(No Model.) 5 Sheets—Sheet 1.

H. LINTON.

ELECTRICAL GOVERNOR.

No. 256,228. Patented Apr. 11, 1882.

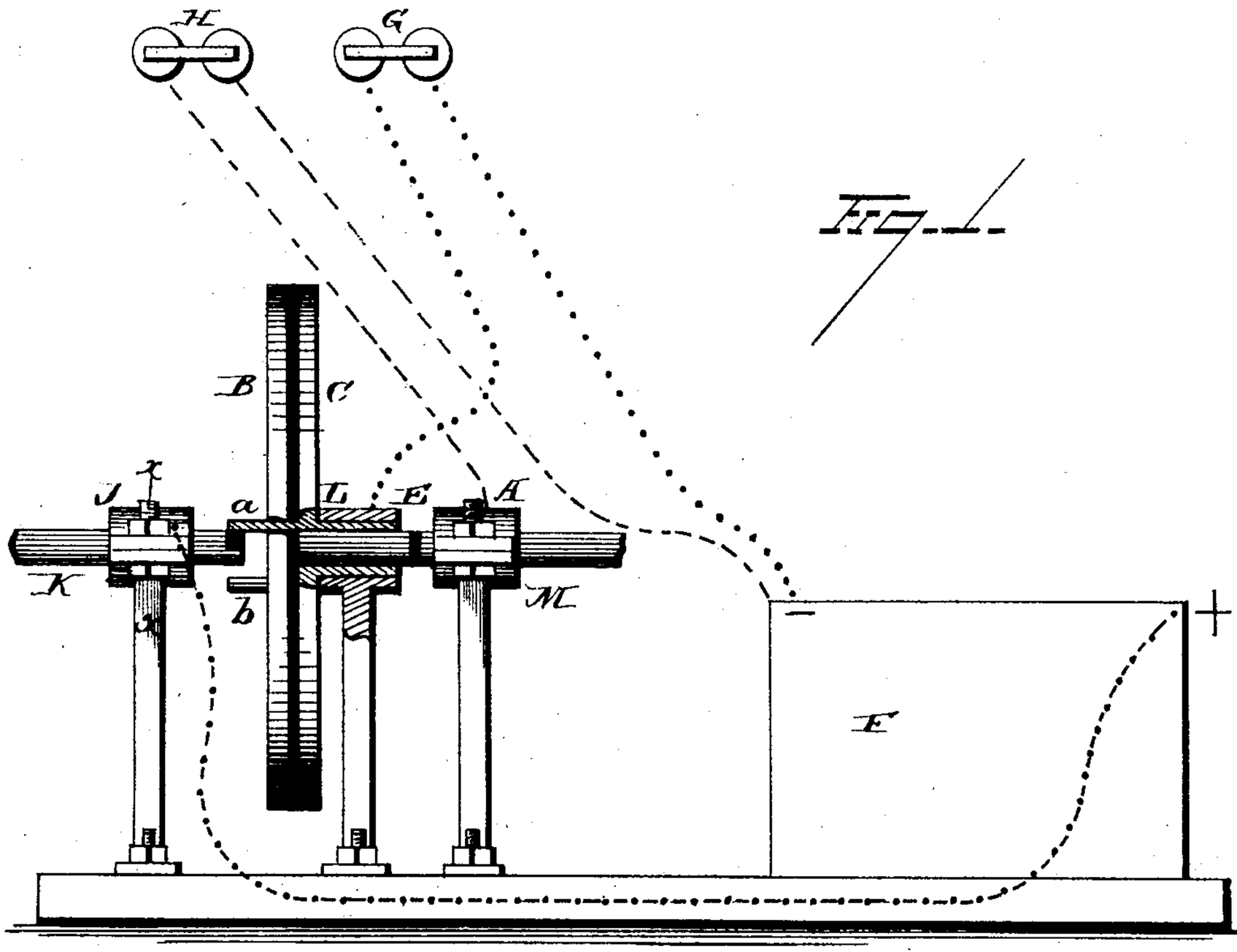

Fig. 1.

