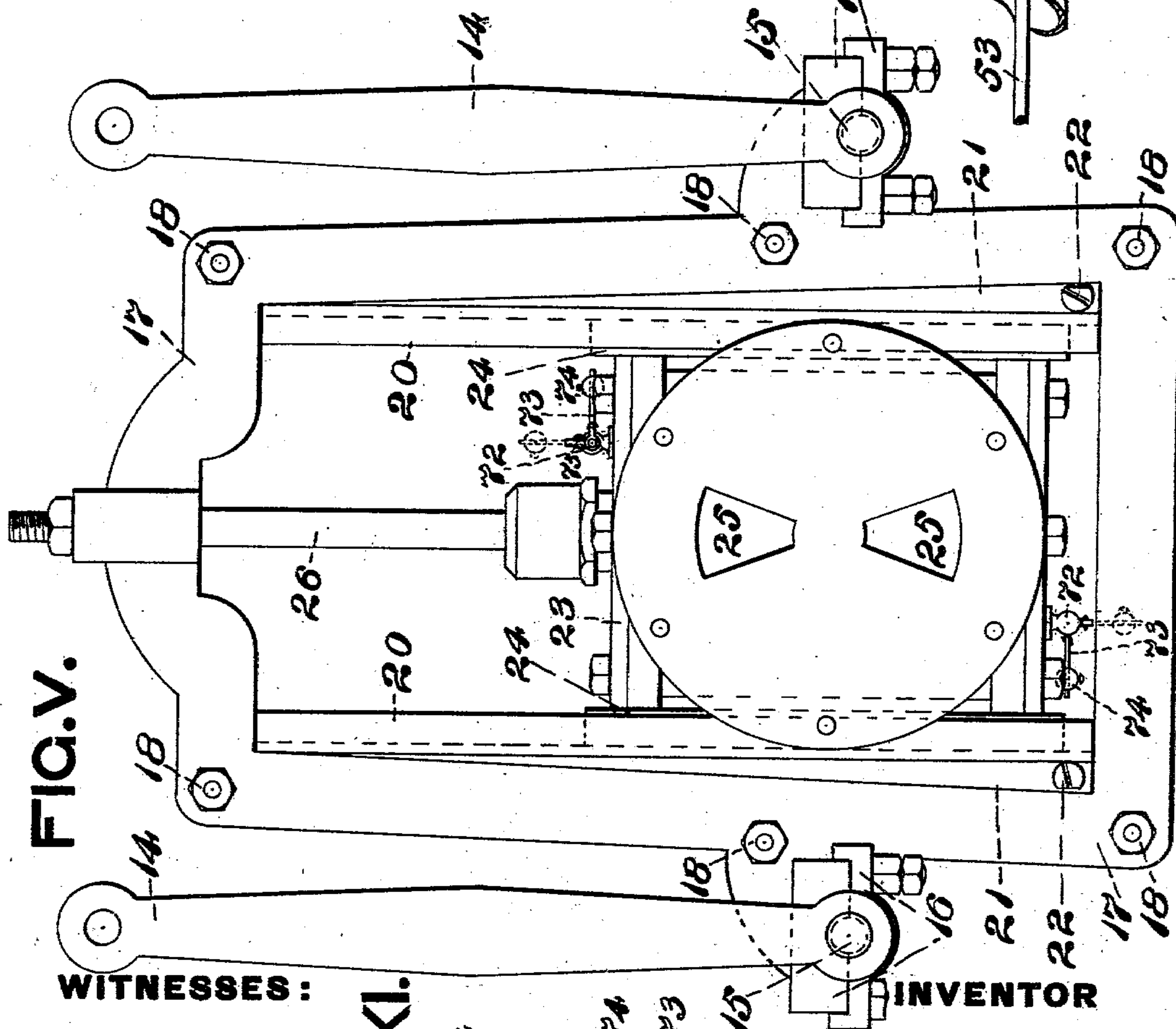


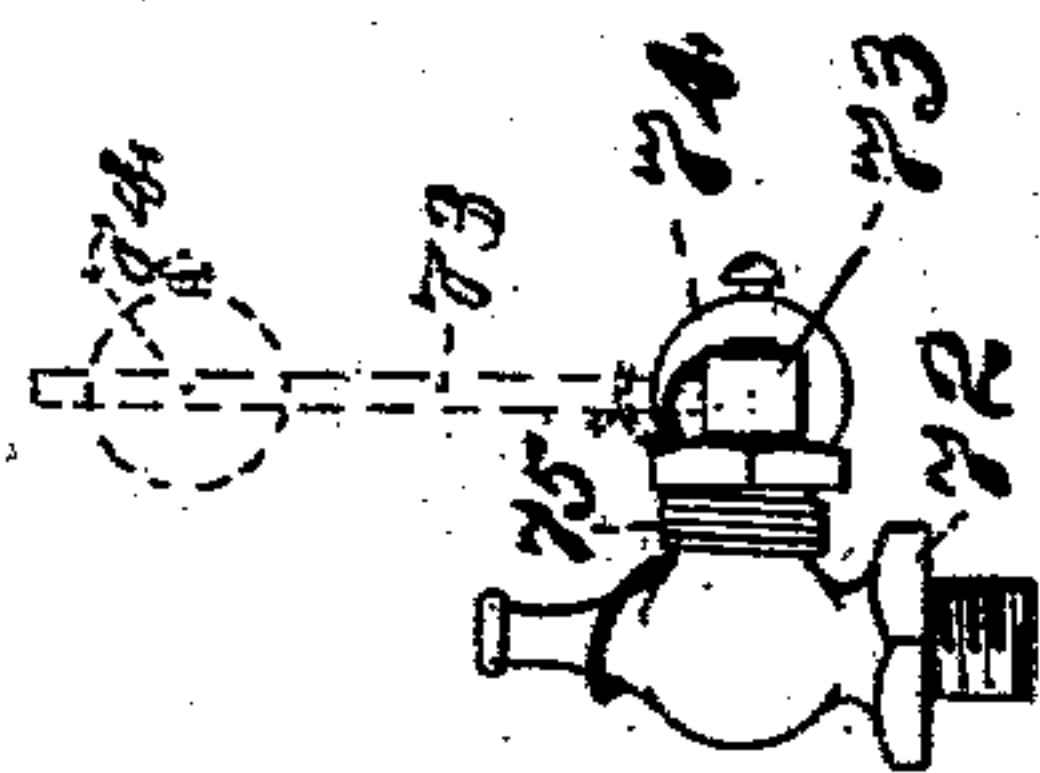
FIG.V.



WITNESSES:

*W. Adams.*  
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FIG. XI.



