No. 795,726. PATENTED JULY 25, 1905.

W. H. NIGHTINGALE.

ELECTRIC AND PNEUMATIC GOVERNOR.

APPLICATION FILED JULY 16, 1904.

3 SHEETS—SHEET 1.

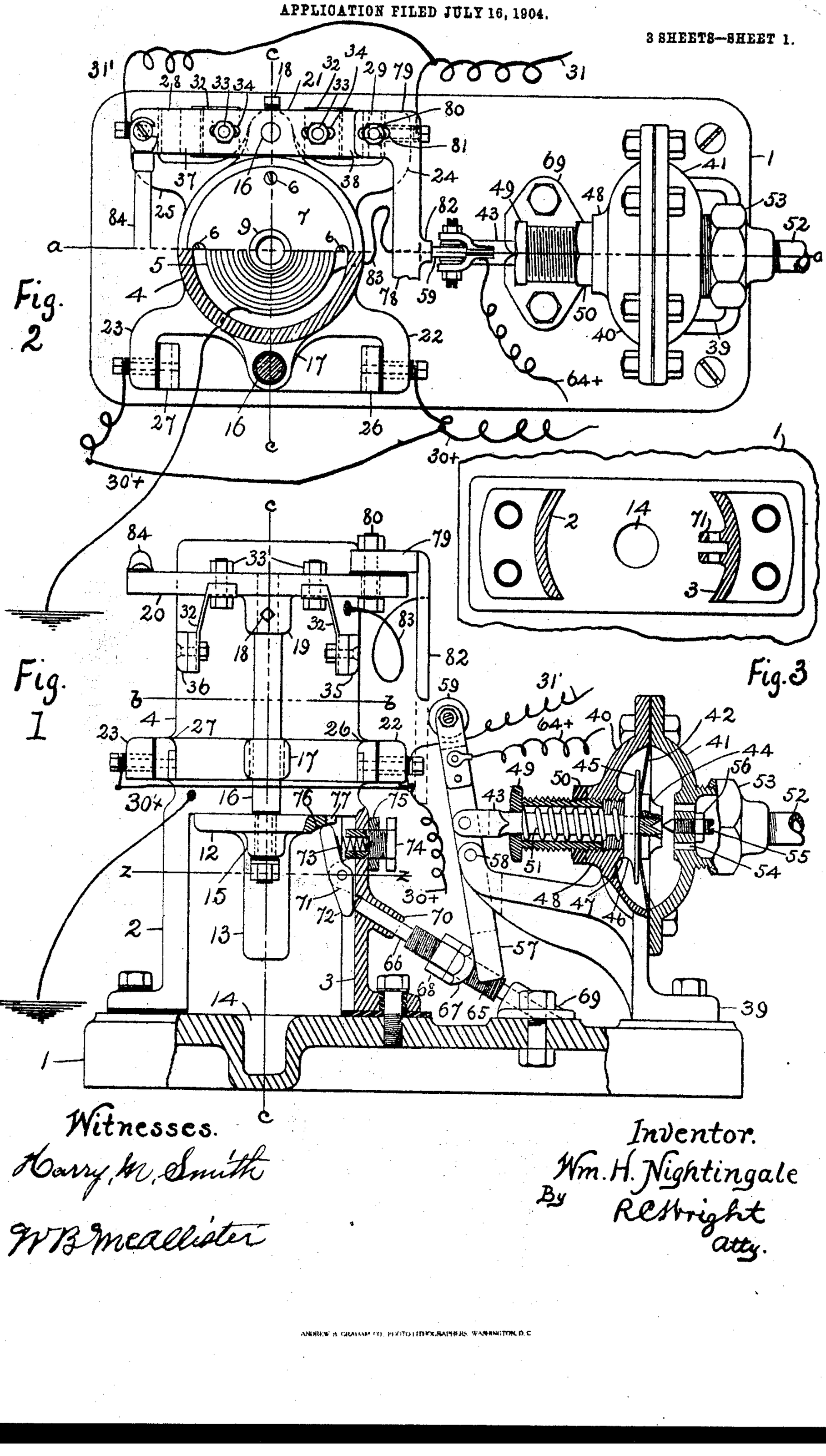

Fig. 3

Witnesses.

