(No Model.)

G. T. BRIGGS.

ELECTRIC SWITCHING APPARATUS.

No. 452,359. Patented May 19, 1891.

Fig. 1.

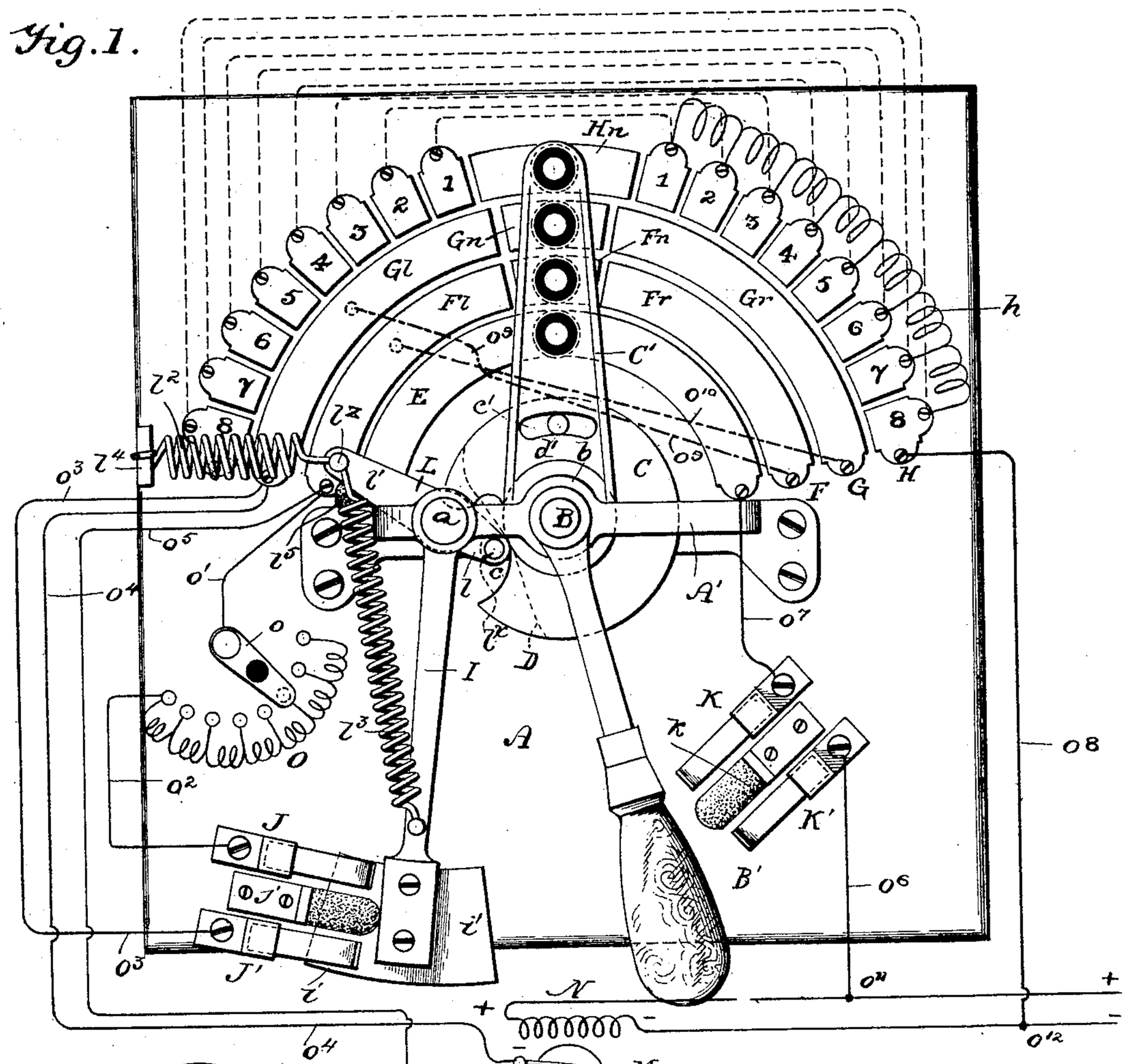


Fig. 3.

