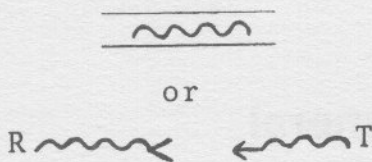


COMMITTEE G: Education & Training
Communication & Signal Division, AAR

D-8 Audio Frequency Track Circuit-General

Definition: An ac overlay track circuit utilizing 20 Hz to 20 kHz frequencies at low levels with electronic frequency generator and receiver having level and frequency sensing means. Overlay circuit is usually used without insulated joints to define the track circuit limits.

Symbol:



Description: The audio frequency track circuit is in general use for control of highway grade crossing warning systems and other signaling functions. This type of track circuit detects the presence of a train in a manner similar to the dc track circuit, except that insulated rail joints are not required. As in the dc track circuit, the rails form a part of the electrical circuit and must be bonded to provide reliable circuit continuity.

Audio frequency equipment consists of a transmitter unit, a receiver unit and a control relay. The transmitter unit generates an audio frequency signal which travels through the track connections and the rails to the receiver unit. The receiver unit responds to a signal of the proper frequency, above a predetermined level, and furnishes a dc voltage output sufficient to pick up a relay.

The audio frequency carrier signal is usually modulated by amplitude, frequency, phase or pulse at a lower frequency which is also detected in the receiver. This detected modulation is an added condition for output relay pickup affording further means of identifying the specific transmitted signal.

When a train occupies the circuit, the audio frequency signal from the transmitter is shunted through the axles of the train as in conventional track circuits. The receiver, not obtaining a proper signal from the rails at a specific frequency, does not furnish a dc voltage output and the relay is de-energized.

Purpose and Application: Two advantages of audio frequency track circuits are:

1- Two or more track circuits may be adjacent or overlapped without the use of insulated joints and repeating relays, due to separation by frequency.

2- Audio frequency track circuits may be superimposed over existing dc, ac power frequency or coded track circuits.

The point at which the transmitter wires are connected to the rails closely defines one end of the audio frequency circuit and the point at which the receiver wires are connected to the rails closely defines the other end of the circuit. However, circuit definition is not as precise as with insulated joints. The degree of definition depends on the type of equipment used, ballast, frequency and supply voltage conditions.

Because of its rather unique operating capabilities, the audio frequency track circuit may be applied easily in situations where major modifications to the signal and track layout would be necessary if conventional dc track circuits were used.

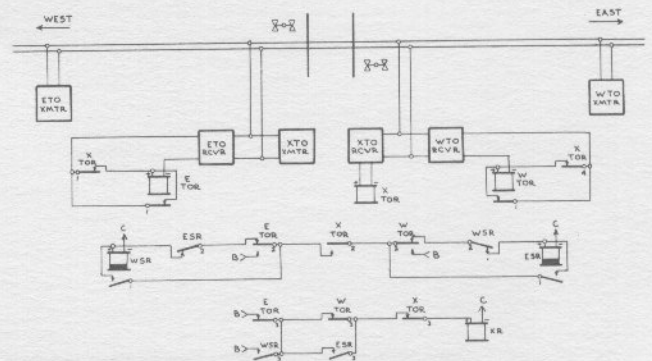


FIGURE 1

Figure 1 shows application of audio frequency track circuits to a highway grade crossing warning system.

Audio frequency track circuits can be provided for application in many track circuit configurations. For example, one transmitter can be used to furnish the signal for two or more receivers for use in time-out or other circuitry.

General Information: Due to the receivers being frequency selective, more than one audio frequency circuit may be operated through the same rails. Care must be taken in selecting frequency assignments to provide adequate channel spacing and to prevent harmonic and "beat" interference.

The circuit conductors (including underground track wires) which carry audio frequency signals should be twisted to reduce or cancel the effects of inductive coupling.

Because of rail inductance, the signal from the transmitter is attenuated (reduced) rapidly as distance from the transmitter increases. This attenuation is proportional to frequency and ballast conditions and results in higher frequencies having a shorter range than lower frequencies.

Care must be taken to insure that overlay equipment is properly installed and adjusted according to manufacturer's instructions.

Detailed Operation: Figure 1 shows audio frequency track circuits as applied to highway crossing circuit operation. Note that the track circuits are not isolated from one another by insulated joints. This is a major advantage of audio frequency track circuits. The audio frequency track circuits, as shown, can operate within the limits of conventional track circuitry. No insulated joints would be required for the audio frequency circuits and the conventional circuit would continue to operate normally.

Audio frequency track circuit transmitters and receivers are generally designed to operate from a 10 or 12-volt battery supply and may be energized from the conventional signal rectifiers. The units are designed along conventional closed circuit principles. Single component failure or opening of circuit leads will result in a drop of receiver relay drive output.

By-pass units can be used to extend audio frequency track circuits around existing insulated joint locations without affecting the conventional dc or coded track circuits. Broad band by-pass units will pass a number of

alternating frequencies while narrow band by-pass units will pass only a specific band of frequencies. Both types of by-pass units effectively block the flow of direct current. They are designed to greatly attenuate ac power frequencies when power frequency ac track circuits are used.

The existing batter of a conventional track circuit will shunt the audio frequency signal so that a blocking reactor installed in series between the battery and the rail is necessary. The reactor is used to block the audio frequency signal while permitting the passage of the conventional track energy. A 4-ohm dc track relay has sufficient inductance to block and audio frequency signal. A 0.5-ohm track relay does not have sufficient inductance and a blocking reactor may be necessary depending on the distance between the relay and the audio frequency device. Selection of the proper reactor is of utmost importance where coded track circuits are used as the reactor might adversely affect the signal circuits.

The equipment used with audio frequency track circuits is susceptible to damage from lightning and other surges. Precautions must be taken to furnish surge protection. Fast acting arresters and/or surge protectors must be used to protect transmitters and receivers from damage due to surges on the ac power line input, the dc power input, and all wires connected to the track or pole line.

Audio frequency track circuit systems with the ability to detect stops and starts of trains within the limits of crossing approach circuits are used to provide more uniform operating time of the highway crossing warning systems. These motion sensing systems have given added credibility to highway grade crossing warning systems by reducing unnecessary operation.

One word of caution: When checking or adjusting motion sensing devices, this type of equipment must be installed and adjusted as specified by the manufacturer. This equipment operates in a different manner to detect trains, and under certain conditions, proper operation can be seriously affected by improper adjustment.

It is important to use a meter recommended by the manufacturer when adjusting this equipment.

Note: This Bulletin is for general information only. For specific applications consult the rules, standards and instructions published by your railroad.

Notes:

