No. 730,791. PATENTED JUNE 9, 1903.

# W. H. NIGHTINGALE.

## GOVERNOR FOR PNEUMATIC PRESSURE.

APPLICATION FILED MAR. 17, 1902.

NO MODEL. 3 SHEETS—SHEET 1.

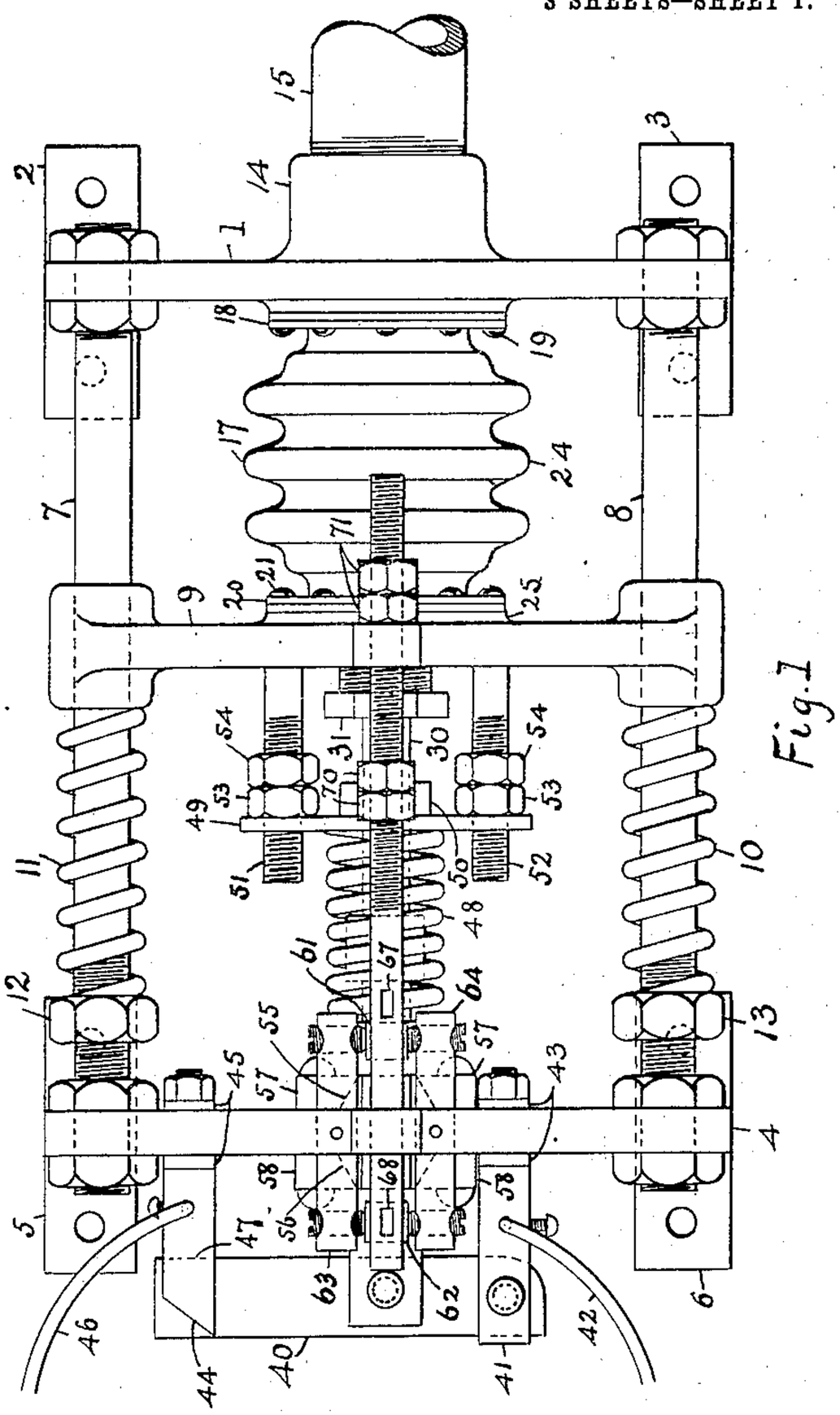

Fig. 1

