(No Model.) 2 Sheets—Sheet 1.

E. E. RIES.

METHOD OF BRAKING TRAINS.

No. 452,041. Patented May 12, 1891.

Fig. 1.

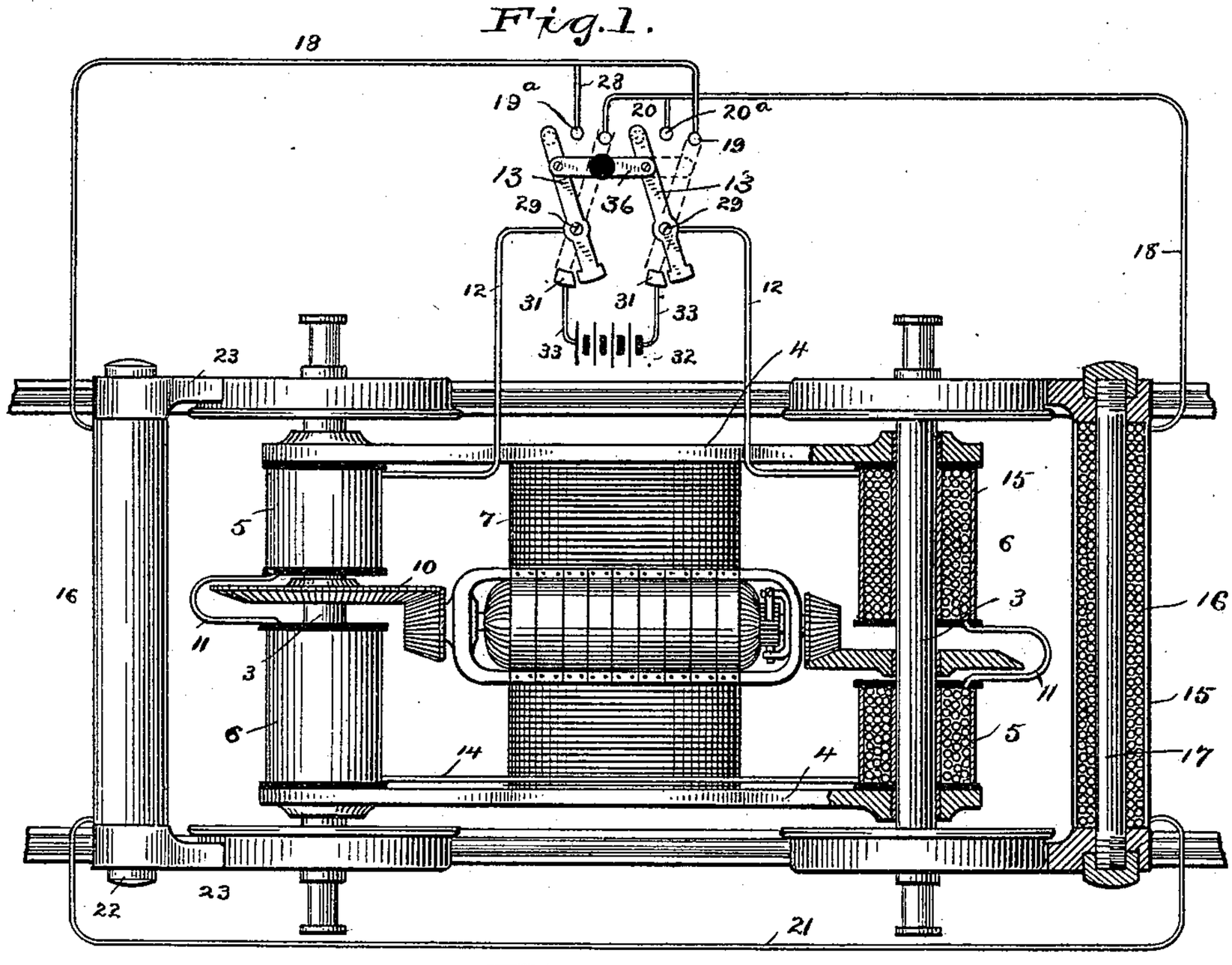
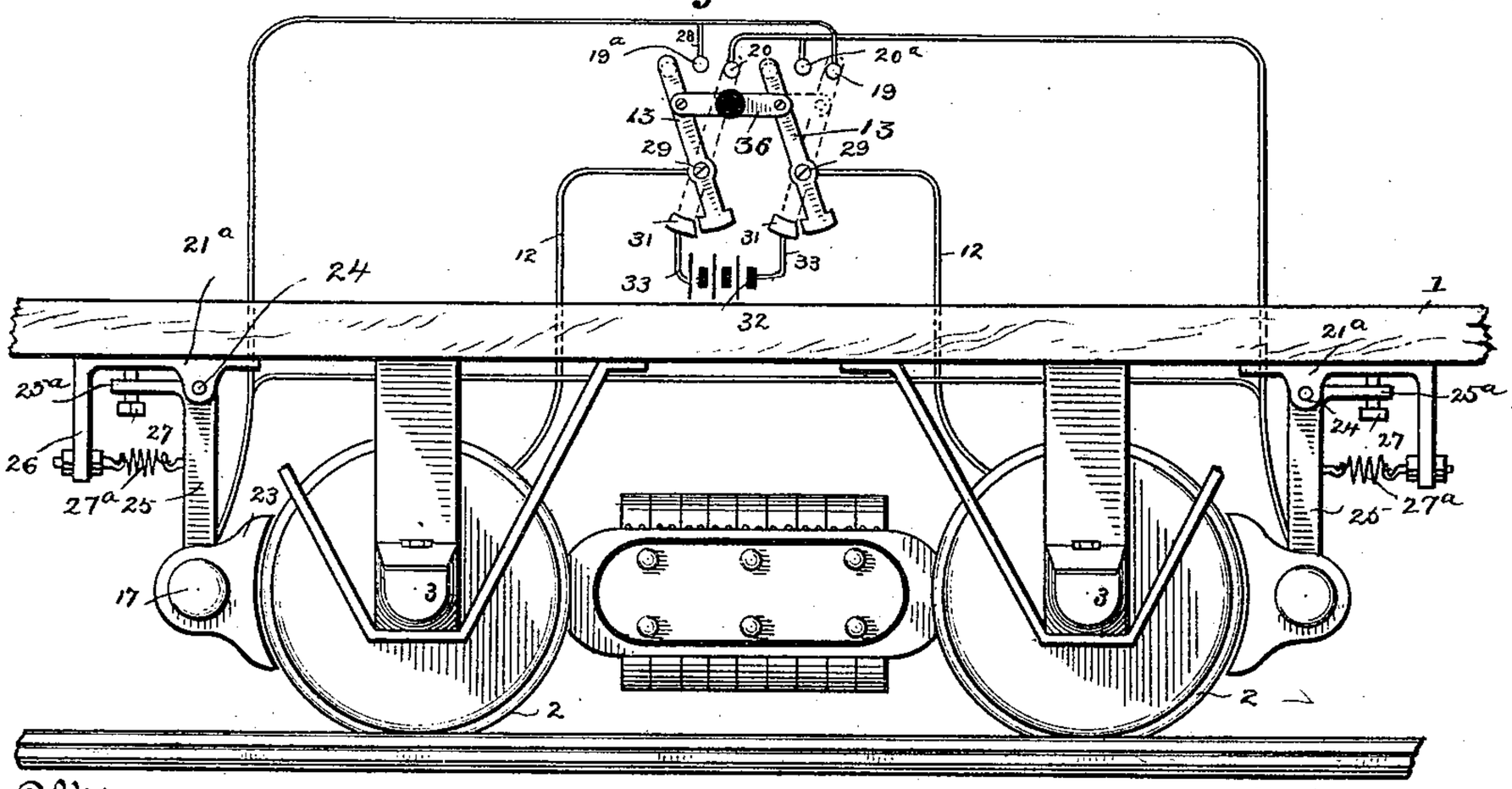


