No. 712,994.

Patented Nov. 4, 1902.

F. E. CASE.

METHOD OF OPERATING ELECTRIC BRAKES.

(Application filed Apr. 24, 1902.)

(No Model.)

2 Sheets—Sheet 1.

Fig. 1.

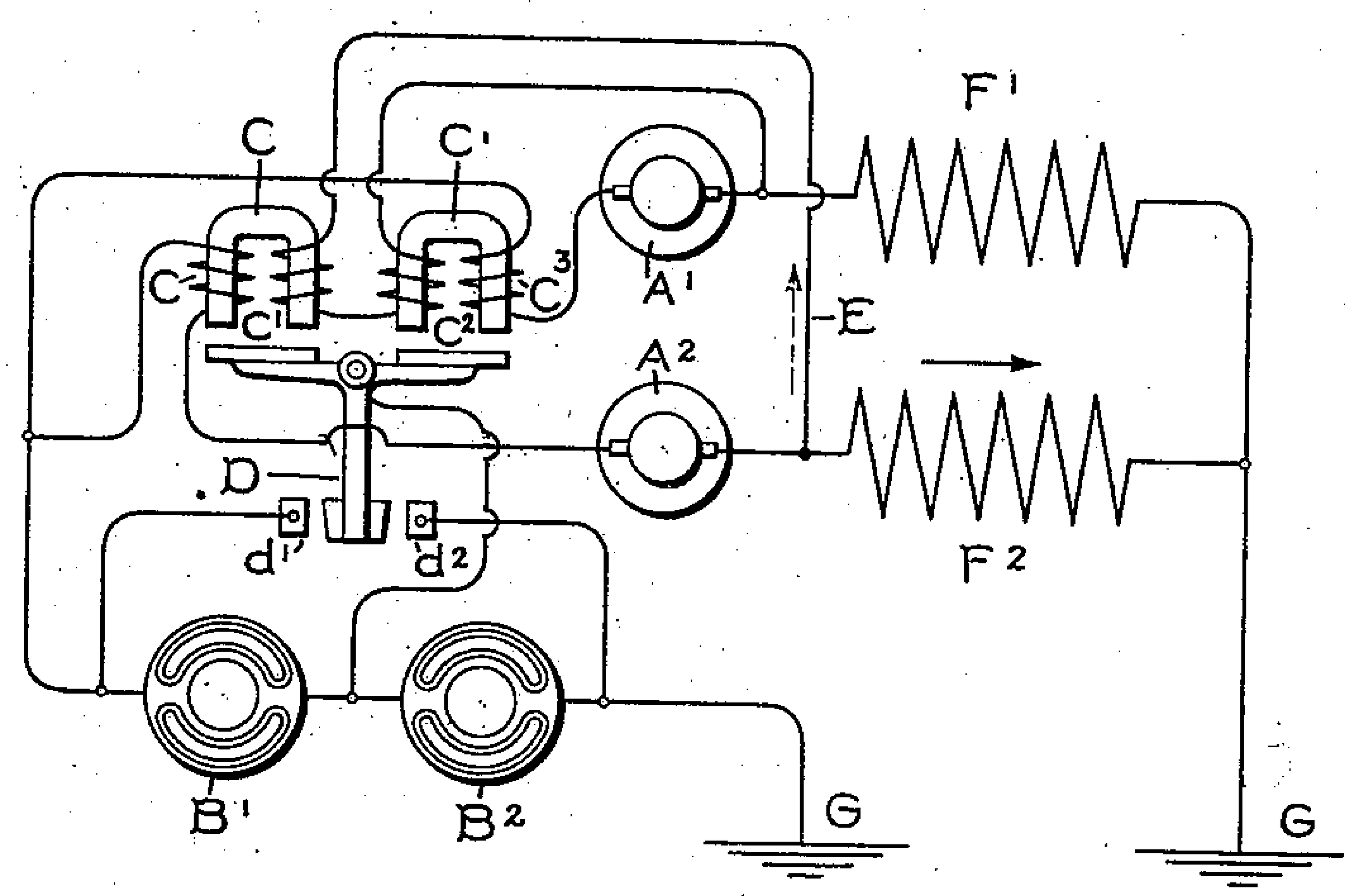
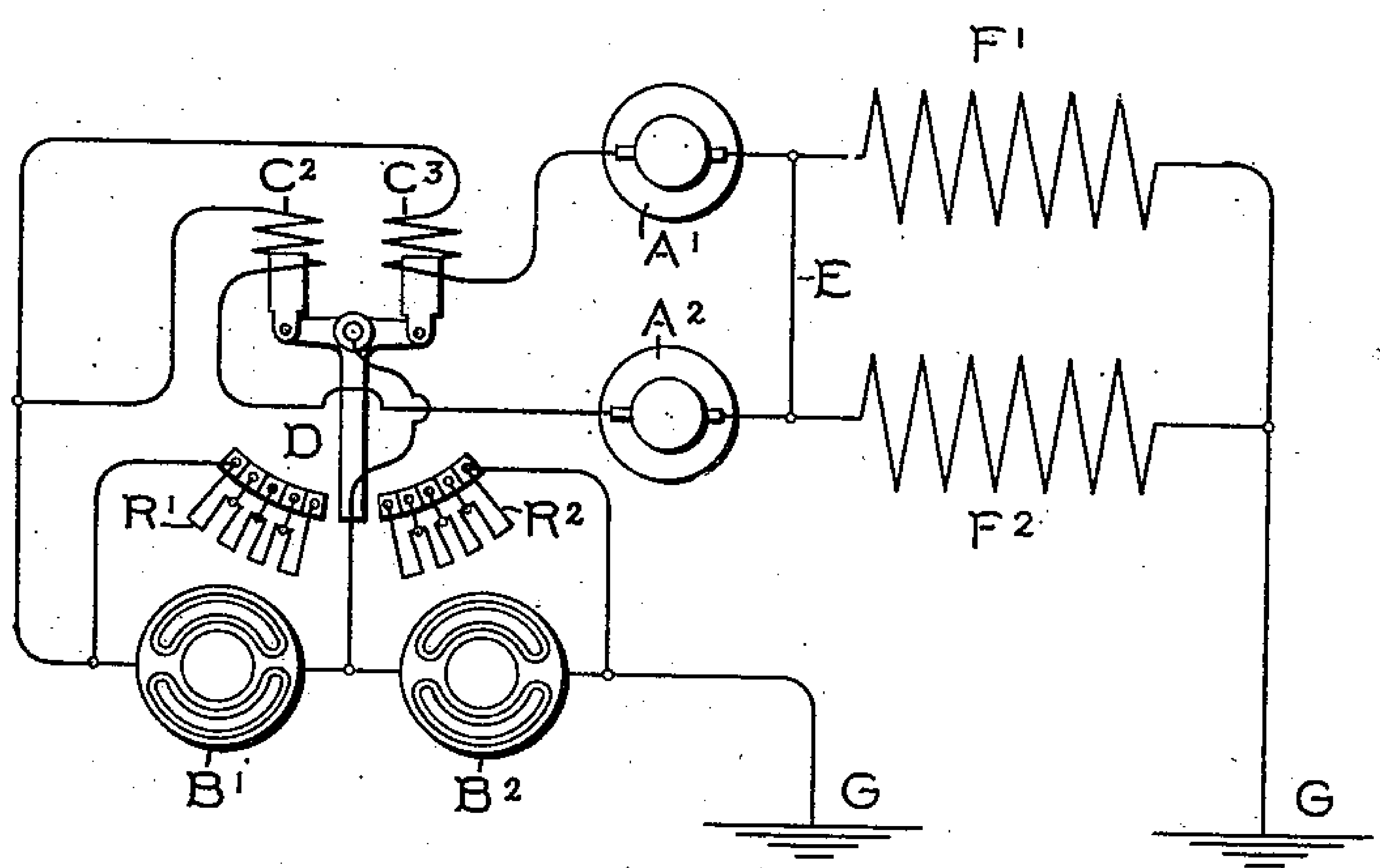


