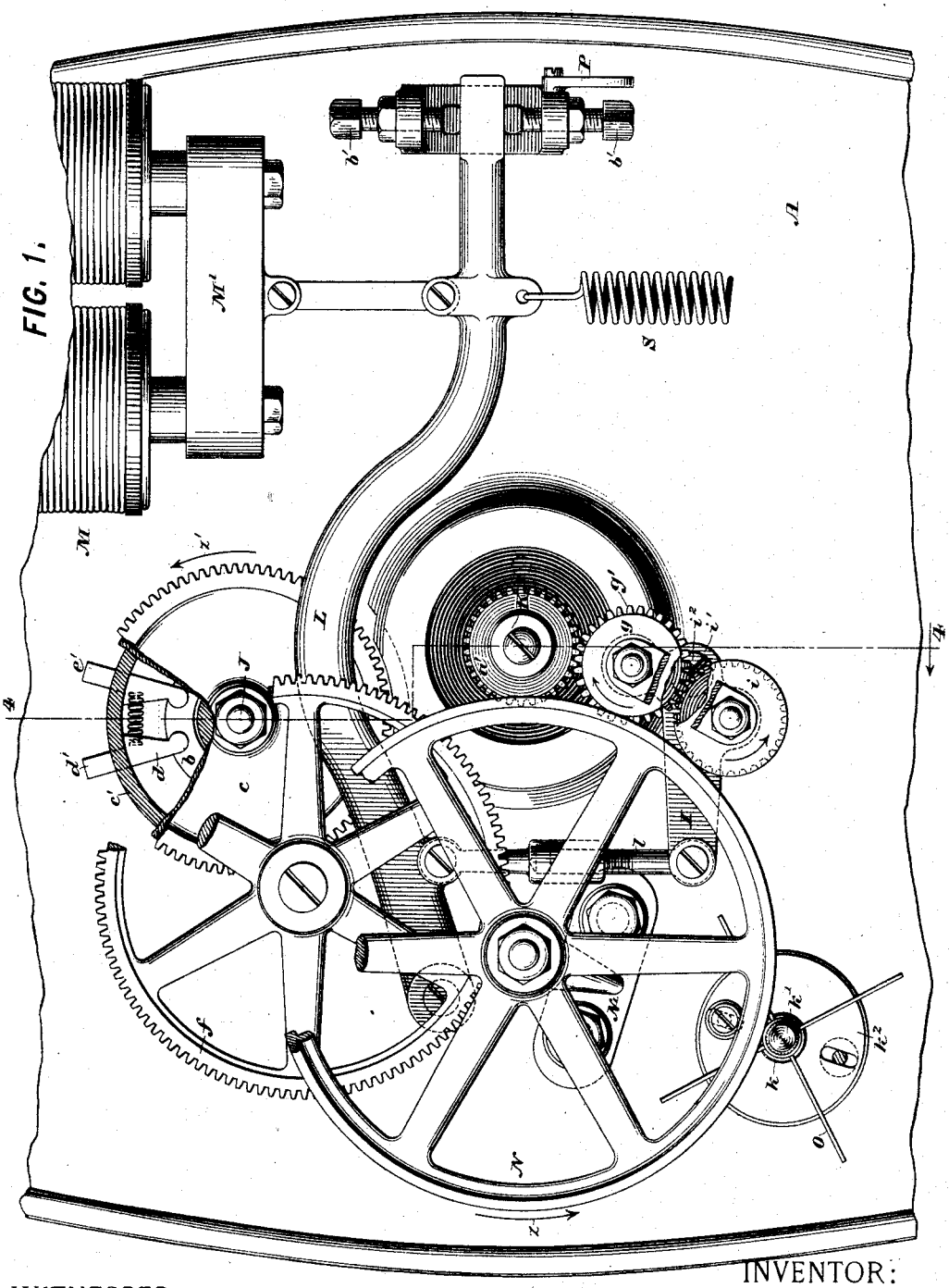
(No Model.) 4 Sheets—Sheet 1.

J. J. WOOD.

REGULATOR FOR DYNAMOS.

No. 420,138. Patented Jan. 28, 1890.

FIG. 1.



WITNESSES:

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C. K. Fraser.

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(No Model.) 4 Sheets—Sheet 2.

J. J. WOOD.

REGULATOR FOR DYNAMOS.

No. 420,138. Patented Jan. 28, 1890.

FIG. 3.

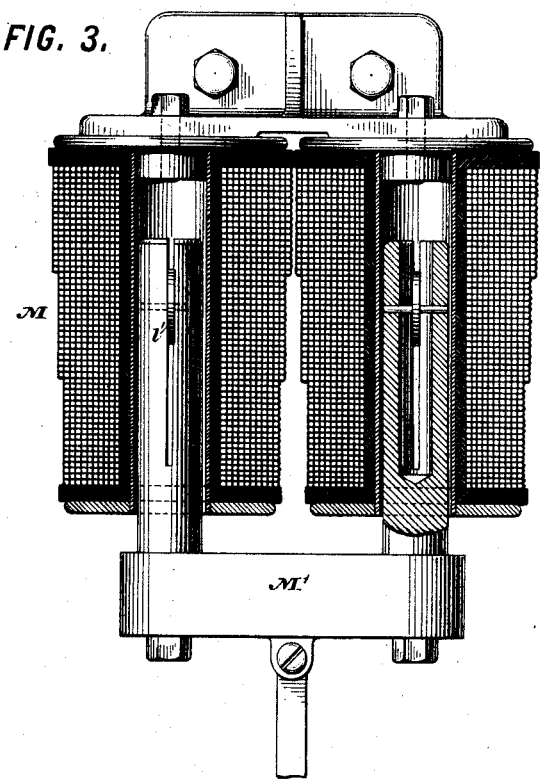


FIG. 4.

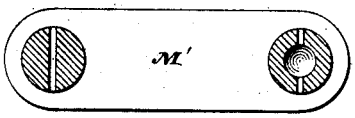
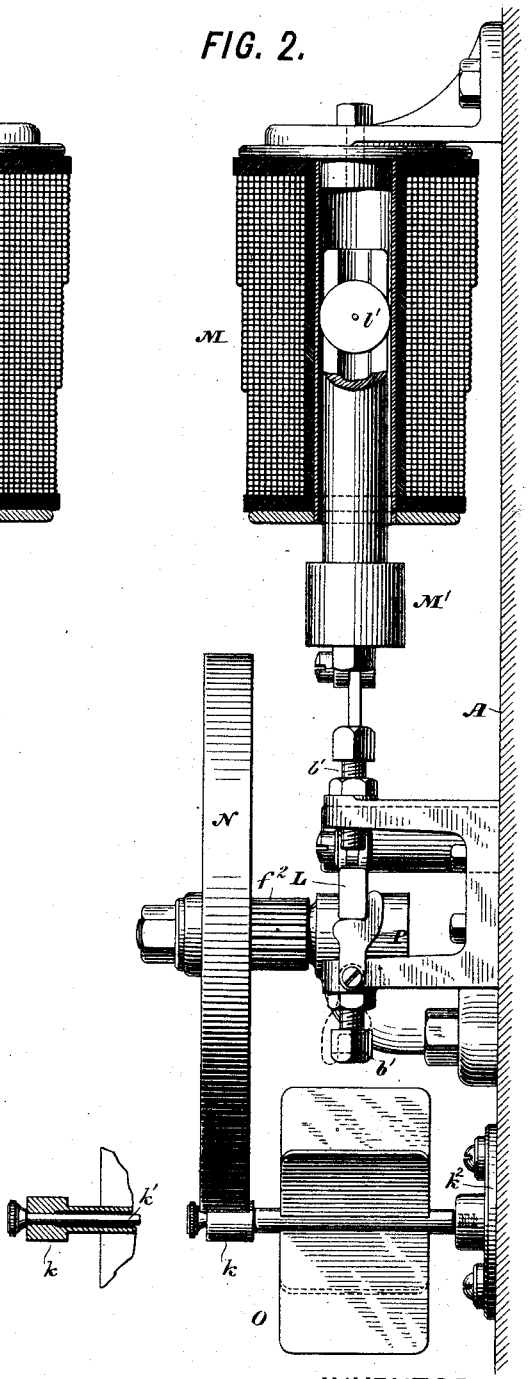


FIG. 2.