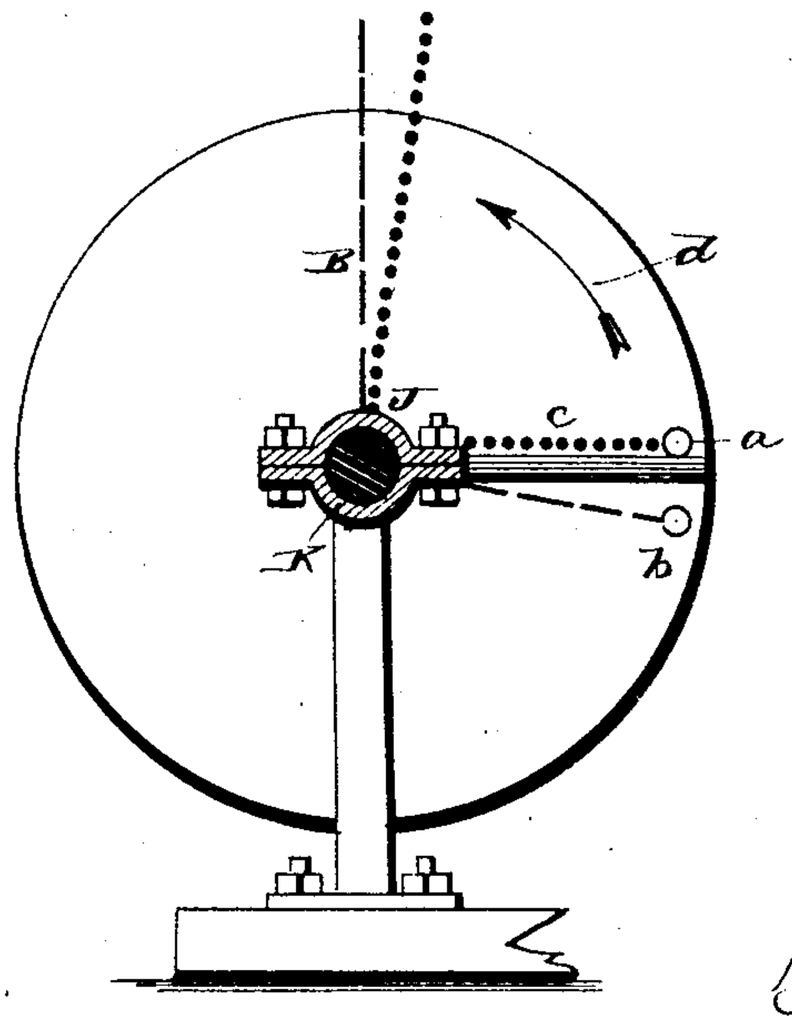

Fig. 2.

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(No Model.) 5 Sheets—Sheet 2.

H. LINTON.

ELECTRICAL GOVERNOR.

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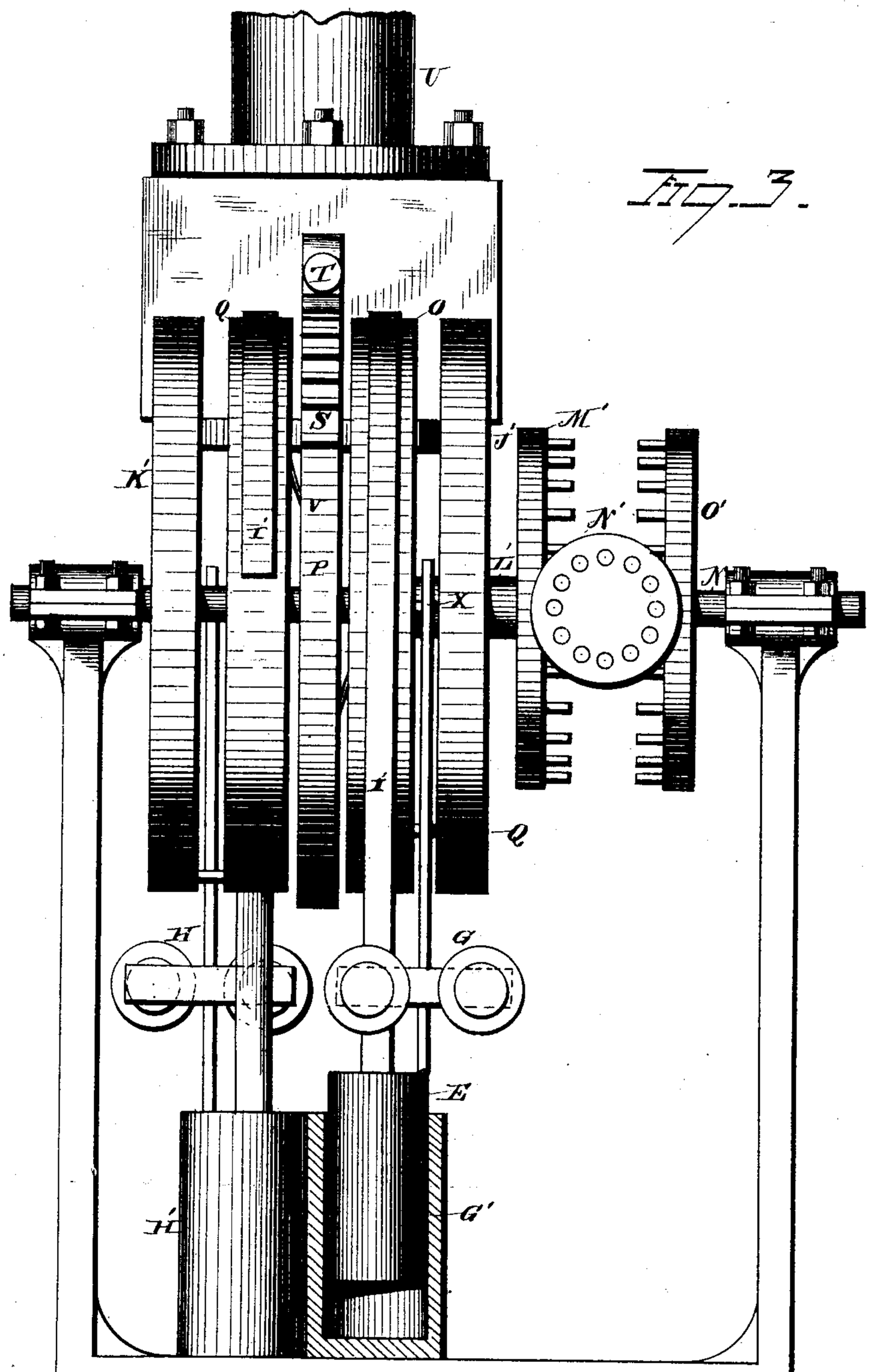

FIG. 3.

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(No Model.) 5 Sheets—Sheet 3.