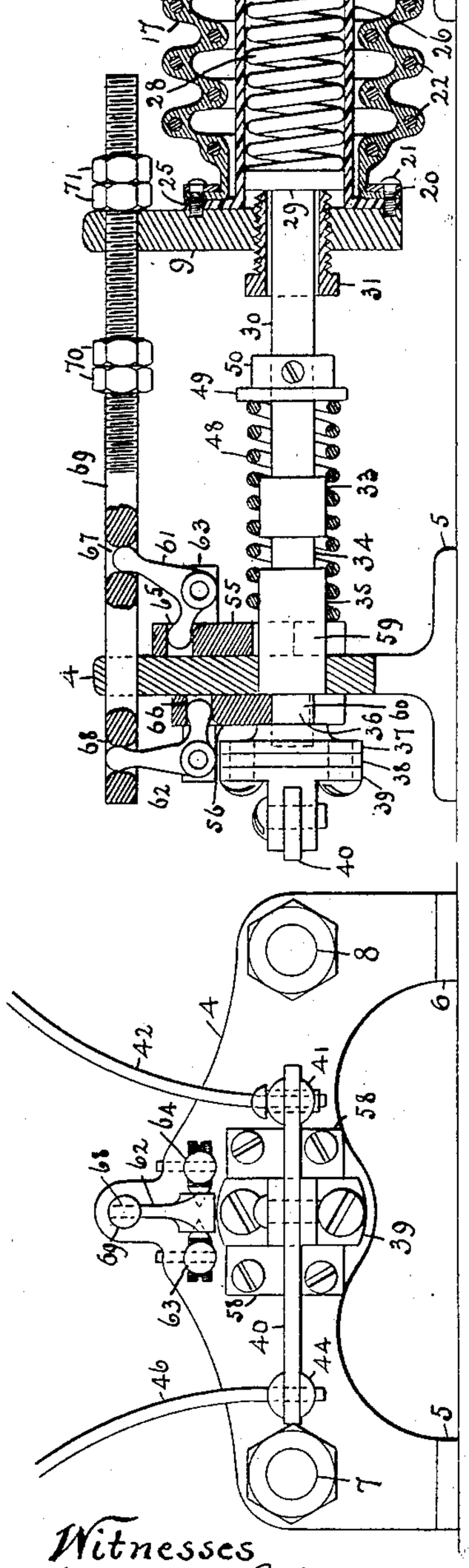

Fig. 2



Fig. 3

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## GOVERNOR FOR PNEUMATIC PRESSURE.

APPLICATION FILED MAR. 17, 1902. 3 SHEETS—SHEET 2.

NO MODEL.