INVENTOR

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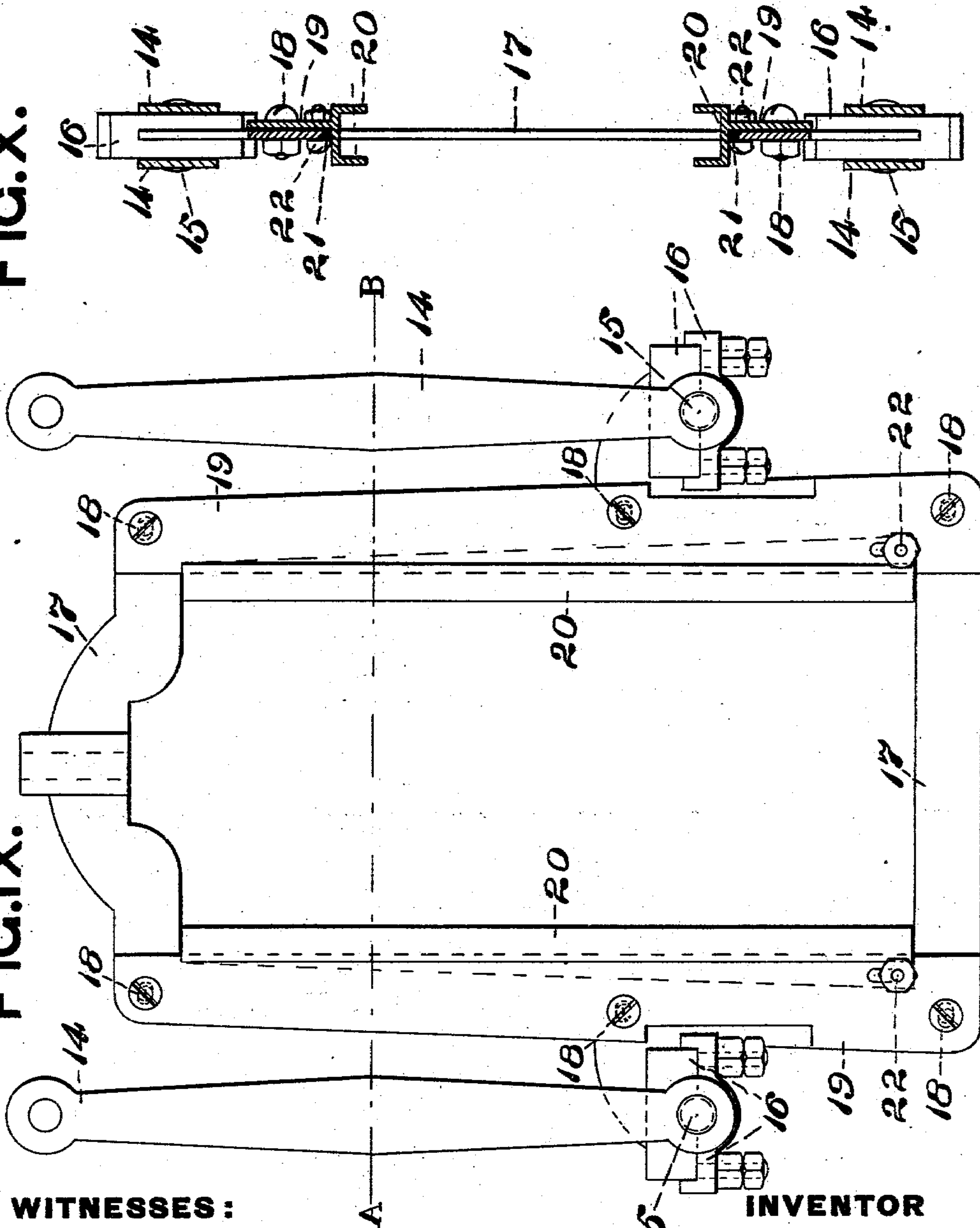
APPLICATION FILED JUNE 28, 1902.