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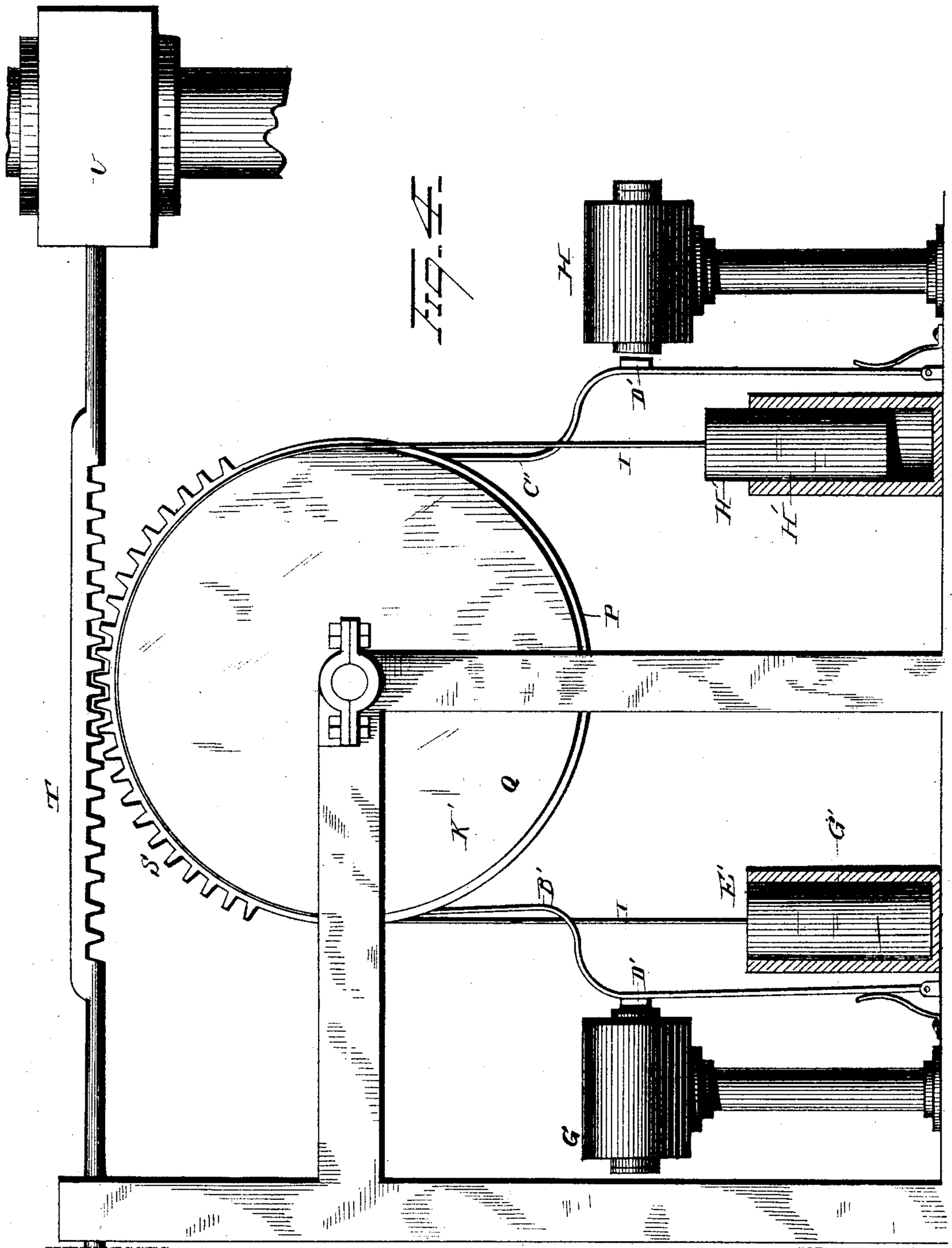
No. 256,228. Patented Apr. 11, 1882.



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5 Sheets—Sheet 4.

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ELECTRICAL GOVERNOR.

No. 256,228. Patented Apr. 11, 1882.

