D. BELDEN.

DAMPER CONTROLLING APPARATUS.

APPLICATION FILED MAR. 28, 1914.

1,154,600.

Patented Sept. 28, 1915.

3 SHEETS—SHEET 1.

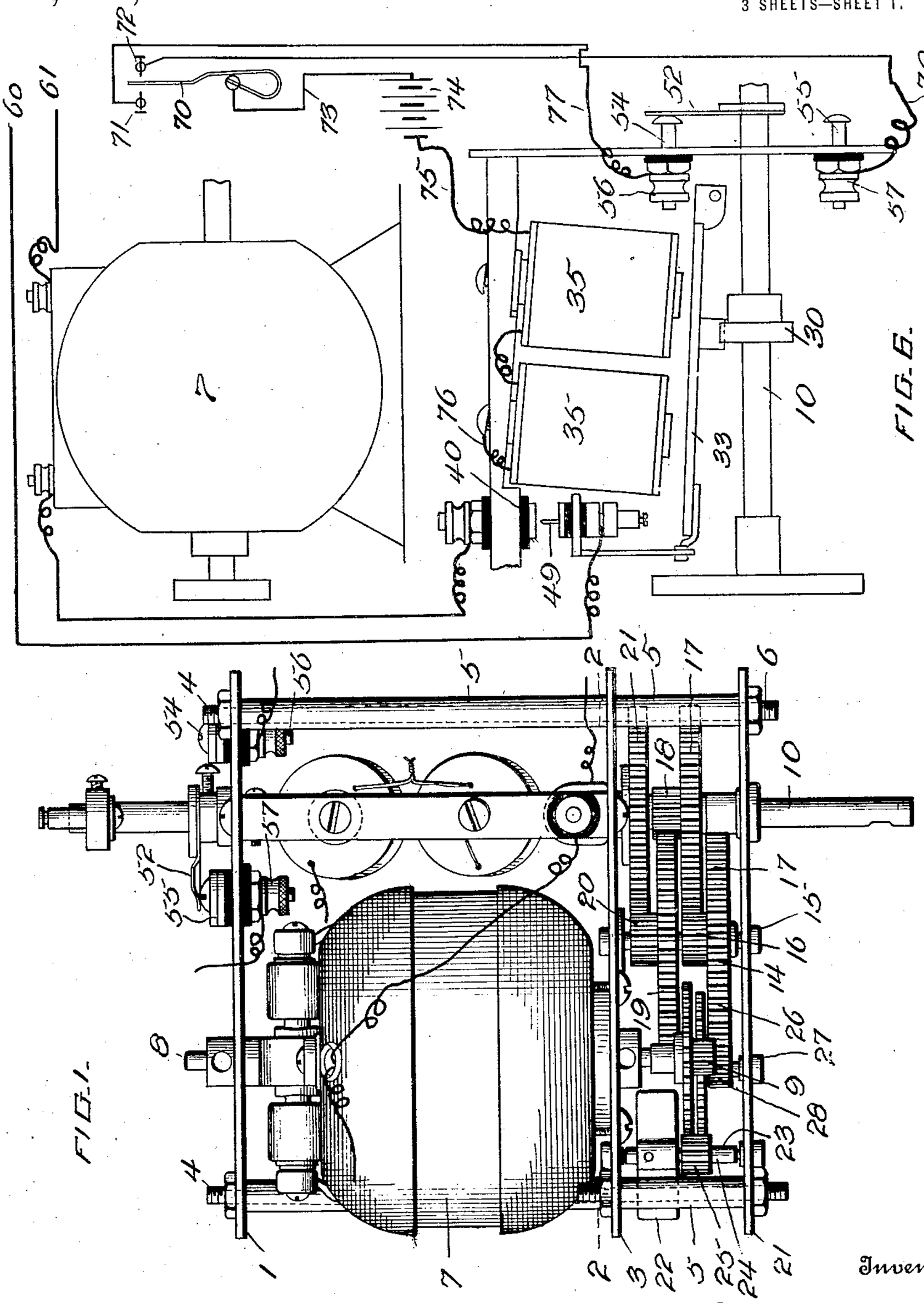

FIG. 6.

FIG. 1.