NO MODEL.

5 SHEETS—SHEET 5.

FIG.X.

FIG.IX.



WITNESSES:

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INVENTOR

*Frederick W. Reeves*  
BY *Richard D. Garrison* ATTORNEY



# UNITED STATES PATENT OFFICE.

FREDERICK W. REEVES, OF ALLEGHENY, PENNSYLVANIA.

## RECIPROCATING ROTARY ENGINE.

SPECIFICATION forming part of Letters Patent No. 720,845, dated February 17, 1903.

Application filed June 28, 1902. Serial No. 113,673. (No model.)

*To all whom it may concern:*

Be it known that I, FREDERICK W. REEVES, a citizen of the United States, residing at Allegheny, in the county of Allegheny and State of Pennsylvania, have invented a new and useful Improvement in Reciprocating Rotary Engines, of which improvement the following is a specification.

The object of my invention is to provide a steam-engine of reciprocating rotary character adapted for service in driving dynamos and other machinery where constant and high speed are essential.

The engine is so constructed and arranged as to be durable and compact and is provided with a positive quick-acting boiler-pressure expansion-balance-valve mechanism capable of giving as early a compression or exhaust as may be desired, which, taken with other new and novel features, makes the same admirably adapted for the purpose for which it is intended.

In the accompanying drawings I have illustrated an operative engine embodying the essential features, with detail parts thereof, in which drawings—

Figure I is a side elevation of the complete engine, showing the cylinder assuming an angle approximating forty-five degrees. Fig. II is an end view of the same. Fig. III is a view of a portion of the side in reverse to that shown at Fig. I. Fig. IV is a longitudinal sectional view of said engine, showing the cylinder assuming an approximate vertical position. Fig. V is an enlarged vertical elevation of the cylinder and its attending wheel connection or parallelogram. Fig. VI is a horizontal side view of a portion of the valve, also enlarged. Fig. VII is a front view of the same. Fig. VIII is a transverse sectional view through said valve on the line C D of Fig. VI. Fig. IX is a vertical rear side view of the parallelogram. Fig. X is a transverse sectional view through the same on the line A B of Fig. IX. Fig. XI is a vertical side elevation of one of the automatic cylinder-cocks.

In order that others may fully comprehend the nature of my invention, I deem it advisable to briefly and plainly describe the de-

tails of construction and then in like manner describe the operation and advantages.

