(No Model.)

3 Sheets—Sheet 1.

L. C. WERNER.

ELECTRIC SIGNAL SYSTEM.

No. 603,369. Patented May 3, 1898.

Fig. 1.

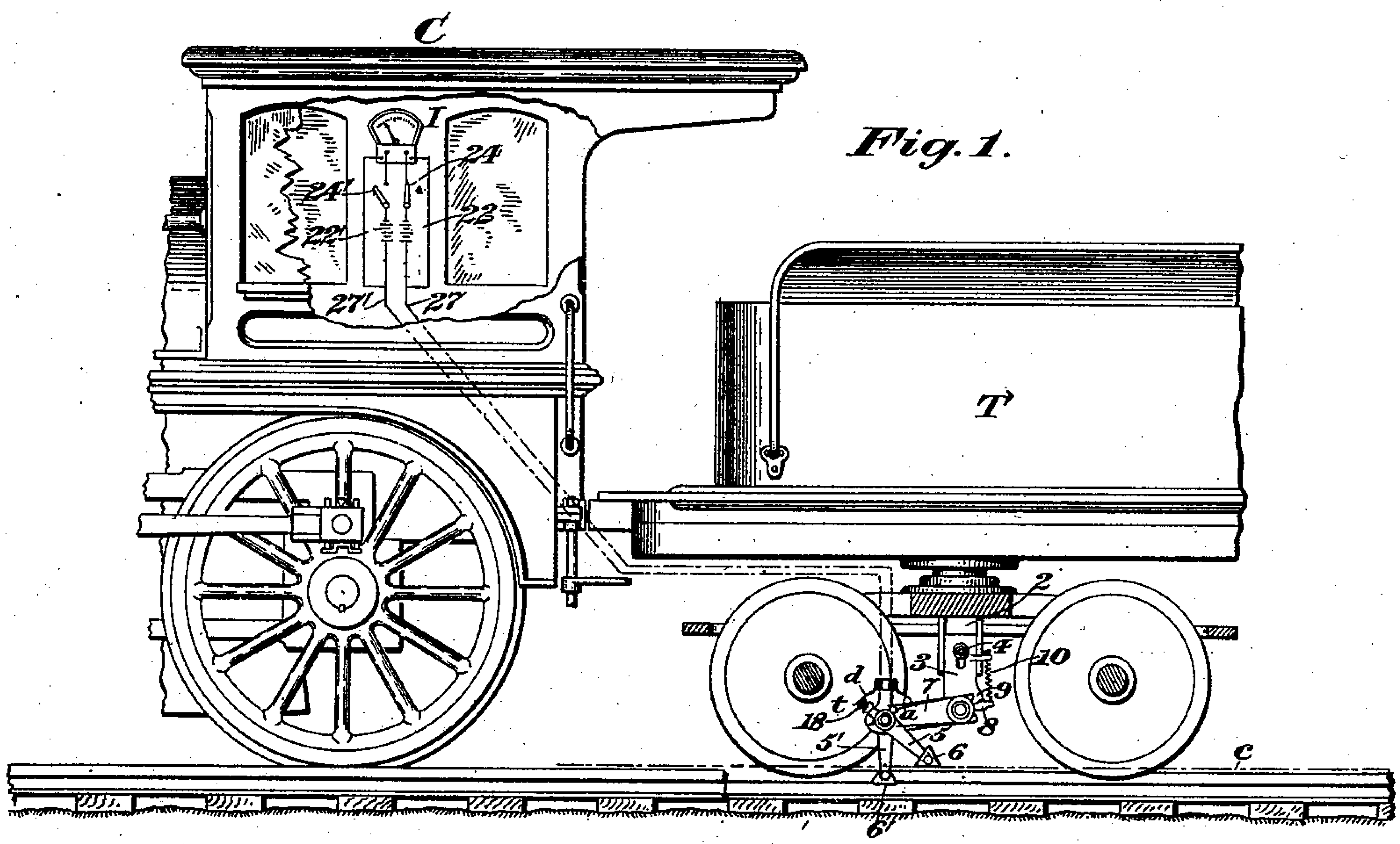


Fig. 3.

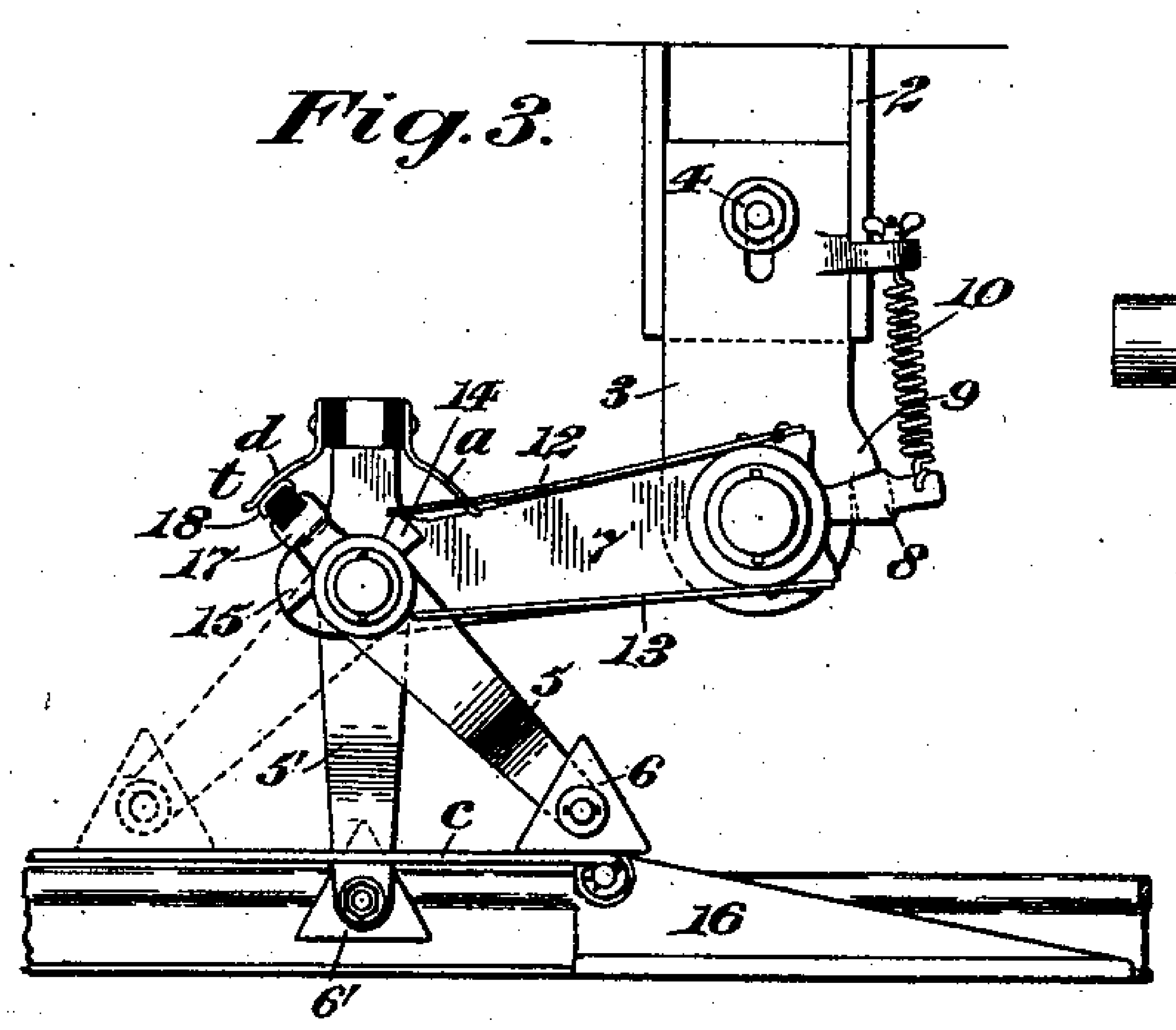


Fig. 2.

