will be placed in the yellow unit every 230 days, the lamp taken from the yellow unit will be placed in the red unit, and the lamp removed from the red unit will be placed in the marker lamp.

Discoloration of Glass

C. H. TILLETT
Signal Engineer, Canadian National, Toronto, Ont.

Practically all of our automatic signals are of the multiple-light type, equipped with a relay that cuts in the yellow indication in case the lamp of the green unit is burned out. The lamps of the red indication are connected to the circuits in the normal manner.

An examination of the bulbs, when they receive their weekly cleaning, will reveal a discoloration on the glass, thus permitting the lamp to be changed long enough before the actual burn-out takes place. Occasionally a lamp will fail shortly after it has been put to use but these are rare occurrences; however, when it does happen no advance warning is given. Our lamps in the green indication average about two years; the ones in the red about four years, and we have rarely to change the yellow.

We attribute the long life we get out of our lamps to the fact that they are approach lighted, and are lighted directly off of the storage battery instead of the alternating current supply with power-off relays. This latter method of lighting was discarded early in our experience because of the loss of lamps caused by bad voltage regulation of the power supply.

Discontinued Transference of Lamps

L. S. WERTHMULLER
Assistant Engineer, Missouri Pacific, St. Louis, Mo.

It formerly was the practice on the Missouri Pacific to transfer the lamps from the green to the yellow and from the yellow to the red unit, and for a time we felt that this was giving us very good results. We determined, however, that we probably were damaging the filament more in transferring than if we had permitted the lamp to run its life in the unit in which it was originally installed. On a large percentage of our signal mileage we use the double-filament bulb and by inspection of the lamps, we are able to detect approximately 75 per cent of the lamps with one filament burnt out before we have failure of other filament. On the single-filament lamps, the signalmen are able to avoid a large percentage of failures by inspecting the filament while burning for weak points which are shown by increased illumination at the weak point in the filament or by discoloration when the lamp is not illumined. As we have but an average of five train delays per year due to burnt-out lamps in our 2,000 miles of automatic signals, I believe our present system is very satisfactory.

Left in Service for a Fixed Period

W. N. HARTMAN
Assistant Signal Engineer, Chesapeake & Ohio, Richmond, Va.

Several years of experience with various types of lamps in color-light automatic signals finally led to the adoption, in 1936, of differential filament lamps. These lamps after being installed in the signals are not transferred from one unit to the other but are left in service in the unit, in which originally installed, for a fixed period of time as follows: 300 days in normally burning (green) lamp units and two years in yellow and red lamp units, the burning time of which is dependent on volume and speed of traffic. These fixed periods of time for retaining the lamps in service in the various units are, for the present, arbitrary but were tentatively adopted as the result of extensive tests which indicated an expectancy of 6,000 or more hours burning life without failure of either the primary or secondary filament, when burned at a maximum of 90 per cent of their rated voltage.

It is not possible to state, at this time, how long an average life may be expected from lamps of this kind, as this will depend on the percentage of lamps requiring renewal prior to the end of the fixed life period due to burned out filaments and other defects. The arbitrary fixed life period may be lengthened or shortened, depending on future performance records.

Track Shunting Problems

"Where a certain few track circuits at interlockings are causing trouble due to failure to hold a shunt, on account of infrequent use by trains, what practical remedy can be applied?"

Trouble Due to Film

A. R. WHITEHORN
Commercial Engineer, General Railway Signal Co., Rochester, N. Y.

It is evident that the problem we are confronted with in holding a shunt is due to a film or corrosion on the track circuits or rails due to infrequent use by trains. If the equipment using this track circuit is of a sufficient weight, the problem is to be sure that the relay shunts when the train enters the section and it has been found in the past year or two that the most logical assurance of a shunt when film or corrosion is present on the rails is to increase the potentials which will break this film down and, consequently, be assured of the shunt.