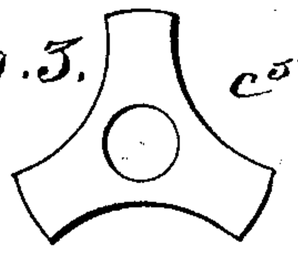
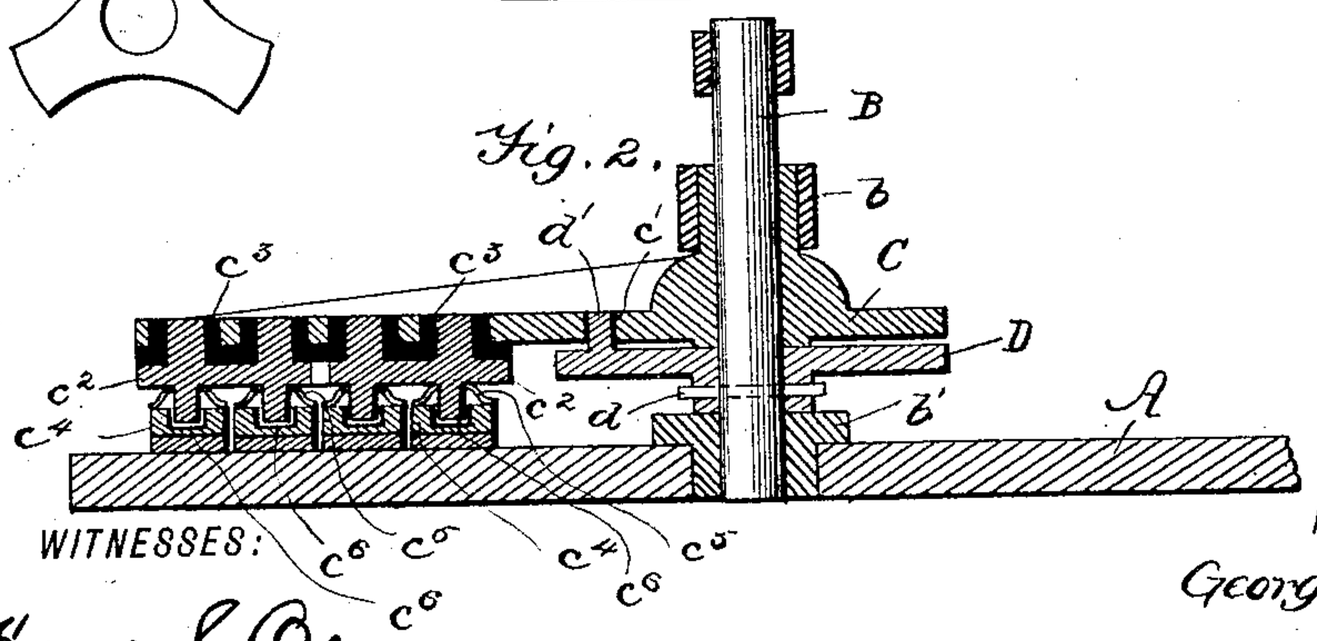


Fig. 2.



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ELECTRIC SWITCHING APPARATUS.

SPECIFICATION forming part of Letters Patent No. 452,359, dated May 19, 1891.

Application filed April 7, 1890. Serial No. 346,889. (No model.)

To all whom it may concern:

Be it known that I, GEORGE T. BRIGGS, a citizen of the United States, residing in Windsor, in the county of Hartford, and State of Connecticut, have invented certain new and useful Improvements in Electric Switching Apparatus, of which the following is a specification.

This invention has reference to switching apparatus adapted for reversing electric motors and controlling their speed.

In hoisting and similar operations it is necessary that the motor should come to a complete stop very suddenly at the end of each movement and also be capable of instant reversal. Hitherto, so far as known to me, this has never been accomplished with an electric motor, and the object of my invention is therefore to provide an apparatus by means of which these functions may be carried out. A further object is to perform these functions in a simple manner and with simple mechanism.

The invention consists, in general terms, of the combination of a make-and-break switch and a reversing-switch mounted upon the same base, with a single operating mechanism which operates both the make-and-break and the reversing mechanism in one movement. The switch is ordinarily arranged so as to short-circuit the armature simultaneously with or immediately after the supply of current has been cut off from the armature. The field-circuit, however, is left complete and active. The counter electro-motive force induced in the armature by reason of its circuit being closed upon itself and the active field causes the armature to come to an immediate stop. I am aware that this sudden generation of electro-motive force in the armature is liable to injure it; but I am able to construct an armature capable of withstanding the shock. I may, however, introduce any desired amount of external resistance into the armature-circuit before closing it.

In the accompanying drawings, Figure 1 is a plan view of the apparatus complete. Fig. 2 is a detail section, and Fig. 3 is a detail of the spring for the contact-feet.