Fig. 2.



Witnesses
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(No Model.) 2 Sheets—Sheet 2.

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METHOD OF BRAKING TRAINS.

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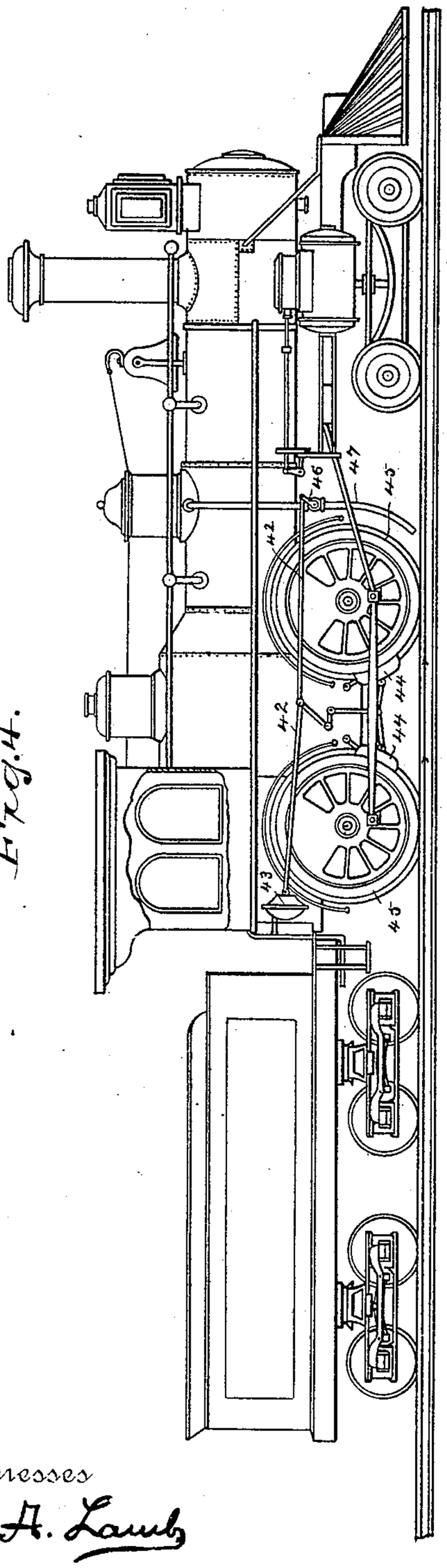

Fig. 4.

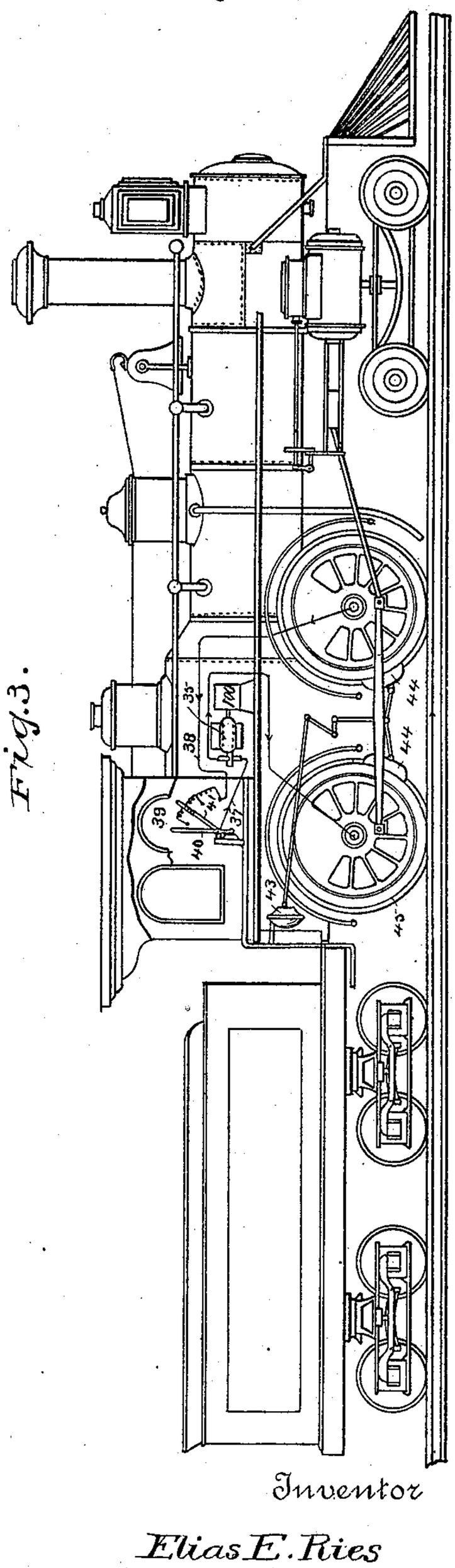

Fig. 3.

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UNITED STATES PATENT OFFICE.

ELIAS E. RIES, OF BALTIMORE, MARYLAND, ASSIGNOR TO RIES & HENDERSON, OF SAME PLACE.

METHOD OF BRAKING TRAINS.

