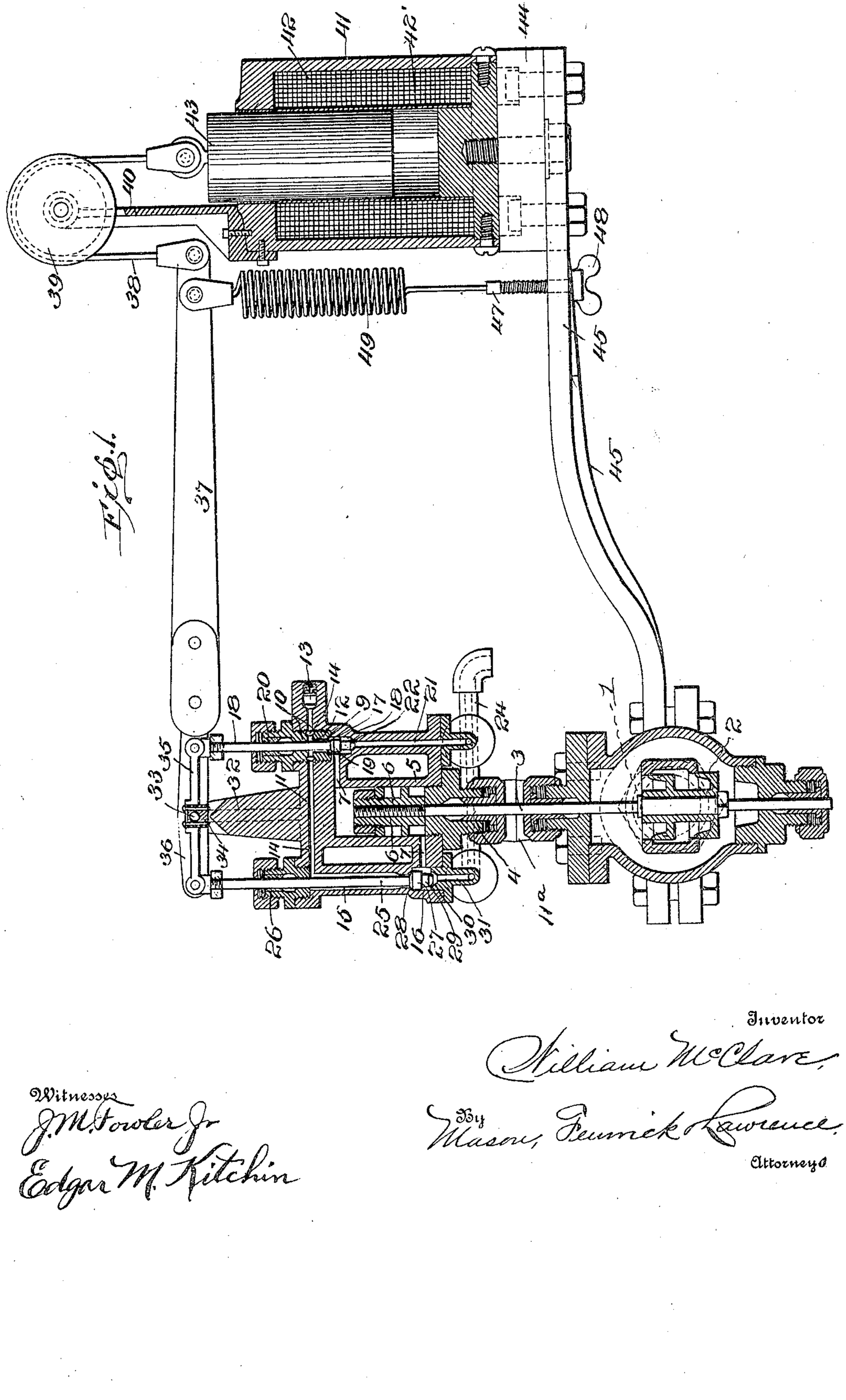
No. 812,669. PATENTED FEB. 13, 1906.

W. McCLAVE.

FURNACE DRAFT CONTROLLER.

APPLICATION FILED NOV. 3, 1904.

6 SHEETS—SHEET 1.



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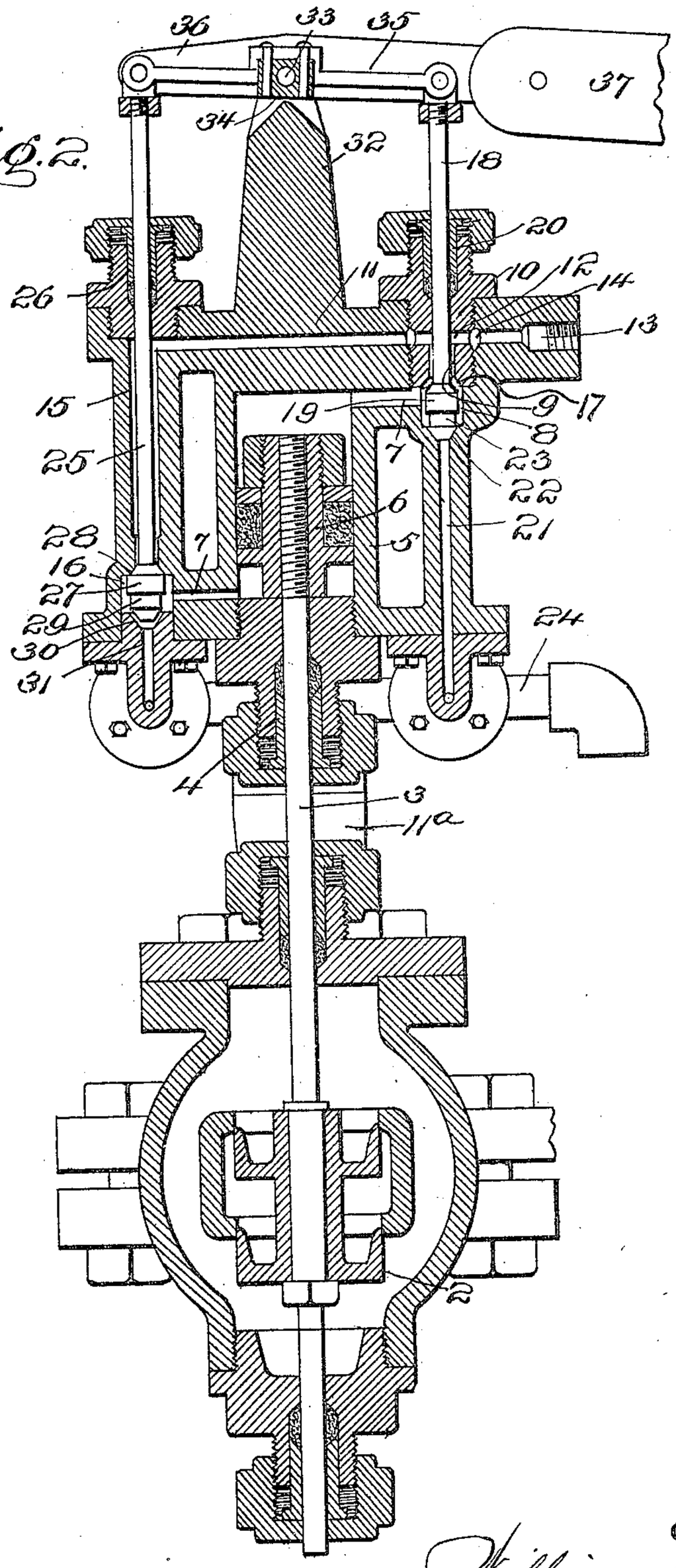
6 SHEETS—SHEET 2.