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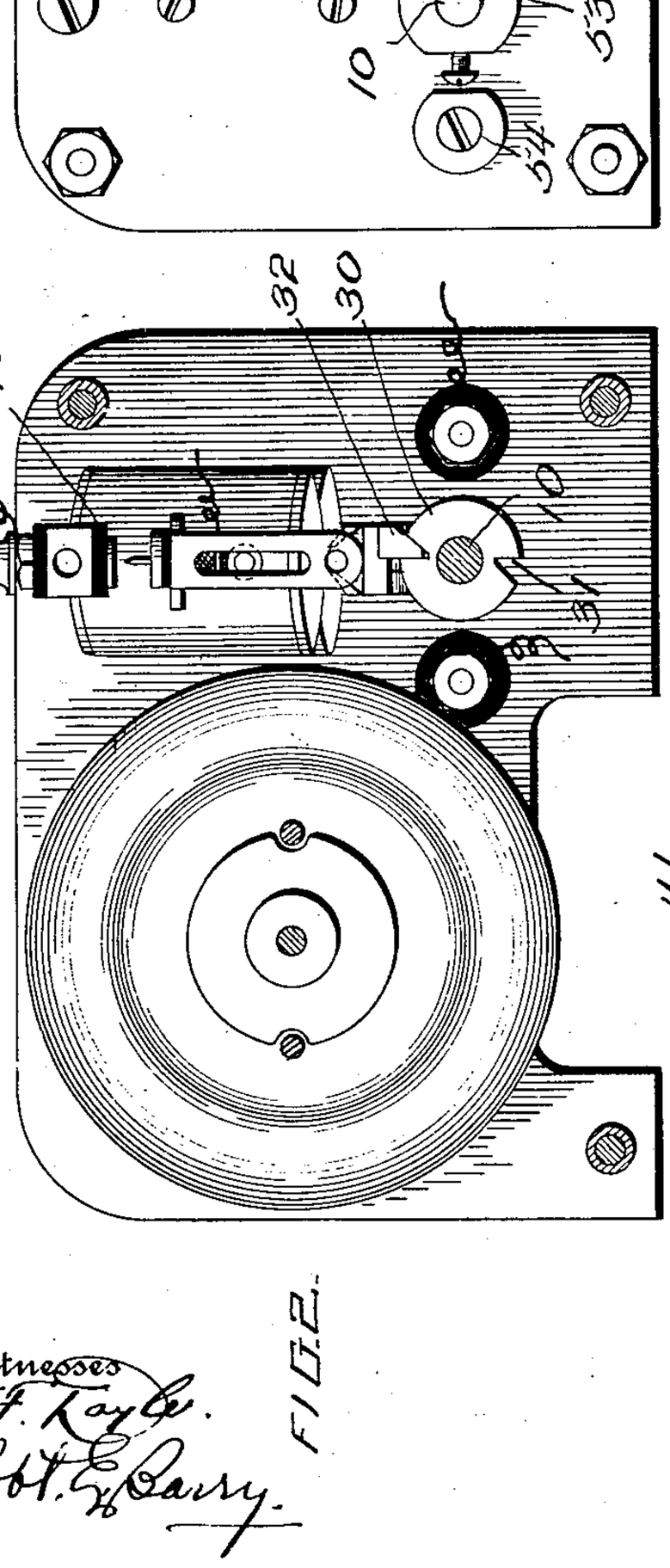

FIG. 4.

