(No Model.) 2 Sheets—Sheet 1.

G. T. WOODS.

ELECTRO MAGNETIC BRAKE APPARATUS.

No. 371,655. Patented Oct. 18, 1887.

Fig. 1.

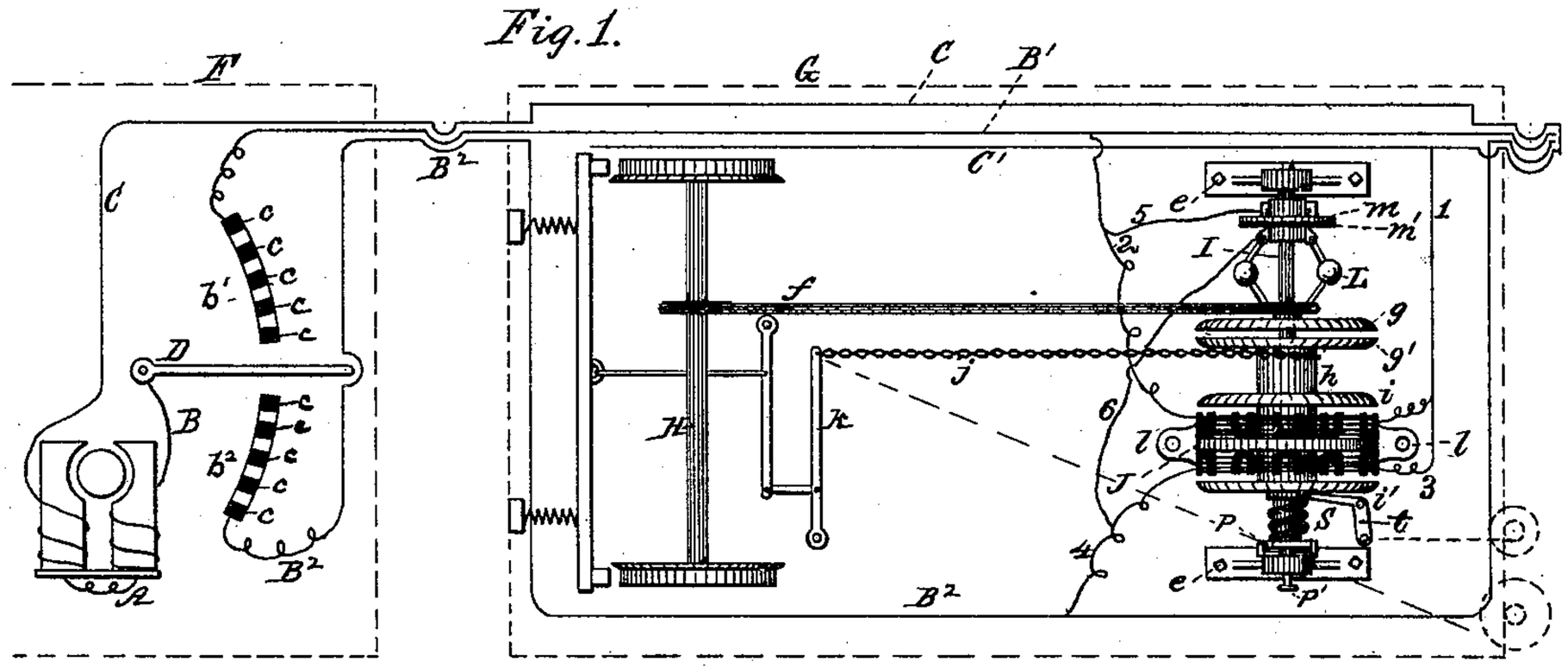


Fig. 2.