Fig. 2.



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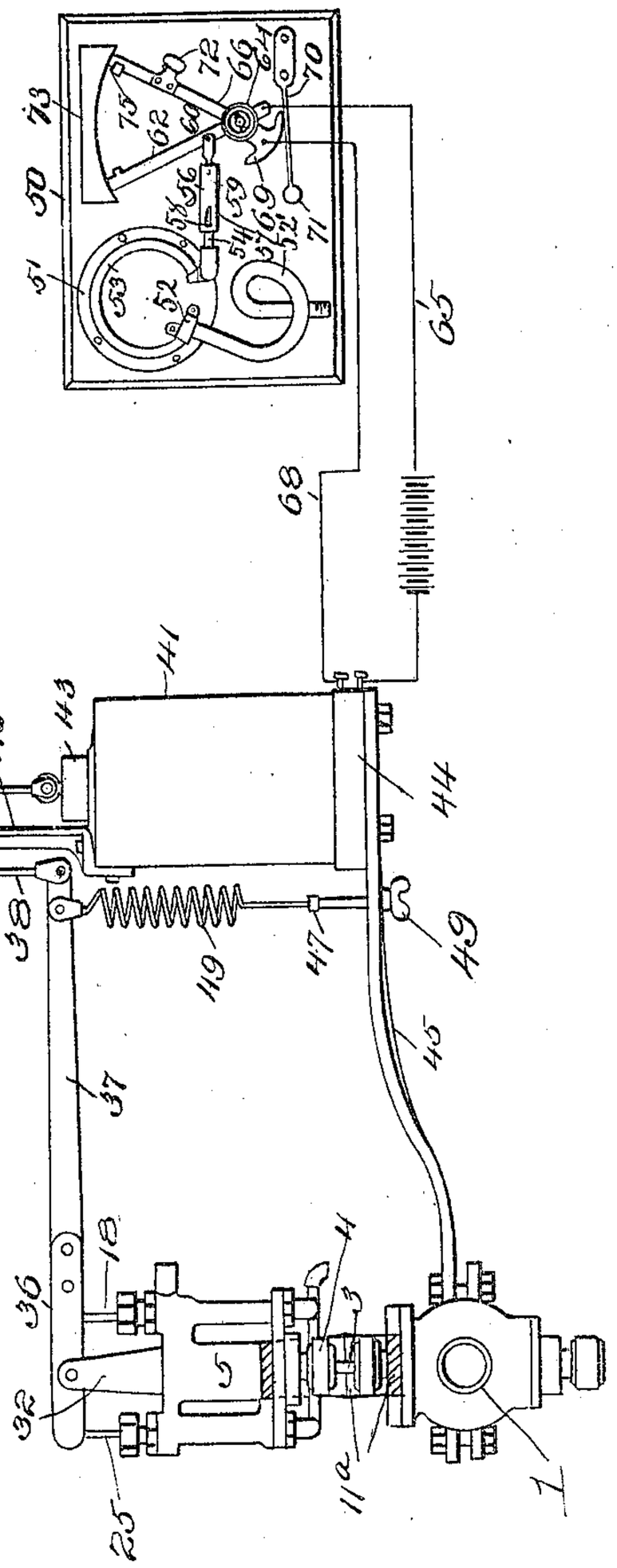
6 SHEETS—SHEET 3.

Fig. 3.