Harry W. Smith

W B Meallister

Inventor.

Wm. H. Nightingale

By R C Wright

Atty.

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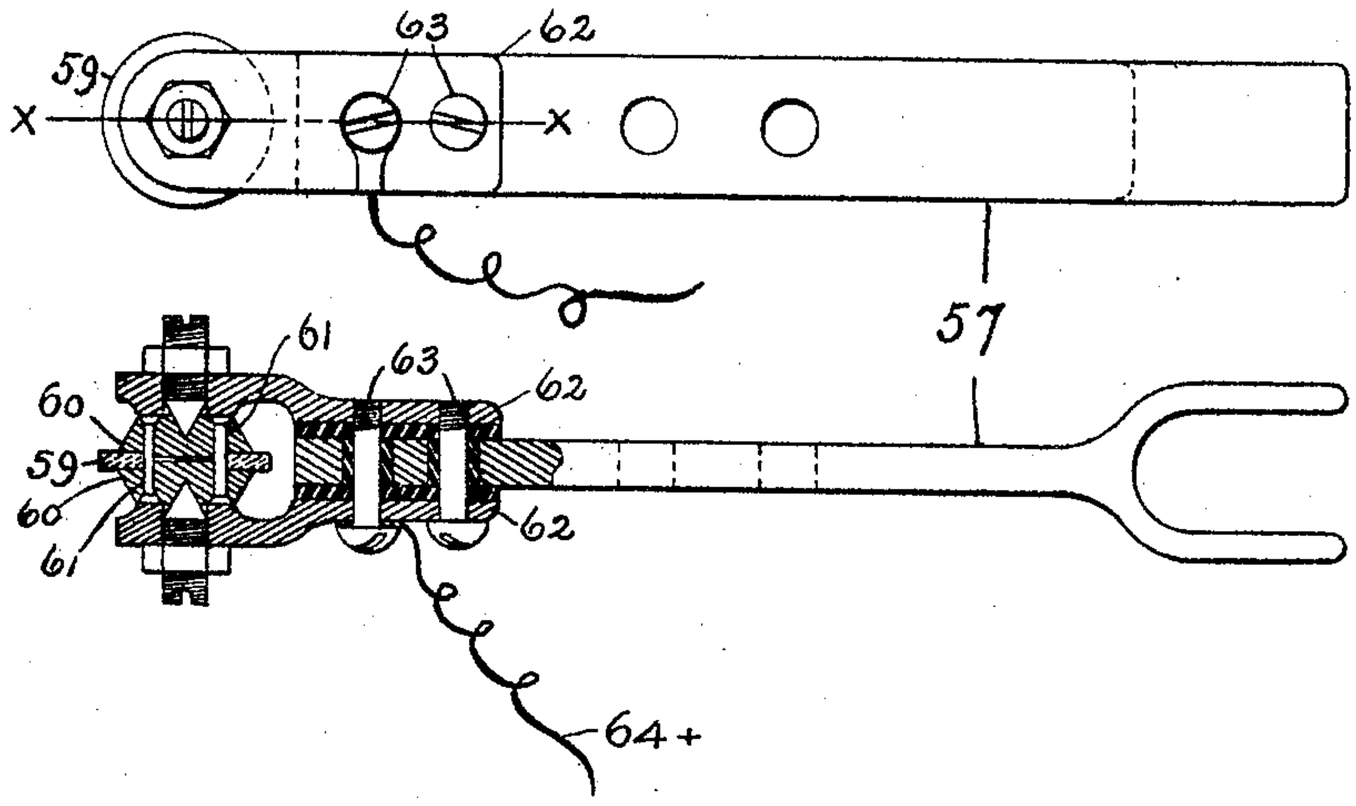