SPECIFICATION forming part of Letters Patent No. 452,041, dated May 12, 1891.

Application filed October 4, 1888. Serial No. 287,197. (No model.)

To all whom it may concern:

Be it known that I, ELIAS E. RIES, a citizen of the United States, residing at Baltimore, in the State of Maryland, have invented certain new and useful Improvements in Methods of Braking Railroad-Trains; and I do hereby declare the following to be a full, clear, and exact description of the invention, such as will enable others skilled in the art to which it appertains to make and use the same.

My invention relates to a new and improved system of braking a traveling vehicle or train wherein both the friction between the wheels and brake-shoes and the frictional adhesion between the rails and wheels are utilized as factors instrumental in braking the train.

Heretofore, as is well known, when a train is running at full speed and it is attempted to quickly stop the same by the application of brakes with sufficient power to lock the wheels against rotation, such application of the brakes, although preventing revolution of the wheels, will be ineffectual for preventing further progress of the train, for the reason that the impetus or inertia of the latter will serve to propel it forward, causing the wheels to slide or skid along the surface of the track-rails a certain distance until the resulting friction brings said train to a position of rest. Thus it will be seen that if a train is running at the rate of fifty miles per hour and it is desired to check the same opposite a certain station in proper position for the deposit and reception of passengers or freight, or in case of danger ahead, an accident, or an emergency stop, although the brakes are applied at the right time or to effect stoppage, if the track is wet or slippery the skidding action of the train will carry the train beyond the designated point of stoppage, thereby causing great inconvenience, to say nothing of the wear and tear upon the track-rails and the rolling-stock. Therefore my invention has for its object to overcome these difficulties by embodying a method of braking a traveling vehicle or train, whereby the latter may be slowed up and effectually checked in a short space of time and within a very limited distance.

Taking a somewhat different view of the subject, it is well known that in order to entirely check a traveling train it is first necessary to transfer the *vis viva* of the parts thereof into some other form of energy (heat) by means of friction, which transformed energy is wasted in some unneeded form and place, so that it will no longer constitute an obstacle to the effectual braking of the train. Manifestly, therefore, it is necessary to provide some efficient manner of quickly transferring and educing such impedimental *vis viva* before the train can be stopped. Consequently the object of this invention (stated in other words than heretofore expressed) is to provide an adequate method of quickly transferring the *vis viva* of a traveling vehicle or train from its seat in the parts of said vehicle or train to some other place where it will not act as an impediment during the operation of braking.

With this object in view my invention consists, essentially, in retarding or stopping the rotation of one or more wheels of a traveling vehicle or train by the application of braking agency and contemporaneously increasing the friction between the said wheels and the surface upon which they travel, whereby both the braking agency and the frictional adhesion between the said rails and wheels are jointly utilized in the braking process.

My invention as defined by the above statement may assume a variety of forms, some of which are herewith shown and described, and others are obvious; and the means whereby the said invention may be carried out may be changed and modified in a number of ways, as will be seen hereinafter. Therefore I wish it to be understood that I do not confine myself to such special forms shown and described, nor in fact to any particular details of construction, as long as the fundamental principle as set forth in the appended claims is adhered to.

In the accompanying drawings I have shown three separate and independent organizations of apparatus, each capable of carrying out the method comprising the essence of my invention, so that my assertion that the invention may assume many forms may be substantiated by the drawings and description.

Referring to the drawings, Figure 1 is a

plan view, partly in section, partly in diagram, of a railway-car truck equipped with one form of my invention and showing conventionally an exciting source of electricity and the circuits and electrical connections constituting auxiliary parts of this form of my invention. Fig. 2 is a view in side elevation, partly in diagram, of Fig. 1. Figs. 3 and 4 are views in side elevation of a steam-locomotive and its tender, the former being provided with certain apparatus comprising two other forms which my invention may assume.

Like numbers of reference designate like or corresponding parts in the several views of the drawings.

Referring now to Figs. 1 and 2, the car there shown is arranged to be propelled by an electric motor of any approved type, which may derive current from any convenient or available source, the conductors from which latter may be overhead or underground, or the source itself may be a storage system carried upon the vehicle.

