No. 860,433. PATENTED JULY 16, 1907.

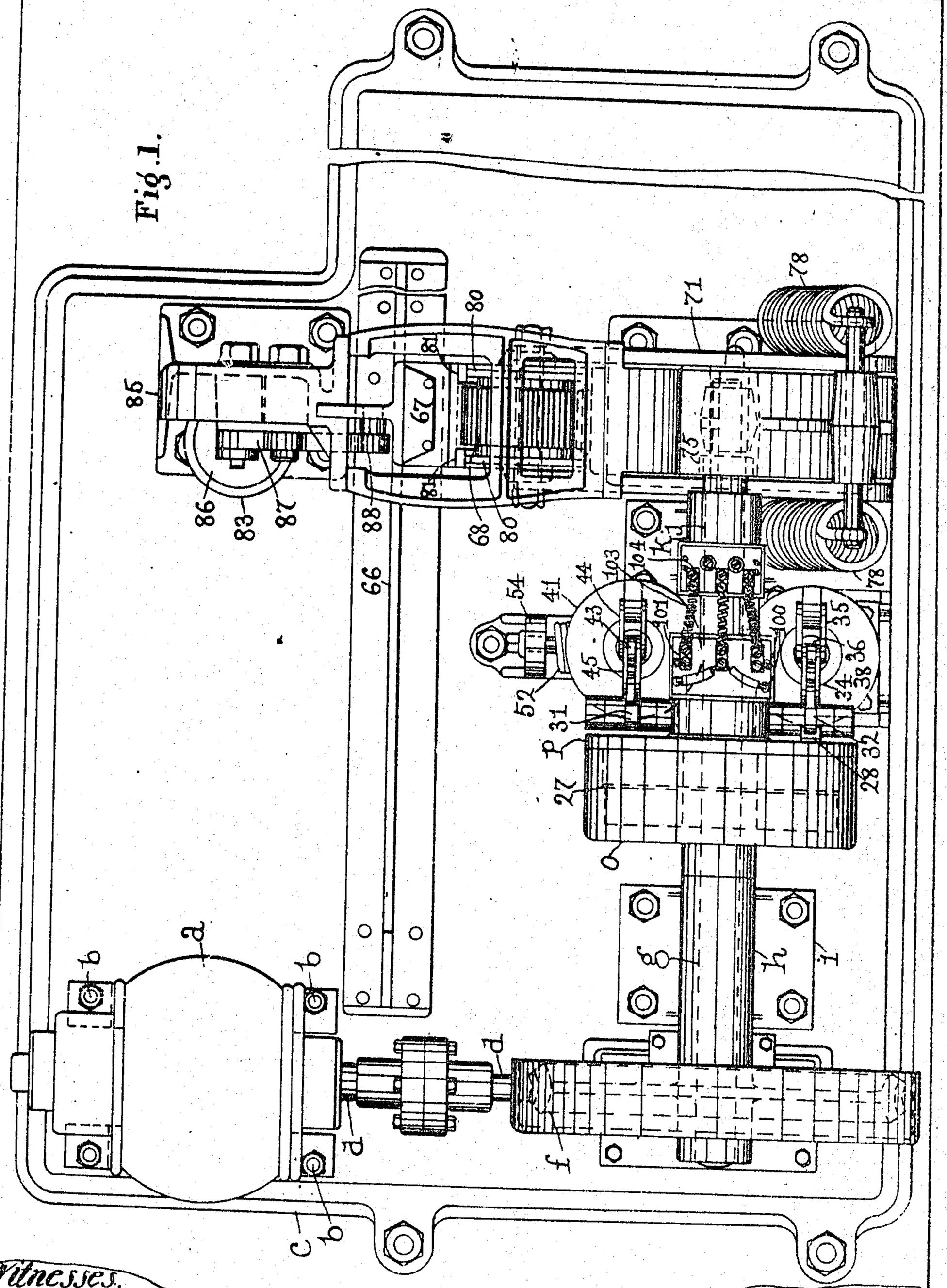
J. M. ANDERSEN.

OPERATING MECHANISM FOR ELECTRIC SWITCHES.

APPLICATION FILED MAR. 30, 1907.

6 SHEETS—SHEET 1.

Fig. 1.



Witnesses.
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J. Dunphy

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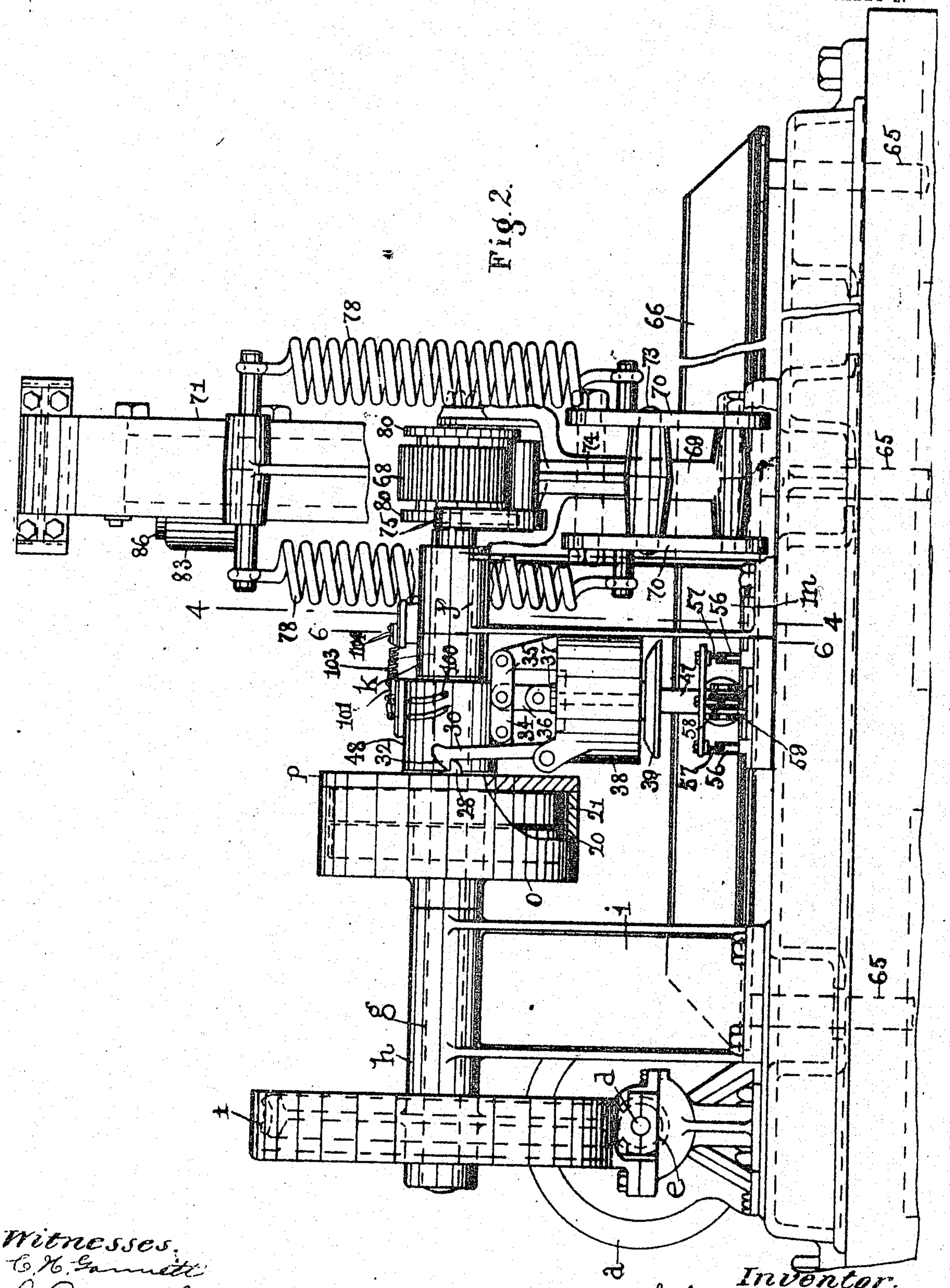
6 SHEETS—SHEET 2.