Fig. 6

Fig 7

Fig. 4

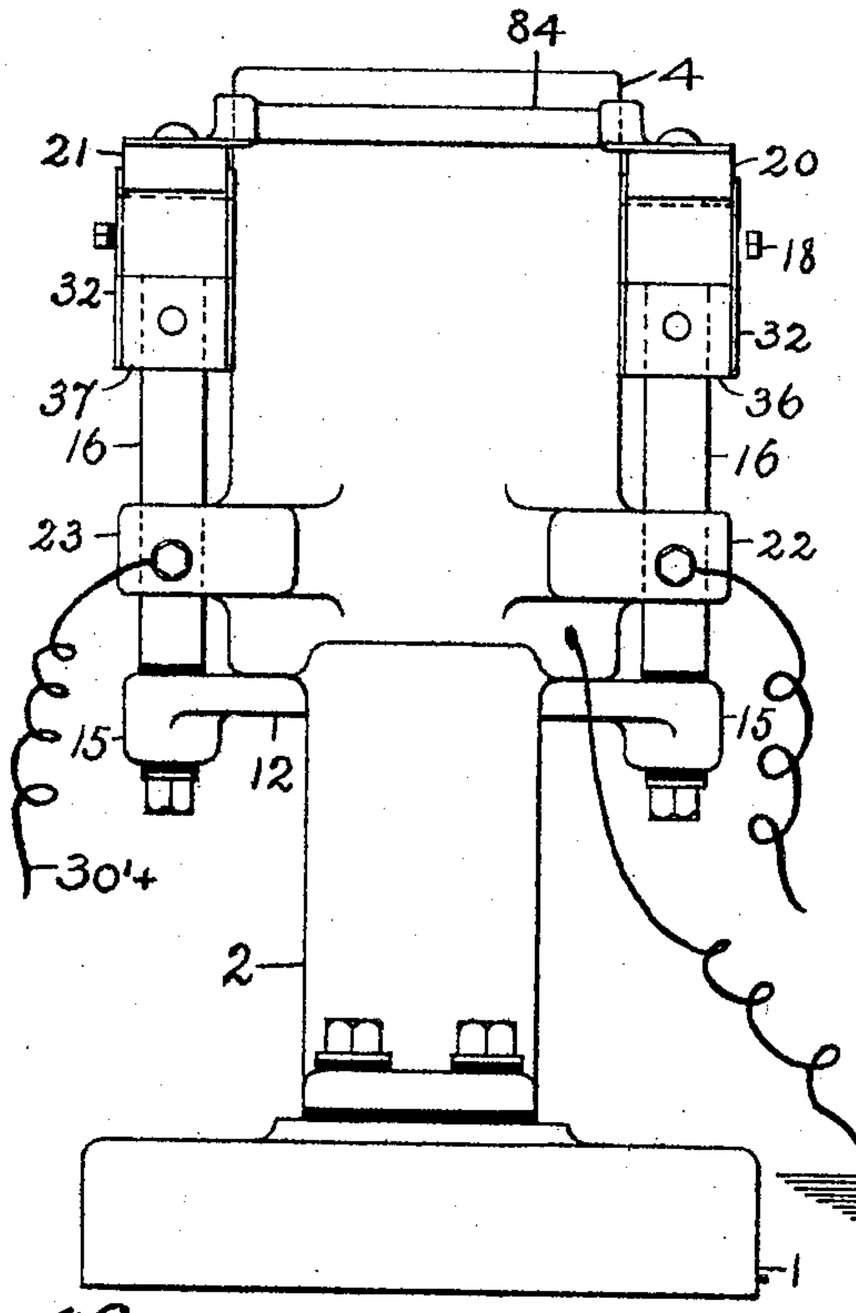
