(No Model.) 5 Sheets—Sheet 1.

S. H. SHORT.

PNEUMATIC CONTROLLING MECHANISM FOR ELECTRIC RAILWAY CARS.

No. 599,807. Patented Mar. 1, 1898.

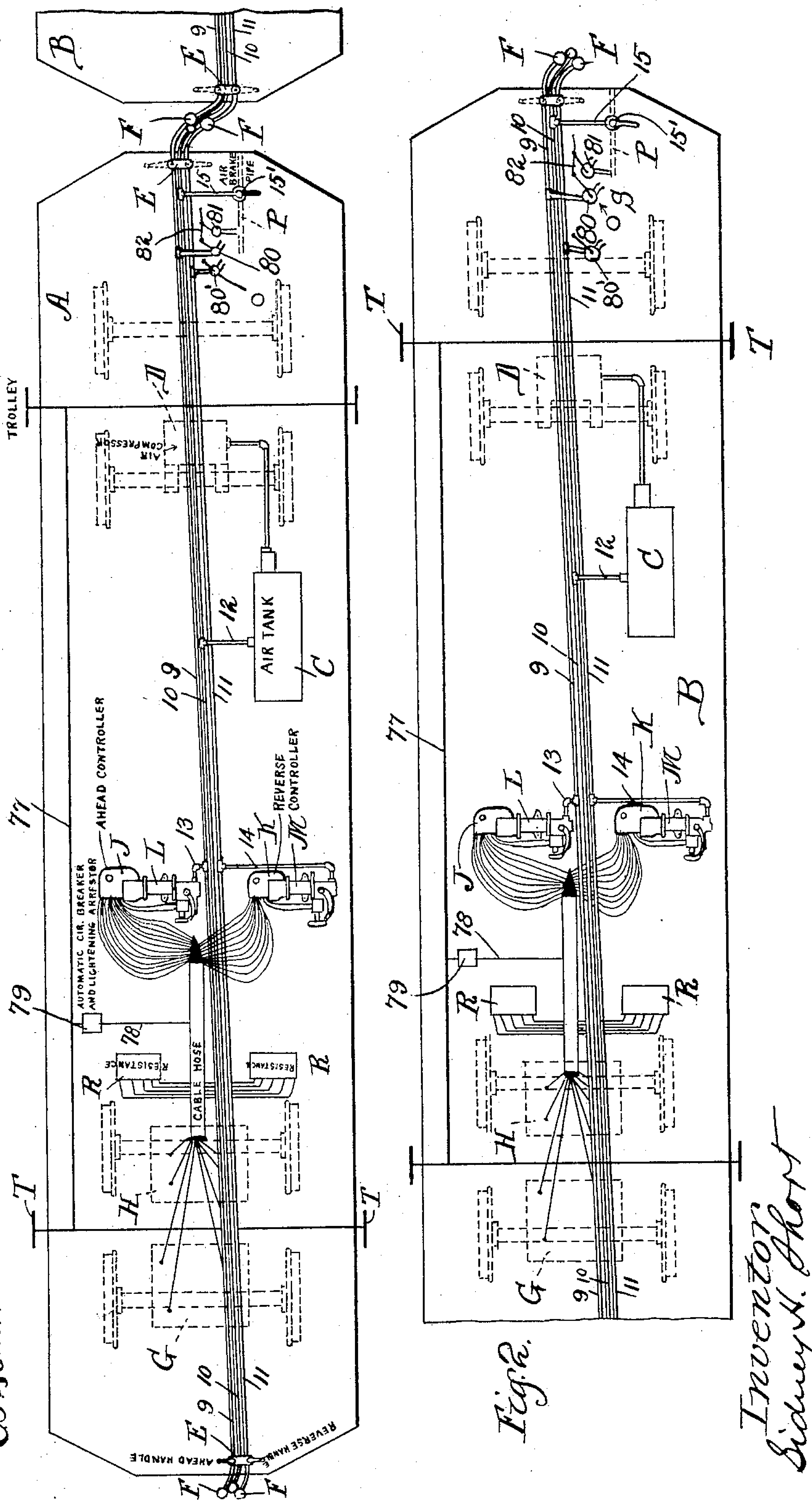

Fig. 1.

Fig. 2.

Witnesses
Wm. M. Rheem
O. S. Plumtree

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Sidney H. Short
by Brown & Darby attys.

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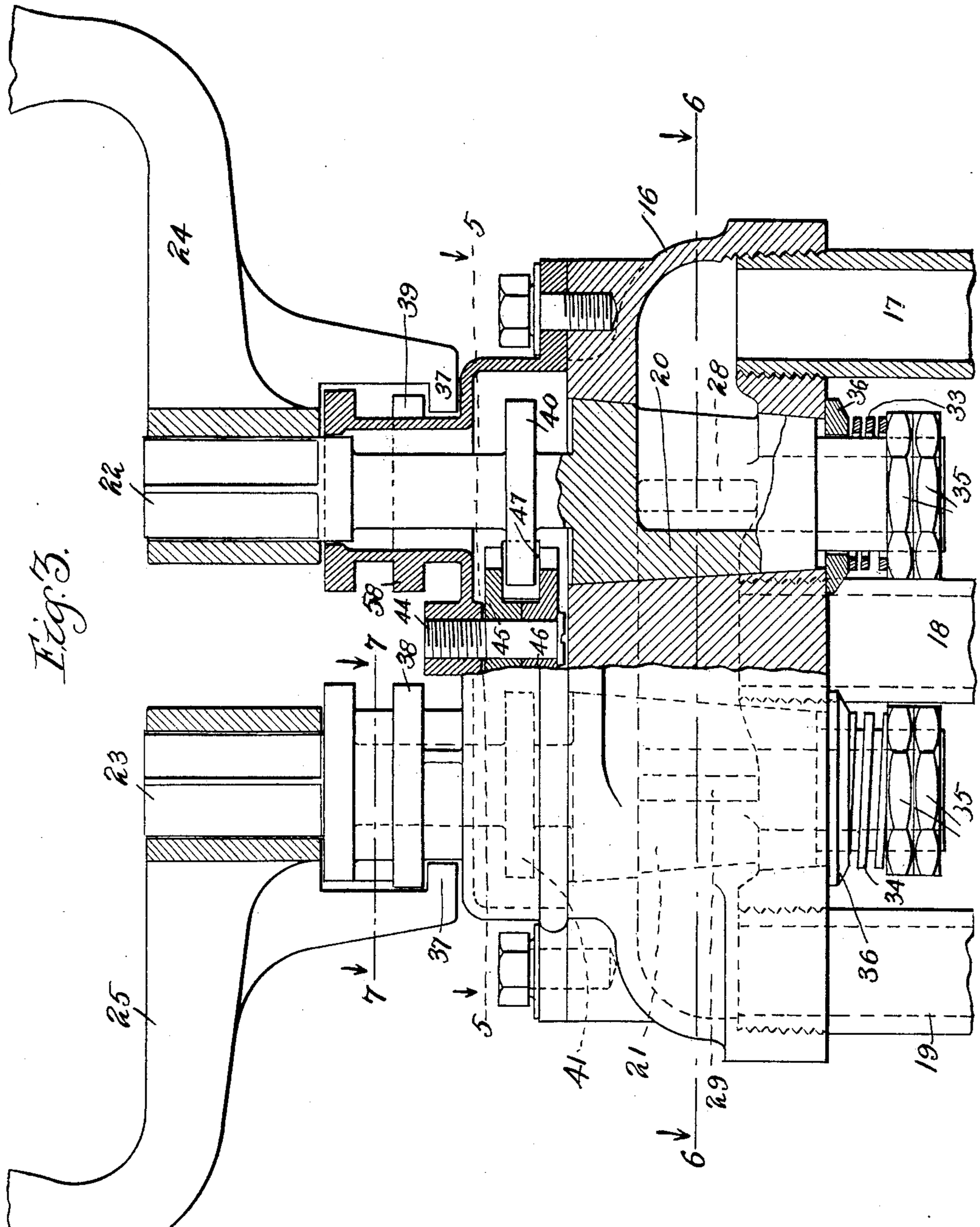
(No Model.) 5 Sheets—Sheet 2.

S. H. SHORT.

PNEUMATIC CONTROLLING MECHANISM FOR ELECTRIC RAILWAY CARS.

No. 599,807. Patented Mar. 1, 1898.

Fig. 3.



Witnesses.
Wm. M. Rheem.
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(No Model.)

5 Sheets—Sheet 3.

S. H. SHORT.

PNEUMATIC CONTROLLING MECHANISM FOR ELECTRIC RAILWAY CARS.

No. 599,807. Patented Mar. 1, 1898.

