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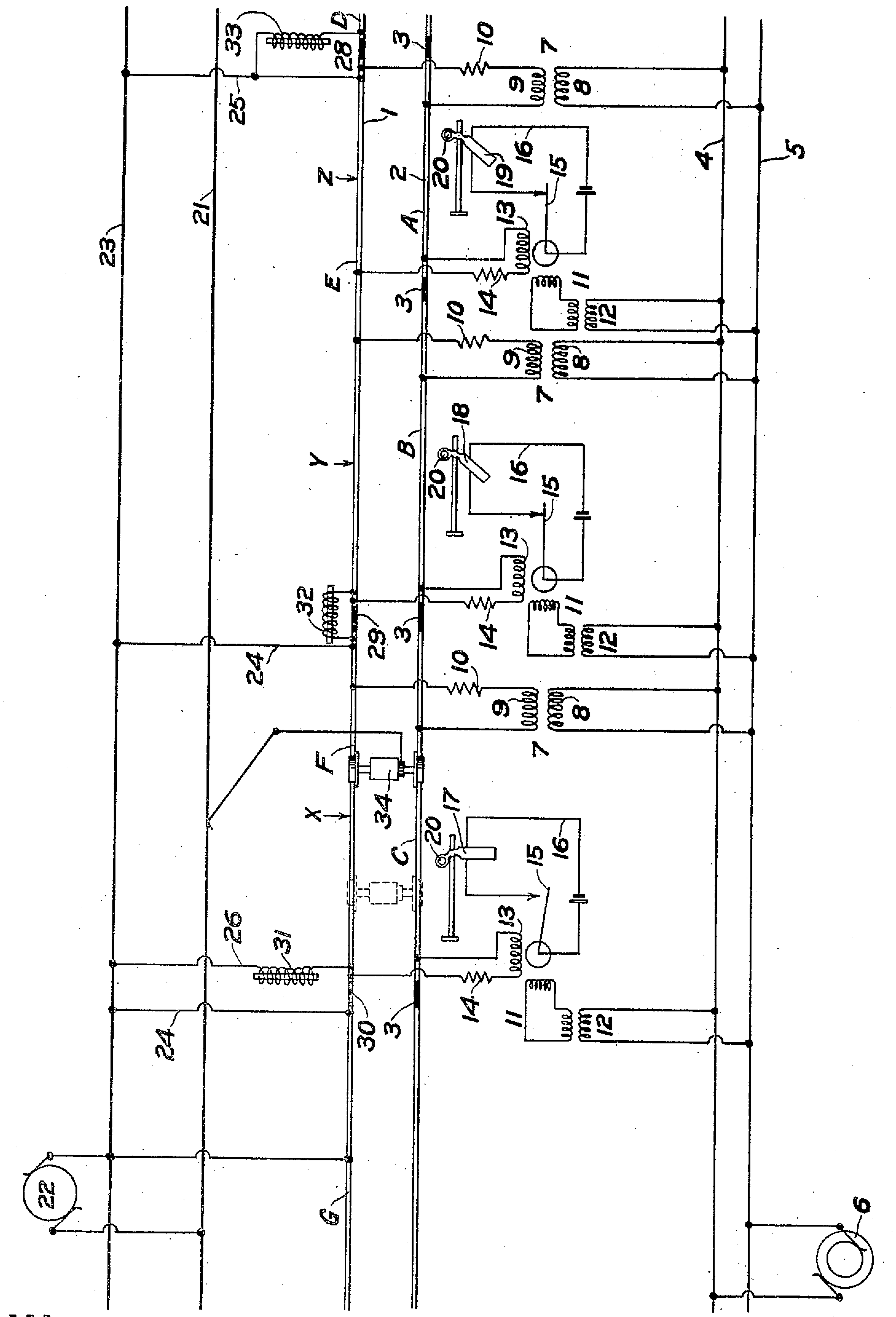
W. W. SALMON.

RAILWAY SIGNALING SYSTEM.

APPLICATION FILED JULY 3, 1907.



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RAILWAY SIGNALING SYSTEM.

No. 880,329. **Specification of Letters Patent.** **Patented Fɛ.. 25, 1908.**

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To all whom it may concern:

Be it known that I, WILMER W. SALMON, a citizen of the United States, and resident of Rochester, in the county of Monroe and State of New York, have invented certain new and useful Improvements in Railway Signaling Systems, of which the following is a specification.