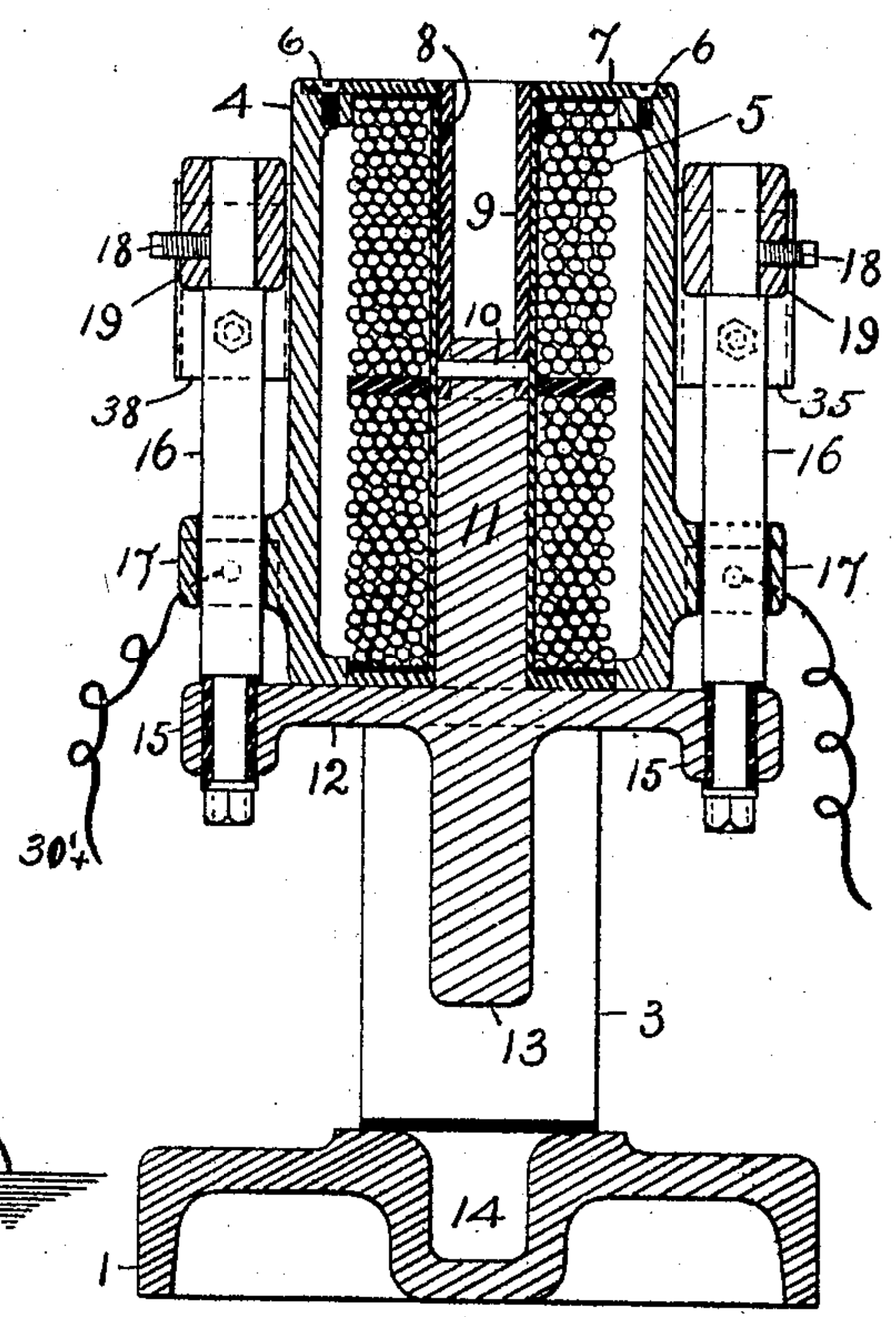