Fig. 4.

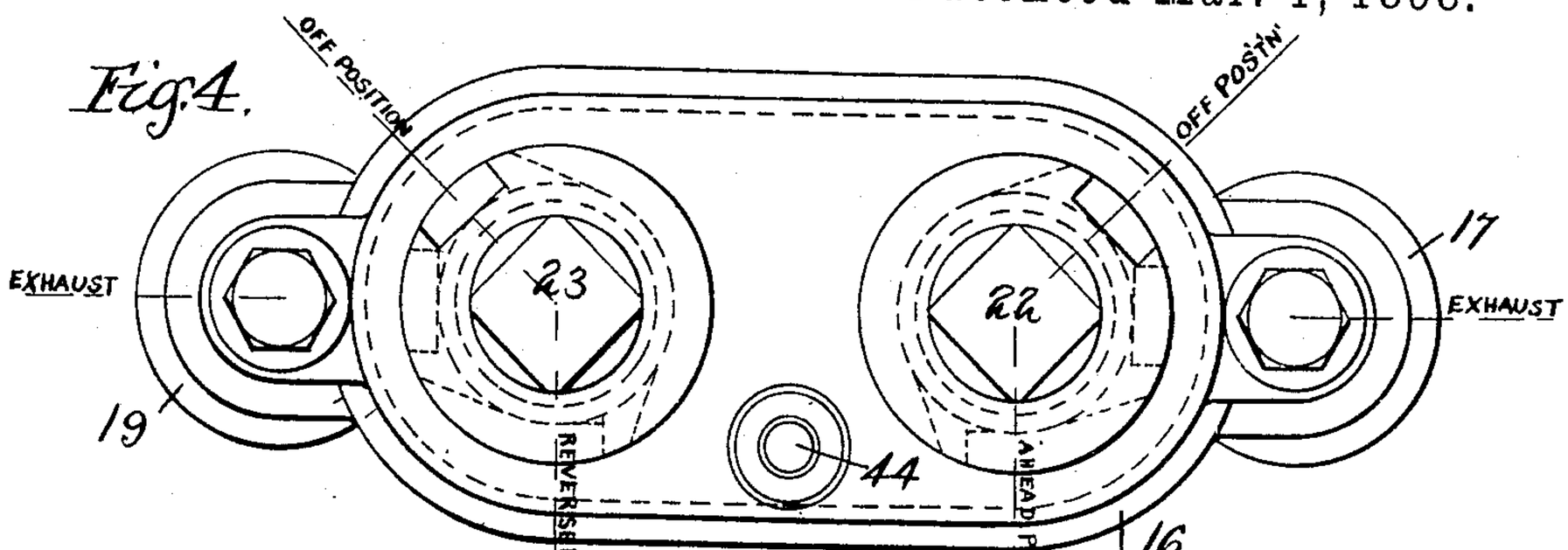


Fig. 5.

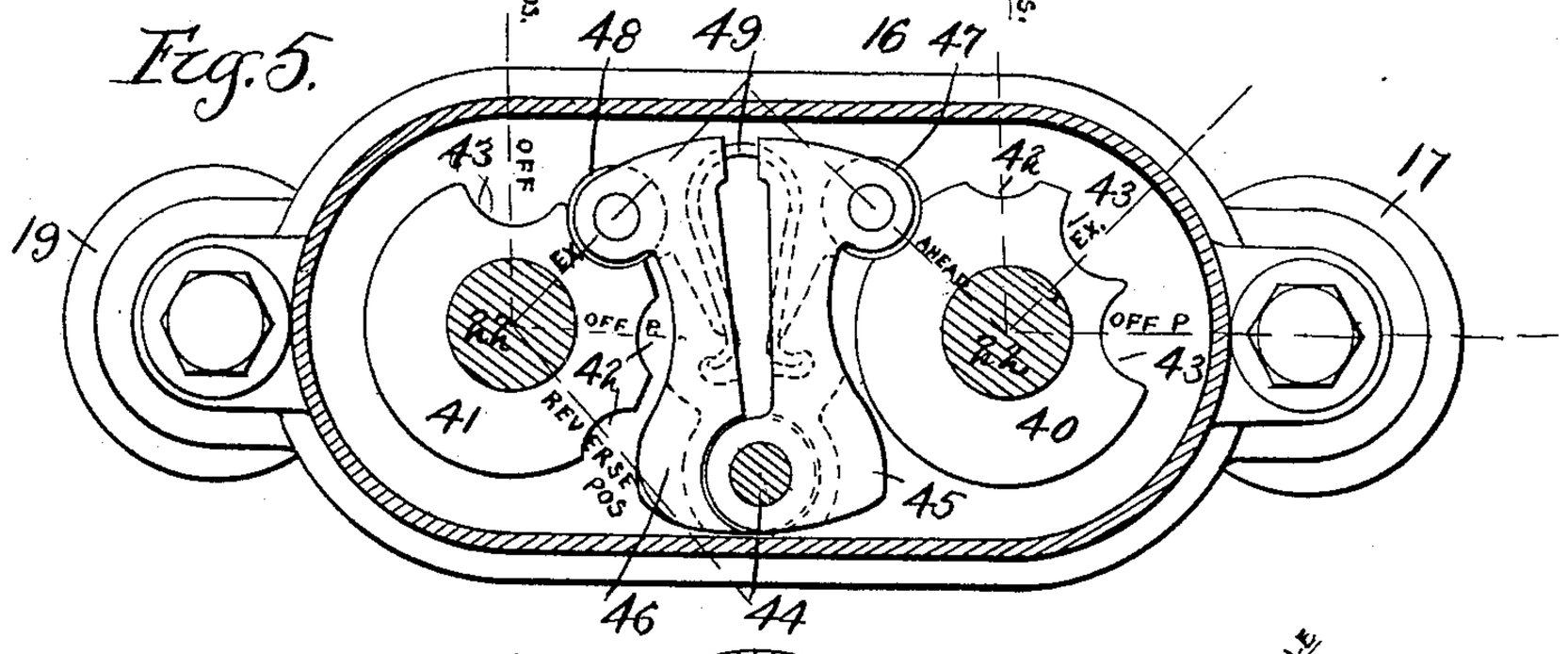


Fig. 6.

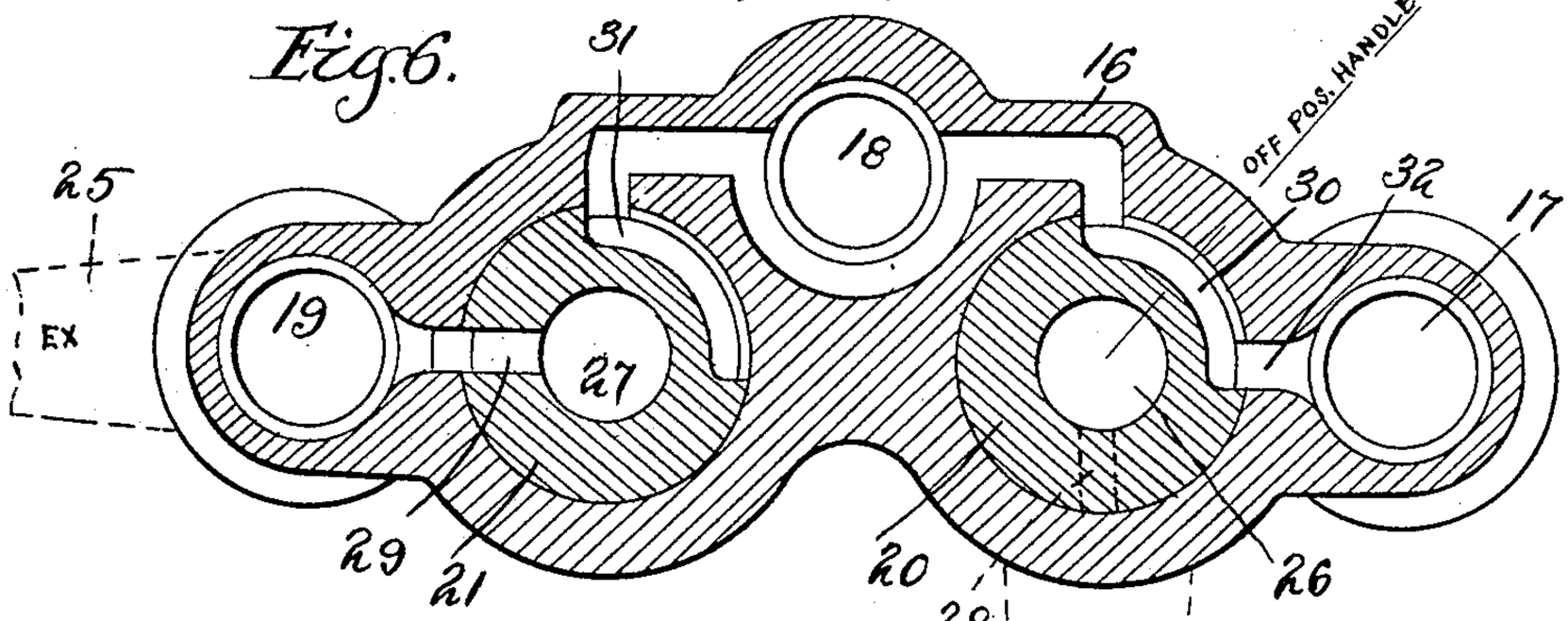
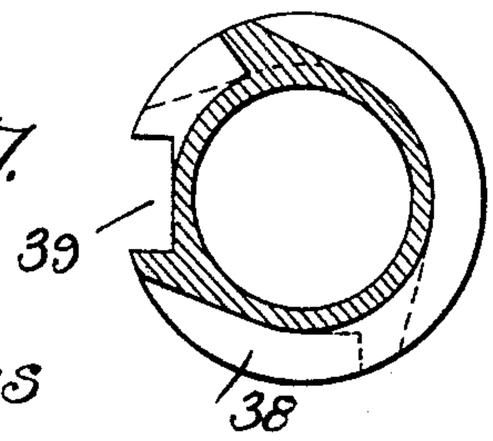