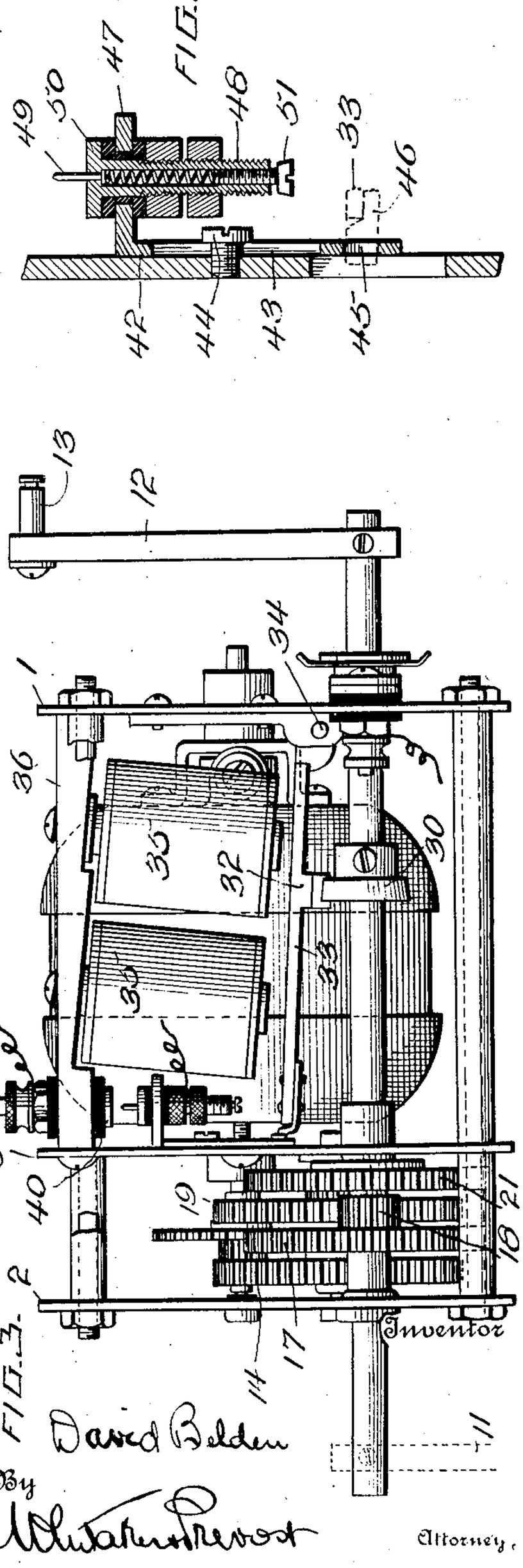

FIG. 5.

FIG. 2.

FIG. 3.

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3 SHEETS—SHEET 3.