This invention relates to railway signaling systems, and particularly to means for adding new features of safety to signaling apparatus already known.

The invention consists in the apparatus hereinafter described and claimed.

In adapting a system of signals to electric railways it has been found desirable to employ electric currents having different properties or characteristics, for the propulsion and for the signaling. As an example of these different currents, direct current will be described for the propulsion, and alternating current for the signaling. The example of signal exhibited will be a semaphore arm.

The railway track has two rails, of which rail 1 in the diagrammatic drawing will be called the propulsion rail herein, and is employed for the return of the direct or propulsion current, while the rail 2 is called the signaling rail herein, and is employed for conducting the alternating or signaling current only. A signaling circuit is employed which includes signaling devices and includes a portion of the propulsion rail. Ordinarily, for signaling purposes, the signaling rail is divided into a series of insulated sections A, B, C, each of which has relation to the operation of a particular signal or semaphore, and is a part of the signaling circuit pertaining thereto.

In the said drawing, 3, 3 are the insulating joints for separating, electrically, the sections of the signaling rail.

4, 5 are the wires of the signaling feed system, which are connected with the alternating current dynamo 6. For each signaling section there is a transformer 7, having its primary 8 connected in multiple with the signaling feed system, and its secondary 9 connected with the rails 1 and 2. The resistance 10 is inserted in the connection to the propulsion rail 1 of the said secondary, in order to cut down direct current which might pass into the transformer. An alternating current relay 11 has its primary 12 connected in multiple with the wires 4 and 5 of the signaling feed system, and its secondary 13 connected at one terminal with the signaling section in question, and at its other terminal with the propulsion rail. In the connection of said secondary 13 to the propulsion rail 1 is a resistance 14, for the same purpose as the resistance 10. The relay has an armature 15 in the local motor circuit of the signal. When the armature is attracted, the local motor circuit is closed, and the motor operates to actuate the semaphore arm and to hold it at safety, as at 18 and 19; while if the relay armature is not attracted, it falls away from its contact, the said local motor circuit opens, and the semaphore arm is no longer held at safety, but automatically moves to the danger position by the action of its counterweight 20, as shown at 17. The propulsion feed wire 21 is connected with a direct current dynamo 22, which is also connected to the propulsion rail 1.

When a car enters upon any one of the signaling sections A, B, C, shown in the diagrammatic plan, current from the transformer 7 passes through the wheels and axles of the car, and not through the secondary 13 of the relay 11, whereupon current through the relay ceases, the armature drops, the circuit 16 opens, and the semaphore arm moves to the danger position.

It has been customary to provide an additional or supplemental return conductor 23 for the direct current, and to connect it by a suitable number of cross-bonds 24, 25, with the propulsion rail, so that there shall be a certainty of free and ample return for the propulsion current after passing through the motor of the car. With the construction thus far described, the presence of a car on any of the signaling sections is exhibited as described. In case the signaling rail should be broken, the current to the relay would be cut off, and the semaphore relating to the section in which the break exists, would immediately go to danger. But if a break should occur in the propulsion rail, a circuit is formed through the cross-bonds and return conductor, so that the current from the transformer 7 would pass through the relay, and the break of the propulsion rail would not be signaled.

It is a fundamental rule of railway signaling practice that in case of the failure of any part that controls a signal, that signal must automatically and immediately take the danger position. Heretofore there has been no efficient protection against a broken propulsion rail in electric railway systems in which an additional return conductor has been cross-bonded with the propulsion-rail; and it is to the removal of this dangerous defect that the present invention is directed. For this purpose, the propulsion rail is divided into a series of sections, such as E, F, by means of insulating joints 28, 29, 30, and two cross-bonds are provided extending from the return conductor 23, one to one end of an insulated section of the propulsion rail, such as F, and the other to the other end of the same section. One end of the section has a simple cross-bond, or connection, such as 24. The other end of the same section (F) has a cross-bond or connection 26 in series with a reactance 31, of such character that with the particular alternating current employed, the said current will be stopped or choked to an extent sufficient to deënergize the relay 11 of the section in question; and thus a circuit for the passage of alternating current through the relay of section F cannot be made either through a break in a section of the propulsion rail or around the break through the cross-bonds and return conductor.