Fig. 7.



AHEAD
24

Witnesses

Wm. N. Rheem.

C. D. Shumtree

Inventor
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By Brown & Darby
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(No Model.)

5 Sheets—Sheet 4.

S. H. SHORT.

PNEUMATIC CONTROLLING MECHANISM FOR ELECTRIC RAILWAY CARS.

No. 599,807. Patented Mar. 1, 1898.

Fig. 9.

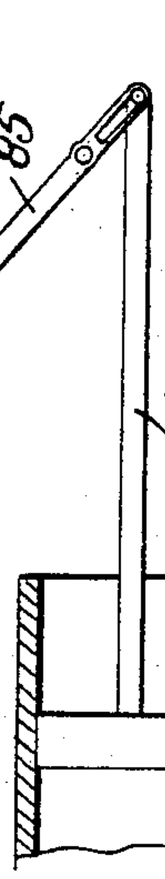


Fig. 8.

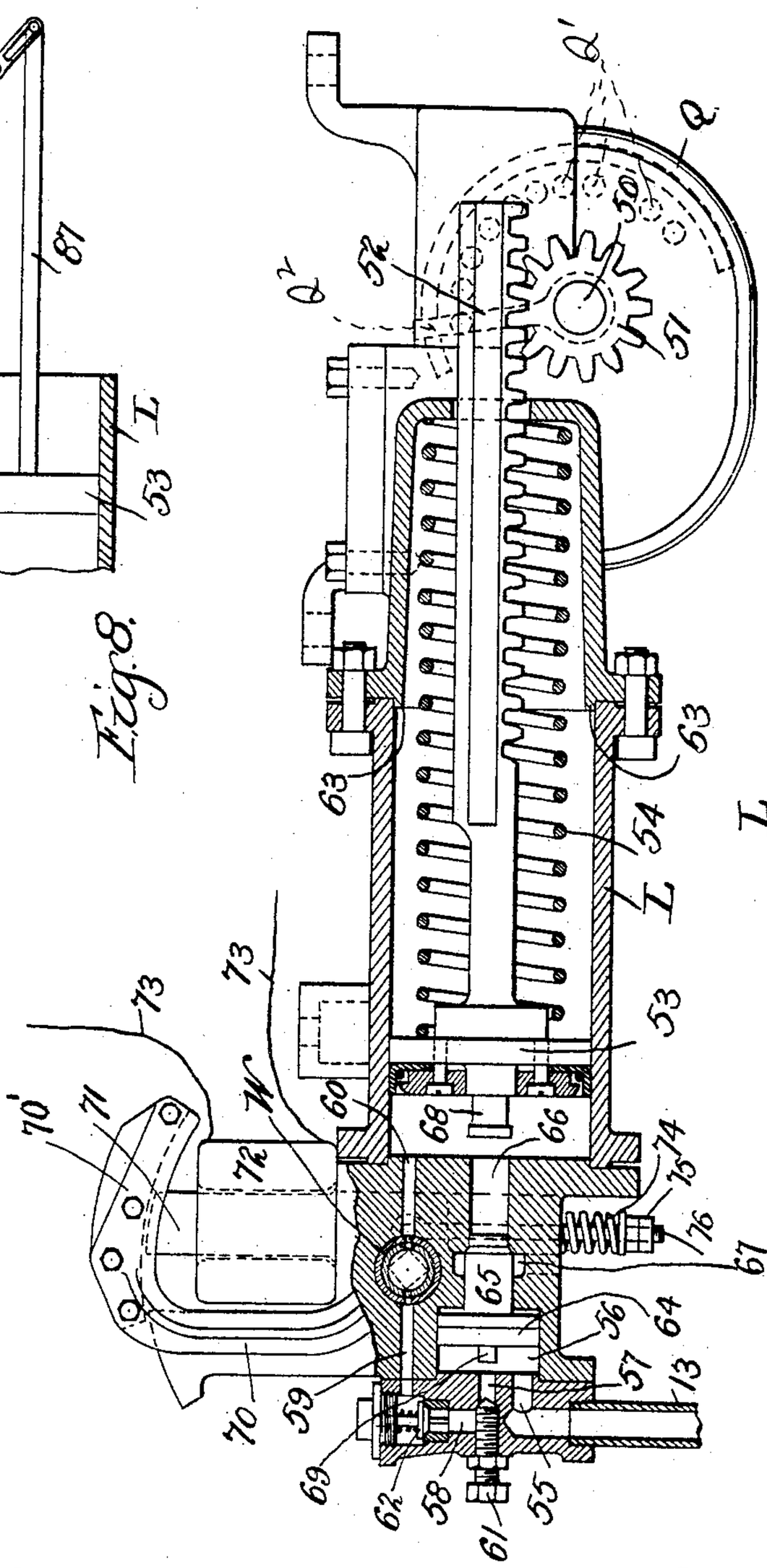
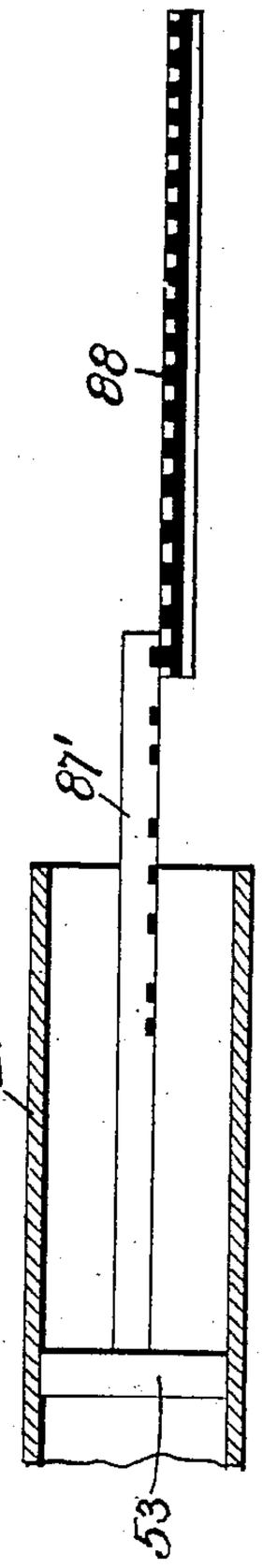


Fig. 10.



Witnesses.

Wm. N. Rheems.

S. Shumphrey

Inventor

Sidney H. Short

by Brown & Darby

Atty's.

(No Model.) 5 Sheets—Sheet 5.

S. H. SHORT.

PNEUMATIC CONTROLLING MECHANISM FOR ELECTRIC RAILWAY CARS.

No. 599,807. Patented Mar. 1, 1898.