1 indicates the car-truck, consisting of the flanged wheels 2 2, the axles 3 3, and the motor-supporting bars 4 4. The motor 7 is centrally supported between the front and rear axles of the car by the side bars 4 4, and has its armature-shaft geared at its end to the center of its respective axle 3. In order that the armature-shaft may be thus mechanically connected to each axle, it will be obvious that the magnetizing-coils 5 6, which are wound, respectively, around the axles 3 3, are centrally divided at the motor-gearing point 10, and each division or coil 5 or 6 is electrically connected with the other by the loop 11. It will be clear that these coils 5 and 6 may be arranged stationary and independent of the respective axles or may be constructed to revolve with said axles, as desired, without departing from the spirit of my invention. In Fig. 1 they are shown mounted rigidly over the driving-axles 3 3, the latter being free to revolve therein. One terminal of each coil 5 or 6 is connected by the conductor 12 with one of the switch-levers 13, and the other respective terminals of the coils 5 and 6 are mutually in electrical connection by the conductor 14. Thus it will be seen that there is a closed metallic circuit in series from one switch-lever 13 to the other through the respective helices 5 and 6. In the event of the magnetizing-coils being constructed to revolve with the axles, as mentioned above, it will be manifest that instead of the conductors 12 12 and 14 suitable stationary spring-brushes or their equivalents must be substituted for maintaining a rotating electrical contact with the terminals of the respective magnetizing-coils. However, I have not deemed it necessary or essential to show these features, as they form merely well-known expedients for accomplishing this purpose. When the magnetizing-coils are placed upon the axles of a vehicle not provided with propelling-motor, such as a car or cars of a train, or when the motor used is not geared to the axle shown, it will be apparent that an uninterrupted coil may be, and preferably is, enveloped the entire length of the axle without being divided into two parts in the manner shown in Fig. 1. The coils 5 and 6 are insulated at each extremity from the side bars 4 4, which in turn are of non-magnetic metal or are magnetically insulated from the axles by brass bearings, and the coils are preferably protected throughout by a concentric shield or wrapping 15, as shown clearly in section in Fig 1. Each one of the four wheels 2 2 of the vehicle is magnetically in contact with its respective axle, whereby forming a closed magnetic circuit through the two axles, their attached wheels, and the intervening track, whether the vehicle is stationary or in motion, such magnetic circle being from axle to wheel, wheel to rail, rail to wheel, wheel to axle, and so on.

16 16 respectively designate magnetizing-coils for the brake-shoes 23 23, wound around the brake-cores 17 17, and each having one terminal connected electrically by conductor 18 with the switch-contacts 19^a 19 or 20^a 20, as the case may be, while the two magnetizing-terminals of both coils 16 16 are electrically in circuit with each other by the conductor 21 or its equivalent. The coils 16 16 are so wound as to be approximately of equal resistance to the magnetizing-coils 5 6 on the axles 3 3, and said coils 16 16 are respectively insulated electrically from the brake-shoes 23 23 and core 17, and, similarly to the coils 5 6, are provided with protecting-shields. (See Fig. 1.) At each extremity of the core 17 is a brake-shoe 23, forming an enlarged pole-piece of said core and rigidly secured thereupon, so as to be magnetically in contact with the core in any suitable manner, as shown. Securing-nuts 22 are preferably placed on the screw-threaded ends of each core, serving to prevent any lateral displacement or loosening of the brake-shoes and to hold the same against the adjacent end of the coil 16.

Referring to Fig. 2, the brake-shoes 23 23 are supported in proper relative position with their respective wheels by the dependent pivoted plates 25, which are respectively secured at their lower extremities to the core 17 and at their upper ends are pivoted to the brackets 21^a by the pivot-pins 24.

25^a indicates a horizontal plate formed integral with the vertical plate 25 and provided with a screw-threaded limiting-pin 27, the upper extremity of which rests normally against the bracket 21^a, but is not fastened thereto.

26 is a depending arm integral with the bracket 21^a and serves to support the adjusting-nut of the retractile spring 27^a, which is at one extremity attached to the adjacent nut and at the other end is fastened to one side of the plate 25. Each bracket-shoe 23 is

made of a large mass of magnetizable metal and may be formed in any approved shape or manner for the sake of economy or durability, and is provided upon its face with a concave arc-shaped recess conforming in contour and dimensions to the convex periphery of its respective driving-wheel 2. Thus each core 17 carries a pair of brake-shoes, which latter are capable of being moved in unison to or from their respective wheels in a manner hereinafter explained.