A reactance is a device that, under determined conditions, separates, either completely or partially, two currents flowing in the same conductor. In the present instance of the invention, the reactance described is the well known reactance which chokes or stops the passage of an alternating current but which permits the passage of a direct current. It is, of course, possible, and will cause a saving in wiring and construction in some cases, to connect the reactance on one side of an insulated joint with the cross-bond on the other side of said joint, and to employ a common connection to the return conductor 23 for the cross-bond and the reactance. This connection is shown in the diagram by connecting the reactance 33 and the cross-bond 25, so that the greater part of the cross-bond 25 is employed as a common connection to the return conductor for both. The same construction is produced by bridging the insulated joint 29 by the reactance 32, so that the cross-bond 24 and a portion of the rail section F are employed as the common connection or cross-bond in series with said reactance.

By the use of two cross-bond connections with the return conductor from each insulated section of the propulsion rail, either of which affords a sufficiently free path to the propulsion current, and one of which contains a reactance and checks the signaling current, the employment of a small reactance is possible, as will be explained. The cross-bonds are connected to the insulated sections as near to the insulations as possible. One terminal of the secondary 9 of the transformer 7 is likewise connected near to one end of an insulated section of the propulsion rail, and the other terminal near to the end of the adjacent insulated section of the signaling rail; and the terminals of the secondary 13 of the relay are connected near to the other ends of the same insulated sections. With the arrangement shown, in which the return conductor has two cross-connections for each insulated section of the propulsion rail, one cross-connection to one end of said section and the other cross-section to the other end of said section, and a reactance in series with one of said cross-connections, the signal will go to danger immediately upon a break in the propulsion rail between said cross-connections thereto and when no car is on the broken insulated section. For this reason the car is not a necessary element of this invention, and the entry of a car upon the same broken insulated section of the propulsion rail will not set the signal to safety.

When the car is on the section F in the full line position, and a break has occurred in the propulsion rail at the point marked X, propulsion current passes through the cross-bond 26, and the whole return from the car motor must pass through the cross-bond 24. The signaling current from the transformer 7 is shunted by the wheels and axles of the car, so that no current will pass around through the cross-bond 24, return conductor 23, and cross-bond 26 to energize the relay attached to the signaling section C. If any signaling current should escape by reason of imperfect shunting by the wheels and axles of the car, it would be choked by the reactance 31 so far as to prevent energization of the relay. If a break has occurred in the section F at the point marked X, and the car is in the position shown in dotted lines, the entire return of the propulsion current occurs through the cross-bond 26 and the reactance 31, but signaling current, even if it could pass the reactance 31, is shunted from the relay, so that the current from the transformer passes through the cross-bond 24, return conductor 23, cross-bond 26, reactance 31, propulsion rail section F, wheels and axles in the dotted line position, signaling section C, and to the transformer. If the propulsion current passing through the reactance is sufficient to saturate the core thereof, the said reactance will cease to act as a reactance, and, under these circumstances, the shunt just mentioned would be sufficient to prevent current from passing to the relay 11; but if the propulsion current is not sufficient to saturate the reactance (and the reactance should be so constructed as not to be saturated), then the reactance chokes or prevents the signaling current from passing through the cross-bond 26, and breaks the circuit to the relay for the signaling current.

It is clear from this descriptionthat a cross-bond should be connected to the same end of the insulated section of the propulsion rail to which the relay is connected. In the specific arrangement shown, the reactance can be made small, because when it is necessary for it to act as a reactance, no propulsion current passes through it, and when it is not acting as a reactance, it does not matter whether it is saturated or not. It will be noted that the section E of the propulsion rail has adjacent to it two insulated sections A and B of the signaling rail. If a break in the propulsion rail should occur at Y between the terminal connections to the propulsion rail of the transformer and of the relay, the signal 18 will go to danger, and the signaling current cannot pass through the return conductor or through the cross-bonds of the section E, but the signal 19 will not be affected by the break at Y. A break at Z will set the signal 19 to danger, but will not affect the signal 18.

Insulated joints in the traffic-rail need be placed only at those points where cross-bonds are placed. It will be clear from the above description that a signal circuit may include either the whole or a part of an insulated section of the traffic rail.

It will be clear that in this invention a break at any point in the propulsion rail between two cross-connections prevents passage of propulsion current through the reactance in one of said cross connections, because the break and an insulated joint preclude the access of propulsion current thereto.

What I claim is:—

1. In a signaling system for electric railways, a track in which one rail is the return conductor for the propulsion current; a supplemental return conductor for the propulsion current; cross connections between the propulsion rail and the supplemental return conductor; a signaling circuit which includes a portion of the propulsion rail; signaling devices in said signaling circuit adapted to be energized by a current of different properties from the propulsion current; and means for preventing the operation of the signaling devices while a break exists in said portion of the propulsion rail.