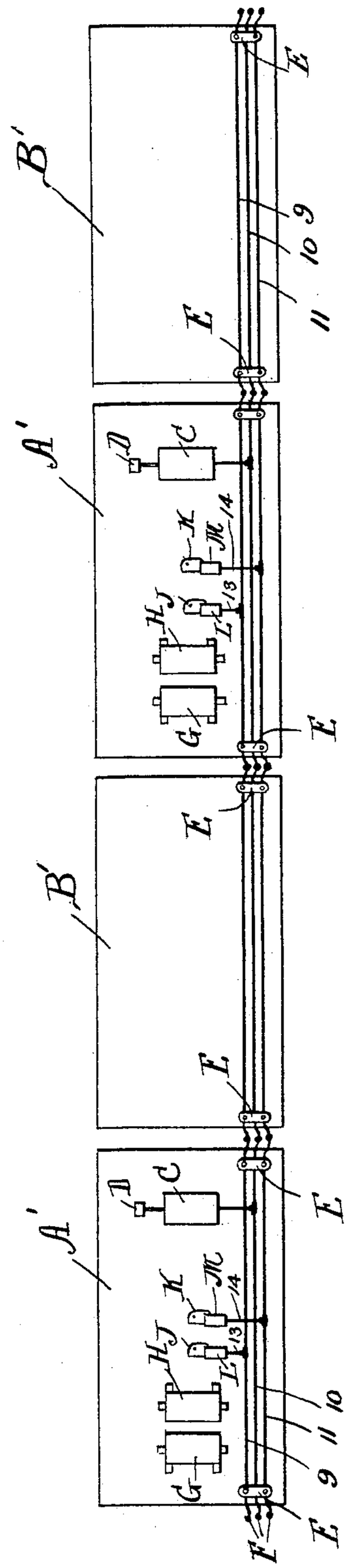


Fig. 1.

Witnesses
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O. F. Lunt

Inventor
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By Burton A. Darby
Atty's

UNITED STATES PATENT OFFICE.

SIDNEY HOWE SHORT, OF CLEVELAND, OHIO.

PNEUMATIC CONTROLLING MECHANISM FOR ELECTRIC-RAILWAY CARS.

SPECIFICATION forming part of Letters Patent No. 599,807, dated March 1, 1898.

Application filed November 13, 1897. Serial No. 658,392. (No model.)

To all whom it may concern:

Be it known that I, SIDNEY HOWE SHORT, a citizen of the United States, residing at Cleveland, in the county of Cuyahoga and State of Ohio, have invented a new and useful Pneumatic Controlling Mechanism for Electric-Railway Cars, of which the following is a specification.

This invention relates to pneumatic controlling mechanism for electric-railway cars.

The object of the invention is to provide a pneumatic system and arrangement for automatically controlling the motors of electric cars.

A further object is to provide a system wherein one or more cars throughout the train is equipped with its own controlling and braking apparatus and may be operated independently when detached from the train or in cooperation with the other cars when connected up in a train therewith.

Further objects of the invention will appear more fully hereinafter.

The invention consists, substantially, in the construction, combination, location, and relative arrangement of parts, all as will be more fully hereinafter set forth, as shown in the accompanying drawings, and finally specifically pointed out in the appended claims.

Referring to the accompanying drawings and to the various views and reference signs appearing thereon, Figure 1 is a diagrammatic plan view illustrating a car equipped in accordance with the invention and illustrating the connection between adjacent cars in a train. Fig. 2 is a similar view of the adjacent car of the train, showing the part of such car broken off from Fig. 1. Fig. 3 is a broken view, partly in vertical section and partly in side elevation, of the "engineer's" or controlling valve. Fig. 4 is a top end view of the same with the operating-handles removed. Fig. 5 is a transverse sectional view of the same on the line 5 5, Fig. 3, looking in the direction of the arrows. Fig. 6 is a transverse sectional view of the same on the line 6 6, Fig. 3, looking in the direction of the arrows. Fig. 7 is a detail view, in transverse section, on the line 7 7, Fig. 3, looking in the direction of the arrows, with the operating-handle removed. Fig. 8 is a view in central longitudinal section of the air-cylinder for actuating the motor-controller. Figs. 9 and 10 are detail views illustrating various types of motor-controllers to the operation of which the invention is adapted. Fig. 11 is a diagrammatic view in plan, illustrating the application of the principles of the invention to a train of cars composed of interspersed "motor" and "trailer" cars.

The same part is designated by the same reference sign wherever it occurs throughout the several views.

In the drawings reference signs A B designate, respectively, the adjacent cars in a train. As it is designed, in accordance with the principles of the invention, to supply one or more of the cars with their own equipment of motors, brake-rigging, motor-controllers, and the like, and their own pneumatic controlling system, whereby such cars, when detached from the train, may proceed upon their way independently without interfering with the operation of the train or the other cars in the train, and whereby, when coupled up with other cars in the train, the control of the equipment of all the cars throughout the train may be effected from any desired point on any one of the cars of the train, it is deemed sufficient to specifically describe the construction, arrangement, and relative operation of parts of the equipment of only one car and explain the connections between the cars, whereby the desired control of all the cars in the train may be effected from any desired point.

Upon the car is mounted an air tank or reservoir C, (marked "air-tank" in Fig. 1,) into which air may be compressed in any well-known, suitable, or desirable manner, as by means of an air-compressor (indicated at D) and which may be actuated, preferably, by an independent electric motor, or, if desired, from the car or truck axle, or in any other suitable or convenient manner. The construction and arrangement of air-tank and compressor may be identical with similar apparatus commonly employed in connection with the ordinary air-brake mechanism on railway-cars, and as such construction in the specific details thereof is well known and understood and forms no part of the present invention specific description and illustration thereof are unnecessary herein.

Mounted on the car and arranged to extend

longitudinally thereof are three pipes 9, 10, and 11, each communicating at each end of the car in what I shall term an "engineer's valve" E, presently to be more particularly described in detail. Said pipes are provided at the extremities thereof with connections or pipe-couplings F, which may be of the usual and well-known type of Westinghouse air-brake hose-couplings, whereby said pipes may be coupled up at each end thereof to the corresponding pipes on the adjacent cars in the train, and as the construction and arrangement of such couplings are well known and understood by persons skilled in the art, specific description and illustration thereof in the present case are unnecessary. A suitable pipe connection 12 opens communication between air-tank C and one of the car-pipes—say pipe 10. Mounted on the car are one or more propelling-motors G H and also a controller for controlling the motor-circuits and resistances R. In the particular form shown, to which, however, I do not desire to be limited or restricted, I employ two controllers J K on the car, one of which is marked "Ahead-controller," and controls the circuits of the motors for moving the car or train in one direction, and the other marked "Reverse-controller," and controls the circuits of the motor for operating in the reverse direction. In connection with each controller is an air-cylinder L M, presently to be described more specifically, the function of which is to effect a proper actuation of the controller. Air-cylinder L is in communication through pipe connection 13 with car or train pipe 9, while air-cylinder M is in communication through pipe 14 with train or car pipe 11.

Before proceeding to a specific description of the engineer's valve and the air-cylinder I will first explain generally the operation of the system embodying the invention.

Air-pressure is supplied to the air-tank and from thence to car-pipe 10. By suitably manipulating the engineer's valve the air-pressure is admitted to either one or the other of train-pipes 9 11. These pipes 9 11, as above explained, are coupled to corresponding pipes on each car throughout the train, and hence by the manipulation of the engineer's valve pressure is supplied to one or the other of these pipes throughout the train, and hence to one or the other of the air-cylinders on each motor-car throughout the train, thereby effecting an actuation, as will presently be more fully explained in detail, of all the corresponding motor-controllers throughout the train, and by arranging a controller or engineer's valve at each end of each car, each valve being connected to the train-pipes 9, 10, and 11 on the same car therewith, it will be seen that all the motors throughout the train are controlled from any desired point on any one of the cars of the train. It will also be seen that any motor-car may be detached from the train, whereupon such car may proceed independently of the train. Of course the pipes 9, 10, and 11 on a detached car must be closed at the ends thereof, and also the ends of these pipes on the end cars of the train must be closed in order to prevent the escape of air-pressure admitted thereto from pipe 10. This may be effected in the usual manner by angle-cocks or in any other convenient way. If desired, the train-pipe of the braking system, and which is indicated at P, Figs. 1 and 2, and which may be of the usual arrangement employed in the Westinghouse air-brake system, may be supplied with air-pressure from the air-cylinder C, which furnishes the pressure for effecting the actuation of the controllers. This may be effected by coupling the brake-pipe P with car-pipe 10, as through connection 15. An engineer's brake-valve 15′ controls this connection. Thus it will be seen that the manipulation of any of the engineer's valves E throughout the train controls the air-pressure, which effects the actuation of all the motor-controllers, and the manipulation of one of the engineer's brake-valves 15′ will from the same source of air-pressure control the air-pressure for the braking system throughout the train.

