No. 708,289. Patented Sept. 2, 1902.

H. B. P. WRENN.

REGULATOR.

(Application filed Aug. 10, 1901.)

(No Model.) 5 Sheets—Sheet 1.

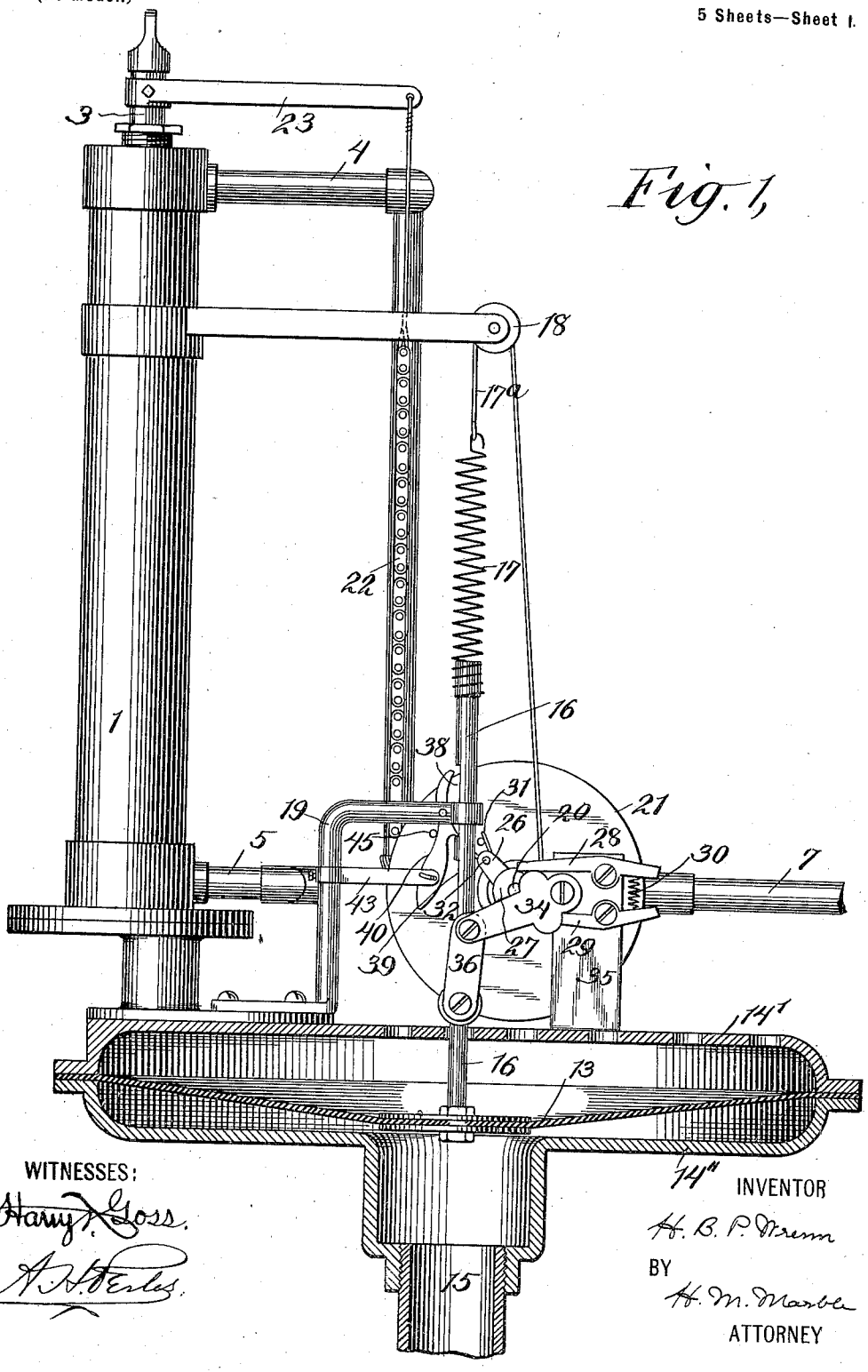


Fig. 1.

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No. 708,289. Patented Sept. 2, 1902.

H. B. P. WRENN.

REGULATOR.

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(No Model.) 5 Sheets—Sheet 2.

Fig. 2.

