No. 712,650.

Patented Nov. 4, 1902.

F. E. CASE.

BRAKE SHOE.

(Application filed June 30, 1897.)

(No Model.)

2 Sheets—Sheet 1.

FIG. 1.

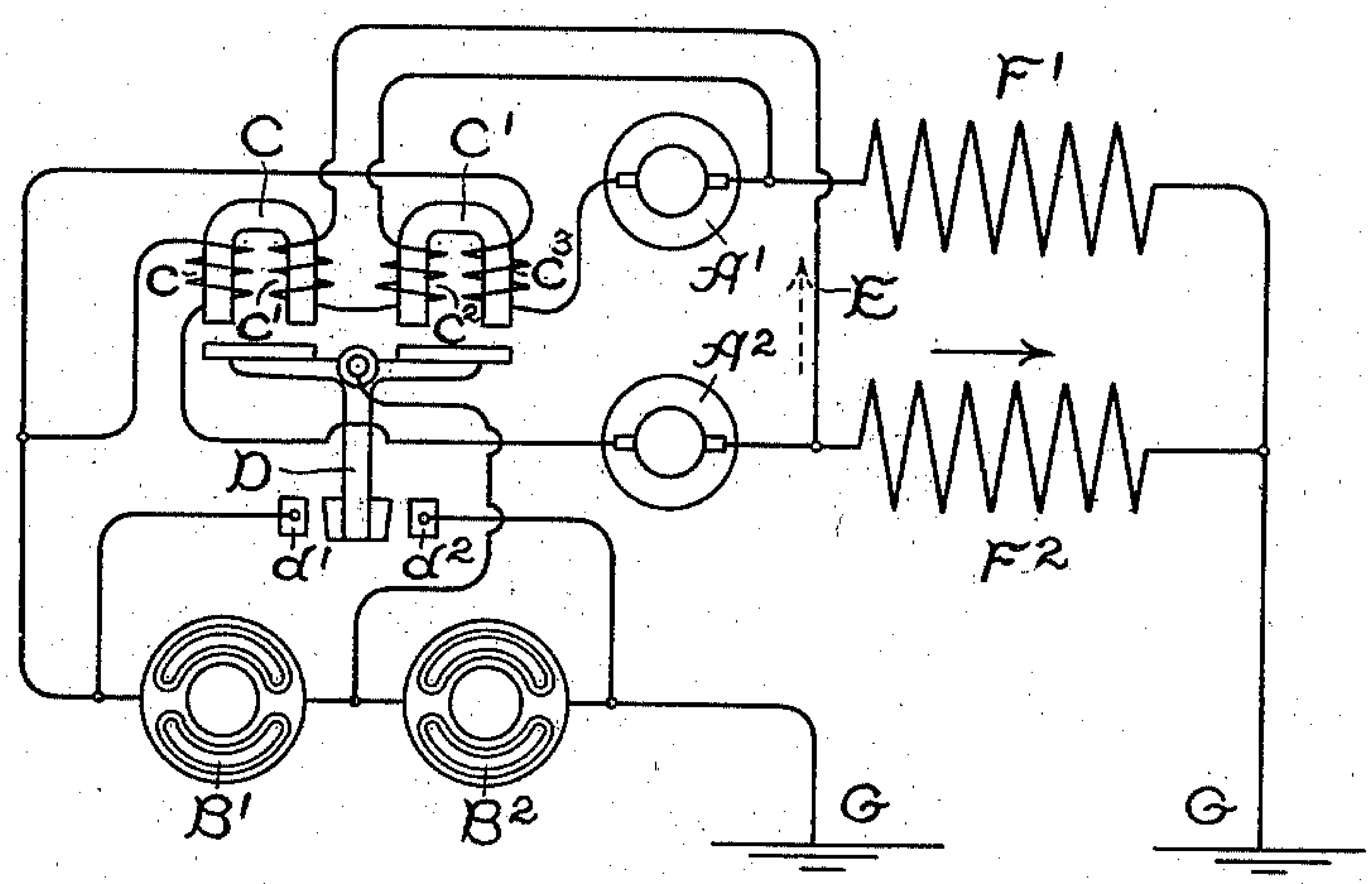
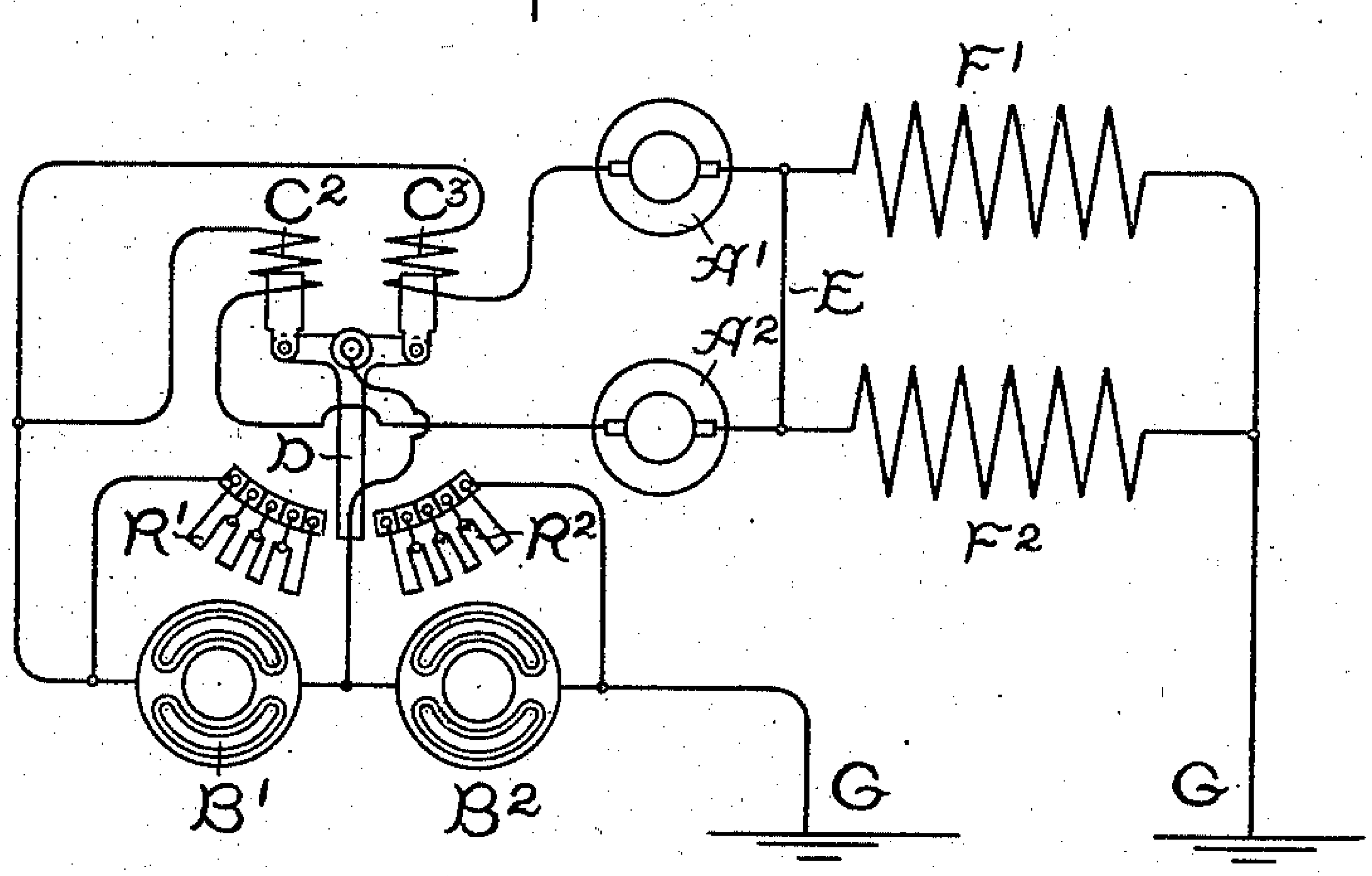