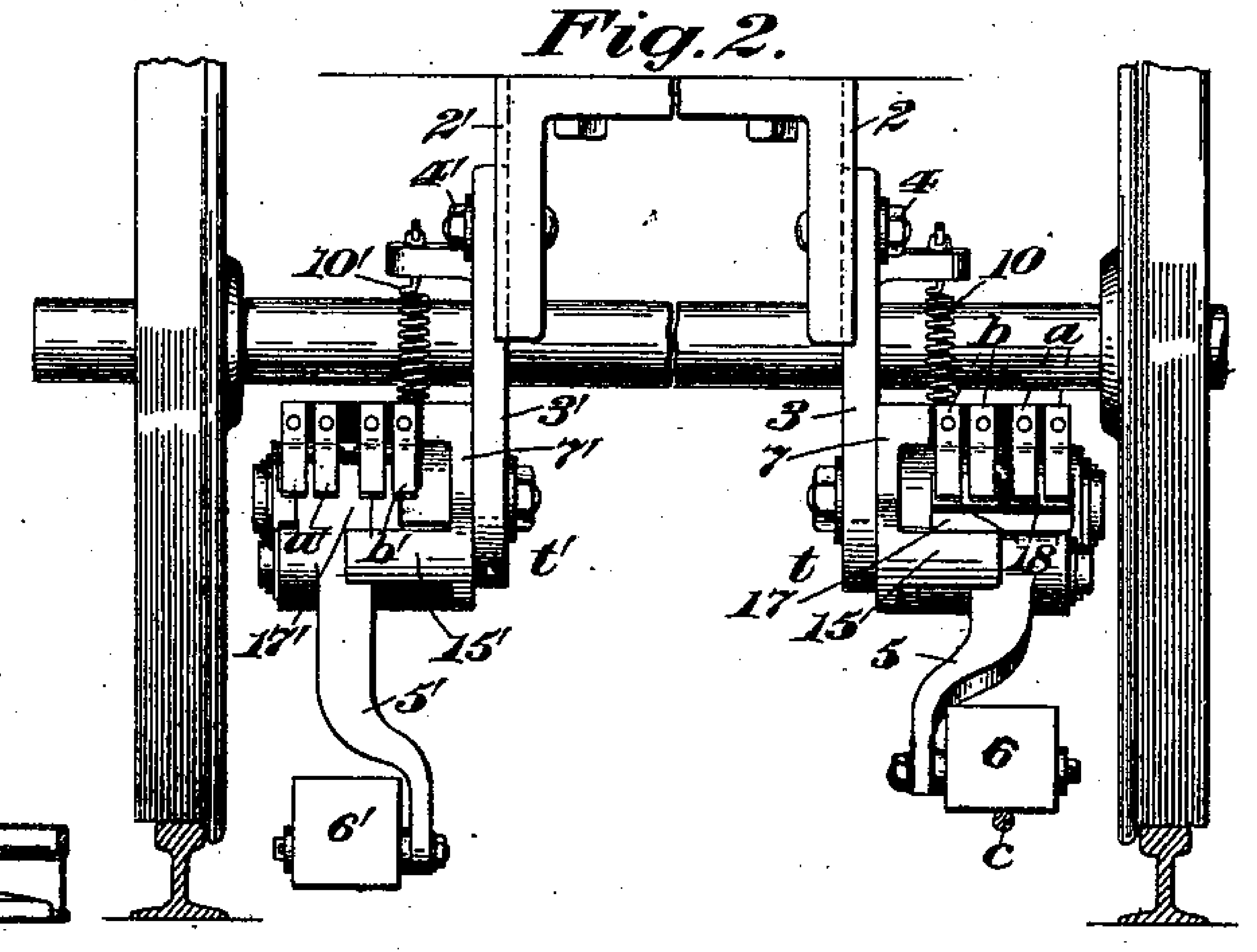
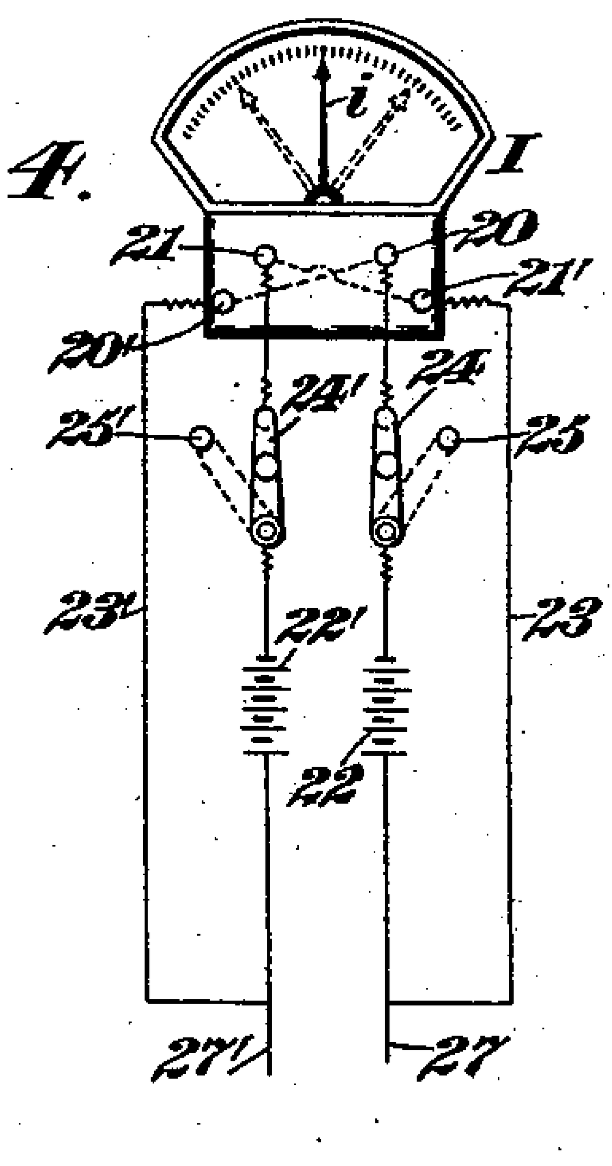


Fig. 4.



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THE NORRIS PETERS CO., PHOTO-LITHO., WASHINGTON, D. C.

(No Model.) 3 Sheets—Sheet 2.

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No. 603,369. Patented May 3, 1898.

Fig. 5.

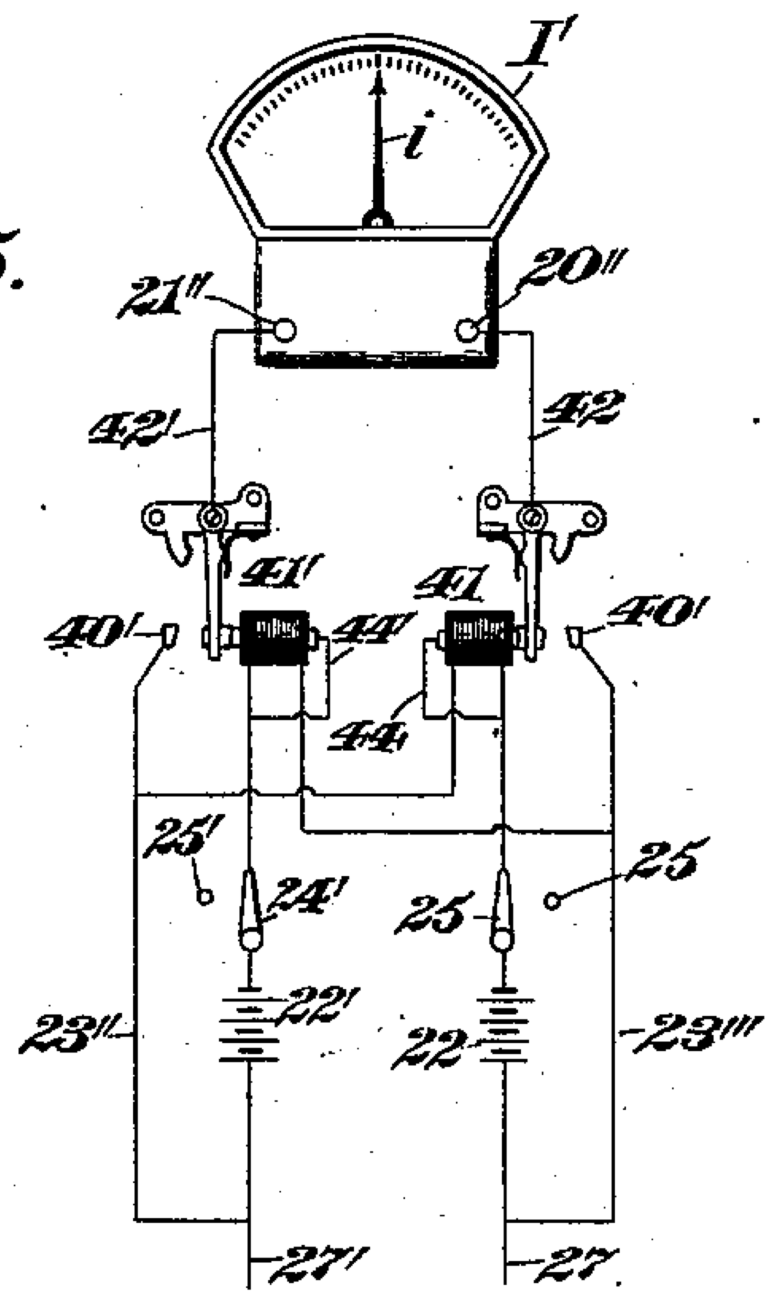


Fig. 6.