Fig. 2.



Witnesses.
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6 SHEETS—SHEET 3.

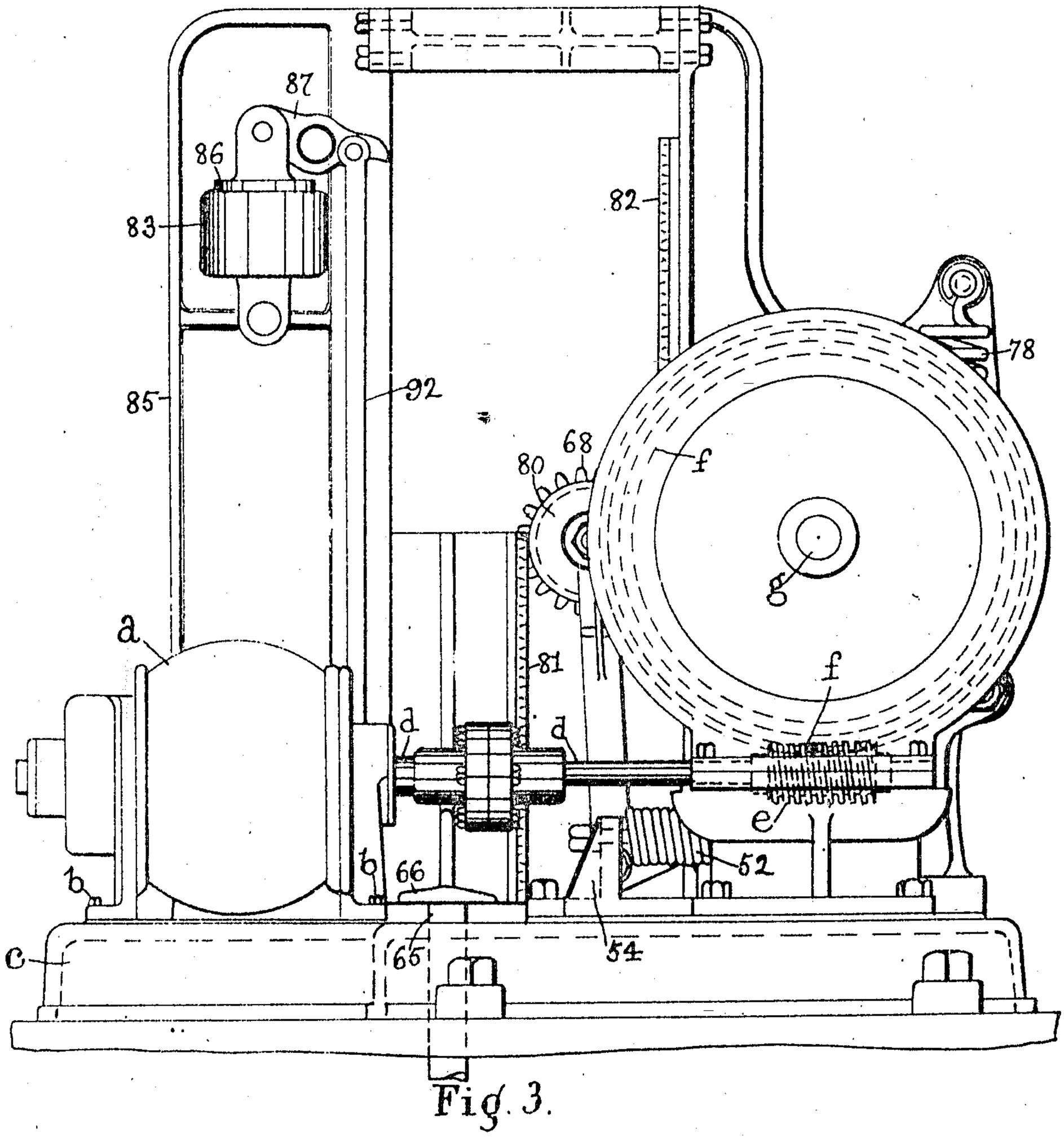

Fig. 3.

Witnesses.
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6 SHEETS—SHEET 4.