Fig. 2.



Witnesses.

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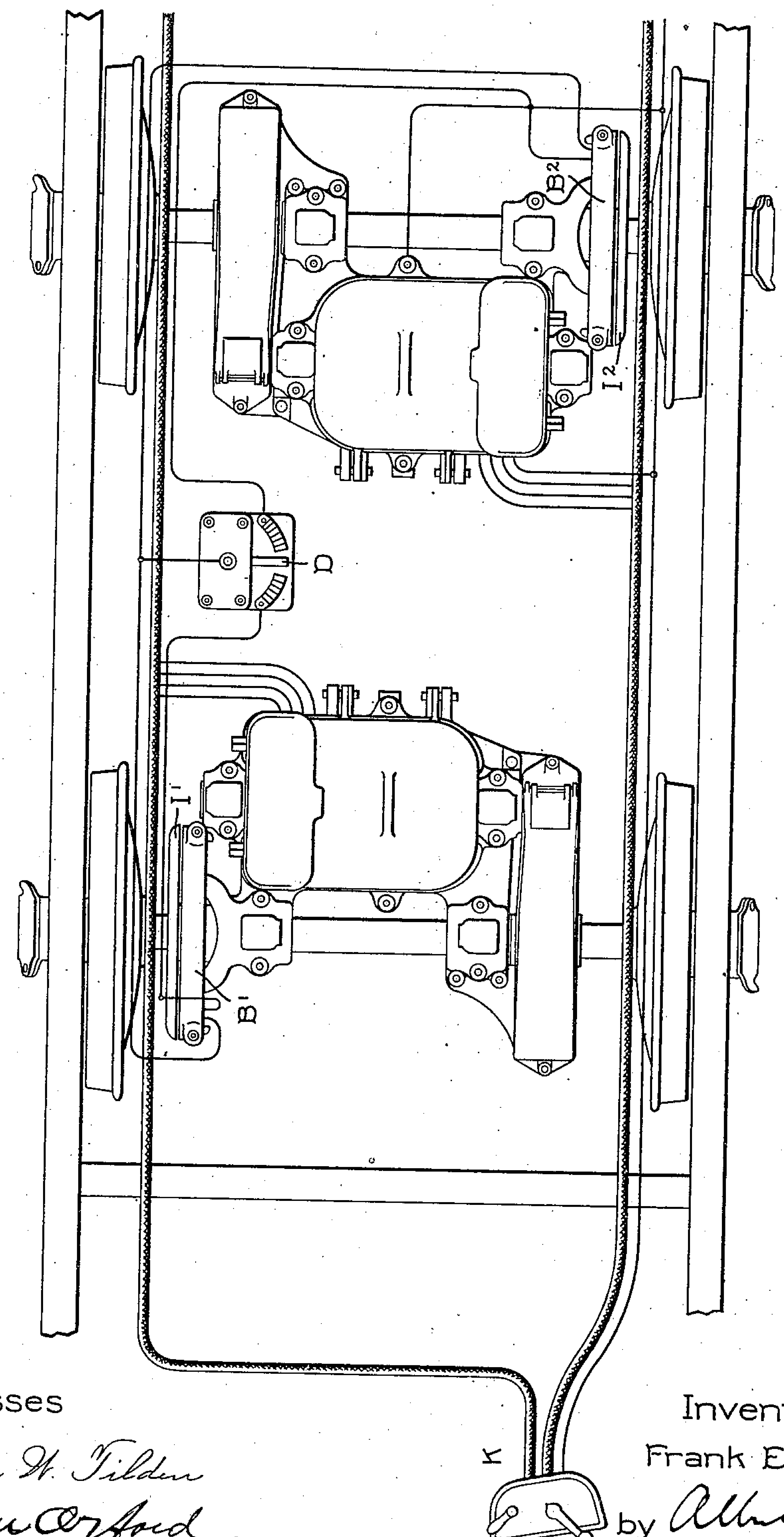
Fig. 3.



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UNITED STATES PATENT OFFICE.

FRANK E. CASE, OF SCHENECTADY, NEW YORK, ASSIGNOR TO GENERAL ELECTRIC COMPANY, A CORPORATION OF NEW YORK.

METHOD OF OPERATING ELECTRIC BRAKES.

SPECIFICATION forming part of Letters Patent No. 712,994, dated November 4, 1902.

Original application filed June 30, 1897, Serial No. 642,908. Divided and this application filed April 24, 1902. Serial No. 104,480. (No model.)

To all whom it may concern:

Be it known that I, FRANK E. CASE, a citizen of the United States, residing at Schenectady, county of Schenectady, State of New York, have invented certain new and useful Improvements in Methods of Operating Electric Brakes, (Case No. 2,853,) of which the following is a specification.

This application is a division of my prior application, Serial No. 642,908, filed June 30, 1897.

My invention relates to electric brakes, and has for its object to prevent one of the difficulties which sometimes arise in the operation of cars equipped with these devices.