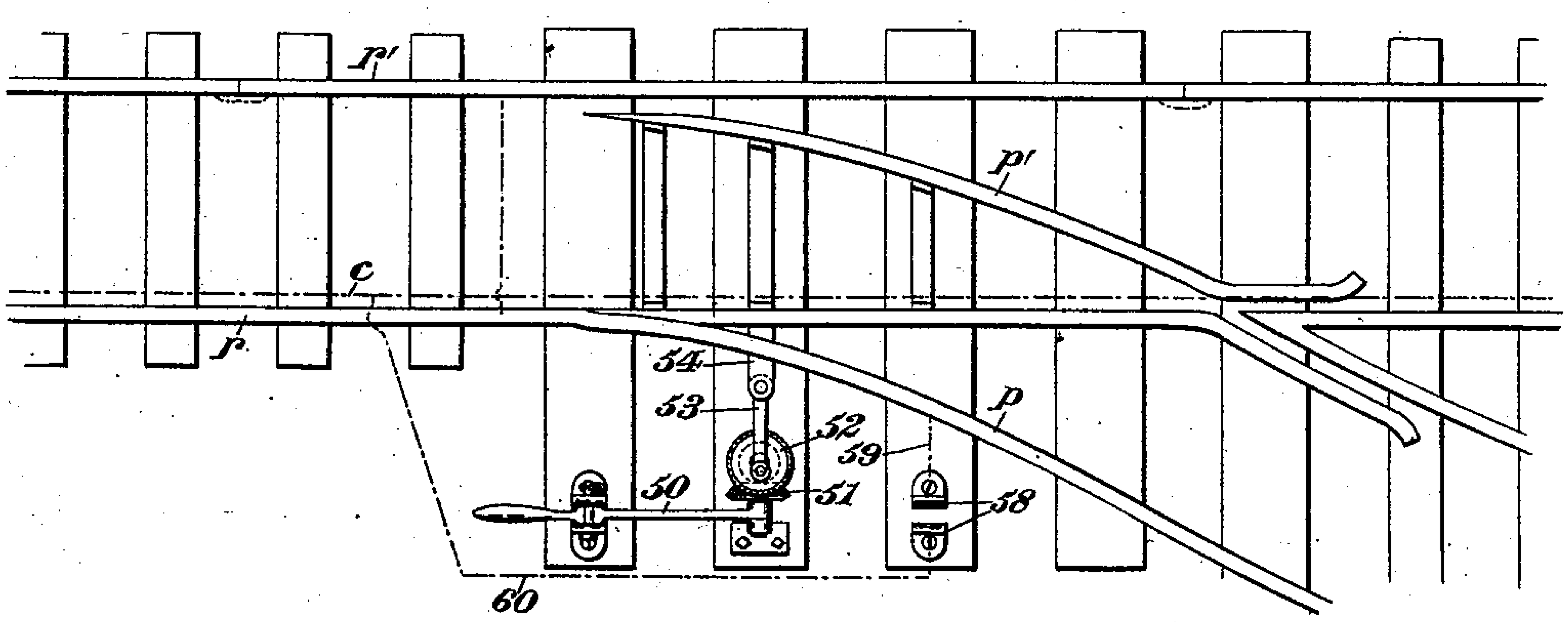
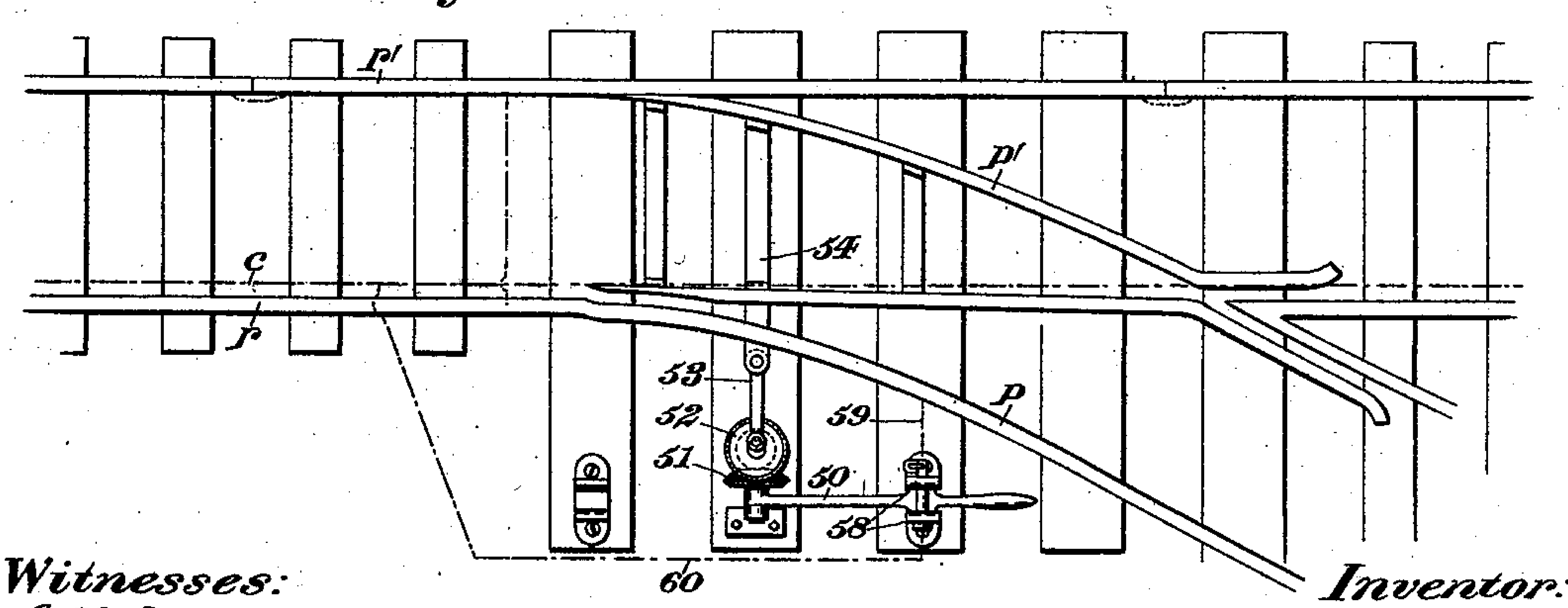


Fig. 7.



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3 Sheets—Sheet 3.

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Fig. 8.