FIG. 2.



Witnesses.
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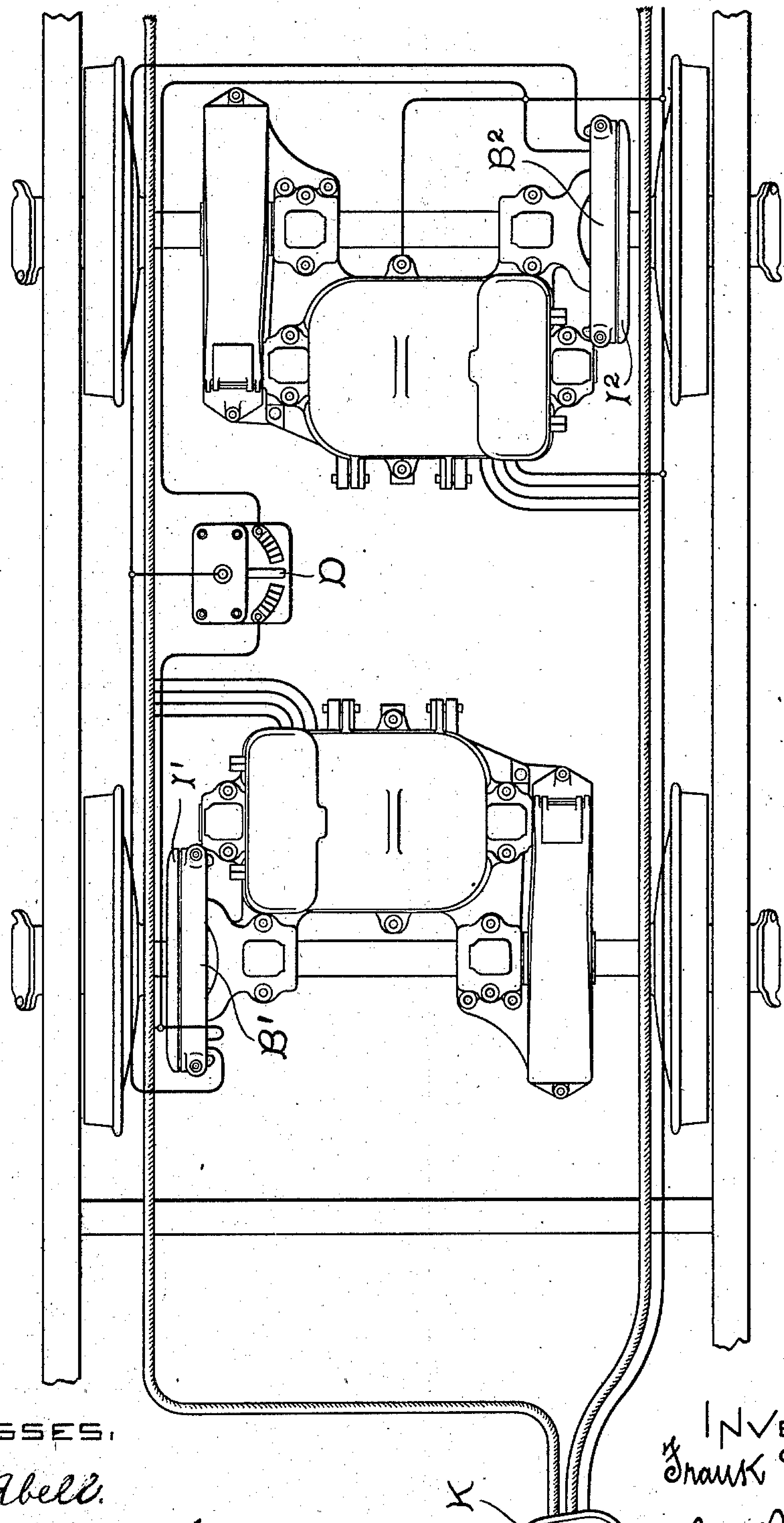

FIG. 3.

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UNITED STATES PATENT OFFICE.

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

BRAKE-SHOE.

SPECIFICATION forming part of Letters Patent No. 712,650, dated November 4, 1902.

Application filed June 30, 1897. Serial No. 642,908. (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, in the county of Schenectady, State of New York, have invented certain new and useful Improvements in Electric Brakes, (Case No. 363,) of which the following is a specification.

My invention relates to braking systems, and has for its object to prevent one of the difficulties which sometimes arise in the operation of cars equipped with braking 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 in an electric-brake system involves the use of a so-called "limit-switch," a device for preventing the current-flow in the 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.

According to the principles of my present invention I am enabled to regulate the braking effect at the shoes themselves, proportioning this braking effect to the coefficient of track-friction. This I much prefer to do automatically, and the devices which I employ are so arranged that as the coefficient of friction increases the braking effect of the brake-shoe also increases and in proper proportion.

The particular system which I have shown in the drawings annexed to this specification constitutes the best mode in which I have contemplated applying the principles of my invention. In this system the brake-shoes are electrically actuated, and in applying my invention to such a system I arrange devices for shunting the brake-shoes, and these devices are arranged to be 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. While the specific arrangement in this case differs from that disclosed in my present application, it is evidently but another way of carrying out my present invention, and I desire in this case to make broad claims to the individual regulation of the brake-shoes or the braking effect upon the axles of the car, particularly in proportion to the coefficient of track-friction, and this irrespective of the particular means by which said regulation is to be accomplished.

The drawings annexed show in diagram particular ways of 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 are 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 device 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 which I prefer, however, 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 the mechanical embodiment of my invention. 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 means for carrying out the invention just stated which shall not be the same as those set out in this application, but which will employ the same principles, and I aim to embrace in the claims appended to this specification all means which do not involve a departure from the spirit and scope of my invention.

I have not stated in my specification all of the causes which may exist tending to retard one axle more than another, as I have thought this to be unnecessary; but any mechanism which relieves the individual axle from undue retarding, by whatever circumstances it may be caused, would manifestly be within the scope of my invention, as I believe it to be new with me to regulate the braking of the individual axles.