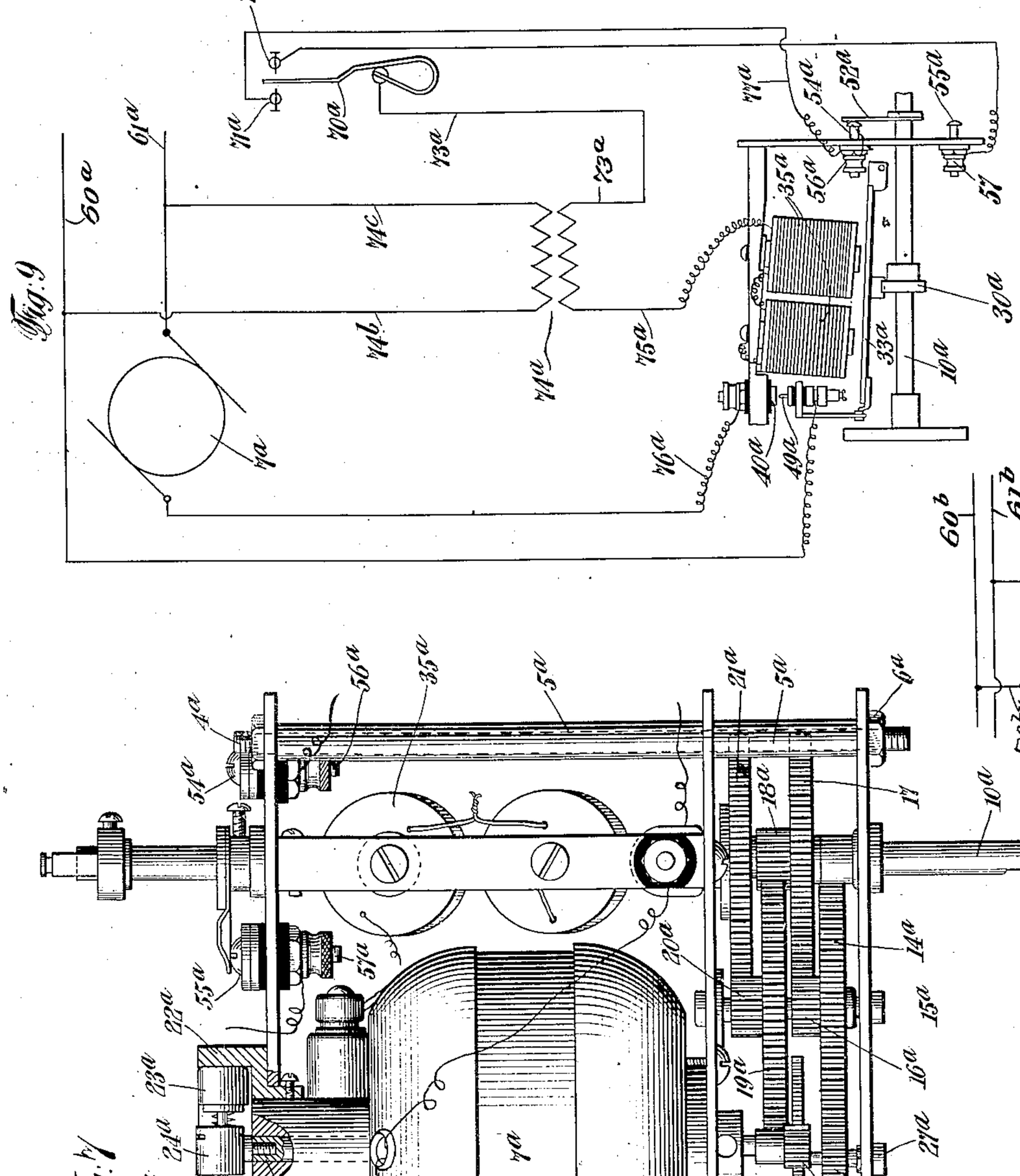

Fig. 9.

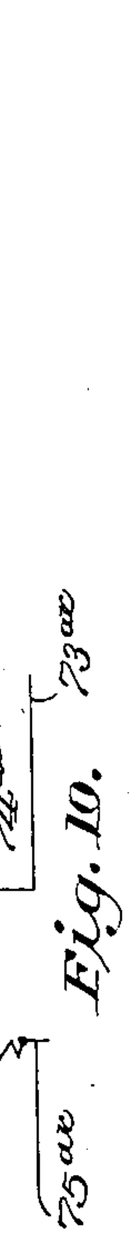

Fig. 10.

Fig. 7.

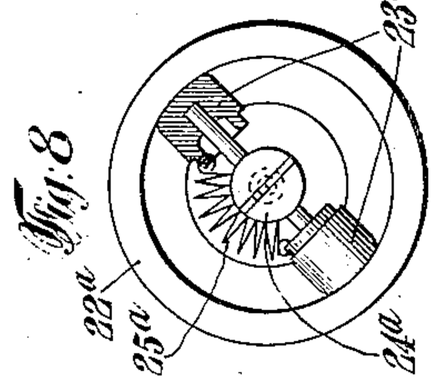

Fig. 8.

Witnesses:
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UNITED STATES PATENT OFFICE.

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DAMPER-CONTROLLING APPARATUS.

1,154,600. Specification of Letters Patent. Patented Sept. 28, 1915.

Application filed March 28, 1914. Serial No. 828,049.

To all whom it may concern:

Be it known that I, DAVID BELDEN, a citizen of the United States, residing at Auburn, in the county of Cayuga and State of New York, have invented certain new and useful Improvements in Damper-Controlling Apparatus; 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 consists in the novel features hereinafter described, reference being had to the accompanying drawings, which show one embodiment of my invention and certain modifications thereof, selected by me for purposes of illustration, and said invention is fully disclosed in the following description and claims.

Referring to the said drawings, Figure 1 is a top plan view of a damper controlling apparatus embodying my invention, one of the actuating crank arms being removed therefrom. Fig. 2 is a vertical sectional view of the apparatus on line 2—2 of Fig. 1. Fig. 3 is an end elevation of the apparatus, portions being broken away. Fig. 4 is a side elevation of the apparatus with the crank arm removed from the crank shaft. Fig. 5 is a detailed sectional view illustrating the circuit closing device for the motor circuit. Fig. 6 is a diagrammatical view illustrating the circuits. Fig. 7 is a plan view similar to Fig. 1 showing the motor provided with a different form of retarding mechanism. Fig. 8 is a detail view of the retarding mechanism shown in Fig. 7. Fig. 9 is a diagrammatic view illustrating the circuits with the thermostat in a low voltage circuit in a shunt from the lead of the high voltage circuit, a transformer being shown for reducing the voltage. Fig. 10 is a detail illustrating a slight modification of the circuit plan shown in Fig. 9, a resistance being substituted for the transformer, for use with direct current.