Fig. 5



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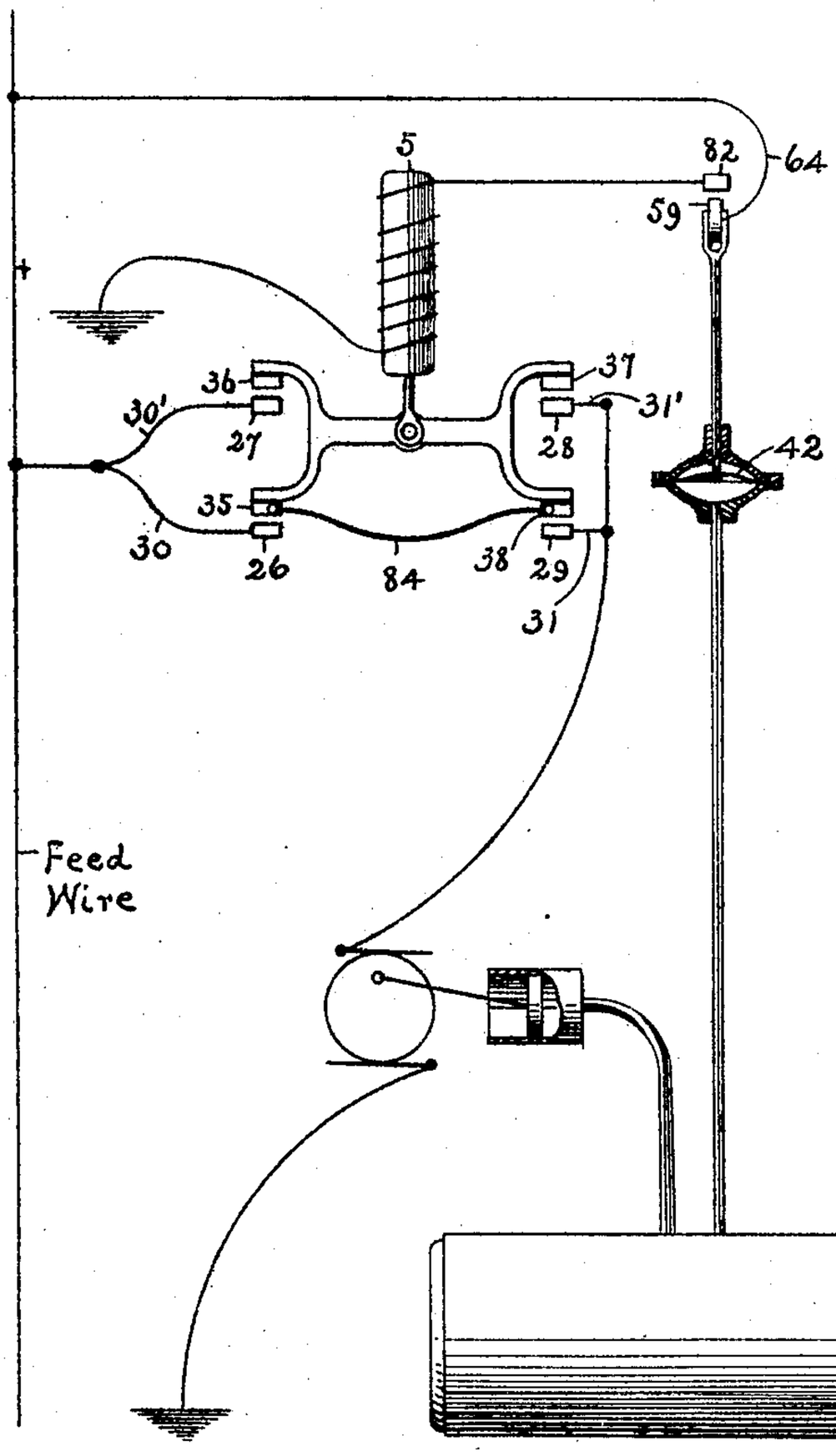

Fig. 8

Witnesses.
Harry W. Smith
W. B. McAllister

Inventor.
Wm. H. Nightingale
By R. C. Wright
Atty.

UNITED STATES PATENT OFFICE.

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

ELECTRIC AND PNEUMATIC GOVERNOR.

No. 795,726. Specification of Letters Patent. Patented July 25, 1905.

Application filed July 16, 1904. Serial No. 216,826.

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 Electric and Pneumatic Governors, of which the following is a specification.