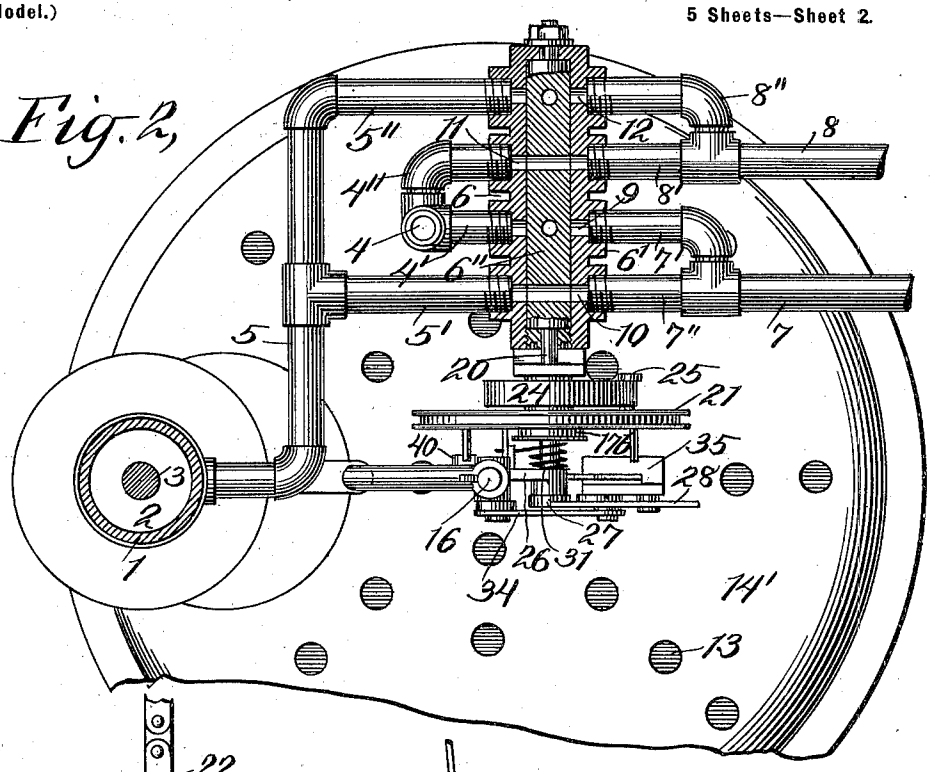
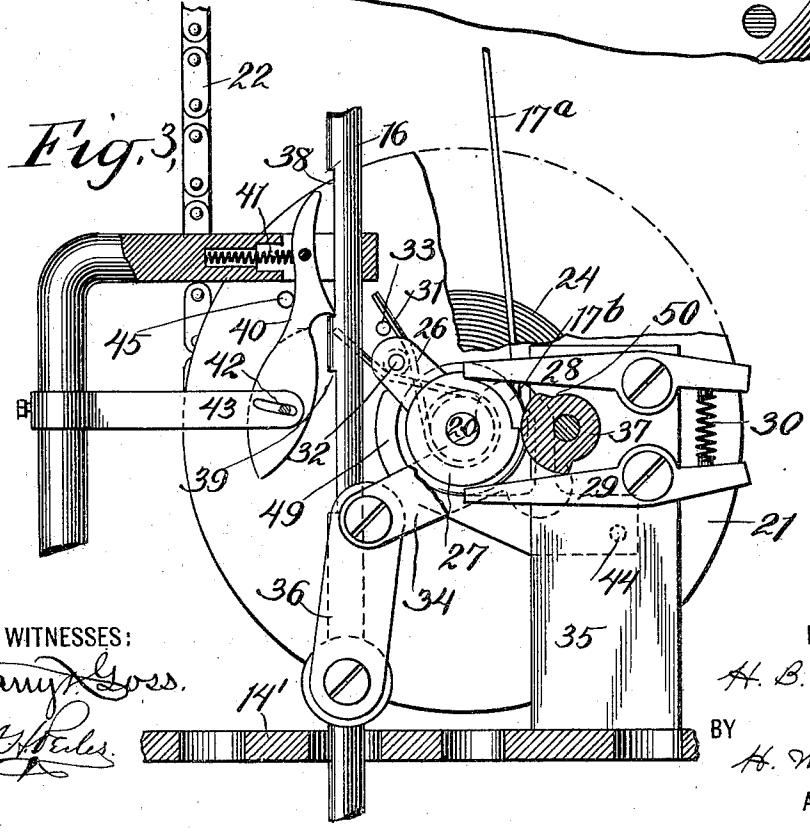


Fig. 3.



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REGULATOR.

(Application filed Aug. 10, 1901.)

(No Model.)

5 Sheets—Sheet 3.

Fig. 4,

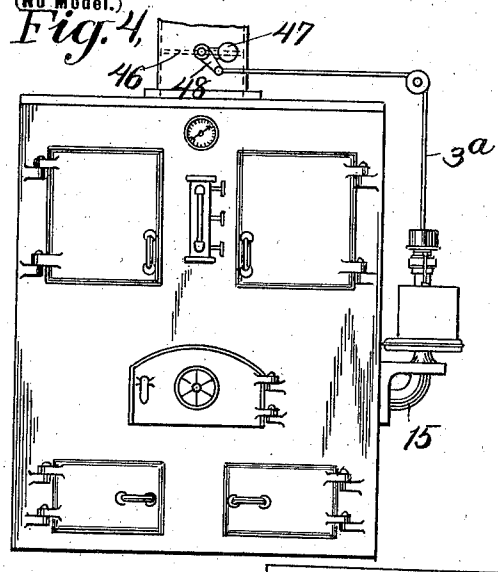


Fig. 5,

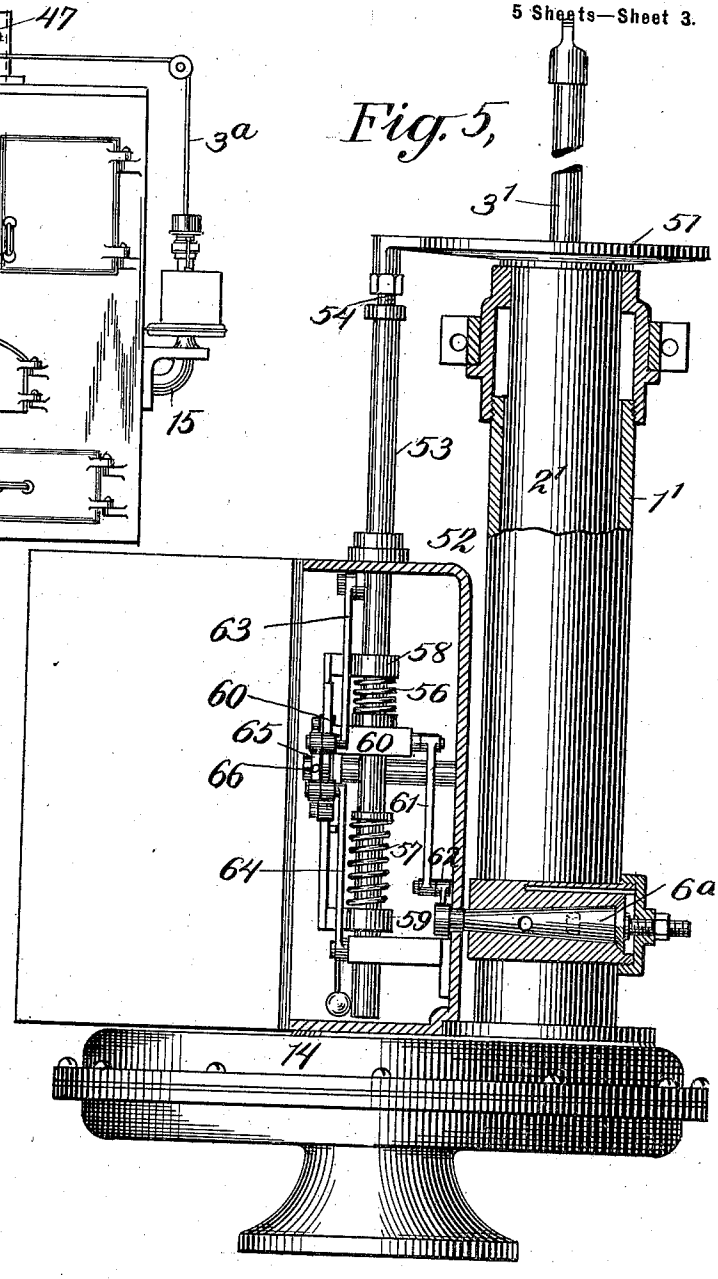
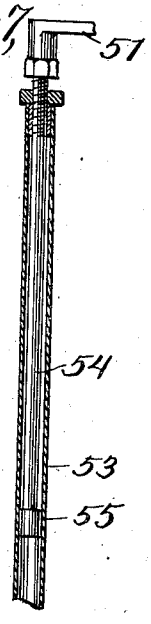


