(No Model.) 4 Sheets—Sheet 1.

# A. B. HERRICK.

## ELECTRIC SIGNAL FOR RAILWAYS.

No. 507,125. Patented Oct. 24, 1893.

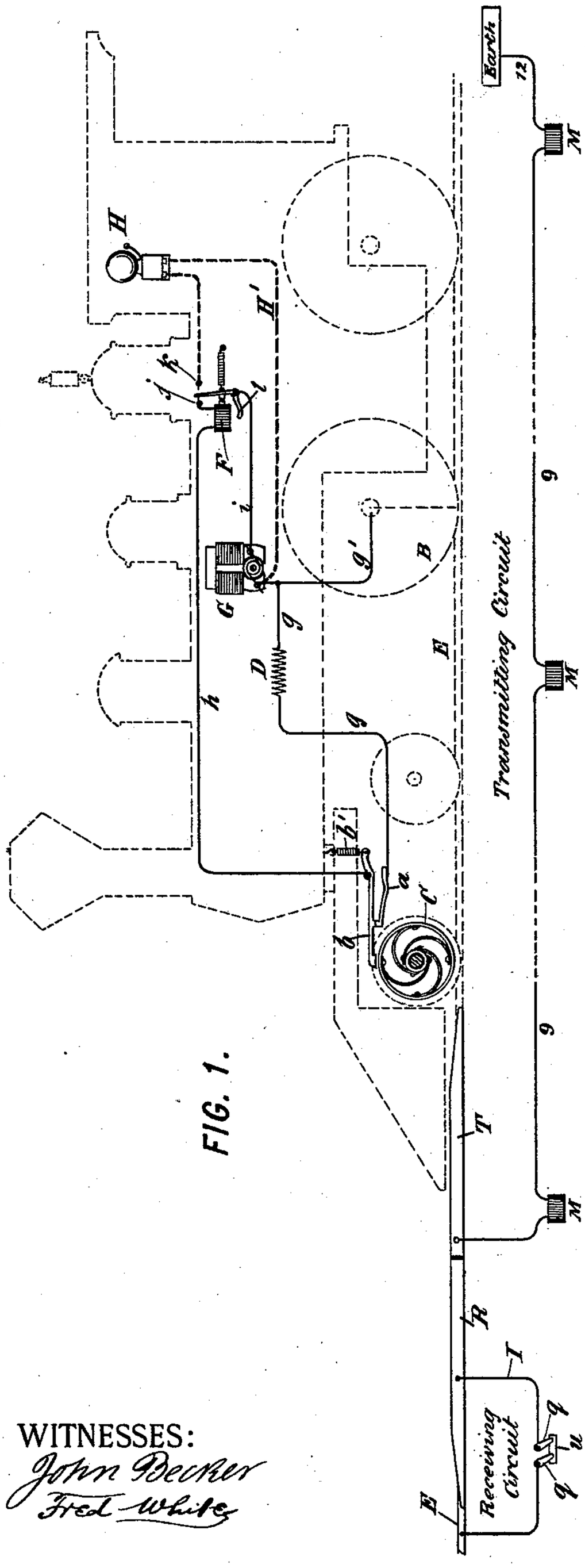


FIG. 1.

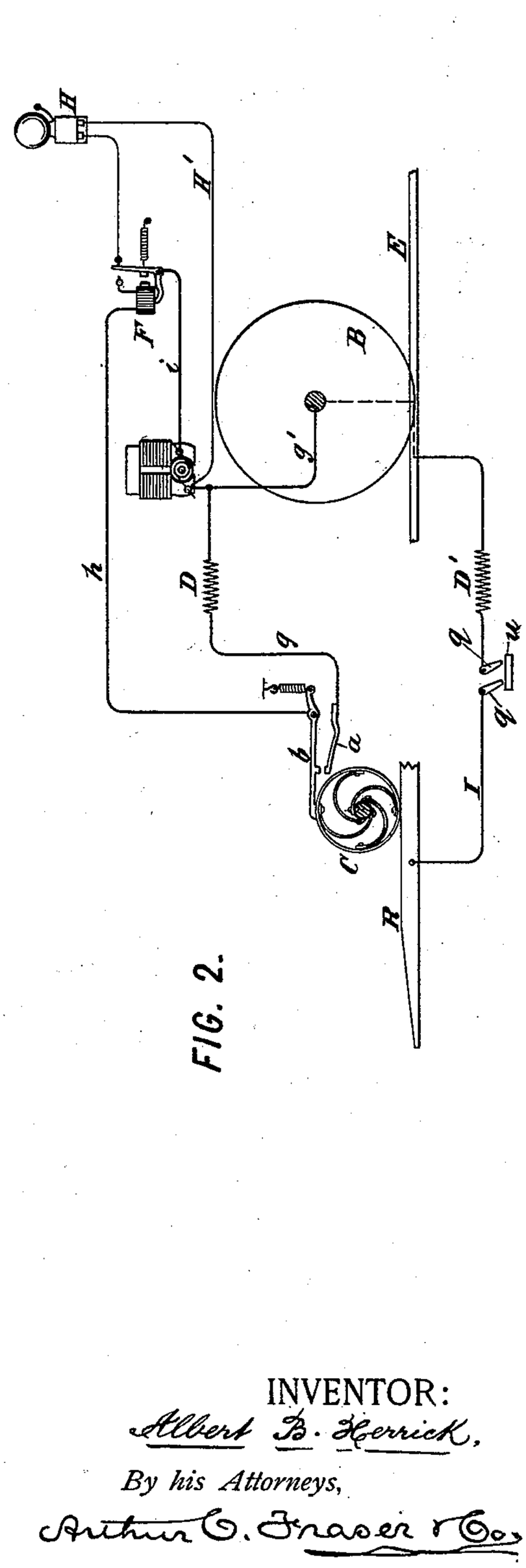


FIG. 2.

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(No Model.) 4 Sheets—Sheet 2.

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## ELECTRIC SIGNAL FOR RAILWAYS.

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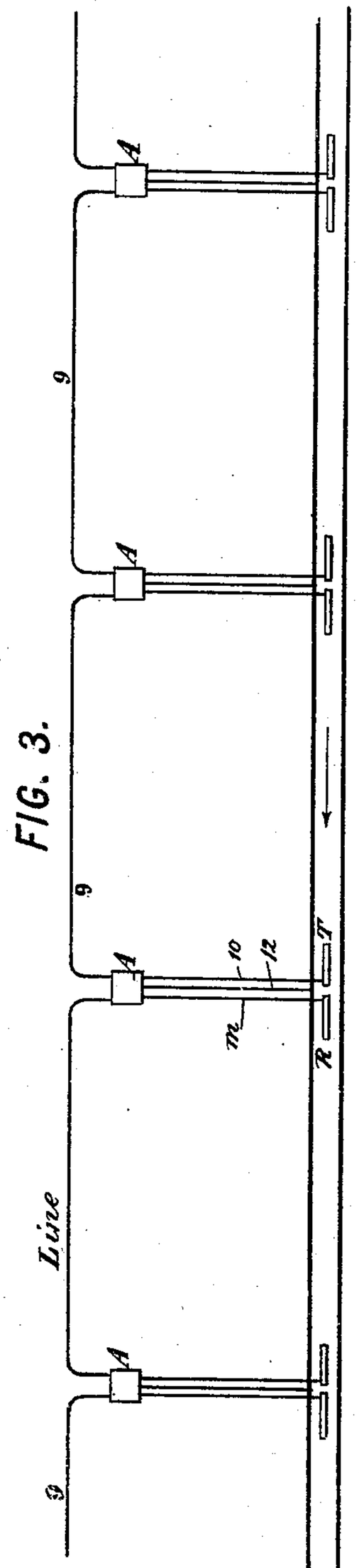


FIG. 3.