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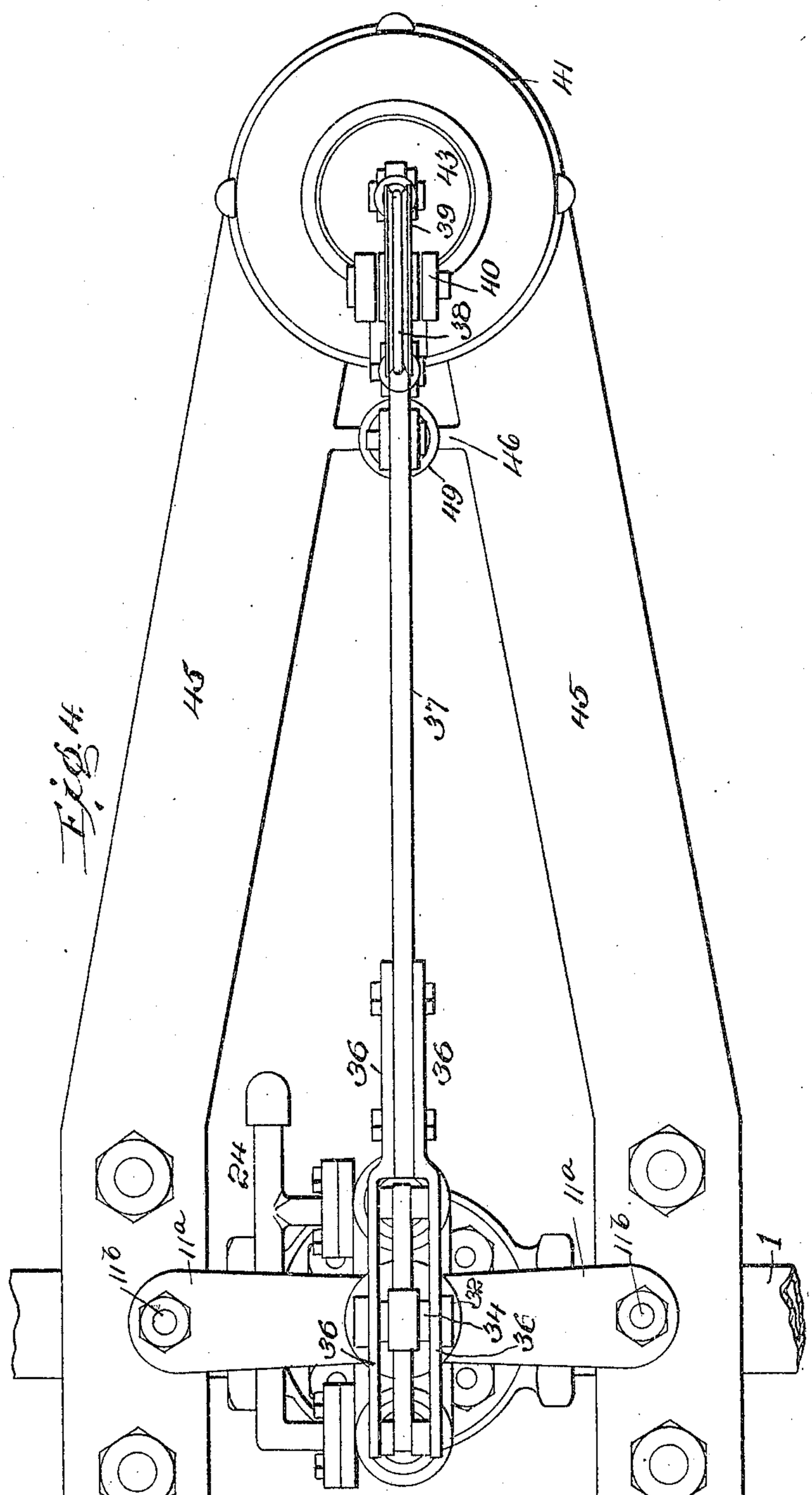
6 SHEETS—SHEET 4.

Fig. 4.



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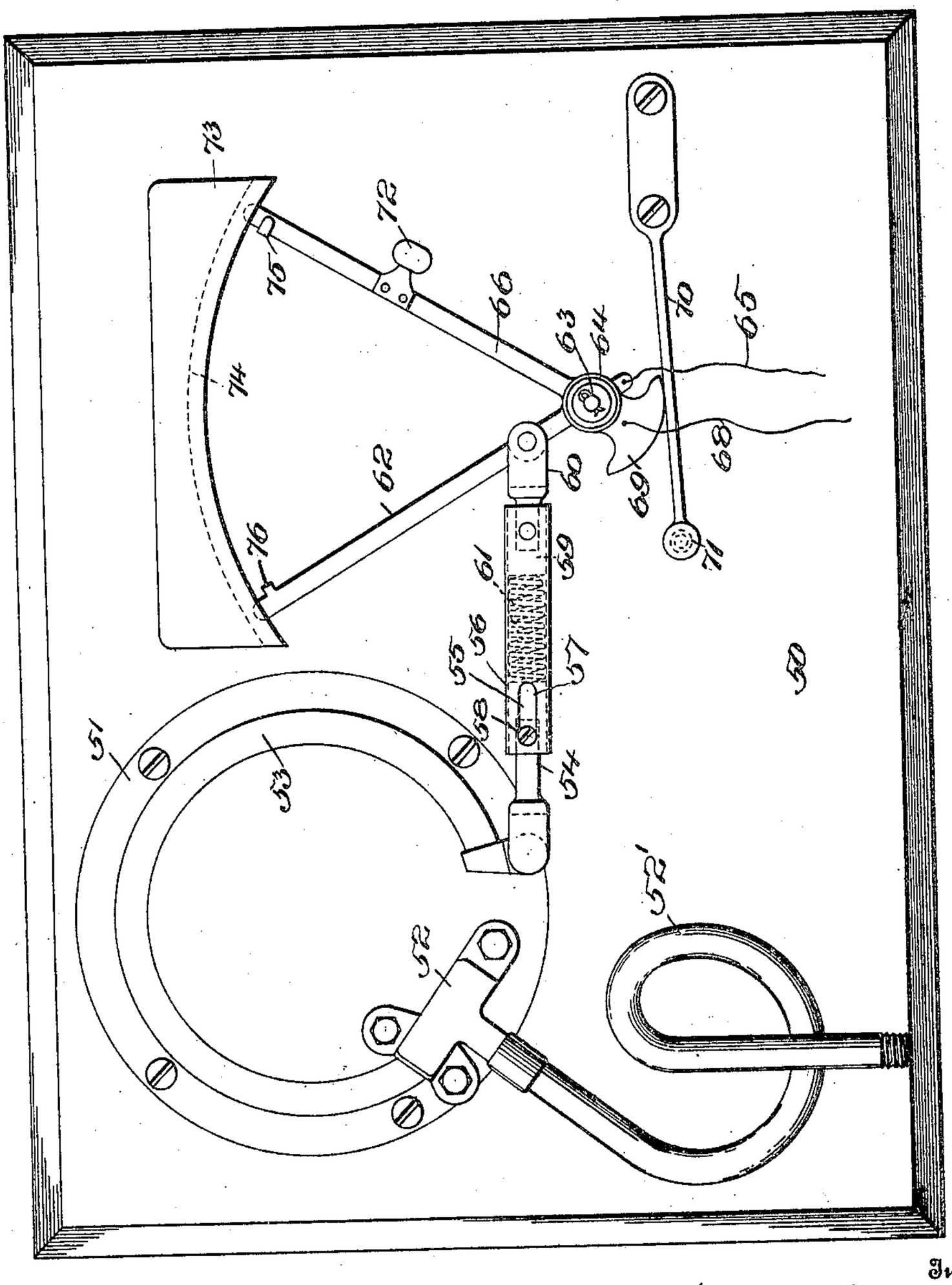
6 SHEETS—SHEET 5.