Again referring to said drawings for a detailed description of said engine, the numeral 1 designates a suitable bed-plate, upon the rear portion of which is supported a shaft 2, carrying a fly-wheel 3 and band-wheel 4, said shaft being held in rotatable position by caps 5 and 6. A pair of segmental supports 7 are attached to the inner periphery of said fly-wheel by means of bolts 8, extending through elongated slots into said wheel-rim. These supports are provided at their inner extremities with lugs 9, through which extends a connecting-bolt 10, carrying nuts 9' to permit said supports being adjusted to or from one another. In and near the outer extremities of these supports are formed openings into which are fitted the supporting-blocks proper, 11, which blocks are held firmly in position by engagement with set-screws 12 in the wheel-rim. Pivotally suspended from pins 13, carried by said blocks, is a device, which I term a "parallelogram," comprehending parallel connecting-bars 14 of equal length, pivotally connected at their upper extremities to said pins 13 and at their lower extremities to similar pins carried by bearings 16 of the frame 17. The frame 17 is constructed somewhat narrower at one end than at the other, and upon the rear side thereof is adjustably attached by screw-bolts 18 the plates 19, having upon their inner edges the guides 20. These guides are capable of being adjusted laterally in order to bring about a parallel condition with one another and are held in such positions by the wedges 21, said wedges being held in position by screw-bolts 22. Within said frame is arranged a cylinder 23, having thereupon at diametrically opposite points the slides 24 to engage within the guides of said frame, said cylinder being provided with ports 25 for receiving and exhausting steam at either end. The rod 26 of the piston 27 is rigidly attached at its outer end to said frame 17, and in order to balance the wheel a weight 28 is attached thereto at a point opposite the suspension of the parallelogram. Upon the forward part of said bed-plate in line with the shaft of said fly-wheel, but at an



elevation or distance from said shaft equal to one-half of the piston-stroke, is mounted in bearings a hollow shaft 29, terminating at its forward end in a stuffing-box 30 and at its rear end in a valve-chamber 31, said shaft being secured in rotatable position by caps 32. The valve-chamber end of this shaft is bolted direct to the cylinder, inclosing the ports thereof, and upon the interior portion of said shaft, midway between the bearings, is tightly fitted a tube 29', forming one wall of and cutting off the air-chambers 33 from the interior of said shaft, which chambers are adapted to prevent undue heating of the shaft at the bearings. Within the stuffing-box end of said shaft is loosely fitted a tube 34, to the outer end of which is threadably attached the steam-inlet chamber 35. Suitable packing 36 is placed within the stuffing-box and compressed about said tube by the gland 37, which is adjustably secured to said stuffing-box by bolts and nuts 38. Threadably arranged upon the outer end of said steam-inlet chamber is the exhaust-chamber 39, having an exhaust-opening in its wall and a hollow stuffing-box extension 39' at its outer end, to which is adjustably attached a cap 40. An exhaust-tube 41, having an exterior diameter less than the interior diameters of said shaft 29 and tube 34 to permit a steam-space therebetween, extends through said shaft and tube, the outer end of which is provided with a threaded shoulder, by which the same is secured to a collar 42 by a nut 43, said collar being threadably secured within the outer end of the steam-inlet chamber. The opposite end of this exhaust-tube is provided with a convex shoulder engaging in a concaved receptacle in the valve 44 and cap 45, which are arranged within the chamber 31, said tube being held in operative connection with the valve against turning by a pin 46, projecting from the latter into a slot 47 at the tube end. This ball-and-socket form of connection between the valve and tube insures perfect seating of the valve irrespective of the alinement of the tube. The valve referred to is provided with an exhaust port 48, communicating with the tube thereof, and a cavity 49, communicating with the interior of the hollow shaft 29 by a port 50 in the rear wall thereof. The face of this valve has formed therein a plurality of radiating slots or ports 51, which communicate with said cavity 49, through which slots the steam enters the cylinder-ports. A governor-valve 52 in the form of a sector is movably fitted within the cavity of said valve proper, which is adapted to oscillate therein and control the passage of steam through said ports 51. This valve-sector is secured fast to the head of rod 52, which extends through the stuffing-box 39' and shaft 41, by a pin 54, extending therefrom into an opening in the central web thereof. To prevent possible leakage at the point where the said sector is connected to the rod, a small

orifice 54' is formed within the valve proper to permit steam to act upon the head of the rod and press the same against the shoulder of the orifice.