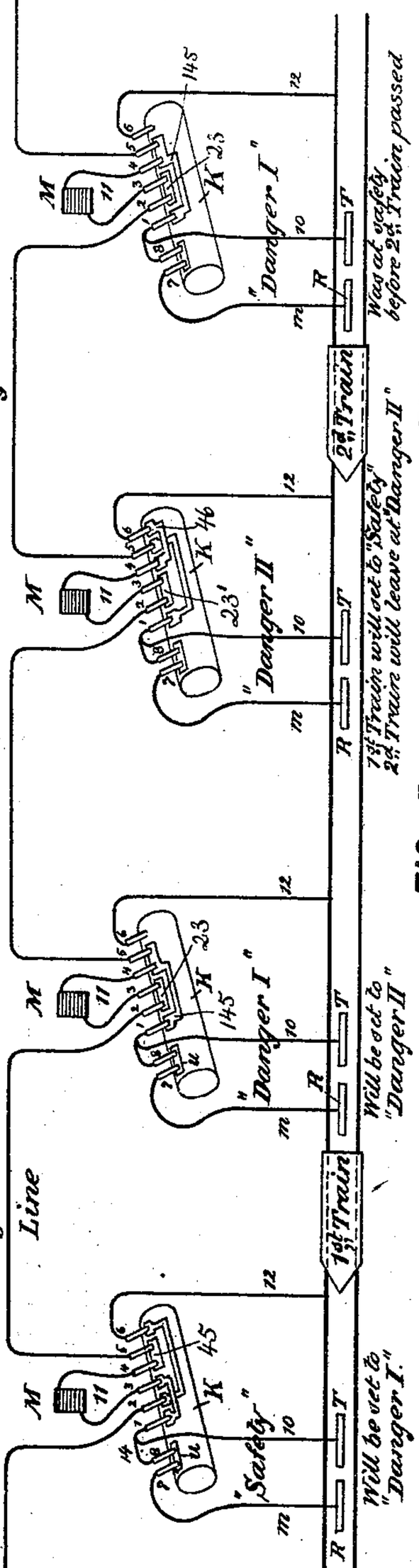


FIG. 4.

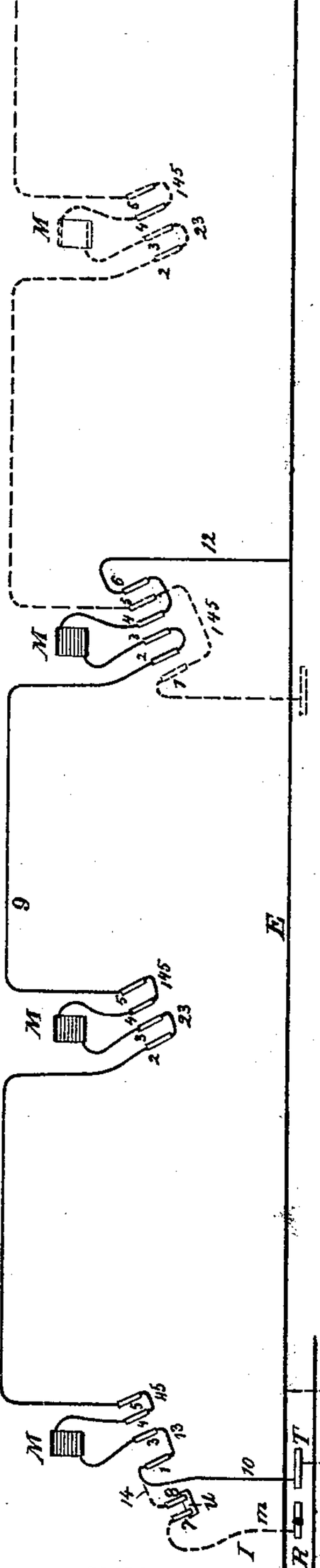


FIG. 6.




FIG. 5.




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## ELECTRIC SIGNAL FOR RAILWAYS.

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FIG. 7.

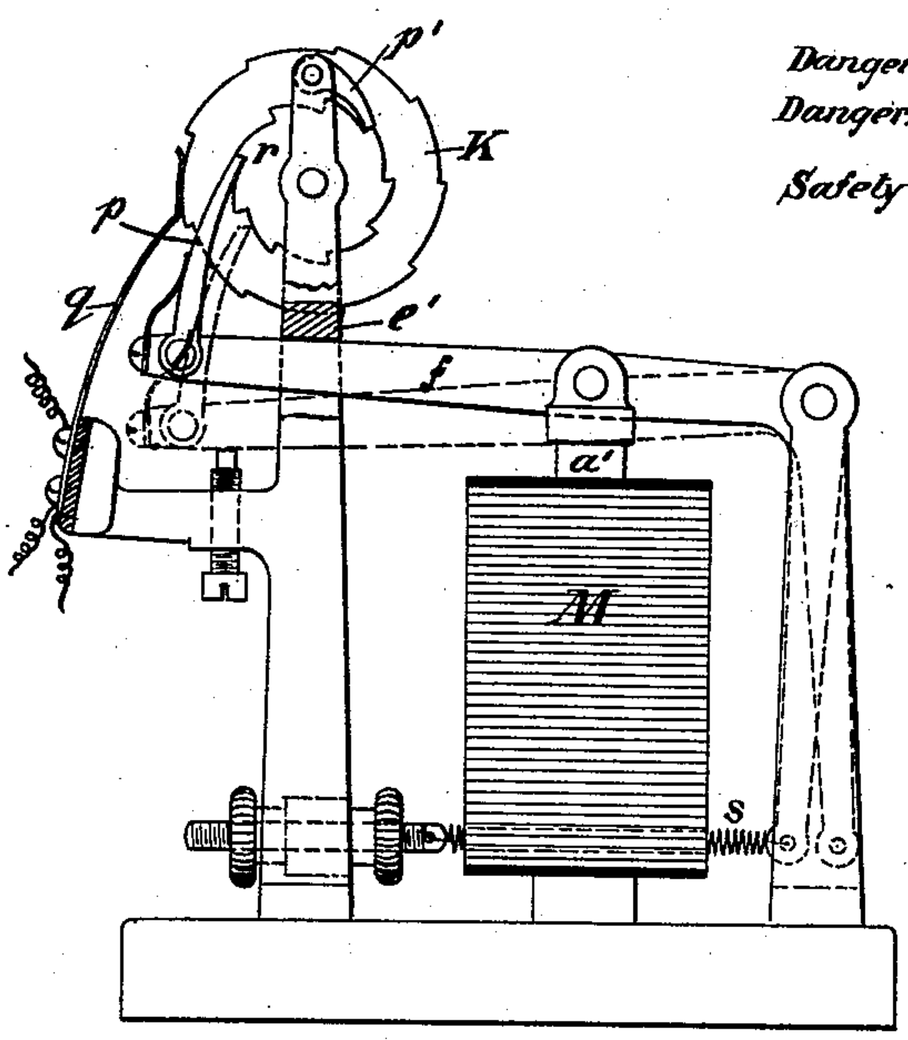



FIG. 8.

