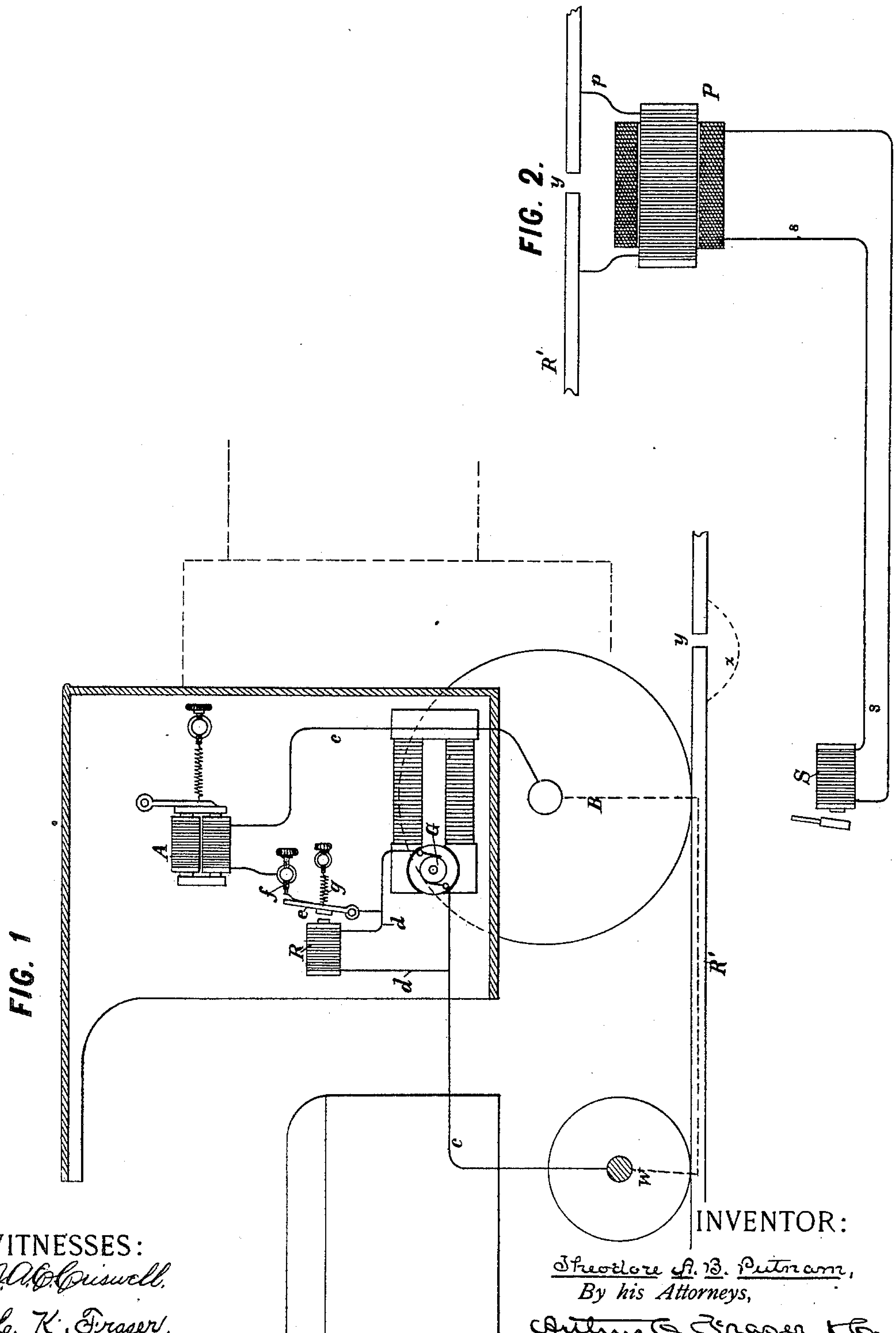
(No Model.) 2 Sheets—Sheet 1.

T. A. B. PUTNAM.

ELECTRIC RAILWAY SIGNAL.

No. 399,556. Patented Mar. 12, 1889.