With this general and preliminary explanation of the arrangement, function, and operation of the apparatus I will now proceed to a detailed description of the main controlling or engineer's valve, particular reference being had to Figs. 3, 4, 5, 6, and 7. This valve comprises a casing 16, communicating through pipe connections 17, 18, and 19 with the train or car pipes 9, 10, and 11, connection 18 leading to pipe 10 and connections 17 and 19 leading, respectively, to pipes 9 and 11. In casing 16 are formed one or more valve-seats adapted to receive valves therein. In the particular form shown, to which, however, I do not desire to be limited or restricted, I employ rotary valves 20 21, two of such valves being shown, though it is evident that one or more than two valves may, if desired, be employed. Each valve is provided with a stem having a squared or other suitably-shaped head 22 23, adapted to receive the hubs of the operating-handles 24 25. Each valve is provided with a central chamber or passage 26 27, (see Fig. 6,) opening to the outer air, and hence forming an exhaust-passage. A radial opening 28 29 is formed through the wall of the valves, and an elongated peripheral passage 30 31 is formed in the exterior surface of the valves, all as most clearly shown in Fig. 6. The passages 30 31 are of suitable extent and arrangement to open communication, respectively, between connection 18 and 17 or 19, as the case may be, whereas the radial openings or ports 28 29 are arranged to open pipes 17 or 19 to exhaust through the passages 26 or 27 when the levers 24 25 are turned to suitable position.

From this description it will be seen that when arm 24, designated "Ahead" in Fig. 6, occupies the position as indicated by dotted lines in said view of the drawings or the po-

sition indicated by the line marked "Ahead pos.," Fig. 4, communication is established between pipe connections 18 and 17, and hence also between pipes 10 and 9, thereby admitting air-pressure from reservoir C to the air-cylinders L throughout the car or train, and when said lever is moved to the "exhaust" position, as indicated in Fig. 4, communication between connections 17 and 18 is cut off and port-opening 28 is brought into register with passage 32, thereby opening said connection 17 and hence also pipe 9 to exhaust through passage 26 in valve 20, and when the lever 24 stands in the "off" position, as indicated in Fig. 4, all communication from the pipes is cut off. In the same manner the lever 25 may be suitably manipulated so as to open communication between connections 18 and 19, thereby admitting air-pressure to pipe 11, or said pipe may be opened to exhaust, or all the pipe connections may be entirely cut off. In the relative positions of the levers 24 25, as indicated in Fig. 6, the connection 17, and hence also train-pipe 9, is open to air-pressure, while connection 19, and hence also train-pipe 11, is open to exhaust.

The valves 20 21 may be efficiently held to their seats in any suitable or convenient manner, as by means of springs 33 34, interposed between adjusting set-nuts 35 and loose washers 36, said nuts being mounted on the projecting ends of the valves and the washers bearing against the under side of the valve-casing. By adjusting the set-nuts 35 the tension of springs 33 34 is adjusted and regulated, thereby adjusting and regulating the degree of pressure by which the valves are held to their seats.

It is important that when the motorman or engineer leaves his station the operating-levers 24 25 be removed from the valve-stems in order to prevent unauthorized or malicious tampering with the controlling system. To this end the handles are made removable from the valve-stem heads 22 23; but in executing this safety precaution it is important that the valves be left in such position that all train or car pipe connections are cut off, so that no air can escape from them. In order to accomplish this desirable result, the handles are provided with hooks 37, arranged to extend underneath a flange 38, formed on the valve cap or cover. A slot or opening 39 is formed through this flange, and through which slot the hook 37 must pass in removing the handle. The slot or opening 39 is so relatively positioned that when the handle is turned to such a position that hook 37 registers with such slot or opening, thereby permitting the handle to be removed, the valve occupies a position such as to entirely close the connections controlled thereby.

In the proper operation of the apparatus it is important that at no time should air-pressure from the air-tank be admitted simultaneously to both train-pipes 9 and 11, for such action would result in both the "ahead" and "reversing" air-cylinders on each car being simultaneously charged with pressure, thereby actuating both controllers of each motor, but in opposite directions, thus resulting in short-circuiting the current. In order to avoid this objection, it is necessary to provide means whereby one of the valves cannot be operated until and unless the other valve occupies a position such as to open the train-pipe controlled thereby to exhaust. Many specifically different arrangements for accomplishing this purpose may be employed and still fall within the spirit and scope of my invention. While, therefore, I have shown and will now describe a specific construction and arrangement for accomplishing the desired object, I do not desire to be limited or restricted thereto. In the particular form shown I mount on each valve-stem a disk 40 41, having semicircular seats or depressions 42 43 formed in the periphery thereof. Suitably mounted in the cap-plate or cover of the valve and at a point intermediate of the stems or valves 20 21 is a pintle or stud 44, upon which is pivotally mounted at one end thereof the levers 45 46, (see particularly Figs. 3 and 5,) carrying at their outer ends antifriction-rollers 47 48, arranged to engage the peripheries of disks 40 41, and when said disks occupy suitable positions to be received in the recesses or seats 42 43 therein. These plates are arranged in such relative position that the meeting edges thereof abut against each other when said levers are rocked toward each other. Any suitable means may be provided for normally and yieldingly spreading said levers apart or away from each other. In the form shown a spring 49 accomplishes this purpose. From this construction and arrangement it will be seen that when the roller carried in the outer end of one of the levers 45 46 is seated in a depression or seat 42 43 in a disk 40 41 the other lever may be rocked, so as to permit its roller to ride out of the seats or depressions 42 43 in the other disk, thereby permitting said roller to ride over and clear the projections between said depressions or seats, and hence enabling the valve to be rotated. On the other hand it will be seen that unless the roller carried in the outer end of one of the arms is seated in a depression or seat 42 43 the other valve cannot be operated, because the meeting edges or faces of the levers 45 46 would abut against each other before the rollers are in a position to clear the projections between the seats. The seats or depressions in the disks or ratchet-wheels 40 41 are so relatively arranged that only when one valve is in exhaust position can the other valve be turned, and therefore the valves are interlocked and prevented from being properly actuated relative to each other until one of the valves, at least, is in a position to open the car or train pipe connected therewith to exhaust, but when such point is reached the other valve may then be actuated. Therefore by this con-

struction the danger is avoided of actuating both controllers on any of the motor-cars at the same time.

I will now describe the construction and arrangement of the air-cylinder and devices for actuating the controllers, particular reference being had to Fig. 8, wherein reference-sign Q designates a controller-box in which is arranged a series of contact-segments (indicated at Q', Fig. 8,) through which the motor-circuits, resistances, and connections are controlled to secure the necessary variations in speed and power. A contact-arm Q^2, arranged to move over the contact-segments Q', serves to effect the desired circuit variations through the segment-contacts Q'. Switch-arm Q^2 may be mounted on a shaft 50, upon which is mounted a pinion 51, which is arranged to be engaged and actuated by a rack 52, attached to and moving with a piston or plunger 53, operating within the air-cylinder L. A spring 54, arranged in said cylinder and bearing at one end upon the plunger or piston 53 and at the other end against the end wall or head of the cylinder L, serves to oppose the movement of the plunger or piston and its connected rack under the influence of the air-pressure admitted to such cylinder, as will presently be more fully explained, and normally acts to maintain said plunger or piston and rack at one limit of their movement when said air-cylinder is exhausted of air-pressure, this normal position of the plunger and rack corresponding to the "off" position of the controller-arm Q^2, thereby breaking all the motor-circuits, and hence all current is cut off from the motor or motors controlled thereby. The pipe connection 13, above referred to, which is connected to train or car pipe 9, serves to admit air-pressure to air-cylinder L, when such pressure is admitted to pipe 9 from air-tank C, by suitably manipulating the controlling or engineer's valve 20. The air enters the air-cylinder L from pipe connection 13 through the following path: from pipe 13, through passage 55 into chamber 56, through passage 57, passage 58, passage 59, and into the air-cylinder L, behind the piston or plunger 53, at the point 60. Passage 57 is controlled by a plug or needle valve 61, normally held slightly raised from its seat, but which may be adjusted, as may be desired, to regulate the degree of rapidity with which the air-pressure is admitted therethrough. Passage 58 is controlled by an outwardly-seating check-valve 62, which operates to prevent air-pressure from escaping therethrough from the air-cylinder L, and passage 59 is controlled by an automatically-actuated valve W, the purpose and function of which will be presently more fully explained. Thus air-pressure is admitted to air-cylinder L behind the piston or plunger 53, thereby slowly moving said piston and its rack in a direction to rotate pinion 51 and to rock arm Q^2 and in a direction to compress spring 54. As above stated, the speed with which this rocking movement of arm Q^2 is effected can be readily adjusted by adjusting the distance through which needle-valve 61 is raised from its seat, thus permitting the air to enter the cylinder L through a shorter or a longer period of time. This movement of piston 53 and its rack 52, and hence also of the switch-arm, continues slowly and steadily until finally the piston comes in contact with the shoulder 63, in the end of the air-cylinder L, whereupon the further movement of said piston is arrested. In this position the controller-arm will be rocked to "on" position and the motors will be running at full speed. As soon as the air-pressure is relieved from pipe connection 13 and pipe 9 by the opening of the engineer's valve to exhaust said pipe 9 the air-pressure in air-cylinder L is also opened to exhaust in the following manner: A reduction of pressure in the space 56 causes a small piston 64, arranged therein and having a stem 65 arranged to project into an opening 66, which communicates with the air-cylinder L, to be unseated or rather to move under the influence of the pressure exerted upon the end of stem 65 by pressure contained in air-cylinder L in a direction to withdraw said stem 65 from passage or opening 66, thereby uncovering an exhaust-opening 67 for air-cylinder L, hence permitting said air-cylinder to exhanst rapidly. Of course it will be seen that no exhaust from cylinder L can occur through passages 60, 59, 58, and 57 by reason of the check-valve 62. The piston or plunger 53 is provided with a plug 68, arranged to enter the opening or passage 66 when said piston or plunger approaches the limit of its movement during exhaust, thereby cutting off further exhaust of air behind said piston or plunger, and hence cushions said piston or plunger in the cylinder L by compressing a small portion of air thus retained in the air-cylinder. Similarly a small plug 69, carried by piston 64, is arranged to enter passage 57, thereby also slightly cushioning said piston 64 by compressing the air retained in passage 57 and passage 58. Thus plug 69 also serves the purpose of closing passage 57 against the admission of air-pressure therethrough from the train-pipe connection 13 until said piston 64 is moved in a position to cut off the exhaust-port 67 of air-cylinder L, thereby cutting off the exhaust of said air-cylinder before a new supply of air-pressure is admitted thereto.