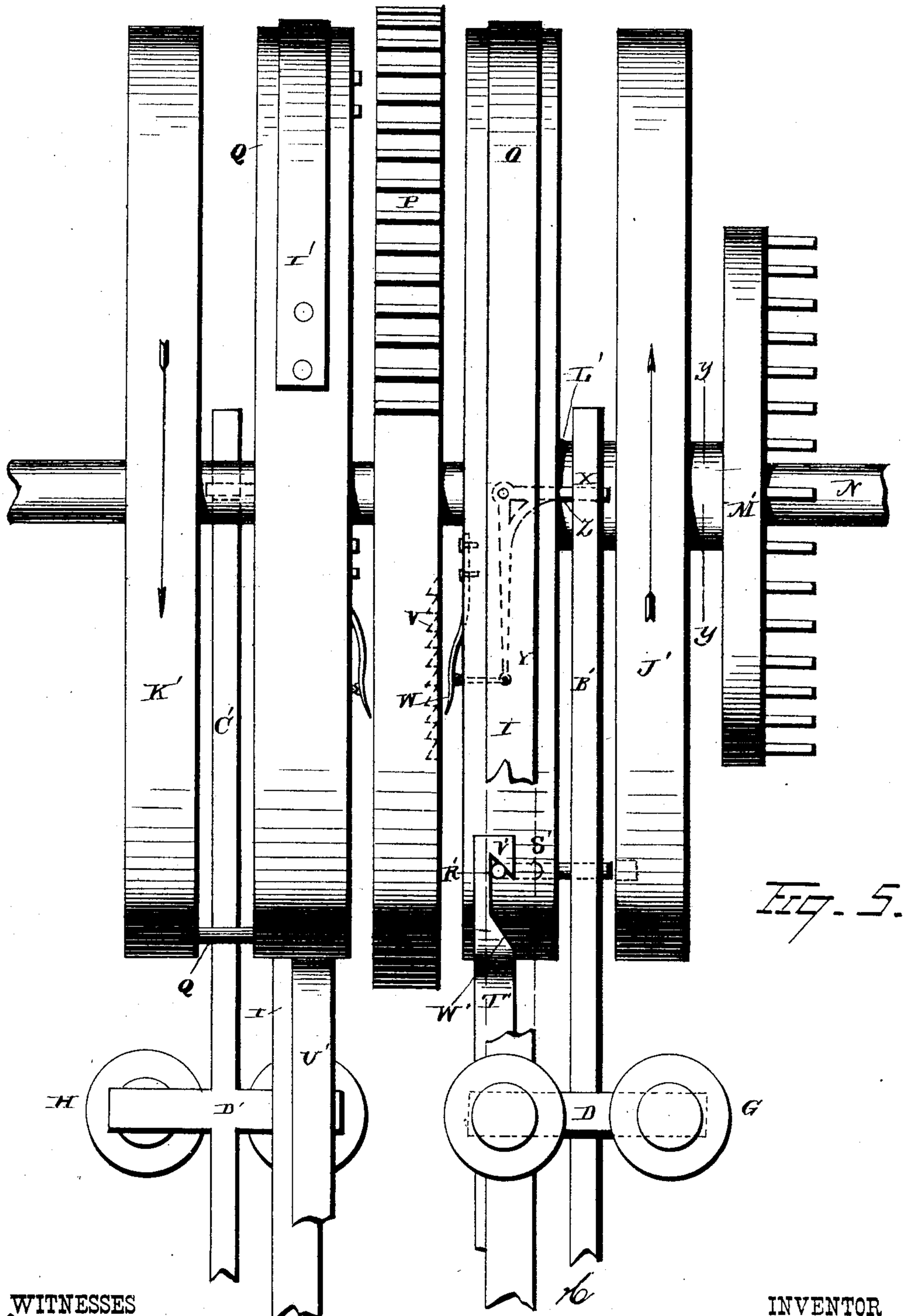

Fig. 5.

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(No Model.) 5 Sheets—Sheet 5.

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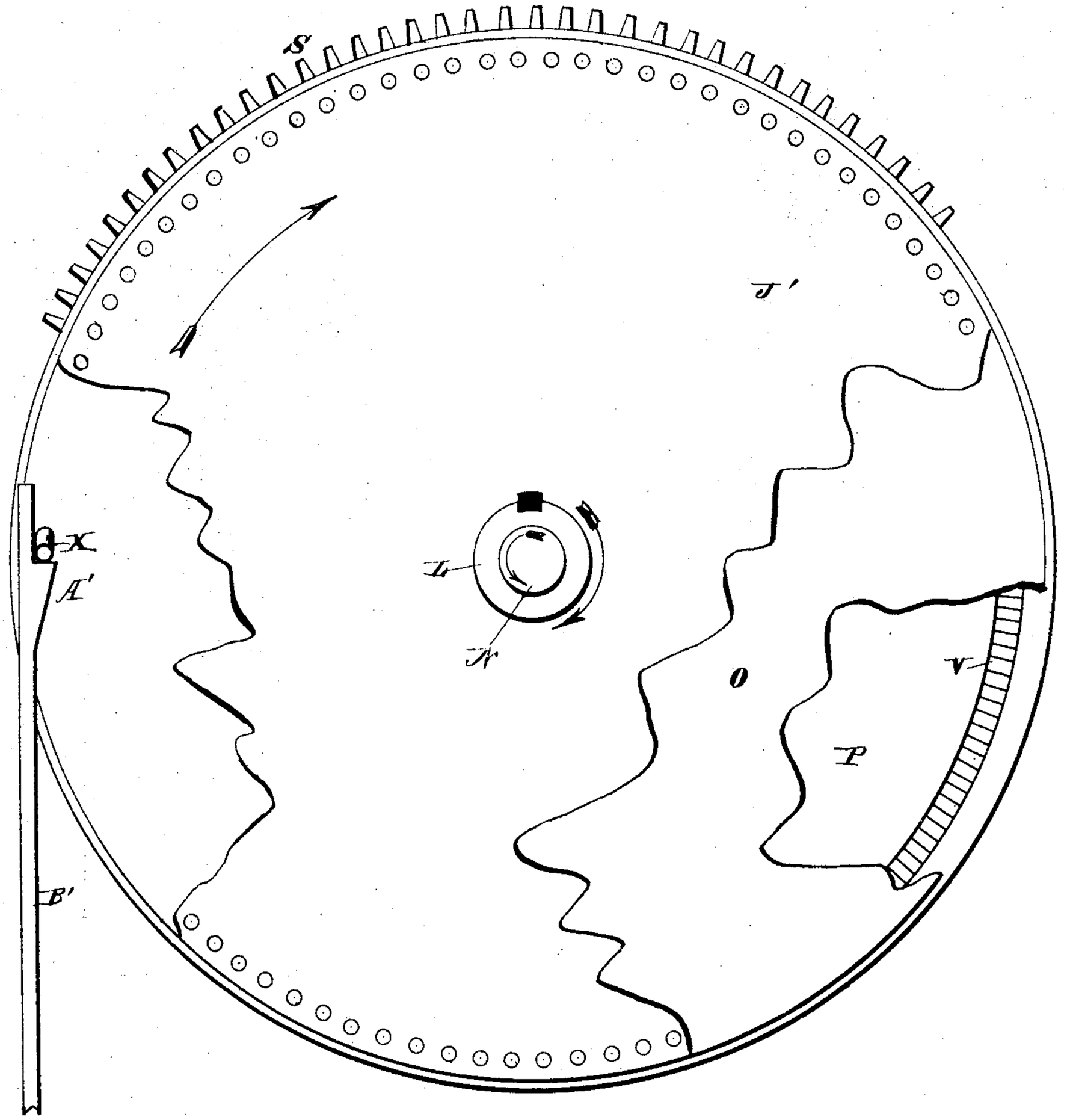
No. 256,228. Patented Apr. 11, 1882.

