be carried concealed from the switch box to a point alongside the rail. The wires in the grooves are covered with standard redwood capping.

This method makes it possible to attach the switch box and wire the assembly complete at the maintainer's headquarters or in the outfit, the only work required in the field being the placing of the tie, attaching the switch box rod and bonding the wires to the rail. From the derails the shunt wires are carried in redwood trunking to the main line rails.

Ordinarily we use two sets of switch box contacts wired independently, that is, one wire from each rail to each pair of contacts. Crossover switch boxes have two pair of contacts for each track. By pressing each pair of contacts together independently, a test of the continuity of each wire is obtained. The instructions for making this test in d-c track circuits are as follows:

"Test each switch circuit controller wire for high resistance by attaching a voltmeter to the main track opposite the controller and note the meter reading with contacts of controller closed (one pair at a time). If a reading of more than 0.05 volt or an increase over previous reading is obtained, or the reading in one wire is different from that of the other wire to the same controller, careful investigation must be made."

By having the pairs of contacts wired independently we pick up many cases of high resistance and open wires which would otherwise pass unnoticed. We have had a number of cases of high resistance develop between the contact springs and terminal posts so we solder the two together to prevent trouble from that source. As a further precaution, we bend the contact springs so that they close instead of remaining open if the spring board cap becomes loose.

San Francisco, Calif. R. D. MOORE,
Assistant Signal Engineer, Southern Pacific.

Two No. 9 Flexible Copper Wires Are Run to Each Rail—This Practice Is Also Adhered to at all Battery and Relay Leads

THE following practice of arranging switch box shunts has been used on the Wabash for a number of years with success, and no failures have occurred on account of broken rail connections. No. 9 Kerite flexible, 19-strand, 5/64 in. wall insulated copper wire is used. Two wires are run from the switch box to each rail, eyelets are soldered to the wires on the switch box end and a No. 8 copper clad bond wire, properly formed, is soldered to the other end for the rail connection, one wire running to the outside and the other to the inside of the rail with 9/32-in. copper clad channel pins.

The wires are protected by cypress trunking and capping, the bootlegs being made of trunking 10 in. long, 1 in. of the groove being cut off of each end so that when the boot-leg is turned bottom up it fits directly on the trunking between the capping with 1 in. overlap on the capping.

A groove just large enough to allow the wire to slip free is made in one end of the boot-leg. Enough slack wire is left in the trunking so that in case of a derailed car or dragging equipment cutting off a wire the wire can be pulled out and a new rail connection soldered on without tearing up the capping.

With a wire tapped on to each side of the rail it is practically impossible for derailed car wheels to cut off both wires and not at the same time tear up the track so badly that it cannot be used. We carry out the practice of running two wires to each rail on all of our battery and relay leads and we very seldom have signal failures caused by broken rail connections.

Forrest, Ill. H. W. COOPER,
Signal Maintainer, Wabash.

Each Switch Box Contact When Closed Must Reduce the Voltage of the Track Circuit at the Switch to a Maximum of 0.04 Volt

THE practice on this road is to use a copper wire not smaller than No. 8 A. W. G. to each rail. The connection is made by soldering to the bond wire, which is channeled to the rail. Not less than two contacts, more if available, are connected in multiple for shunting the track. Testing instructions require that each contact must be tested independently and when closed must reduce the voltage of the track circuit at the switch to a maximum of .04 volt. If the A. R. A. recommended resistance table for governing current flow to track circuits is followed, there will be an ample safety factor in the shunt of two or more contacts under this method. It may be of interest to state that resistance in a shunt box is generally not found in the contacting points, but at the heel where the binding post connections are made.

Cincinnati, Ohio C. F. STOLTZ,
Signal Engineer, Cleveland, Cincinnati, Chicago & St. Louis.

Are Smash-Boards Necessary at Automatic Crossing Plants?

"Should smash-boards be used on home signals at automatic signaling interlocking plants? Why?"

Smash-Boards Not Needed Unless Engine Crew Discipline Is Lax

THE conditions to be met and under which an automatic interlocking plant is installed should govern largely of what the plant should consist. I do not favor the use of smash-boards on home signals at automatic signaling interlocking plants, because a plant of this type should be installed only where it is desired to avoid a train stop; the train to be kept moving only at a restricted and not at time card or scheduled speed and all trains required to approach the crossing under control, expecting the home signal to remain at stop and the crossing occupied until the home signal assumes a proceed position.

To obtain this condition in movement of trains it is necessary to have sufficient discipline to feel assured that the signal indications will be obeyed, just the same as at a crossing with no protection where a full stop is required. A smash-board signal would not prevent an accident, it is only for a post-mortem after an accident has occured and the position of the trains would, no doubt, together with information obtained by investigation, determine the same facts in every case and permit placing the responsibility. If it is thought there is any great necessity for a smash-board signal, immediate steps should be taken to correct such condition.

The added expense and complication of circuits would more than offset any benefit derived and if a smash board signal comes into use very frequently, an alarming condition is in existence. Large interlocking plants are now in service with no derails. Neither is it deemed advisable to equip home signals with smash-boards.