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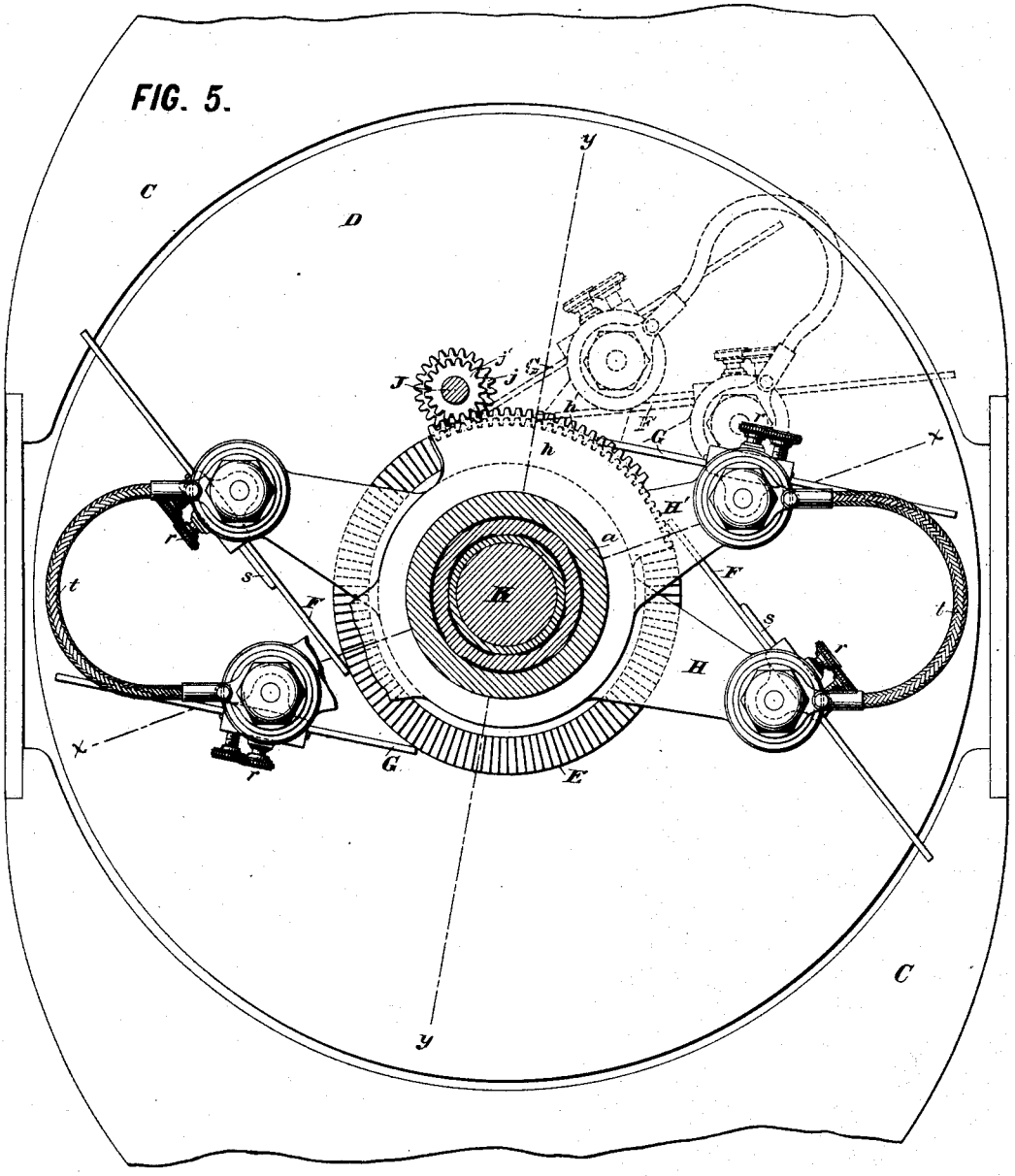
(No Model.) 4 Sheets—Sheet 3.

J. J. WOOD.

REGULATOR FOR DYNAMOS.

No. 420,138. Patented Jan. 28, 1890.

FIG. 5.



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(No Model.) 4 Sheets—Sheet 4.

J. J. WOOD.

REGULATOR FOR DYNAMOS.

No. 420,138. Patented Jan. 28, 1890.

FIG. 6.