Fig. 6.



WITNESSES

Herman Moran.

Frank C. Bowen.

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UNITED STATES PATENT OFFICE.

HARVEY LINTON, OF ALLEGHENY, PENNSYLVANIA.

ELECTRICAL GOVERNOR.

SPECIFICATION forming part of Letters Patent No. 256,228, dated April 11, 1882.

Application filed October 1, 1881. (No model.)

To all whom it may concern:

Be it known that I, HARVEY LINTON, of Allegheny, in the county of Allegheny and State of Pennsylvania, have invented certain new and useful Improvements in Electrical Governors; 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 pertains to make and use the same.

My invention relates to an improvement in motors, the object being to provide apparatus adapted to automatically regulate the speed of steam or other types of motors by means of independently-actuated mechanism, and by devices operated by electrical currents which are deflected the instant the motor governed and the independent mechanism cease to be actuated synchronously.

With this object in view my invention consists in the combination, with two contact-points, of a single contact-point located between them, the said points being revolved respectively by independent mechanism and by the motor governed, and devices in circuit with said points and point, and adapted to regulate the amount of motive force supplied to motor.

My invention further consists in the combination, with two contact-points and a single contact-point which is located between them, the said points and point being revolved respectively by independent mechanism and by the motor governed, of magnets in circuit with the points and point, and devices operated by the said magnets to regulate the amount of motive force supplied to the motor.

My invention further consists in the combination, with two insulated disks rotated by independent mechanism and provided each with a contact-point, and a rod or contact-point rotated by the motor governed, of magnets in circuit with the points and point, and devices operated by the said magnets to regulate the amount of motive force supplied to the motor.

My invention further consists in the combination, with two insulated disks rotated by independent mechanism and provided each with a contact-point, of a contact-point rotated by the motor governed, and adapted, when the speed thereof fluctuates, to engage with one of said points, according as the fluctuation in speed is due to an accelerated or retarded condition of the motor, and close a circuit embracing a magnet, and devices adapted to be operated by said magnet to regulate the amount of motive force supplied to the motor.

My invention further consists in the combination, with two contact-points, and a contact-point adapted, when the speed of the motor fluctuates, to engage with one of said points and close a circuit embracing a magnet, of weights released by the magnets and adapted to regulate the amount of motive force supplied to the motor, and devices to restore the said weights to their normal positions.

My invention further consists in the combination, with magnets located in circuits closed by a contact-point oscillated by fluctuations in the speed of the motor governed, of a pair of weights normally elevated and adapted to be released when the magnets are energized, a device isolated from but adapted to be moved by either of said weights acting alone to regulate the amount of motive force supplied to the motor, and devices adapted to restore the weights to their normal positions.

My invention further consists in the combination, with magnets located in circuits closed by a contact-point oscillated by fluctuations in the speed of the motor, of levers attracted by said magnets, disks supported in position by said levers, weights normally elevated, and adapted, when falling, to rotate said disks in opposite directions, devices arranged to engage said disks the instant they cease to be supported by the levers, with a central disk adapted to vary the amount of motive force supplied to the motor, and devices adapted to restore the weighted disks to the positions occupied by them before falling.

My invention further consists in the combination, with a central disk provided with a rack engaging with valve mechanism and having ratchets on its opposite faces, of disks located on each side of the central disk, weights secured to and adapted to turn the said disks in opposite directions, a pair of levers actuated by magnets, lever systems mounted in said disks and adapted to be engaged by said levers and to operate pawls which engage with the ratchets on the central disk, and devices to connect the said weighted disks with other disks revolving in opposite directions at the

moment they have been sufficiently turned by their weights, and to release them from said revolving disks as soon as they have been elevated to the positions occupied by them before falling.

My invention further consists in certain other details of construction and combinations of parts, as will be hereinafter more fully described, and pointed out in the claims.

In the accompanying drawings, Figure 1 is a view partly in section and partly in elevation of the devices employed for closing two electrical circuits by means of fluctuations in the speed of the motor. Fig. 2 is a view in elevation of the same, taken through line *x x* of Fig. 1. Fig. 3 is a view in front elevation of the devices adapted to automatically regulate the amount of motive force supplied to the motor governed. Fig. 4 is a view in side elevation thereof. Fig. 5 is an enlarged view of the disks shown in Fig. 4, and Fig. 6 is a view in elevation through line *y y* of Fig. 5.

Mechanism actuated independently of the motor governed is connected with and arranged to revolve shaft A, upon which two disks, B and C, insulated from each other by a non-conducting disk, D, are mounted. Two pins, *a* and *b*, projecting from the outer face of the disk B, constitute like electrodes of two normally-broken circuits which are closed only when the motor governed exceeds or falls below that rate of speed which it is desired that it shall maintain. The said pins are located near the periphery of the disk B, from the outer face of which they project. They should be sufficiently separated from each other to allow the revolving rod *c*, constituting the positive electrode of both of the said circuits, a slight oscillatory motion between them. Of these two pins the forward pin, *a*, constituting the electrode of the circuit which is automatically closed when the motor exceeds its normal speed, is secured to the disk C and insulated from the disk B, through which it projects, while the rear pin, *b*, constituting the electrode of the circuit which is closed when the motor falls below its normal speed, is secured directly to the disk B. The disk C is mounted upon a sleeve, E, insulated from and revolved by the shaft A, to which the disk B is secured.