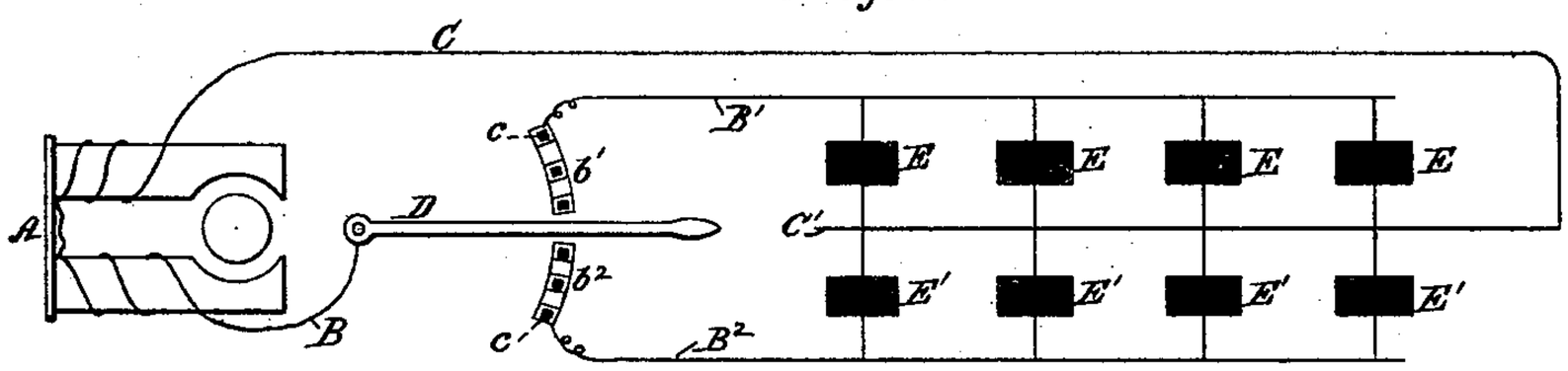
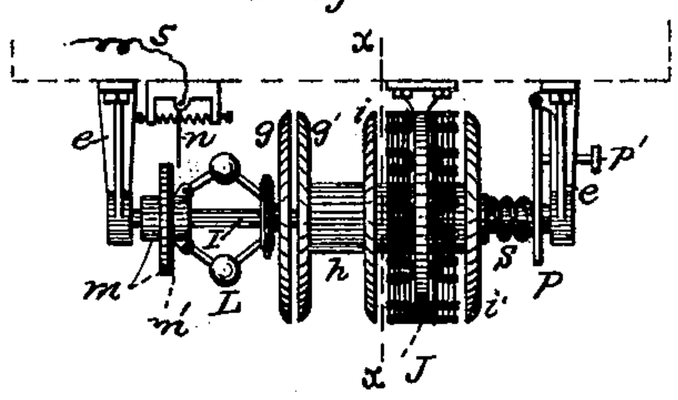


Fig. 3.



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C. D. Kirk,

Inventor:
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his Attorne

(No Model.) 2 Sheets—Sheet 2.

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ELECTRO MAGNETIC BRAKE APPARATUS.

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Fig. 4.

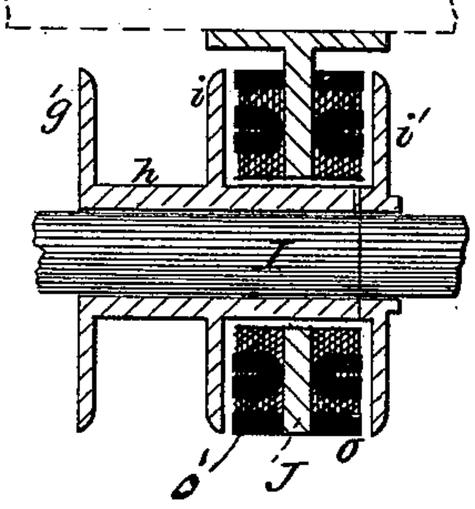


Fig. 5.