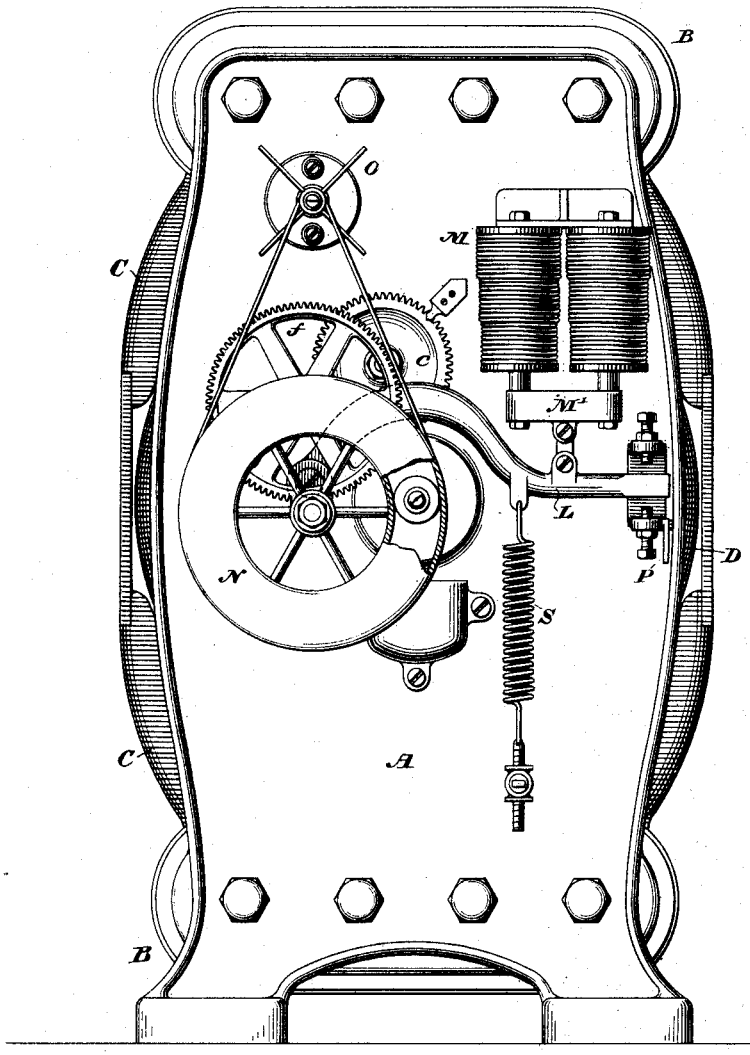
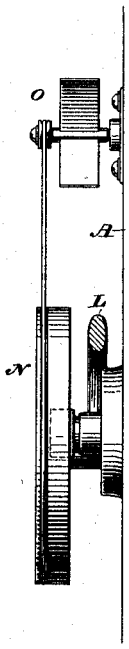


FIG. 7.



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UNITED STATES PATENT OFFICE.

JAMES J. WOOD, OF BROOKLYN, NEW YORK.

REGULATOR FOR DYNAMOS.

SPECIFICATION forming part of Letters Patent No. 420,138, dated January 28, 1890.

Application filed October 12, 1889. Serial No. 326,853. (No model.)

To all whom it may concern:

Be it known that I, JAMES J. WOOD, a citizen of the United States, residing in Brooklyn, in the county of Kings and State of New York, have invented certain new and useful Improvements in Regulators for Dynamo-Electric Machines, of which the following is a specification.

This invention relates to automatic regulators for dynamo-electric machines, being designed most particularly for machines of that class which generate a current of uniform volume, such as are used for feeding arc lamps in series. The invention is, however, applicable also to regulators for machines generating constant potential.

The improvements introduced by the present invention are chiefly applicable to regulators of that class employing a shifting mechanism which is driven in one direction or the other from a source of power, its connection with which is determined by a regulating electro-magnet or electro-motive device which is introduced in the circuit in which the current is to be regulated. The shifting mechanism is best applied to the shifting of the collecting-brushes to different positions around the commutator, moving them toward or from the "neutral line," or position of maximum difference of potential in compensation for changes occurring in the external circuit. The shifting mechanism may, however, be applied for giving motion to other known means for regulation.