WITNESSES:

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INVENTOR:

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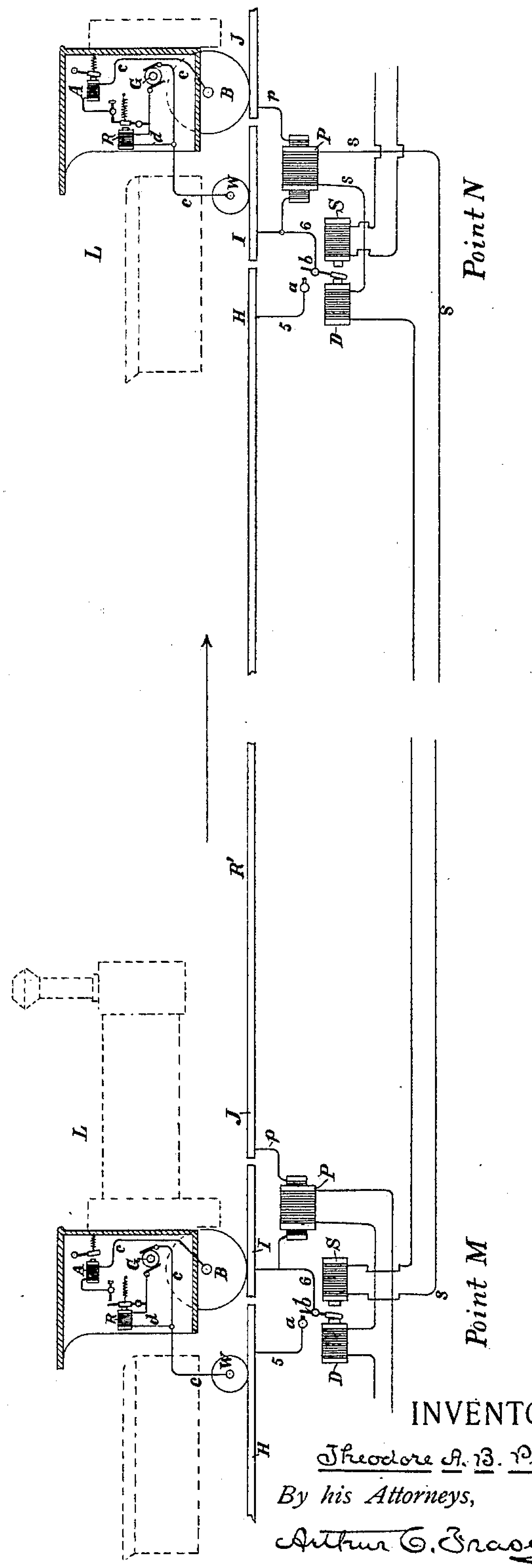
FIG. 4.

FIG. 3.



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UNITED STATES PATENT OFFICE.

THEODORE A. B. PUTNAM, OF NEW YORK, N. Y., ASSIGNOR TO THE RAILWAY CAB ELECTRIC SIGNAL COMPANY, OF SAME PLACE.

ELECTRIC RAILWAY-SIGNAL.

SPECIFICATION forming part of Letters Patent No. 399,556, dated March 12, 1889.

Application filed October 3, 1885. Serial No. 178,888. (No model.)

To all whom it may concern:

Be it known that I, THEODORE A. B. PUTNAM, a citizen of the United States, residing in the city, county, and State of New York, have invented certain new and useful Improvements in Electric Railway-Signals, of which the following is a specification.

This invention relates to improvements in electric railway-signals of that character in which upon the passage of a locomotive or train past the signaling-point an electric impulse is transmitted to a distant signaling-point.

The invention relates especially to signaling systems wherein the track-rails constitute a portion of the signaling-circuits.

One feature of this invention consists in the application of an induction-coil at a signal-transmitting point arranged to receive a current through its primary wire upon the passage of a train, and with its secondary wire connected through the medium of an intervening circuit or conductor with a distant signaling-point, and an electro-magnet or equivalent signal-receiving instrument at such distant point adapted to be acted upon by the secondary currents generated in the induction-coil.

This improvement is especially applicable in connection with the system of railway-signals embodied in my patents, No. 243,619, dated June 28, 1881, and No. 258,600, dated May 30, 1882. The system introduced by those patents consists, briefly stated, of a partial electric circuit on the locomotive terminating in two electrodes or contacts in connection with the rail—one in advance of the other—the wheels of the locomotive and tender being preferably utilized as such contacts, with an electric generator (preferably a dynamo) included in said partial circuit, so that the current therefrom normally flows through said circuit and through the portion of the rail between the wheels, by means of which said partial circuit is completed. In said partial circuit is an electro-magnetic alarm which operates upon the cessation of the current due to the breaking of the circuit by the passage of the locomotive over a break or insulation between two successive rails of the track. Such breaks or insulations are provided at intervals, and the insulation at each signal-receiving point is bridged over by an electric conductor provided with a circuit-breaker and operated by suitable means to break the connection in case of danger and leave it closed when the line is safe. Thus when danger exists it is indicated by a signal exhibited or sounded within the cab of the locomotive.