A represents the base of the apparatus, and A′ a bridge-piece, having its ends secured to the base. In bearings *b b′* in the base and bridge is mounted the vertical shaft B, having handle B′ at its upper end, and loosely mounted on this shaft is the recessed disk C, having the circuit-controlling radial arm C′, the disk having a sleeve projecting upward between the shaft and the bridge-bearing. Under disk C, and secured to the shaft by key *d*, is the cam-disk D, the shape of the cam being indicated by dotted lines in Fig. 1. A pin *d′* projects from cam-disk D into the segment-slot *c′* of disk C, thus permitting a partial movement of handle B′ and cam D before the disk C and arm C′ are swung. The recess in disk C is shown at *c*.

In arm C′ are four openings to receive the upwardly-projecting studs of guide-plates c^2, insulating material being placed at c^3 between said plates and their studs and their arm C′. These plates, of which there are two, have each, besides two upwardly-projecting studs, two downwardly-projecting studs, which carry contact-feet c^4. Between the bottom of the plates and the top of each contact-foot is a spring c^5, which, as shown in Fig. 3, has three bearing-arms and a central opening to surround its stud. The feet have their recesses c^6 slightly larger than the studs which enter them to allow the feet to rock somewhat, if necessary, to keep a flat contact with the segmental contact-plates presently to be described. The feet, as seen, are arranged in two pairs, inner and outer, the two pairs being insulated from each other, but the two feet of each pair being electrically connected through plates c^2, and the four feet being in a radial line from the center of motion.

On the base are the four rows of segmental contact-plates E, F, G, and H under the feet c^4. The inner segment E is continuous from end to end. The second segment F is divided into left and right portions F^l and F^r and central neutral portion F^n. The third segment G is similarly divided into portions G^l, G^r, and G^n, and the outer segment H is divided into a plurality of short segments connected to resistance-coils *h*. These short segments may be of any required number. In the drawings I show sixteen—eight on each side of the neutral plate H^n, and numbered from 1 to 8, beginning at the neutral plate. The short segments are connected, as indicated, by the dotted lines, the segments 1 be-

ing connected together, the segments 2 also connected together, and so on. The resistance-coils *h* connect the segments 1 to 8 on one side, and owing to said segment being connected to the corresponding ones on the other side, both sets become the resistance-coil contact-plates.

At *a* in the bridge-piece A′ is pivoted the switch-arm I, carrying at its end two plates *i i′*, the plate *i* being adapted to connect the terminals J J′, and the plate *i′* to connect the terminals K K′. Between terminals J J′ is placed a buffer *j*, and between terminals K K′ is set a buffer *k*, these buffers being elevated to form stops for the end of the arm I and yet allow the plates *i* or *i′* to pass underneath and connect with the terminals.

At the point *a* under the bridge is pivoted the trip-lever L, having its short arm *l* provided with a friction-roller l^x to enter the recess *c* in disk C and also to be operated by cam D, and the longer arm *l′* being provided with a pin l^z for connection of springs l^2 l^3. The other end of spring l^2 is connected to a post l^4 on the base, and consequently the tension of said spring serves to keep the friction-roller l^x on arm *l* in contact with the edges of the two disks or in their recesses. A buffer for arm *l′* is shown at l^5. The other end of spring l^3 is connected to a lug near the outer end of arm I, and the tension of said spring serves to keep the arm in either of its two extreme positions or to move said arm, as will presently be described.

At M, on a reduced scale, is indicated the armature, and at N the field-circuit of a shunt-wound motor.

At O is a series of resistance-coils arranged in a semicircular row about the center of switch-lever *o*. From one end of the series O a connection o^2 is made with terminal J, and from center *o* a connection *o′* to plate F^l. The following connections are also made, viz: o^3 from terminal J′ to plate G^l, o^4 from plate G^l to the minus-brush of armature M, o^5 from plus-brush of the armature to plate F^l, o^6 from plus of field-circuit N to terminal K′, o^7 from terminal K to continuous plate E, o^8 from the short segment on the right to minus of the field-circuit. Connections o^9 are also made through the base from plate G^l to plate F^r, and o^{10} from plate F^l to plate G^r. The connections from the dynamo to connections o^6 and o^8 are indicated at o^{11} and o^{12}, respectively.

With the radial arm C′ in the position shown in Fig. 1 the armature-circuit is closed upon itself, and the field-circuit is left intact or complete, as will be understood upon reference to the connections shown in Fig. 1. The three outer contact-feet being on the neutral plates, there is no connection through the two pairs thereof, and the armature-circuit is therefore restricted to the connections which include the resistance-coils O when such are employed. When the said resistance-coils are to be omitted from the circuit, they can be cut out by the switch-lever *o*, or any number of the coils can be so cut out, as is obvious, thus forming an adjustable resistance in the armature-circuit. This position of the handle B′, shaft B, radial arm C′, cam D, switch-arm I, and trip-lever L, as shown in Fig. 1, is that in which they are placed when the motor is to be brought to a sudden stop, the connections being such that, as explained, the counter electro-motive force induced in the armature by reason of its circuit being closed upon itself and the active field causes the armature to come to an immediate stop.