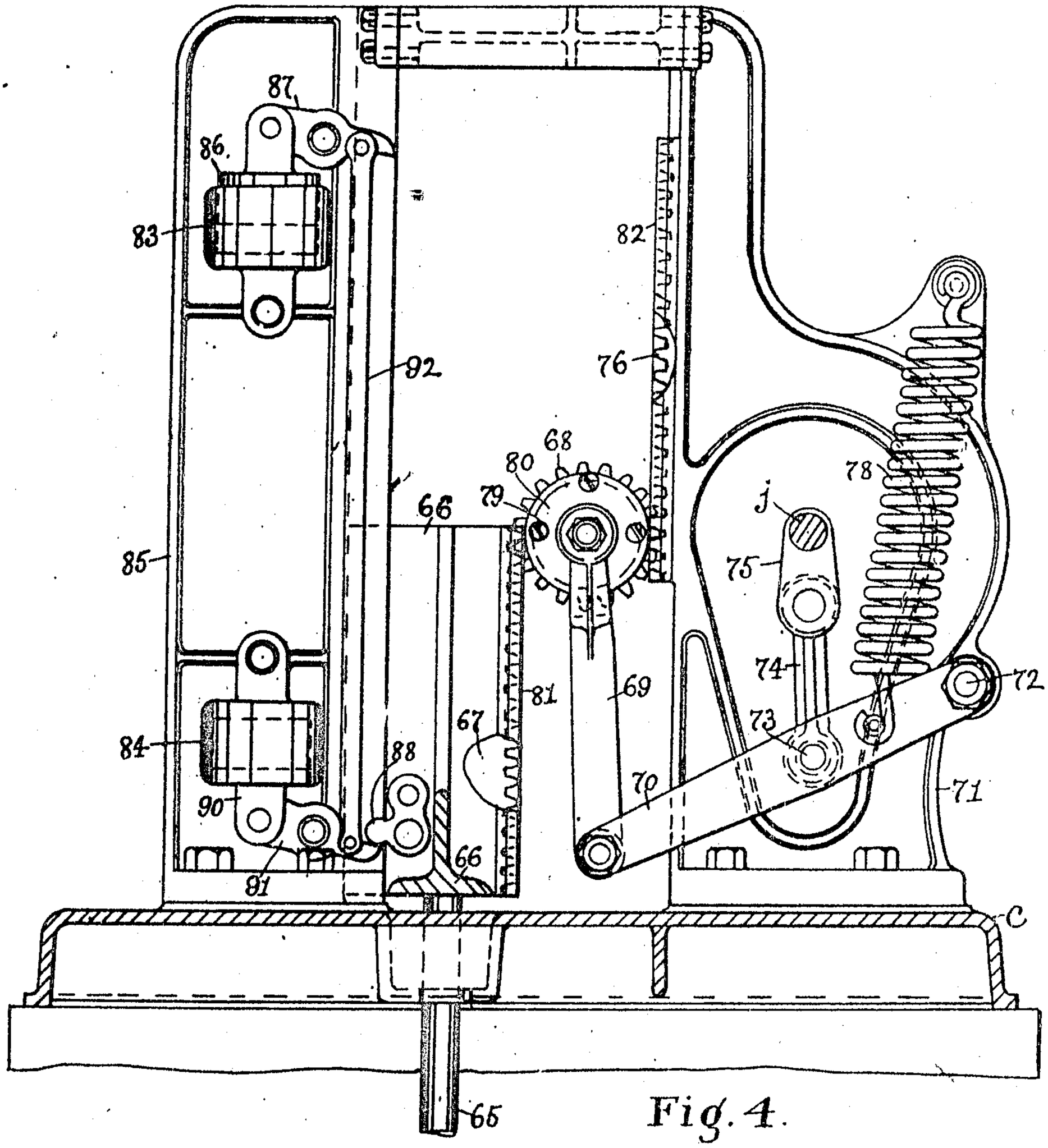

Fig. 4.

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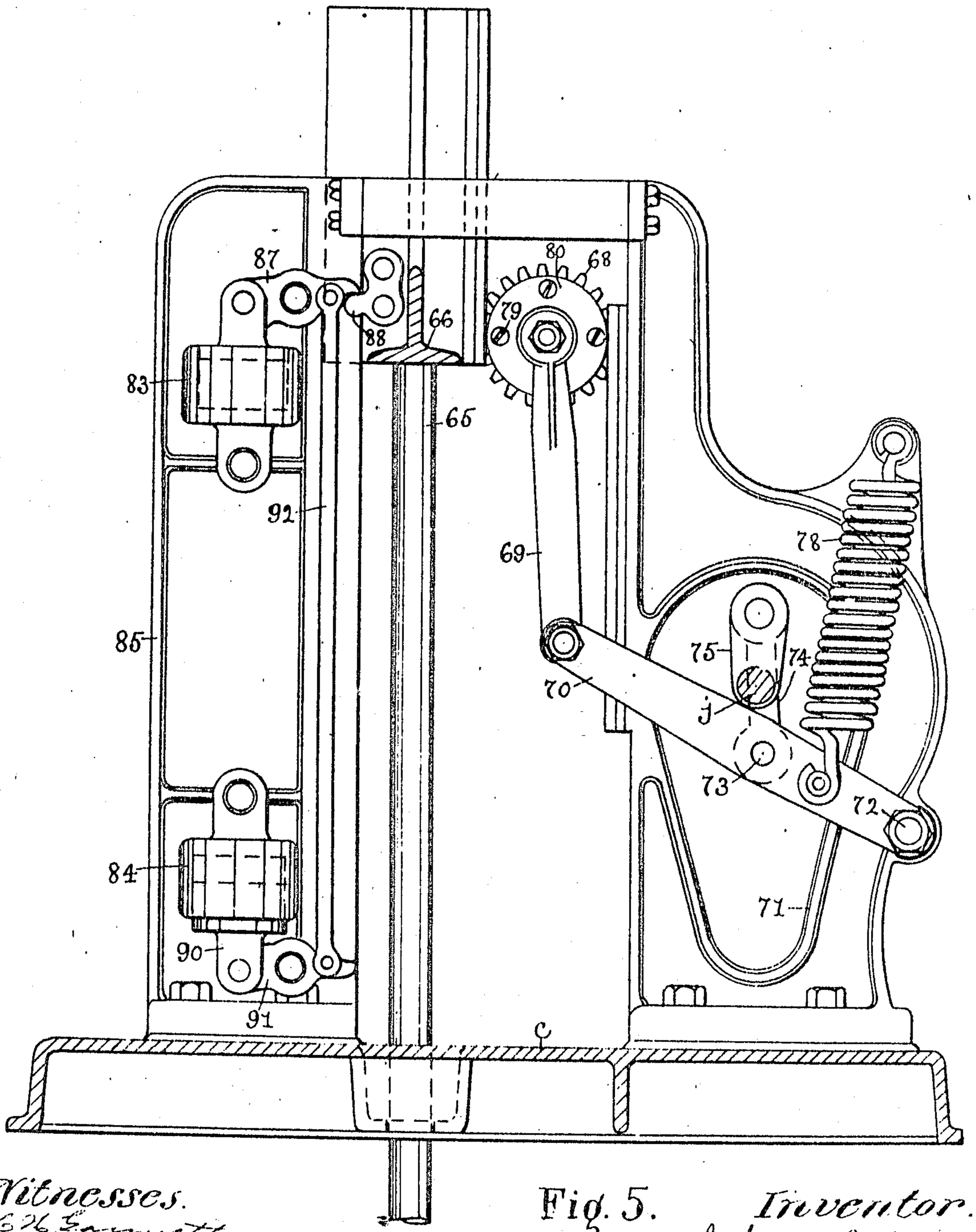
6 SHEETS—SHEET 5.



