

J. S. HOLLIDAY,
RAILWAY SIGNALING.
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1,325,324.

Patented Dec. 16, 1919.

FIG. 1

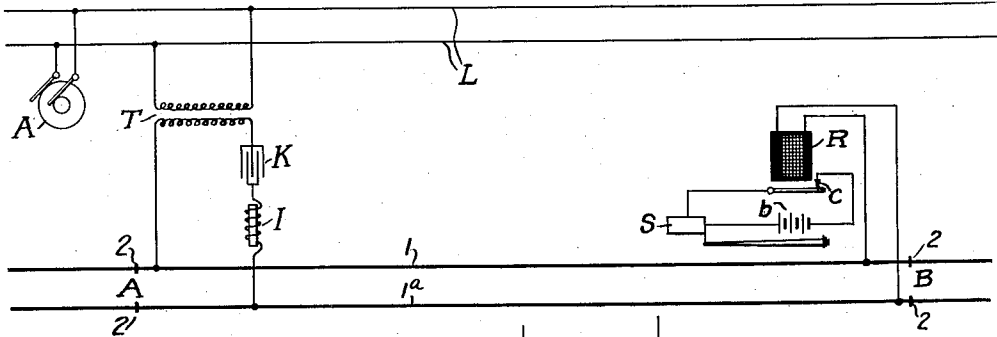


FIG. 2

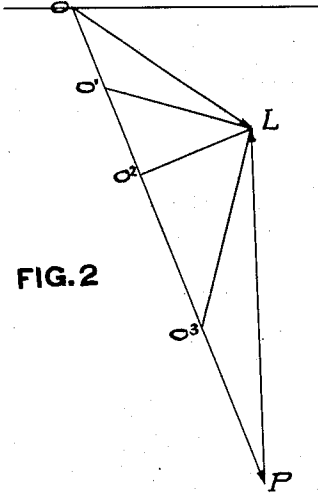


FIG. 3

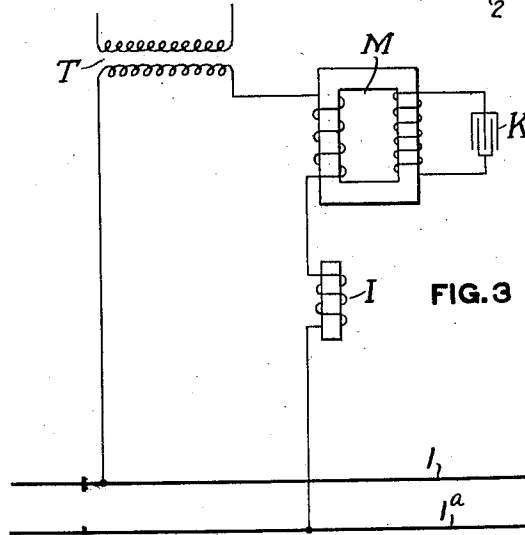
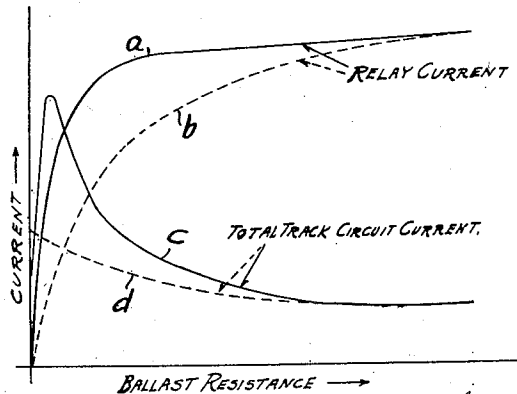


FIG. 4



WITNESSES

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RAILWAY SIGNALING.

1,325,324.

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To all whom it may concern:

Be it known that I, JOHN S. HOLLIDAY, a citizen of the United States, residing at Wilkinsburg, in the county of Allegheny and State of Pennsylvania, have invented certain new and useful Improvements in Railway Signaling, of which the following is a specification.

My invention relates to railway signaling.

I shall describe two forms and arrangements of apparatus embodying my invention and then point out the novel features thereof in claims.

In the accompanying drawing, Figure 1 is a diagrammatic view showing one form and arrangement of apparatus and circuits embodying my invention. Fig. 2 is a vector diagram showing the variation of the impedance between the transformer and the track in Fig. 1. Fig. 3 is a view showing a modification of Fig. 1. Fig. 4 is a group of curves showing the variation of total track circuit current and the voltage at the relay with variation of the ballast resistance.

Similar reference characters refer to similar parts in each of the views.

Referring first to Fig. 1, reference characters 1 and 1^a designate the track rails of a railway. Insulations 2 are inserted in these rails at intervals to divide them into sections, of which only one, A—B, is shown in the drawing. Each section of track is provided with a track circuit which comprises a source of energy connected to the rails at one end of the section, and an electromagnetic translating device receiving energy from the rails at the other end of the section. The source of energy is, as here shown, a transformer T which is fed from a transmission line L energized by an alternator A. The electromagnetic translating device is here shown to be a relay R, which is connected to the track rails near end B of the section. As long as there is no train in the block, current from transformer T flows through one track rail to relay R and returns through the other track rail, so that the relay is energized and closes a contact *c*. When a train enters the track section A—B, its wheels and axles form a bridge of low resistance from one track rail to the other, so that the greater part of the current is shunted around the relay, which in consequence is practically deenergized and opens contact *c*. This contact remains open until the train leaves the block, when the relay again re-

ceives sufficient current to move its armature or other movable member. This operation of the contact is utilized to control signals or other apparatus for the control of railway traffic. In the drawing I have shown a railway signal S of the semaphore type, which is energized by a local circuit comprising a battery *b* to hold its arm in a vertical position while this circuit is closed at contact *c* of relay R. While the semaphore arm is in this position the signal indicates "proceed". When a train enters section A—B, contact *c* opens the circuit for signal S, so that its arm drops to a horizontal position, indicating "stop".