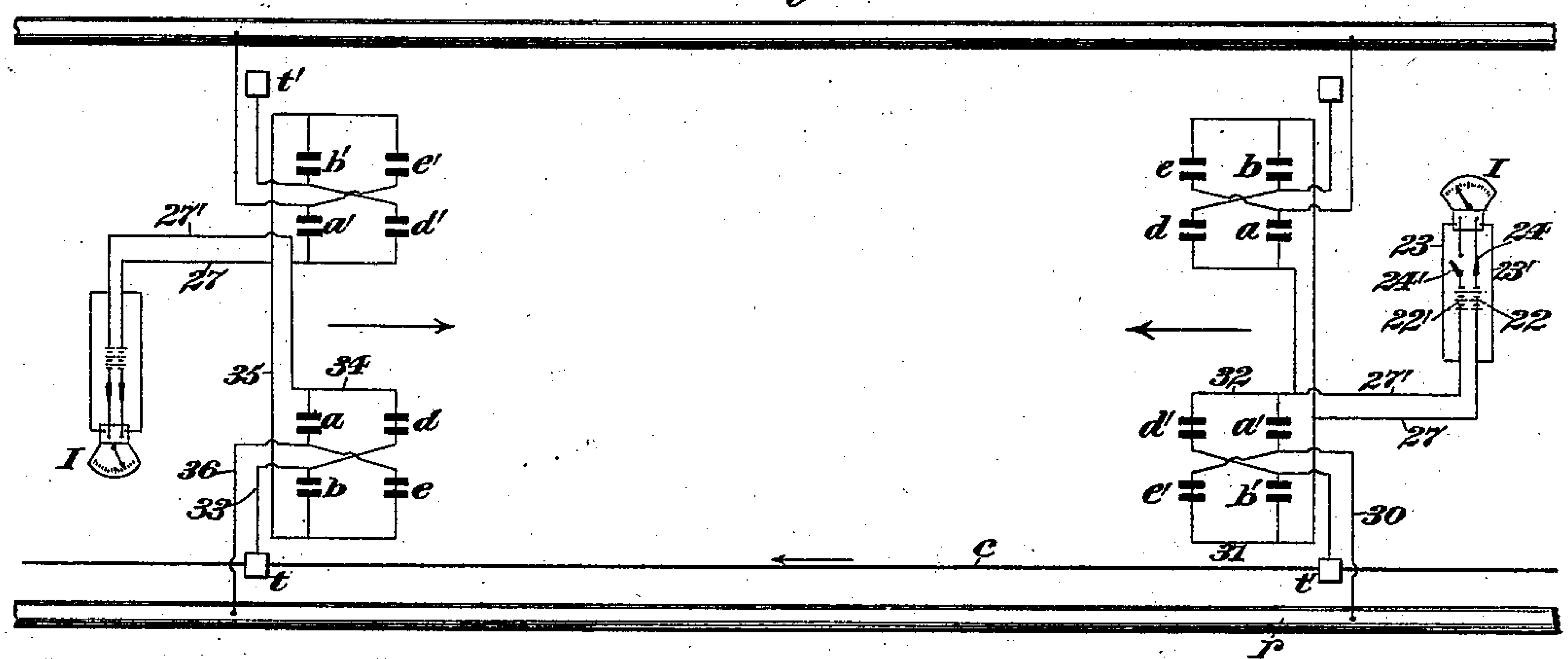


Fig. 9.

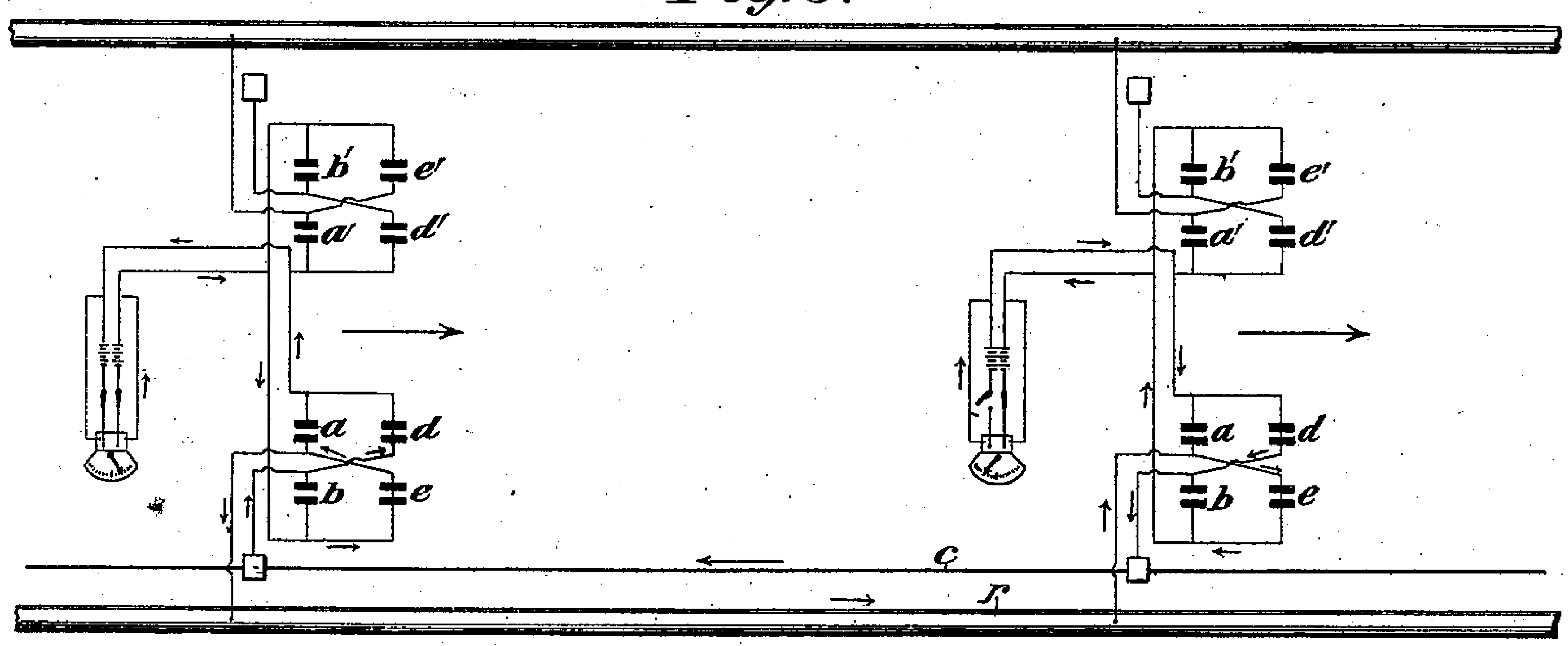
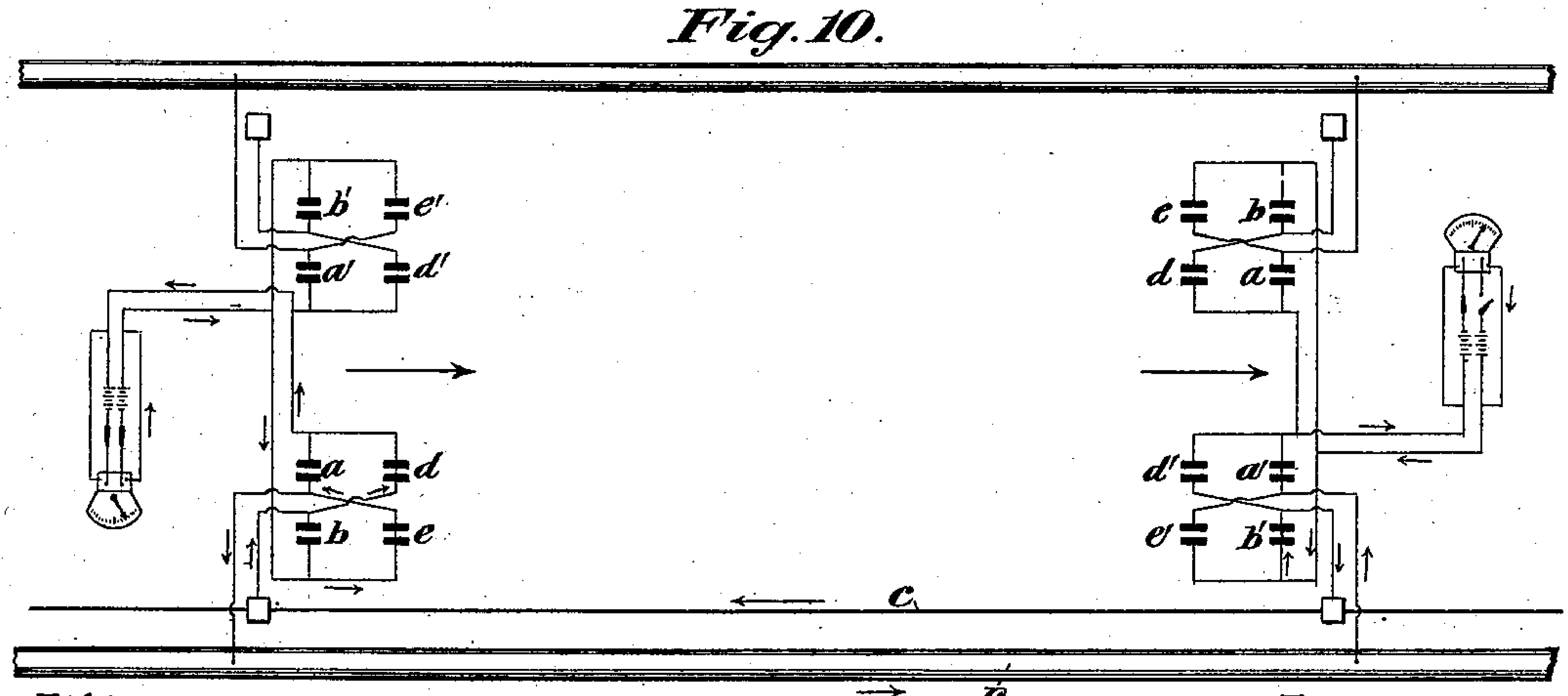


Fig. 10.