This invention relates to mechanism for controlling the supply of electric current to air-compressors, the current being cut in and cut out by the pressure in the receiver-tank, as when a maximum pressure is produced the circuit will be closed by the air-pressure and so remain until the pressure is decreased to a predetermined degree, regulated by means within the governor, at which time the decrease of pressure will close the circuit and start the compressor, thus governing the electric flow and the maximum and minimum air-pressure. The governor, although illustrated as used for trolley-car air-brakes in connection with means for compressing and storing air by electric current, is by no means limited in use to cars or brakes, as it is equally available and valuable wherever pneumatic pressure is electrically produced for any purpose whatever.

The mechanism is illustrated in the accompanying drawings, wherein each part bears the same reference character wherever the part is shown.

Figure 1 is a side elevation with some parts in central section on line *a a*, Fig. 2. Fig. 2 is a plan or top view with a portion in section on line *b b*, Fig. 1. Fig. 3 is a section on line *z z*, Fig. 1. Fig. 4 is a front elevation. Fig. 5 is a central section on lines *c c*, Figs. 1, 2. Fig. 6 is an enlarged side view of the pneumatically-operated lever and contact-wheel. Fig. 7 is an edge view of the lever, with the wheel and attachments in section on line *x x*, Fig. 6. Fig. 8 is a diagrammatical view showing the electrical connections.

A base-plate 1 supports legs 2 3 of a case 4, within which is a solenoid 5, secured to the case by screws 6. In its upper flange 7 is the solenoid-spool 8, within which is a stem having an upper cylindrical part 9, of brass or other non-magnetic material, secured by a pin 10 to a solid cylindrical part 11, which at its lower end is integrally joined to a pole-plate 12, these latter parts being of soft cast-iron or other magnetic material to have more pull than if the whole stem is made of magnetic material, and having a lower stem 13, adapted to freely enter a pocket 14 in base-plate 1, to thereby form an air-cushion to prevent a shock when the plate descends. Pole-plate 12 has hubs 15 oppositely placed and wherein are secured rods 16, which are insulated from case 4 to prevent any leakage of current from the carbons through stems 16 to the case and thereby to the solenoid, and which extend upwardly and are guided through bosses 17 formed on case 4, and at their upper end the rods are secured by screws 18 to hubs 19 of bars 20 21, extending by the sides of the case 4 at each side in parallel relation. Upon case 4 in the same plane as bosses 17 are lugs 22 23, and at the opposite side of the case are lugs 24 25, and thereon are insulated carbons 26 27 28 29, 26 27 having connected positive incoming conductors 30 30′, and 28 29 having connected positive outgoing conductors 31 31′. Bars 20 21 have attached thereto spring-supports 32 by bolts 33 in slots 34 to permit horizontal adjustment, and at the lower ends of the supports are carbons 35 36 37 38, adapted to contact with carbons 26 27 28 29 by the means hereinafter described.

Upon base-plate 1 is secured a stand 39, having a semireceptacle 40, and thereto is secured a plate and semireceptacle 41. Within the receptacle so formed is secured a flexible diaphragm 42, having a stem 43 passing through its center, with a nut 44 at one side and a disk 45 at the opposite side, the hub 46 of the disk abutting a boss 47 of stand 39 to limit the movement of the diaphragm when under pressure. A boss 48 projects from the semireceptacle 40 and is screw-threaded to receive a follower 49, having a lock-nut 50. Within follower 49 and over stem 43 is a spring 51, which abuts the follower at one end and the disk 45 at the opposite end, and this is the means to resist the air-pressure and regulate its limit against the diaphragm 42 and the maximum pressure in the air-receiver, which is admitted to the opposite side of the diaphragm through pipe 52, coupled to cover 41 by union 53 and through passages 54. A screw 55 with a lock-nut 56 prevents too great a movement of the diaphragm by spring 51 when no pressure exists in the receiver. Coupled to stem 43 at its outer end