2. In a signaling system for electric railways, a track in which one rail is the return conductor for the propulsion current; a supplemental return conductor for the propulsion current; cross connections between the propulsion rail and the supplemental return conductor; a signaling circuit which includes a portion of the propulsion rail; signaling devices in said signaling circuit adapted to be energized by a current of different properties from the propulsion current; and means for limiting the flow of signaling current flowing through the cross connections while a break exists in said portion of the propulsion rail.

3. In a signaling system for electric railways a track in which one rail is the return conductor for the propulsion current, a supplemental return conductor for the propulsion current; cross connections between the propulsion rail and the supplemental return conductor; a signaling circuit which includes a portion of the propulsion rail between adjacent cross-connections; signaling devices in said signaling circuit adapted to be energized by a current of different properties from the propulsion current; a reactance in series with one of said adjacent cross connections; and means for preventing access of the propulsion current to said reactance while a break exists in said portion of the propulsion rail.

4. In a signaling system for electric railways, a track in which one rail is the return conductor for the propulsion current and is divided into insulated sections; a supplemental return conductor for the propulsion current; cross connections between the ends of an insulated section of the propulsion rail and the supplemental return conductor; a signaling circuit which includes the whole or a part of said section of the propulsion rail; signaling devices in said signaling circuit adapted to be energized by a current of different properties from the propulsion current; and a reactance in series with one of said cross-connections.

5. In a signaling system for electric railways, a track in which one rail is the return conductor for the propulsion current and is divided into insulated sections; a supplemental return conductor for the propulsion current; cross-connections between the ends of an insulated section of the propulsion rail and the supplemental return conductor; a signaling circuit which includes the whole or a part of said section of the propulsion rail; signaling devices in said signaling circuit adapted to be energized by a current of different properties from the propulsion current; and means for limiting the flow of signaling current through one of said cross-connections while a break exists in said portion of the propulsion rail.

6. In a two-rail electric railway system, in which one rail is the propulsion rail and is divided into insulated sections and is used for conducting a propulsion current, and the second rail is the signaling rail and is divided into insulated sections adjacent to the sections of the propulsion rail and is used for conducting a signaling current of different properties from the propulsion current; a feed conductor for the propulsion current; a return conductor for the propulsion current; two cross-bond connections extending

from the return conductor to opposite ends of an insulated section of the propulsion rail; a reactance in series with one of said cross-bond connections constructed to permit passage of the propulsion current and to choke the signaling current; a signaling circuit including the said insulated section of the signaling rail and the whole or a part of the adjacent insulated section of the propulsion rail; and signaling apparatus controlled by said signaling circuit.

7. In a two-rail electric railway system, in which one rail is the propulsion rail and is divided into insulated sections and is used for the return of direct current, and the second rail is the signaling rail and is used for conducting alternating current; a feed conductor for the propulsion current; a return conductor for the propulsion current; a feed system for the alternating current; two cross-bond connections extending from the return conductor to opposite ends of an insulated section of the propulsion rail; a reactance in series with one of said cross-bond connections constructed to permit passage of direct current and to choke the alternating current; a signaling circuit including the said insulated section of the signaling rail and the whole or a part of the adjacent insulated section of the propulsion rail; a transformer and an alternating current relay, each having a primary winding connected with said feed system and a secondary winding in said signaling circuit; and a local motor circuit for a signal controlled by said relay.

8. In a two-rail electric railway system, in which one rail is the propulsion rail and is divided into insulated sections and is used for the return of direct current, and the second rail is the signaling rail and is divided into insulated sections and is used for conducting alternating current; a feed conductor for the propulsion current; a return conductor for the propulsion current; a feed system for the alternating current; two cross-bond connections extending from the return conductor to opposite ends of an insulated section of the propulsion rail; a reactance in series with one of said cross-bond connections constructed to permit passage of direct current and to choke the alternating current; a signaling circuit comprising the said section of the signaling rail and the whole or a part of the adjacent insulated section of the propulsion rail; a transformer at one end of the said two sections and an alternating current relay at the other end of said two sections, each having a primary winding connected with said feed system and a secondary winding in said signaling circuit; and a local motor circuit for a signal controlled by said relay.

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Witnesses:
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