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UNITED STATES PATENT OFFICE.

LOUIS C. WERNER, OF BROAD BROOK, CONNECTICUT.

ELECTRIC SIGNAL SYSTEM.

SPECIFICATION forming part of Letters Patent No. 603,369, dated May 3, 1898.

Application filed June 12, 1897. Serial No. 640,436. (No model.)

To all whom it may concern:

Be it known that I, LOUIS C. WERNER, a citizen of the United States, residing in Broad Brook, in the county of Hartford and State of Connecticut, have invented certain new and useful Improvements in Electric Signal Systems, of which the following is a specification.

This invention relates to electric signal systems, and more particularly to a system for indicating to a vehicle or train moving along a line of way its position relatively to a distant point on the same track and especially the distance between it and the nearest vehicle on such track.

Ordinarily the several component parts of the system will be so organized as to show, by means of indicators on adjacent vehicles or trains, the positions of these vehicles relatively to each other by indicating to each variations in the resistance of a circuit therebetween, which variations will be due to the increase or decrease of the distance between the vehicles as they move in opposite directions or in the same direction toward or following each other on the same track.

As will be obvious, my invention is in the nature of a safety system by means of which the engineer of each train on the same track may at all times know or ascertain the position of the nearest train thereto and whether such adjacent train is approaching toward or receding from it, and hence the system may be used either as a substitute for or as an auxiliary to the usual block systems or interlocking block systems commonly employed on railways.

As is well known, the current flowing through an electrical conductor is proportional not only to the cross-section, but also to the length of such conductor, and hence if two vehicles be equipped to make traveling contact with a conductor extending along the line of way over which the vehicles are running and these vehicles be furnished with devices which may make a complete circuit from one train to the other the resistance of such circuit will be varied in accordance with variations in the length of that portion of the conductor which is between the two trains as the latter move toward or from each other. Moreover, if suitable devices be included in the circuit on each train variations in the strength of the current flowing through the circuit may be noted, and these variations may be made to serve as a means for correspondingly operating an indicator located at a proper point on each such train or vehicle. Thus it will be obvious that by means of suitable signaling devices in this circuit, preferably in the form of visual indicators, such as galvanometers, every change in the positions of two adjacent trains may be indicated by reason of the corresponding change in the resistance of the conductor extending along the line of the track. In a similar manner the distance between any single train or vehicle and a distant point on the same track—such, for instance, as an open switch—may be indicated to an aproaching train by providing at such danger-point or switch suitable means for closing the circuit between the conductor and the rails at that point—as, for instance, a circuit-closer operative to close the circuit at the switch when the latter is thrown open.

Another feature of my invention is the provision, in connection with a vehicle, of a traveling current-collector supported thereon and adapted to have its position automatically reversed when the movement of the vehicle is correspondingly changed, thus obviating the necessity for constantly looking after the current-collector when a train is moving back and forth on a track or is headed in the opposite direction at the end of a line.

In connection with my improved signal system I also deem it desirable to employ pole-changing switches, by means of which the direction of travel of the current through any indicator may be reversed when the direction of travel of the vehicle on which such indicator is carried is changed, and while this pole-changing switch may be a hand-operated one it will preferably be automatic in its action and controlled by the change in position of the current-collector.

In the drawings accompanying and forming part of this specification, Figure 1 is a sectional side elevation of a portion of an engine and tender movable along a suitable track and equipped with an indicator adapted to respond to variations in the resistance of a conductor between the engine and a distant point, which conductor extends along the line and with which a current-collector on the vehicle makes a traveling contact. Fig. 2 is an enlarged detail end elevation, broken away in the center, of a portion of one of the trucks of the vehicle carrying a pair of current-collectors for making traveling contact with a conductor. Fig. 3 is a side elevation of a portion of the same looking from the left in Fig. 2 and illustrating the different positions which the current-collector may assume. Fig. 4 is an enlarged detail of the indicator and its connections to a suitable source or sources of energy. Fig. 5 is a similar view of a modified form of indicator and its connections. Fig. 6 is a plan of a portion of a road-bed, illustrating the main line and a closed switch in connection with my system. Fig. 7 is a similar view showing the switch open and the circuit closed at the switch between the rails and the conductor extending therealong. Figs. 8, 9, and 10 are diagrammatic views illustrating a section of railway equipped with my improved safety system and showing the manner in which the indicators on two adjacent trains operate under different conditions.

Similar characters designate like parts in all the figures of the drawings.

The essential elements of my improved system which distinguish it from other safety systems heretofore employed for communicating from one moving train to another or from any distant point to a train approaching the latter are a line of way, a conductor extending therealong and insulated from the track thereof, a source of electric energy connected to send current in either direction through the indicator on the vehicle, a vehicle movable along the track, a current-collector on the vehicle for making traveling contact with the conductor, means for closing the circuit between the indicator and the track at some point distant from the vehicle or train, and an electrical indicator on the vehicle and in the circuit of the current-collector, this indicator being preferably a visual one, such as a galvanometer, and adapted to indicate variations in the distance between the vehicle and a distant point on the increase or decrease of the length and a corresponding variation in the resistance of the conductor between the vehicle and that point.

Reference will first be made to Figs. 1, 2, and 3, in which I have illustrated one method of making contact between a traveling vehicle and a conductor extending along the line of the track.

In Fig. 1, C designates in a general way the cab of the vehicle or train, in which a signaling device or indicator I is stationed, this indicator being suitably connected with one or more current-collectors, preferably supported on the trucks of the vehicle—as, for example, beneath the tender T, coupled to the engine.

In the preferred construction I provide duplicate current-collectors on each train, one adjacent to each rail of the track, and hence at opposite sides of the tender. These current-collectors may be attached to the trucks of the vehicle in any usual manner; but in this case I deem it advantageous to secure them to the trucks in such a manner as to be capable of adjustment in a vertical direction to bring the contact-face of the collector into proper working position. Hence I have shown in the depending arms 2 and 2′ of the trucks vertical guideways in which slides 3 and 3′ are adjustable vertically by means of suitable bolt-and-slot connections, (indicated in a general way by 4 and 4′.)

The current-collectors, which are designated in a general way by t and t', are carried by these slides in the present case, and each will embody a carrier-arm pivotally connected with the slide on the vehicle and a contact-maker pivoted to the carrier-arm.

As before stated, the current-collector is intended to be automatically reversible and is carried by, and controlled by the reversal of the movement of, the vehicle or train. It comprises, preferably, a carrier-arm 5 and a contact-maker 6, in this case in the form of a sliding contact-shoe, preferably triangular and pivoted to the carrier-arm and adapted to operate therewith as a toggle-joint when the train is reversed. As the two current-collectors on each train are substantially similar in construction and operation, a description of one will suffice for both, appropriate prime-marks being employed to designate those corresponding parts of the second or duplicate current-collector not referred to particularly herein.

The current-collector t is connected with a spring-pressed carrier 7, pivotally secured to the slide 3, and the carrier-arm of the collector is preferably spring-pressed also and pivotally secured to the carrier 7.