My invention relates to a damper controlling apparatus adapted particularly for use with a thermostat and conveniently employed for operating the dampers of a furnace or heater for a dwelling house or other building, or for operating dampers or valves in this or other connections.

The object of my invention is to provide a small inexpensive and reliable apparatus for generating sufficient power to operate the valves or dampers with which it is connected and controlled by electrically actuated devices connected with the thermostat, the power being supplied by means of an electric motor located in a separate circuit from the thermostat circuits and operated preferably by current supplied at the proper times from an ordinary incandescent lighting circuit of, for example, 110 volts such as is ordinarily used for the illumination of houses so that the apparatus will operate continuously without attention. Heretofore an apparatus of this character has usually been actuated by springs or weights which required to be wound up at more or less frequent intervals and where such apparatus was so actuated safety mechanism was necessarily associated therewith to prevent the dampers being left in an "open draft" position, which would endanger the heating apparatus or the occupants of the house. In my improvement the electric motor operated from the house lighting circuit not only furnishes an inexhaustible supply of power as needed but dispenses with the necessity for the safety devices heretofore referred to, as the source of current remains constant at all times.

My invention also comprises novel means for making and breaking the high voltage motor circuit by means actuated by the making of one or other of the low voltage thermostat circuits and also means for enabling the motor to supply power to the actuating shaft of the apparatus so easily and with such leverage that it may readily be started and acquire its normal speed, mechanism being also provided to prevent overspeeding and permit the motor to stop without danger of injury to the apparatus. My invention also includes certain novel features in the construction of the apparatus, all of which will be hereinafter more fully described.

Referring to Figs. 1 to 6 inclusive of the accompanying drawings, which illustrate an embodiment of the invention selected by me for the purpose of illustrating the same, the frame of the apparatus comprises three metal plates 1, 2, and 3, arranged parallel to each other and rigidly connected together by means of threaded rods 4 and spacing sleeves 5 and nuts 6, by means of which the said plates are rigidly secured in fixed relation with each other. 7 represents the

electric motor which is secured to the frame so formed, in any desired way, between the plates 1 and 3 and is provided at one end with a small driving pinion 9. 10 represents the actuating shaft or crank shaft of the apparatus, mounted in suitable bearings in the frame and provided at its ends with oppositely disposed crank arms 11 and 12 carrying crank pins 13 at their outer ends which are connected in any desired manner with the dampers or other devices to be actuated. In practice I find it convenient to connect one of said cranks with the main draft damper of the furnace and the other crank with the check draft damper so that one of said dampers will be open and the other closed, and vice versa, according to the position of the shaft 10, and I provide means hereinafter described for stopping the shaft 10 in two positions 180° apart. As is well known an electric motor does not exert its full power until it has attained its normal speed of rotation and it is necessary to so connect the motor with shaft 10 that the motor may certainly start under all conditions and quickly attain its normal speed. To this end I interpose between the motor shaft and the actuating shaft a train of reducing gearing by which the leverage of the motor is greatly increased and the speed of the actuating shaft very greatly reduced with respect to that of the motor shaft, the said train of gearing being so connected as to enable the motor shaft to make a large number of revolutions before it imparts any material movement to the actuating shaft 10. This renders the movement of shaft 10 slow, but this is not objectionable as it is only required to turn it through a half revolution at any one time and I find in practice that with a suitable gearing train to accomplish the results above stated the shaft 10 can be moved to that extent in from 30 seconds to a minute. As shown in the drawings the pinion 9 of the motor shaft engages a large gear 26 on a short shaft 27, connected with a pinion 28 which engages a large gear 14 on a short shaft 15 said gear 14 carrying a pinion 16 engaging a large gear 17 loosely mounted on shaft 10 and provided with a pinion 18 fast thereto and meshing with a large gear 19 loose on the shaft 15 and having connected therewith a pinion 20 meshing with a large gear 21 fast on the shaft 10.

