Signal Training Bulletin

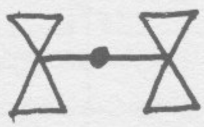
COMMITTEE G: Education & Training
Communication & Signal Division, AAR

E-4 Highway Grade Crossing Warning Device- Flashing-Light Signal

Approved November 1981

Definition: A device used to provide warning at railroad-highway grade crossings.

Symbol:



Description: A flashing-light signal consists of a RAILROAD CROSSING sign, commonly called a "crossbuck" and flashing red lamp units mounted 30 inches apart on a horizontal crossarm. These are attached to a mast mounted on a foundation.

Purpose and Application: A flashing-light signal provides visible warning for vehicular traffic and pedestrians at railroad-highway grade crossings.

General Information: Figure 1 shows a typical flashing-light signal. The flashing red lamp units are generally attached to the mast 7 ft. 6 in. to 9 ft. 6 in. above the crown of the highway. Each lamp is alternately illuminated at a rate of 45 to 65 times per minute. Generally, the lamp units are installed "back to back" where the traffic over the track is in both directions. The back lamps provide close-up aspects. Variations in light distribution as well as location of the signals are often made where such deviations are desirable or required to meet specific conditions. There are also different methods of assembly such as mounting of lights, etc., depending on the particular manufacturer.

When there are two or more tracks at the crossing, a sign indicating the number of tracks is attached to the mast under the crossbuck. A few states require a STOP ON RED SIGNAL sign. This is no longer recommended by the AAR, but when required by a state, it is to be mounted on the mast below the lights.

Through the use of other devices, the warning afforded by a flashing-light signal is supplemented in many ways. These devices include the bell, rotating STOP sign, gates, NO RIGHT TURN or NO LEFT TURN signs, and pre-emption of highway traffic signals. Only limited use is made of the rotating STOP sign. It should be kept in mind that the devices described in this paragraph are adjuncts which only supplement the basic warning provided by the flashing-light signal.

Detailed Operation: Directional control in general use with railroad-highway grade crossing warning systems uses the stick circuit arrangement to provide for the starting and stopping of the warning devices. This prevents operation of the crossing warning system by a receding train after it has passed the crossing.

Figure 2 shows a basic directional stick circuit used for control of highway grade crossing warning devices.

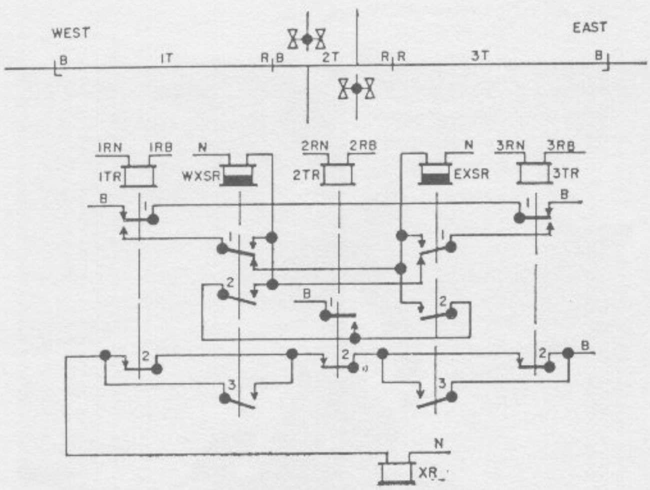


Figure 2 shows one basic directional stick circuit for control of highway grade crossing warning devices.

NOTE: Other directional stick circuit arrangements may be used. Refer to actual circuits and operation used on your railroad.