In the operation of braking devices it often happens that one of the axles is so far checked that the wheel begins to slide upon the track. This not only diminishes the braking effect, and that very rapidly, but it also makes flat places on the wheels and tends to increase the sliding, because when a wheel once begins to slide the friction on the track diminishes very rapidly. This effect increases with the speed, so that though while the wheel is rolling a good retarding effect is obtained as soon as the wheel begins to slip it tends to continue to slip and retards the progress of the car very little. It also often happens that the other axle or axles of the car will be acting normally at these times, and the strain on that, due to the slipping of the first axle, will be greatly increased. These difficulties have been recognized and some attempt has been made to provide for them, but without entire success. One of the methods which has been applied with some success involves the use of a so-called "limit-switch," a device for preventing the current-flow in an electric-brake system from increasing beyond a predetermined amount. The difficulty with this expedient has been that while the limit-switch could be adjusted for any particular current-flow it could not be changed to suit all the varying demands of traffic. When adjusted for a dry rail, for instance, where much greater current can be permitted than where the rails are greasy, it would work well so long as the rails were in that condition; but when the track became slippery the wheels would stick and slide, giving rise to the difficulties above pointed out.

In a braking system arranged to be operated in accordance with the method constituting my invention no limit-switch is required, the braking effect being regulated in the shoes themselves in such a manner that it is at all times proportional to the coefficient of track friction. Preferably the method is performed automatically in such a manner that as the coefficient of friction increases the permitted current-flow in the brake-shoes also increases and in proper proportion.

In the particular organization of the braking system which I have illustrated herein devices are arranged for shunting the brake-shoes, and the arrangement is such that these devices are controlled by the current in the individual motor-circuits, it being understood that the motors are used as a source of current for the brakes. Of course other sources of current could be substituted, so far as my invention is concerned, if it were desirable to use the trolley-current or a storage-battery current, but ordinarily the described arrangement is commercially more desirable, as is well known.

I have shown in this application two ways of shunting the shoes, one of these by a switch under the control of the motor-current, so arranged that when the motors are out of balance in the generation of current (which ordinarily is caused by their running at different speeds) the switch will shunt the shoe corresponding to the motor running at the lower speed. This may be done either by momentarily closing the shunt-circuit and as the motor speeds up opening it again, or it may be effected by closing the circuit through a variable resistance and changing the resistance in accordance with the effect desired.

The ways suggested, which will be more fully explained, are only typical of other ways which can be utilized. For instance, in my application, Serial No. 644,884, filed July 17, 1897, I have shown ways in which a shoe which tends to stick may be momentarily demagnetized. It will then of course immediately release the revolving disk with which it coöperates. As soon as its own motor begins to revolve it will be magnetized again, and the braking effect will be renewed.

The drawings annexed show in diagram apparatus for carrying out the invention which I have just pointed out.

Figure 1 illustrates the means of momentarily short-circuiting the brake-shoe, and Fig. 2 shows a shunt around the brake-shoe, including a variable resistance. Fig. 3 is a plan view of a truck, showing the mechanical construction.

In the drawings, A′ A^2 are the motor-armatures, the motors being understood to be operated as generators in braking and being the source of current for the brakes.

F′ F^2 are the field-magnets.

B′ B^2 are the brake-shoes.

The circuit is grounded in the usual way at G.

An equalizer E is employed, and this I use to balance the current between the motors in the customary way; but it has also in this case the additional function of determining the balance of braking effect.

Referring to Fig. 1, the motors are connected in multiple, with an equalizer-circuit E joining the corresponding points between the armature and field windings of said motors, and the said motors operating as generators supply current to the brake-shoes B′ B^2, connected in series.

D indicates an automatic switch for controlling the brake-shoes. The lever of this switch is connected to a point between the brake-shoes B′ and B^2 and through the contacts d' d^2 may short-circuit either of them.

C C′ indicate magnet-cores coöperating with armatures on the lever D to operate the same, and these cores are provided with coils c to c^3. The coils c and c^3 are wound in the same direction and are connected in circuit with the armatures A^2 and A′, respectively, while the coils c' and c^2 are wound in opposite directions and are connected in the equalizer-circuit. The operation of these parts is as follows: While both of the motor-armatures A′ A^2 are revolving at a substantially uniform rate or generating substantially equal electromotive forces no current will flow in the equalizer E, and the entire current of both motors will pass through the fields to ground, returning from ground through the brake-shoes in series back to the motors in multiple, giving a substantially uniform pull on the different brake-shoes. The currents in the coils c and c^3 will be equal, and hence the switch-lever D will be maintained in its intermediate position. If, however, one of the motor-armatures—as, for example, A′—should cease to turn for any reason, the corresponding brake-shoe B′ would with the ordinary connections still be supplied with the full current from the armature A^2 so long as the latter continued to revolve; but with the connections shown in this figure the current will flow from the armature A^2 through the equalizer-circuit in the direction shown by the dotted arrow and through the coils c^2 and c', increasing the magnetization of the core C and decreasing that of the core C′, so that the lever D will be moved into engagement with the contact d', thereby momentarily short-circuiting the shoe B′ and releasing it. The current flowing through the equalizer connection will divide, part flowing through the field-winding F′ in a direction to maintain its magnetization and part flowing through the armature A′ in such a direction as to drive it as a motor. The speed of the armature A′ will therefore quickly rise until the two armatures are running at substantially the same speed, when the flow of current through the equalizer connection will cease, and the switch-lever D will be returned to its intermediate position. In the same manner if the armature A^2 should cease to turn the brake-shoe B^2 would be momentarily short-circuited.