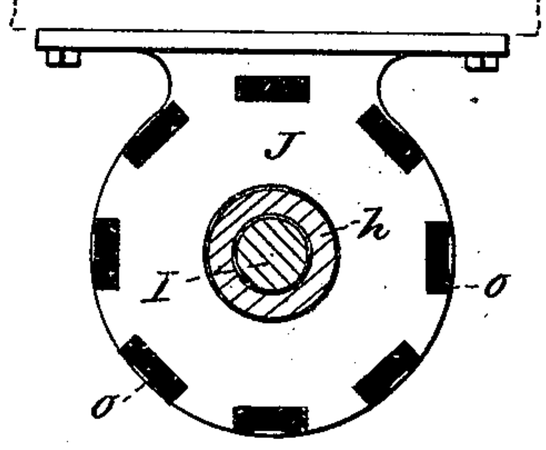
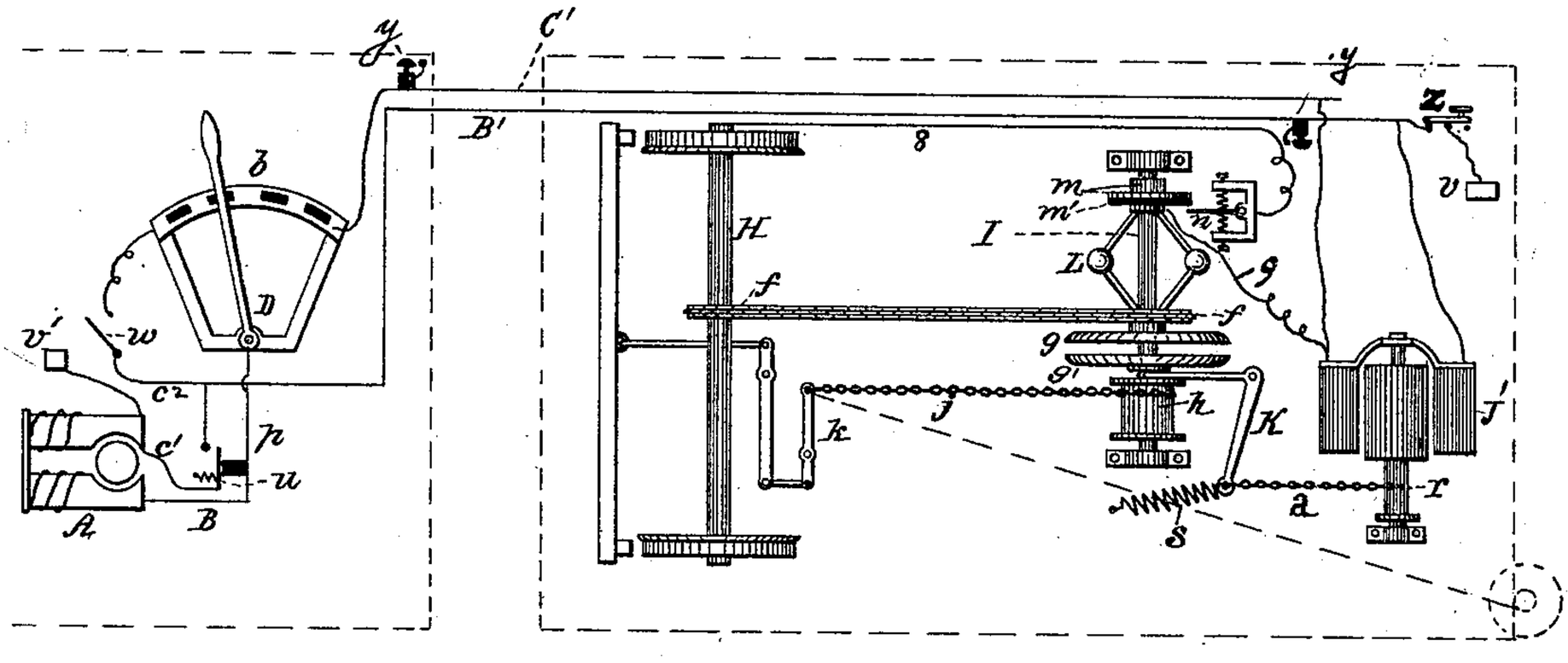


Fig. 6.



Witnesses:
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Inventor:
Granville T. Woods
by Lothrop
his Attorney.

UNITED STATES PATENT OFFICE.

GRANVILLE T. WOODS, OF CINCINNATI, OHIO, ASSIGNOR TO THE WOODS ELECTRIC COMPANY, OF SAME PLACE.

ELECTRO-MAGNETIC BRAKE APPARATUS.

SPECIFICATION forming part of Letters Patent No. 371,655, dated October 18, 1887.

Application filed October 2, 1886. Serial No. 215,125. (No model.)

To all whom it may concern:

Be it known that I, GRANVILLE T. WOODS, a citizen of the United States, residing at Cincinnati, Ohio, have invented new and useful Improvements in Electro-Magnetic Brake Apparatus, of which the following is a specification.

My invention relates to railway-brakes, its object being to provide an economical and efficient system and apparatus for the operation and control of railway-brakes by electro-motive force.

To this end it consists in the system and apparatus hereinafter described and illustrated, whereby the rotative force of the car-axles is brought into use by connected mechanism controlled by a current of electricity passing from a generator carried upon the locomotive or car of a train for setting, controlling, or releasing the brakes.