Fig. 5.



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6 SHEETS—SHEET 6.

Fig. 7.

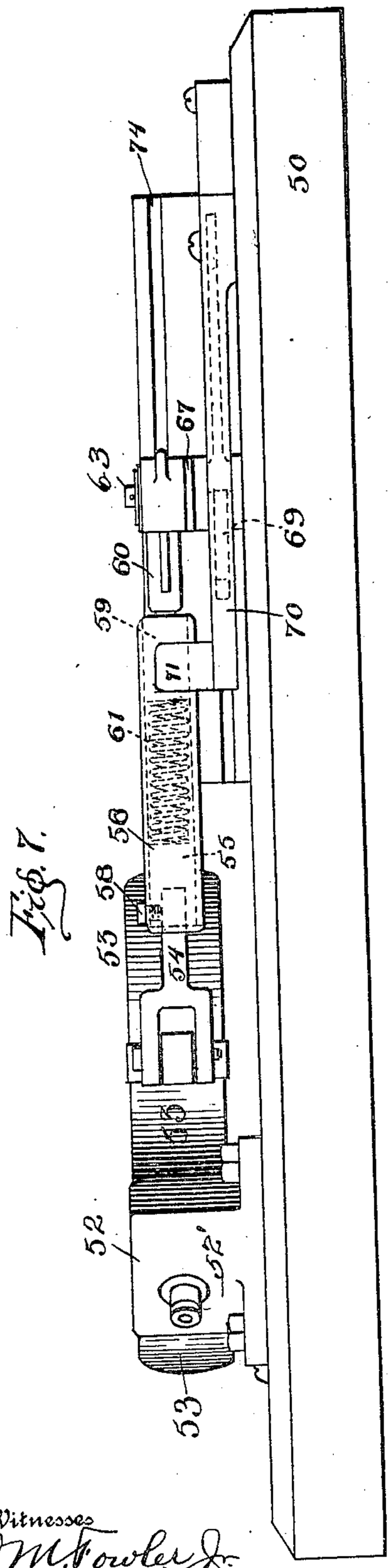
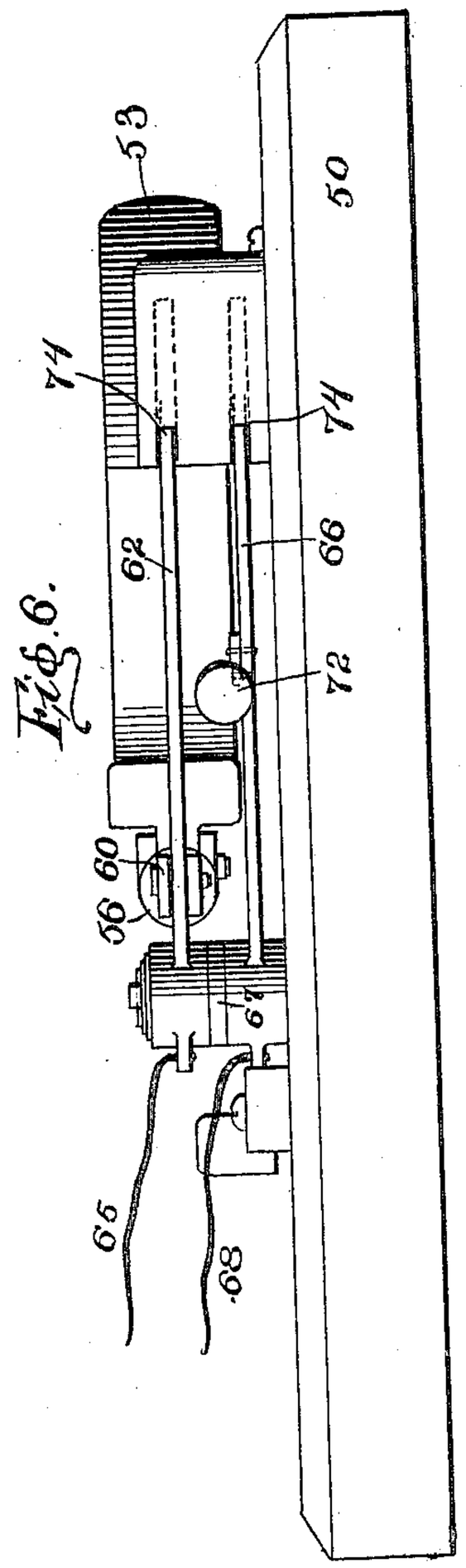


Fig. 6.



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UNITED STATES PATENT OFFICE.

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FURNACE DRAFT-CONTROLLER.

No. 812,669. Specification of Letters Patent. Patented Feb. 13, 1906.

Application filed November 3, 1904. Serial No. 231,251.

To all whom it may concern.

Be it known that I, WILLIAM McCLAVE, a citizen of the United States, residing at Scranton, in the county of Lackawanna and State of Pennsylvania, have invented certain new and useful Improvements in Furnace Draft-Controllers; and I do hereby declare the following to be a full, clear, and exact description of the invention, such as will enable others skilled in the art to which it appertains to make and use the same.

This invention relates to improvements in pressure-regulators, and is directed more particularly to mechanism for controlling the supply of air to boiler-furnaces for governing the combustion therein, and thereby controlling the pressure of steam generated in the boilers heated thereby.

The object in view is the provision of means which shall be extremely sensitive and at the same time be capable of controlling the supply of steam at high pressure employed for producing forced draft.

A further object of the invention is the provision of a sensitive controlling means for steam-pressure, such controlling means being adapted to be operated with very short movements, means being provided producing relatively long movement and further means being provided for transforming the long movements into short movements for increasing the power thereof.