By the provision of auxiliary piston 64, arranged and operating in the manner above described, it will be readily seen that when it is desired to move the controllers to "off" position the air-pressure in train-pipe 9 is reduced by suitably manipulating one of the engineer's valves so as to open said pipe to exhaust. This causes a reduction of pressure in the chamber 56 of each air-cylinder L throughout the train, and hence each auxiliary valve 64 is moved in a direction to unclose the exhaust-passage 67. Thus all the

air-cylinders throughout the train are instantly and independently opened to exhaust, and hence the main pistons 53 quickly move in a direction to cause the controllers to move to "off" position. A much more rapid "off" movement of the controllers is thus effected than would be the case if all the air-cylinders had to exhaust through train-pipe 9, and a simultaneous or synchronous "off" movement of all the controllers throughout the train is also secured.

From the foregoing description it will be seen that a very slow "on" movement of the controllers is accomplished, while the "off" movement is almost instantaneous and is simultaneous throughout the train by the sudden and simultaneous release of air-pressure through passage 66 and exhaust-port 67 of all the air-cylinders throughout the train. The admission of air into air-cylinder L is easily and readily adjusted by raising or lowering the needle-valve 61 toward or from its seat, thereby regulating the speed of the "on" movement of the controller-cylinder.

In the proper operation of the system it is desirable and important that all the motors on each car throughout the train operate as nearly synchronously as possible in order that each motor may do its proportionate share of work in accelerating the train. In my application, Serial No. 637,212, filed May 19, 1897, I have disclosed an arrangement whereby a uniform acceleration is attained. The same principle is involved in the present invention, wherein not only do I secure uniformity of the acceleration but also uniformity in the proportional work done by the motors throughout the train, whereby one or more motors may not take the load more rapidly than the others. In other words, should the motor-controller on any particular car cause the current to be turned on more rapidly to the particular motors controlled thereby than the current is being supplied to any other motor or set of motors throughout the train it is important to arrest the operation of the controller-actuating means until the other motors attain the same current-supply, thereby again equally dividing the current supplied to all the motors and hence also enabling all the motors to perform their work proportionately. Many specifically different arrangements may be employed for accomplishing this purpose. While, therefore, I have shown and will now describe an arrangement for effecting this purpose, I do not desire to be limited or restricted thereto. In the particular form shown I provide in passage 59 60 an automatically-actuated valve W, and I arrange this valve to be actuated automatically by the current supplied to each motor. This may be accomplished by mounting said valve W on a lever 70, pivotally mounted and having attached to one end thereof an armature 70', arranged to move over the magnetic core 71 of an electromagnet. As shown, this magnetic core is U-shaped and the coil 72 is mounted upon one leg thereof. This coil is included in the circuit 73 of the motor, controlled by said air-cylinder L. The normal position of this valve is to open passage 59 to its fullest extent, and spring 74, interposed between adjusting-nuts 75 on a rod 76, which is attached to said lever 70 and a convenient part of the casing of air-cylinder L, serving to hold said valve in its normal position. If more than the proper proportion of current is passing through the motor-circuit 73, the increased energization of the electromagnet causes armature 70' to move, thus moving lever 70 against spring 74 and in a direction to cause said valve W to close more or less the passage 59, thereby more or less cutting off the supply of air-pressure to the cylinder L, and hence arresting the supply of more current to the motor until such current has dropped below the maximum quantity required by reason of the development of counter electromotive force, thus weakening the effect of magnet 72, thereby permitting spring 74 to move said valve W in the opposite direction to again open said passage 59, thus again admitting air to the air-cylinder, whereupon the piston 53 and its rack 52 will resume their operation of effecting an actuation of the controller-cylinder toward the "on" position. The wire 73 should be placed in circuit with only one motor where two or more motors are mounted on each car, and especially where a series parallel control is employed, and the valve-controlling magnet 72 should be adjusted to shut off or close passage 59 at a point where the safe maximum accelerating current for one motor is reached, thereby producing practically uniform acceleration for the entire train, regardless of the motor combinations.

I have specifically described the construction and arrangement for actuating pneumatically only one of the controllers on a motor-car; but it is to be understood that the other or reversing controller is actuated in the same manner and by a similar arrangement of apparatus from air-pressure supplied through train-pipe 11.

In Figs. 1, 2, and 8 I have shown the invention as applied to the operation of a controller employing a rocking switch-arm. In Fig. 9 I have indicated a type of controller wherein the motor-circuits are governed by a movable switch-arm 85, arranged to move over relatively stationary contacts 86, the rod 87 of piston 53 being connected to and actuating said switch-arm. In Fig. 10 I have shown the movable contacts of the motor-controller carried by the piston-rod 87' of the air-cylinder, the coöperating contacts 88 being arranged in position for said piston-rod to slide thereover.

I have shown in diagram in Figs. 1 and 2 the trolley or contact-making devices for completing circuit from the supply-conductor to the car and the translating devices carried thereby. The trolleys or collectors T may be

of the usual and ordinary construction and arrangement, electrically connected through connection 77, current being supplied therefrom to the motors through connection 78, containing the usual automatic circuit-breaking lightning-arresting devices, (indicated at 79.)

I have not deemed it necessary to specifically show and describe the various leads of the motor-circuits in the specific detail thereof with reference to the arrangement of the movable and relatively stationary contacts of the controller, as such arrangements are well known and understood by persons skilled in the art.

As a safety appliance whereby in case of accident or for other purpose it may be desired to suddenly and quickly arrest the car or train, I have shown an emergency arrangement at S, Figs. 1 and 2, comprising valves 80 81, valve 80 being arranged to open car-pipe 9 to the atmosphere and valve 81 being arranged to open air-brake train-pipe P to the atmosphere. These valves are suitably connected to a cord or rope 82, arranged to extend throughout the length of the car or train after the fashion of a bell-rope, whereby should an emergency arise said valves may be simultaneously opened, thereby immediately exhausting air-pressure from the controlling system and also from the braking system and hence immediately shutting off all the motors on the train and simultaneously applying the brakes. This idea may also be embodied in an arrangement wherein is insured an exhaust of the particular controller train-pipe which may be in service, as by coupling a valve 80′ to the other controller train-pipe 11. It will be remembered that while one controller train-pipe is in service the other is opened to exhaust. Therefore in the arrangement just described an opening to exhaust of the particular pipe in service, whichever it may be, is insured.

Preferably, and as shown, the pipe 10 is also arranged to extend throughout the entire train, and to this end this pipe is also adapted to be detachably coupled at the ends thereof to the ends of the corresponding sections of said pipe on the adjacent cars. This is advantageous for the reason that all the air-reservoirs throughout the train are thus coupled up and pressure for service application is drawn from all the reservoirs of the train and not from any one particular reservoir, and hence the size and capacity of the individual compressors and reservoirs may be reduced to a point such as will be sufficient to operate only one motor-car and at most a single additional trailer. From this it will be seen that each reservoir throughout the train supplies its proper proportion of pressure for the work of operating the controllers.