The two conductors 18 18 terminate, respectively, in two sets of switch-contacts 19ª 19 and 20ª 20, as before stated, each contact 19ª 20ª being connected with its respective conductor 18 by a branch 28, as shown, the relative arrangement and situation of such contacts being such that when one switch-lever 13 is upon a contact 19ª the other will be upon a contact 20ª, and so forth. Both switch-levers are pivotally supported beyond their respective and central points upon fulcrum-pins 29 29, which in turn are severally in electrical connection with the conductors 12 12, leading to the magnetizing-coils 5 and 6.

36 is an insulated pivoted bar or yoke loosely connected at each extremity to a switch-lever 13 13 and provided with an insulated handle, as shown, so that the said levers can be moved in unison and adjusted to any desired position. The source of electricity for the magnetizing-coils 5 6 and 16 16 is not connected directly with the switch-levers 13 13 in the usual manner, but, on the other hand, is in electrical communication with the terminal plates 31 31 by the conductors 33 33, as shown in Fig. 1, and the rear extremities of said levers 13 13 are normally out of contact with the terminal plates 33 33, so that no current passes through the magnetizing-coils of the axles or brakes until the switch is manipulated in a manner hereinafter described. The terminal plates 31 31 are respectively arranged under the rear extremities of the respective switch-levers, and are so shaped as to allow the rear extremities of the latter to be in electrical contact therewith only when they are placed upon either of the two sets of contacts 19ª 20ª and 19 20.

The source of electricity 32, which is in circuit with the terminal plates 31 31, may be either located upon the car or may be situated at a fixed station and the current therefrom collected from line-conductors. This source 32 has been conventionally shown in the drawings as independent of the motor-circuit, so that the operation of the brakes may be entirely separate and distinct from that of the motor.

The operation of the apparatus shown in Figs. 1 and 2 is as follows: Should it be desired to apply the brakes for slowing down or stopping the vehicle when under headway, the operator simply adjusts the switch-levers 13 13 upon the switch-contacts 19 20, as shown in dotted lines in Figs. 1 and 2, which action would bring the rear extremities of such levers respectively in contact with the terminal plates 31 31, throwing the current from the source of electricity 32 simultaneously through the magnetizing-coils 5 6 and 16 16 over the following path. Assuming that the current flows from the plus pole of the point 32, it will continue over 33, 31, and 13 to the point 29. Now, the magnetizing-coils 5 6 being equal in resistance to the magnetizing-coils 16 16, the current will divide at the switch-levers 13 and equal parts will simultaneously pass through both the magnetizing-coils 5 6 and 16, or, in other words, will traverse contemporaneously the brake and traction circuits. Accordingly I will now first trace the path of the current through the brake-circuit. Continuing from the switch-lever 13 it flows over 19 18 16 21 16 18 20 13 31 33 back to the minus pole of the source 32. Thus a closed electric circuit is established through the magnetizing-coils 16 16 of the brake-shoes, thereby producing the magnetism in the cores 17 17 and magnetic polarities in the respective pole-pieces 23 23. Following the circuit thus traced, the first pole induced will be plus and the next minus, then plus and then minus, thereby making each pair of brake-shoes 23 23 of opposite polarity. Next we will trace the traction-circuit. The current dividing at the pivot 29, then passing over the traction-circuit, would traverse 29 12 6 11 5 14 6 11 5 12 29 31 33 back to the minus pole of the source 32. Thus the magnetizing-coils 5 6 would be energized at the same time that the coils 16 16 were charged, and consequently successive poles of opposite polarity would be established in the respective driving-wheels 2 2, and a closed magnetic circuit would be formed by the wheels, intervening rails, and axles; but, as will be ascertained by following the circuits traced, the polarity of any one driving-wheel 2 would be unlike that of its respective brake-shoe. Therefore the law of magnetic attraction would force the pivotally-supported brake-shoe 23 in magnetic adhesion against each wheel 2, and the arch-shaped recess of the former would embrace and adhere to the periphery of the latter and retard the rotation of said wheel, and therefore all of the four brake-shoes are instantaneously attracted and two closed magnetic circuits established through the respective wheels, brake-shoes, rails, and axles. In this event it will be apparent that there will three closed magnetic circuits traveling with the vehicle, and the brake-shoes will retard the rotation of the wheel, while the adhesion of the wheel to the rail, caused by the passage of the magnetic lines of force through the traction-circuit, will have an auxiliary function essential to the braking of the vehicle, since such adhesion of the wheels and rails will within certain wide limits prevent the skidding or sliding of the locked wheels by virtue of the magnetic attraction and increased roughness due to the molecular changes in the iron or steel surfaces. Thus