is a lever 57, fulcrumed to stand 39 at 58. At the upper end of the lever is a contact-wheel, and its construction can best be seen by reference to Figs. 6, 7. The wheel has a central annular ring 59 of high electrical conductivity secured between disks 60, held to each other by rivets 61. Semijaws 62 are secured to lever 57 by screws 63 and are insulated from the lever, one of the screws carrying a terminal with a positive electrical connection 64. The wheel is journaled on pivotal screws having lock-nuts. Below fulcrum 58 lever 57 at its lower end is bifurcated over the threaded part 65 of trip-rod 66, the bifurcations abutting the rounded face of nut 67, secured in place by lock-nut 68, the rod 66 being guided at one end in a seat 69, secured to base-plate 1, and at the opposite end in a boss 70 on leg 3 of case 4. Leg 3 on its inside has lugs 71, to which are fulcrumed a trip-support 72, the lower end of which is engaged by trip-rod 66, and the upper end engages at its back a spring 73, pocketed in a screw 74, which passes through leg 3 and has a lock-nut 75. The top of support 72 is rounded to fit into a seat 76 under plate 12 when the plate is in the position shown in Fig. 1; but when rod 66 pushes the trip-support the spring yields and permits the upper end of the support to assume a vertical position controlled by screw 74 and allows plate 12 to drop by gravity, there being a slot 77 in plate 12 to permit the plate to pass the support.

Secured above bars 20 21 and insulated therefrom is a cross-bar 78, having end feet 79 held by screws 80 through slotted holes 81, so that the bar can be adjusted toward or from case 4. At the back of bar 78 is a pendent contact-strip 82, passing downward for engagement with wheel 59 and having a yielding connection 83 with the solenoid and by which the solenoid is energized when wheel 59 and strip 82 are in contact. As represented in Figs. 1, 4, 5, the pressure in the receiver has reached its maximum and forced diaphragm 42 forward to its limit, bringing forward wheel 59 and formed a contact with strip 82 while it was in the position shown by dotted lines, at which time the circuit was formed between conductors 64 and 83 through strip 82, which energized the solenoid and lifted pole-plate 12, rods 16, bars 20 21, and carbons 35 36 37 38, which broke the contact between 26 35, 27 36, 28 37, 29 38, and broke the circuit from conductors 30 30′, through fuse 84 to conductors 31 31′ at which time spring 73 forced support 72 to its seat 76 under pole-plate 12. When the pressure in the air-receiver is reduced, the diaphragm 42 is carried back by spring 51 and lever 57 is moved back at its top and forward at its lower bifurcated end, rod 66 at such time being removed from contact with support 72, the amount of decreased pressure being regulated by the movement backward of rod 66 by nuts 67 68, while screw 55 prevents the distortion of diaphragm 42. When the predetermined amount of pressure has been reached, the lever 57 will have moved rod 66 to engagement with and forced support 72 from its seat 76 into slot 77. The pole-plate 12 will then drop by gravity, carrying down carbons 35 36 37 38 to contact with carbons 26 27 28 29 and contact strip 82 will be in the dotted-line position for contact with wheel 59. The circuit will be re-established between conductors 30 30′ and 31 31′ through bars 20 21, connected by fuse 84, and the compressor put in operation.

By the mechanism described the solenoid will be durable for long service, as no current passes through it except for the instant of time the strip 82 passes upward in contact with wheel 59. Fuse 84, connecting bars 20 21, not only completes the circuit from one set of carbons to the other set, but protects the armature and fields of the compressor. The circuit being completed by the contact of carbons at four points reduces the arc to a minimum when the circuit is broken.

I claim—

1. In an electric and pneumatic governor, a base-plate, a case mounted thereon, a solenoid within the case, carbons fixed to the exterior of the case and at opposite sides thereof, electrical connections to one series and from the opposite series, a pole-plate for the solenoid, two series of movable carbons having attachments to the pole-plate and whereby they are moved by gravity to contact with the fixed carbons and from contact therewith by the solenoid, a fuse between the movable carbons, and means whereby the solenoid is energized, the contact of the carbons and the electrical circuit therethrough is broken at a predetermined accumulation of pressure, and the pole-plate is released to form the circuit at a predetermined decrease of pressure, substantially as set forth.