Much difficulty has been experienced in the practical operation of track circuits because of their variations with weather conditions. The ties and ballast between the rails 1 and 1^a conduct current from one rail to the other so that, even when there is no train in the track section A—B, a part of the current from transformer T never reaches relay R. The resistance of the ballast varies with the nature of the ballast, and is, furthermore, low in wet weather but high in dry weather. Sometimes this resistance decreases with a change in the weather to such an extent that the relay does not receive enough current to hold its contact closed.

It is undesirable to overcome this difficulty by sending at all times a large amount of current into the track circuit so that even in the wettest weather the relay receives sufficient current to hold its contact closed, because then during dry weather the current reaching the relay is so great that when there is a light train in the block the relay may still receive enough current to prevent it from opening its contact. If this happens the signaling apparatus fails to give an indication of the presence of the train in the block. Furthermore, an unnecessarily high current is an expensive waste of energy. Again, nearly all the present types of alternating current relays chatter when they are over-energized so that during dry weather there is an undue wear on the bearings and other moving parts of the relay.

By my invention I provide apparatus in the track circuit which increases the current supplied to the track rails as the ballast resistance decreases and vice versa, so that when the block is unoccupied the current in the relay winding remains approximately the same for wet or dry weather. As shown.

in Fig. 1 this apparatus comprises a condenser K and an impedance coil I, which are connected in series between the transformer and the track. The impedance coil I is provided with a core which is substantially saturated when normal current flows through the track circuit. (By normal current I mean the current supplied to the track circuit to produce the desired energization of the relay when the ballast resistance is at substantially its maximum value.) The impedance of this coil decreases as the current through its winding increases above normal, due to the saturation of the core.

This apparatus functions in a manner which I shall now explain with particular reference to the vector diagram, Fig. 2, in which vector O—P represents the impedance of coil I when the current is normal, vector P—L represents the impedance of condenser K and vector O—L represents the combined impedance of condenser K and coil I. When during wet weather the ballast resistance decreases, the total impedance of the track circuit is lowered so that a greater current flows into the track rails because the voltage of transformer T remains unchanged. This current flowing through the winding of coil I causes a decrease in the impedance of the coil to a value represented by vector O'—P. The impedance of the condenser remains unchanged so that the combined impedance of coil and condenser is now represented by vector O'—L. This vector is smaller than vector O—L, in other words, there is a decrease in the total impedance between transformer T and the track rails, which has a tendency to make a greater amount of the voltage of the transformer available across the track rails so that more current reaches the relay than if an impedance of fixed value were used between the transformer and the track. The apparatus should be so adjusted and proportioned that, when the ballast resistance is lowest the impedance of coil I is approximately represented by vector O²—P, for then the resultant impedance between transformer and track, represented by vector O²—L, is at its minimum. When a train is in the block and short circuits the track rails the impedance of the coil I decreases still further, to a value represented by vector O³—P. The resultant impedance O³—L is now greater than before, so that it will tend at least to reduce the short circuit current.

In practice I prefer to use the arrangement of apparatus shown in Fig. 3, wherein the condenser K is connected into the track circuit through a transformer M, so that a condenser of smaller capacity may be used. Furthermore, I have found that by designing this transformer so that its core is

saturated when the track circuit is occupied, it is possible to cause a very large increase in the total impedance between the transformer T and the track whereby the short circuit current is still further decreased. This is shown in Fig. 4, in which the total track circuit current is plotted against ballast resistance as curve c. It will be noted that the current fed into the track circuit increases rapidly to a maximum as the ballast resistance decreases, thus tending to hold the current actually reaching the relay about constant. A still further decrease in the resistance between the rails, as when a train is in the track section, causes a rapid decrease in the track circuit current until at short circuit this current is comparatively small, which is very desirable for obvious reasons. Dotted curve d shows for purposes of comparison the variation of the current when a constant reactance is used between transformer and track, as usual in present practice.

Curves a and b show to a larger scale the variations of current through the relay with variations in ballast resistance, the former being drawn for a track circuit provided with apparatus of my invention and the latter being drawn for a track circuit having an ordinary resistance or reactance between the transformer and the track rails. These curves show distinctly that with my invention it is possible to obtain an approximately constant flow of current through the relay throughout a wide range of variation in the ballast resistance, whereas with the ordinary reactance the current through the relay drops off rapidly.

Although I have herein shown and described only a few forms of apparatus embodying my invention, it is understood that various changes and modifications may be made therein within the scope of the appended claim without departing from the spirit and scope of my invention.

Having thus described my invention, what I claim is:

An electric circuit regulator comprising a transformer whose primary is included in the circuit and whose core is substantially saturated when current of a given value flows in the circuit, a condenser connected with the secondary of said transformer, and an impedance coil connected in series with the primary of said transformer and so designed that its core is substantially saturated when current of less than said given value flows in the circuit.

In testimony whereof I affix my signature in presence of two witnesses.

JOHN S. HOLLIDAY.

Witnesses:

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