Mechanism embodying my invention is illustrated in the accompanying drawings, in which—

Figure 1 is a plan view of the apparatus as arranged upon the locomotive and adjacent car; Fig. 2, a diagram of the circuit as used upon a train of several cars; Fig. 3, a vertical cross-elevation of the counter-shaft carrying the governor, friction-plates, winding-drum, and magnet-ring; Fig. 4, a detail horizontal section of the adjustable winding-drum with its friction-plate; Fig. 5, a cross-section of same on the line *x x* of Fig. 3; Fig. 6, an under plan view of the car, showing modified construction of the braking apparatus.

Referring now to the drawings, a clear comprehension of the general features of the system of circuits will be had from Fig. 2, in which A designates a generator; B′ B², outgoing conductors; C, a return conductor; D, a resistance-switch, and E E′, &c., the operating-magnet constructions used in controlling the brake mechanism on each of the several cars, respectively, the constructive details of which will be given later. The outgoing current from the generator over conductor B is shunted by the switch D by moving its lever to connect with the conductor B′ or B², according to its position upon the side *b′* or *b*², respectively, of its contact-bar. In the central position shown in the drawings the switch-lever D stands upon an insulation, and the circuit is thereby open. Each side *b′* or *b*² of the contact-bar is provided with resistance-coils *c*, a greater or less number of the same being brought into circuit, according to the position to which the lever is thrown, the extreme outer positions of the lever-closing circuit without the resistances thus giving the full current.

It will thus be seen at the outset that the force of the current over the conductors may be regulated as desired. The return conductor C is extended back over the train, connection being made with its auxiliary extension C′ in rear of the last brake mechanism in use.

Each two magnet systems E E′ are in practice combined in one structure, J, the respective series of magnets presenting their poles in opposite directions, one set or series, *o*, acting to set the brakes, and the other set or series, *o′*, acting to release the brakes. The energizing of the sets of magnets, respectively, is effected by throwing the lever D upon the respective sides *b′* or *b*² of the contact-bar, whereby the current is shunted upon the conductors B′ or B², as the case may be. There is thus formed a double series of multiple-arc circuits—one for each movement of the brakes—and by the arrangement of the conductors the resistance is equalized for the several brakes in the series.

Referring now to Fig. 1 for a description of the details of construction and arrangement, F designates the locomotive upon which the main generator A and the controlling-switch D are located, and G the car upon which the braking apparatus is arranged. The actual setting of the brakes is effected by a power-driven counter-shaft, I, revolving in fixed bearings *e e* beneath the car-bottom. The motive force is derived from the car-axle H by a chain-and-sprocket-wheel connection, *f*. Upon the shaft I is fixedly centered a disk or plate, *g*, of cast or wrought iron, which therefore partakes of the rotation of the shaft at all times. Adjacent to the plate *g*, mounted loosely upon the shaft for lateral adjustment into or out of frictional contact with the plate *g*, is a similar plate, *g′*, whose hub *h* is extended as a sleeve to form a winding-drum bounded by a flange, *i*, and further extended through the magnet structure J and terminated by a flange, *i′*, similar to that last mentioned. These two

flanges *i* and *i'* are utilized as armatures of the magnet structure J, and by the alternative energizing of the opposite sets of magnets and their action upon the armature-flanges the sleeve or extended hub is shifted laterally to bring the friction-disks *g g'* into or out of rotative contact. Thus when the armature-flange *i* is drawn toward its magnets the friction-plates *g g'* are out of contact and the winding-drum *h* is inert; but when the armature-flange *i'* is drawn toward its magnets the friction-plates are brought into contact and cooperation ensues, by which a chain, *j*, connecting with the brake-lever *k*, is wound upon the drum.

The magnet structure J consists of a number of ordinary electro-magnets, *o o'*, of U form, arranged in circles with their poles outward from a central disk or support and suitably insulated. The magnets of each set are arranged so that their poles are in common planes, respectively, each set being independent of the other and acting in opposite directions, and the coils of each set are connected in a common circuit, one set being in multiple arc with conductors C' B' by cross conducting-wires 1 and 2, and the other in multiple arc with the conductors C' B^2 by connections 1 3 4.

The magnet structure is securely bolted to the car-body by suitable flanges, *l l*, and is immovable.

Upon the shaft I, adjacent to the friction-plate *g*, is arranged an ordinary centrifugal ball-governor, L, whose movable collar *m* is a contact-wheel insulated from its axle and the other parts of the governor, and provided with a flange, *m'*, having one side surfaced with insulating material, as indicated by the heavy black line. The contact-wheel *m* has a constant electrical connection with a wire, 6, connecting with the conductor B^2 through the cross-connection 4.