Witnesses.
G. H. Bennett
J. Murphy

Fig. 5.

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No. 860,433. PATENTED JULY 16, 1907.

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OPERATING MECHANISM FOR ELECTRIC SWITCHES.

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6 SHEETS—SHEET 6.

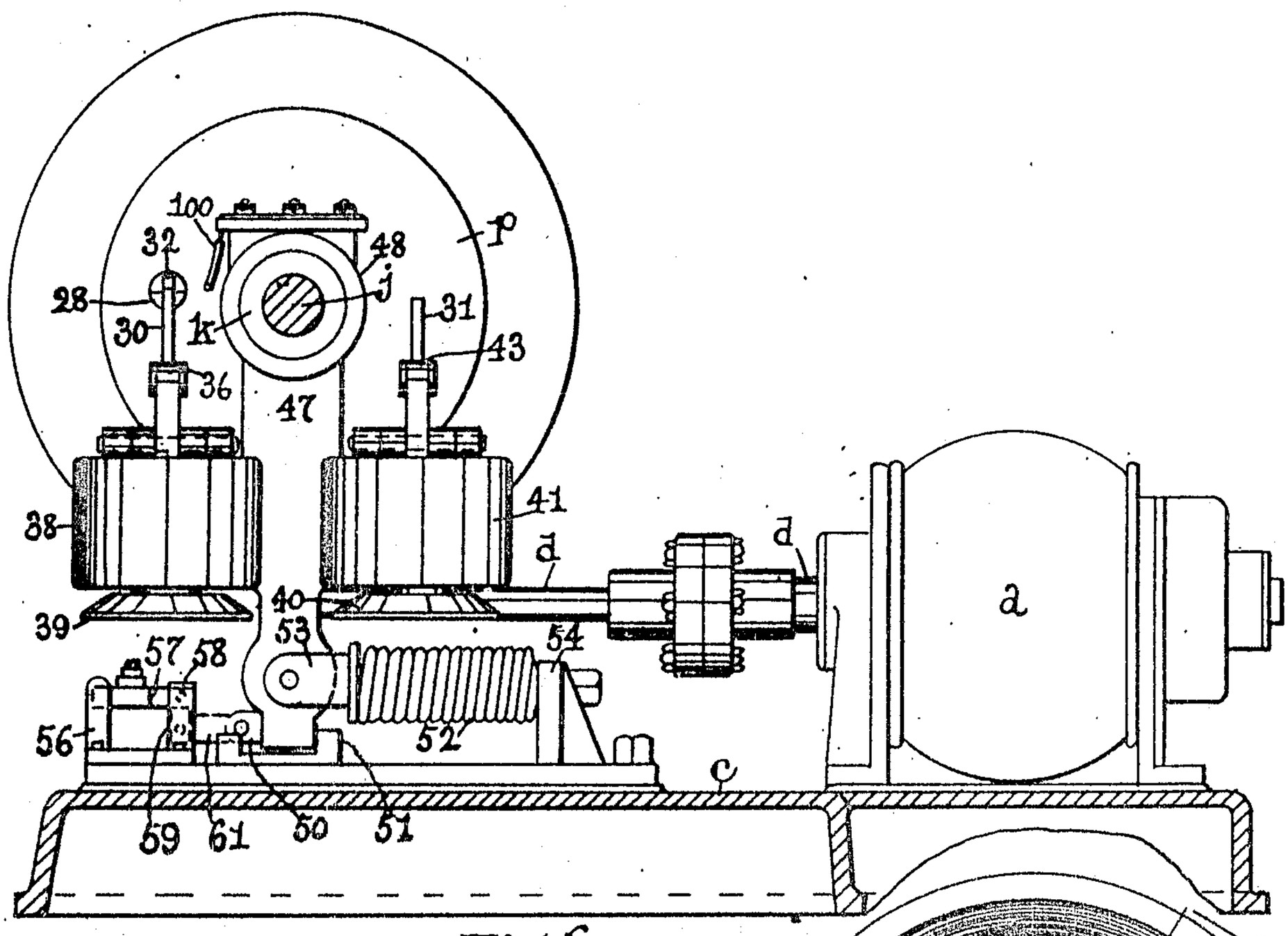

Fig. 6.