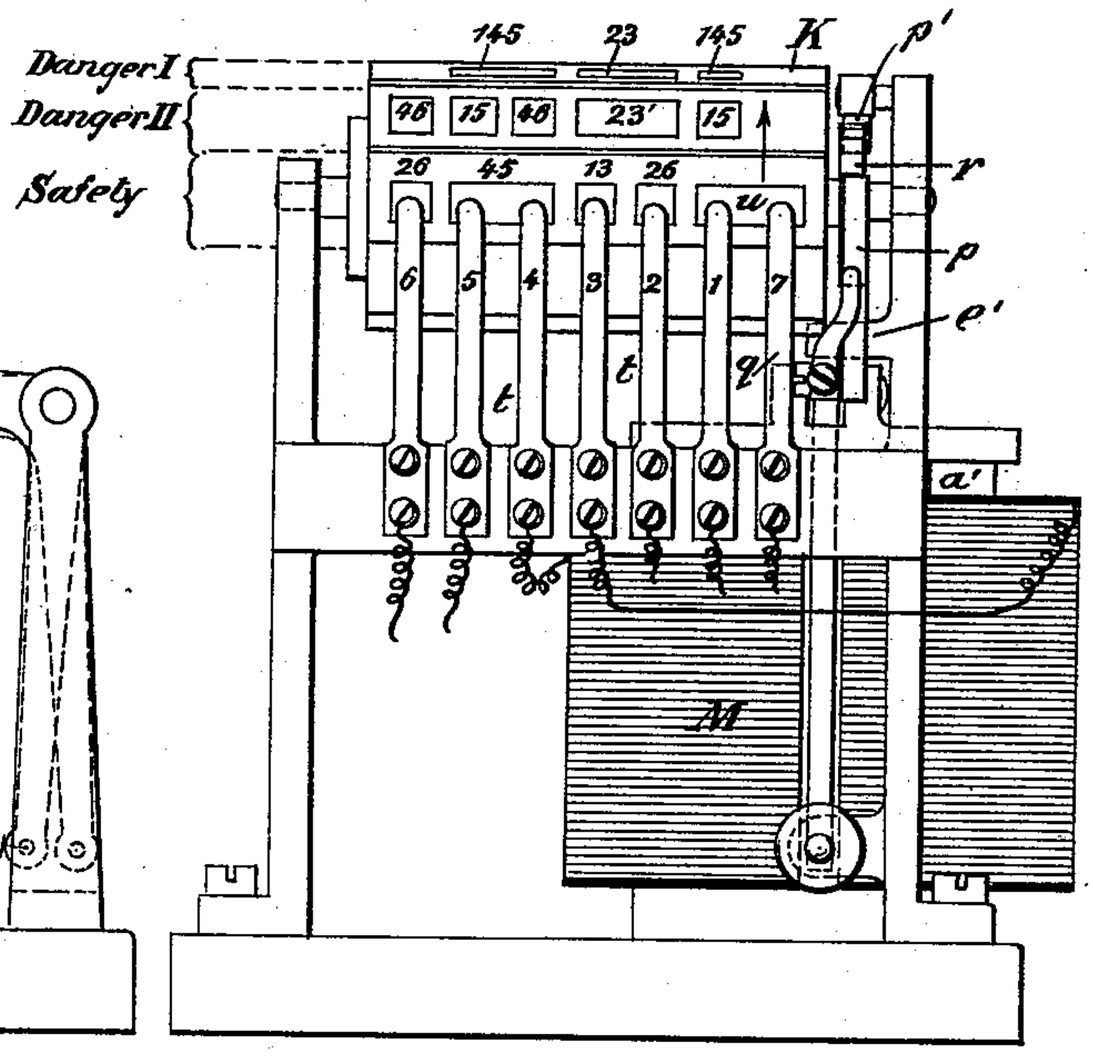
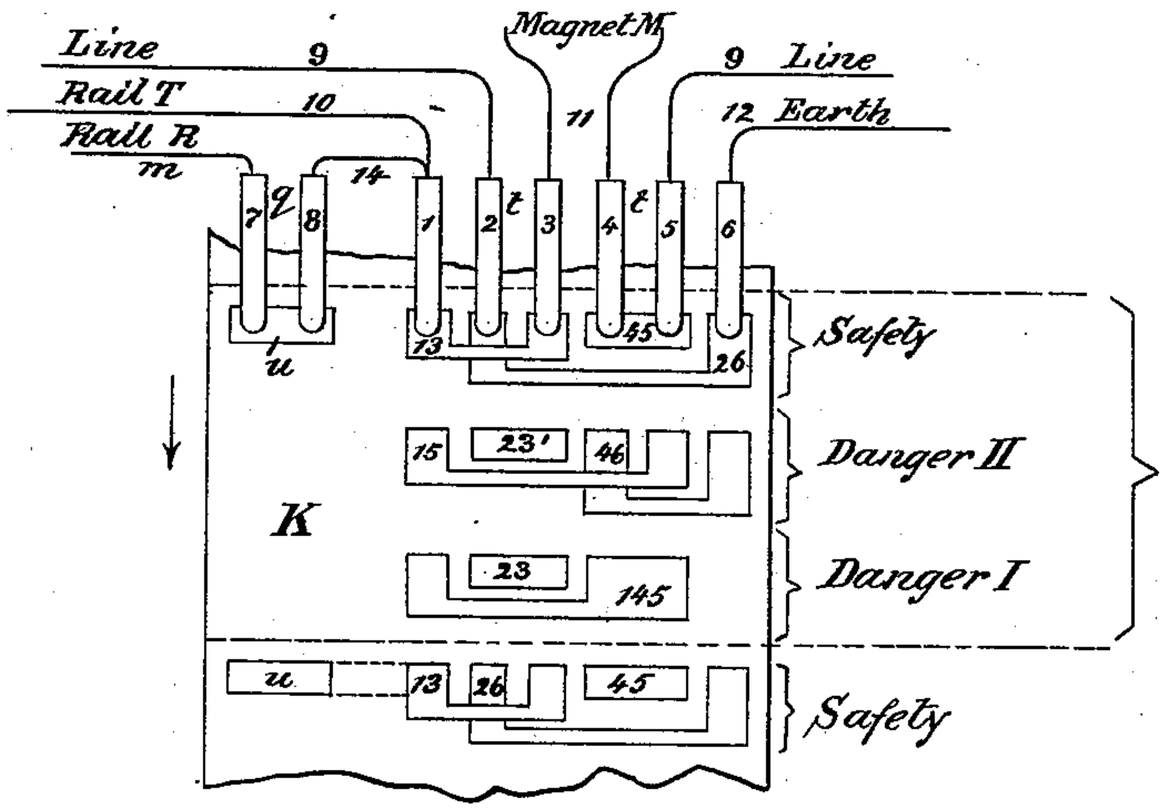



FIG. 9.

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# A. B. HERRICK.

## ELECTRIC SIGNAL FOR RAILWAYS.

No. 507,125. Patented Oct. 24, 1893.

FIG. 10.

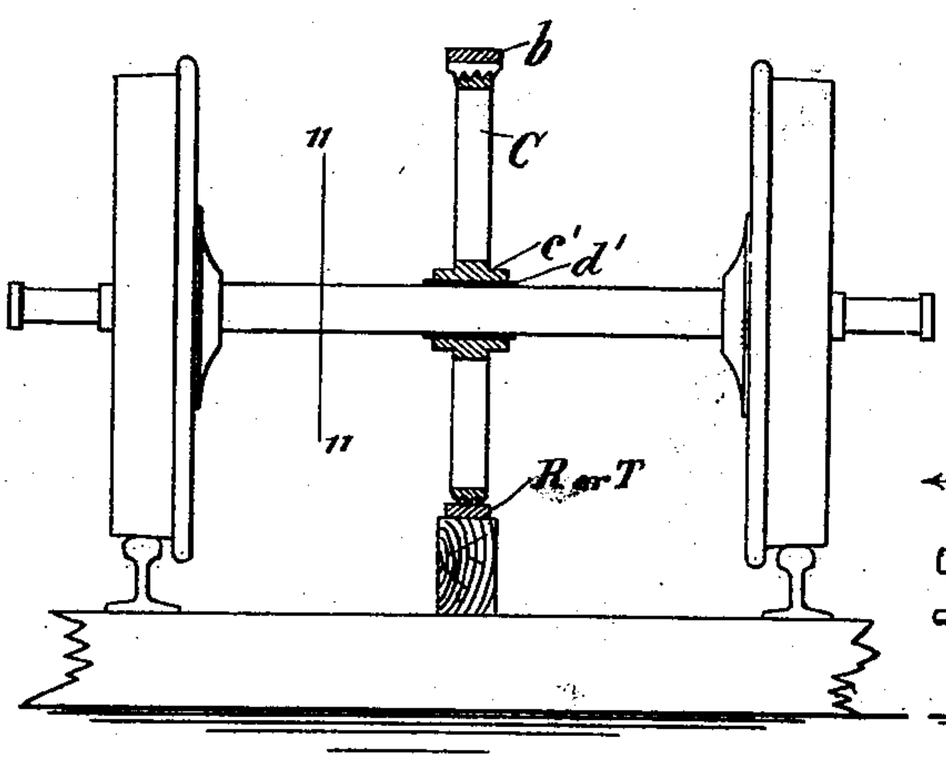



FIG. 11.