The regulator for application to which my present improvements are especially designed is that disclosed in my application for patent filed April 27, 1889, Serial No. 308,890. My present invention is, however, applicable to other regulators than that shown in said application.

Figure 1 of the accompanying drawings is a front elevation of a part of the frame of a dynamo with the regulating mechanism applied thereto, the view being partly broken away in section to show the relation of the parts more clearly. Fig. 2 is a side elevation of part of the regulating mechanism, the controlling electro-motive device or solenoid being partly in mid-section and the dynamo-frame being in section. In this view certain parts of the regulating mechanism are omitted in order to show the remaining parts to which my invention pertains more clearly. Fig. 3 is a front view of the regulating electro-motive device or solenoid partly in vertical mid-section. Fig. 4 is a transverse section of the solenoid cores. Fig. 5 is a vertical transverse section showing the commutator-brushes, brush-holders, and yokes. Fig. 6 is an end elevation of the dynamo with a modified construction of the regulator to which my present invention is applied. Fig. 7 is a side view of the regulating mechanism shown in Fig. 6, partly in vertical section, and certain of the parts being omitted.

In the drawings, A designates the frame of the dynamo, B B in Fig. 7 the field-magnet coils, C C the field-magnet pole-pieces, D in Figs. 5 and 6 the armature, F F in Fig. 5 the main commutator-brushes, and G G in Fig. 5 the auxiliary or supplemental commutator-brushes.

The regulator shown in the drawings is of that class wherein a shifting mechanism is employed which is driven in one direction or the other from a source of power, its clutching to which in either direction is determined by the regulating electro-magnet or other electro-motive device. In the regulator shown the shifting mechanism is driven from the armature-shaft through frictional gearing. The shifting mechanism may be used to effect any change by which the dynamo may be regulated or governed. In the construction shown it is used to shift the collecting-brushes F G around the commutator.

M is the regulating electro-magnet or other electro-motive device, which is preferably of the solenoid type, and its movable core M′ is connected to an operating-lever L, which receives on the opposite side the stress of a retracting-spring S or other retractile force. When the attraction of the electro-magnet and the tension of the spring are balanced, the lever L stands in mid-position with its free end midway between two stop-screws b' b'. The lever L is connected through a link l to a lever I, fulcrumed at i^2, and having two arms carrying revolving friction-rollers g and i. These rollers are revolved continuously in opposite directions from any source of power,

preferably by being geared to the armature-shaft K. A gear-wheel a', fixed on the end of this shaft, drives a gear g', fixed to the friction-roller g, which in turn drives a gear i', fixed to the friction-roller i.

The shifting mechanism consists in the construction shown of a train of wheels, the first of which is a friction-wheel N, the periphery of which comes close to the peripheries of the rollers g i. When the levers L I are in mid-position, both these rollers are slightly out of contact with the wheel N; but if the levers L I be vibrated in either direction by reason of the attraction of the magnet M becoming greater or less than the retractile force of the spring S, one or other of the rollers g or i is pressed into contact with the wheel N, and the latter is thereby driven frictionally in one direction or the other, so that motion is imparted from the source of power to the shifting mechanism. The wheel N is mounted on a shaft or spindle which turns in a bearing in a bracket N', and on its spindle is fixed a pinion (not shown) which meshes with a gear-wheel f, and this wheel has a pinion (not shown) which meshes with a gear-wheel c mounted loosely on a shaft J. Between the rim c' of this wheel and a boss b, fixed on the shaft J, are two friction-pawls d and e, acting in opposite directions and pressed into action by an intervening spring, so that when the wheel c is turned in either direction power is transmitted through one or other of these pawls, and the boss b and shaft J are turned with the wheel c so long as the pawls remain in engagement. The shaft J passes through the end frame of the dynamo and has fixed on its opposite end two pinions j j', (shown in Fig. 5,) which mesh, respectively, with toothed sectors h and h', formed on the brush carriers or yokes H and H', respectively. The commutator-brushes F F and G G are carried, as usual, in insulated holders, which are mounted on opposite arms of these yokes, the main brushes being carried by the yoke H and the supplemental brushes by the yoke H'. Thus the shifting mechanism is connected to the brushes, so that as it is moved in one direction or the other by contact with one or other of the friction-rollers g i it effects the shifting of the brushes in one direction or the other around the commutator in a manner now well understood in the art.