With these and further objects in view the invention comprises the combination with a valve controlling the flow of steam, a stem therefor, a piston connected with said stem, and a cylinder inclosing said piston, suitable ports being arranged for supplying steam to the piston for causing actuation thereof for opening and closing said valve, the balanced valves controlling the passage of steam within said ports, and means for effecting simultaneous actuation of said valves.

The invention further comprises the combination with a piston and a cylinder inclosing the same, said cylinder being formed with ports for supplying fluid under pressure to said piston, of balanced valves for controlling the supply of fluid under pressure through said ports, the stroke of said valves being relatively short, power-supply means having a relatively long stroke, and means for transmitting motion from said power-supply means to said valves, said transmitting means serving to transform the relatively long stroke of the power-supply means into relatively short strokes of the valves with a corresponding increase in the power relative to the decrease in the length of the stroke.

The invention further comprises certain other novel constructions, combinations, and arrangements of parts, as will be hereinafter fully described and claimed.

In the accompanying drawings, Figure 1 represents a longitudinal central sectional view through a controlling mechanism and a solenoid for actuating the same embodying the features of the present invention. Fig. 2 represents a similar view of the controlling mechanism on an enlarged scale. Fig. 3 represents a view in side elevation of the parts shown in an assembled relation. Fig. 4 represents a top plan view of the controlling mechanism. Fig. 5 represents a view in side elevation of the circuit-closing apparatus and pressure-gage for actuating the same. Fig. 6 represents a side view of the same. Fig. 7 represents a top plan view thereof.

Referring to the drawings by numerals, 1 indicates a steam-supply pipe extending from any suitable source of supply to any desired point of utilization, it being clearly apparent that the present invention is not to be limited to any particular art and while adapted especially for governing the supply of steam employed for producing the forced draft of a furnace is by no means restricted to such use, but is susceptible of employment wherever it is desired to effectually control the steam to any particular point by a highly-sensitive mechanism. The pipe 1, therefore, may be of any preferred type and has interposed in its length a suitable valve 2, preferably of the balanced type; but of course any common form of valve may be used. Extending from the valve 2 is its stem 3, which projects upwardly through the usual packing-gland of the valve and through a packing-gland 4 of a cylinder 5, the upper end of the stem 3 carrying a piston-head 6 within the cylinder 5.

At each end of the cylinder 5 is formed a port 7, each of said ports serving both as an intake and an exhaust port, the outer end of the upper port 7 communicating with a valve-chamber 8, which valve-chamber is adapted to be supplied with steam under pressure through the passage 9, formed in a plug 10,

threaded into the casing 11, of which the cylinder 5 is a part. The casing 11 is preferably supported by brackets 11^a, secured thereto or formed integral therewith and engaging the casing of valve 2, each of said brackets 11^a being preferably formed of separable parts connected by a bolt or other suitable connecting means 11^b. The plug 10 is formed with a transverse passage 12, communicating with any suitable pressure-supply pipe at 13, it being understood that the pressure ordinarily used is relatively high, and the present improved apparatus is especially adapted for use under high pressure. The plug 10 is further formed with an annular groove 14, arranged in the same horizontal plane with passage 12, so that steam supplied to passage 12 will at the same time be permitted to pass about the plug 10 and will be directed by passage 14 into passage 15, said passages 14 and 15 being formed in the casing 11 and the passage 15 communicating with the valve-chamber 16, with which the lower port 7 communicates. The passage 9 is formed with a valve-seat 17 at its lower end just outside the valve-chamber 8, and a valve-stem 18 extends longitudinally through the passage 9 and carries a valve 19 at its lower end in position for engaging the seat 17 when the stem 18 is at its uppermost position, whereby the passage 9 may be closed. The valve-stem 18 is of course of less diameter than the passage 9 and when the valve 19 is off its seat will permit the passage of steam into the chamber 8. The stem 18 extends upwardly throughout the length of the plug 10, through a packing-gland 20, and upwardly into engagement with operating means hereinafter described. An exhaust-port 21 communicates with the valve-chamber 8 just beneath and preferably in line with the lower end of the passage 9 and is provided with a valve-seat 22, adapted to receive a valve 23, formed integral with or suitably connected to the valve 19 in such manner that whenever the valve 19 is off its seat the valve 23 will be upon the seat 22 and whenever the valve 19 is upon its seat the valve 23 will be off its seat, the length of the stroke of the valve-stem 18 being of course sufficient for alternately bringing the valves 19 and 23 to their respective seats. The lower end of the exhaust-port 21 may communicate with any suitable waste-pipe 24, or the exhaust may be disposed of in any other manner desired. The passage 15 is at its lower end of the same diameter as the passage 9, and the valve-stem 25 extends longitudinally throughout the passage 15, said stem 25 being of the same diameter as valve-stem 18 and extending upwardly from the passage 15 through a suitable stuffing-box 26 and beyond the stuffing-box to an operating-lever, hereinafter described. The lower end of the valve-stem 25 carries a valve 27, disposed within the valve-chamber 16 and adapted to engage a seat 28, formed at the lower end of the passage 15.

A valve 29 is formed integral with or suitably secured to the valve 27 and is positioned for engaging a seat 30, formed at the upper end of an exhaust-port 31, communicating with the valve-chamber 16. The exhaust-port 31 communicates with the waste-pipe 24 in a similar manner to exhaust-port 21. The valves 27 and 29 are so disposed within the chamber 16 that when a sufficient stroke is imparted to the valve-stem 25 one of said valves will be unseated and the other seated, and the reverse stroke of the stem will produce a reverse action, one of said valves being always seated in a manner similar to the operation of valves 19 and 23. Now in order that the piston 6 may be actuated when desired and may be effectually controlled in its operation I have provided means for reciprocating the valve-stems 18 and 25 alternately in opposite directions, so that when the valve 23 is upon its seat 22 and fluid under pressure is being supplied to the upper end of the cylinder 5 the valve 29 must be off its seat 30 and the lower end of the cylinder thereby opened to the exhaust. The unseating of the valve 27 and seating of valve 29 through the connections between valve-stems 25 and 18 will produce an unseating of the valve 23 and a seating of valve 19, whereby the upper end of the cylinder 5 is open to the exhaust and the lower end supplied with fluid under pressure. It is to be noted that the pressure upon valves 19 and 27 is equal, and said valves are thus balanced with respect to each other, the upper ends of the stems 18 and 25 being connected for producing the balanced action, as will now be described.