In Fig. 11 I have shown the invention applied to a train made up indiscriminately of what are known as "motor-cars" and "trailers"—that is, cars not equipped with motors may be interspersed throughout the train with cars equipped with motors. For instance, the cars A′ are shown as motor-cars, and cars B′ are shown as trailers. In the practical handling of trains, however, it is desirable to avoid the necessity of a particular arrangement of the cars in a train, as such necessity would require frequent shifting and manipulation of the individual cars in making up a train. In a system of control in accordance with my invention, and as above described, such objection is avoided, because the pipes 9, 10, and 11 extend throughout the train and each car thereof, and an engineer's valve E is placed at each end of each car whether it is a motor-car or a trailer, and hence so long as there is a motor-car in the train the proper control thereof may be effected from any desired point, and it is wholly immaterial whether the motor-car is in advance or behind the trailer so far as the operation of the system is concerned.

From the foregoing description it will be seen that I provide an exceedingly simple and efficient controlling system and at but a small additional cost above the cost of the air-brake equipments which are usually employed. It will also be seen that by exhausting the air simultaneously from both controller-cylinder train-pipes and the air-brake train-pipe the entire train may be instantly stopped in case of accident. It will also be seen that unless the whole controlling apparatus, as well as the air-brake apparatus, is in perfect working condition the train cannot be operated, and unless the air-brake is in working order air cannot be procured with which to turn on the current. It will also be seen that all the controllers throughout the train may be simultaneously actuated pneumatically from any car of the train.

Many variations in the details of construction and arrangement would readily suggest themselves to persons skilled in the art and still fall within the spirit and scope of my invention. I do not desire, therefore, to be limited or restricted to the exact details of construction and arrangement shown and described; but,

Having now set forth the object and nature of my invention and a form and arrangement of apparatus embodying the same, what I claim as new and useful and of my own invention, and desire to secure by Letters Patent of the United States, is—

1. In a system of controlling motors in a train of cars, a controller for each car, fluid-pressure mechanism for simultaneously actuating said controllers, and means mounted on each car of the train for controlling said fluid-pressure mechanism, as and for the purpose set forth.

2. In a train of several cars, motors mounted on one or more of the cars of the train, a motor-controller mounted on each motor-car, a fluid-pressure mechanism for actuating all of the controllers throughout the train, and

means located on each car of the train for controlling said fluid-pressure mechanism, as and for the purpose set forth.

3. In a system of controlling motors in a train of cars, a controller for each motor, fluid-pressure mechanism for simultaneously actuating the controllers throughout the train, and manually-actuated means located on each car of the train for controlling said fluid-pressure mechanism, as and for the purpose set forth.

4. In a system of controlling motors in a train of cars, a controller for each motor, fluid-pressure-actuated me hanism for each controller, a source of fluid-pressure, a train-pipe extending throughout the train and communicating with all the controller-actuating mechanisms throughout the train, and means mounted on each car of the train for controlling communication between said source of fluid-pressure and said controller train-pipe, as and for the purpose set forth.

5. In a pneumatic controlling system for electric cars, a source of fluid-pressure, a motor-controlling mechanism, means for supplying pressure to said motor-controlling mechanism in combination with means for automatically controlling the supply of pressure from said source of fluid-pressure to said motor-controlling mechanism, as and for the purpose set forth.

6. In a pneumatic controlling system for electric cars, a source of fluid-pressure, a motor-controlling mechanism, and means for supplying pressure to said controller mechanism, in combination with a valve arranged to automatically control the supply of pressure to said motor-controlling mechanism, as and for the purpose set forth.

7. The combination with a car, a propelling-motor mounted thereon, a pressure-actuated controller for said motor, an air-pipe for supplying pressure to said motor-controller, a valve for controlling the admission of pressure to said pipe, and means for controlling the pressure in said pipe, as and for the purpose set forth.

8. The combination with a car, a propelling-motor mounted thereon, a pressure-actuated mechanism for controlling said motor, an air tank or reservoir mounted on said car, a controller-pipe communicating with said tank, a valve device arranged to control the admission of pressure to said pipe, and electrically-operated means for regulating said pressure, as and for the purpose set forth.

9. The combination with a car, a propelling-motor mounted thereon, a controller for governing the circuits of said motor when operating in one direction, a separate controller for governing the circuit of said motor when operating in the opposite direction, and means for actuating said controllers, as and for the purpose set forth.

10. The combination with a car, a propeller-motor mounted thereon, a controller for governing the "ahead" movements of said motor, a separate controller for governing the "reverse" movements of said motor, and means whereby when one of said controllers is actuated the other is locked, as and for the purpose set forth.

11. The combination with a car, a propelling-motor mounted thereon, a pressure-actuated "ahead" controller for said motor, a pressure-actuated "reverse" controller for said motor, a pressure-tank, pipes for supplying pressure therefrom to said controllers, and a valve device arranged to control the admission of pressure from said tank to said pipes, as and for the purpose set forth.

12. The combination with a plurality of cars in a train, a propelling-motor mounted on one or more of the cars, a pneumatically-actuated controller for each motor, connections extending throughout the train for synchronously operating said controller-actuating means, and means mounted on each car of the train for controlling the supply of pressure to the controller-actuating means throughout the train, as and for the purpose set forth.

13. The combination with a plurality of cars in a train, a propelling-motor mounted on one or more of the cars, a pneumatically-actuated controller for each motor, connections extending throughout the train for simultaneously supplying pressure to said controller-actuating means, means mounted on each car of the train for controlling the admission of pressure to the controller-actuating means throughout the train, and means mounted on each car for automatically controlling the supply of pressure to the controller-actuating means on the same car therewith, as and for the purpose set forth.

14. The combination with a plurality of cars in a train, a propelling-motor on one or more of the cars, a pressure-actuated controller for each motor, a controller-pipe arranged to be connected up throughout the train for supplying pressure to said controllers, a pressure-storage tank, a valve device for controlling the communication between said tank and pipe, and means for automatically regulating the supply of pressure to each controller-actuating means, as and for the purpose set forth.

15. The combination with a plurality of cars in a train, a propelling-motor on one or more of the cars, a pair of pressure-actuated controllers for each motor, a train-pipe for each controller, the controller-pipes of one car adapted to be coupled up to the controller-pipes of the next car, a pressure-storage tank, and a valve device arranged to control the communication between said tank and said pipes, whereby when pressure is supplied to either of the controller-pipes pressure is exhausted from the other of said pipes, as and for the purpose set forth.

16. The combination with two or more cars in a train, a propelling-motor mounted on one or more of said cars, a controller for the circuits of each motor, an air-cylinder for ac-

tuating said controller, a pipe arranged to extend the length of the train and communicating with each cylinder, a pressure-storage tank mounted on one or more of the cars, a second pipe arranged to extend throughout the length of the train and communicating with all of said tanks, and a valve device arranged at each end of each car for controlling the communication between said pipes and to the atmosphere, as and for the purpose set forth.

17. The combination with a car, a propelling-motor mounted thereon, a controller therefor, pressure-actuated means for effecting the movements of said controller, a pipe arranged to extend throughout the length of the car and communicating with said controller-actuating means, a pipe arranged to extend throughout the length of the car for supplying pressure to the brake mechanism, a pressure-storage tank, a supply-pipe communicating therewith and extending throughout the length of the car, a valve device arranged at each end of the car for controlling the communication between said controller and supply pipes and to the atmosphere, and an independent valve for controlling said brake-pipe, as and for the purpose set forth.

18. The combination with a car, a propelling-motor mounted thereon, a controller for controlling the "ahead" movements of said motor, a controller for controlling the "reverse" movements of said motor, pipes communicating respectively with said controllers, a pressure-storage tank, and a common valve device for controlling the communication between said pipes and said tank, whereby when pressure is admitted to one of said pipes it is exhausted from the other, as and for the purpose set forth.

19. The combination with a car, a propelling-motor mounted thereon, two controllers for said motor, one controlling the "ahead" movements and the other the "reverse" movements of said motor, pipes arranged to extend throughout the length of the car and respectively communicating with the actuating means of said controllers, a brake-pipe mounted on the car for supplying pressure to the brake mechanism, a storage-tank, a delivery-pipe communicating therewith, a valve device arranged at each end of the car for controlling the communication between said supply-pipe and said control-pipes, and an independent valve for controlling the communication between said supply and brake pipes, as and for the purpose set forth.

20. The combination with two or more cars in a train, a propelling-motor mounted on each car, two controllers for each motor, one controlling the "ahead" movements and the other the "reverse" movements of said motor, pipes arranged to be detachably coupled up throughout the entire train and respectively communicating with the actuating devices for said controllers, a storage-tank, and a common valve device arranged to respectively open communication between said pipes and said tank, as and for the purpose set forth.