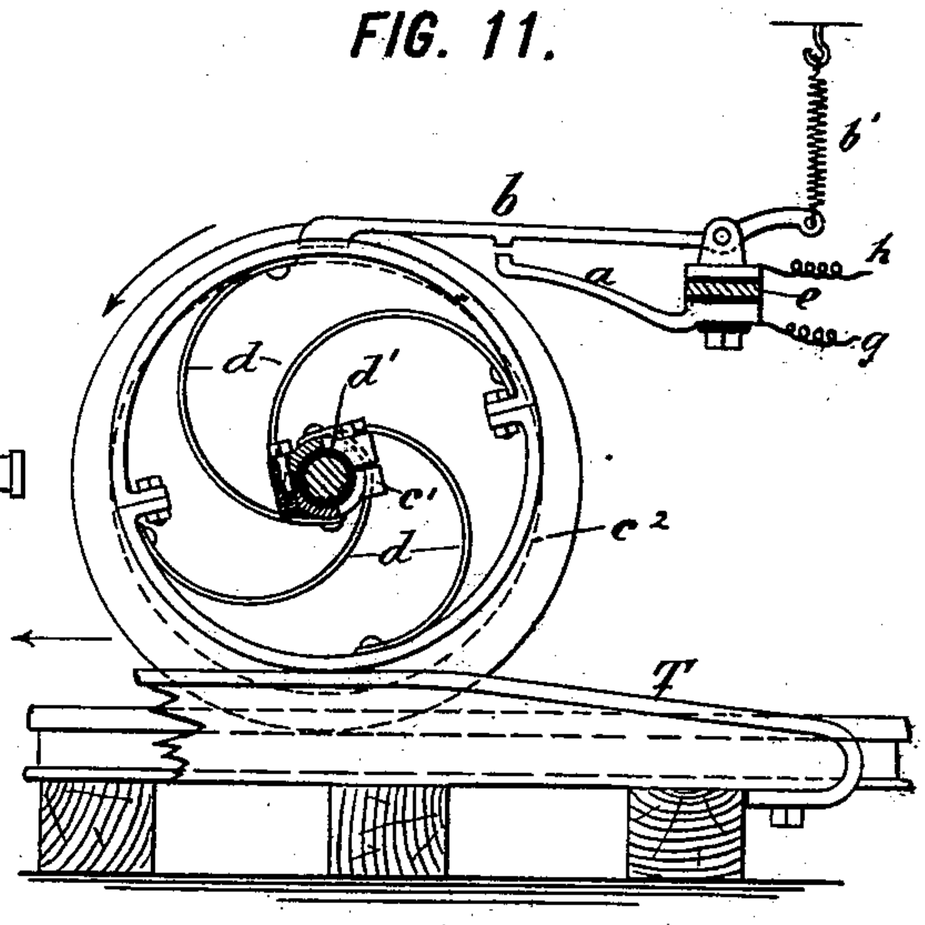
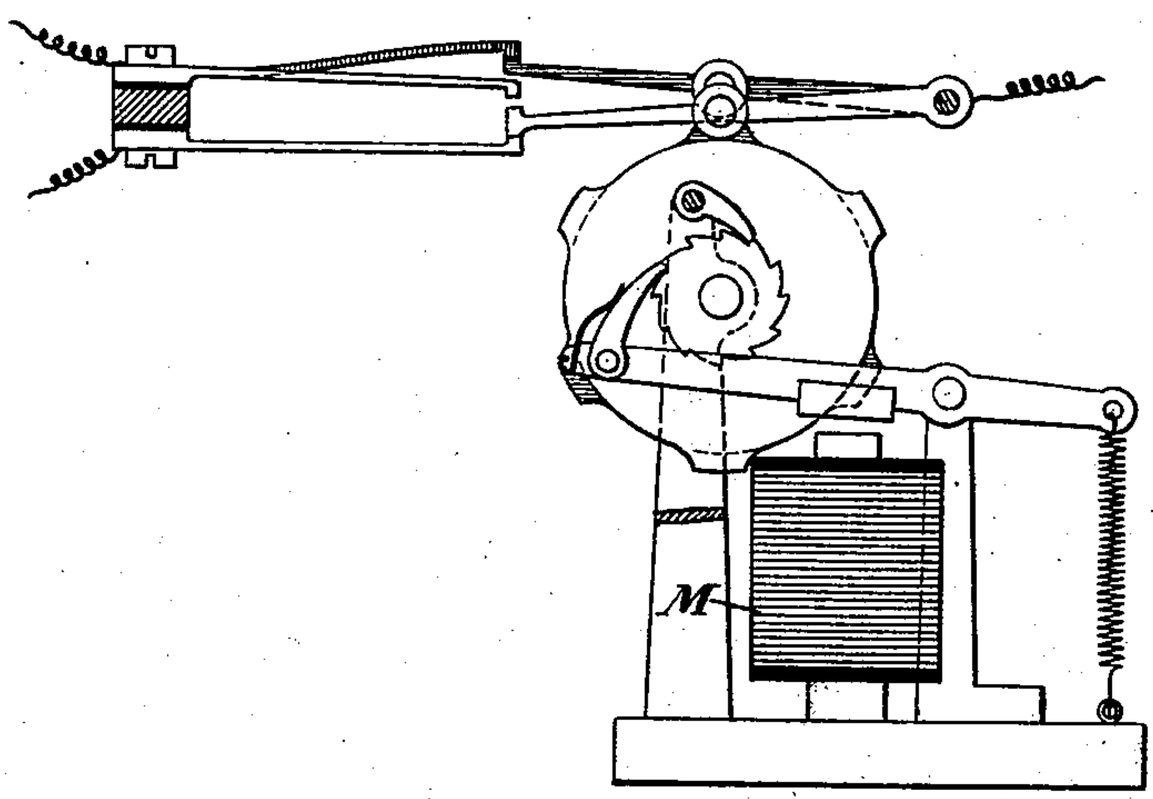



FIG. 12.

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# UNITED STATES PATENT OFFICE.

ALBERT B. HERRICK, OF BAYONNE, NEW JERSEY, ASSIGNOR TO ARTHUR C. FRASER, TRUSTEE, OF BROOKLYN, N. Y.

## ELECTRIC SIGNAL FOR RAILWAYS.

SPECIFICATION forming part of Letters Patent No. 507,125, dated October 24, 1893.

Application filed February 11, 1891. Serial No. 381,119. (No model.)

*To all whom it may concern:*

Be it known that I, ALBERT B. HERRICK, a citizen of the United States, residing in Bayonne, (Bergen Point,) in the county of Hudson and State of New Jersey, have invented certain new and useful Improvements in Electric Signals for Railways, of which the following is a specification.

This invention relates to electric signals of that class wherein a danger alarm or warning is given in the cab of a locomotive or at some other suitable part of the train, either by sounding a bell or whistle, or by bringing into view a visual signal or otherwise, in lieu of or in addition to the employment of semaphores or other visible signals upon the track.

It is well known that locomotive engineers frequently fail, especially in fogs or snowstorms, to see danger signals placed along the track, so that it is an important advantage of the class of signals to which my invention relates that the alarm is given in the cab where the engineer cannot fail to be cognizant of it.

My invention relates to that class of signals which employ contact rails or plates at intervals along the track wherever it is desired that the signal shall be received in case of danger, these rails being most conveniently arranged between the track rails; and wherein the locomotive carries a normally closed electric circuit on which normally a current is maintained by a dynamo or other generator, so that an electro-magnet in or in connection with this circuit is caused to restrain the signal or alarm device from acting. The arrangement is such that upon a cessation of current in this circuit, the electro-magnet will act and the alarm, being no longer restrained, will operate. A movable part is carried by the locomotive and arranged to come in contact with the contact rail on the track and be mechanically displaced thereby, and it is so connected with a circuit-breaker upon the locomotive that upon being so displaced it will operate it and break the local circuit. The said movable part is in connection with the portion of the local circuit on one side of the circuit breaker, and by its contact with the contact rail puts the latter in connection therewith. The circuit on the other side of the circuit breaker is connected to the wheels of the locomotive or is otherwise put into communication with the track rails to constitute essentially an earth circuit.