Preferably from the upper end of the casing 11 projects a fulcrum 32, which is bifurcated at its upper end, and in the arms of such bifurcation is journaled a shaft 33, carrying a block 34 between the arms of said bifurcation. To the block 34 is bolted or otherwise rigidly secured a spring 35, extending in opposite directions from the block and pivotally engaging at its outer ends the upper ends of the respective valve-stems 18 and 25. Each of said valve-stems is illustrated as threaded into a suitable nut at its upper end, which nut is bifurcated and incloses the respective free end of the spring 35. However, any suitable connections may be made between the valve-stems and the spring 35. Suitable bars 36 36 are fixed to the block 34 between the arms of the bifurcation 32, and said arms 36 are secured upon the opposite sides of an operating-lever 37, which lever extends to a point at a distance from the mechanism above described and is engaged at its free end by a chain, cable, or other flexible operating means 38, extending about a pulley or other antifriction means 39, jour-

naled in the standard 40, mounted upon the casing 41 of a solenoid 42. The flexible connecting means 38 extends downwardly from the pulley 39 and at its end opposite that engaging lever 37 engages the core or plunger 43 of the solenoid 42. A brass or other non-magnetic cylinder 42′ is arranged within the winding of the solenoid 42 and surrounds the plunger 43 and extends a sufficient distance above the winding to prevent the possibility of sticking of the plunger against the cap of the casing 41.

The solenoid 42 may be of any preferred type and may, if desired, take the form of an ordinary electromagnet, it being understood that the solenoid may be termed an "electromagnet," as the solenoid is considered by me as one species of the general class of electromagnets. It of course will be obvious that an armature might be substituted for the core 43 with no suggestion of invention over the present structure, and I propose to utilize either the armature or the moving core, as is preferred. For the purpose of concentration of the lines of force I preferably inclose the winding 42 in the casing 41, which is of soft iron or other magnetic material, while the standard 40 is preferably of brass or other non-magnetic substance. The solenoid 42 rests upon any preferred base 44, carried by brackets 45 45, connected to the pipe 1. A web 46 connects the brackets 45 at a point contiguous to the base 44, and a bar 47 extends therethrough and has threaded upon its lower end a wing-nut 48, adapted to be threaded up against the web 46 for adjusting the rod 47 longitudinally. The upper end of the rod 47 connects with a tension-spring 49, and said spring 49 at its upper end engages the lever 37 near the point of engagement of the chain or cable 38. Thus it will be seen that the weight of the core 43 is counterbalanced by the weight of the lever 37 and by the action of spring 49, the tension of spring 49 being governed by the wing-nut 48 and being maintained preferably at that point, producing an equal balance of the core 43.

As will be hereinafter fully described, suitable mechanism is provided for closing the circuit of the electromagnet 42, which mechanism serves to maintain the circuit in a broken condition until the pressure of steam passing through the pipe 1 or the steam within the boiler being heated by the furnace supplied with air by the steam passing through the pipe 1 has arrived at the desired degree, when the circuit will be closed, the plunger 43 drawn downwardly, and the lever 37 elevated. Here it is to be observed that the stroke of the core 43 produces a relatively long stroke of the end of lever 37, engaged by flexible connection 38, while the opposite end of said lever needs only to move a relatively short distance, so that the difference in the distance of movement of the pivoted end of the lever 37 relative to the movement of the free end must mean an increase in the power of such limited movement, so that the valve-stems 18 and 25 may be moved against a relatively great resistance. With the high-pressure steam being utilized it is necessary that the packing within the boxes 20 and 26 must be pressed down until a relatively great friction is caused, and this friction is overcome by reason of the fact that movement of the valves 19 and 27 is only relatively small compared with the moved ment of the core 43, so that the force with which the core 43 is drawn downwardly will be multiplied in a ratio proportionate to the difference in distance of the travel of said plunger and the travel of said valves. For the sake of illustration, assuming that the valves 19 and 27 have a stroke of one-eighth of an inch and the core 43 has a stroke of one inch, it will be observed that the force with which the core 43 moves will be multiplied eight times as applied to the valve-stems 18 and 25. Of course it will at the same time be apparent that the power transmitted from the core 43 to the valves 19 and 27 will be decreased to the extent of the resistance of spring 49, the amount of power with which the plunger 43 is drawn downwardly minus the resistance of the spring 49 being multiplied relative to the length of the lever 37. This multiplication of power by reduction in the length of the stroke makes possible the overcoming of the friction occasioned by the packing within the stuffing-boxes 20 and 26 by a comparatively weak magnet. If the length of stroke of the valves 19 and 27 were reduced to one-sixteenth of an inch while the core 43 moves an inch, the power of the core, minus the pressure of spring 49, would be increased sixteen times. The ratio of course will be maintained with any alteration in the distance of stroke of the valves 19 and 27 relative to the length of stroke of the core 43, the only difference in apparatus with cores having various lengths of stroke being the difference in the length of lever 37.