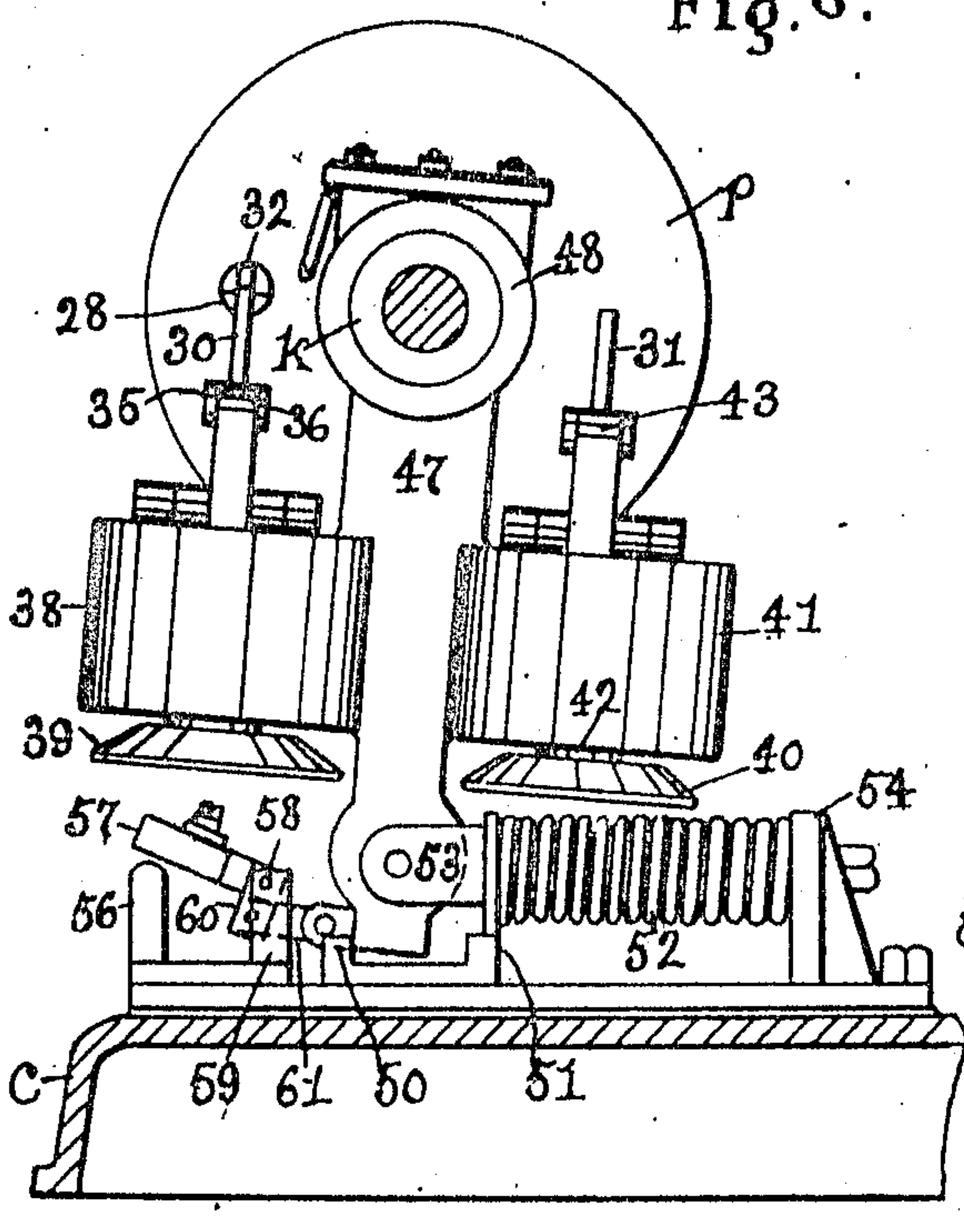

Fig. 7.

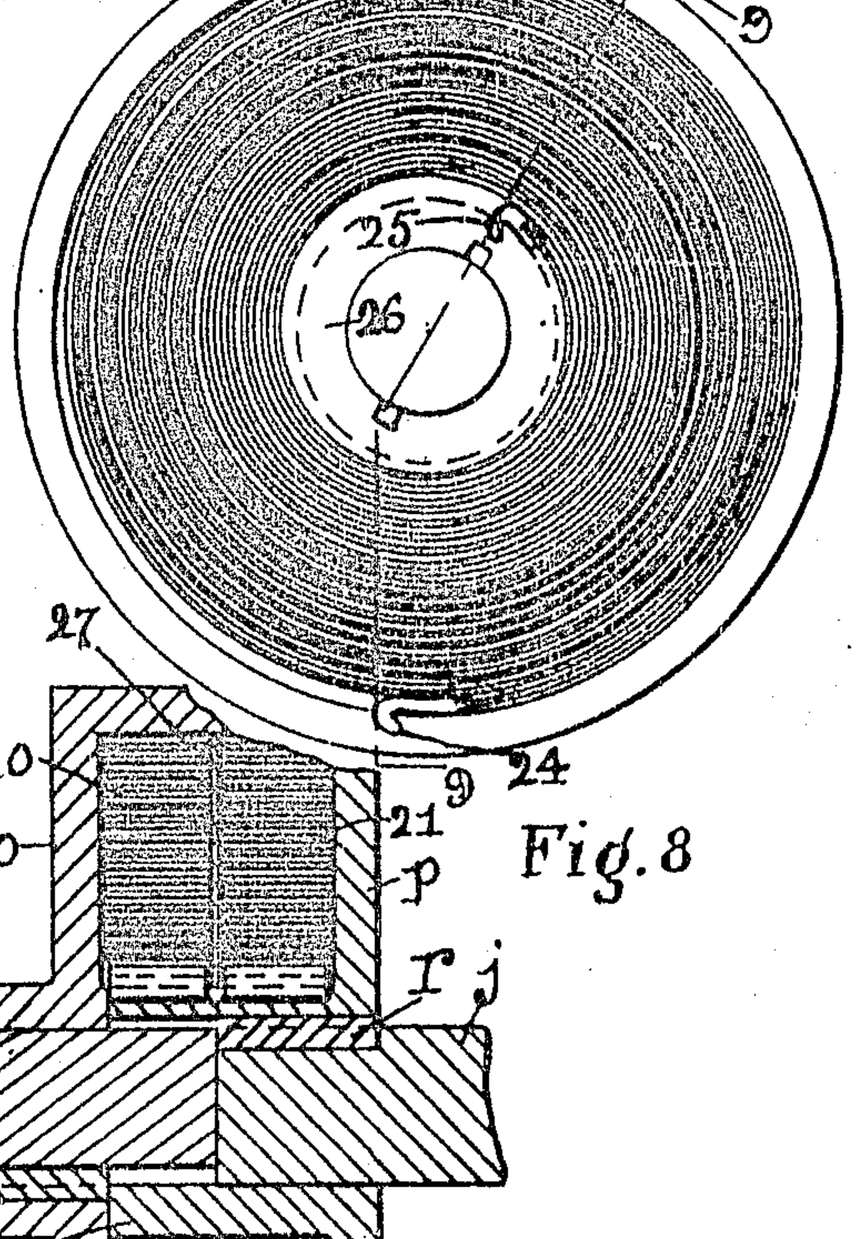

Fig. 8

Fig. 9

Witnesses.
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J. Murphy

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UNITED STATES PATENT OFFICE.

JOHAN M. ANDERSEN, OF BOSTON, MASSACHUSETTS, ASSIGNOR TO ALBERT AND J. M. ANDERSON MANUFACTURING COMPANY, OF BOSTON, MASSACHUSETTS, A CORPORATION OF MAINE.

OPERATING MECHANISM FOR ELECTRIC SWITCHES.

No. 860,433. Specification of Letters Patent. Patented July 16, 1907.

Application filed March 30, 1907. Serial No. 365,589.

To all whom it may concern:

Be it known that I, JOHAN M. ANDERSEN, a citizen of the United States, residing in Boston, in the county of Suffolk and State of Massachusetts, have invented an Improvement in Operating Mechanism for Electric Switches, of which the following description, in connection with the accompanying drawings, is a specification, like letters on the drawings representing like parts.

This invention relates to apparatus especially adapted among other uses for operating the movable member of substantially large electric switches, such, for instance, as are employed in circuits carrying high tension currents.

The invention has for its object to provide a simple and efficient apparatus for the purpose specified.

To this end the operating apparatus is provided with a rotatable shaft, which is operatively connected with the movable member of the switch and which is driven by a spring motor. Provision is made for controlling the rotation of the rotatable shaft by its spring motor and also for restoring power to said motor after the said power has been diminished in rotating its shaft. These and other features of this invention will be pointed out in the claims at the end of this specification.