A suitable governor 57 is employed in connection with the engine to operate the sector-valve, the governor in this case consisting of a standard 80, through which extends a vertical shaft 81, having a miter-wheel 82 arranged upon its lower end and a cross-piece 82' at its upper end, to which cross-piece are pivotally connected a pair of weighted arms 83, said arms being provided at their lower ends with cross-pieces 84, which are connected together by spiral springs 85. Loosely fitted over said vertical shaft is a sleeve 86, and upon this sleeve is loosely mounted a circular weight 87, which weight is connected to said arms by the links 88. Upon the lower end of said sleeve 86 are formed lugs 88', to which is connected a rod 89, which rod is connected at its opposite end to a crank 90 upon the rock-shaft 56. The opposite end of this rock-shaft is provided with another crank 58, which is connected to a crank 55 upon the valve-rod 53 by a rod 59. To impart the necessary motion to the governor, a shaft 91 is arranged therebelow, which carries a miter-wheel 92 to mesh with that of the governor-shaft, and upon the opposite end of this shaft is secured a wheel 93, which is coupled to the rotatable shaft or valve-chamber 31 by a belt 94. In setting said valve-sector relative to the governor it is necessary that the same assume its extreme normal position, as shown at Figs. VII and VIII.

A device for balancing the valve proper is employed in connection with the engine, consisting of a small steam-chamber 60, formed upon the housing 61, which projects from the side of the bed-plate, the forward end of which chamber is provided with a removable head 62 and cap 63 and the rear end thereof with packing 64 and gland 65, said chamber being connected with the steam-inlet chamber by a pipe 66. Upon the rear side of said steam-inlet chamber is formed a pair of lugs 67, which engage with the forked end of the upright lever 68, said lever being provided with an opening at its lower end to engage over the stem of a piston 69 in said chamber 60. A fulcrum-block 70 is adjustably attached to an upright rod 71, extending from the housing 61, the forward end of which is tapered to a knife-edge and engages said lever 68. Each head of the cylinder is provided with an automatic cock 72, each cock consisting of an ordinary steam-cock casing and valve, to the valve-stem of which is attached a lever 73, carrying an adjustable weight 74. A spiral spring 75 is wound about the neck of the valve-casing with one end engaging about said body and the other end about said lever in such manner that the tension of the spring will hold the valve in its normal or open position when the cylinder



is at rest and when in motion automatically closed by the centrifugal force of the weight upon the lever.

Having thus described the details of construction, I will now proceed and plainly set forth the operation and effect. Assuming that a steam-supply pipe is connected to the chamber 35 and the engine is in a position slightly over the center, similar to that shown at Fig. IV, with the exhaust-ports open at the lower end and the receiving-ports likewise open at the upper end, when these conditions are established the steam upon being turned on enters the chamber 35, passing through the tube 34, hollow shaft 29, and valve-ports 50 and 51, through port 25 to the upper end of the cylinder, exerting its force upon the piston 27, and as the rod of said piston is secured direct to the frame 17 and said frame secured to the inner periphery of the fly-wheel 3 by the parallel bars 14 it is evident that the movement of the piston through the medium of these members will exert a leverage upon said wheel and cause the same to begin rotating, and as the cylinder is directly attached to the shaft 29, but upon a different center than said wheel and indirectly to said wheel, it is evident that the cylinder and wheel will rotate together, the cylinder sliding in said frame as it rotates to compensate for the differential motion which would otherwise occur if the piston-rod was connected pivotally or flexibly to the wheel-rim. Now as the valve proper, 44, remains at all times stationary this semirotation of the cylinder about said valve will automatically cut off the steam-supply through the ports 51, permitting the steam to expand in the cylinder and force the piston to the opposite end of said cylinder, completing the half-revolution, and at the completion of said stroke the steam at that end of the cylinder will be exhausted by way of the cylinder-port 25, valve-port 48, hollow shaft 41, and chamber 39 to the atmosphere. The cylinder now being again in position to receive steam, but at the opposite end, receives and exhausts, as described, forcing the piston outward and completing the revolution of the cylinder and fly-wheel, each semirevolution being completed in rapid succession, as described, causing a continuous rotation of the fly-wheel. As the sector-valve 52 is capable of being oscillated within the cavity of the valve proper and the rod thereof is connected up with the governor rock-shaft, it is obvious that the rotation of the governor-arms 83 will become spread farther apart in a direction toward a horizontal plane, lifting the weight 87, which in its ascent carries therewith the sleeve 86, and as this sleeve is also connected to said rock-shaft the said shaft will be partially rotated upon its axis and transmit a relative movement to said valve-sector, causing said sector to oscillate to a position more or less covering the radiating-