For the purpose of holding the carrier up to its working position a stop 9 is provided on the slide and is adapted to coöperate with a corresponding stop-arm 8 on the carrier to limit the downward movement of the end of the carrier which supports the current-collector t. In order to permit the upward movement of this carrier, however, it is mounted for oscillation on the slide and is connected thereto at its opposite end by a spring 10, by which it will be returned to its normal position after being oscillated to permit the reversal of the position of the contact-maker 6. The carrier-arm 5 is also mounted for oscillation, it being pivoted to the free end of the carrier 7, so as to be capable of movement to the several positions illustrated in Fig. 3. Springs, such as 12 and 13, may be used also for holding the contact-maker in its working position, the springs coöperating in this instance with a boss or projection 14 on the carrier-arm 5. The movement of the carrier-arm to its opposite positions is limited by suitable stop-faces—as, for instance, by those of a stop 15—projecting sidewise from the carrier 7 and adapted to engage the carrier 5 at opposite sides of its axis of oscillation when said arm is in its respective opposite positions. It will be noted that when this arm is not in operation it may hang loosely and be suspended in a substantially vertical position.

I prefer to employ a sliding contact-maker instead of a trolley for the reason that a trolley would not oppose sufficient resistance to the conductor when in contact therewith to permit the automatic reversal of the current-collector. I use a sliding contact-shoe having a substantially flat contact-face, and this shoe may be triangular in cross-section, so that any side of the shoe may be a working face.

When a vehicle is moving to the left, as seen in Fig. 3, the arm 5 will of course be in the position shown in full lines at the right in said view. If now the direction of travel of the vehicle be reversed, the working face of the triangular contact-shoe will be pressed against the conductor *c* with great force, and the resistance between the contact-faces of the shoe 6 and the conductor will be sufficient to cause the arm 5 to oscillate and raise the end of the arm 7, to which it is connected, this action taking place in opposition to the force of the spring 10 and being due to the pull of the vehicle. As the shoe 6 is held tightly against the conductor, the pull of the train results in a toggling action taking place, which causes the carrier 5 to move to the position illustrated in dotted lines in said figure, and thus automatically assume a reversed position suitable for the running of the train along the track in the opposite direction. The conductor *c* will usually be a wire of uniform cross-section extending along the track, and it may be mounted in any suitable manner, preferably within the rails of a track and adjacent to one of them, as shown in Fig. 2.

It will be noticed that the conductor is elevated slightly above the tread of the rails, this being done to clear crossings, as at switches, &c.

In order to facilitate the making of contact between the current-collector and the conductor as the former starts from one end of the line of way, I may connect the ends of the conductor to inclined guides 16, as shown in Fig. 3, the shoe 6 normally hanging in the middle position illustrated in said view and being so disposed as to ride up the incline of said guide and onto the conductor on the starting of the vehicle or train.

I have made reference in the preceding description to the use of pole-changing switches for reversing the direction of the current traveling through the indicators, (which latter will be described hereinafter in detail,) and these switches are preferably carried by the current-collectors. In this instance the current-collector *t* embodies in its construction a pole-changer the fixed contacts of which are mounted on the carrier 7, while the switch-arm is movable with a part of the swinging member which forms the carrier-arm 5. In this case there are four pairs of fixed contact-arms, the pairs being designated, respectively, by *a*, *b*, *d*, and *e*. The pairs *a* and *b* are disposed oppositely to those shown at *d* and *e*, and all are constructed as yielding or spring arms, having their inner sides in the path of movement of the switch 17. This switch carries thereon two contacts 18, insulated from each other and from the arm 17, by which they are supported, the function of these contacts being to bridge the contact-arms of the respective pairs of spring-contacts *a* and *b* or *d* and *e*. In order to avoid confusion, the manner in which these contact-arms are wired up and connected to the conductor *c* and the trucks connected with the wires of the return-circuit is not illustrated in the detail views, but is shown clearly in the diagrammatic views Figs. 8, 9, and 10, from which the wiring will be obvious. As the bridging-contacts 18 are carried and swing with the carrier-arm 5, it will be clear that when the contact-shoe is not in engagement with the conductor, but hangs in the central position, (shown in Fig. 3,) both of the circuits at the contacts *a*, *b*, *d*, and *e* will be broken, while if the shoe is in the position shown at the right in full lines in said view contact will be made through the terminals *d* and *e*, and if in the position shown in dotted lines at the left circuit will be made at the terminals *a* and *b*.

As before stated, the indicator is preferably a visual one, operating substantially on the principle of a galvanometer, and the type of instrument which I prefer to employ is shown in Fig. 4, together with the connections thereto and a source of energy therefor. This indicator is designated in a general way by I, and as the construction of a galvanometer is well understood this signaling device will not be described in detail. Indications are made by means of the usual pointer or index-finger *i*, this being controlled by the direction and strength of the current traversing the coils of the galvanometer. In this case, however, the usual form of galvanometer is slightly modified by providing two oppositely-wound coils, (not shown,) either one of which may operate the pointer. As these coils are oppositely wound, the current will traverse them in opposite directions, and hence cause the index-finger to move toward one side or the other, as the case may be. The terminals of these two coils, only one of which will operate at a time to deflect the needle, are indicated by 20 and 20′ and 21 and 21′.

The current by means of which the indicator is operated may be taken from any suitable source of energy, whether located on the traveling vehicles or at a distance therefrom; but I prefer to make use of a source upon each train, preferably in the form of a battery. In this case two batteries 22 and 22′ are shown for each instrument, the plus-poles of the respective batteries being connected directly to the terminals 20 and 21, respectively, while the minus-poles are connected to the pole-changing switches in such a manner that current may flow in either direction through the wires which connect with the minus-poles of the batteries and in either direction through the indicator. In order to permit the passage of the return-current through either of these wires leading to the batteries, it is necessary to make use of two coils for the galvanometer in the construction shown in Fig. 4, the wires for carrying current being designated, respectively, by 23 and 23′ and being connected, respectively, to the terminals 20′ and 21′ at the indicator and to wires leading to the batteries 22 and 22′ at points behind these batteries.

Between the batteries and the terminals 20 and 21 I interpose in the circuit switches, such as 24 and 24′, normally closing the circuits between these batteries and said terminals and adapted to be thrown onto stop-points 25 and 25′, conductors 27 and 27′ being connected with the minus-poles of the batteries.

It will be obvious that when the switches are in the positions shown in full lines in Fig. 4 and a circuit is not completed at the track by the closure of the circuit between the conductors c and the rails of the line of way the batteries 22 and 22′ and the two coils of the galvanometer will be united in series with one another. When current from another battery on another train passes through the conductors 27 or 27′ into this indicator, however, one of the batteries of this indicator will then have no complete circuit therethrough, and the indicator will be operated by the other battery and also by the current from that battery through which current flows from the other train.

In Figs. 8, 9, and 10 I have illustrated diagrammatically the operation of the system under different conditions met with regularly on railways.

In Fig. 8 two trains are supposed to be approaching each other on the same track, and at the proper distance, which may be the length of one or more blocks of an ordinary railway, each indicator should show that there is another train on the same track ahead of it. The current-collectors on each vehicle make traveling contact with the conductor c, and all the parts are in the positions to indicate to each of the two trains the presence of the other when the proper switch 24 or 24′ is thrown by the engineer, both of the indicators being in closed local circuits, in which the two pointers are maintained in their central positions by the equal and opposite currents flowing through the two coils of each indicator until this is done. It will be noted, however, that while the pointers of both indicators are thus maintained in their central idle positions until such switch is shifted, yet both indicators are at all times in condition to coöperate with each other and to indicate each to the other its own position on the track with respect to such other train. When two trains are approaching each other, as shown in Fig. 8, the switch 24′ on one of the trains (in this case the one at the right in Fig. 8) is shifted by the engineer, and thereupon a circuit is closed from the rail r, through conductor 30, contacts e', conductor 31, conductor 27, battery 22, (see also Fig. 4,) switch 24, and contact 20, through that coil of the galvanometer with which the terminals 20 and 20′ are connected, whereupon the indicator-finger i is thrown to the left by the current traversing such coil, and the current passes on through the conductor 23, conductor 27′, conductor 32, contacts d', current-collector t', and conductor c, whence it goes to the opposite current-collector t on the train ahead of it, the circuit then being through conductor 33 to contacts d, conductor 34, conductor 27′, and the other indicator, through such indicator, causing the deflection of the pointer toward the first-mentioned approaching train, the current then passing out by way of conductor 27, conductor 35, contacts e, and conductor 36, back to the rail r. Each engineer of these trains now knows that there is a train ahead of him and approaching, and hence each will be warned by the indicator to stop his train in time to avoid a collision. It will be noted that not only is this the case, but that the amount of deflection of the needle at each indicator will also show to the engineer how far ahead of him the other train is, and the amount of such deflection will be controlled entirely by the length of that portion of the conductor c which is between the current-collectors t and t', and hence by the interval between the trains themselves.

