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RAILROAD SIGNALING SYSTEM

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FIG. 1

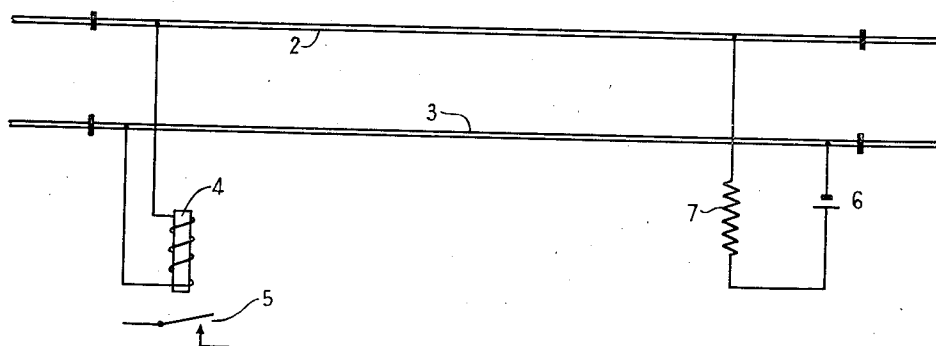
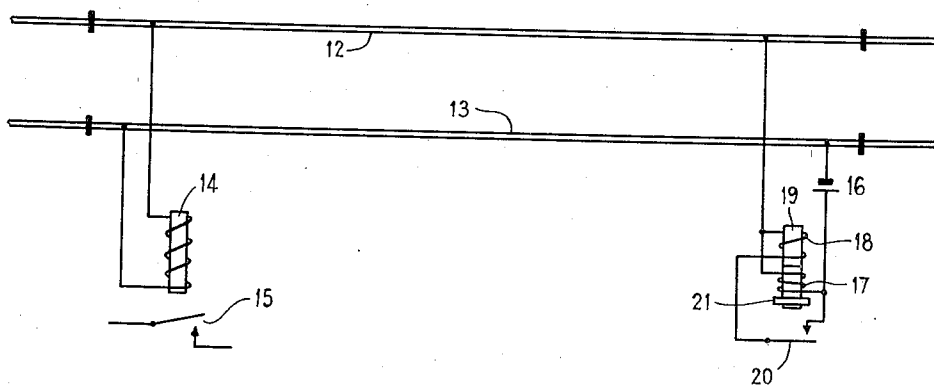


FIG. 2



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RAILROAD SIGNALING SYSTEM

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4 Claims. (Cl. 246—41)

The present invention relates in general to railroad signaling, and more in particular to a type of track circuit commonly used in this art which includes a track relay normally energized over the two rails of a track section in series with a battery. The object of the invention is an arrangement which will automatically compensate for excessive ballast leakage in such a circuit, and insure reliable operation of the track relay under adverse conditions.

The invention is described hereinafter in connection with the accompanying drawing, comprising Figs. 1 and 2. Fig. 1 shows a standard track circuit of the type above referred to, while Fig. 2 shows a similar track circuit equipped with the ballast leakage compensating device.

Referring to the drawing, Fig. 1, the reference numerals 2 and 3 indicate the two rails of a section of track, insulated at the ends according to the usual practice. The usual track relay is shown at 4, and has any desired arrangement of contacts such as 5. A battery 6 supplies current to the track circuit through a resistance 7.

In Fig. 2 there is shown a track circuit including rails 12 and 13, the track relay 14, and battery 16. These parts are the same as the corresponding parts in Fig. 1. The resistance such as 7 is omitted, however, and in place thereof there is connected the winding 17 of the relay 19. This relay, which constitutes the ballast leakage compensating device, is a marginal double wound differential relay of special design. Its construction and operation will be discussed in detail hereinafter.

It will be advisable first to recall the operation of the track circuit shown in Fig. 1 and explain the effect of excessive ballast leakage. The track relay 4 may have a resistance of about 4 ohms, and the battery 6 may be a single cell storage battery giving a voltage of about 2 volts. The track relay 4 is normally energized, but when a train enters the section the relay is short-circuited and falls back, pulling up again when the train leaves the section. The resistance 7, which may have a value of 4 ohms, prevents short-circuiting of the battery 6 when the section is occupied.

The ballast leakage referred to is the leakage that occurs from rail to rail through the ties and the ballast on which they rest. Under normal conditions the resistance from rail to rail is from 8 to 20 ohms, or even higher. This leakage path between the rails is a shunt around the track relay 4, but under normal conditions does not interfere with its proper operation. In wet

weather, however, the resistance of the leakage path decreases and if it gets low enough the track relay will obviously be rendered inoperative. For circuits such as the one described the resistance of the leakage path cannot fall below about 2 ohms and still retain reliable operation of the track relay. Failure consists in the relay being unable to pull up when a train leaves the section, the heavy leakage path shunting so much current away from the relay that it cannot operate.

Now it will be clear that if the resistance of the leakage path falls so low as to amount to practically a short-circuit there is nothing that can be done about it. The signaling system is put out of commission until the ballast dries out somewhat and operative conditions are restored. Such an extreme condition rarely occurs, however. Usually some substantial resistance remains, even though it may fall very low. It will be understood, therefore, that if some means could be devised to raise the voltage of battery 6, or cut out some of the resistance 7, which amounts to the same thing, the proper operation of the track relay could be maintained under most wet weather conditions; or at least an increased range of operation could be secured. This must be done only as a temporary measure when abnormal conditions occur, as a permanent lowering of the resistance would increase the current consumption unnecessarily under normal conditions.