Another feature of my invention constitutes an improvement upon the system of railway-signals embodied in my aforesaid patents. In the operation of that system of signals difficulty has at times been caused by the leakage of the electric current across the breaks or insulations in the rails. This leakage, which occurs to the greatest extent in wet weather, tends to prevent the breaking of the alarm-circuit on the locomotive, and when it becomes so great that sufficient current may pass the insulation to continue the attraction of the alarm-restraining magnet the danger-alarm fails to act, and the system becomes inoperative as a warning against danger. To avoid this result, great care has been necessary to insure perfect insulation between the rail-sections.

My present invention has for its object to render this system of signaling and other analogous systems operative in spite of defective insulation, so that the signals may be absolutely depended upon in all weathers and under all conditions which occur in practice.

In the accompanying drawings, Figure 1 is an elevation of a portion of a locomotive and tender, showing the electrical apparatus on the locomotive. Fig. 2 is a diagram showing the connection of the induction-coil with the signal-transmitting point on the track and with a remote signal-receiving point. Figs. 3 and 4 are diagrams showing two signaling-points on the track with locomotives traversing these points. In Fig. 3 the locomotive is in the receiving position and is receiving the danger-signal, and in Fig. 4 the locomotive is in the transmitting position.

The rails of the track R′ are insulated at intervals wherever it is deemed expedient to provide a signaling-point, thereby forming the insulating spaces or breaks *y*. At each signaling-point, by preference, a rail, I, is insulated at both ends from the preceding and succeeding rails H and J, as shown in Figs. 3 and 4. The break or insulation between the rails H and I constitutes the signal-receiving point or position, while the break between the rails I and J constitutes the signal-transmitting point or position. Figs. 3 and 4 show one of the two tracks of a double-track railway on which trains are moving from left to right.

An induction-coil, P, has its primary wire connected by a partial circuit, *p*, with a signal-transmitting point, and with its secondary wire connected by a closed circuit, *s*, with a suitable receiving-instrument at a signal-receiving point. The induction-coil is preferably arranged close to the transmitting-point in order to reduce the resistance in the partial circuit *p* to the minimum. The terminals of this partial circuit are connected, respectively, with the rails I and J. In the preferred arrangement of block-signaling the secondary circuit *s* includes the "danger-magnet" D at the signal-receiving point nearest and immediately in the rear of the signal-transmitting point, and this circuit *s* is also extended to some previous block-signal point back on the line, and is there connected with a "safety-magnet," S.

The installation of the signal-receiving points of the block-signaling is the same as in my said patent, No. 243,619—that is to say, the rails H and I are connected by a bridge of conducting-wires, 5 and 6, in which bridge is a circuit-breaker consisting of a contact-lever, *b*, working against a stop, *a*. The lever *b* is an armature-lever, and is vibrated to one side or the other by the action of one or other of the two magnets D and S. The magnet D serves to break the connection, and thereby set the circuit for giving a danger-signal, while the magnet S acts to close the connection in order to set the circuits to "safety."

As best shown in Fig. 1, the locomotive L is provided with a partial circuit, *c*, its opposite terminals being adapted for connection with the track-rail, one in advance of the other, these terminals or electrodes consisting, preferably, of the wheels of the locomotive or train. In practice I select the wheels or one of the wheels B of the locomotive, and the wheels or one of the wheels W of the tender, to serve as these electrodes, the respective wheels B and W being insulated from one another. The partial circuit *c* includes an electric generator, G, which is preferably a small dynamo in the cab of the engine, driven by a small independent engine, as in my said previous patents, which causes a current to circulate through the partial circuit *c* and through the portion of the track-rail between the two wheels B and W, which track-rail normally closes and completes the locomotive-circuit. This circuit also includes a magnet, A, which operates the danger alarm or signal in the cab. The armature of this magnet is normally held attracted, and a retractile spring tends to draw it away in order to give the alarm or signal. As thus far described, the locomotive-circuit is the same as in my said previous patents.