ports 51, thereby regulating the admission of steam through said ports to the cylinder in proportion to the load or speed of the engine. In this form of valve mechanism as early a compression or exhaust as desired may be attained by establishing the proper area or proportion of the exhaust-port 48. As the steam enters the chamber 35 a small portion thereof passes down through the pipe 66 into the chamber 60, forcing the piston 69 outward against the fulcrumed lever 68, and as this lever is attached to or bears upon the end of the chamber 35, to which the valve proper is attached, by the tube 41, an outward pressure equal to that of the steam upon said valve is placed thereupon (by adjusting the fulcrum-block 70) in opposition to said steam-pressure, thereby balancing the same, and consequently reducing the friction, making a perfectly-balanced valve. As the cylinder rotates it is evident that the centrifugal force acting upon the weights 74 of the cock-levers will overbalance the force of the springs 75 and cause said levers to assume positions at right angles from their normal or open-cock positions, thereby closing said cocks automatically and maintaining closure until the engine ceases to operate, when the springs will again overbalance the force of the weights and automatically open said cocks. As the rods 14 are equidistant between centers and pivotally connected in parallel relation to the wheel-rim and frame 17 at their ends and at equidistant points thereat a perfect parallelogram is formed, and as the frame therein is slidably fitted to the cylinder it is evident that as the wheel is rotated by the action of the reciprocating piston through the medium of said parallelogram, said parallelogram will rotate therewith and at the same time perform an oscillating movement occasioned by the gradual decrease and increase of the distance between the fixed centers, at which the rods are attached to the wheel-rim, rotating with the wheel about the fixed center of the cylinder, causing the frame to slide upon said cylinder with the accompanying movement of the piston, which oscillating movement will be in proportion to the difference between the fixed centers of the wheel and cylinder or piston stroke. The parallelogram remains truly such no matter what the angle of deflection may be in performing its oscillating or rotary motion, and as the members 14 thereof are nothing more than levers of equal length and of never-changing distance between their operative centers 13 and 15 and as the frame 17, to which they are attached, oscillates to compensate for the difference between the fixed centers of the wheel and cylinder it is evident that the rotation of the wheel and cylinder will be relatively constant.

In the same class of engines where the piston is yieldingly connected to the wheel without the use of intermediate connecting mechan-



ism to prevent a differential motion the piston-rod becomes the lever of transmission, and as said piston decreases in stroke during one-half of every wheel revolution it is plain  
 5 that the rotation of the cylinder will increase, and it is equally evident that as said piston increases upon the other half-revolutions of the wheel that the cylinder rotation will decrease. This differential motion renders the engine unfit for service where high  
 10 speed is desired and will occur even where a plurality of pistons are employed.

Having described an operative capable of producing the desired results, it is plain that  
 15 the detail parts thereof may be changed or modified without departing from the spirit of my invention.

Having thus fully shown and described my invention, what I claim as new, and desire to  
 20 secure by Letters Patent, is—

1. In a steam-engine, a rotatable cylinder provided with a reciprocating piston, a rotatable wheel the axis of which is out of line with but parallel with that of said cylinder,  
 25 and members yieldingly connecting said piston-rod with said wheel whereby a relatively invariable rotary motion is imparted by said piston to said wheel and cylinder.

2. In a steam-engine, a rotatable cylinder  
 30 provided with a reciprocating piston adapted to receive and exhaust steam at either end, a rotatable wheel the axis of which is out of line with but parallel with that of said cylinder, and members yieldingly connecting  
 35 said piston-rod with said wheel whereby a relatively invariable rotary motion is imparted by said piston to said wheel and cylinder.

3. In a steam-engine, a rotatable cylinder provided with a reciprocating piston adapted  
 40 to receive and exhaust steam at either end, a rotatable wheel the axis of which is out of line with but parallel with that of said cylinder, and members yieldingly connecting said piston-rod and the cylinder thereof to  
 45 said wheel whereby a relatively invariable rotary motion is imparted by said piston to said wheel and cylinder.