In Fig. 9 I have illustrated the operation of the system when two trains are following each other on the same track. As the circuit through the several devices of the system has been traced out with respect to Fig. 8, it is not thought necessary to follow it in detail in Fig. 9, but, instead, the course of the current is indicated by arrows. In this view corresponding sets of contacts d and e are bridged by the pole-changing switches on each train, this being due to the fact that the trains are traveling in the same direction on the same track, and hence making contact with the conductor c in the same manner. In this case also the engineer on the train at the right in said view shifts his switch 24, which points to the train in the rear, thus closing the circuit between his own train and that following him, and indicating not only that there is a train behind him but also the interval between the two trains. It will be clear that the circuit completed will indicate to the train in advance that there is one following it, and also to the second train that there is one in advance of it, and also the interval between the two trains. As the two trains are following each other, it will not be necessary for them to stop; but the second train should proceed cautiously and keep at a sufficient distance in the rear of the first train.

It will be seen from the preceding description of the operation of the devices shown in Figs. 8, 9, and 10 that when a train is going ahead and the engineer on that train desires to know whether there is a train ahead of him he always shifts the switch 24′, while if his train is going ahead and he desires to know whether there is a train behind him he always shifts his switch 24, it being understood, of course, that he will never shift both switches simultaneously. If, on the other hand, his train is running backward, the manner in which he operates these switches will be exactly reversed—that is to say, if he desires to find out whether there is a train in front of the head end of his train he will shift the switch 24, while if he desires to know whether there is a train beyond the rear end of his own train he shifts the switch 24′. The amount of deflection of the indicating-fingers will indicate at all times just what the interval between the two trains is, and will thus enable each engineer to gage the running of his train accordingly.

In Fig. 10 I have shown the operation of the indicators for the two trains following each other on the same track and one of which has been reversed and is running backward. In this case, as the movement of the train indicated at the right in said figure is the reverse of that which it ordinarily would have, the pointer on the indicator is moved in a direction which is the opposite of that in which it would be deflected usually, and hence instead of pointing toward the train following it, it points away from it toward the rear of the train on which it is mounted, thus showing that there is a train following it. Of course the switch which would be shifted by the engineer in this case would be that illustrated at 24 instead of the switch 24′. The direction of flow of the current through the circuit of the other train is indicated by arrows in Fig. 10. It will be noted here that the conditions are similar in most respects to those indicated in Fig. 8, except that the direction of movement of the train at the right in Fig. 8 is reversed, and hence different pairs of contacts are bridged by the pole-changing switch in Fig. 10 from those bridged in Fig. 8. In Fig. 8 the circuit is closed through contacts d' and e', whereas in Fig. 10 there is an open circuit at d' and e' and the circuit is closed through the pairs of contacts a' and b'.

In all of these diagrammatic views the duplicate current-collectors and pole-changing switches are properly connected with the respective indicators, but none of the pairs of contacts is bridged by the pole-changing switches, and the current-collectors are freely suspended and out of contact with any conductor, and hence there is no circuit through these parts.

In Fig. 5 I have illustrated a modification of the indicator, in which the ordinary galvanometer may be employed—that is to say, one having a single coil and only two terminals for connection with the circuits to the batteries and the current-collector. The indicator is here represented by 1′ and the terminals of the galvanometer-coil by 20″ and 21″. The batteries 22 and 22′, the switches 24 and 24′, the stop-points 25 and 25′, and the conductors 27 27′ are the same as in Fig. 4; but the conductors connecting the terminals 20″ and 21″ with the conductors 27 and 27′ are not continuous. Instead I have illustrated conductors 23″ and 23‴, ending in contact-points 40 and 40′, controlled by relays 41 and 41′, the electromagnets of which are normally in series with each other and with the batteries and circuit-breaking switches. The armatures of these relays are connected by conductors 42 and 42′ to the respective terminals 20″ and 21″ of the indicator, and these armatures, while normally attracted by their electromagnets and while normally forming complete closed circuits from the batteries through the switches and through conductors 44 and 44′ and through the cores of the electromagnets, the armatures of the relays, and the indicator, are adapted, when released, to be carried by the usual light springs onto the terminals 40 and 40′ to close the circuits through conductors 23″ and 23‴. The normally-closed circuit through the relays is as follows: from battery 22 to relay 41, through the coils of the relay to conductor 23″, through conductor 23″ to conductor 27′, to battery 22′, through battery 22′ to relay 41′, through the coils of this relay to conductor 23‴, to conductor 27, and back to battery 22. The release of either one of these armatures is effected either by shifting one of the switches 24 or 24′ or else by a current flowing from another train and entering by way of conductor 27 or 27′. Both of the batteries 22 and 22′ are of the same efficiency, and it will be seen that when a current enters either of these batteries from the outside one of the relays will be deënergized, owing to the fact that its battery will then have no circuit therethrough, and the indicator will be operated by one battery on each train. For example, if current enters the conductor 27 (see Fig. 5) from another train while the parts are in the position shown in said figure there will then be no circuit through the battery 22′ and the armature of the relay 41′ will be released and will be carried onto the contact 40′, while the current from the battery 22 and from the battery on the other train will energize the electromagnet 41, keep its armature attracted, and will pass through the coils and the core of said electromagnet and through the indicator, the return-circuit being by way of conductors 23″ and 27′. When the parts are in the positions shown in this view, there is a conducting-path between the batteries and the indicator through the cores of the electromagnets; but as the batteries are disposed in opposition to each other no current flows therethrough, and hence the indicator-hand remains in its normal position. This construction obviates the necessity of employing a double-coil galvanometer, as in use the relays will take opposite positions, and thus, when the circuit passes from the track through either battery, a return-circuit therefor will be completed at the other side of the indicator.

It will be noticed that when current enters the conductor 27, Fig. 5, from another train in the manner just referred to the current passing through the relay 41 from the battery 22 is augmented by the current from the battery which is left in the circuit on the other train. As the two batteries 22 and 22′, Fig. 5, are opposed to each other, of course the current flowing through and from the battery 22 will not be able to pass through conductor 44 and through the core and the armature of the relay 41 to conductor 42 and through the coil of the galvanometer to conductor 42′ and thence to the battery 22′. Hence this current from the battery 22 and from the other train must pass through the coils of the electromagnet of the relay 41 to conductor 23″ and out through conductor 27′, owing to the fact that instead of the two relays being connected in series with the batteries 22 and 22′, as is the case normally when no current is flowing through the instrument from another train, and instead of each of such relays receiving the full strength of the current of the two batteries 22 and 22′, as when connected in a normally-closed local circuit, the battery 22′ is the only one from which current can pass through the relay 41′ when current from another train enters through the conductor 27; but as both the current from the battery 22 and the current from the battery on the other train pass through the coils of the relay 41 and out through conductors 23″ and 27′ this current is strong enough when opposed to the current from the battery 22′ to neutralize the latter, and as soon as said battery 22′ is neutralized it, having then no complete circuit to traverse, is rendered ineffective, and the electromagnet of the relay 41′ being deënergized the armature of said relay is shifted to make circuit at 40′, whereupon the current from the battery 22 may divide, part following the original course through the coils of the electromagnet of the relay 41 and out through conductors 23″ and 27′, while the other part passes through the core and armature of the relay 41 and through the indicator and out through the armature of the relay 41′ to contact 40′ and to conductor 23″ to join the current passing through the latter from the first-described parallel branch of the circuit.

It has been found by experiment that if the relays are properly constructed and the batteries are of equal strength either one of the relays will respond instantaneously to an increase in the current of the battery to which the other relay is directly connected.