Each time the locomotive passes over a contact rail its local circuit is broken, and if no new circuit were formed the electro-magnet would act and give the alarm. When no alarm is to be given, however, a new circuit is formed through the contacting moving part, the contact rail, and an electric conductor connecting the contact rail with one or both of the track rails, and thence through the wheels and frame of the locomotive, the dynamo and electro-magnet being included in this newly formed circuit, so that the passage of the current is not interrupted and the electro-magnet cannot act. Provision is made that in case of danger this electric connection on the track shall be broken, thereby insuring that the circuit on the locomotive shall be interrupted and the electro-magnet shall act to give the alarm. For breaking this partial circuit, a relay has heretofore been employed actuated by connection with some remote signaling point on the line.

In order to leave a length of at least one block or section of track between a train and the point set to danger, which it leaves in its rear, what is called an overlapping block system has been employed. This system necessitates as heretofore proposed the employment of at least two line wires for each track, or if a metallic ground or return wire is employed, it requires three wires.

The most important object of my invention is to provide for operating the signal setting instruments through the medium of only one line wire, thereby saving the expense of an additional wire. My invention enables the blocks to be overlapped to the extent of a second, third or other additional number of blocks, or in other words it enables a trail of points set to danger to be left behind a passing train, the last point being restored to safety at the instant that a new signaling point is passed and set to danger.

Another object of my invention is to provide means for avoiding the varying of the current on the locomotive circuit at the instant it passes over a signaling point. Heretofore, on passing each point a heavy line re-

sistance has been thrown into series with the circuit on the locomotive, thereby greatly reducing the normal current. My invention introduces a means of balancing the resistances on the line and locomotive so that the total resistance in the circuit remains uniform whether the locomotive be running between points or crossing a signaling point.

Another object of my invention is to provide an improved contact device and circuit-breaker for the locomotive.

Figure 1 of the accompanying drawings is a side view of a locomotive equipped with circuits according to my invention, the circuits being shown diagrammatically. Fig. 2 shows the same circuits in the position of receiving a danger signal. Fig. 3 is a plan of one track of a double-track railway, showing the instrument boxes A A at the signaling points and the circuit connections exterior to these boxes. Fig. 4 shows the complete circuit connections. Fig. 5 shows the circuit to be traversed by the current from the first train in Fig. 4, and Fig. 6 the circuit to be traversed by the second train. Fig. 7 is a side elevation of the signal setting or commutating instrument which is inclosed in the box A. Fig. 8 is an end view of this instrument. Fig. 9 is a diagrammatic view showing the commutator brushes and a section of the commutating cylinder of this instrument. Fig. 10 is a transverse section of the track and contact-wheel applied to the axles of a pair of the wheels of a locomotive or tender. Fig. 11 is a longitudinal section of the track and of the axle, showing the contact wheel and circuit-breaker in side elevation. Fig. 12 is a side view showing a modification of the commutating instrument shown in Fig. 7.

Referring to Fig. 1, let G designate a dynamo or other generator of electric energy feeding a normally closed circuit *g h i*. This circuit includes the coil of an alarm magnet or relay F and the respective members of a circuit-breaker *a b*. The current normally flows from one brush of the dynamo through wire *i*, magnet F, wire *h*, circuit-breaking lever *b*, contact arm *a*, and wire *g* back to the other brush of the dynamo. A connection is also made with the frame of the locomotive or otherwise to establish a ground connection with the track rails, this circuit being designated by the line *g'*.

The locomotive carries a contact wheel or device C which is adapted to put the wire *h* of the circuit into communication with contact rails T and R in passing over them. This contact device may be constructed in any manner heretofore known in the art for the construction of circuit-breaking contact devices, but I prefer the construction shown which I consider an improvement thereon. This construction is best shown in Figs. 10 and 11. On the axle of any of the wheels of the locomotive or tender is clamped the two-part hub *c'* of the contact wheel C, so that this wheel revolves with the axle. It is constructed with elastic spokes *d d* and a light rim. In ordinary running, the rim is concentric with the axle, as shown by the dotted circle $c^2$ in Fig. 11, and its lower side projects down to perhaps an inch above the level of the track rails. In riding over the contact rails R or T, which project up to perhaps two inches above the level of the track rails, the wheel C in rolling onto them is lifted to the eccentric position shown in Figs. 2 and 11, its spokes *d* sufficiently resisting this displacement to keep its rim pressed down into firm contact with these rails. The rim of the wheel is insulated from the axle preferably by an insulating bushing *d'* interposed between the hub and the axle. Above the wheel and normally out of contact with it as shown in Fig. 1, projects the end of the contact lever *b*, which is normally pressed down by its spring *b'* into firm contact with the arm *a*. This contact lever and arm may be mounted on any suitable part, as for example on the frame *e* Fig. 11, which, in the case of a tender, may be some part of the frame of the tender-truck. When the wheel C is pressed upward by riding over a contact rail, its upper side is brought into contact with the end of the lever *b*, and it lifts the latter sufficiently to cause it to break contact with the arm *a*, thereby breaking the normally closed circuit on the locomotive. When riding off the contact rail, the elastic spokes of the wheel C cause it to resume its normal concentric position, so that it drops out of contact with the lever *b* and the latter drops back into contact with the arm *a*, restoring the normal circuit. While the wheel C is lifted, its rim is rubbing in metallic contact with the end of the lever *b* and consequently makes electric-connection therewith, so that the current may flow from the wire *h* through the lever *b* and wheel C to the contact rail. This construction of contact device is preferable to other devices for the same purpose heretofore proposed by reason of the greater lightness and less inertia of the parts which are displaced mechanically by the contact rails, and by the fact that the wheel C when it strikes the contact rail is revolving at the same speed as the wheels to which it is connected, so that it has not to be started from a condition of rest by its impact against the contact rail and consequently is subject to less shock. This wheel is also normally out of circuit. Being of somewhat smaller diameter than the track wheels, its periphery makes a rubbing contact with the contact rail as it rides over it. In order to avoid the insulation of the contact rail by a coating of ice over it, I construct the rim of the wheel C with sharp-edged grooves, as shown in Fig. 10, which as they ride over the contact rail, cut through any coating of ice, so that the ice is continually broken up by the passage of successive trains and cannot form in a thick cake sufficiently to prevent electric contact between the wheel and the rail being effected. The end of the lever

*b* is serrated in like manner, so that during the instant of contact its serrations enter the grooves in the contact wheel and keep them cleared of ice or dirt.

The circuit on the locomotive is normally closed, and the current flowing through it maintains the magnet F excited and its armature attracted. When, however, the wheel C is lifted by a contact rail and operates the circuit breaker, this circuit is broken, and if no other path for the current be established the magnet will release its armature, which by falling off causes the danger alarm to be given. This alarm may be given by any known means, either audibly or visibly. The danger alarm may consist of a whistle, bell or other device, but I prefer a rheotomic bell which may be operated from the magnet F acting as a relay; such a bell is shown at H in Fig. 1, being included in the circuit H′ shown in dotted lines, and which constitutes a shunt between the terminals of the dynamo, the wire *i*, and the armature lever of the magnet F and its stop *k* forming a part of this circuit.

