

F. L. DODGSON.
ELECTRIC TRAFFIC CONTROLLING SYSTEM.
APPLICATION FILED MAY 6, 1910.

1,083,669.

Patented Jan. 6, 1914.

FIG. 1.

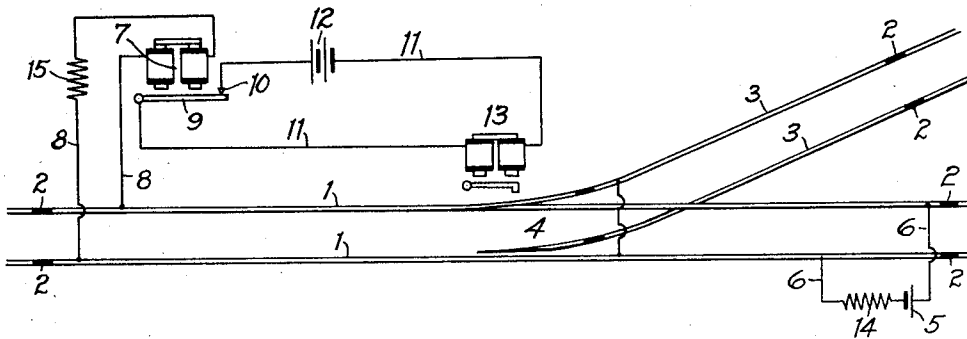


FIG. 2.

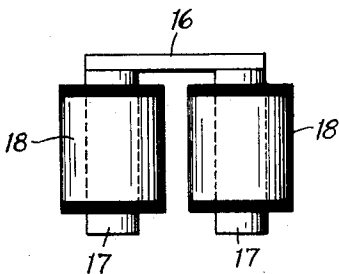


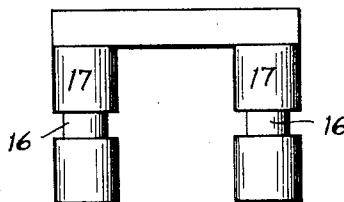
FIG. 3.



FIG. 4.



FIG. 5.



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ELECTRIC TRAFFIC-CONTROLLING SYSTEM.

1,083,669.

Specification of Letters Patent.

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To all whom it may concern:

Be it known that I, FRANK L. DODGSON, 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 Electric Traffic-Controlling Systems, of which the following is a specification.

This invention relates to electric traffic-controlling systems in which track circuits energized by direct currents are employed to control various devices, such as electric switch locks, semaphores, &c.

In systems of the kind above referred to it is customary to employ a track-circuit comprising two track-rails having a portion of their length insulated from the remainder, together with a track-battery connected across the rails and a track-relay also connected across the rails and energized by the track-battery. The track-relay controls a secondary circuit or circuits by which the traffic-controlling devices, of whatever character, are operated. In a track-circuit of this type the track-relay is normally energized by current flowing through the track-rails from the track-battery, but in case of either a broken rail in the track-circuit, or of a short-circuit between the rails resulting from the presence of rolling-stock upon the rails, the track-relay is deenergized. In the case of a broken rail, or other failure in the circuit, the winding of the relay is put in open circuit thereby, so that it operates substantially instantaneously to break the circuit normally held closed by its armature. In the case of a short-circuit due to the wheels and axles of a train upon the track-circuit, however, the relay is deenergized by the short-circuiting action of the wheels and axles upon the track-battery, practically all of the current from the battery being diverted through the wheels and axles in preference to passing through the comparatively high resistance of the relay-winding. In this case, therefore, the relay is not put in open circuit, but, on the contrary, the wheels and axles of the train act as a shunt, so that the relay-winding is in a closed or shunt circuit of low resistance through the wheels and axles and the track-rails.

It is a well known fact that when an electromagnet in which the magnetic core is magnetized by a current flowing therethrough is deenergized by a shunt or short-circuit

across the terminals of its winding, the magnetism in the core does not disappear instantaneously. This is due to the fact that as the magnetic lines in the field of the magnet contract, they induce in the closed circuit of the winding a current flowing in the same direction as that by which the core was previously magnetized. This current, conversely, tends to maintain the magnetization of the core. By this reciprocal action the disappearance of the magnetism in the core is rendered gradual, so that in case of an ordinary track-relay an appreciable interval of time elapses between the entrance of a train upon the track circuit and the interruption, by the relay, of the circuit controlled thereby. On a track traversed by express trains this time interval may be sufficient to permit the train to pass a considerable distance upon the track-circuit before the relay operates, so that in such case it is necessary to use a considerably longer track-circuit than would otherwise be necessary, and, conversely, the safety factor of the system is reduced by such delay.

The object of the present invention is to so construct and arrange a track-circuit of the kind hereinbefore referred to as to substantially reduce the delay in relay operation due to the cause above described, and thus to correspondingly reduce the necessary length of the track-circuit and increase the safety factor thereof. To this end I employ two novel arrangements, both of which contribute to the desired result, although in different manners and, to some extent, under different circumstances.

One of the devices just referred to consists in a change in or rearrangement of the resistance in the track-circuit by which the shunt circuit through the relay-winding is given a higher resistance than that necessarily or usually residing in the conductors employed in this portion of the track-circuit, so that the flow of induced current through the shunt circuit is diminished, and thus the maintenance, by this current, of the magnetization in the core is reduced. The other device consists in a modification of the relay itself, by which the magnetization of the core of the relay-magnet is substantially limited to a more or less definite maximum, so that under conditions in which the maximum current is transmitted from the track-battery to the relay-winding the magnetization

is not substantially greater than the minimum necessarily provided for under opposite conditions, that is to say, when a minimum current is transmitted from the battery to the relay-winding.

The features of the invention above referred to will be more particularly described, together with the means by which they are preferably carried out, in connection with the description of the embodiment of my invention illustrated in the accompanying drawings.

In the drawings:—Figure 1 is a diagram of a track-circuit, illustrating the application of the present invention thereto; Fig. 2 is a side elevation, of a diagrammatic character, illustrating the electromagnet of the track-relay employed in connection with the track-circuit of Fig. 1; Fig. 3 is a cross-section of the yoke of the electromagnet of Fig. 2; Fig. 4 is a cross-section of one of the arms of the core of the electromagnet of Fig. 2; and Fig. 5 is a side elevation of a modified form of core.

In Fig. 1 the track-circuit is illustrated as comprising two main track-rails 1, insulated at points 2, in any ordinary or suitable manner, from the remainder of the rails. The track-circuit also includes the rails 3 of a spur similarly insulated at points 2 and connected with the main rails 1 by a switch 4, the switch being connected and insulated in the usual manner. The track-battery 5 is connected, through wires 6, with the rails 1 at the right-hand end of the track-circuit. The track-relay is indicated generally by the reference number 7, and its winding is shown as connected in the usual manner, through wires 8, with the two track-rails 1. The relay armature 9 cooperates with a fixed contact 10, and the armature and fixed contact are connected, through wires 11, in series with a battery 12 and a traffic-controlling device 13 which may be an electric lock for the switch 4.

In many track-circuits, particularly such comparatively short track-circuits as are used for the protection of trains passing over switches, as in such an installation as that of Fig. 1, the resistance in the track-circuit normally due to the track-rails, the winding of the track relay, and the short wires or conductors connecting these parts, is so low that even with a battery of low electromotive force, such as the ordinary gravity battery, and with the cells connected in parallel so as to give a voltage equal to that of only one cell, the flow of current through the track-circuit and through the relay winding is unnecessarily large. For this reason it is customary in such cases to introduce supplementary or excess resistance of some form, an ordinary resistance coil being commonly used for this purpose. This resistance is interposed in the conductors

connecting the track-battery with the track-rails. Such a resistance is shown diagrammatically at 14 in Fig. 1. This location of the resistance has been universally selected for the reason that the resistance so located not only acts to reduce the normal flow of battery current, but it also acts to reduce the flow of current on short-circuit when the train is upon the track-circuit, and thus to save the loss of current which would occur in case the battery were dead-short-circuited by the wheels and axles of the train. I have discovered, however, that by placing the excess resistance, or a part of it, in the branch of the track-circuit which includes the relay-winding, instead of in that branch which includes the track-battery, the speed of operation of the relay when short-circuited may be substantially increased. This is due to the fact that the resistance, as so located, is present in the shunt circuit through the relay, so that it acts to cut down the induced current generated as above described in the relay-winding. I have illustrated this novel arrangement of the resistance in Fig. 1 by indicating a resistance-coil 15 interposed in one of the wires 8 connecting the relay-winding with the track rails.

It will be apparent that in reducing or removing the excess resistance in the battery branch of the track-circuit, and relocating it in the relay branch, the resistance of the track-circuit is not necessarily modified. Under certain conditions, however, as, for example, when the insulation of the rails is impaired by moisture in the ties and in the road-bed, and also when the track-battery is short-circuited by the wheels and axles of the train, the flow of current from the battery will be substantially greater in this novel arrangement than in the usual arrangement where all of the excess resistance is at the point 14 in Fig. 1. While this additional waste of battery current is disadvantageous, it may be compensated for by using a battery of greater capacity and electromotive force than that ordinarily employed, and this I do in practice, in using my novel track-circuit. The additional expense of maintenance in the battery is more than justified by the greater responsiveness of the relay and the resulting increase in the safety-factor in the system.