The foregoing description of the precise regulating mechanism to which I have shown my invention applied will suffice for a complete understanding of my present invention. Those, however, who wish to understand it more completely in detail and to have a full description of its operation may refer to my said previous application, Serial No. 308,890. Fig. 1 of my present drawings corresponds to Fig. 5 of the drawings of that application.

I will now proceed to describe in detail the preferred form of the improvements introduced by my present invention.

In the practical use of dynamo-regulators of the kind thus far described it has been found that under some circumstances the brushes in being shifted to a new position will be carried too far, moving beyond that position, and thereby causing the machine not merely to correct the abnormal condition of the circuit which caused the regulator to operate, but also to create, although to a less extent, an abnormal condition of opposite character, which must again be compensated for by an opposite movement of the regulator, and this movement being in its turn carried too far gives rise to a counter movement in the original direction again, so that the commutator-brushes continue to rock for some time, first to one side and then to the other of their perfect position. In practice it has been found that this tendency to rock exists only or chiefly when the dynamo is being used to supply a current of much lower electro-motive force than its full capacity—as, for example, when a dynamo for sixty arc lamps is used to feed, say, ten lamps or less. When the machine is operating under nearly a full load, the regulator acts to quickly compensate for any switching out or in of lamps, and if the brushes are carried too far they are instantly returned to the correct position and come to rest without any objectionable movement. Thus when a great number of lamps is thrown in or out of circuit, so long as any approximation to a full load is maintained the regulator will quickly bring the brushes to rest, although for an instant they may be carried beyond their proper position, and on the return movement may even again be carried beyond, so that the rocking of the brushes is of such short duration as to be practically unobjectionable; but when the machine is used for a very small number of lamps the regulator sometimes keeps up an almost incessant rocking movement, so that under some conditions it never brings the brushes to rest. This difficulty is experienced to the greatest extent in the construction of the friction-gear regulator shown when the regulator is new, and decreases as the frictional surfaces of the gears g i N wear smooth, eventually ceasing to be troublesome. To correct this defect I apply to the shifting mechanism a retarding device, which acts to sufficiently resist the movement of the shifting mechanism to prevent or obstruct any undue movement thereof, so that although its momentum may at times, in case of a sudden rocking movement, carry the shifting mechanism too far, it is not carried so much too far as to give rise to an equally forcible return rocking movement, but, on the contrary, is so retarded or resisted that its undue or excessive movement is shortened, and on the return rocking movement the brushes are not apt to be carried again beyond their proper position, or if so carried beyond their excessive movement is again shortened. The result of the addition of this retarding device is that the shifting mechanism comes to rest almost instantly in

the case of compensation for a slight increase or decrease of current; or in the case of a sudden and forcible rocking movement to compensate for a very considerable current-fluctuation the rocking movement imparted to the brushes is much shortened in duration, and the brushes are brought to rest as quickly while the regulator is running under light load as when carrying its normal load.