Fig. 7,



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No. 708,289. Patented Sept. 2, 1902.

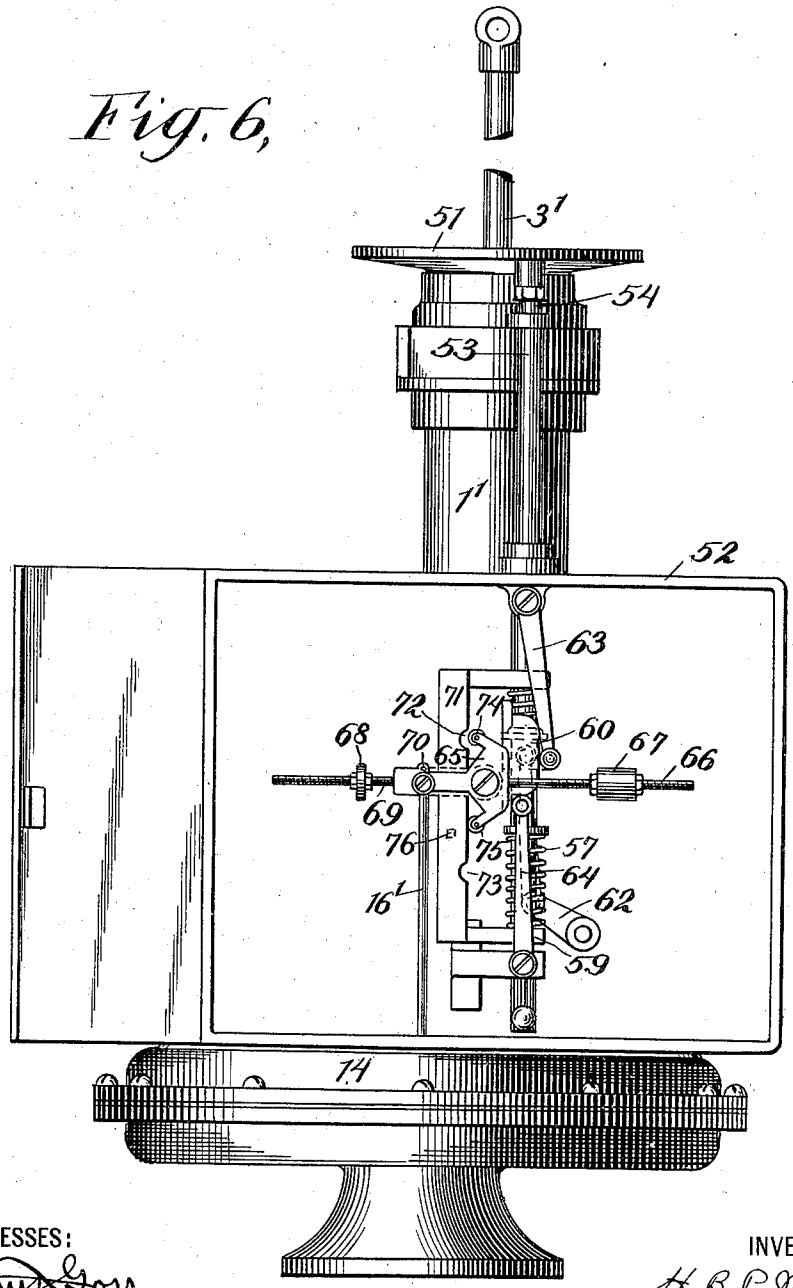
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REGULATOR.

(Application filed Aug. 10, 1901.)

(No Model.) 5 Sheets—Sheet 4.

Fig. 6,



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(Application filed Aug. 10, 1901.)

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Fig. 8

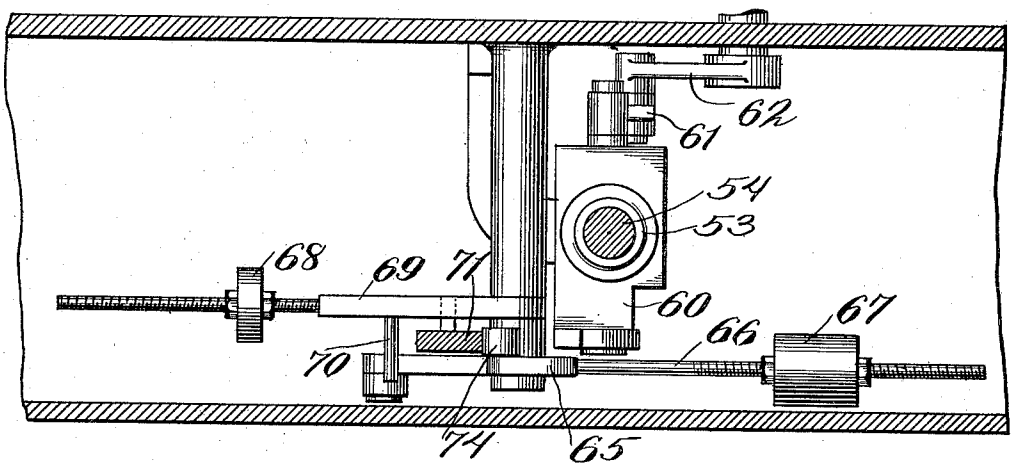
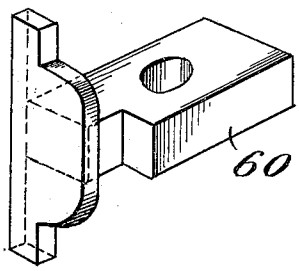


Fig. 9.