21. The combination with two or more cars in a train, a propelling-motor mounted on each car, two controllers for each motor, one controlling the "ahead" movements and the other the "reverse" movements of said motor, pressure-actuated devices for operating said controllers, pipes mounted on each car and communicating respectively with the controller-actuating devices on that car, the controller-pipes of one car adapted to be detachably connected to the corresponding controller-pipes of the adjacent car throughout the train, a storage-tank mounted on each car, a supply-pipe also mounted on each car and communicating with said tank, and a valve device mounted on each car for controlling the admission of pressure from said supply-pipe to said controller-pipes, as and for the purpose set forth.

22. The combination with a car, a propelling-motor mounted thereon, a controller for controlling the "ahead" movements of said motor and a controller for controlling the "reverse" movements of said motor, independent pressure-actuated means for effecting the movements of said controllers, a storage-tank, a valve device for controlling the communication between said controller-actuating means and said tank, said valve device comprising two valves and means for locking one of said valves until the other of said valves is moved to a position corresponding to the "off" position of the controller governed thereby, as and for the purpose set forth.

23. The combination with a car, a propelling-motor mounted thereon, an "ahead" controller and a "reverse" controller for said motor, an air-cylinder for actuating each of said controllers, an air-tank, a double valve for controlling the air-pressure supplied from said tank to said cylinders, and means for locking one of said valves during the operation of the other, as and for the purpose set forth.

24. The combination with a car, a motor mounted thereon, an "ahead" controller and a "reverse" controller for said motor, an independent air-cylinder for actuating each of said controllers, an air-tank, a valve device for controlling the supply of air therefrom to said cylinders, comprising two valves, a notched disk mounted on the stem of each of said valves, and locking-pawls arranged to engage said disks, as and for the purpose set forth.

25. A double-valve device comprising two valves, disks mounted on the stem of each valve, said disks provided with peripheral seats or depressions, pivotally-mounted pawl-arms arranged to peripherally engage said disks, and operating-handles for said valves, as and for the purpose set forth.

26. In a double-valve device, two valves having peripherally-recessed disks mounted

on the stems thereof, a pair of pawl-arms pivotally mounted at one end and arranged to engage the peripheral seats in said disks at the other end, and means for yieldingly spreading said pawl-arms apart whereby one of said valve-stems is locked against movement until the other has been moved into a predetermined position, as and for the purpose set forth.

27. In a valve device, a valve having a notched flange, a detachable operating-handle for said valve, said handle provided with a hook arranged to engage underneath said notched flange, whereby said handle is prevented from being removed until it is moved to a predetermined position, as and for the purpose set forth.

28. The combination with a car, of a propelling-motor mounted thereon, a controller for said motor, an air-cylinder, means for admitting and exhausting air-pressure to and from said cylinder, a piston arranged in said cylinder, means actuated by the movements of said piston for effecting the movements of said controller, and means actuated by the amount of current supplied to the motor for controlling the supply of air to said cylinder, as and for the purpose set forth.

29. The combination with a car, a motor mounted thereon, a controller therefor, an air-cylinder, means of supplying air-pressure thereto and exhausting same therefrom, a piston mounted in said cylinder, means actuated by the movements of said piston for effecting the movements of said controller, a valve arranged to control the admission of air to said cylinder, and means arranged in the motor-circuit for actuating said valve, as and for the purpose set forth.

30. The combination with two or more cars in a train, a motor mounted on one or more of the cars, and air-cylinder mounted on each motor-car and having a piston, means actuated by the movement of said piston for controlling the circuits of said motor on that car, means for admitting air-pressure to each of said cylinders simultaneously throughout the train, and means actuated by variations in the current supplied to each motor throughout the train for automatically controlling the supply of air-pressure to the individual air-cylinders throughout the train, whereby the action of all the motors throughout the train is synchronized, as and for the purpose set forth.

31. A motor-controller, an air-cylinder for actuating the same, means for supplying air-pressure to said cylinder, a valve controlling said air-pressure supply, a magnet arranged in the motor-circuit, and means actuated by variations in the strength of the current traversing said magnet for automatically actuating said valve, as and for the purpose set forth.

32. The combination with a car, a propelling-motor mounted thereon, a pneumatically-actuated controller for governing the "ahead" movements of said motor, an independent pneumatically-actuated controller for governing the "reverse" movements of said controller, an air-pressure tank carried by the car, independent pipes for delivering pressure from said tank to said controller-actuating means, and means whereby, when pressure is supplied to one of said pipes it is exhausted from the other, in combination with a brake-pipe for supplying air-pressure to the brake mechanism, a safety exhaust-valve for each of said pipes and a controlling-rope for simultaneously actuating said valves, as and for the purpose set forth.

33. The motor-controller, an air-cylinder, a piston mounted therein, means actuated by the movements of said piston for effecting the movements of said controller, a valve arranged to control the supply of air-pressure to said cylinder, a spring arranged to hold said valve in normally open position, and electrically-operated means for closing said valve, said electrical means being arranged in the motor-circuit, as and for the purpose set forth.

34. An air-cylinder having a piston, a casing communicating with said cylinder, a supply-pipe communicating with said casing, a supply-passage formed in said casing and delivering from said pipe to said cylinder, an exhaust-passage formed in said casing and communicating with said cylinder, a plunger arranged to close said exhaust-passage, a piston for actuating said plunger, said piston arranged in said supply-passage, in combination with a motor-controller, and means actuated by the movements of said cylinder-piston for effecting the movements of said controller, as and for the purpose set forth.

35. An air-cylinder having a piston, a casing having a passage therein communicating with a source of fluid-supply and delivering into said cylinder, means for adjusting the area of the opening of said passage, an outwardly-seating check-valve arranged in said passage, an exhaust-passage formed in said casing, means actuated by fall of pressure in said passage for opening said exhaust-passage, a motor-controller, and means actuated by the movements of said piston for actuating said controller, as and for the purpose set forth.

36. An air-cylinder having a piston, a casing having a passage communicating with a source of fluid-supply and delivering into said cylinder, an exhaust-passage communicating with said cylinder, a plunger for opening and closing said exhaust-passage, a piston arranged to actuate said plunger, said piston arranged in said supply-passage, and a plug carried by said cylinder-piston arranged to enter said exhaust-passage as said piston approaches the limit of its movement, whereby said piston is cushioned in combination with a motor-controller, and means actuated by the movements of said piston for moving said controller, as and for the purpose set forth.

37. In a pneumatic controlling system for a train of cars, a propelling-motor mounted on one or more of the cars, a controller for each motor, pressure-actuated mechanism for actuating said controllers, connections extending throughout the train for supplying pressure to said controller, actuating means, and means actuated by reduction of pressure in said connections for simultaneously opening each controller-actuating means directly and independently to the atmosphere, as and for the purpose set forth.

38. In a pneumatic controlling system for a train of cars, a propelling-motor mounted on one or more of the cars, a controller for each motor, an air-cylinder mounted on each motor-car, and having a piston, a source of air-pressure, a train-pipe communicating between said source of fluid-pressure and the air-cylinders throughout the train, a passage opening direct communication between each cylinder and the outer air, means actuated by the reduction in pressure in said train-pipe for simultaneously opening said passages, and connections between said pistons and controllers for actuating the latter, as and for the purpose set forth.

39. In a pneumatic controlling system for a train of cars, a propelling-motor mounted on one or more of the cars, a controller for each motor, an air-cylinder mounted on each car and having a piston, a source of air-pressure, a train-pipe communicating between said source of fluid-pressure and the air-cylinders throughout the train, a passage opening direct communication between each cylinder and the outer air, a plunger arranged to control said passage, said plungers arranged to be moved simultaneously to close said passages when pressure is supplied to said train-pipe, and to simultaneously open said passages when pressure is exhausted from said train-pipe, as and for the purpose set forth.

40. The combination with a car, a propelling-motor mounted thereon, a controller for said motor, pressure-actuated devices for effecting the movements of said controller, an air-pressure tank carried by the car, a supply-pipe for delivering air-pressure therefrom to said controller, actuating devices, a brake-pipe for supplying air-pressure to the brake mechanism, a safety exhaust-valve for each of said pipes, and a controlling-rope for simultaneously actuating said valves, as and for the purpose set forth.

In witness whereof I have hereunto set my hand, this 4th day of Novembe'. 1897, in the presence of the subscribing witnesses.

SIDNEY HOWE SHORT.

Witnesses:
M. A. KENSINGER
S. E. DARBY.