Referring to Figure 2, relays 1TR, 2TR, and 3TR are track relays. If either the west or east approaches consisted of more than one track section, line relays would be used and they would be called WXR and EXR, respectively. The WXSR (westward crossing stick relay) and EXSR (eastward crossing stick relay) are slow release relays. For purposes of explanation, assume a train movement from west to east entering the control territory at 1T and leaving it at 3T. When the train enters 1T, relay 1TR is de-energized, opening its front contact 2, which causes XR to become de-energized and the crossing signals to operate. Simultaneously, current flows through front contact 1 of 3TR, through back contact 1 of 1TR, through back contact 1 of WXSR to the coil of EXSR, causing EXSR to be energized, closing its front contacts. When the train enters 2T, relay 2TR is de-energized, opening its front contact 2 in the XR circuit and closing its back contact 1.

A stick or holding circuit results from current now flowing to the coil of EXSR through its own front contact 2 and back contact 1 of 2TR. As the train enters 3T, relay 3TR is de-energized and EXSR is held energized through back contact 1 of 2TR only. When the rear of the train leaves 1T, relay 1TR is energized and current now flows through front contact 1 of 1TR, through back contact 1 of 3TR, through front contact 1 of EXSR to its coil. When the train leaves 2T, relay 2TR is energized and current flows to the coil of XR through front contact 3 of EXSR, through front contact 2 of 2TR and through front contact 2 of 1TR, and the crossing signals cease operating.

As soon as the train leaves 3T, relay 3TR is energized which opens the circuit to EXSR, causing it to become de-energized. The sequence of operation for a train entering 3T is similar, except that WXSR is energized when the train enters 3T.

The following descriptions apply to the local control of the crossing signals. Figure 3 shows a method of control for flashing-light signals and bell. This description begins with the XR or control relay referred to previously.

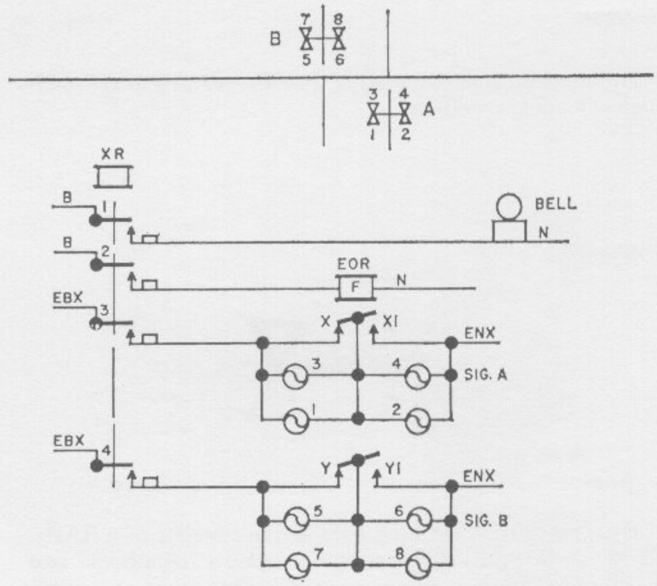


Figure 3 shows a method of control of flashing-light signals and a bell.

With relay XR de-energized, current flows through its back contact 1 to the bell, through its back contact 2 to the flasher relay EOR coil, and through its back contacts 3 and 4 to the lights. From the study of the flasher relay, it is known that when current flows in its coils, its armature operates, first closing lighting contacts X and Y and then lighting contacts X1 and Y1 at a rate of 45 to 65 times per minute. The armature of the flasher relay is either mechanically or electrically biased so that upon de-energization one or the other set of contacts is closed. This illustration shows when the XR relay is de-energized, current from the power supply will flow through its back contact 3, through flasher contact X to lights 2 and 4 and return to the power supply. When the armature is in the opposite position, current will flow through back contact 3 of XR, through lights 3 and 1, through flasher contact X1 and back to the power supply. In each position the non-lighted lamps are shunted.