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UNITED STATES PATENT OFFICE.

HENRY B. P. WRENN, OF NEW YORK, N. Y.

REGULATOR.

SPECIFICATION forming part of Letters Patent No. 708,289, dated September 2, 1902.

Application filed August 10, 1901. Serial No. 71,649. (No model.)

To all whom it may concern:

Be it known that I, HENRY B. P. WRENN, a citizen of the United States, residing at New York, in the county of New York and State of New York, have invented certain new and useful Improvements in Regulators; 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.

My invention relates to improvements in apparatus for operating dampers in furnace-offtakes, such as are employed for opening and closing such dampers automatically, for the purpose of preventing wasteful passage of air through the furnace and unnecessary loss of heated gases.

My improved damper-regulating apparatus is operated through variation in pressure or suction in the furnace consequent upon the opening or closing of the furnace-door.

My invention consists in the combination, with a suitable motor for operating a damper in the offtake of a furnace, and a controlling device, usually a diaphragm, operated by variation in pressure within the furnace produced by the opening and closing of the furnace-door and by the opening and closing of the damper in the furnace-offtake, of an actuating device for controlling the operation of the motor, itself controlled by said controlling device or diaphragm, but deriving the power by means of which it controls the operation of the motor from a source independent of the said controlling device or diaphragm.

My invention further consists in the use in the above combination of an energy-storing actuating device and in storing in such actuating device the power required for the control of the motor through the operation of the motor itself.

My invention further consists in the many novel features of combination, construction, and arrangement of the parts.

In the operation of furnaces, such as the furnaces of steam-boilers, in the ordinary manner much loss results from the inrush of air at times when the furnace-doors are opened, as they must be for the purpose of adding fuel and for cleaning the fire. The air so entering is not necessary for combustion, and its entry produces a considerable loss, as in passing up the chimney it carries with it a great quantity of heat, which is practically wasted. Moreover, the air so entering chills the furnace and injuriously affects the boiler, if a boiler is used in connection with the furnace, by chilling the parts of the boiler with which the air comes in contact, thus setting up destructive stresses. Such inrush of air can be prevented by providing in the chimney or between the chimney and the combustion-chamber of the furnace a damper which may be closed before the furnace-doors are opened and may be opened as soon as the furnace-doors are closed; but such dampers if not operated automatically do little good, as the furnace attendants neglect to operate them. For operating such dampers automatic apparatus has been used, the operation of which is caused by the variation in pressure in the combustion-chamber of the furnace consequent upon the opening and closing of the furnace-door and upon the opening and closing of the furnace-damper. When the furnace-door is closed, the chimney-draft produces a slight vacuum in the combustion-chamber. When the furnace-door is opened, this vacuum is relieved in a measure. It is these variations in pressure which operate the pressure-operated controlling device or the diaphragm of the apparatus above mentioned; but since the difference between atmospheric air-pressure and the air-pressure in the combustion-chamber is never very great and the variations in pressure in the combustion-chamber relative to atmospheric pressure are small but very little power is available for the operation of a device controlling the opening and closing of the damper.

Heretofore attempts have been made to operate a damper in a furnace-offtake by a diaphragm exposed on one side to atmospheric pressure and upon the other side to the pressure in the combustion-chamber of the furnace and mechanically connected with the said damper; but it has been found impossible to operate a damper in this way, because the pull which may be exerted by a diaphragm of practicable dimensions is much too small to operate the heavy dampers that must be employed in furnace-offtakes. Likewise the

variation in pressure consequent upon the opening of the furnace-door after the draft of the furnace is fully established does not take place between the same limits as variation in pressure consequent upon closing the furnace-door after the damper in the furnace-offtake has been closed or nearly closed. For example, when the furnace-door is closed and the damper in the offtake open and the draft fully established the pull upon the entire area of the diaphragm may be equal to twenty ounces. (The amount of this pull is assumed for the purpose of illustration. The amount in any particular case will depend upon the area of the diaphragm and upon the normal draft of the furnace.) Opening of the furnace-door may reduce this pull to eighteen ounces, and such reduction in pull must cause the operation of the apparatus and the closing of the damper in the offtake. The closing of this damper and the consequent cutting off of the draft may reduce the pull upon the diaphragm to practically zero, and the closing of the furnace-door (the damper in the offtake being nearly closed) may raise the total pull upon the diaphragm to no more than two ounces, and this increase in pull upon the diaphragm to two ounces must be sufficient to cause the operation of the apparatus and the opening of the damper in the offtake. After the damper is opened wide the furnace-draft will be fully reëstablished and the pull on the diaphragm will increase to twenty ounces, as before. It will be seen, therefore, that the variations in pressure in the combustion-chamber, which must suffice to produce closing of the damper in the offtake, take place at one end of a pressure-scale, while the variations which must suffice to cause opening of the damper in the offtake take place at the other end of such pressure-scale. When a diaphragm is mechanically connected to a damper, there is no provision for compensating for this difference between the variations in pressure which must cause the closing of the damper and those which must cause its opening. Attempts have also been made to operate dampers in furnace-offtakes by employing a hydraulic motor for operating the damper and causing the diaphragm to operate directly the controlling-valve of the motor. Such apparatus has been only partially successful and has been in the main unreliable, because it has been found impossible to obtain from a diaphragm sufficient power to operate the controlling-valve reliably. It has been found that the controlling-valves are apt to stick in their seats, either as the result of corrosion, the tightness of their stuffing-boxes, the presence of sediment in the water, or wedging of the valve in its seat. In my improved damper-regulating apparatus herein described I overcome these difficulties by interposing between the pressure-operated controlling device or diaphragm and the motor-controller an actuating device which derives its power from a source independent of the pressure-operated controlling device and preferably from the motor itself and which is merely controlled by said controlling device and in turn controls the operation of the motor-controller. The said actuating device is, in a word, a relay, by means of which the very slight power available at the diaphragm may be sufficient to effect the operation of a motor-controller requiring for its reliable operation much greater power. This actuating device may be a simple spring or plurality of springs or equivalent device provided with suitable tripping means which may be operated by the diaphragm and which may be placed under tension or otherwise have power stored in it by the motor itself when operated, the operation of the tripping device by the diaphragm when the pressure in the combustion-chamber varies releasing the spring, and so causing the latter to operate the motor-controller. A spring provides ample power for this purpose, and the work required to release it by the operation of a suitable tripper is very slight and is well within the range of power obtainable from a diaphragm or other pressure-operated controlling device of convenient size.