Figure 1 is a plan view of an operating apparatus embodying this invention. Fig. 2, a front elevation of the apparatus shown in Fig. 1. Fig. 3, an end elevation of the apparatus shown in Fig. 1. Fig. 4, a cross section on the line 4—4, Fig. 2, looking toward the right. Fig. 5, a cross section on the line 4—4, with the parts in a different position from that shown in Fig. 4. Fig. 6, a cross section on the line 6—6, Fig. 2, looking toward the left. Fig. 7, a similar section showing the parts in a different position from that shown in Fig. 6. Fig. 8, an enlarged detail of the spring motor, and Fig. 9, a section on the line 9—9, Fig. 8.

In the apparatus herein shown as embodying this invention, *a* represents an electric motor, which may be of any suitable or desired construction and which is secured as by bolts or screws *b* to a suitable base *c*. The motor *a* has its armature shaft *d* provided with a worm *e* (see Fig. 3), which meshes with a worm gear *f* fast on a shaft *g*, having bearings in a hub *h* supported by an upright *i* secured to the base *c* (see Fig. 2). In line with the shaft *g* is a second shaft *j*, having bearings in a hub *k*, supported by an upright *m* secured to the base *c*. Provision is made for operatively connecting the shaft *j* with the shaft *g*, so that the shaft *j* may be driven by a spring motor, which is wound up by rotation of the shaft *g* as will now be described. To this end, the shaft *g* (see Fig. 9) has secured to it as by the key *n* a drum *o* provided with a side plate or disk *p*, which is free to turn independently of the drum and which is secured as by the key *r* to the shaft *j*. Within the drum *o* is located one or more spring motors, and in the present instance I have shown two coiled springs 20, 21, similar to clock springs but of sufficient strength to enable either spring to rotate the shaft *j* one or more times, for a purpose as will be described.

The springs 20, 21 have their outer ends suitably connected with the drum *o* and their inner ends suitably connected with the disk *p*. In the present instance the outer end of each spring 20, 21, is represented as provided with a hook 24, which engages a suitable recess in the inner circumference of the drum *o*, (see Figs. 8 and 9), and the inner end of each spring is provided with a like hook 25, which engages a suitable recess in the hub 26 of the disk *p*. The springs 20, 21 may be separated by a disk or partition 27, mounted on the hub 26 and serving to separate the drum *o* into two chambers in which the springs are located. (See Fig. 9). It will thus be seen, that if the shaft *j* is stationary and the shaft *g* is rotated, the springs 20, 21 will be wound up and placed in condition to rotate the shaft *j* when the latter is released, as will be described.

In the present instance, provision is made for stopping rotation of the shaft *j* at each half revolution, and for this purpose, the disk *p* is provided with a lug or projection 28, (see Figs. 2, 6 and 7), which coöperates with and is adapted to engage two stops, herein shown as pivoted arms or levers 30, 31, located on opposite sides of the shaft *j* and normally projecting into the path of movement of the lug 28 on the disk *p*.

The stop lever 30 is provided at its upper end with a hook 32 so as to engage the lug 28 on the upward movement of the latter, and the lever 31 is made flat on its upper end so as to engage the lug 28 on its downward movement. The movable stops or levers 30, 31 may be electrically controlled, and in the present instance I have shown them so controlled. To this end the stop lever 30 is connected by toggle levers 34, 35 and link 36, (see Fig. 2) to a rod or spindle 37, which is extended through an electromagnet 38 and has attached to it the armature 39 for said magnet. The stop lever 31 is connected in a similar manner to the armature 40 of an electromagnet 41, having its rod or spindle 42 joined by a link 43 to toggle levers 44, 45, which are connected to the said stop lever, as best shown in Figs. 1, 2 and 6.

The stop levers 30, 31 are normally in the path of movement of the lug 28, and at such time, the electromagnets 38, 41 are deënergized, their armatures being in their lowered or unattracted position represented in Figs. 2 and 6, and the toggle levers being in their

straightened position. When the electromagnets 38, 41 are energized, which may be effected by closing their circuits in the well-known manner, by a manually operated switch, not shown, but which may be located at or near the apparatus, as herein shown, or at a point remote therefrom, their armatures are attracted and their toggle levers are moved into an inclined position, thereby drawing back the stop levers from the path of movement of the lug 28, which is released and places the shaft *j* under the influence of the spring motor 20 or 21. The electro-magnets 38, 41 in the present instance are suspended from the bearing hub *k*, they being secured to or forming part of an arm or frame 47 attached to a hub 48 which is loosely mounted on the bearing hub *k* (see Figs. 2, 6 and 7). The arm 47 is extended down between the magnets 38, 41, and between two stops or lugs 50, 51 secured to the base *c* and which coöperate with said arm to limit the movement of the same in opposite directions. The magnet-carrying frame or arm 47 is rocked in one direction by the spring motor 20 or 21, and is arrested in this movement by the stop 50 as shown in Fig. 7; and the said frame or arm is rocked in the opposite direction by a spring 52 fastened at one end to a link 53 attached to the arm 47 and at its opposite end to an upright 54 secured to the base *c*.

The strength of the spring 52 is so proportioned to the strength of the spring motor 20 or 21, that the spring motor when wound up to its working capacity as will be described, overcomes the tension or strength of the spring 52 and rocks the magnet frame or arm 47 into contact with the lug 50 as shown in Fig. 7, and when the strength of the spring motor falls below a given point or amount, as will be described, the spring 52 predominates and turns the arm 47 into contact with the lug 51.

When the spring motor 20 or 21 has been wound up sufficiently to perform the work required, it is desirable that the electric motor *a* should be stopped, and for this purpose, a switch controlling the circuit of said electric motor is operatively connected with the movable arm 47. In the present instance, the switch for the motor *a* is shown as a two-pole switch, comprising the terminals 56 and contact blades 57 (see Fig. 2), the latter being secured to a movable member pivoted at 58 (see Figs. 6 and 7) to an upright 59 and having an arm 60, which is connected by a link 61 to the arm or frame 47. When the spring motor is being wound up, the switch for the motor *a* is closed as represented in Fig. 6, and remains closed until the spring motor has been wound up sufficiently to overcome the spring 52 and rock the arm 47 into the position shown in Fig. 7, at which time the switch for the motor *a* will be opened automatically by the arm 47 and link 61 acting on the movable member of the switch to move its contact blades out of engagement with the coöperating terminals. It will thus be seen that the spring motor 20 or 21 is controlled in its operation upon the shaft *j* by the electro-magnets 38, 41, and that the electric motor *a* is controlled by the spring motor. The rotation of the shaft *j* by the spring motor may be employed for various uses, and is particularly well adapted for opening and closing electric switches for high tension circuits, which switches are not herein shown specifically, but are represented by the rods 65, herein shown as three in number, and which in practice may and preferably will be connected with the movable members of oil switches of any suitable, desired or well-known construction, and not herein shown, or to the movable member or members of any other form of electric switch.