by this arrangement I am enabled to attain a double braking effect—viz., one due to the frictional contact of the brake-shoes and the other due to the adhesion of the wheels to the supporting-rails. When this increased friction is produced by electro-magnetism, as in the present instance, a still further retarding effect is obtained on account of the molecular change before mentioned, that takes place both between the brake-shoes and wheels and between the wheels and rails, which I find enormously increases the friction and vastly increases the useful braking effect. By employing both these co-operating features a traveling vehicle or train can be slowed up or checked at a moment's notice by the mere adjustment of the hand-switch, the application of the brakes being in a certain sense automatic and the increase of traction between the wheels and rails serving to act as a vehicle for transforming the *vis viva* located in the parts of the moving vehicle. It will be clear from what has been stated that as the frictional adhesion between the wheels and rails is greatly increased when the brakes are applied the skidding action incident to the present methods of braking cannot so readily occur, and the brake-shoes may therefore be applied with much greater force than is now permissible before the wheels will commence to skid, thus enabling a car or train to be stopped within a much shorter distance and within less time than now possible by the most approved form of brake. When necessary to withdraw the brake-shoes and break the circuit, the operator throws the switch into the position shown in full lines in Fig. 2, thereby placing the rear extremities of the switch-levers out of contact with the terminal plates 31 31, which action will cause the de-energization of magnetizing-coils of both circuits, and consequently will cut off the flow of magnetism. Then the retracting agency of the springs 27^a will restore the brake-shoes to their normal position out of contact with the wheels, and the limiting-pin 28 will engage plate 21, preventing said brake-shoes from being withdrawn out of the influence of the mutual attraction or repulsion between brake-shoes and the respective wheels.

From the foregoing description it will be understood that the method of braking a traveling vehicle, consisting in applying the brakes and contemporaneously increasing the adhesion between the wheels and rails, is effected by electro-magnetic means. However, the same method may be carried out in a radically different manner, as will appear hereinafter.

Referring now to Fig. 3, I have shown an arrangement where the ordinary air-brakes may be applied for arresting or retarding the revolution of the driving-wheels of a steam-locomotive, and at the same time the frictional adhesion between the track-rails and said driving-wheels may be increased by the passage of an electric current between said wheels and rails. By reference to my patent, No. 379,815, of March 20, 1888, it will be seen that the invention covered thereby is based upon the fact that a strong adhesive effect between metallic conductors in contact with each other is produced when an electric current is passed through one to the other, and this patent covers, broadly, the utilization of the phenomenon of increased friction produced by the passage of an electric current between the wheels of a traveling vehicle or train and the rails upon which it travels for increasing the traction of the said moving vehicle or train at the will of the operator or engineer.

In order to attain increased traction by the passage of an electric current from one or more wheels to the rails, as stated in my said patent, it is preferable to employ a current of large volume and comparatively low tension. I have shown such method of increasing the frictional adhesion between the wheels and the rails in Fig. 3 in connection with my improved system for braking the vehicle or train. Accordingly there is shown upon the locomotive a dynamo-electric generator 35, adapted to furnish effective traction-current, and preferably driven by a small steam-engine 100, which is independent of the driving-engine of the locomotive and supplied with steam from the steam-dome of the latter. The dynamo can be thus operated at any desired speed, whether the locomotive is running or not, and the circuit 37 38 from this dynamo includes both a rheostat 39, located in the cab of the engineer, and the driving-wheels of the locomotive, as shown. In the drawings the circuit-wires are shown as terminating at the axles of the driving-wheels, and it will be understood that they may make contact with these axles by brushes or in any other suitable manner. The circuit may be traced with reference to unfeathered arrows marked along the conductors. If it is desired to increase the traction of the locomotive, the engineer closes the traction-circuit at the rheostat 39 by means of a switch-lever shown, and thus he can increase or decrease the resistance of the circuit at will and can thereby increase or decrease the amount of current passing through the same. The friction between the wheels and rails can thereby be graduated at will, and the best and most economical effects are produced if this friction is gradually increased in the same manner in which the braking power is gradually increased, so that there will always be a certain definite proportion between the braking power and the friction between the wheels and rails. The current from the dynamo passes through the wires 38 39, and from one driving-wheel or set of driving-wheels through the intervening section of rails. As shown, the air-brake lever 40 is located in the cab of the engineer in proximity to the rheostat-lever 41, in fact, is mounted upon the same fulcrum, so that

both levers 40 41 may be moved in unison or severally, as may be desired. Thus the operator by grasping and moving them in unison can simultaneously close the traction-circuit and put on the air-brakes, or by moving them severally can operate either the traction system or the air-brakes, or both, as may be desired.