While I have illustrated the excess resistance in Fig. 1 as resulting from the use of a resistance-coil 15, it will be understood that this resistance may be employed in any part of the branch of the track-circuit including the relay-winding. In some cases it is preferable, in fact, to employ the resistance in the relay-winding itself. This is done by using in this winding a wire of substantially smaller diameter than that normally employed or necessitated by the

usual limitations of space, but with the same number of turns as would otherwise be employed. It should be particularly noted in this connection that for the best embodiment of the invention the resistance should not be secured by increasing the number of turns of the winding in the relay, for in such case the strength of magnetization of the relay core would be proportionately increased, as would also the inductive effect of the core upon the winding, so that such an arrangement would, to some extent at least, defeat its own purpose.

The arrangement just described operates under all conditions to reduce the flow of current in the shunt-circuit through the relay winding, and thus to diminish the retarding effect of such induced current. The second feature of my invention operates, however, to accomplish the same ultimate result in accordance with the conditions in the track-circuit. I have discovered that in an electromagnet having a magnetic core of a given diameter and magnetized by currents within a certain maximum, the strength of magnetization of the core is not substantially diminished by a considerable reduction in the diameter of the core or of its magnetic conductivity, for a limited portion of its length, particularly if such portion occurs between the windings or solenoids of the magnet, as, for example, in the yoke of a magnet of ordinary horse-shoe form. With currents of strength above such maximum, however, the magnetization of the core of this form does not increase in the usual proportion, but, on the contrary, a fairly definite point is reached at and above which very little increase in magnetic strength will result from a considerable increase in current strength. The core acts, in fact, in the manner of an automatic device for limiting the strength of magnetization without substantially impairing the efficiency of the magnet for currents below the given maximum.

I employ the principle above described in my track-circuit by providing the relay with a core having a portion of reduced diameter, the diameter of the core throughout the greater portion of its length, or particularly in those portions upon which the windings are mounted, being so large that with the minimum flow of current through the track circuit, such as occurs, for example, under the most adverse circumstances met in practice, the strength of magnetization in the relay is sufficient to insure reliable operation therein. In such an arrangement, however, when the conditions are better, as, for example, in dry weather when the insulation of the track-rails is most complete, the enhanced flow of current through the relay does not substantially increase the magnetization of the relay-core, owing to the

peculiar form of the core above described. From this it results that this magnetization is always at, or nearly at, the minimum requisite for reliable operation, and, as a further consequence, the retardation in the release of the relay-armature is never greater than that due to the necessary minimum of magnetization in the relay-core.

Figs. 2, 3 and 4 illustrate diagrammatically a form of relay-core suitable for use in the present connection. In these figures the yoke 16 of the core is of a cross-sectional area substantially less than that of the arms 17 of the core, so that the magnetic resistance of the yoke is substantially greater than that of the arms. The portion of the core comprised in the yoke and having this comparatively high magnetic resistance is only a fraction of the entire length of the core, however, and does not include any of the portions of the core upon which the windings are mounted. Fig. 5 shows another arrangement in which two portions of comparatively high magnetic resistance are produced by reducing the diameter of the arms 17 of the core at two points 16. In order that this reduction of the arms shall not substantially effect the strength of magnetization with the minimum current flow, these reduced portions must be short so as to correspond to only a small fraction of the length of the portions of the core occupied by the windings.

While I have illustrated and described my improved track-circuit as including both of the two devices hereinbefore described for reducing the induced current in the relay-winding, and while these two devices operate in conjunction in a more complete and uniform manner than either of them alone, it will be apparent that either device may be employed with useful effects in the absence of the other, and that my invention is not limited to their conjoint use.

In the following claims, where I refer to "excess resistance," I intend thereby to designate a resistance supplemental or additional to that normally and necessarily employed in a given portion of the track-circuit, whether or not such resistance is produced by a supplemental device such as a resistance coil, or by so proportioning any of the usual conductors of the circuit in such manner as to give them a resistance substantially greater than that normally employed and necessarily imposed by the conditions of use.

I claim:—

1. In an electric traffic-controlling system, a track-circuit comprising track-rails, a track-battery connected across the rails, and a track-relay having its winding connected across the track-rails, the portion of the track-circuit connecting the track-rails through the relay-winding having a resist-

ance inserted therein sufficient to reduce the flow of induced current in the shunt circuit through the relay below the holding value.

5 2. In an electric traffic-controlling system, a track-circuit comprising track-rails, a track-battery connected across the rails, and a track-relay having its winding connected across the rails, the connections of
10 said winding having a resistance therein sufficient to reduce the flow of induced current in the shunt circuit through the relay below the holding value.

15 3. In an electric traffic-controlling system, a track-circuit comprising track-rails,

a track-battery connected across the rails, and a track-relay having its winding connected across the rails, the portion of the track-circuit connecting the rails through the relay-winding having a resistance inserted for diminishing the flow of induced current in the shunt circuit through the relay, and the relay having a core of which a portion of limited length is of substantially greater magnetic resistance than the portions next to the polar extremities. 20 25

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Witnesses:

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D. GURNEE.

Copies of this patent may be obtained for five cents each, by addressing the "Commissioner of Patents, Washington, D. C."