Although my invention primarily is intended as a means for preventing collisions between trains by signaling to two approaching trains their relative positions with respect to each other, yet it is adapted for operation for preventing any kind of accident which might be due to errors in the running of trains, in the throwing of switches, &c.

It will be obvious that if the circuit be closed between the rails and the conductor c at any point distant from a train approaching on the track a circuit through the indicator on the train may be closed when the engineer shifts the proper switch 24 or 24′, as the case may be, and that the presence of such danger-point and its distance will be indicated to the approaching train, whereupon the engineer will of course take the proper precautions to insure the safety of his train.

In both constructions of the indicator and its operating devices shown herein when the switches 24 and 24′ are in their normal positions the indicator-hand is held in its central or normal position in Fig. 4 by reason of its being within the field of equal and opposite currents and in Fig. 5 owing to the fact that there is no current flowing through the indicator, and in both cases the current of one battery on each train is used to deflect the indicator-hand. Hence in every case when a signal is transmitted there are two batteries in circuit, one on each train, and as all of the batteries should be of standard strength the only variable factor in the circuit at such time is the length, and hence the resistance, of the conductor between the trains.

One manner of indicating danger ahead is illustrated in Figs. 6 and 7, in which a main track and siding are shown, the main track being open in the former view, while in the latter view the switch is open. As a means for signaling to the engineer the approach of his train toward such a danger-point I have shown herein, in connection with the track-rails and switch-rails, suitable means for operating the latter and circuit-closing means controlled by the opening of the switch for closing the circuit at such point to indicate to an approaching train that the siding is open and that the main track is not clear.

The track-rails are designated, respectively, by r and r', and the point-rails or switch-rails by p and p'. These point-rails may be connected in any usual manner and operated by any suitable switch-throwing means. In this case a switch-lever, which is shown at 50, operates a pair of gear-wheels 51 and 52, the latter of which is connected by means of a crank 53 with the usual switch-rod 54 in such manner that when the switch-lever is thrown to open the switch the gears will be operated, the crank actuated, and the point-rails shifted.

The switch-lever is intended to be locked in its extreme positions and to close the circuit between the rails and the conductor c. In this instance the switch-lever constitutes an electric switch adapted, when thrown to the position shown in Fig. 7, to bridge a pair of terminals 58, constituting the pole-pieces of the switch, and thus close the circuit between the rails and the conductor, one of these pole-pieces or terminals being connected to the rails by a conductor 59 and the other to the conductor c by a conductor 60, the switch-lever, of course, being locked in its extreme position in order to prevent tampering with the track system.

As before stated, the visual indicators will not only indicate the presence of an approaching, following, or receding train, but also the distance between one train and another train or danger-point, and this indicator may have thereon a scale showing distances—as, for instance, in yards or multiples thereof—to indicate to the engineer at a glance the distance between his train and such other point.

It should be understood that it will be the duty of the engineer of the train or operator of the vehicle to shift the switches 24 and 24′ from time to time to determine whether there is any obstruction on the track either ahead of his train or vehicle or in the rear thereof. Moreover, a code of signals may be adopted by means of which the engineers of adjacent trains may indicate to each other the direction in which they are moving on the track. For instance, an engineer moving north or east may indicate that fact by shifting his switch twice from its normal position, and thus make a circuit twice to the other train, while if going south or west he may shift it, say, four times, and thus make the circuit to the other train a corresponding number of times.

Having described my invention, I claim—

1. In an electric signal system, the combination, with a track of a line of way, of a conductor extending along the line of way and insulated from said track; a vehicle movable along said track; a source of electric energy; an electrical pole-changing switch connected to send current in either direction through the indicator on said vehicle; circuit-controlling means between the source of energy and the two sides of the indicator; a traveling current-collector carried by said vehicle and adapted to make contact with said conductor; means for closing the circuit between the conductor and the track at a point distant from the vehicle; and a visual electrical indicator carried by said vehicle and in circuit with said current-collector and responsive to every variation in the length, and hence in the resistance, of the conductor between said vehicle and such distant point, within the range of the indicator, and having an indicator-hand movable at either side of a normal, idle, central position, in accordance with the direction of movement of the vehicle, and adapted to indicate every variation in the distance between the vehicle and such distant point, as the former approaches the latter, and also to show changes in the direction of movement of the vehicle.

2. In an electric signal system, the combination, with a track of a line of way, of a conductor extending along the line of way and insulated from said track; vehicles movable along said track; traveling current-collectors carried by said vehicles and adapted to make contact with said conductor; a source of electric energy for each vehicle; electrical pole-changing switches connected to send current in either direction through the indicators on said respective vehicles; circuit-controlling means between the source of energy and the two sides of the indicator on each vehicle; and visual electrical indicators carried by said vehicles and in circuit, respectively, with said current-collectors and responsive to every variation in the length, and hence in the resistance, of the conductor between said vehicles, within the range of such indicators, and each having an indicator-hand movable at either side of a normal, idle, central position, in accordance with the direction of movement of the vehicle and adapted to indicate every variation in the distance between said vehicles and also to show changes in the direction of movement of each vehicle.

3. In an electric signal system, the combination, with a track of a line of way, of a conductor extending along the line of way and insulated from said track; vehicles movable along such track; automatically-reversible traveling current-collectors carried by said vehicles and adapted to make traveling contact with said conductor and automatically reversible by the reversal of the movements of said vehicles; a source of electric energy connected to send current in either direction through the indicators on said respective vehicles; visual electrical indicators carried by said vehicles and in circuit, respectively, with said current-collectors and adapted to indicate the direction of movement of said vehicles; and pole-changing switches carried by said current-collectors and controlling the circuits through the indicators.

4. The combination, with a track of a line of way, of a conductor extending along the line of way and insulated from said track; a source of electric energy; a vehicle movable along said track; and a current-collector automatically reversible, while in contact with said conductor, by the reversal of the movement of the vehicle, and comprising a carrier-arm pivotally connected with the vehicle, and a triangular sliding contact-shoe pivoted to said carrier-arm and reversible, on the reversal of the movements of the vehicle, to bring its different sides into engagement with the conductor.

5. The combination, with a track of a line of way, of a conductor extending along the line of way and insulated from said track; a source of electric energy; a vehicle movable along said track; a spring-pressed carrier piv-

otally connected with the vehicle; and an automatically-reversible current-collector trailing at an acute angle to the conductor while in contact therewith, and reversible to an opposite trailing position, while in contact with said conductor, by the reversal of the movement of the vehicle, and comprising a spring-pressed carrier-arm pivotally secured to said carrier and a contact-maker pivoted to said carrier-arm and movable therewith toward and from the vehicle and said conductor.

6. In an electric signal system, the combination, with a track of a line of way, of a conductor extending along the line of way and insulated from said track; a vehicle movable along such track; a signaling device on said vehicle; a source of electric energy connected to send current in either direction through said signaling device; an automatically-reversible traveling current-collector carried by, and controlled by the reversal of the movement of, said vehicle and adapted to make traveling contact with said conductor; and an automatic pole-changing switch controlled by the current-collector and controlling the direction of flow of the current through said signaling device.

7. In an electric signal system, the combination, with a track of a line of way, of a conductor extending along the line of way and insulated from said track; a vehicle movable along such track; a signaling device on said vehicle; a source of electric energy connected to send current in either direction through said signaling device; an automatically-reversible traveling current-collector carried by, and controlled by the reversal of the movement of, said vehicle and adapted to make traveling contact with said conductor; and an automatic pole-changing switch carried by, and reversible with, the current-collector and controlling the direction of flow of the current through said signaling device.

8. In an electric signal system, the combination, with a track of a line of way, of a conductor extending along the line of way and insulated from said track; a traveling current-collector carried by said vehicle and adapted to make traveling contact with said conductor; means for closing the circuit between the conductor and the track at a point distant from the vehicle; a source of electric energy; a pair of relays connected in a normally-closed local circuit with the source of energy, and also connected with opposite sides of the main circuit, and oppositely operative, on the passage of a current through either side of the main line, to send current in a corresponding direction through the indicator on the vehicle; circuit-controlling means between the source of energy and the relays; and a visual electrical indicator carried by said vehicle and in circuit with said current-collector and adapted to indicate variations in the distance between the vehicle and such point.

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Witnesses:
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WM. H. BLODGETT.