The rods 65 are extended up through the base *c* and are attached to a cross bar 66, having secured to or forming part of it a vertically movable rack bar 67 (see Fig. 4), with which meshes a pinion or gear 68 journaled in the forked upper end of a lever or link 69, pivotally connected to the free end of levers 70, which are located on opposite sides of an upright 71 erected upon the base *c* and are mounted on a pivot rod 72 supported by said upright. The levers 70 intermediate their ends are connected by a rod 73, which is joined by a connecting rod 74 to a crank 75 on the shaft *j*, (see Figs. 2 and 4). The pinion 68 also engages a stationary rack bar 76 secured to the upright 71 and located so that the said pinion meshes with its lower end when the rack bar 67 is in its lowered position (see Fig. 4). The levers 70 have connected to them one end of helical springs 78, having their other end connected with the upright 71 and acting as counterbalances for the weight of the movable rack bar and the parts movable with it. The pinion 68 may and preferably will have secured to its opposite faces as by screws 79, bearing disks 80, which coöperate with metal strips or runners 81, 82, located on opposite sides of the rack bars 67, 76, whereby the gear or pinion is caused to travel in a straight path with the least possible friction, as the teeth of the pinion engage the teeth of the rack bars to a uniform depth.

Provision is made for preventing injury to the operative parts, caused by the lug 28 being suddenly arrested in its movement by the stop levers 30, 31, under the influence of the spring motor, and this result may be accomplished as herein shown by means of dash pots 83, 84 secured to an upright 85, so as to become effective at or near the end of the movement of the rack bar 67 in opposite directions. The dash pot 83 is provided with a piston 86 having its rod connected to one end of a lever 87, pivoted to the upright 85 and having its other end extended into the path of movement of a stud or device 88 attached to the rack bar 67. The dash pot 84 has the rod 90 of its piston connected to one end of a lever 91 pivoted to the upright 85 and having its free end extended into the path of movement of the stud or device 88. The free ends of the levers 87, 91 may and preferably will be connected together by a link 92, so that both levers are moved by the engagement of the stud or device 88 with either lever. The dash pots 83, 84 are arranged so that their pistons move simultaneously in opposite directions, that is, when the piston of one dash pot as 84 is moved into its cylinder by the engagement of the device 88 with the lever 91, the piston of the other dash pot 83 is moved out of its cylinder and into position to become effective when the device 88 engages the lever 87.

From the above description, it will be seen that with the apparatus herein shown, the high tension switch represented by the rod 65 is opened and closed at each complete reciprocation of the movable rack bar 67, and that such reciprocation is effected by each revolution of the crank shaft *j*.

In Figs. 3 and 4, the movable rack bar 67 is shown in its lowered position, and at such time the high ten-

sion switch may be supposed to be closed, and in Fig. 5, the rack bar 67 is shown in its elevated position, and at such time the high tension switch may be supposed to be open. The opening movement of the high tension switch takes place while the crank shaft *j* is turned by its spring motor 20 or 21, a half revolution from the position shown in Fig. 4 to that shown in Fig. 5. During this half revolution of the crank shaft, the levers 70 are turned upward on their pivot 72 and carry with them the pinion 68, which is revolved by the stationary rack bar 76 in such direction as to cause the rack bar 67 to be moved upward. On the next half revolution of the crank shaft *j* in the same direction, that is, from the position shown in Fig. 5 to that shown in Fig. 4, the levers 70 are moved downward and the pinion 68 rolls over the stationary rack bar 76 and causes the rack bar 67 to be moved downward.

The crank shaft *j* as above described is driven by the spring motor 20 or 21, which is controlled in its action by the electromagnets 38, 41, and these may be energized and deënergized by the operator closing a suitable switch located at any desired point and not herein shown.

The electric motor *a* is employed to replenish the spring power employed to revolve the crank shaft and is automatically governed by the circuit controller operated by the arm or frame 47, the said motor being set in operation to rotate the shaft *g*, when the power of the spring motor 20 or 21 has been reduced by turning the crank shaft *j*, and being stopped when the power of said spring motor has been restored.

I have herein shown and described the crank shaft *j* as being arrested in its movement at each half revolution, which is desirable when the apparatus is employed to operate the movable member of an electric switch, but I do not desire to limit my invention in this respect, as for some purposes, it may be desirable to have the crank shaft make one or more revolutions before being stopped, in which case it is only necessary to omit one of the electromagnets.

It will be observed, that when the shaft *j* is released and the spring motor is allowed to act, the latter exerts a sudden and powerful action on the crank shaft *j* and turns the same rapidly, thereby effecting a quick opening and closing of the switch represented by the rod 65.

The electric magnets 38, 41 are connected by suitable wires 100, to terminals 101, which are secured to but suitably insulated from the hub 48, so that said terminals and wires 100 move with the swinging frame or support 47 for the electromagnets. The terminals 101 are connected by wires 103 with stationary terminals 104 secured to but suitably insulated from the bearing *k*.

By reference to Figs. 6, 7, 8 and 9, it will be observed that the spring motor 20 or 21 is connected at one end to the drum *o* and at its other end to the disk *p*, and the action of the spring upon the switch member 57 is transmitted through the disk or lug 28, stop lever 30, and frame 47 to the movable member of the circuit controller governing the operation of the electric motor, and it will also be observed that as soon as the frame 47 is released from the disk *p*, as by the energizing of the magnet 38, then the spring 52 becomes active and immediately closes the circuit of the motor. As a result of this construction, if for any reason the power of the spring should not be sufficient to rotate the crank shaft *j*, the electric motor would immediately start to wind up the spring and thereby supply it with more power until sufficient power had been stored up in the spring to turn the shaft *j*.

I have herein shown one construction of apparatus, which I may prefer, but I do not desire to limit my invention to the particular construction shown.

Claims.