The spring 35 is preferably relatively stiff, so that the stem 18 will normally be moved with the movement of lever 37; but said spring 35 is sufficiently resilient to permit one of the valve-stems to be moved to a greater extent than the other. For instance, if by wear or from other causes the relative position of the valves 19 and 27 and valves 23 and 29 should become slightly changed with respect to each other and their seats, so that, for instance, the valve 19 should become seated upon the downward stroke of the core 43 before the valve 29 has become seated, further movement of the lever 37 will not be arrested; but the spring 35 will permit the valve 29 to be forced downwardly to its seat. The arm of the spring 35 which engages valve-stem 18 will be sprung sufficiently out of its

normal position to accommodate the necessary movement of the stem 25. Of course the foregoing is merely given as illustrative of the operation of spring 35, and said spring may of course serve to permit the valve 19 to take its seat should the valve 29 become seated before the lever 37 has completed its stroke. In other words, while the valves 19 and 27 and valves 23 and 29 and their stems are adjusted to take their seats with respect to each other without any giving on the part of the spring 35 and the adjustment of said valves and connecting parts is made so accurately ordinarily that the spring 35 will maintain its normal position with one of its arms extending in line with the other if from any cause the said adjustment should become deranged the spring 35 will maintain the balanced valves in operative condition, the arms of the spring 35 moving out of line with the other whenever necesary for accommodating any required extra movement occasioned by any slight derangement of the adjustment of the balanced valves. Assuming, therefore, that the valves are perfectly adjusted, the downward movement of the actuating element of the electromagnet will elevate the free end of the lever 37 and will cause the valve 19 to take its seat, the valve 27 of course leaving its seat, the valve 29 taking its seat, and the valve 23 leaving its seat, so that the steam within the upper end of the cylinder 5 may be exhausted past the valve 23 out port 21, and live steam may enter the lower port 7 past the valve 27, which steam will effect upward travel of the piston 6, elevating and closing the valve 2, so that the supply of steam within the pipe 1 is cut off or otherwise controlled, according to the particular adaptation of the controlling mechanism above set forth. Upon decrease of the pressure within the boiler being heated or at any predetermined condition the circuit-closer, hereinafter described, will break the circuit of the magnet 42 and release the core 43, permitting the lever 37 to be drawn downwardly under the action of spring 49. The downward stroke of the lever will unseat the valve 19, will cause the valve 23 to take its seat, will unseat the valve 29, and cause the valve 27 to take its seat, so that the steam within the lower end of the cylinder 9 will escape through exhaust-port 31 and live steam be admitted through the upper port 7 into the upper end of the cylinder 5 for moving the piston 6 downwardly and again opening the valve 2.

As above suggested, I propose to provide a circuit making and breaking apparatus which shall control the electromagnet 42 and cause the same to be energized whenever the required pressure has been attained. Of course any of a series of various forms of thermostats or other contact-making and breaking apparatus might be employed; but I preferably utilize a structure, such as is disclosed in Figs. 5, 6, and 7, in which 50 indicates a base of non-conducting material, to which is secured a preferably metallic disk 51. Bolted or otherwise rigidly secured to the disk 51 is a pipe-coupling 52, communicating with a coiled-pipe pressure-gage 53, the said gage 53 being rigidly connected to the coupling 52 and curving about the disk 51, preferably normally concentric thereto and having its end opposite that engaging the coupling 52 free to move relative to the amount of pressure within the gage. A pressure-supply pipe 52′ connects with the coupling 52 for supplying pressure to the gage 53. To the free end of the gage 53 is secured a rod 54, having its free end extending into a plunger 55, movably mounted within a cylindrical casing 56. A slot 57 is formed longitudinally within the casing 56, and a screw 58 or other securing means is passed through the plunger 55 into engagement with the end of the rod 54 for locking said rod and plunger together, the said screw extending outwardly into the slot 57 and being movable longitudinally thereof. At the opposite end of the cylinder 56 is preferably fixed an insulating-block 59, into which extends the rod 60, similar in construction to the rod 54. A spring 61 is disposed between the block 59 and the plunger 55, said spring being of sufficient length for making it necessary to compress the same when assembling the parts in order to insert the screw 58 into the plunger 55 through the slot 57, so that said plunger is normally pressed outwardly by the spring and maintains the screw 58 in contact with the outer end of the slot 57. The outer end of the rod 60 pivotally engages a contact-arm 62, which arm is journaled on a stub-shaft 63 and is insulated therefrom by a suitable insulation 64, the lower end of the arm 62 being adapted to carry an electrical conductor 65, constituting a part of the circuit of magnet 42. An arm 66 is journaled upon the shaft 63 in a similar manner to arm 62 and is insulated from the arm 62 by a suitable insulating-washer 67, the lower end of the arm 66, carrying an electrical conductor 68, also constituting a part of the circuit of said magnet. The lower end of the arm 66 terminates in a segment 69, and a spring 70 is fixed to the base 50 and positioned for normally engaging the periphery of said segment. A suitable handle 71 is preferably formed at the outer end of the spring 70 for facilitating depressing of the spring for releasing engagement thereof with the segment. Any suitable knob or handle 72 is connected with the arm 66 for facilitating manual moving of the same upon its pivot. At the upper ends of the arms 62 and 66 is arranged a guiding-block 73, formed with its under surface struck on the arc of a circle, as clearly seen in Fig. 5, said block being formed with parallel grooves 74 74, into

which the ends of the arms 62 and 66 extend, the grooves thus serving to guide the arms in their movement. A pin or other suitable device 75 extends laterally from the arm 66 into the path of movement of a lug 76, extending from arm 62, it being of course understood that the arms 62 and 66, the lug 76, and the pin 75 are electrical conductors.

In operation the arm 72 may be adjusted to any desired position, and as the pressure increases within the gage 53 the arm 62 will be swung upon its pivot, due to the outward movement of the free end of the gage 53, such outward movement of the gage of course occasioning longitudinal movement of the bar 54, which operation through the action of the plunger 55 tends to compress the spring 61; but as said spring has already been partially compressed the same will have sufficient resistance to occasion longitudinal movement of the casing 56 and connected parts, so that the arm 62 must swing upon its pivot. This operation continues until the pressure has arrived at the maximum, which maximum of course is governed by the position of the arm 66. Upon arriving at this point the pressure is sufficient for having caused the gage 53 to move outwardly to a sufficient extent for causing the lug 56 to engage the pin 55, whereupon current will flow, for instance, from the battery (seen in Fig. 3) through conductor 65, arm 62, lug 76, pin 75, arm 66, conductor 68, through the winding of magnet 42, and thence back to the battery. The supply of steam for producing forced draft is thus cut off by the operation of the mechanism above described, and when the temperature of the furnace has dropped to a sufficient degree for making any appreciable decrease in the pressure within the boiler the free end of the gage 53 will begin to move inwardly, effecting a breaking of the circuit above described, which operation will immediately open the steam-supply pipe. This operation will normally continue; but if for any reason—as, for instance, the polarization of the cells of the battery or the breaking of the circuit by accident—the electromagnet should not be energized upon contact of the lug 76 with pin 75 the upper end of gage 53 may continue to move outwardly, simply resulting in compressing the spring 61 until the screw 58 arrives at the opposite end of slot 57 from that usually occupied. If normal conditions have not been restored and the pressure continues to increase, further outward movement of the free end of gage 53 will be accommodated by reason of the fact that sufficient pressure upon the arm 76 will cause the arm 66 to drag or move upon its pivot against the pressure of the spring 76. Thus it will be observed under ordinary conditions that the circuit of the electromagnet will be closed in proper time, and under exceptional conditions provision is made for preventing undue straining of the gage 53.