I do not claim in this application the novel method disclosed herein, since it constitutes the subject-matter of a divisional application, Serial No. 104,480, filed April 24, 1902.

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

1. In a brake system, a source of current, a plurality of brake-shoes supplied therefrom, and means for proportioning the braking effect in the different shoes to the coefficient of track friction.

2. In a brake system, a source of current, a plurality of brake-shoes supplied therefrom, and means for automatically deënergizing any shoe which tends to stick.

3. In a brake system, a plurality of dynamo-electric machines, a plurality of brake-shoes, circuits electrically connecting said dynamo-electric machines and said brake-shoes, and means for automatically deënergizing any shoe which tends to stick.

4. In a brake system, a plurality of brake-shoes, a plurality of dynamos furnishing current to the shoes, and means for regulating the braking effect of each shoe in proportion to the current-flow in the dynamo on the same axle.

5. In a brake system, a source of current, a plurality of brake-shoes supplied therefrom, and means for so regulating the individual braking effect of the different shoes that undue retardation of any one axle is prevented.

6. In a brake system, a source of current, a plurality of brake-shoes supplied therefrom, and means for automatically shunting any brake-shoe which tends to stick.

7. In a brake system, a source of current, conductors leading therefrom to a plurality of brake-shoes, and means for shunting any of the brake-shoes through a variable resistance.

8. In a brake system, a source of current, conductors leading therefrom to a plurality of brake-shoes, and means for shunting any of the brake-shoes through an automatically-variable resistance.

9. In a brake system, a source of current, conductors leading therefrom to a plurality of brake-shoes, and means for shunting any of the brake-shoes through a resistance automatically variable in proportion to the desired braking effect in each shoe.

10. In a brake system, a source of current, conductors leading therefrom to a plurality of brake-shoes, and means for balancing the braking effect of the different shoes in proportion to the coefficient of track friction, which consists in a shunt around the shoes having the greater braking effect, the shunt including a resistance automatically variable in proportion to the current-flow.

11. In a brake system, the combination of electric brake mechanism acting upon different axles of a truck or train, and means for automatically relieving the brake mechanism upon any given axle when for any reason its speed is checked below that of the other axle or axles, as set forth.

12. The combination of brake mechanism acting upon different axles of a truck or train, and means for relieving or reducing the braking action upon any given axle, without affecting the braking of the other axles when the speed of the given axle for any reason, as by slipping of the wheels, is checked below that of the other axle or axles, as set forth.

13. The combination of brake mechanism acting upon different axles of a truck or train, and automatic mechanism for relieving or reducing the braking action upon any given axle, without affecting the braking of the other axles when the speed of the given axle

for any reason, as by slipping of the wheels, is checked below that of the other axle or axles, as set forth.

14. In combination, a plurality of dynamos connected in multiple, a plurality of brake-shoes supplied with current therefrom, an equalizing connection for said dynamos, and means operating upon a flow of current in said equalizing connection for releasing one or the other of said brake-shoes.

15. In combination, a plurality of car-axles, each provided with a dynamo-electric machine and with an electrically-actuated braking device, means whereby said dynamo-electric machines may supply current to operate said braking devices, and means whereby any one of the said braking devices will be released whenever the speed of rotation of its axle becomes substantially less than that of another axle.

16. In a brake mechanism, the combination of brake-magnets acting upon different axles of a truck or train, dynamo-electric machines driven as generators by said axles and supplying current to the brake-magnets, and automatic mechanism for relieving the braking action upon any given axle, independently of the other brake-magnets, when the speed of said axle is checked below that of the other axle or axles.

17. The combination in a brake system, of a number of dynamo-electric machines geared to different axles of a common load, which may slip independently, and thereby vary the relative speeds of the dynamo-machines, with electric brake-magnets for said different axles, and means for automatically relieving the braking action on any one of said axles when its speed is checked below that of the other axles, and for reapplying the braking mechanism when the speed rises, as set forth.

18. The combination of brake-magnets acting upon different axles of a truck or train, and connected in a brake-circuit, dynamo-machines driven by said axles and connected in parallel with the brake-circuit, magnets in the circuits of the different dynamo-machines, and a switch mechanism actuated by the magnets and shunting one or another of the brake-magnets according as the speed of one or another of the axles is checked without corresponding checking of the other axle or axles, as set forth.

19. The combination of a number of dynamo-electric machines geared to different axles or shafts capable of independent slip, electric brake mechanism for said axles, magnets or coils responding to changes of current generated by the respective dynamo-machines, and automatically-acting switch mechanism for relieving the brake mechanism acting upon any given axle, actuated by the difference between the currents generated by the dynamos.

In witness whereof I have hereunto set my hand this 15th day of June, 1897.

FRANK E. CASE.

Witnesses:
B. B. HULL,
M. H. EMERSON.