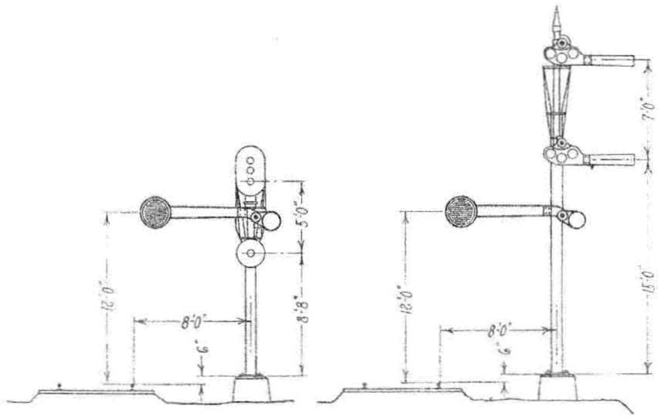
The arguments for "derails vs. no derails" and "smash-boards vs. no smash-boards" all appear to come within the same category, with the final analysis that when a signal installation is made there must be obedience to the signal indications. If this is not had there will be accidents, regardless of whether derails or smash boards are provided.

Springfield, Mo. I. A. UHR,
Signal Engineer, St. Louis-San Francisco.

A Road With Several Automatic Plants Does Not Favor the Use of Smash-Boards

As a general proposition I am of the opinion that the use of the smash-board is not necessary.

The use of the smash-board tends to force the proper observance of signals. In former years it was the practice to provide derails at railroad crossings



Interlocking Home Signals of Both Semaphore and Color-Light Type Equipped With Smash-Boards

throughout some of the middle western states and the smash-board in some cases has been used in lieu of derails removed.

St. Paul, Minn. C. A. DUNHAM,
Superintendent of Signals, Great Northern.

A Discussion of Both Sides is Desirable Until a Definite Consensus of Opinion is Established

The use or non-use of the smash-board on the home signal at "automatic interlockings" should, of course, be based on its relative advantages and disadvantages. Its disadvantages are:

(a) It greatly increases and complicates the control circuits, thereby increasing the opportunities for plant interruptions. This type plant is usually at an outlying point where failures can not be cleared up quickly and engineers tend to lose respect for a plant which is out of order very much.

(b) It almost doubles the cost of the plant.

(c) It will not prevent a train from fouling the crossing if an engineman, for any reason, overlooks and runs by the home signal.

Its advantages, in my opinion, are:

(a) It will assist in forcing respect for the "stop" signal on the part of enginemen.

(b) It *may* assist to establish responsibility as between two companies in the case of a collision at a crossing, but always, there *may* be the claim that the signals and smash boards changed position too late for an approaching train to stop.

I consider that the advisability of using the smash board will be an open subject for some time; however, pending further developments, I vote against the smash board on the basis that its known disadvantages materially outweigh its known advantages. I have been pleased to note the discussion that this subject is receiving and hope that it will be kept in the foreground until a definite consensus of opinion will have been established.

Chicago LEROY WYANT,
Signal Engineer, Chicago, Rock Island & Pacific.

Will They Do Any Good?

Do smash-boards have any function?

Will it do any good to find a broken smash-board after the wreck has occurred?

I think these two questions indicate my opinion.

Topeka, Kans. THOS. S. STEVENS,
Signal Engineer System, Atchison, Topeka & Santa Fe.

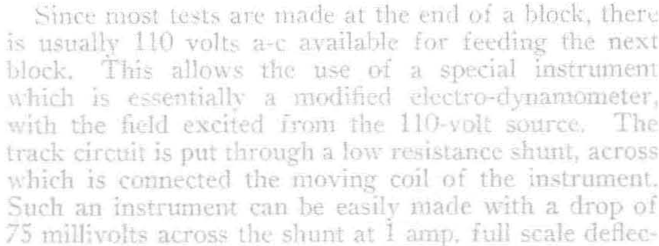
Measuring A-C. Train Control Current

"What kind of an ammeter is best suited to measure a-c train control current which is superimposed on a d-c track circuit?"

Electro-Dynamometer Type of Ammeter Equipped With Externally Excited Field Gives Promise of Being Suitable for This Service

We have gone into considerable study on the matter of measuring the alternating current component only, in track circuits in which both direct and alternating current are superimposed. The most obvious proposition is to place a transformer in the circuit first, as shown in the sketch, and read the secondary current on an ordinary commercial alternating current ammeter. While special transformers may be made having very low losses, the ammeter takes considerable energy and the total energy necessary for full scale deflection becomes considerable, perhaps 0.5 watt, which is of the order of 0.5-volt drop for a full scale value of one ampere.

While such an instrument will give indications of the alternating current only, it will be found that the indications are somewhat modified by the amount of direct current, due to the fact that the direct current magnetizes the core and the true ratio of the transformer will change to a certain extent, depending upon the amount of direct current. However, the biggest objection to this combination is the drop in the transformer.



Two Methods of Metering A-C Train Control Current in a Track Circuit

Since most tests are made at the end of a block, there is usually 110 volts a-c available for feeding the next block. This allows the use of a special instrument which is essentially a modified electro-dynamometer, with the field excited from the 110-volt source. The track circuit is put through a low resistance shunt, across which is connected the moving coil of the instrument. Such an instrument can be easily made with a drop of 75 millivolts across the shunt at 1 amp. full scale deflection of the instrument. The readings of such an instrument are of course proportional to the voltage which excites the field as well as to the cosine of the angle of lag of the alternating current in the track circuit behind the voltage, or in other words, its power factor. For a given system, however, the latter is usually within certain limits and the instrument can be designed for instance, for a lag of 30 deg. Slight deviations from