The retarding device should be so connected to the shifting mechanism that while acting to resist or obstruct any undue movement tending to occur by reason of the momentum of the parts, it shall not prevent the quick or instantaneous action of the regulator in case it becomes necessary to compensate for sudden and extreme changes in the load or the resistance of the circuit. Thus, for example, if a dynamo is feeding sixty lamps, and these are suddenly short-circuited, it is of the utmost importance that the regulator shall act with extreme quickness to carry the brushes instantly to the minimum position on the commutator, as otherwise the armature is liable to be burned out. The retarding device should be of such character as to throw itself automatically out of action during this sudden and extreme compensating movement. The best construction for this retarding device I believe to be that of a fan, as shown at O in Figs. 1 and 2, having wings or vanes to beat against the air and connected to the shifting mechanism, so as to be driven thereby. It may be geared to the shifting mechanism in any known way; but the mechanical connection between them should be of such character as would allow of slip in case of sudden or violent movements of the regulator, so that the fan need not at such times be revolved at the full speed of the shifting mechanism. The simplest and, as I believe, the most perfect construction for realizing these conditions is to provide the fan with a friction-roller *k*, and so mount it that this roller is pressed lightly against the surface of the friction-wheel. I prefer to have the roller mounted elastically, so that it will press with a yielding pressure against the wheel. To this end I mount the roller and fan on a slender and elastic metal pin *k'*, as shown in the sketch at the left of Fig. 2. This pin is fastened to a base-plate k^2, and the hub of the fan, formed with the roller *k*, is mounted to turn freely on this pin. The plate k^2 is adjustable by means of slotted screw-holes, as shown in Fig. 1, in direction toward and from the wheel N, and should be so adjusted that the roller *k* will bear with a light tractive contact against the wheel, so that when the wheel turns at any ordinary speed it will drive the fan; but when it turns with unusual rapidity it will slip past the roller *k*, so that it does not drive the fan at a proportionally rapid speed. This part of my invention may be applied in many different ways and to different constructions of regulating mechanism. For example, Figs. 6 and 7 show a regulator of well-known type, being that shown in my patent, No. 326,894, dated September 22, 1885, to which reference is made for a complete understanding of its construction in detail. Suffice it here to say that the end of the armature-shaft is fitted with a friction-roller, which turns between two concentric flanges on a friction-wheel N, which latter is moved to bring one or the other flange into contact with the roller by being mounted on the operating-lever L. The fan O instead of having a friction-wheel *k* has a small grooved pulley or sheave, which is driven from the friction-wheel N through the medium of a light belt, which runs in a groove in the periphery of the wheel N, as shown. In the ordinary operation of the regulator the fan O is driven by this belt; but when the wheel N is revolved at an unusually high speed the resistance of the fan to the air causes the belt to slip. The retarding device introduced by my invention to prevent or resist undue or excessive movements of the shifting mechanism of the regulator may be modified in many other ways, as may readily be inferred.

Another feature of my present invention consists of a movable stop arranged to be applied manually to the operating-lever L or other part through which the magnet M is caused to act upon the regulator, in order to hold this lever in its mid-position against the stress of the spring or other retractile force, and thereby to temporarily throw the regulator out of action during a time when the dynamo is running below its normal speed or is carrying more than its normal load. This stop is constructed preferably as a pivoted pawl or dog P, (shown best in Fig. 2,) which normally hangs down out of the way, as indicated by the dotted lines in Fig. 2 and shown in full lines in Fig. 1. Before starting up the dynamo this pawl is to be turned up to the position shown in full lines in Fig. 2, the lever L being first lifted by hand. The pawl thus holds the lever in its mid-position, thereby keeping the wheel N unclutched from the driving friction roller or rollers, notwithstanding the pull of the spring tending to draw down the lever and throw the regulator into action. The pawl continues thus to uphold the lever until the dynamo is being driven at its normal speed and until the magnet N becomes excited to its normal excitation, whereupon the magnet will exert an upward pull against the lever sufficient to overcome the downward pull of the spring, and when the magnet thereby lifts the lever off from the pawl P the latter at once falls back to its normal position, thus automatically moving itself out of the way and establishing the normal action of the regulator. To this end the pawl or stop P is given a normal tendency to remove itself from the position in which it upholds the lever L, being acted upon by gravity or by some other suitable retractile force. Preferably the pawl is con-

structed with an upwardly-projecting arm, as shown in Fig. 2, which comes against the back of the lever to prevent the pawl being moved too far forward, and its weight is so distributed that its center of gravity in this position is in the rear of the vertical plane of its pivotal axis, so that it tends to fall backward. The most important use of this stop P is for throwing the regulator out of action when the dynamo is overloaded or running below its normal speed, so that the unnecessary wear of the regulator in striving to carry the brushes beyond the maximum position is avoided. This wear occurs chiefly between the clutch-pawl *d* and the flange *c'* of the gear *c*, which rotates continually and rubs past the end of this pawl. In case, however, it becomes necessary, by reason of an increase of speed or a decrease of load, for the regulator to act to reduce the current the stop does not interfere with such action, but automatically removes itself. This manually-applied and self-removing stop for upholding the lever may be constructed in many other ways, as will be apparent to mechanics.