1. In an apparatus of the class described, in combination, a movable rack bar, a stationary rack bar, a pinion or gear interposed between said rack bars and meshing with both, a support for said pinion or gear, pivoted levers to which said support is connected, a crank shaft, means for connecting said levers with said crank shaft, a disk attached to said crank shaft, a coiled spring having one end connected with said disk, a drum to which the other end of said spring is connected, a shaft on which said drum is fast, an electric motor, gearing connecting the armature shaft of said motor with said drum shaft, a lug on said disk, stop levers coöperating with said lug and arranged substantially diametrically opposite, electromagnets provided with armatures, means for connecting said armatures with said stop levers, a movable support for said electromagnets, and a circuit controller for said electric motor operatively connected with the movable support for said electromagnets, substantially as described.

2. In an apparatus of the class described, in combination, a movable rack bar, a stationary rack bar, a pinion or gear interposed between and in mesh with both of said rack bars, a rotatable shaft, mechanism connecting said pinion with said shaft to produce bodily movement of said pinion by rotation of said shaft, a spring motor connected to said shaft to effect rotation of the same, means for controlling rotation of said shaft by said spring motor, and means for winding up said spring motor, substantially as described.

3. In an apparatus of the class described, in combination, a rotatable shaft, a spring motor to rotate it, a second shaft connected with said spring motor to wind up the same, holding means to restrain the first-mentioned shaft from rotation under the influence of said spring motor, an electromagnet for releasing said holding means, an arm or frame mounted to swing in one direction under the influence of said spring motor, means to move said arm in the opposite direction, a circuit controller operated by said arm, and an electric motor for rotating said second shaft governed by said circuit controller, substantially as described.

4. In an apparatus of the class described, in combination, a rotatable shaft, a spring motor to rotate it, a second shaft connected with said spring motor to wind up the same independently of the rotatable shaft, means to rotate said second shaft, means for rendering said second shaft stationary when said spring motor is wound up to a predetermined power, means for controlling the rotation of said rotatable shaft by its spring motor, and means governing the rotation of the second shaft according to the condition of the spring motor and independent of the rotation of the shaft driven by said spring motor substantially as described.

5. In an apparatus of the class described, in combination, a movable switch member, a rotatable shaft, mechanism for connecting said switch member with said shaft to effect reciprocation of said switch member by rotation of said shaft, a spring motor connected with said shaft to rotate it intermittently in the same direction, a second shaft to which said spring motor is connected, an electric motor for rotating said second shaft and thereby restore power to said spring motor, a circuit controller governing the operation of said electric motor, means operatively connecting said circuit controller with said spring motor to move the circuit controller into its open position when the power of the spring motor has reached a predetermined point, and a spring to act on said means in opposition to said spring motor and close the circuit controller when the power of the spring motor expended in rotating the shaft connected with the switch member has been diminished to a predetermined point, substantially as described.

6. In an apparatus of the class described, in combination, a rotatable shaft, a spring motor to rotate it in the same direction, means for restoring power to said spring motor when the said power has been expended to a predetermined point in turning the said rotatable shaft, and means acting in opposition to said spring motor to effect the operation of the power restoring means, when the power of the spring motor has been diminished to a predetermined point, substantially as described.

7. In an apparatus of the class described, in combination, a rotatable shaft, a spring motor to rotate said shaft in the same direction, an electric motor for restoring power to said spring motor when the latter has been diminished to a predetermined point, a circuit controller for said motor, and means rendered effective by the diminished power of the spring motor for operating said circuit controller to close the circuit of said motor and which is overcome by the spring motor when the power has been restored to the latter to operate said circuit controller and open the circuit of said electric motor, substantially as described.

8. In an apparatus of the class described, in combination, a rotatable shaft, a spring motor to rotate it a bearing in which a shaft is mounted to turn, a swinging frame mounted to turn on said bearing, an electromagnet carried by said frame, a circuit terminal fast on said frame to move with it, a stationary circuit terminal fast on said bearing, and a conductor connecting said terminals, substantially as described.

9. In an apparatus of the class described, in combination, a rotatable shaft, a spring motor to rotate it, means to control the action of said spring motor on said shaft, and an electric motor for restoring power to said spring motor, said electric motor being inactive when the power of the spring motor reaches a predetermined point and rendered active by means acting in opposition to said spring motor when a portion of the power of the spring has been expended in rotating the said shaft and said power has been diminished to a predetermined point.

10. In an apparatus of the class described, in combination, a rotatable shaft, an electric motor, a spring motor interposed between said shaft and electric motor and operatively connected with both to have power stored up in it by said electric motor, which power is expended in rotating said shaft, means operated by the spring motor for rendering said electric motor inactive upon the spring motor, and means independent of the spring motor and acting in opposition thereto for rendering the electric motor active, substantially as described.

11. In an apparatus of the class described, in combination, a crank shaft, a second shaft substantially in alinement with said crank shaft, a drum secured to one of said shafts and having a movable side disk secured to the other of said shafts to rotate independently of said drum, a coiled spring within said drum having one end connected with one shaft and its other end with the other shaft, a lug on said disk, a stop coöperating with said lug, and an electromagnet governing the action of said stop, substantially as described.

12. In an apparatus of the class described, in combination, a crank shaft, a second shaft substantially in alinement with said crank shaft, a drum secured to one of said shafts and having a movable side disk secured to the other of said shafts, a coiled spring within said drum having one end connected with one shaft and its other end with the other shaft, a lug on said disk, stop levers located on opposite sides of said shaft and coöperating with said lug, electromagnets for operating said stop levers, a swinging support for said electromagnets actuated in one direction by said spring, and a spring to move said support in the opposite direction, substantially as described.

13. In an apparatus of the class described, in combination, a crank shaft, a second shaft substantially in alinement with said crank shaft, a drum secured to one of said shafts and having a movable side disk secured to the other of said shafts, a coiled spring within said drum having one end connected with one shaft and its other end with the other shaft, a lug on said disk, stop levers located on opposite sides of said shaft and coöperating with said lug, electromagnets for operating said stop levers, a swinging support for said electromagnets actuated in one direction by said spring, spring to move said support in the opposite direction, an electric motor, gearing connecting said motor with said second shaft, and a circuit controller for said electric motor connected with said swinging support to operate, substantially as described.

14. In an apparatus of the class described, in combination, a rotatable shaft, a spring motor to revolve it in one direction, a second shaft connected with said spring motor, an electric motor to rotate said second shaft, a circuit controller for said electric motor, means actuated by said spring motor for moving said circuit controller into its opened position, and a spring acting on said means for moving said circuit controller into its closed position, said spring becoming effective when the power of said spring motor has been diminished to a predetermined point, substantially as described.

In testimony whereof, I have signed my name to this specification in the presence of two subscribing witnesses.

JOHAN M. ANDERSEN.

Witnesses:
JAS. H. CHURCHILL.
J. MURPHY.