4. In a steam-engine, a rotatable cylinder provided with a reciprocating piston, a rotatable wheel the axis of which is out of line with but parallel with that of said cylinder,  
 50 a member connected to and movable with said piston engaging said cylinder, and parallel members yieldingly connecting said piston member with said wheel whereby a relatively invariable rotary motion is imparted to said wheel and cylinder by said piston through the medium of said members.

5. In a steam-engine, a rotatable cylinder  
 60 provided with a reciprocating piston and adapted to receive and exhaust steam at either end, a rotatable wheel the axis of which is out of line with but parallel with that of said cylinder, a member connected to and movable with said piston engaging said cylinder,  
 65 and parallel members yieldingly connecting

said piston member with said wheel whereby a relatively invariable rotary motion is imparted to said wheel and cylinder through the medium of said members. 70

6. In a steam-engine, a valve mechanism provided with a movable governor-controlled cut-off member, a cylinder rotatable thereabout adapted to receive and exhaust steam  
 75 therethrough and provided with a reciprocating piston, a rotatable wheel the axis of which is out of line with but parallel with that of said cylinder, a member connected to and movable with said piston engaging said cylinder, and parallel members yieldingly connecting  
 80 said piston member with said wheel whereby a relatively invariable rotary motion is imparted to said wheel and cylinder through the medium of said members.

7. In a steam-engine, a valve mechanism  
 85 provided with a movable governor-controlled cut-off member, a cylinder rotatable thereabout adapted to receive and exhaust steam at either end therethrough and provided with a reciprocating piston, a rotatable wheel the  
 90 axis of which is out of line with but parallel with that of said cylinder, a member connected to and movable with said piston engaging said cylinder, and parallel members yieldingly connecting said piston member  
 95 with said wheel whereby a relatively invariable rotary movement is imparted by said piston to said wheel and cylinder through the medium of said members.

8. In a steam-engine, a valve mechanism  
 100 provided with a movable governor-controlled cut-off member, a cylinder rotatable thereabout adapted to receive and exhaust steam therethrough and provided with a reciprocating piston, a rotatable wheel the axis of which  
 105 is out of line with but parallel with that of said cylinder, a member connected to and movable with said piston engaging said cylinder, and parallel members yieldingly connecting said piston with said wheel whereby  
 110 a relatively invariable rotary motion is imparted by said piston to said wheel and cylinder.

9. In a steam-engine, a valve mechanism provided with a movable governor-controlled  
 115 cut-off member, a cylinder rotatable thereabout adapted to receive and exhaust steam therethrough and provided with a reciprocating piston, a rotatable wheel the axis of which is out of line with but parallel with that of  
 120 said cylinder, a member connected to and movable with said piston engaging said cylinder, parallel members connecting said piston member with said wheel whereby a relatively invariable rotary motion is imparted  
 125 by said piston to said wheel and cylinder through the medium of said members, and a steam-actuated fulcrumed lever connected with said valve adapted to be adjusted to and place a balancing pressure thereupon in op-  
 130 position to the ingoing steam.

10. In a steam-engine, a valve mechanism



provided with a movable governor-controlled cut-off member, a cylinder rotatable thereabout adapted to receive and exhaust steam at either end therethrough and provided with  
 5 a reciprocating piston, a rotatable wheel the axis of which is out of line with but parallel with that of said cylinder, a member connected to and movable with said piston engaging the cylinder, parallel members connecting  
 10 said piston member with said wheel whereby a relatively invariable rotary motion is imparted by said piston to said wheel and cylinder through the medium of said members, and a steam-actuated fulcrumed lever con-  
 15 nected with said valve adapted to be adjusted to and place a balancing pressure thereupon in opposition to the ingoing steam.

11. In a steam-engine, a valve mechanism provided with a movable governor-controlled  
 20 cut-off member, a cylinder rotatable thereabout adapted to receive and exhaust steam therethrough and provided with a reciprocating piston, a rotatable wheel the axis of which is out of line with but parallel with that of  
 25 said cylinder, parallel members connecting said piston with said wheel whereby a relatively invariable rotary motion is imparted by said piston to said wheel and cylinder through the medium of said members, and a  
 30 steam-actuated fulcrumed lever connected with said valve adapted to be adjusted to and place a balancing pressure thereupon in opposition to the ingoing steam.