With the apparatus arranged in the way just pointed out the lever D would go first to one side and then to the other as the motor-armatures, respectively, began to run at different speeds or at speeds so materially different as to throw the attraction of the magnets C C′ out of balance in the way pointed out, it being of course designed that minor variations in the speed shall not affect the magnets. As the lever touches one or the other of the contacts d' d^2 it would shunt the entire current around one of the brake-shoes, the latter would release its grip, and the regulation of the braking effect would be obtained by the opening and closing of the short circuit around the shoe. The arrangement, however, which I prefer to use in practicing my invention is that shown in Fig. 2. In this the parts are marked as before, except that in place of the electromagnets C C′, I substitute solenoids C^2 C^3, each in series with one of the motor-armatures, and in addition I employ resistances R′ R^2, over the contacts of which the lever D moves. The effect of this arrangement is to be preferred to that in Fig. 1, because if, for instance, the armature A′ begins to run at a less rate than A^2 the current in the coil C^3 falls off, and the entire resistance R′ is connected in a shunt-circuit around the brake-shoe B′. This resistance may be so proportioned that comparatively little current will flow through it, and the magnetization of the shoe will be thus slightly reduced and the shoe partially released. If, however, the armature A′ continues to be retarded, part of the resistance is cut out, until should the armature practically cease rotation the entire resistance would be cut out, and the brake-shoe would thus be entirely released or "killed." As the armature increases its speed, sending more and more current through the coil C^3, the lever D would move over the resistance-contacts until it opened the circuit, sending again the entire current through the brake-shoe B'.

In the organization shown in Figs. 1 and 2 whenever the electromotive force generated by the armature A^2 is high relatively to that of the armature A' the brake-shoe B' will be released, and whenever, on the other hand, the electromotive force generated by the armature A' is high relatively to that of the armature A^2 the brake-shoe B^2 will be released. It will be apparent, then, that in both cases the brake-shoes are controlled according to the relative values of the electromotive forces generated by the armatures of the dynamo-electric machines which supply current thereto.

In Fig. 3 I illustrate a complete braking system as it would be applied to a railway-car. In this figure I show in plan two motors of a common type attached to their respective axles in the way generally employed. Each of the axles has a brake-shoe B' B^2, coöperating with disks I' I^2 in the usual way. The controlling device K is also shown in plan, with a cable from which wires extend to the motors and brake-shoes. The switch D, with its resistances, is illustrated conventionally. Wires are shown extending from it to the brake-shoes. The operation of the different parts has been described in connection with the circuits as shown in Fig. 2.

It will be apparent that engineers can readily devise other apparatus for carrying out my invention which shall not be the same as the apparatus disclosed in this application, but which will involve the same method of operation. This method of operation I aim to cover in the claims hereto appended whatever may be the character of the apparatus by means of which it is carried out.

What I claim as new, and desire to secure by Letters Patent of the United States, is—

1. The method which consists in supplying current to electrically-actuated braking devices on a plurality of car-axles, and automatically releasing any one of the said braking devices whenever the speed of rotation of its axle is substantially less than that of another axle.

2. The method of braking a car or train having a plurality of axles provided each with a dynamo-electric machine and with an electrically-actuated brake-shoe, which consists in causing said dynamo-electric machines to supply current to actuate said brake-shoes and controlling the application of the said shoes according to the relative values of the electromotive forces generated by said dynamo-electric machines.

3. The method of braking a car or train having a plurality of axles provided each with a dynamo-electric machine and with an electrically-actuated brake-shoe, which consists in causing said dynamo-electric machines to supply current to actuate said brake-shoes and controlling the application of the said shoes according to the flow of current through an equalizer connection between the said dynamo-electric machines.

In witness whereof I have hereunto set my hand this 23d day of April, 1902.

FRANK E. CASE.

Witnesses:
BENJAMIN B. HULL,
HELEN ORFOND.