Fig. 2 shows the engine in the act of receiving a danger signal at one of the signal points. Each of these points is provided with two contact rails, a receiving contact rail R and a transmitting contact rail T. The rail R is connected by a receiving circuit or connection I with one of the track rails E, while the transmitting rail T is in connection with the transmitting circuit as shown in Fig. 1. The general circuit arrangement is clearly shown in Fig. 3, where the signal box A at each station is connected by three wires with the rails E, R and T respectively, and by line wires with the boxes at the preceding and succeeding points. These boxes contain "signal setting instruments" which control the receiving circuit I in order to break or close it. This circuit includes two contact brushes *q q* which when the instrument is set to safety are electrically connected by a metal strip *u* as shown in Fig. 1, but when set to danger are disconnected by this strip *u* moving out of connection with them and leaving this circuit broken as shown in Fig. 2. If the instrument in the signal box is set to safety, the locomotive circuit although broken at *a b*, is nevertheless completed through lever *b*, wheel C, contact rail R, circuit I, track rail E, locomotive wheel B and circuit connection *g′*. But if the signal setting instrument is set to danger, the circuit is broken at *q u* in the branch I, and at *a b* on the locomotive, and the magnet F releases its armature, thus causing the alarm to be given.

On passing each signaling point, the contact wheel first rides over the transmitting rail T thereby sending a current over the transmitting circuit, which can be traced at a glance in Fig. 5, to the second station in the rear, where this circuit is grounded by connection with the track rail E, through which the current returns to the wheels and frame of the locomotive. The next instant the contact wheel passes into connection with the receiving rail R, and the current passes over the circuit I if the latter be closed, but if it be broken as shown in Fig. 2, the current is interrupted and the danger alarm is given.

It is obvious that the transmitting circuit shown in Fig. 5 necessarily has considerable resistance by reason of its two lengths of line wire and three magnets in series. The throwing of this resistance into the locomotive circuit necessarily reduces the current and consequently lowers the attractive force of the magnet F. To avoid this result, I introduce in the portion of the locomotive circuit which is cut out by the operation of the circuit-breaker *a b*, a resistance D as shown in Figs. 1 and 2, which is preferably equal to or approximates the resistance of the line. Consequently the normal current traversing the locomotive circuit is that which, with the given electro-motive force of the dynamo, will flow against this resistance, and at the instant of passing over the transmitting rail the current has no effect since the resistance of the line is thrown into circuit at the same instant that this resistance is cut out of circuit. Obviously that which determines the electro-motive force is the resistance to be overcome and the work to be done over the line in transmitting;—in other words, the dynamo must furnish sufficient power to do this work. With the arrangement heretofore adopted, a dynamo having a sufficient electro-motive force to do this work would necessarily generate a much greater current in the locomotive circuit while running between signaling points, during which time it is being practically short-circuited. This useless work entails expenditure of power and useless heating of the magnets and armature. By my invention of the introduction of this resistance D in the locomotive circuit to replace the line resistance while running between signaling points, the work of the dynamo is reduced, the expenditure of power diminished, heating is avoided, and the current is maintained uniform under all conditions, except when a danger signal is received.

To render my improvement fully available, it is desirable that the receiving circuit I instead of being a mere short-circuit as shown in Fig. 1 of practically no resistance, shall have the same resistance as the transmitting circuit, in order that the current on the locomotive circuit shall not be increased when passing a signal point that is set to safety. To this end I may introduce a resistance D′ into this circuit as shown in Fig. 2, equal to the resistance D. But to avoid the complication of providing such a resistance at each signaling point, I propose to utilize the line resistance of the transmitting circuit in a manner to be hereinafter explained.

I will now proceed to describe that part of my invention whereby one line wire is en-

abled to be used in the place of the two or more heretofore necessary. Heretofore the receiving circuit has been broken or closed by means usually of a relay operated by two magnets, one setting it to danger by a current from a passing locomotive, and the other setting it to safety by a current from a locomotive one, two or three points in advance. The excitation of the latter magnet from the points in advance necessitated a special wire for each magnet so that if it were worked two points in advance two line wires for each track are required. This relay is superseded according to my present invention by the signal setting instrument shown in Figs. 7 and 8 and diagrammatically in Fig. 4. This instrument is constructed with an electro-magnet or solenoid M, (a solenoid being shown) the movable member or core $a'$ of which is connected to a lever $f$ which is retracted by a spring $s$ against a stop $e'$. This lever carries a pawl $p$ which works in the teeth of a ratchet-wheel $r$ having an arresting pawl $p'$ to prevent back motion. The wheel $r$ may have any multiple of three (or more) teeth. In the construction shown it has nine teeth. When the current is sent through the magnet M it draws down the lever $f$ to the position shown in dotted lines, carrying the pawl $p$ into engagement with the next tooth of the wheel $r$, but without turning this wheel. Upon the cessation of the current the spring $s$ restores the lever and the pawl turns the ratchet-wheel the distance of one tooth. This ratchet-wheel is connected to a commutating cylinder K, the periphery of which is divided into as many spaces as the number of teeth to the wheel $r$. This cylinder, being made of wood, vulcanite or other non-conducting material, has fixed upon its surface conducting plates or strips of metal, after the manner shown in Figs. 8 and 9, in order to effect different electrical connections with certain conducting brushes $q$ and $t$. The brushes $q$ are for receiving a signal as already described, and the brushes $t$ are for transmitting. These latter are numbered successively 1, 2, 3, 4, 5 and 6. The commutator cylinder is formed with multiples of three series of contacts corresponding to the three different conditions of each signaling instrument, and designated respectively by "Danger I", "Danger II" and "Safety." In the "safety" position the receiving brushes $q$ (numbered 7 and 8) are connected by a metal plate $u$; transmitting brushes 1 and 3 are connected by a plate 13; brushes 2 and 6 by a plate 26; and brushes 4 and 5 by a plate 45. In the "Danger II" position, brushes 1 and 5 are connected by plate 15; 2 and 3 by plate 23′; and 4 and 6 by plate 46. In the "Danger I" position, brushes 2 and 3 are connected by plate 23; and brushes 1, 4, and 5 by plate 145.

The circuit arrangements are clearly shown in Fig. 4. From the transmitting rail T a wire 10 leads to brush 1; brush 2 is connected to the line wire 9 leading to the station in advance; brushes 3 and 4 are connected to the opposite terminals of a loop 11 which includes the coils of magnet M; brush 5 is connected to the line wire 9 leading to the rear; and brush 6 is connected by line wire 12 to the earth or to the rail E. Three successive signaling points being set respectively to "Danger II", "Danger I" and "safety" as shown, the respective connections give a continuous circuit from Point 12 back to Point 10 and returning through the rail E or earth as shown by full lines in Fig. 5. The receiving circuit I, shown by dotted lines in Fig. 5, extends by wire $m$ from receiving rail R to brush 7, plate $u$, brush 8, wire 14, and thence over the transmitting circuit to the second station in the rear, as shown in Fig. 5, so that thereby the resistance of the transmitting circuit is included in the receiving circuit.

The operation may now be understood. We will assume a train to be in the position marked "1st. train" in Fig. 4, "Point 12," being set to "safety" and "Points 10" and "11" to "danger." The "2nd. train" may for the present be disregarded. On reaching "Point 12," the locomotive first makes connection with the transmitting rail T, and sends a current through wire 10, brush 1, commutator plate 13, brush 3, magnet M, brush 4, commutator plate 45, brush 5, and over the line 9 to "Point 11;" passing then by brush 2, commutator plate 23, brush 3, magnet M, brush 4, commutator plate 145, brush 5, to line wire 9, extending back to "Point 10;" at that point by brush 2, commutator plate 23′, brush 3, magnet M, brush 4, commutator plate 46, brush 6, and wire 12 to the earth or track rail, and back through this rail to the transmitting point, where it completes the circuit through the wheels and frame of the locomotive. This circuit may be clearly traced in Fig. 5. The momentary current from the locomotive in passing over the rail T thus energizes the three magnets at "Points 12," "11" and "10," so that each attracts its armature, and upon the cessation of the current the retraction of these armatures rotates the commutating cylinder of each instrument forward one space, thereby setting "Point 12" to "Danger I," "Point 11" to "Danger II," and "Point 10" to "safety." Thus as the locomotive proceeds it sets each signaling point as it passes to "danger," leaves the preceding signaling point at "danger," and sets the second point in the rear to "safety," thereby clearing the line for the next following train. The following train will receive two danger alarms before it can collide with its predecessor. By a different arrangement of circuits and instruments any desired number of signaling points in the rear may be left at "danger," and the point last passed over may be left either at "danger" or "safety," being set in the latter case to "danger" after the locomotive has passed to one or more signaling points in advance.