When the motor is to be started slowly in one direction, the operator moves handle B′ to the right and carries the radial arm until its outer post rests on short segment 1 at the left. The shape of the cam D is such that as the radial arm C′ is moved over neutral plate H^n the roller l^x on the end of lever L is being operated upon by the cam to carry the pin l^z on the other end of lever L over to the right, past the center of motion *a* of arm I. The pin l^z arrives far enough to the right to cause spring l^3 to swing switch-arm I over to the terminals K K′ just after the outer foot c^4 has arrived on the segment 1. This prevents sparking at the feet, for the reason that the feet have passed entirely from the neutral plates before the circuit is completed at the terminals K K′. The current from the dynamo now passes through the following parts and connections: o^6 from o^{11} K′ *i′* K o^7 E, inner pair of feet c^4 F^l o^5, motor-armature o^4 G^l, outer pair of feet c^4, segment 1, all of coils *h* o^8 to wire at o^{12}. A further motion of handle B′ to the right simply moves the radial arm to a segment of the series H more to the left, thus sending the current through a lesser number of resistance-coils *h* and giving greater speed to the motor. A motion of the handle B′ now to the left first reduces speed, then brings the motor to an immediate stop by bringing the contact-feet to the neutral plates; but before they have so arrived the arm I has broken the circuit at K K′ and moved to J J′, this being due to the recess *c* of disk C allowing spring l^2 to operate trip-lever L and carry the end of spring l^3 to the left and so swing the arm I. The object of the pin-and-slot connection *d′ c′* is to allow the first motion of the handle and cam D to lift roller l^x out of recess *c*, and the last motion of said handle to remove the cam from over the recess, so the entry of roller l^x into said recess will be sudden, and consequently the swing of arm I will be immediate. As will be understood, a motion of handle B′ to the left operates to reverse the direction of the current through the connections and the motor-armature, and the same difference of speed can be obtained in the reverse direction. The cam D, as seen, is double, so as to give the same motion to arm I, whether the handle is moved to the right or left.

Having thus described my invention, I claim—

1. In a reversing and regulating switch, a circuit-controlling arm, in combination with a plurality of segmental contact-plates, one of which is divided into a neutral plate, and a series of short segments on each side of said plate, the corresponding segments of the two series being connected together, and the series on one side being connected to each other through resistance-coils, and a contact carried by said arm for connecting one of said plates with another.

2. In a reversing and regulating switch, a circuit-controlling arm, in combination with a plurality of segmental contact-plates, said arm having spring-pressed contact-feet for connecting one of said plates with another, substantially as described.

3. In an electric switching apparatus, the combination, with a plurality of segment contact-plates, of a swinging arm carrying contact-feet for connecting one of said plates with another, said feet having a yielding or rocking connection with said arm, substantially as described.

4. In combination with arm C′, the plates c^2, having downwardly-projecting studs, the feet c^4, having recesses c^6 larger than said studs, and springs c^5 between said plates and studs, substantially as described.

5. In an electric switching apparatus, the combination, with terminals of the armature-circuit and terminals of the field-circuit of an electric motor, of a swinging arm carrying plates for alternate contact with either set of terminals, said arm having a spring connected to it, and the other end of the spring being connected to a movable point of attachment, and means for throwing said point either side of the center of motion of said arm, substantially as described.

6. In combination with a swinging arm I, having plates $i\,i'$, the circuit-terminals J J′ and K K′, and the buffers j and k, said buffers being placed between the terminals, but in a different horizontal plane, substantially as described.

7. In combination with the base, a bridge-piece having a bearing for the circuit-controlling arm, and a bearing for a switch-arm and trip-lever, the circuit-controlling arm having a recessed disk, the trip-lever having a roller at its inner end, a cam for operating against the roller, and the switch-arm having a spring leading from it to the outer end of the trip-lever, substantially as described.

8. The combination, with the disk C, having circuit-controlling arm C′, recess c, and slot c', of the cam D, having pin d' to enter said slot, the trip-lever L and switch-arm I, having springs l^2 and l^3, and an operating-handle connected to the cam D, substantially as described.

9. A swinging arm carrying plates for contact, in combination with two terminals or sets of terminals and a movable pin, said arm having a spring connected to it, the other end of the spring being connected to said pin, and means for throwing the pin either side of the center of motion of the arm, substantially as described.

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

GEORGE T. BRIGGS.

Witnesses:
A. D. NEWTON,
A. L. BRIGGS.