In connection with the flange *m'* and mounted upon the car-body is a contact-switch, *n*, held at opposite sides by retractile springs, and arranged to rest normally inside (that is, at the insulated side) of the flange *m'*, and is connected by a wire, 5, with conductor B' through cross-connections 2. When the car is in motion, the flange *m'* is drawn beyond the switch *n*, which is then out of contact upon the other side of the flange. If in the braking the wheels should be set too firmly and their rotation stopped, the action of the governor brings the flange *m'* into contact with the switch *n*, and thus shunts a portion of the current from conductor B^2 through the circuit 4, 6, *m'*, *n*, 5, and 2, thus passing through the other set of magnets, and placing them in equilibrium as to their magnetic action upon the armatures *i i'*, respectively, until the relief of pressure allows the wheels to rotate and restores the governor to its normal position.

At the opposite end of the shaft I may be placed a coiled spring, S, having a pivoted backing-plate, *p*, adjustable by a set-screw, *p'*, threaded through the bearing-bracket *e*. The object of the spring S is to bear against the end of the sleeve *h* and aid in holding the friction-plates *g g'* in contact.

With the construction and arrangement of apparatus thus far described it will be seen that the electric current may be used either to set or release the brakes, as desired. Where the spring S is employed, its elastic force is added to the attractive force of one set of magnets to set the brakes, while the other set of magnets operates against the force of the spring to release the brakes; but the spring may be entirely omitted, as also may the governor, without rendering the apparatus inoperative. When used, an accidental break in the electrical connections will release the spring and set the brakes.

A bell-crank lever, *t*, pivoted upon the car-body and bearing at one end against the spring S in an outward direction and provided with an actuating-chain and windlass, may be employed to throw the spring out of action for the time being.

Fig. 6 exhibits a modification in which the elastic force of a spring solely is used to engage the friction-disks and set the brakes, and the electric current employed to release them. The construction of the mechanical parts directly employed in controlling the brakes is here exactly the same as before described, excepting that the magnet structure J is omitted and an ordinary rotary dynamo, J', secured upon the car-body, independent of the shaft I, at a little distance therefrom, whose rotating shaft is extended into or geared with a winding-shaft, *r*. A chain, *a*, winding upon the shaft *r*, engages the long end of a bell-crank lever, *k*, pivoted upon the car-body, and the short end of the lever engages the sleeve *h* by the usual yoke-and-stud connection, whereby the rotation of the dynamo-shaft winds up the chain *a*, and the movement of the bell-crank K draws the friction-disk *g'* out of engagement with the disk *g*. In this figure I have shown a coiled tension spring, *s*, secured at its fixed end to the car-body and at the free end to the long arm of the bell-crank K, acting in opposition to the chain *a*, as the means of forcing the friction-disks into engagement; but it will be obvious that this is the equivalent of the spring S, before described as arranged in compression around the shaft I, and performs the same function. The electrical connections in this form of the apparatus are simple, inasmuch as but two of the conductors—namely, B' C'—are required, the dynamo J' being in multiple between them upon each car. The contact-bar *b* is in this instance single and continuous, instead of double, as in the former case, and connects in front with the conductor C' and in rear with conductor B' by a line, c^2, in which is a hand-switch, *w*. The generator A connects at one pole by a line, B, with the switch-lever D and at the other pole by a line, *c'*, to conductor B'. In the line *c'* is a switch, *u*, normally held open by a magnet, *p*, in the

line B against the force of a retractile spring, which is adjusted with sufficient force to retain the switch *u* closed against its back-stop when once released by its magnet against a subsequent energizing of the magnet until opened by hand. The generator is also furnished with a ground-connection, *v'*.

Upon the caboose is placed a ground-connection, *v*, for conductor B', with a key by which the ground-circuit may be opened at will.

In the position shown in Fig. 6 the circuit is as follows: ground *v'*, generator A, line B, switch-lever D, resistances *b*, line C', dynamo J', to ground at *v*, and the action is to hold friction-disks *g g'* out of contact against the force of spring S, and brakes are released. To set brakes, switch *w* is closed and switch-lever D moved so as to introduce more resistance into conductor C', thus shunting portion of the current through conductor B' direct to ground, thus depriving the dynamo J' of motive force and allowing the spring S to act.