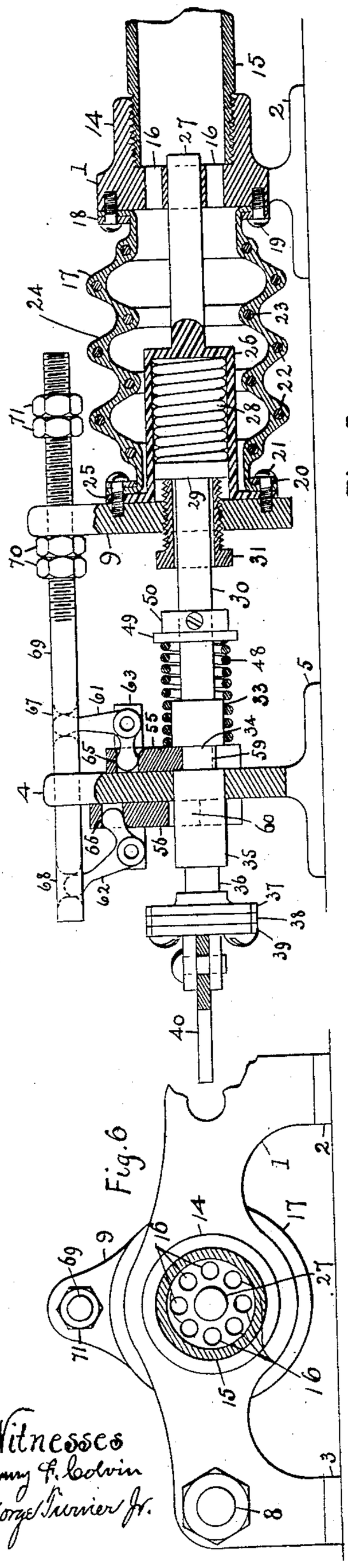

Fig. 5

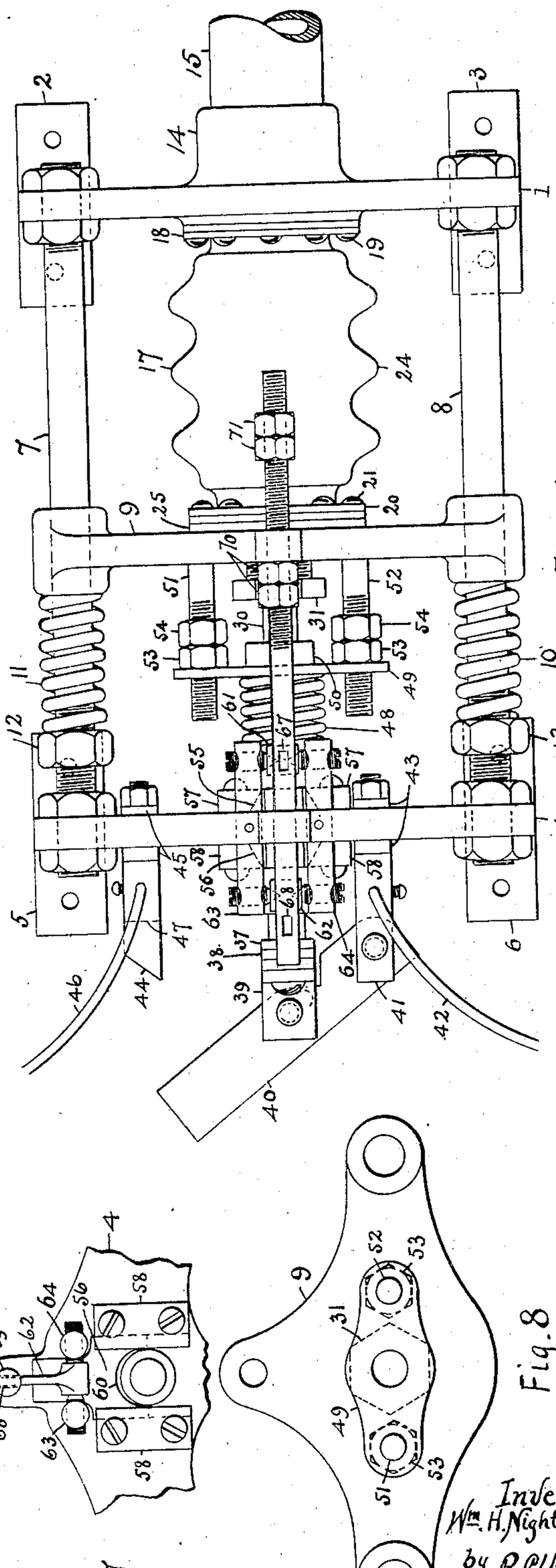

Fig. 4



Fig. 6



Fig. 7



Fig. 8

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## GOVERNOR FOR PNEUMATIC PRESSURE.

APPLICATION FILED MAR. 17, 1902.

NO MODEL. 3 SHEETS—SHEET 3.