In order to prevent injury to the motor and connected mechanism and for assisting in stopping the same, I connect with the motor shaft a retarding device such as a fan 22 frictionally secured on a shaft 23 connected with the motor shaft by a multiplying gearing comprising in this instance a large gear wheel 24 on the motor shaft engaging a pinion 25 on the fan shaft 23. When the motor circuit is closed, the motor shaft will quickly attain normal speed before it begins to exert any appreciable effect on the dampers, and the retarding device prevents over speeding, so that there is no shock to the mechanism when the motor takes up its load and begins to move the dampers.

The actuating shaft 10 is provided with a stopping disk 30 provided with two recesses 31, 31, constructed to receive a detent 32 on an armature lever 33 pivoted at 34 to plate 1 below the coils 35, of an electric magnet, said magnet being rigidly secured to a cross bar 36 connected with the plates 1 and 3 and also serving as a strengthening brace between said plates.

The terminals of the motor circuit comprise a fixed contact 40 connected with binding post 41 and a movable contact operatively connected with the armature lever. The movable contact is carried by a vertically movable bracket or angle plate 42 in this instance provided with a slot 43 through which passes a retaining screw 44 for guiding the plate in its vertical movements, said plate having at its lower end an aperture 45 which is engaged by a projection 46 secured to or formed integrally with the armature lever 33. The bracket 42 has a horizontal flange 47 having an aperture therein to receive a binding post 48 which is insulated from the bracket by means of suitable insulating washers and I prefer to provide this binding post with a yielding device for engaging the fixed contact 40. In the present instance I have shown the binding post hollow and its upper end provided with a headed pin 49 extending through an aperture in the upper end of the post, the slot within the post being engaged by a spring 50 adjustably held in position by a screw 51 in the lower end of the post. Yielding contact pin 49 is conveniently made of platinum as is the contact 40 to insure their durability.

It will be obvious that whenever a current is passed through the magnet coils 35 the armature lever 33 will be raised out of the notch or recess 31 which it then engages and simultaneously raises the bracket 42 so as to bring the contact 49 into engagement with the contact 40 and close the motor circuit, thus instantly starting the motor which rapidly attains its normal speed of rotation and imparts a very slow rotary movement to the shaft 10. The forward edge or face of each recess 31 in the notch disk 30 is made substantially radial and the corresponding face of the detent 32 is similarly shaped. When the detent is raised out of the recess the movement of the shaft 10 brings one of the concentric portions of the disk beneath the detent so that the armature lever 33 will not be permitted to fall until the opposite recess comes beneath the detent and thus holding the contacts 40 and 49 together and

maintaining the motor circuits closed. Each of the recesses 31 is provided with an angular face opposite the radial face and the rear face of the detent 32 is similarly beveled as shown. It therefore follows that when the disk 30 is rotated far enough to permit the detent to reëngage one of the said recesses the forward substantially radial face permits the detent to drop instantly and break the motor circuit through contacts 40 and 49, and the motor very quickly stops under the retarding influence of the fan 22 or other retarding device, which thus serves an additional function. The motor circuit is broken before the detent is fully seated in the notch in disk 30, and the motor will be brought to rest before the inclined face of the engaged notch has been brought into very forcible contact with the beveled face of the detent, but in case such contact results, the engagement of these inclined or beveled faces will merely tend to check the momentum of the motor and train without causing jar, and without lifting the armature lever 33, far enough to again close the motor circuit. The engagement of these beveled faces also performs an additional function in the operation of the device. It is a fact that the thermostatic element moves so delicately that in responding to very slight variations of temperature it frequently makes a contact for an instant, only to break it a moment after and it may take a more pronounced change to cause the delicate instrument to press firmly on the contact which it is approaching. In my improved device the magnet 35 responds instantly to the slightest contact, and the motor is started. If the circuit is immediately broken the movement of the motor and train will have nevertheless caused a slight advance of the inclined face of the recess in disk 30, and a partial elevation of the armature lever 33. A series of these slight contacts will eventually close the motor circuit so as to cause the actuation of the dampers even if no one of them is sufficient, and the machine will operate the dampers before the change of temperature is sufficiently pronounced to firmly press the thermostatically moved contact into engagement with its adjacent contact. The retarding device, either fan or centrifugal brake, is not brought into effective operation until the motor attains considerable speed and hence it will not interfere with these slight progressive operations, while it is fully operative to prevent overspeeding and to assist in stopping the motor when the motor is operating at high speed. This construction, therefore, renders the device exceedingly sensitive to very slight changes in temperature and tends to maintain more uniformly the precise temperature for which the thermostat is set.