In order to guard the disks and their auxiliary mechanism from injury should the speed of the revolving rod *c* be greatly accelerated or retarded over the speed of the disks, neither the disk B nor the sleeve E is rigidly secured to the shaft A; but they are so mounted thereupon that ordinarily they will revolve with it, and yet slip and slide upon it when the safety of the apparatus is endangered.

The amount of friction between the disk B and sleeve E and the shaft A necessary to insure the above results may be regulated by a spring and thumb-screw or equivalent devices, none of which are herein shown.

It may here be observed that the disks, which, if undisturbed, are actuated in unvarying speed, should be set to revolve in perfect accordance with that rate of speed which it is designed to maintain in the motor governed.

The rod *c* is revolved, by motion transmitted from the motor governed, in a plane parallel with that in which the disks B and C are revolved. Its outer end, which is located between the pins or electrodes *a* and *b*, will be sustained in a position equidistant from them as long as the disks and rod revolve synchronously. Exceedingly delicate variations in the speed of the latter will, however, cause the rod to oscillate and to be brought in contact with the forward or with the rear pin, respectively, according as such variation is caused by the acceleration or retardation of the motor.

Turning now to the consideration of the electrical circuits and to the functions which they fulfill, the positive pole of the battery F is connected with the revolving electrode *c* by a wire (represented by a line made up of alternating dots and dashes) which extends from the battery to the bearing J, in which the shaft K, to which the said electrode *c* is secured, is journaled. The negative pole of the battery is connected with electrode or pin *a* through a wire illustrated by a line composed of dots, which extends from the battery to the bearing L, and which includes in its circuit the electro-magnets G. The said pole is also connected with the electrode or pin *b* through a wire (illustrated by a line composed of dashes) which extends from the battery to the bearing M, and which includes in its circuit the electro-magnets H. By virtue of these connections the said rod *c* will constitute the positive electrode of both circuits. Assuming now that the disks and rod are revolving in the direction of the arrow *e*, and that the speed of the motor has become sufficiently accelerated to bring the electrodes *c* and *a* into contact, a circuit will be closed and a current will flow through the wire illustrated by a line composed of alternating dots and dashes, through the bearing J, the shaft K, the rod or electrode *c*, the pin or electrode *a*, the disk C, the sleeve E, the journal L, the wire illustrated by dots, the magnets G, which will be energized, and through the dotted line connecting them with the negative pole of the battery. On the other hand, when the speed of the motor suffers a sufficient retardation to bring the electrodes *c* and *b* in contact a circuit will be closed, and a current will flow through the wire indicated by a line composed of alternating dots and dashes, through the bearing J, the shaft K, the rod or electrode *c*, the pin or electrode *b*, the disk B, the shaft A, the bearing M, the wire illustrated by a line composed of dashes, the magnets H, which will be energized, and through the dashed line to the negative pole of the battery.

Having thus considered the manner in which any acceleration or retardation in the speed of the motor effects the deflection of an electrical current and the energization of two independ-

ent electro-magnets, it now remains only to consider the action of the said magnets in restoring the motor to its normal speed.

In Fig. 3 of the drawings the magnets G and H, which respectively operate to retard the motor when it exceeds and to accelerate it when it falls below its normal speed, are shown as located on opposite sides of the shaft N, upon which five disks are mounted, the said shaft being revolved by power transmitted from the motor. Of these disks those lettered O, P, and Q are loosely mounted upon the said shaft, the disk P being provided on its upper face with a segmental rack, S, arranged to operate, through valve-rod T, a valve or cut-off located in the valve-box of the supply-pipe U, which conveys steam to the engine. The disks O and Q, although normally independent of the disk P, which is situated between them, are adapted to be engaged therewith by means of two independent ratchet-and-pawl systems consisting of ratchets V, Fig. 5, secured to the opposite faces of the central disk, and spring-pawls W, located near the peripheries and on the inner faces of the disks O and Q. The said pawls are automatically operated to be engaged with the ratchets, or held out of engagement with them by means of the arms X of the levers Y, with the arms Z of which the pawls W are connected. The said levers are pivotally mounted in recesses formed near the peripheries of the disks O and Q, from the outer and inner faces of which the arms X and Z respectively project. The arms X are adapted to engage with brackets A′, Fig. 6, formed on the inner faces and near the upper ends of vertical levers B′ and C′, provided with armatures D′, Fig. 5, which are located in front of the poles of the electro-magnets, the said levers being normally sustained in engagement with the arms X and away from the poles of the magnets by means of springs or equivalent devices.

Weights E′ and F′, located on opposite sides of the shaft N, and reciprocating in suitably-disposed dash-pots G′ and H′, are suspended from the opposite faces of the said disks O and Q by means of flexible metallic bands I′, secured to the peripheries thereof. The said weights are so arranged that when the arms X are engaged with the brackets A′ of the levers B′ and C′ they will force the said arms against the upper walls of the recesses in which the levers Y are mounted, and thus by moving the said levers and their arms Z overcome the spring-power of the pawls W, disengaging them from the ratchets V. When, however, by reason of the energization of the magnets, the armatures D′ are attracted to them, and the brackets A′ are withdrawn from engagement with the arms X, the said pawls, now released from all opposing force, will at once engage with their respective ratchets.