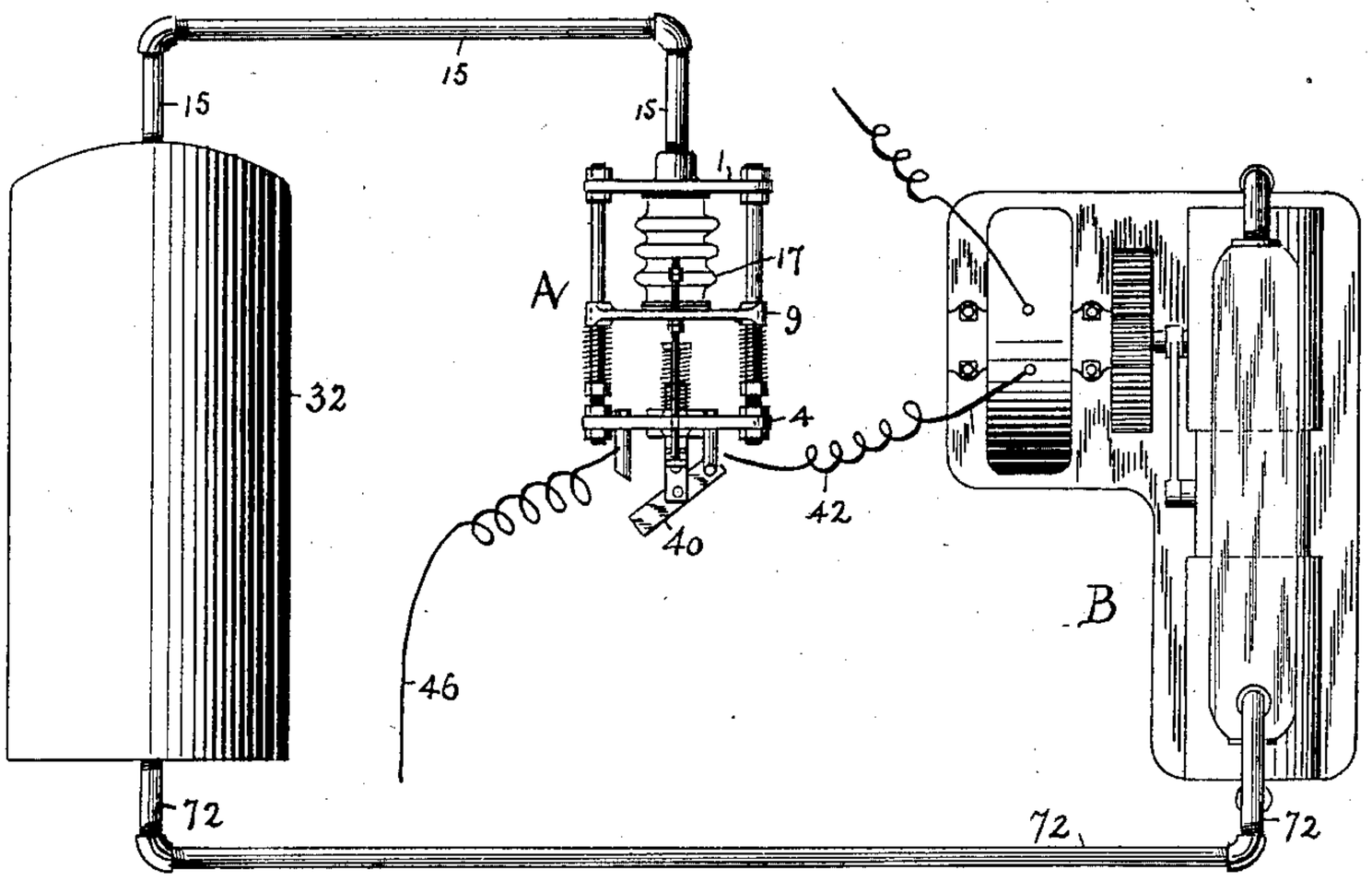


Fig. 11

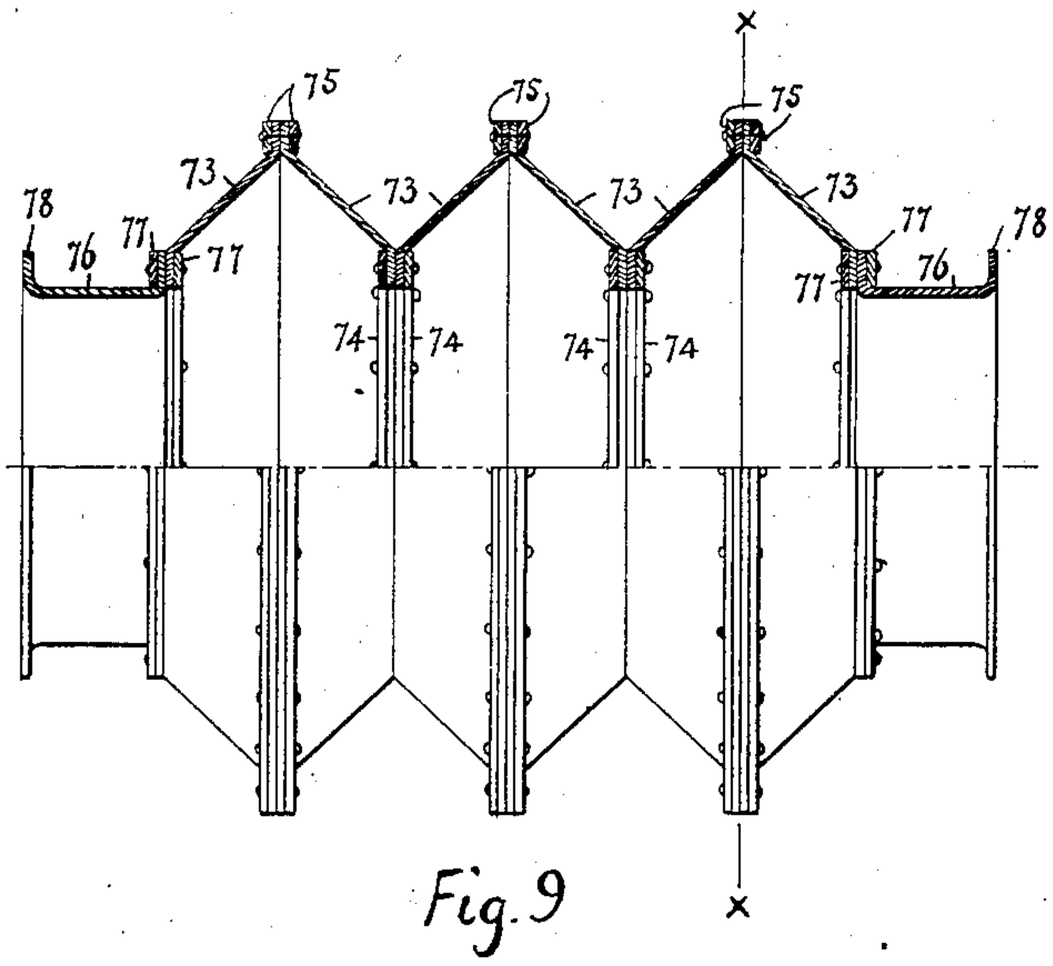


Fig. 9

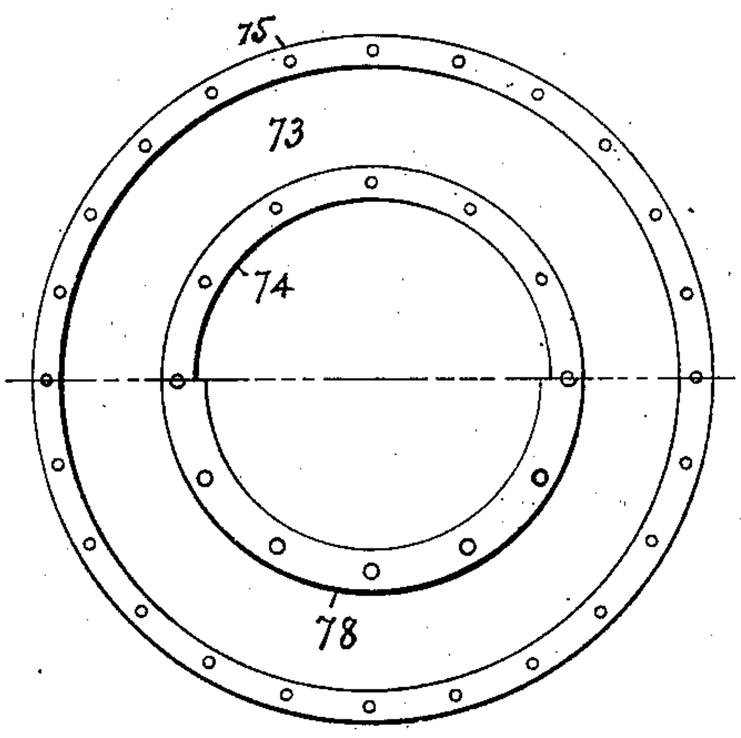


Fig. 10

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No. 730,791. Patented June 9, 1903.

# UNITED STATES PATENT OFFICE.

WILLIAM H. NIGHTINGALE, OF PHILADELPHIA, PENNSYLVANIA, ASSIGNOR TO JOHN E. REYBURN, OF PHILADELPHIA, PENNSYLVANIA.