In case the train should break in two the ground-connection *v* would be broken and (switch *w* being open) the automatic switch *u* would fall against its back contact, thus closing line *c'* and connecting the generator with line B in a closed metallic circuit. The brakes would still remain open and the engineer would still control the circuits of the cars attached to the engine. A signal device in the conductor C' upon the engine and a similar one in the conductor B' upon the caboose, as shown, may be employed to give notice to both engineer and conductor of such severance of the train.

The action of the governor is as follows: The circuit being grounded, as described, and the dynamo being for the time inert, in case the wheels should "skid," the contact-switch *n*, forming connection, as before described, with the flange *m'*, connects the dynamo J' to ground by wires 8 9, thus shunting a portion of the current from conductor B' through the dynamo and giving sufficient force to partially relieve the brakes.

I claim as my invention and desire to secure by Letters Patent of the United States—

1. The combination, in an electro-magnetic railway-brake apparatus, of a counter-shaft upon the car-body normally in rotation by driving-connections with the car-axle and provided with a friction-disk rigidly secured to such counter-shaft, a winding-drum and attached friction-disk loosely centered and laterally adjustable on said counter-shaft and normally held in rotative engagement with the driving-disk by a spring, a fixed magnet or system of magnets arranged to shift said winding-drum disk out of engagement with the driving-disk by means of the electric current, and a cord or chain connecting with the brake-levers and winding upon said drum, substantially as set forth.

2. In an electro-magnetic brake apparatus, in combination with the rotating counter-shaft and laterally-fixed friction-disk, a winding-drum provided with a friction-disk at one end, a disk-armature at the other, and a second disk-armature upon an extension of the winding-drum, and a fixed annular double-magnet structure embracing the drum-extension and presenting a series of magnet-poles outwardly toward each disk-armature, whereby the alternate energizing of the magnet systems shifts the winding-drum and friction-disk into and out of engagement with the counter-shaft friction-disk, substantially as set forth.

3. In an electro-magnetic brake system, the combination of the generator, the two independent sets of magnets for throwing brakes on and off, respectively, the main outgoing conductor carried to the rear and returned between the said magnets, the two branch return-circuit conductors, and the cross-circuits connecting said magnets, respectively, in multiple arc between the outgoing and return conductors, substantially as set forth.

4. In an electro-magnetic brake system, the combination of the generator, the two independent sets of magnets for throwing brakes on and off, respectively, the main outgoing conductor carried to the rear and returned between the said magnets, the return-circuit conductor branched at the two sides of said magnets, the cross-circuits connecting the series of magnets, respectively, in multiple arc between the outgoing and return conductors, the two resistance-contacts arranged at the home terminals of said return branches, and the controlling switch-lever arranged centrally in relation to said resistances and branches, substantially as set forth.

5. In an electro-magnetic brake apparatus of the character described, having a normally rotating counter-shaft and a winding-drum adjustable thereon into and out of rotative engagement with the same by electro-magnetic action, a centrifugal governor arranged upon said counter-shaft controlling the position of circuit-contacts, whereby in the event of sudden stoppage of rotation of the car-wheels through excess of braking force a loop-circuit is formed shunting a portion of the actuating-current to ground or through the opposite series of actuating-magnets, (as the case may be,) substantially as set forth.

6. In a brake system of the character described, in combination with the governor L and double-magnet structure J, the spring-held contact-finger *n*, contact and insulating disk *m m'*, and the cross-circuit between conductors B^2 B', consisting of wires 4 6, connecting the disk *m* with the conductor B^2, and wires 5 2, connecting the finger *n* with the conductor B', substantially as set forth.

7. The combination, in an electro-magnetic brake apparatus, of a friction-disk normally in rotation from the car-axle with an adjustable friction-disk having actuating connections with the brake-levers and a spring act-

ing against the adjustable disk to hold the same in normal engagement with the rotating disk, substantially as set forth.

8. In a braking apparatus of the character described, the combination of the counter-shaft, the laterally-fixed friction-disk, the adjustable winding-drum with its engaging friction-disk, the engaging-spring, and the adjusting-plate P, provided with set-screw P′, substantially as set forth.

9. In electro-magnetic braking apparatus, in combination with mechanism, substantially as described, for holding the brakes normally set by the rotative force of the car-axle, a system of electrical currents, substantially as described, including a generator, conductors, and magnets, for releasing the brakes and holding the same temporarily out of action, all arranged and operating substantially as set forth.

In testimony whereof I have hereunto set my hand in the presence of two subscribing witnesses.

GRANVILLE T. WOODS.

Witnesses:
L. M. HOSEA,
C. D. KERR.