The objects of my invention are therefore to render damper-operating apparatus of the class described more certain in operation and reliable and also to improve the construction of such apparatus and to render the same simple, compact, durable, and inexpensive as possible.

My invention consists in the operation of the motor-controllers of damper-operating apparatus of the class described by an actuating device interposed between the motor-controller and the primary actuating device or diaphragm of the apparatus; and it consists also in the many novel features of combination, construction, and arrangement of the parts by which the above-mentioned objects are accomplished.

In the accompanying drawings, which illustrate two embodiments of my invention, Figure 1 is a front elevation of one form of damper-operating apparatus embodied in my invention, the diaphragm-chamber being sectioned. Fig. 2 is a transverse section of the apparatus shown in Fig. 1 through the motor-cylinder and the regulating-valve of the motor. Fig. 3 is a detail side view of the tripping mechanism employed on a scale larger than that of Fig. 1. Fig. 4 is a view showing the method of connecting the damper-operating apparatus to a furnace. Fig. 5 is a side elevation of another form of apparatus embodying my invention. Fig. 6 is a front elevation of such second form of apparatus. Fig. 7 is a detail section through the resetting-sleeve. Fig. 8 is a horizontal section showing a top view of the principal portion of the mechanism of such second form of apparatus, and Fig. 9 is a perspective view of plate 60.

Referring now to the drawings, and first to Figs. 1 to 4, inclusive, 1 is the cylinder of a hydraulic motor, 2 the piston thereof, and 3 the piston-rod. The piston-rod may be connected to the damper to be operated by a chain or other connecting device 3^a. (Shown in Fig. 4.)

4 and 5 are pipes communicating with the interior of the cylinder 1 above and below the piston, respectively.

6, Fig. 2, is a turn-plug valve regulating the admission of water to the cylinder 1 and the exhaust therefrom and is the controller of the motor. 7 is a supply-pipe, and 8 an exhaust-pipe. The valve-casing 6′ is provided with separate inlet-passages 9 and 10 for each end of the cylinder. It is also provided with exhaust-passages 11 and 12 for each end of the cylinder. The valve-plug 6″ is provided with ports corresponding to these passages, the ports being so arranged that when the entrance-passage for one end of the cylinder is open the corresponding exhaust-passage and the entrance-passage for the other end of the cylinder are closed, the exhaust-passage at the other end of the cylinder being open. Pipe 5 is connected by branches 5′ and 5″ with its entrance-passage 10 and exhaust-passage 12, respectively. Pipe 4 is connected by branches 4′ and 4″ with its entrance-passage 9 and exhaust-passage 11, respectively. Pipe 7 is connected to the two admission-passages 9 and 10 by branches 7′ and 7″, and the exhaust-pipe 8 is connected to the two exhaust-passages 11 and 12 by branches 8′ and 8″, respectively.

13 is a flexible diaphragm dividing into two parts a chamber inclosed by two sections 14′ and 14″ of a diaphragm-casing. The upper section 14′ is perforated in various places to permit free passage of atmospheric air. To the section 14″ is connected a pipe 15, which may lead to the combustion-chamber of the furnace. Any decrease in pressure below atmospheric pressure in the combustion-chamber will cause a depression of the diaphragm 13. The diaphragm is provided with a stem 16, which passes upward through one of the perforations in the section 14′ of the diaphragm-casing and has secured to it at one end a spring 17, the other end of the spring being connected to a cord or the like 17^a, passing over a pulley 18 and wound upon a small drum 17^b, connected to a spring-drum 21, hereinafter mentioned. The spring 17 serves both to balance the weight of the stem and the diaphragm and through the winding up of its cord 17^a upon the drum 17^b to compensate for the difference in range between those variations in pressure which cause the closing of the damper and those variations in pressure which cause the opening of the damper.

20 is the stem of the valve-plug 6″. Upon this stem there is mounted loosely a drum 21, to which is attached a sprocket-chain 22, suspended from a bracket 23, carried by the piston-rod 3. The sprocket-chain serves to rotate the drum in one direction when the piston 2 rises. A coiled spring 24 also surrounds the stem 20 and is attached at one end to the drum 21 by a pin 25. At the other end it is attached to any fixed portion of the apparatus. This spring serves to rotate the drum 21 backward when the piston 3 descends, and for it may be substituted any other device for producing reverse rotation of the drum, such as a second drum, weight, and cord. An arm 26 is keyed to the stem 20 and carries a locking-disk 27, having two shoulders with which pivoted triggers 28 and 29 are adapted to engage. A spring 30 between these triggers tends to press them against the locking-disk 27. A spiral spring 31 is mounted upon the valve-stem 20, its ends being extended and crossed, as shown particularly in Fig. 3. Between these extended ends is a pin 32, carried by the arm 26, and also another pin 33, carried by the drum 21.

A rocker-arm 34 is pivoted to a suitable support 35 and is connected by a link 36 with the stem 16 of the diaphragm. It also carries a tripper-cam 37, Fig. 3, adapted to trip the triggers 28 and 29 at proper times.

The diaphragm-stem 16 is provided with two notches 38 and 39. To its guiding-bracket 19 is pivoted a tilting locking-lever 40, adapted to engage the rod 16 in said notches. A spring 41 tends to hold the locking-lever 40 in either extreme position in which it may be placed. The motion of said lever is limited by a pin 42, working in a slot in bracket 43. Upon the side of the drum 21 are two pins 44 and 45, adapted to engage the lower end of the locking-lever 40, which is broadened out, as indicated in dotted lines in Fig. 3 and as shown in Fig. 2.