## GOVERNOR FOR PNEUMATIC PRESSURE.

SPECIFICATION forming part of Letters Patent No. 730,791, dated June 9, 1903.

Application filed March 17, 1902. Serial No. 98,633. (No model.)

*To all whom it may concern:*

Be it known that I, WILLIAM H. NIGHTINGALE, a citizen of the United States, residing at Philadelphia, in the county of Philadelphia and State of Pennsylvania, have invented certain new and useful Improvements in Governors for Pneumatic Pressure, of which the following is a specification.

My invention relates to automatic governors or cut-outs for air-compressor motors in which the pressure in the receiver or reservoir governs the motor's movements, as when maximum pressure is reached the motor is stopped until with a predetermined decrease of pressure the motor is again put in action until the desired pressure is again accumulated. I employ resilient means, in conjunction with air-pressure, to operate the parts of the mechanism and the locking of the cut-out in contact and out of contact with the current supplied to the motor. In order that my mechanism may be very sensitive, I have eliminated the use of stuffing-boxes to prevent air-escape and have substituted therefor a flexible cylinder covering the air-admission and capable of extension and contraction as necessary to permit the pressure-actuated parts to freely move within the cylinder and at the same time prevent air-escape and the creation of friction. The mechanism is illustrated as used for air-brakes for cars; but it is not thereby intended to limit its use to such purpose only, as there are various other uses to which it may be applied as a pneumatic pressure-regulator.

My mechanism is illustrated in the accompanying drawings, in which—

Figure 1 is a plan of the governor when in circuit. Fig. 2 is a central vertical section as to most parts, as when in circuit, same as Fig. 1. Fig. 3 is an elevation at the current end. Fig. 4 is a plan when cut out or out of circuit. Fig. 5 is a central vertical section of Fig. 4, some parts not being in section. Fig. 6 is an elevation at the air-inlet end. Fig. 7 is an elevation of the outer locking-plate, its guides, and bell-crank arm. Fig. 8 is an elevation of the cross-head on the current side. Fig. 9 is a longitudinal view of a modified form of the flexible cylinder, its upper half being a central section and its lower half an elevation. Fig. 10 is at its upper half a section on line $x$ $x$, Fig. 9, and at its lower half an end view of Fig. 9. Fig. 11 is a plan showing the position of the governor as related to a receiver or reservoir and a compressor.

Similar characters of reference indicate similar parts throughout the views.

The governor has end supports 1, with feet 2, 3, and 4, with feet 5 6, the feet being provided with suitable holes for the insertion of screws or bolts to secure the governor in position. Supports 1 4 are connected by rods 7 8, which are screw-threaded at their ends and provided with nuts inside and outside of the supports to hold all of these parts in proper position. A cross-head 9 embraces rods 7 8 at its ends, and is thereby guided in its movements. The cross-head abuts springs 10 11 on rods 7 8 at one side, and nuts 12 13 serve to adjust the springs to proper tension to regulate the maximum pressure exerted against the cross-head, as hereinafter described. A boss 14 is formed on support 1 at its outer side, and it has an internal screw-thread to receive an inlet-pipe 15, leading from the air receiver or reservoir, and within boss 14 through support 1 a series of inlet-holes 16 are formed. Secured to the inner face or side of support 1 is one end of the flexible accordion-shaped extension and contraction-cylinder 17, by ring 18 and screws 19, and to the adjacent face or side of cross-head 9 the other end of cylinder 17 is secured by ring 20 and screws 21, the cylinder having outwardly-extending flanges at each end which are adapted to be compressed to form air-tight joints by rings 18 20. Cylinder 17 is formed of major diameter metallic and non-compressible rings 22 and similar minor diameter rings 23, alternately placed and incased and connected by a covering 24, of rubber or other similar suitable material which will permit the extension of the cylinder, as seen in Figs. 4, 5, and its contraction, as seen in Figs. 1, 2. Within cylinder 17 and secured to cross-head 9 by a flange 25 is a pressure-case 26, having a guiding-stem 27 passing through support 1 into inlet-pipe 15, and within the case is cut-out spring 28, one end of which seats in the case end, and at the other end is placed