When a locomotive thus equipped passes over an insulation, *y*, Fig. 1, between two rails, the circuit *c* would be broken if the insulation at *y* were absolutely perfect. In practice, however, it is found that there is a considerable leakage at such a rail-joint, as indicated by dotted lines at *x* in Fig. 1, so that the passing over such a joint is equivalent to suddenly introducing a high resistance into the circuit. If this resistance is so high as to reduce the current in the circuit *c* sufficiently to so far demagnetize the magnet A that it can no longer resist the retractile tendency of its armature, the signal-alarm will act. If, however, the leakage be so great as to afford less than this degree of resistance at the break *y*, the magnet A will continue to attract its armature and the signal will not be given. To overcome this difficulty, I have devised the arrangement which I will now describe.

I provide the locomotive with a shunt-circuit, *d*, extending from one pole of the dynamo G to the other, which shunt-circuit includes a magnet, R, of high resistance, or other suitable resistance, whereby the resistance of this shunt is made considerably greater than that of the circuit *c*. For example, assuming the resistance of the circuit *c* to be one ohm and that of the circuit *d* to be nine ohms, the current from the dynamo G will normally divide, nine-tenths thereof flowing through the circuit *c* and magnet A and one-tenth thereof through the circuit *d* and magnet R. The magnet R is a relay-magnet, its armature-lever *e* being included in the circuit *c* and normally drawn against a contact, *f*, by the tension of a retracting-spring, *g*, which spring has sufficient tension to resist the attraction of the magnet R when the latter is excited by the current normally flowing through it—*i. e.*, one-tenth of the total current generated by the dynamo. Let us assume, for example, that the insulation at *y* is so perfect that even in the most advantageous weather its minimum resistance is twenty ohms. Then upon the passage of the locomotive over this insulation this resistance will be momentarily introduced into the circuit *c*, making the total resistance thereof approximately twenty-one ohms, while that of the shunt-circuit *d* remains at nine ohms. Consequently the current from the dynamo will divide in the proportion of nine-thirtieths flowing through the circuit *c* and twenty-one thirtieths flowing through the circuit *d*. The increase of current through the magnet R from three-thirtieths to twenty-one thirtieths is sufficient to so increase the excitation of this magnet that it attracts its armature, and consequently draws the armature-lever *e* out of contact with the stop *f*, whereby the circuit *c* is broken and the entire current flows thenceforth through the shunt-circuit *d*, thereby maintaining the attraction of the magnet R, and consequently continuing the break between *e* and *f*. By this breaking of the circuit *c* the alarm-magnet A is caused to operate and release its armature, if it has not already done so, upon the diminution of the current through it in the ratio stated of from nine-tenths to nine-thirtieths of the total current. Thus my invention insures the giving of the alarm upon the passing of the locomotive over any track the insulation of which exceeds the minimum resistance that is fixed upon. This minimum resistance should be such proportionally to those in the circuits *c* and *d* that, by its inclusion in the circuit *c*, it will divert a sufficient excess of current into the circuit *d*, to so far increase the excitation of the magnet R as to enable it to attract its armature against the retractile tension of the spring *r*. The proportions may be greatly varied in practice; but those stated are suitable, with a corresponding adjustment of the spring *g*.

The danger signal or alarm may be given in any suitable manner—as, for example, by the means illustrated in my said patent, No. 243,619. It is preferably given by the magnet A; but inasmuch as the magnet R should always be so adjusted as to attract its armature L whenever the circuit conditions are such that an alarm should be given, and at no other time, it is obvious that the movement of this armature might be made to give the alarm in lieu of the magnet A, in which case the magnet A might be omitted. For many practical reasons, however, I much prefer the use of the magnet A and its armature, as shown.

In this description I have assumed that the insulation *y*, with its leak-circuit *x*, in Fig. 1, presenting a resistance, say, of twenty ohms, is the insulation at one of the signal-receiving points. If, however, the circuit arrangement shown in Fig. 1 of my said patent, No. 243,619, were adopted, wherein when the locomotive is at the signal-transmitting position the current from its dynamo G is required to traverse the circuit, extending thence to the remote signal-receiving point, it is apparent that in many instances the resistance of the circuit extending to such remote point might largely exceed the minimum resistance at such insulation *y*, in which case a danger-alarm would be given when it was not intended and while the locomotive was at the transmitting-point. In such case the arrangement of the locomotive-circuits shown in Fig. 1 would not be applicable; but by the use, in connection with locomotives thus equipped, of the line installation shown in Figs. 2, 3, and 4, wherein the induction-coil P is used at each signal-transmitting point, this difficulty is overcome. For example, the resistance of the primary coil with its circuit *p* may be very low—say, for example, half an ohm—so that when the locomotive traverses the signal-transmitting point the resistance of its circuit *c* is increased only one-fortieth as much as when it passes over an insulation *y* at a receiving-point when the conducting-bridge 5 6 is broken at *a b* in order to give the danger-signal. Thus, in transmitting, the current from the dynamo on the locomotive does not pass to the distant signaling-point, but traverses only the local partial circuit *p* and the primary wire of the induction-coil.