The problem stated in the foregoing is solved by means of the special relay 19 shown in Fig. 2. The winding 17 of this relay, which is in series with the battery 16, may have a resistance of 4 ohms, corresponding to the resistance 7, Fig. 1, which it replaces. The winding 18 may have a resistance of 9 ohms or slightly more, so as to give a resistance of approximately 2.8 ohms when the two windings are connected in parallel. This is about as low a resistance as it is practicable to use. The two windings are connected in parallel by operation of armature 20.

Under normal conditions the relay 19 does not operate, except of course when the section is occupied by a train. When conditions change due to wet weather the ballast leakage increases, that is, the resistance from rail to rail through the ballast decreases; and when conditions become severe enough to call for an increased voltage across the rails, the relay operates. For example, the relay 19 may be adjusted to operate when the combined resistance of relay 14 and the leakage path amounts to about 1.5 ohms. In

other words, relay 19 operates with a resistance of 1.5 ohms in series with winding 17. It does not operate in series with a slightly greater resistance.

5 With the armature 20 attracted, the winding 18 is connected in parallel with winding 17. The resistance of the two windings in parallel is about 2.8 ohms, as previously stated, and the voltage across the rails is accordingly increased, with the result that the track relay 14 is still able to operate reliably. It will be understood that the characteristics of relay 19 should be such that 10 with a gradually decreasing ballast resistance the operating point of relay 19 is reached somewhat before the track relay 14 begins to fail. The operation of relay 19 then prevents failure of relay 14 at the point where it would otherwise occur, and extends the range of the latter relay to include lower values of the ballast resistance.

20 The windings 17 and 18 of relay 19 are in opposition, but the pulling power of winding 17 measured in ampere turns is in the neighborhood of three times that of winding 18. Relay 19 is therefore able to complete its operation after armature 20 closes its contact, and it stays operated 25 while the condition of excessive ballast leakage continues.

When the track dries out the ballast resistance increases and before long the relay 19 tends to fall back again. The point at which relay 19 de-energizes is reached sooner than otherwise would be the case because of the effect of winding 18 opposing winding 17, and when the ballast resistance increases enough so that the total resistance 30 in series with relay 19 is somewhat over 3 ohms the relay restores to normal. The winding 18 is thus cut out and the resistance between battery 16 and the rails is restored to its normal value of 4 ohms, the resistance of winding 17 alone.

40 A more complete description of a relay which can be used as relay 19 will now be given, by way of example. This relay may be a so-called telephone type relay, as manufactured by the Automatic Electric Company of Chicago, and well 45 known to telephone engineers throughout the country. The core, heel piece, and armature are preferably made of Allegheny metal, which is a nickel-iron alloy containing about 48 per cent nickel and 52 per cent iron. Winding 17 is on the armature end of the core and comprises 575 turns of No. 26 enameled copper wire, having a resistance of 4 ohms. Winding 18 comprises 380 turns of No. 33 enameled copper wire, having a resistance of 9.3 ohms. The relay should be adjusted 50 so that the armature has a relatively short stroke. While not absolutely necessary it is desirable to put a ring or slug of copper on the core, as indicated at 21 in the drawing. The purpose of this is to eliminate the slight chattering which might 60 sometimes occur on energization of this relay if the slug were not provided.

Certain definite values of resistance, etc., have been given in the foregoing, as an aid in the explanation of the invention. It will be understood, however, that these specific values are given only as an example, and that the invention 65 is not limited thereto in practice.

What is claimed is:

1. In combination, a section of railroad track, a track relay bridged across the two rails of said section, a source of current, a normally inoperative double wound differential relay having one winding bridged across the two rails of said section in series with said source, whereby a normally closed circuit is established including the two relays, the two track rails, and said source in series, said circuit also including the ballast leakage path from rail to rail as a shunt of the track relay, and contacts on said differential relay for connecting its second winding in parallel with its first winding responsive to an increased ballast leakage sufficient to operate the differential relay, thereby increasing the voltage applied across the track rails by said source and counteracting the effect of the increased leakage on said track relay.

2. In combination, a track circuit including the rails of a track section, a source of current, a relay having a winding through which said source supplies current to said circuit, said relay being inoperative with the ballast in normal condition and operative if the ballast leakage increases to a predetermined value, a second and less powerful winding for said relay, and contacts on the relay for connecting said second winding in parallel with said first winding but in opposed relation thereto, said second winding functioning to increase the voltage applied to the rails when the ballast leakage is severe and to assist the relay in deenergizing when the ballast leakage approaches a normal value.

3. The combination, with a track circuit including the two rails of a track section, a track relay, and a source of current, all connected in series, of means included in said circuit for automatically regulating the voltage applied to said track relay in accordance with the amount of ballast leakage from rail to rail, said means comprising a relay having a winding connected in series with said source to limit the current flow to the track circuit and serving to operate the relay responsive to an increase in ballast leakage, a second winding for said relay, and contacts operated by energization of the relay for connecting said second winding in parallel opposition to said first winding, said second winding constituting means for increasing the current flow to the track and serving at the same time to partially neutralize the magnetizing effect of the first winding, thereby enabling the relay to deenergize responsive to a moderate decrease in the ballast leakage.

4. The combination, with a track circuit and a source of current therefor, of a self-regulating variable resistance inserted between said circuit and said source, said resistance comprising a double wound differential relay operable over one winding responsive to an increase in ballast leakage to connect the second winding in parallel with and in opposition to the first winding, thereby lowering the effective resistance, said second winding serving to lower the magnetization of the relay to enable it to readily deenergize when the ballast leakage decreases.

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