a disk 29, which abuts a locking-stem 30, as seen in Fig. 5. Around stem 30, but not touching it, is an adjusting-sleeve 31, screw-threaded through cross-head 9 and abutting disk 29 and which is the means by which the desired tension is put upon spring 28 to require the maximum pressure in pipe 15 and the receiver or reservoir 32, to which it is connected, as seen in Fig. 11. Stem 30 passes outward and through support 4. It has an enlargement 33 passing through support 4, a cut-out locking-groove 34, an enlargement 35, which guides the stem through support 4, and a cut-in locking-groove 36, beyond which is secured a hub-plate 37, insulation 38, and a jar-plate 39, pivotally connected to a switch-bar 40. Switch 40 is fulcrumed on pole-stud 41, carrying conductor 42, secured to support 4 and having insulation 43. Opposite stud 41 is a stud 44, secured the same as 41, having insulation 45, carrying conductor 46 and having contact-slot 47, into which switch 40 passes when pressure in tank 32 decreases to a sufficient degree to require the current to be turned onto the motor for operating the compressor. Over stem 30 and its enlargement 33 is a cut-in spring 48, abutting the locking-plate guides at one end and at the other end abutting a plate 49, through which stem 30 passes, and a collar 50 is adjustably secured on the stem to secure the desired tension of spring 48. Plate 49 is carried on studs 51 52, secured to cross-head 9 and having nuts 53 and lock-nuts 54, which bear against plate 49. By the means described the spring 48 is compressed, while spring 28 is being compressed as cross-head 9 is being forced by air-pressure toward support 4. The spring 48 is meantime storing energy to shoot stem 30 inward when it is unlocked to close the switch and form the circuit when the air-pressure is sufficiently exhausted and just before the parts are moved to the positions seen in Figs. 1, 2. Engaging locking-grooves 34 36 are vertically-moving locking-plates 55 56, having guides 57 58 secured to support 4, which plates have slots 59 60 at their lower ends adapted to pass into grooves 34 36 when dropped to lock and to permit the enlargement 35 of stem 30 to pass under them when raised to unlock, the plates being moved up and down by bell-cranks 61 62, fulcrumed on supports 63 64, secured to main support 4, one arm of the cranks entering one of the slots 65 66 of the locking-plates and the other arms entering one of the slots 67 68 of the rod 69, guided through the tops of support 4 and cross-head 9. The rod 69 has at one side of cross-head 9 double nuts 70 and at the other side double nuts 71, the rod being screw-threaded to receive them and permit their secure adjustment to move the rod, the bell-cranks, and the plates, for locking the switch into or out of circuit by the movement of the cross-head due to air-pressure and its return movement by springs 10 11 as the air-pressure decreases.

In Fig. 11 is shown the position of my governor as related to the coöperative compression and air-receiving means, in which the governor A is connected to the tank 32 by pipe 15 and the compressor B is connected to tank 32 by pipe 72. Fig. 11 illustrates in a general way only the relative positions of the different mechanisms, as it will readily be understood that other arrangements may be made by observing the proper air and electrical connections.

It will readily be understood that slight modifications of my constructions as illustrated and described can be adapted to the same use without departing from the spirit of my invention. Having described the preferable forms of my mechanism as at the present time deemed best, I will now describe their operation.

By reference to Figs. 1, 2 the governor parts will be seen in the positions they assume when there is a lack of pressure in the tank or receiver 32 and the parts have been operated to close the circuit and start the compressor. As the air-pressure accumulates it will pass through pipe 15 and holes 16 to the interior of cylinder 17, pressing against the end of case 26 and the surrounding surface of cross-head 9. This will compress spring 28, pushing disk 29 against stem 30 and cross-head 9 against springs 10 11 and plate 49 against spring 48, and as the stem is now locked against outward movement the continued accumulation of pressure will continue to move cross-head 9 until it reaches nuts 70, moving them and rod 69, operating bell-cranks 61 62, locking-plates 55 56, when spring 28 quickly shoots stem 30 outward, opening the switch 40, breaking the circuit, and stopping the motor, and so quickly that all sparking and burning are avoided. As spring 28 shot stem 30 the collar 50 followed up plate 49 and spring 48, leaving the spring compressed, as seen in Figs. 4, 5, retaining its power to shoot stem 30 back when unlocked by decreased pressure in the tank or receiver 32. The parts are now in the positions shown in Figs. 4, 5. As the receiver-pressure drops springs 10 11 28 expand and contract cylinder 17, move back cross-head 9, case 26, studs 51 52, and their nuts 53 54 until the cross-head 9 meets and moves nuts 71 of rod 69, when the locking mechanism is released and the compressed spring 48 quickly shoots stem 30 back, closing the switch 40, forming the circuit, and starting the motor and compressor, and the governor parts assume the positions seen in Figs. 1, 2. I have provided means for the adjustments of all of the working parts, so that I am enabled to set the governor for any desired amount of pressure and also to keep the springs up to the desired or required tension in case they become weakened from any cause.