12. In a steam-engine, a rotatable cylinder  
 35 provided with a reciprocating piston, a rotatable wheel the axis of which is out of line with but parallel with that of said cylinder, means connecting said piston with said wheel whereby a relatively invariable rotary motion  
 40 is imparted by said piston to said wheel and cylinder, and cylinder-cocks arranged upon and communicating with said cylinder adapted to automatically close when the cylinder is in motion and open when at rest.

45 13. In a steam-engine, a rotatable cylinder provided with a reciprocating piston adapted to receive and exhaust steam at either end, a rotatable wheel the axis of which is out of line with but parallel with that of said cylinder,  
 50 means connecting said piston with said wheel whereby a relatively invariable rotary motion is imparted by said piston to said wheel and cylinder, and cylinder-cocks arranged upon and communicating with said  
 55 cylinder adapted to automatically close when the cylinder is in motion and open when at rest.

14. In a steam-engine, a rotatable cylinder provided with a reciprocating piston, a rotatable  
 60 wheel the axis of which is out of line with but parallel with that of said cylinder, a member connected to and movable with said piston engaging said cylinder, parallel members connecting said piston member with said  
 65 wheel whereby a relatively invariable rotary motion is imparted to said wheel and cylinder

by said piston through the medium of said members, and cylinder-cocks arranged upon and communicating with said cylinder adapted to automatically close when the cylinder  
 70 is in motion and open when at rest.

15. In a steam-engine, a rotatable cylinder provided with a reciprocating piston and adapted to receive and exhaust steam at either end, a rotatable wheel the axis of which  
 75 is out of line with but parallel with that of said cylinder, parallel members connecting said piston with said cylinder whereby a relatively invariable rotary motion is imparted by said piston to said wheel and cylinder, and  
 80 cylinder-cocks arranged upon and communicating with said cylinder adapted to automatically close when the cylinder is in motion and open when at rest.

16. In a steam-engine, a valve mechanism  
 85 provided with a movable governor-controlled cut-off member, a cylinder rotatable thereabout adapted to receive and exhaust steam therethrough and provided with a reciprocating piston, a rotatable wheel the axis of which  
 90 is out of line with but parallel with that of said cylinder, a member connected to and movable with said piston engaging said cylinder, parallel members connecting said piston member with said wheel whereby a rela-  
 95 tively invariable rotary motion is imparted by said piston to said wheel and cylinder through the medium of said members, and cylinder-cocks arranged upon and communicating with said cylinder adapted to auto-  
 100 matically close when the cylinder is in motion and open when at rest.

17. In a steam-engine, a valve mechanism provided with a movable governor-controlled  
 105 cut-off member, a cylinder rotatable thereabout adapted to receive and exhaust steam therethrough at either end and provided with a reciprocating piston, a rotatable wheel the axis of which is out of line with but parallel with that of said cylinder, a member con-  
 110 nected to and movable with said piston engaging said cylinder, parallel members connecting said piston member with said wheel whereby a relatively invariable rotary motion is imparted by said piston to said wheel and  
 115 cylinder through the medium of said members, a steam-actuated fulcrumed lever connected with said valve adapted to be adjusted to and place a balancing pressure thereupon in opposition to the ingoing steam, and cyl-  
 120 nder-cocks arranged upon and communicating with said cylinder adapted to automatically close when the cylinder is in motion and open when at rest.

18. In a steam-engine, a valve mechanism  
 125 provided with a movable governor-controlled cut-off member, a cylinder rotatable thereabout adapted to receive and exhaust steam therethrough at either end and provided with a reciprocating piston, a rotatable wheel the  
 130 axis of which is out of line with but parallel with that of said cylinder, parallel members



connecting said piston with said wheel where-  
by a relatively invariable rotary motion is  
imparted by said piston to said wheel and  
cylinder through the medium of said mem-  
5 bers, a steam-actuated fulcrumed lever con-  
nected with said valve adapted to be adjust-  
ed to and place a balancing pressure there-  
upon in opposition to the ingoing steam, and  
cylinder-cocks arranged upon and communi-  
10 cating with said cylinder adapted to auto-

matically close when the cylinder is rotated  
and open when at rest.

In testimony whereof I have hereunto  
signed my name in the presence of two sub-  
scribing witnesses.

FREDERICK W. REEVES.

In presence of—

H. E. MIX,  
S. R. COOK.