2. In an electric and pneumatic governor, a case, a solenoid therein, a pole-plate vertically guided and carrying movable carbons at opposite sides of the case, a fuse connection between the carbons, fixed carbons at opposite sides of the case with electrical connections to the carbons of one side, and from the carbons of the opposite side, an adjustable bar mounted upon the opposite bars supporting the movable carbons, a contact-strip pendent therefrom, a diaphragm mounted within a case and means for its deflection by pneumatic pressure, a contact-wheel having connections to the diaphragm and moved thereby to contact with the pendent strip aforesaid by an accumulation of pressure upon the diaphragm, an electrical connection to the wheel, an electrical connection from the strip to the solenoid and through which the solenoid is

energized and the contact between the movable and fixed carbons is broken, and means to hold the carbons separated until a predetermined decrease of pressure upon the diaphragm has taken place.

3. In an electric and pneumatic governor, a solenoid, a pole-plate having connections to movable carbons, fixed carbons having electrical connections, the circuit being closed when all of the carbons are in contact, at which time the solenoid-circuit is broken, the current at such times passing through the carbons to an electric motor, means to form the solenoid-circuit, energize the solenoid, lift the pole-plate and the movable carbons and break the motor-circuit at a predetermined increase of pressure, and means to support the movable carbons out of contact until the pneumatic pressure has decreased to a predetermined amount.

4. In an electric and pneumatic governor, a solenoid, carbons exterior to the solenoid and having leading-in and leading-out conductors, a pole-plate lifted by the solenoid, connected carbons attached to and moved with the pole-plate, means whereby the circuit is closed to energize the solenoid, lift the pole-plate, and the movable carbons and thereby break the circuit through the carbons, at a predetermined increase of pressure means to lock and support the pole-plate when the circuit is broken, and means at a predetermined decrease of pneumatic pressure to unlock and release the pole-plate, drop the movable carbons by gravity and form the circuit to a motor.

5. In an electric and pneumatic governor, a solenoid having means for its energizing by the action of accumulated pneumatic pressure, a pole-plate actuated in one direction by the solenoid and means to then lock it in position, means to release the lock by a decrease of pneumatic pressure and permit the pole-plate to be actuated by gravity, and means to cushion the pole-plate's descent.

6. In an electrical and pneumatic governor, a solenoid and electrical connections therefor, electrical motor connections closed and broken by the solenoid and its connected mechanism, a pneumatically-actuated diaphragm having means to make the circuit to the solenoid at a predetermined increase of pressure and thereby break the motor's electrical connections aforesaid, and means to move the diaphragm in an opposite direction as the pneumatic pressure decreases which releases a latch and allows the motor's electric circuit to be closed.

7. In an electric and pneumatic governor, a diaphragm actuated by pneumatic pressure and having means to resist the pressure and thereby govern the amount of movement of the diaphragm due to a desired maximum pressure, and also the opposite movement due to a desired minimum decrease of pressure, a solenoid having electrical conductors whereby it is energized, means operative by the diaphragm to close the circuit to the solenoid, and break the electrical circuits to a motor by the joint action of the diaphragm and the solenoid through their connected mechanisms when the diaphragm is deflected in one direction due to a maximum pneumatic pressure, and when the diaphragm is deflected in an opposite direction due to a minimum pneumatic pressure, to again make the circuit to the motor.

8. In an electric and pneumatic governor, a contact-wheel comprising an annular ring of highly-conducting material, partially incased and held in oppositely-disposed disks rotatable on adjustable pivotal bearings, insurlarly secured to a radially-movable bar attached to a diaphragm operative by pneumatic pressure, to form and break an electrical circuit by rolling contact, which continually presents a new surface, thus lessening the disintegration and burning produced by the arc.

9. In an electric and pneumatic governor, a magnet adapted to be energized on maximum pressure, a switch adapted to be opened by the magnet when energized, and a latch adapted to hold the switch in open position, and to be released on minimum pressure, whereby the switch is closed by gravity.

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

WILLIAM H. NIGHTINGALE.

Witnesses:

RANSOM C. WRIGHT,

WILLIAM C. STOEVER.