I claim—

1. In a pressure-governor, supports therefor, rods connecting the supports, a cross-head

adapted to move on the rods, and an air-tight flexible cylinder secured at one end to one of the supports, and its opposite end secured to and moved by the cross-head and a compressor, and a switch for the governor, controlling the compressor, substantially as set forth.

2. In a pressure-governor, a compressor, a switch governing the compressor, a framework for the governor, a flexible cylinder supported thereon at its fixed end, a cross-head guided upon the framework and carrying the movable end of the cylinder, a pressure-case within the cylinder, guided at one end by the framework and at its opposite end attached to the cross-head aforesaid, a locking-stem, passing through the cross-head and entering the pressure-case, a disk in the case, at the end of the stem, and resilient means within the case and operative on the disk and stem, in manner and form substantially as specified.

3. In a pressure-governor, a compressor, a framework for the governor, a cross-head guided thereon, a longitudinally expansible and contractible cylinder secured to the framework and the cross-head, a pressure-case within the cylinder and means to subject it to air-pressure, a locking-stem projecting into the case, resilient means within the case and acting upon the stem when the case is under pressure, and means to regulate the tension of the resilient means, and a switch governing the compressor, substantially as set forth.

4. In a pressure-governor, a motor, a compressor, a reservoir, a framework for the governor having a flexible cylinder carried thereon in manner for its elongation and contraction, resilient means within the cylinder and arranged for and adapted to receive air-pressure, a locking-stem subject to movement by the resilient means and the air-pressure, locking-grooves in the stem, locking-plates adapted to enter the grooves, means to lock the stem by one plate when the cylinder is elongated, and by the other plate when the cylinder is contracted, resilient means upon the stem adjacent to the locking means, and means for its compression as the cylinder is elongated and to hold it in compression until the cylinder is contracted and the locking-stem is released, electrical conductors, and an interposed switch forced into and out of circuit with the conductors by the elongation and contraction of the cylinder and the consequent movement of the locking-stem, substantially in the manner and form set forth.

5. In a pressure-governor, an extensible and contractible accordion-shaped cylinder, mounted upon a framework adapted for the aforesaid actions, the extension of the cylinder being accomplished by pneumatic pressure, and resilient means supported upon the framework and contracted by the cylinder's extension and adapted to expand and contract the cylinder as the pneumatic pressure therein decreases, substantially as set forth.

6. In a pneumatic governor, a motor, a compressor, a receiver, and an accordion-shaped cylinder, mounted upon a framework and means for its extension by pneumatic pressure, resilient means for its contraction as the pneumatic pressure decreases, a locking-stem, a double locking means therefor, means to actuate the stem in one direction by the pressure which extends the cylinder, resilient means on the stem and means for its compression as the cylinder is elongated, means to retain the compression of the resilient means on the stem until the stem is unlocked for its return by the aforesaid resilient means to its original position when the cylinder is contracted, electrical conductors insulated upon the framework, a switch interposed between the conductors, attached to the locking-stem, and adapted to break the current as the cylinder is extended, and to connect the current when the cylinder is contracted, substantially as set forth.

7. As a new article of manufacture, a flexible cylinder comprised of rings of large and small diameter, alternately arranged, embedded in and connected by a flexible and non-porous material to thereby permit the cylinder to expand and contract in length, and means to secure the cylinder's ends for such action, substantially as specified.

8. As a new article of manufacture, an accordion-shaped cylinder of flexible non-porous material, rings for the support of the large and small diametral portions of the accordion shape, and means to secure the cylinder for longitudinal expansion and contraction, substantially as set forth.

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

WILLIAM H. NIGHTINGALE.

Witnesses:

RANSOM C. WRIGHT,

WILLIAM C. STOEVER.