In case a second train follows so closely after the first as to receive danger signals left thereby, it is able to telegraph back to set the last signal in its rear to safety, but does not affect the signaling instrument from which it receives the danger signal. If it were to send a current through the magnet M at the station it is passing, if this station were already set to "Danger II," it would set it forward one space to "safety," thereby leaving a delusive safety signal behind instead of a danger signal. To avoid this, I so construct the commutator that if a train finds a signaling instrument set to danger it leaves it at danger, but if it finds it set to safety it sets it to danger. This is accomplished by the arrangement of the magnet M in the loop 11, terminating in brushes 3 and 4, and controlled by the commutator plates. It will be seen that in the positions "Danger I" and "Danger II," the wire 10 and brush 1 are connected not through magnet M as in the safety position, but directly with the line through commutator plates 145 or 15 respectively. To illustrate:—Referring to Fig 4, let us assume that the "2nd. train" will reach "Point 10" before the "1st. train" reaches "Point 12." The "2nd. train" will then find "Point 10" set to "Danger II" and will send a current over the circuit shown in Fig. 6, thereby avoiding magnet M at "Point 10," but including magnets M in the rear. It thus has no effect upon the instrument at "Point 10," which it leaves at danger as it found it. Heretofore in railway signals of this class it has been customary to arrange the parts in such manner that the locomotive on reaching a signaling point would first receive the safety or danger signal, and subsequently would transmit a current back over the line to set the instruments in its rear. This was done in order to avoid receiving the signal that the locomotive itself has just set, as would ordinarily result from first transmitting and subsequently receiving the signal. By preference I reverse the previous arrangement, arranging the transmitting rail T to be first encountered by the train, and the receiving rail R to be subsequently reached. By this means the transmission of the signal to the rear is first effected, and subsequently the signal set by the previous train is received. To avoid the displacement of the local signal-setting instrument before the reception of this signal, or in other words the effacing of the signal left by the preceding train before it has been received, I arrange that the current sent over the receiving circuit, if the latter be not broken, shall traverse the coils of the magnet M, thereby keeping the latter excited and preventing the retraction of its armature and the advancement of the commutator. This enables me to adopt the construction of the locomotive circuits shown in Fig. 1, wherein the magnet F constitutes a relay for its own circuit as well as for the bell circuit H', the normal locomotive circuit traversing the armature lever of this magnet and its stop. Upon the breaking of the circuit at the instant of receiving a danger signal, the demagnetization of the magnet F causes its armature to be retracted against the stop *k*, so that the instant it breaks contact with the stop *j* it makes a second break in the normal locomotive circuit, the advantage of which is, that if the duration of the break is so short that the armature would not ordinarily have time to drop fully back and consequently upon the resumption of the current would be re-attracted thereby suppressing a danger alarm, this re-attraction is prevented by the breaking of the normal circuit at the first of the retractile movements of the armature. This has been a desideratum heretofore, but could not be realized because with the normal circuit thus broken no impulse can be sent back over the line upon subsequently reaching the transmitting position. Upon the falling off of the armature, the bell circuit H' is closed and the bell H will continue to ring until the engineer by pulling down on a handle *l* restores the armature lever against the stop *j*, thereby re-establishing the normal circuit.

By making the receiving circuit I a part of the line or transmitting circuit, I give it the same resistance as the transmitting circuit and avoid the necessity of introducing a special resistance D' as shown in Fig. 2. If the line resistance and the resistance D in the locomotive circuit are uniform, as they should be, the current traversing the locomotive circuit will be uniform so long as the electromotive force of the dynamo G is unchanged.

My improved signal-setting instrument may be simplified by re-arranging the brushes and connections. For example, the receiving brush 8 might be omitted by extending the plate *u* to form part of the plate 13, as indicated by dotted lines in Fig. 9, and as shown in Fig. 8. Other analogous changes might also be made to reduce the number of brushes and commutating plates, but the construction shown is the most simple of comprehension, as it makes the various connections more clear.

It is preferable to make the commutator cylinder with steps or teeth on its periphery or contacting surface, as best shown in Fig. 7, in order that the contact-springs *q t* may make a positive break in snapping from one tooth or ledge to the next as the cylinder is turned, thereby reducing sparking and contributing to keep the contact surfaces bright.

My improved signal-setting instrument is not confined in its application to the use of separate contact-rails T and R, but may be used with those systems of signaling wherein at each signaling point one of the track rails is insulated from the preceding and succeeding rails, as shown for example in Patent No. 243,619, dated June 28, 1881.

In applying my invention, the connection of one terminal of a locomotive circuit to one

of the locomotive wheels B is selected as the most convenient means for connecting this terminal of the circuit to the track rail. Any other contact terminal for making connection with the track rail, may, however, be substituted, such as springs or brushes sliding in contact with the track rail. The portion of the locomotive circuit which is opened and closed by the circuit-breaker, is essentially a circuit-completing connection for normally completing or closing the partial circuit on the locomotive the opposite terminals of which are the wheels B and C. It is not essential that this entire circuit shall be closed by such circuit closing connection, it being sufficient that the portion of the circuit including the dynamo and including or controlling the signaling electro-magnet F be thus completed, to be broken upon the separation of the circuit breaker contacts.

The contact device which makes contact with the contact rail is preferably of the construction described, but any other suitably arranged electrical contacting part may be substituted if it be adapted for establishing electric connection with the contact rail, and also by the same movement to break the circuit at the circuit-breaking contact *a*.

My invention may be otherwise modified in its practical application without departing from its essential features.

My improved signal-setting instrument comprises essentially a commutator for changing the circuit connections, and an electro-magnet or other analogous or equivalent electro-motive device for operating the commutator. By the word "commutator" I mean not necessarily a rotary part itself comprising or carrying the circuit making or transposing contacts, but any progressively moving part operated by the magnet and through or by the rotation of which the necessary changes in the circuit connections are effected. For example, these circuit changes might be effected by circuit breakers operated through cams carried by a cylinder rotated intermittently by the electro-magnet, as shown in Fig. 12.

I make no claim in this application to the employment on a locomotive of a circuit-breaking contact device which breaks the normal locomotive circuit coincidently with making electrical contact with a contact plate on or along the track.

I claim as my invention the following-defined novel features or improvements, substantially as hereinbefore specified, namely:

1. In an electric railway signal, the combination with a railway track divided into blocks or sections by signaling points at intervals, of a line wire along the track, and signal-setting instruments at the signaling points in connection with said line wire, and comprising each an electro-magnet and a circuit-changing device having electric terminals in connection with the line in advance and in rear, and with the earth, and adapted upon the receipt of a signal by the excitation of said magnet to ground the line circuit, whereby a succession of such instruments may be operated with but a single line wire.

2. In an electric railway signal, the combination with a railway track divided into blocks or sections by signaling points at intervals, of a line wire along the track, and signal-setting instruments at the signaling points in connection with said line wire and comprising each an actuating electro-magnet, and a circuit-changing device constructed to connect the line wire in one position with the station in the rear and in another position with the ground.

3. In an electric railway signal, the combination with a railway track divided into blocks or sections by signaling points at intervals, of a line wire along the track, and signal-setting instruments at the signaling points in connection with said line wire and comprising each an actuating electro-magnet, and a circuit-changing device having circuit-connections with the line and ground, and constructed in one position to connect the line in advance through the magnet with the line in the rear, in another position to connect it through the magnet to ground, and in a third position to connect it directly to ground.

