track circuit so the signals will display the approach aspect as long as the signal lever remains in the "L" position, with a predetermined time interval between the time the signals are restored to stop and crossover "B" operated. This would take care of the switching movements without the operator reclearing Signals 2 and 3 for each movement, and would be safe.

Why Coded Track Circuits Can Be Longer

"Please explain the reasons why coded track circuits can be so much longer than conventional d-c. track circuits, and also explain the factors which limit the maximum length of coded track circuits."

Several Reasons

By R. M. Gilson

Electrical Engineer, Union Switch & Signal Company, Swissvale, Pa.

Much longer coded than conventional d-c. track circuits can be operated because of the characteristics of the code-following track relay which make for better shunting and a higher degree of broken rail protection coupled with less battery consumption and immunity to false-clear failures due to foreign current and to defective insulated joints.

In a conventional track circuit, to give a stop indication, it is necessary that the train shunt or a broken rail reduce the relay current to its release value of about 50 per cent of its minimum working value. In the coded track circuit, the stop indication is given when the relay current is reduced to but slightly below its minimum working current, at which point the relay no longer follows the coded energy applied to the circuit. As a result of the relatively higher current value at which the code-following relay fails to maintain a proceed indication, it is evident that for equal length track circuits the coded track circuit will have much better shunting sensitivity and a much higher degree of broken-rail protection. It follows that for equal shunting and broken rail protection values, much longer coded than conventional track circuits can be operated.

The code-following relay requires less electrical energy for operation than the conventional relay. This, coupled with the fact that coded energy is applied to the track circuit but half the time, reduces the track battery consumption, so that the longer coded track circuits do not mean correspondingly increased energy consumption over the shorter conventional track circuits. This is an important point where primary battery is used as the energy source.

Since the code-following track relay must be operating continuously to give a proceed indication, it is apparent that, with the coded track circuit, a false proceed indication cannot be caused by foreign current which might hold the relay steadily energized. This characteristic makes it safe to use longer circuits, in territory where foreign current may be encountered, than should be used with conventional circuits.

As the coded d-c. track relay responds to but one polarity, protection against false-proceed indications, due to broken down or defective insulated joints, can be insured by reversal of the polarity of adjacent track circuits. On the other hand, the conventional track circuit is subject to possible improper operation because of foreign current or defective insulated joints, the possibility of trouble increasing with the length of the circuit, which does not apply to coded track circuits.

The only limitations imposed on the length of the coded track circuit are those imposed by the requirements of adequate shunting sensitivity and broken-rail protection for the minimum ballast resistance, resistance of the bonded rail, and battery voltage.

As a general rule, it may be stated that coded track circuits of approximately twice the length of conventional track circuits can be operated with but half the track battery consumption per mile of track, with no sacrifice in shunting or broken-rail protection, and with highly improved protection against foreign current and defective insulated joints.

Determining Transformer Polarity

"What simple method can be used to determine the polarity of a low-voltage track transformer without using a meter if possible?"

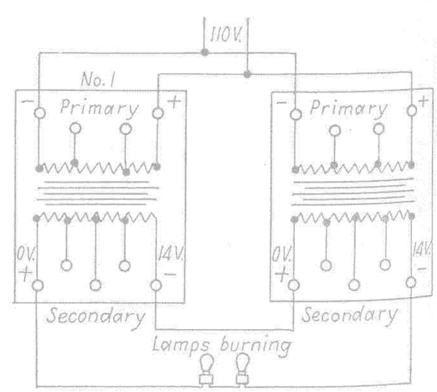
Lamp Method

James Ward

Signal Maintainer, Toronto Terminals Railway, Toronto, Ont.

As the polarity of a transformer indicates only the relative direction of the induced voltages between the high and low-tension terminals thereof, it follows, that when dealing with the polarity of a-c. track circuits, the polarity at the terminals of one track transformer, at a given instant, must bear some definite relation to a second circuit or transformer. This is encountered when the polarities of adjacent track circuits are staggered to obtain broken-down insulated-joint protection, thus necessitating a test in order to determine the proper relative polarity of the transformers.

Without the use of a voltmeter, a simple method is to connect the primary coils of two of the transformers in question in parallel across the line, placing a jumper between any of the outside secondary terminals of the two transformers and connecting two 16-volt signal lamps in series across the remaining outside terminals. Should the lamps light, the polarities of the transformers are additive and can be marked as shown on the accompanying drawing. If no voltage is indicated at the lamps, the polarities are subtractive and the secondary connections should be changed to secure the result illustrated. The reason for using the two lamps in series is so that their



Circuit for determining polarity

rated voltage will be approximately equal to the combined voltages of the two secondaries. Any number of track transformers can be checked for polarity in this manner, relative to No. 1 transformer. The same primary connections should be maintained throughout.