The shaft 10 is also provided with the usual mechanism for alternately closing one or the other of the thermostat circuits comprising in this instance a spring contact plate 52, secured to a collar 53 on the shaft 10 and making contact with oppositely disposed screws or projections 54 and 55 connected with binding posts 56 and 57 secured to but insulated from the plate 1.

A diagram of the circuits is illustrated in Fig. 6 and may be briefly described as follows. 60 and 61 represent the line wires of the high voltage electric circuit which will be ordinarily an incandescent lighting circuit of 110 volts, one of said wires being connected to the motor and through the motor to one of the contacts 40 or 49, and the other line wire being connected to the other of said contacts. 70 represents the thermostatic element of the thermostat and 71 and 72 the contacts coöperating therewith. The thermostatic element may be conveniently connected by a wire 73 with a battery 74 and thence by wire 75 to the coils 35—35 of the magnet and thence by wire 76 to the frame of the apparatus, thence by spring contact 52 to one or other of the contacts 54 and 55 according to the position of the shaft 10. The contact 54 is connected by a wire 77 from binding post 56 to contact 71 of the thermostat and the contact 55 is connected by wire 78 from binding post 57 to the contact 72 of the thermostat. It will be understood that the movement of the thermostatic element 70 induced by a change of temperature of the room in which it is located will cause the said element to make contact with one or other of the contacts 71 and 72, in this instance as shown in Fig. 6, with the contact 71, thus energizing the magnet and causing a half revolution of shaft 10 to take place as previously described. The thermostatic element will remain in contact with the contact 71 but the rotation of shaft 10 will swing the contact plate 52 from the contact 54, thus breaking the circuit through the magnet and releasing the armature. The plate 52 is of such width, however, that before this breaking of the magnet circuit occurs the notch in the disk 30 will have been moved beyond the detent 32 so that when the circuit is broken through the magnet the armature lever will be held in raised position until the half revolution of the shaft 10 is completed when the plate 52 will be in contact with the contact 55 and thus in position to actuate the magnet as soon as the thermostatic element shall move into contact with the contact 72.

In Figs. 7 and 8 I have shown a slightly modified form of motor in which the fan mechanism is dispensed with and a different form of retarding mechanism is employed, to wit, a centrifugal brake. In these figures the parts which correspond to those in the previous figures have been given the same

numerals with the addition of the letter "a," and it will only be necessary to describe the parts which differ from those heretofore described.

In the form of mechanism shown in Figs. 7 and 8, 22^a represents a brake sleeve which is rigidly secured to a bearing portion at one side of the motor and the armature shaft, 8^a, is provided with a centrifugal brake consisting, in this instance, of a boss 24^a having a screw threaded stem which screws into the end of the armature shaft, said boss being provided with radial arms engaged by brake blocks 23^a which can slide outwardly on said arms into engagement with the inner face of the brake sleeve, said brake blocks being held normally in retracted position by a spring 25^a until acted upon by centrifugal force.

In the arrangement of the circuits shown in Fig. 6 of the accompanying drawings, I have shown a battery for supplying current for the thermostat circuits. This may be deemed objectionable by some persons as the battery might lose its strength and refuse to operate the electromagnetic control mechanism so that the dampers would not be properly actuated, and I, therefore, prefer to derive all the current for the apparatus from a single source, to wit, from the line wires of a suitable electrical system connected with a generator, as, for example, the line wires for incandescent lighting which are available in most modern buildings and usually carry 110 volts, either direct or alternating.

In Fig. 9 I have shown the apparatus arranged so that all the power is derived from the line wires which are connected directly with the motor circuit. I also provide a shunt circuit indicated by the wires 74^b and 74^c which in the case of alternating current being supplied, extend to a transformer 74^a from which the wire 73^a extends to the thermostatic element and a wire 75^a extends to the magnet 35^a, the other parts in this figure being identical with those shown in Fig. 6 and given the same reference numerals with the addition of "a."