4. In an electric railway signal, the combination with a railway track divided into blocks or sections by signaling points at intervals, of a line wire along the track and signal-setting instruments at the signaling points in connection with said line wire and comprising each an actuating electro-magnet and a circuit-changing device operated thereby in substantially the manner described, having connections with the line in advance and in the rear, and with earth, such connection arranged substantially as described, whereby the instruments at two or more successive points behind a train are set to "danger" and connected through the line, and each impulse from the advancing train sets a new instrument to "danger" and sets the last one in circuit to "safety," thereby operating a trail of danger signals over one wire.

5. A signal-setting instrument for railway block signaling, consisting of the combination of a rotative commutator or circuit-changer, a ratchet-wheel connected thereto, a pawl, an electro-magnet with its movable member or armature connected to said pawl and adapted upon the excitation of the magnet to retract the pawl, the retractile spring for said armature adapted upon the release thereof to advance the pawl and turn the ratchet and commutator forward, and circuit-connections with the line in advance, with the line in rear, with the ground, and with a signal-receiving point, governed by said commutator.

6. In an electric railway signal, the combination with a railway track divided into blocks or sections by signaling points at intervals, of a contact-rail at each point, an electro-magnetic signal-setting instrument at each point, electric connections from said instru-

ment to said rail and to the track-rails respectively, and a line wire connecting together the successive instruments, and said instruments having terminal connections with the line in advance and in rear, and with the earth, and having a commutator with conducting portions arranged in intermediate positions to connect the line wires together, and in a final or "safety" position to connect the line in advance to earth, all constructed so that a train will leave two or more instruments behind it set to "danger" and with their actuating-magnets in connection with the line, and upon passing each point will set its instrument to "danger" and restore the last "danger" instrument to "safety" and ground the line.

7. In an electric railway signal, the combination with a railway track divided into blocks or sections by signaling points at intervals, of a contact-rail at each point, a signal-setting instrument at each point, electric connections from said instrument to said rail and to the track-rails respectively, and a line wire connecting together the successive instruments, and each instrument comprising an actuating electro-magnet and a circuit-changer movable thereby to "danger" and "safety" positions, in the safety position connecting the contact-rail with the line in the rear through said magnet, and in the danger position connecting the line in advance through said magnet to operate it from a point in advance, and cutting the magnet out of the connection between the contact-rail and the line in the rear, whereby a passing train will set the instrument from safety to danger, but if it is already at danger will not operate it.

8. In an electric railway signal, a locomotive carrying a partial electric circuit terminating in rail connections and including a current generator, combined with a track having signaling points at intervals, a partial signal-receiving circuit at each point, terminating in rail-connections, a line-circuit, a signal-setting instrument at each signaling point for controlling the signal-receiving circuit, terminal rail-connections and earth and line connections leading to said instruments, and each of said instruments comprising an electro-magnet, and a commutator actuated thereby for controlling the respective circuit-connections, adapted to connect the line in advance successively with the line in the rear and with the earth, whereby two or more signaling points may be operated over a single line wire.

9. In an electric railway signal comprising a normally closed locomotive circuit having terminals in a ground connection and in a circuit-breaking contact-device to touch and be displaced by a contact-rail along the track forming a terminal of a track-circuit, the combination therewith of a resistance introduced in the part of the locomotive circuit which is cut out by the circuit-breaker, whereby when the resistance of the track-circuit is thrown in this resistance is cut out.

10 In an electric railway signal comprising a normally closed locomotive circuit having terminals in a ground connection and in a circuit-breaking contact-device to touch and be displaced by a contact-rail along the track forming a terminal of a track-circuit, the combination therewith of a resistance introduced in the part of the locomotive circuit which is cut out by the circuit-breaker, said resistance being equal to the resistance of the track-circuit, whereby the current in the locomotive circuit is unaffected by the throwing in of the track-circuit.

11. In an electric railway signal comprising two successive contact-rails at each signaling point, a signal-receiving circuit terminating in one of said rails and a signal-transmitting or line circuit terminating in the other, and a normally closed circuit carried by the locomotive having terminals in a ground connection and in a circuit-breaking contact-device to touch and be displaced by said contact-rails, the combination therewith of a resistance, approximately equal to that of the transmitting circuit, introduced in the part of the locomotive circuit which is cut out by said circuit-breaker, and a similar resistance introduced in the signal-receiving circuit, whereby the current in the locomotive circuit is substantially unaffected by the throwing in of either track-circuit.

12. In an electric railway signal comprising two successive contact-rails at each signaling point, a signal-receiving circuit terminating in one of said rails and a signal-transmitting or line circuit terminating in the other, and a normally closed circuit carried by the locomotive having terminals in a ground connection and in a circuit-breaking contact-device to touch and be displaced by said contact rails, the combination therewith of a resistance, approximately equal to that of the transmitting circuit, introduced in the part of the locomotive circuit which is cut out by said circuit-breaker, and a similar resistance introduced in the signal-receiving circuit, by arranging this circuit to traverse the transmitting circuit, whereby the provision of a separate resistance for the receiving circuit is avoided.

13. In an electric railway signal comprising two successive contact-rails at each signaling point, a signal-receiving circuit terminating in one of said rails and a signal-transmitting or line circuit terminating in the other, and a normally closed circuit carried by the locomotive having terminals in a ground connection and in a contact-device to touch and be displaced by said contact rails, the construction of said contact-rails as a continuation one of the other with their adjacent ends electrically separated or insulated and their remote ends inclined downwardly, whereby the contact-device in passing over said rails is dis-

placed by the inclined end of the first rail and is held displaced during its passage over the interval between the rails and until it rides down the inclined end of the second rail, so that the signal-receiving and transmitting are performed in immediate succession and during a single displacement of the contact device.

14. In an electric railway signal comprising a normally closed locomotive circuit having terminals in a ground connection and in a circuit-breaking contact-device to touch and be displaced by a contact-rail along the track and including a generator and a circuit-breaking alarm magnet, the armature lever of which is normally attracted but upon its release breaks the circuit by its retraction, the combination therewith of two successive contact-rails at each signaling point, a signal-transmitting or line circuit terminating in the first of said rails, a signal-receiving circuit terminating in the second thereof, and a signal-setting instrument comprising a circuit-breaker introduced in said receiving circuit and an actuating electro-magnet included in the transmitting circuit, said contact rails being arranged in immediate succession so that the second may be touched by the contact-device before it breaks contact with the first, and the signal-receiving circuit arranged to include the coil of said magnet, whereby an electric impulse is first sent through the signal-transmitting circuit energizing the magnet of the signal-setting instrument, and immediately thereafter, if the signal-receiving circuit be closed, an impulse is sent through the latter maintaining the excitation of said magnet and delaying its action on the signal-setting instrument until the locomotive contact-device passes beyond the signal-receiving rail, but if the signal-receiving circuit be broken, it momentarily breaks the locomotive circuit and the retraction of the armature of the alarm magnet effects a second break in said circuit.

15. In an electric railway signal, the combination with a locomotive carrying an electric circuit, of a contact device adapted to connect one terminal of said circuit with a contact rail or plate along the track consisting of a wheel comprising a hub mounted on but insulated from the axle of a pair of track wheels, a light annular rim, and elastic spokes connecting the rim and the hub, whereby on encountering a contact rail the rim of the wheel is forced thereby into an eccentric position against the tension of the spokes.

16. In an electric railway signal, the combination of a locomotive carrying an electric circuit, of a circuit-breaking contact-device adapted to break said circuit and connect one terminal thereof with a contact rail along the track consisting of a contact wheel mounted on but insulated from the axle of a pair of track wheels and constructed with its rim elastically supported, so that upon encountering a contact rail it may be forced upwardly thereby into an eccentric position, and a circuit-breaking arm normally resting against a contact stop and projecting over some part of said wheel, whereby upon the displacement of the wheel it lifts said arm out of contact with said stop, thereby breaking the circuit and forming a new connection through the arm and wheel with the contact rail.

In witness whereof I have hereunto signed my name in the presence of two subscribing witnesses.

ALBERT B. HERRICK.

Witnesses:
ARTHUR C. FRASER,
GEORGE H. FRASER.