The solenoid or electro-motive device M, by which the regulator is controlled, is constructed in general of two parallel coils suitably mounted and attached to the frame of the dynamo, and with a U-shaped or horseshoe core, the legs of which are thrust into these coils. This construction of double solenoid is already known. One of the legs of the core is reduced in mass preferably by being bored out tubularly, as shown in the right-hand leg in Figs. 3 and 4, in order to compensate for the polarization of the core by induction from the frame of the dynamo, which is itself magnetic. The pole of the solenoid-core which is thus reduced in mass is the one which otherwise would be unduly strong by reason of the preponderance of polarization induced in it from the dynamo-frame. This feature is claimed in my application filed November 22, 1888, renewed September 3, 1889, Serial No. 322,853.

In order to render the solenoid more sensitive, I subdivide the polar or end portions of its core by splitting or sawing them down, as shown in Figs. 3 and 4, and I provide for guiding the end or ends of the core, which are inserted within the coil or coils, by pivoting in each an anti-friction roller or disk *l'*, the periphery of which projects slightly beyond the opposite sides of the core, so as to roll against the inner surface of the spool and hold the core out of contact therewith. The end of the core within the coil is thus properly guided and kept in place.

I claim as my invention the following defined novel features or improvements, substantially as hereinbefore specified, namely:

1. The combination, with a dynamo-regulator of the class wherein a shifting mechanism is connected in either direction to a source of power by the action of an electro-motive device, of a retarding device for resisting undue movements of the mechanism connected thereto through the medium of a frictional connection adapted to slip in the case of a quick and forcible movement.

2. The combination, with a dynamo-regulator of the class wherein a shifting mechanism is connected to a source of power by the action of an electro-motive device, of a retarding device for resisting undue movements of the mechanism, consisting of a fan connected thereto through the medium of a frictional connection adapted to slip in the case of a quick and forcible movement, so that the fan shall offer greater proportional resistance to slower than to rapid movements.

3. The combination, with a dynamo-regulator of the class wherein a shifting mechanism is connected to a source of power by the action of an electro-motive device and comprising as part of said mechanism a friction-wheel, of a retarding device for resisting undue movements of the mechanism, consisting of a rotary fan having a friction-roller connected to it, which is in frictional contact with said friction-wheel to be driven thereby.

4. The combination, with a dynamo-regulator of the class wherein a shifting mechanism is connected to a source of power by the action of an electro-motive device and comprising as part of said mechanism a friction-wheel, of a retarding device for resisting undue movements of the mechanism, consisting of a rotary fan having a friction-roller connected to it, and an elastic support for maintaining said roller in yielding frictional contact with the friction-wheel.

5. The combination, with a dynamo-regulator of the class wherein a shifting mechanism is connected to a source of power by the action of an electro-motive device and comprising as part of said mechanism a friction-wheel, of a retarding device for resisting undue movements of the mechanism, consisting of a rotary fan having a friction-roller connected to it, which is in frictional contact with said friction-wheel to be driven thereby, and a supporting-base for said fan and roller, adjustable toward and from the friction-wheel to adjust the tractive contact between the wheel and roller.

6. The combination, with a dynamo-regulator of the class wherein a shifting mechanism is connected to a source of power by the action of an electro-motive device against a resisting or retractile force, of a movable stop constructed to be applied manually to receive the stress of the retractile force and prevent the action of the latter upon the mechanism, whereby the regulator can be held out of action during the time that the dynamo is running below its normal speed or is overloaded, and when the excitation of the electro-motive device is insufficient to overcome the retractile force.

7. The combination, with a dynamo-regulator of the class wherein a shifting mechanism is connected to a source of power by the ac-

tion of an electro-motive device against a resisting or retractile force, of a movable stop constructed to be applied manually to receive the stress of the retractile force and prevent the action of the latter upon the mechanism, and tending to remove itself from such position, whereby when the electro-motive device acquires sufficient excitation to overcome the retractile force and remove its stress from the stop the latter moves automatically out of the way.

8. The combination, with a dynamo-regulator of the class wherein a shifting mechanism is connected to a source of power by the action of an electro-motive device against a resisting or retractile force and comprising as one of its parts a lever moved by the electro-motive device and retractile force, of a pivoted stop movable against said lever to receive the stress of the retractile force thereagainst, and when so moved having its center of gravity above its pivotal axis, so that when the lever is drawn out of contact with it by excitation of the electro-motive device it falls of itself out of engagement therewith.

In witness whereof I have hereunto signed my name in the presence of two subscribing witnesses.

JAMES J. WOOD.

Witnesses:
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