The practical operation of the complete system will be apparent from Figs. 3 and 4. The locomotive in Fig. 3 has reached the signal-receiving position and has received a danger-signal. It is supposed that this locomotive has reached this position before the locomotive in Fig. 4 reached the position there shown, which is the signal-transmitting position. When this latter locomotive reaches this position and actuates the induction-coil P, the induced current traversing the circuit *s* excites the magnet D at the point N, thereby setting the signal there to "Danger," and also excites the magnet S at the point M, thereby setting the signaling-circuit there to "Safety."

The winding of the respective magnets, the character of the induction-coil, and the arrangement of the necessary circuits for developing this system to adapt it to all practical conditions are matters of technical electrical detail, which I do not consider necessary to herein set forth.

I claim—

1. In an electric railway-signal, the combination of an induction-coil with the opposite terminals of its primary connected electrically to a signal-transmitting point along the track, and a remote signal-receiving point, to which the terminals of the secondary coil are electrically connected, substantially as set forth.

2. The combination, with a railway-track having insulated spaces or breaks, of an induction-coil with the opposite terminals of its primary connected, respectively, to two rails insulated from each other, and a signaling-point to which the terminals of the secondary coil are connected, substantially as set forth.

3. The combination, with two successive rails of a railway-track insulated from each other, of an induction-coil having the opposite terminals of its primary wire connected to said rails, respectively, and a signaling-point to which the terminals of the secondary coil are connected, substantially as set forth.

4. The combination of two rails of a railway-track insulated from each other, an induction-coil having the opposite terminals of its primary connected to said rails, respectively, a locomotive running on said track, a partial electric circuit on said locomotive with its terminals in connection with the rails, and normally closed and completed therethrough, and a generator and alarm in said circuit, substantially as set forth, whereby at the instant of crossing the insulation between

said rails the partial circuit will be completed through the primary of said coil.

5. The combination, with a locomotive, of a partial circuit terminating in connections with the rails, a generator in said circuit, and a closed shunt-circuit of relatively higher resistance connecting the poles of said generator, substantially as set forth.

6. The combination, with a locomotive, of a partial circuit terminating in connections with the rails and normally closed or completed through the rails, a generator in said circuit, a closed shunt-circuit extending from one pole of the generator to the other, and an electro-magnet in said shunt-circuit, substantially as set forth, whereby the diversion of an excessive current into said shunt-circuit actuates said magnet.

7. The combination, with a locomotive, of a partial circuit terminating in connections with the rails and normally closed or completed through the rails, a generator in said circuit, a shunt-circuit extending from one pole of the generator to the other, whereby the current from said generator is normally divided between said two circuits, an electro-magnet in said shunt-circuit, and the armature of said magnet provided with a retractive resistance sufficient to prevent its attraction by the normal current in said shunt-circuit, but insufficient to prevent its attraction when the current therein is greatly increased by the introduction of an extraordinary resistance in said partial circuit, substantially as set forth.

8. The combination, with a locomotive, of a partial electric circuit terminating in connections with the rails and normally closed or completed through the rails, a generator in said circuit, an alarm electro-magnet in said circuit, a shunt-circuit extending from one pole of the generator to the other, an electro-magnet in said shunt-circuit, and circuit-breaking contacts in connection with the armature of said magnet and with said partial circuit, substantially as set forth, whereby upon a sufficient increase of the current in said shunt-circuit said armature is attracted and the said partial circuit is thereby broken.

9. A locomotive, a partial circuit thereon terminating in connection with the rails, and normally closed or completed through the rails, a generator in said circuit, a shunt-circuit extending from one pole of the generator to the other, and an electro-magnet in said shunt-circuit, combined together and with the track-rails, with insulations between the rails and with an induction-coil, the primary of which is connected at its opposite terminals to two rails on opposite sides of the insulation, whereby on crossing such insulation the partial circuit on the locomotive is completed through the primary of said coil, substantially as set forth.

THEO. A. B. PUTNAM.

Witnesses:
HENRY EICHLING,
A. G. N. VERMILYA.