When in use, the damper-operating apparatus above described is customarily mounted in proximity to the furnace the damper of which it is to operate, as shown in Fig. 4, its piston-rod being connected by a cord or chain 3^a or other suitable connecting device to an arm or lever connected to the damper, the pipe 15 connecting its diaphragm-chamber with the combustion-chamber of the furnace. The particular damper-operating apparatus indicated in Fig. 4 is that shown in Figs. 5 and 6; but the apparatus of Figs. 1, 2, and 3 is mounted in the same manner. In Fig. 4 the damper, there shown in dotted lines in its closed position and indicated by reference-number 46, is arranged to be opened by gravity acting on a weight 47 as the piston of the damper-operating apparatus rises, and when the piston descends the cord 3^a, pulling upon lever 48, will close the damper, lifting the weight 47.

The operation of the apparatus is as follows: In Figs. 1, 2, and 3 the parts are shown in the positions occupied when the damper is closed and the diaphragm 13 has just been depressed, owing to the formation of a partial vacuum in the combustion-chamber to

an extent sufficient to cause the apparatus to commence to operate and to open the damper. The admission-passage 10 of the valve 6 is open, as is the exhaust-passage 11, so that water may flow into the cylinder 1 at the bottom and flow therefrom at the top, so as to cause the piston to rise. As the piston rises it causes the drum 21 to rotate against the tension of the spring 24, and the pin 33, carried by said drum, winds up the spring 31, the arm 26 and locking-disk 27 being prevented from rotating by the trigger 28, so that while that end of spring 31 which is in contact with pin 33 is free to move with said pin the other end of the spring is held stationary by pin 32. The diaphragm-stem 16 is also locked against upward movement by the locking-lever 40, and is held locked until through the rotation of the drum 21 the spring 31 has acquired sufficient tension to turn the valve-plug 6″, when the diaphragm rises. After the spring 31 has acquired sufficient tension the pin 44 on the drum 21 encounters the lower end of the locking-lever 40 and moves it to the left of Figs. 1 and 3, thus releasing the diaphragm-stem 16. This occurs just as the piston in the cylinder 1 reaches the upper limit of its stroke. The parts remain in this position, the damper being open, until the vacuum in the combustion-chamber of the furnace falls—as, for instance, when the furnace-door is opened. The spring 17 then lifts the diaphragm-rod 16 and the diaphragm, and in so doing rotates the arm 34 and the tripper-cam 37, raising the trigger 28, and thus leaving the locking-disk 27 and arm 26 free to be rotated by the spring 31. The spring 31 immediately causes rotation of said arm and locking-disk, and therefore of the valve-stem 20, attached thereto, thus rotating the valve-plug 6″, closing the admission-passage 10 and the exhaust-passage 11 and opening the admission-passage 9 and the exhaust-passage 12—that is to say, shutting off the supply of water from the lower end of the cylinder and admitting water to the upper end of the cylinder and closing the exhaust-opening at the upper end of the cylinder and opening the exhaust-opening at the lower end of the cylinder. The piston of the cylinder 1 is thus caused to descend, closing the damper, and as it descends the drum 21 is caused to rotate in a backward direction by the spring 24, the pin 33 engaging that end of the spring 31 which it did not engage formerly and winding up said spring, the locking-disk 27 being prevented from rotating by the trigger 29. As soon as the diaphragm-stem 16 reaches the upper limit of its travel it is engaged in its notch 39 by locking-lever 40. The diaphragm-stem 16 is thus prevented from falling until the spring 31 has acquired sufficient tension to turn the valve-plug 6″ again. After the spring has acquired such tension the pin 45 on the drum 21 engages the locking-lever 40 and moves it to the right, thus leaving the rod 16 free to descend, although as the weight of the rod and diaphragm is balanced by the spring 17 said rod and diaphragm will not descend until the vacuum in the combustion-chamber is restored. The release of the rod 16 occurs just as the piston in the cylinder reaches the lower limit of its stroke.

Compensation for the difference in range between the variations in pressure which cause the opening of the damper and those which cause its closing is accomplished by means of the spring 17, cord 17^a, and drum 17^b, as follows: When the piston is down and the damper closed and the furnace-draft at a minimum, the spring 17 is at its lowest tension, which is just sufficient to balance the diaphragm and its stem. When after the closing of the furnace-door and the consequent depression of the diaphragm the piston rises and the damper opens, as the piston rises and winds up spring 24 it also winds up cord 17^a upon drum 17^b, thereby increasing the tension of spring 17, and the strength of this spring is such that when the piston has reached the top spring 17 will be under sufficient tension so that upon the opening of the furnace-door the slightest decrease in draft caused thereby will still be sufficient to permit spring 17 to raise the diaphragm against the pull yet remaining on the diaphragm.

To return to the description of the operation of the apparatus: When the damper in the furnace-offtake is closed and the furnace-draft is at a minimum, the diaphragm being held upward by the spring 17, although, as above explained, at such time the tension of the spring is at a minimum, if the furnace-door be closed the draft will be reëstablished partially and the damper will be drawn down, rotating the arm 34 and the tripper-cam 37. The trigger 29 is thereby tripped, and the spring 31 rotates the valve-plug 6″, so as to restore it to the position shown in Fig. 2, water being thereby admitted into the lower end of the cylinder and exhausted from the upper end thereof, so that the piston in said cylinder rises and opens the damper. The motion of the locking-disk is limited by stops 49 and 50. (The latter shown in dotted lines in Fig. 3.)