With this arrangement it will be seen that the full voltage from the line wires is supplied to the motor when the contacts 40^a and 49^a are closed, while from the same source a reduced current of say 6 volts is transmitted through the transformer, as low voltage current for opertaing the thermostatic circuits. In case the current supplied for the line wires is direct current it is unnecessary to use a transformer and in lieu thereof a reducing coil will be inserted in the shunt circuit in a well-known way as indicated in Fig. 10 in which a resistance coil is shown at 74^{ax} inserted in the shunt circuit 74^{bx}, 75^{ax}, 74^{cx}, 73^{ax}.

It will be seen that the mechanism is started by the closing of the motor circuit brought about by the electrically operated device in the thermostat circuits, and that the concentric portions of the notched disk prevent the breaking of the motor circuit until substantially a half revolution of the damper actuating shaft has taken place, when the motor circuit is broken and the motor and connected mechanism stops or runs down, as the retarding mechanism assisting in slowing down the motor at first and the reducing gearing bringing the motor shaft quickly to a stationary position without the use of any locking or checking mechanism, and relieving the mechanism entirely from jar and shock. By this improved construction the mechanism is very durable and not at all likely to get out of order. My improved construction also enables me to use positive gearing between the motor and damper operating shaft and obviate the necessity for the use of a centrifugally actuated clutch, thus cheapening the cost of the mechanism and insuring positive and accurate operations of the same at all times.

What I claim and desire to secure by Letters Patent is:—

1. In a damper controlling apparatus, the combination with a shaft provided with damper actuating devices, of an electric motor, a circuit therefor, gearing connecting said shaft and motor, circuit controlling devices in the motor circuit including a movable contact, the said shaft being at all times free to rotate under the power of the motor, a rotary disk operatively connected with the motor and provided with a notch having a radial face and a face angularly disposed thereto, an armature lever operatively connected with said movable contact and provided with a projection for engaging the notch and periphery of the disk, said projection having faces substantially parallel with the faces of said notch, an electromagnet for operating said armature lever, a thermostat and connections between said thermostat and said magnet, whereby faint actions of the thermostat will cause partial rotary movements of said disk and will progressively move said armature lever toward a position to close said motor circuit.

2. In a damper controlling apparatus, the combination with a shaft provided with damper actuating devices, of an electric motor, a circuit therefor, gearing connecting said shaft and motor, circuit controlling devices in the motor circuit including a movable contact, the said shaft being at all times free to rotate under the power of the motor, a rotary disk operatively connected with the motor and provided with a notch having a radial face and a face angularly disposed thereto, an armature lever operatively connected with said movable contact and provided with a projection having angularly

disposed faces and adapted to simultaneously engage the opposite faces of said notch, an electromagnet for operating said armature lever, a thermostat and connections between said thermostat and said magnet whereby faint actions of the thermostat will cause partial rotary movements of said disk and progressively move said armature lever toward a position to close said motor circuit.

3. In a damper controlling apparatus, the combination with a shaft provided with damper actuating devices, of an electric motor, a circuit therefor, gearing connecting said shaft and motor, circuit controlling devices in the motor circuit including a movable contact, the said shaft being at all times free to rotate under the power of the motor, a rotary disk operatively connected with the motor and provided with a notch having a radial face and a face angularly disposed thereto, an armature lever operatively connected with said movable contact and provided with a projection for engaging the notch and periphery of the disk, said projection having faces substantially parallel with the faces of said notch, an electromagnet for operating said armature lever, a thermostat and connections between said thermostat and said magnet and a retarding device operatively connected with the motor and constructed to be brought into effective action only at high speed thereof.

4. In a damper controlling apparatus, the combination with a shaft provided with damper actuating devices, of an electric motor, a circuit therefor, gearing connecting said shaft and motor, circuit controlling devices in the motor circuit including a movable contact, the said shaft being at all times free to rotate under the power of the motor, a rotary disk operatively connected with the motor and provided with a notch having a radial face and a face angularly disposed thereto, an armature lever operatively connected with said movable contact and provided with a projection for engaging the notch and periphery of the disk, said projection having faces substantially parallel with the faces of said notch, an electromagnet for operating said armature lever, a thermostat and connections between said thermostat and said magnet and a centrifugal brake on a shaft operatively connected with the motor adapted to be brought into action only at high speed thereof.

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

DAVID BELDEN.

Witnesses:
BENJ. C. WICKES,
P. J. MURPHY.