We have found that this increased voltage with increased resistance inserted in the relay end of the track circuit has been a decided improvement in shunting, but there is a certain amount of sacrifice of broken rail protection by having this voltage increased. Some attempts have been made to reduce the sacrifice of broken rail protection to the minimum by having a fluctuating potential. The high or peak voltages provide good shunting and the mean voltage, or rather the average voltage, determines the amount of sacrifice on broken rail protection.

The development of the so-called primary secondary track circuit arrangement was brought about in an attempt to overcome momentary loss of shunt but, of course, can have incorporated in it the same features of an increased voltage and in this way it will do double duty by assuring, first, good shunting and second, the overcoming of a possibility for momentary loss of shunt. It is self-evident that the more light-weight equipment and so-called streamlined trains that are used, the possibility for momentary loss of shunt becomes greater.

The use of the primary secondary relay combination using an increased resistance in the relay leads to the

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track will provide a decided improvement on the ordinary track circuit from a shunting standpoint or a momentary loss of shunt. The momentary loss of shunt feature can be further improved by introducing a time feature between the primary and secondary relay that will be of sufficient duration to prevent having energy applied to the secondary relay during these momentary loss of shunt periods. Broken rail protection can be solved somewhat, within certain limitations, by lowering the resistance winding of the relay with a consequent increase in current to pick the relay up.

Two Methods Available

R. M. Gilson
Union Switch & Signal Co., Swissvale, Pa.

The problem, of shunting infrequently-used track circuits, is one which has always presented extreme difficulty on account of the high resistance of the film of silicates or oxides which form on the surface of the rails when they are not used. Two methods of improving shunting sensitivity under this condition are available: One, the use of the special combination known as the primary-secondary relay; the other, the use of increased voltage across the rails which has the faculty of more readily breaking through the rail film insulation.

The primary-secondary combination consists of a primary relay connected to the track which when picked up in turn picks up the secondary relay, a slow pick-up quick-release instrument, through which are carried the signal circuits. Pick-up of the secondary relay also cuts out of the primary relay circuit a portion of the turns of its windings so that its energization is reduced to near its release point, thus making the shunting of this relay much easier than if it were fully energized. On a given track circuit the shunting sensitivity can be approximately doubled by this method.

The second method, involving increased rail voltage, can be effected by inserting resistance in series with the leads of the track relay so that the relay receives but normal energy under worst ballast conditions. This will, of course, require higher battery voltage and reduction of resistance in battery leads. Where alternating current power is available, the track batteries may be replaced by half-wave or full-wave rectifiers and still better application of this principle obtained due to the peaks of the rectified voltage wave being of much higher value than the average or corresponding battery voltage. Unfortunately this method to obtain the most improved results is limited to relatively short track circuits of the order of 2,000 ft. or under, but it should have a useful field in interlockings where the track circuits are generally short.

Train Shunt at Automatic Plants

"What circuits have been designed for automatic interlockings, based on the requisite that a loss of train shunt will not permit a change in line-up?"

Prevents Change in Line-up by Use of Stick Relays

John W. Roth
Chief Draftsman, Western Lines, A. T. & S. F., Amarillo, Tex.

On the Santa Fe, we have a circuit for use at automatic interlocking plants which prevents a change in line-up in case of loss of train shunt. It is illustrated in the accompanying diagram and works as follows: A train enters track circuit 1AT, dropping 1ATP, which picks up 1-2RS. A front contact on this relay, in series with a back contact on 1ATP, picks up 1HR, which opens the control of 1NP. When 1NP drops, it de-energizes 1-2LR. Since 1-2LR and 1-2RS have both opened the control of 3-4RS, a train on 3AT or 4AT does not get a signal until the first train accepts its signal or until signal No. 1 has remained red long enough for the time-element relay 1-2TU to wind up and pick up the lock relay 1-2LR. The lock relay cannot be picked up by the momentary shunt of one track circuit within home signal limits, but requires the occupancy of two track circuits, at which time the slow acting repeaters of the track relays pick up the lock relay. This plan works equally well for trains coming on any of the four approaches.