Figs. 5 to 9, inclusive, illustrate another form of damper-operating apparatus embodying my invention, in which the controlling-valve-actuating device comprises two springs, one of which is compressed during the upstroke of the piston, the other during the downstroke of the piston, suitable tripping mechanism operated by the diaphragm serving to release said springs at the proper time. The compensating device consists of a weight opposing another weight which counterbalances the diaphragm and its stem, said compensating weight bearing down upon the diaphragm-stem when the damper is closed, so that a comparatively slight pull upon the diaphragm will depress the same and cause the operation of the motor, while

when the damper is open the compensating weight is lifted off from the stem of the diaphragm, so that a much greater pull upon said diaphragm is required to keep it depressed. In these figures, numeral 1′ indicates the hydraulic cylinder; 2′, the piston; 3′, the piston-rod; 6ª, the controlling-valve, and 14 the diaphragm-casing. The interior of this casing is not shown, as it and the diaphragm are in all essential particulars the same as the corresponding parts of the apparatus shown in Figs. 1, 2, and 3. The hydraulic motor is single-acting, the piston being caused to descend by reason of its weight, additional weights being placed, if necessary, upon a pan 51, carried by the piston-rod 3′. A casing 52 incloses the valve-actuating mechanism and is provided with sliding bearings for a resetting-sleeve 53. A resetting-rod 54, telescoping within sleeve 53, is provided with a head 55, Fig. 7, adapted to engage the upper end of sleeve 53 near the upper limit of the stroke of the piston and lift said sleeve. Springs 56 and 57 surround the resetting-sleeve 53, being located between abutments 58 and 59, rigidly secured to sleeve 53, and between these springs is a plate 60, loosely mounted upon the resetting-sleeve. A link 61 connects plate 60 with an arm 62, connected to the controlling-valve 6ª of the motor. Two tripping-arms 63 and 64 are pivoted to stationary portions of the casing 52 and are adapted to engage in turn with plate 60. When so engaged, the said plate will be prevented from moving, and upon the movement of the resetting-rod one of the springs 56 or 57 will be compressed against the said plate and power will be stored in such spring to move the said plate and to operate the valve upon the release of the said tripping-arm. The tripping-arms are adapted to be released by means of a tripping-plate 65, pivotally supported upon a stationary portion of the machine and connected to the diaphragm-stem 16′. In Fig. 6 plate 60 is shown as locked by tripping-arm 64, spring 56 being compressed. If with the parts in this position the diaphragm be depressed, the lower end of tripping-plate 65 will swing outward, pushing outward the arm 64 until the plate 60 is released, when said plate will be pressed downward by the spring 56 and the valve 6ª will be reversed, the tripping-arm 63 falling into position over the plate 60, so that upon the upward movement of resetting-sleeve 53 spring 57 will be compressed. To tripping-plate 65 is attached a screw-threaded rod 66, carrying a weight 67, adjustable along said rod for the purpose of counterbalancing the weight of the diaphragm and diaphragm-stem. The compensating weight above mentioned is weight 68, adjustably mounted on a screw-threaded rod 69, pivoted to the same axis about which tripping-plate 65 turns and having a pin 70 overlapping the plate 65. The resetting-sleeve 53 carries a locking-plate 71, in which are recesses 72 and 73. The tripping-plate 65 has two projections carrying friction-rollers 74 and 75, adapted to coact with locking-plate 71. The manner of operation of this locking device will be made apparent in the description of the operation of the apparatus.

In Figs. 5 and 6 the parts are shown in the positions corresponding to a closed position of the furnace-damper and to an open position of the furnace-door. The compensating weight 68 is supported through its pin 70 by the tripping-plate 65, and therefore is counterbalancing in a measure the moment of the counterbalance-weight 67. If now the furnace-door be closed, the diaphragm will be depressed and the tripping-plate 65 will be moved about its pivot, this being permitted by the recess 72 in locking-plate 71, which recess friction-roller 74 will enter, and tripping-plate 65 being thus rocked will press arm 64 out, thereby releasing plate 60, which is then pressed downward by spring 56, thus reversing the controlling-valve 6ª of the motor and admitting water into the cylinder 1′, so as to raise the piston. As the piston rises the furnace-damper will open, and when the piston has neared the upper limit of its stroke the head 55 of resetting-rod 54 will encounter the upper end of resetting-sleeve 53 and, picking up the latter, will cause spring 64 to be compressed against plate 60, which plate is now held locked by tripping-arm 63, now in position over plate 60. Resetting-sleeve 53 in its upward movement carries with it the locking-plate 71, and as soon as recess 72 in said plate is no longer opposite roller 74 the tripping-plate 65 is locked against motion in either direction, and therefore premature rise of the diaphragm, due, for instance, to opening of the furnace-door before spring 56 has acquired sufficient tension to operate valve 6′, can produce no immediate effect. When the piston has reached the upper limit of its stroke and the damper is wide open, a projection 76 on locking-plate 71 will have picked up rod 69, carrying compensating weight 68, so as to relieve the counterbalance-weight 67 of the counteracting influence of said compensating weight. In this position of the parts roller 75 of locking-plate 65 is opposite recess 73, so that if the diaphragm be permitted to rise through decrease of the suction upon it the locking-plate 71 will permit the necessary movement of the tripping-plate 65, the tripping-arm 63 will be moved out, the plate 60 will be moved upward by spring 57, and the valve 6ª will be reversed, so as to open cylinder 1′ to exhaust, thereby permitting the piston to descend by its own weight and close the furnace-damper, and at the same time the tripping-arm 64 will swing underneath plate 60, so that upon the descent of the resetting-sleeve 53, consequent upon the descent of the piston, spring 56 will be compressed, and during the downward movement of the resetting-sleeve the tripping-plate 60 and the diaphragm will be held locked until

spring 56 shall have acquired full tension. As the locking-plate 71 descends the weight 68 is again caused to act through its pin 70 in opposition to the counterbalance-weight 67, thereby compensating for the difference in range between the variations in pressure which must suffice to close the damper and those which must suffice to open it.

It is obvious that both forms of apparatus above described are capable of many modifications and changes in construction, and I do not limit myself to the particular constructions herein illustrated and described.

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

1. In an apparatus for operating dampers in furnace-offtakes, the combination, with a motor for moving such dampers and a motor-controller, of an actuating device for operating said motor-controller, a primary controlling device operated by variations in pressure in the combustion-chamber, means operated by said primary controlling device controlling the operation of said actuating device, which actuating device derives its power from a source independent of the primary controlling device, and a compensating device for compensating for the difference in range between those variations in pressure which operate the apparatus to close the damper and those variations in pressure which operate to open the damper.