Further description of this modification seems unnecessary, as it becomes clearly obvious that the same method can be carried out as described with reference to Figs. 1 and 2 by applying the air-brakes and electric traction-increasing apparatus contemporaneously, thereby locking or retarding the rotation of the driving-wheels of the locomotive and at the same time increasing the frictional adhesion between the driving-wheels and the rails. Of course it will be understood that all the modifications and details of construction whereby this electric traction-increasing system is accomplished, which are shown in the patent before mentioned, may be employed in connection with my invention.

In Fig. 4 I have shown yet another modification of apparatus for carrying out the same method, which consists simply of the ordinary way of increasing traction between the driving-wheels and the rails by the distribution of sand upon the track and the use in conjunction therewith of the ordinary air-brakes controlling the flow of the sand to the track. In this view a system of levers 42 is operated by the air-coupling 43 to adjust the brake-shoes 44 44 against the periphery of the driving-wheels 45 45. One extremity of the lever 42 is connected with a crank-arm 46, which in turn is attached to and controls the rotation of a cock or a valve in the sand-pipe 47, and when the brakes are applied to the driving-wheels 45 in the ordinary manner the consequent movement throws lever 42, and throws the valve in the sand-pipe 47 into such position as to allow the egress of the sand from the sand-box upon the track-rails through the pipe 47.

Thus I have shown three different arrangements, all operating upon the same general principle—viz., braking the vehicle or train by first retarding or locking the rotation of a wheel or wheels by mechanical friction, and, secondly, increasing the frictional adhesion between the wheels and rails by some suitable agency—and I desire it to be distinctly understood that this constitutes the fundamental principle of my invention, and that aside from this definition I am not confined to any particular mode of carrying out the same.

Having described my invention, what I claim, and desire to secure by Letters Patent, is—

1. The method of braking a traveling vehicle or train, which consists in retarding the rotation of the wheels by the application of mechanical friction and by increasing the frictional adhesion between the wheels and the rails by the passage of an electric current from one to the other, substantially as described.

2. The herein-described method of braking a traveling vehicle or train, which consists in braking the wheels in any ordinary or improved manner and increasing the frictional adhesion between the wheel or wheels and the surface or surfaces upon which the same travel by the passage therethrough of an electric current, substantially as described.

3. The herein-described method of braking a traveling vehicle or train, which consists in braking the wheels and in passing a traction-current between the wheels and rails in either sequence, substantially as described.

4. The herein-described method of braking a traveling vehicle or train, which consists in retarding the rotation of the wheel or wheels by the application of a braking power thereto and in increasing the frictional adhesion between the wheels and the rails by the passage of an electric current between the same and proportionate to the braking power employed, substantially as described.

5. The herein-described method of braking a traveling vehicle or train, which consists in electrically increasing the frictional adhesion between the wheels of the vehicle and the rails and in independently applying a suitable braking agency to retard the rotation of the wheels while the tractive adhesion is thus increased, substantially as described.

6. The herein-described method of braking a traveling vehicle or train, which consists in retarding the rotation of the wheels by the application of a suitable braking agency and in electrically increasing the normal tractive adhesion during the application of such braking agency and independently thereof, so as to diminish or prevent the skidding of the wheels, substantially as described.

7. The herein-described method of braking a traveling vehicle or train, which consists in checking the momentum of the vehicle or train by the application of a suitable braking agency or the reversal of the direction of rotation of the driving-wheels thereof and in simultaneously therewith increasing the frictional adhesion between the driving-wheels and rails to an extent proportionate to the braking power employed, substantially as described.

8. The herein-described method of braking a traveling vehicle or train, which consists in applying mechanical pressure to prevent the rotation of the wheels and in braking the vehicle or train by electrically increasing the friction between the said wheels and the rails, substantially as described.

In testimony whereof I affix my signature in presence of two witnesses.

ELIAS E. RIES.

Witnesses:
GEO. R. LEAN,
SUMNER ALBEE.