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

1. In a draft apparatus, the combination with a pressure-gage and an electric circuit-closing means connected therewith, of an electric circuit including a magnet and a source of electrical energy, a lever adapted to be actuated by said magnet, a draft-controlling valve, a piston connected therewith for operating the same, a cylinder inclosing said piston, admission and exhaust valves for said cylinder and yieldable connections between said lever and said admission and exhaust valves.

2. In a draft apparatus, the combination with a draft-controlling valve, a piston connected therewith, a cylinder inclosing said piston, intake and exhaust valves for said cylinder, a lever for actuating said intake and exhaust valves, an electromagnet adapted to operate said lever, an electrical circuit including a source of electrical energy and said magnet, pivotally-mounted arms interposed in said circuit and adapted to be brought into contact for closing the circuit, one of said arms being formed with a segment at its lower end below the point of its pivot, a flat spring fixed in a substantially horizontal plane in position for having its flat face engage the periphery of said segment, and a pressure-gage adapted to swing the other arm into contact with the arm provided with a segment.

3. In a draft-controlling apparatus, the combination with means for governing the draft and electrical means for actuating said governing means, of a pivotally-mounted arm interposed in the circuit of said electrical means, a gage, and cushioning means connecting the gage with said arm for imparting movement from the gage to the arm for effecting a closure of said circuit upon a given movement of the arm.

4. In a draft-controlling apparatus, the combination with means for governing the draft and electrical means for actuating said governing means, of a pivotally-mounted arm interposed in the circuit of said electrical means, a gage spaced from said arm, a bar connected with said arm a bar engaging said gage, a sleeve inclosing the ends of said bars, a spring within said sleeve interposed between said bars for receiving the pressure from one of the bars for actuating the other for moving said arm in position for closing said circuit.

5. In a draft-controlling apparatus, the combination with means for governing the draft and electrical means for actuating said governing means, of a pivotally-mounted arm interposed in the circuit of said electrical means, a gage spaced from said arm, a bar

pivotally connected with said gage, a bar pivotally connected with said arm, a sleeve surrounding the free ends of said bars, a plunger carried by one of said bars, an insulating-block carried by the other of said bars, said sleeve being slotted longitudinally, a pin extending from said plunger through said slot, and a spring interposed between said plunger and insulating-block, whereby movement may be imparted from said gage to said arm for swinging the same into position for closing the said circuit.

6. In a draft-controlling apparatus, the combination with means for governing the draft and electrical means for actuating the same, of a pair of pivotally-mounted arms interposed in said circuit, a segment carried by one of said arms, a spring engaging the said segment for frictionally supporting the arm carrying the segment in any given adjusted position, a gage, and means connecting the same with the other of said arms for swinging the last-mentioned arm into contact with the segment-carrying arm for closing said circuit.

7. In a draft apparatus, the combination with a pressure-gage and an electric circuit-closing means connected therewith, of an electric circuit, adapted to be closed by said gage, including an electromagnet and a source of electrical energy, a draft-controlling valve, a piston connected therewith, a cylinder inclosing said piston, intake and exhaust valves for said cylinder, spring-arms connected with said valves, and means adapted to be actuated by said electromagnet for moving said arms for operating said intake and exhaust valves.

8. In a draft apparatus, the combination with a gage and an electric circuit-closing means connected therewith, of an electric circuit connected with said closing means, including a source of electrical energy and an electromagnet, a draft-controlling valve, a piston connected with said valve, a cylinder inclosing said piston, intake and exhaust valves for said cylinder and yielding operating means for said intake and exhaust valves adapted to be actuated by said magnet.

9. In a draft apparatus, the combination with a pressure-gage and an electric circuit-closing means, of an electric circuit connected with said closing means including an electromagnet and a source of electrical energy, a pivoted lever adapted to be actuated by said magnet and bifurcated at the point of its pivot, a draft-controlling valve, a piston connected therewith for operating the same, a cylinder inclosing said piston, intake and exhaust valves for said cylinder, and spring-arms carried within the bifurcation of said lever and connected to the lever and to said intake and exhaust valves for transmitting a cushioned movement from the lever to the valves.

10. In a draft apparatus, the combination with a draft-controlling valve, pressure-actuating means for operating the same, admission and exhaust valves for said pressure-actuating means, a lever for operating said admission and exhaust valves, an electromagnet adapted to operate said lever and an electrical circuit including said magnet and a source of electrical energy, a pair of arms pivotally mounted and interposed in said circuit, means frictionally resisting pivotal movement of one of said arms and a pressure-gage connected with the other of said arms for swinging the same into contact with the first-mentioned arm.

11. In a draft apparatus, the combination with a draft-controlling valve, a piston connected therewith, a cylinder inclosing said piston, intake and exhaust valves for said cylinder, a lever for actuating said intake and exhaust valves, an electromagnet adapted to actuate said lever, an electrical circuit including a source of electrical energy and said magnet, pivotally-mounted arms interposed in said circuit and adapted to be brought into contact for closing the circuit, one of said arms being formed with a segment, a spring-drag engaging the periphery of said segment for frictionally resisting pivotal movements of said arm and a pressure-gage adapted to swing the other arm into contact with the first-mentioned arm.

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

WILLIAM McCLAVE.

Witnesses:
JOHN L. FLETCHER,
ARTHUR L. KITCHIN.