2. In an apparatus for operating dampers in furnace-offtakes, the combination, with a fluid-pressure motor for moving such dampers, and a controlling-valve for such motor, of an actuating device for operating said valve, a primary controlling device operated by variations in pressure in the combustion-chamber, means operated by said primary controlling device controlling the operation of said actuating device, which actuating device derives its power from a source independent of the primary controlling device, and a compensating device for compensating for the difference in range between those variations in pressure which operate the apparatus to close the damper and those variations which operate to open the damper.

3. In an apparatus for operating dampers in furnace-offtakes, the combination, with a motor for moving such dampers, and a motor-controller, of an energy-storing actuating device arranged to operate said motor-controller when released, means operated by the motor for storing up energy in said actuating device, a primary controlling device operated by variations in pressure in the combustion-chamber, means operated by the said primary controlling device, adapted to release the actuating device, and a compensating device, for compensating for the difference in range between the variations in pressure which operate the apparatus to close the damper and those variations which operate to open the damper.

4. In an apparatus for operating dampers in furnace-offtakes, the combination, with a motor for moving such dampers and a motor-controller, of a primary controlling device operated by variations in pressure in the combustion-chamber, an actuating device for operating the motor-controller, mechanically connected with and controlled by said primary controlling device, but deriving its power from an independent source, and a compensating device for compensating for the difference in range between the variations in pressure which operate the apparatus to close the damper and those variations which operate to open the damper.

5. In an apparatus for operating dampers in furnace-offtakes, the combination, with a motor for moving such dampers and a motor-controller, of a primary controlling device operated by variations in pressure in the combustion-chamber, an energy-storing actuating device for operating the motor-controller, mechanically connected with and controlled by said primary controlling device, but deriving its power from an independent source, and a compensating device for compensating for the difference in range between the variations in pressure which operate the apparatus to close the damper and those variations which operate to open the damper.

6. In an apparatus for operating dampers in furnace-offtakes, the combination, with a motor for moving such dampers and a motor-controller, of a primary controlling device operated by variations in pressure in the combustion-chamber, an energy-storing actuating device for operating the motor-controller, in which power is stored for such purpose by the motor in its operation, and which is mechanically connected with and controlled by said primary controlling device, and a compensating device for compensating for the difference in range between the variations in pressure which operate the apparatus to close the damper and those variations which operate to open the damper.

7. In an apparatus for operating dampers in furnace-offtakes, the combination, with a motor for moving such dampers and a motor-controller, of a primary controlling device operated by variations in pressure in the combustion-chamber, an energy-storing actuating device for operating the motor-controller, comprising a power-storing device, means operated by the motor in its operation for storing power therein, and a tripping mechanism for releasing said power-storing device, such tripping mechanism being arranged to be operated by the primary controlling device; and a compensating device for compensating for the difference in range between the variations in pressure which operate the apparatus to close the dampers and those variations which operate to open the dampers.

8. In an apparatus for operating dampers in furnace-offtakes, the combination, with a motor, a motor-controller, an energy-storing

actuating device for operating the motor-controller, adapted to be released by a suitable tripping device, and means for storing up energy in said actuating device, of a primary controlling device adapted to be operated by change of conditions within the furnace and to release said actuating device, and provided with an automatically-operated locking device which prevents changes of conditions within the furnace from causing the operation of said controlling device, when once the actuating device has been released by said controlling device, until sufficient energy has been stored in said actuating device to again operate the motor-controller.

9. In an apparatus for operating dampers in furnace-offtakes, the combination, with a motor, a motor-controller, an energy-storing actuating device for operating the motor-controller, adapted to be released by a suitable tripping device, and means for storing up energy in said actuating device, of a primary controlling device adapted to be operated by change of conditions within the furnace and to release said actuating device, provided with an automatically-operated locking device which prevents changes of conditions within the furnace from causing the operation of said controlling device, when once the actuating device has been released by said controlling device, until sufficient energy has been stored in said actuating device to again operate the motor-controller, and a compensating device for compensating for the difference in range between the variations in pressure which operate the apparatus to close the damper and those variations which operate to open the damper.

10. The combination, with a motor, a motor-controller, an energy-storing actuating device for operating the motor-controller, adapted to be released by a suitable controlling device, and means for storing up energy in said actuating device, of a controlling device provided with a lock for preventing its operation at intervals, said controlling device being adapted to release said actuating device, and means for operating the lock so as to prevent the operation of said controlling device while energy is being stored in the actuating device.

11. The combination, with a reciprocating motor, a motor-controller, an energy-storing actuating device for operating the motor-controller, adapted to be released by a suitable controlling device, and means for storing up energy in said actuating device, of a controlling device provided with an automatically-operated lock for preventing its operation at intervals, said controlling device being adapted to release said actuating device, and means, operated by the motor, for operating the lock so as to prevent the operation of said controlling device while the motor is operating.

12. In a damper-operating apparatus, the combination with a motor and a motor-controller, of a spring, an arm connected with the motor-controller and engaging one end or the other of said spring according to the direction in which the motor-controller is to be operated, tripping devices adapted to hold said arm stationary while the spring is being wound up, a spring-winding member mechanically connected with the motor and arranged to wind the spring in one direction or the other according to the direction in which the motor-controller is to be operated, and means for operating the said tripping devices to release said arm.

13. In a damper-operating apparatus, the combination, with a motor, a motor-controller, a spring, an arm connected with the motor-controller and revolubly mounted and arranged to engage one end of the spring or the other, according to the direction in which the spring is to be wound, and tripping-triggers, one adapted to hold said arm against motion in one direction and the other to hold it against motion in the opposite direction, of a spring-winding member mechanically connected with the motor and adapted to wind said spring in one direction or the other according to the direction in which the motor-controller is to be operated, and a cam for operating said triggers and releasing said arm.

14. In a damper-operating apparatus, the combination, with a motor, a motor-controller, an energy-storing controlling device for operating the motor-controller, tripping devices controlling the operation of said energy-storing device, and means operated by the motor for storing energy in such energy-storing device as the motor operates, of an actuating member for actuating said tripping devices, having notches, a locking-pawl adapted to engage said notches and hold said actuating member stationary while energy is being stored, and means for releasing said actuating member when full power has been stored.

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

HENRY B. P. WRENN.

Witnesses:
H. M. MARBLE,
A. H. PERLES.