Similar action takes place simultaneously for the light circuit of Signal B. The arrangement, as it can be seen, provides for lights 2 and 4 on Signal A to be illuminated at the same time as lights 6 and 8 on Signal B. This is true also for lights 1 and 3, and 5 and 7. Lights 1 and 2, and 7 and 8 are often referred to as front lights, and lights 3 and 4, and 5 and 6 are referred to as back lights. Should the flasher relay fail to oscillate, lights 2 and 4, and 6 and 8 would be lighted steadily because the flasher relay is so biased that one set of contacts is closed. It also can be seen that with this method of wiring, when the armature is oscillating, there is a period of time when neither flasher contact X or X1 is made. At this time light 3 is in series with light 4, and light 1 is in series with light 2. This reduces the voltage across the armature contacts to about one-half the normal lighting voltage. This feature reduces the arc at the flasher contacts which prolongs their life and assists in minimizing radio interference.

At crossings where automatic gates are used with flashing-light signals (flashers), additional relays and circuitry must be provided.

Unlike ordinary street intersection traffic lights which are operated solely by commercial power, railroad-highway grade crossing warning signals are generally provided with standby battery in the event of failure of the commercial source. Figure 4 shows a typical arrangement of a power transfer circuit.

Figure 4 shows the primary and secondary winding of the transformer and the power transfer relay.

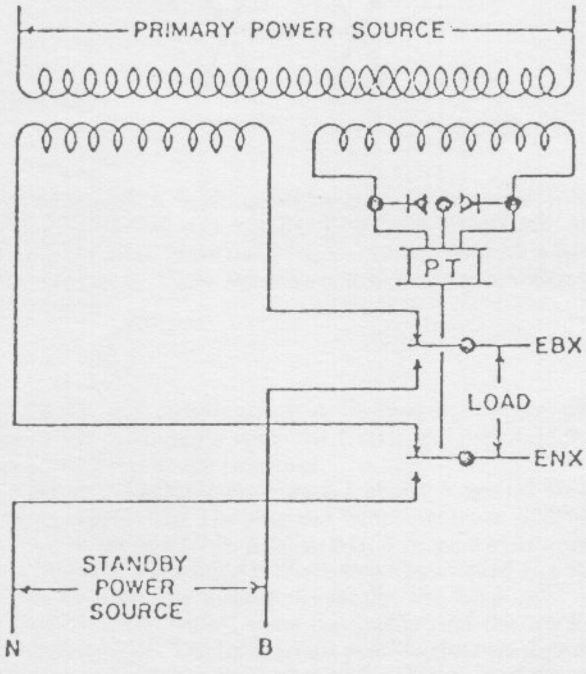


Figure 4 is a typical arrangement of a power transfer circuit.

The power transfer relay is connected to the low-voltage side of a transformer, the primary of which is permanently connected to the 115 or 230-volt ac power source. The mechanical and electrical construction of a power transfer relay is similar to a regular neutral direct current relay with half-wave rectifiers added across each of the operating coils of the relay, allowing full wave rectification.

The power transfer relay should not be connected across the same transformer taps that carry the lamp load. Should it be necessary to connect the relay across taps already carrying a load, those taps should be selected whose load is almost constant and unaffected by the operation of the power transfer relay. This should be kept in mind to prevent oscillating or pumping action of the armature and burning contacts due to variation in lamp load demand.

The illustration shows the standby power source (usually storage battery) terminating at the back contacts of the power transfer relay. Normally, (with ac power on) alternating current from the secondary winding is fed to the load circuit through the front contacts of the power transfer relay. However, in the event of loss of energy from the transformer, the armature drops by force of gravity and closes its back contacts thereby connecting the lamp circuit to the standby power source which carries the load until ac power is restored.

During one-half of each ac cycle, current flows through one relay coil and that leg of the rectifier in parallel with the second relay coil, while during the second half of each cycle current flows through the second relay coil and that leg of the rectifier in parallel with the first relay coil.

Notwithstanding this alternating action, the relay is quiet at all impressed voltages since the mutual inductive coupling of the two legs, and the inductance and low resistance of each leg of the circuit, causes the current flowing therein to have a direct current component. Although the current through each coil pulsates, the average of the currents in both coils is practically constant. This means that the electromagnetic flux acting on the armature is practically constant, therefore there is no tendency for the armature to vibrate and the effect is equivalent to action of direct current.

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