The disks J′ and K′, constituting the outer of the five disks hereinbefore alluded to, are respectively secured to the shaft N and to the sleeve L′, mounted thereupon, and revolved in an opposite direction therefrom by means of a pinion, M′, secured thereto and meshing with an idler-pinion, N′, which in turn is revolved by a pinion, O′, rigidly secured to the said shaft. Although these disks, which are constantly revolved, are normally independent of their adjacent disks, O and Q, they are adapted to be engaged with them, and to this end a series of holes, P′, are formed in their inner faces. The said holes P′ are adapted to receive the longer arms Q′ of suitable two-armed levers, the shorter arms R′ of which project through elongated slots S′, laterally traversing the peripheries of the disks O and Q. The automatic reciprocation of the said levers, whereby their longer arms Q′ are inserted into and withdrawn from the holes P′ in the outer disks, is effected by means of plates T′ and U′, the upper ends of which conform to the shape of the disks, and which are provided with notches having cams V′ and W′ formed at their opposite ends, with which the said arms R′ engage. The distance between the cams V′ and W′ will depend upon the distance which it is desired to have the weights E′ and A′ move the disk P in one descent.

Having thus described in detail the mechanical construction of my device, and the disposition of the electrical connections thereof, I will now proceed to briefly describe its *modus operandi*.

Let it be supposed that the time mechanism employed has been set to actuate the disks B and C at that rate of speed which it is desired the engine or motor shall maintain, and which it is the object of this invention to preserve; and, further, that the motor is being actuated at a rate in perfect consonance with the speed of the said disks. If, now, the motion of the motor becomes accelerated by reason of the removal of a portion of its load or by reason of the too rapid supply of motive force, the rod *c* will be brought into contact with the pin or contact-point *a* and close a circuit. A current will now flow through the battery and the electro-magnets G, temporarily energizing them and attracting to their poles the armature D′ of the lever B′, thus withdrawing the bracket A′ from under the arm X of the lever Y, mounted in the disk O. This will effect a twofold result, in that the pawl W of the said disk will immediately engage with the ratchet V, secured to the adjacent side of the disk P, and in that the said disk O, which is loosely mounted on the shaft, will at once be moved, carrying with it the disk P by the descent of the weight E′. This movement of the disk P will partially close the valve in the valve-box, and the speed of the motor will be retarded by a decrease in the amount of steam supplied to it. The instant the disks have fulfilled their function of closing the valve the shorter arm R′ of the two-armed lever mounted in the disk O will engage with and be moved forward in the slot S′ by the cam W′ of the plate T′,

and the longer arm Q′ of the said lever will be projected into one of the holes P′ of the series formed in the inner face of the adjacent disk, J′. As soon as this union is effected the disk J′, which is being continuously revolved in the direction of the arrow *e*, will restore the disk O and its weight E′ to their original positions, the reinstatement of the arm X upon the bracket A′ of the lever B′ being immediately followed by the withdrawal of the arm Q′ of the two-armed lever from that one of the series of holes in the disk J′ with which it has been engaged by the engagement of the arm R′ of the said two-armed lever with the cam V′ of the plate T′. On the other hand, when the speed of the motor or engine has become retarded by an increased load or by an insufficient supply of steam the rod *c* will be brought in contact with the pin *b* and close a circuit. A current will now flow through the battery and the magnets H, temporarily energizing them and attracting to their poles the armature D′ of the lever C′. This will effect the twofold result of withdrawing the bracket of the lever C′ from the arm X of the lever Y, which is mounted on the disk Q, (but which is not shown in the drawings,) and of releasing the pawl W, secured to the said disk, and permitting its instantaneous engagement with the ratchet secured to the adjacent side of the disk P. The disk P will now be moved by the descent of the weight H′ in an opposite direction from that in which it was before moved, and open the valve in the valve-box to the same extent that it was before closed, thus supplying an increased amount of steam to the engine, which will be accelerated and restored to its normal rate of speed.

The descent of the weight H′ and the motion of the disks will be arrested by the automatic insertion of the longer arm of the two-armed lever of the disk Q into one of the holes P′ of the series formed in the inner face of the revolving disk K′, which will return the disk Q and its weight to their original positions and restore the said arm X to the bracket of lever C′. The instant this is effected the longer arm of the said lever will be automatically withdrawn from the disk K′, and the pawl will be disengaged from the ratchet of the disk P, thus reisolating it.

Independently-actuated mechanism of any approved form may be employed to revolve the disks. The mechanism chosen should, however, be constructed with especial reference to constancy of action, and also its adaptation to revolve the disks should be capable of being readily and delicately adjusted in order to vary their speed as may be required. I have found that weight-actuated clocks having revolving pendulums are well adapted to fulfill the requirements called for in a motor for the disks.

The distance between the pins will determine the sensitiveness of the apparatus to fluctuation in the speed of the motor. They should therefore be made laterally adjustable. Again, the degree of motion imparted to the valve by the rotation of the central disk to the right or left consequent upon one movement of either of the weight-supporting disks O and Q may be varied by increasing or decreasing the distance between the cams V′ and W′ of the plates T′ and U′.

If desired, instead of revolving the rod *c* by means of the motor governed and the disks by an independently-actuated motor, they may be arranged to be operated vice versa.

It should be observed that in view of the fact that the governing mechanism is quickly responsive to any fluctuation in the motor the amount of steam supplied to or excluded from it will meet the requirements of its changed condition almost immediately. If, for instance, the load of the motor is very suddenly increased, it will be only momentarily retarded, for the retardation will cause an increased amount of steam to be supplied to it before it has lost to any appreciable degree its original momentum. On the other hand, if the load is suddenly diminished, the motor will be only momentarily accelerated, for any acceleration will cause the steam-supply to be decreased before the accelerated motion can have become dangerously rapid. As long as the equilibrium of motion between the disks and the rod *c* is destroyed the said rod will be retained in contact with one of the pins, *a* or *b*, according as the destruction of the equilibrium was due to an accelerated or retarded action of the motor governed. If, therefore, the actuation of the valve in the valve-box consequent upon the rotation of the disk P to the right or left is not adequate to the admission or exclusion of that quantity of steam required to immediately restore the rod *c* to a condition of synchronal motion with the disks B and C, the same weight will fall twice or more times in succession until such a result is effected, for the reason that until the circuit closed by the contact of the rod *c* with either of the pins *a* or *b* is broken the magnets will attract the levers B′ and C′ and prevent that engagement between the supporting-bracket A′ of the same and the arms X of the levers Y which sustain the disks and weights in their normally-elevated positions. Practically the device will probably be arranged to be susceptible to very slight deviation from a perfectly synchronal motion of the disks and rod, so that the oscillation of the latter, which must to a certain degree be almost constant, will alternately open and close the two circuits and effect the release of the weights in quick succession.

It will be seen that as the governing mechanism is so quickly responsive to a changed condition of the motor the latter is steady and even in action, all sudden changes being avoided, and thus by means of my improved apparatus I am enabled to maintain the speed of a motor at a rate at once uniform and independent of fluctuations in load, granting, of

course, that it is kept up to the maximum requirement of power.

Instead of weights to actuate the disks O and P, springs may be employed, if desired, So, also, the battery may be dispensed with and any generator of electricity substituted in its stead.

It is apparent that the application of my improvement is not limited to steam-motors alone, but that it may be adapted to regulate the speed of gas, air, and water motors. Nor is it confined to the exact construction shown and described, for aside from those changes which must be made to meet the different requirements caused by the oscillation of ordinary practical conditions in the event of its adaptation to other types of motors it must necessarily undergo some changes and modifications in its mechanical construction. I would therefore have it understood that I do not limit myself to the exact construction shown and described, but hold myself at liberty to make such slight changes and alterations as fairly fall within the spirit and scope of my invention.

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

1. The combination, with two contact-points, of a single contact-point located between them, the said points and point being revolved respectively by independent mechanism and by the motor governed, and devices in circuit with said points and point and adapted to regulate the amount of motive force supplied to the motor, substantially as set forth.

2. The combination, with two contact-points and a single contact-point which is located between them, the said points and point being revolved respectively by the independent mechanism and by the motor governed, of magnets in circuit with the points and point, and devices operated by the said magnets to regulate the amount of motive force supplied to the motor, substantially as set forth.

3. The combination, with two insulated disks rotated by independent mechanism and provided each with a contact-point, and a rod or contact-point rotated by the motor governed, of magnets in circuit with the points and point, and devices operated by the said magnets to regulate the amount of motive force supplied to the motor, substantially as set forth.

4. The combination, with two insulated disks rotated by independent mechanism and provided each with a contact-point, of a contact-point rotated by the motor governed, and adapted, when the speed thereof fluctuates, to engage with one of said points, according as the fluctuation in speed is due to an accelerated or retarded condition of the motor, and thus close a circuit embracing a magnet, and devices adapted to be operated by said magnet to regulate the motive force supplied to the motor, substantially as set forth.

5. The combination, with two insulated disks rotated by independent mechanism and provided each with a contact-point, the point of the inner disk, which projects through the outer disk, being insulated from it, of a point rotated by the motor governed and located between the points of the said disks, of magnets located in circuits closed by the engagement of said point with the points between which it is located, and devices actuated by said magnets to regulate the amount of motive force supplied to the motor, substantially as set forth.

6. The combination, with two contact-points, and a contact-point adapted, when the speed of the motor fluctuates, to engage with one of said points and close a circuit embracing a magnet, of weights released by the magnets and adapted to regulate the amount of motive force supplied to the motor, and devices to restore the said weights to their normal positions, substantially as set forth.

7. The combination, with magnets located in circuits closed by a contact-point oscillated by fluctuations in the speed of the motor governed, of a pair of weights normally elevated and adapted to be released when the magnets are energized, a device isolated from but adapted to be moved by either of said weights acting alone to regulate the amount of motive force supplied to the motor, and devices adapted to restore the weights to their normal positions, substantially as set forth.

8. The combination, with magnets located in circuits closed by a contact-point oscillated by fluctuations in the speed of the motor governed, of levers, weights supported by said levers when the same are not attracted by the magnets, and adapted, when released by the closing of a circuit, to regulate the amount of motive force supplied to the motor, and devices arranged to restore the weights to their normal positions when the circuits are broken, substantially as set forth.

9. The combination, with magnets located in circuits closed by a contact-point oscillated by fluctuations in the speed of the motor, of levers attracted by said magnets, disks supported in position by said levers, weights normally elevated, and adapted, when falling, to rotate said disks in opposite directions, devices arranged to engage said disks the instant they cease to be supported by the levers, with a central disk adapted to vary the amount of motive force supplied to the motor, and devices adapted to restore the weighted disks to the positions occupied by them before falling, substantially as set forth.

10. In an electrical governor, the combination, with a central disk provided with a rack engaging with valve mechanism and having ratchets on its opposite faces, of disks located on each side of the central disk, weights secured to and adapted to turn the said disks in opposite directions, a pair of levers actuated by magnets, lever systems mounted in said disks and adapted to be engaged by said levers and to operate pawls which engage with the

ratchets on the central disk, and devices to connect the said disks with other disks revolving in opposite directions at the moment they have been sufficiently turned by their weights, and to release them from said revolving disks as soon as they have been elevated to the positions occupied by them before falling, substantially as set forth.

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

HARVEY LINTON.

Witnesses:
E. A. HERRING,
M. M. REAMER.