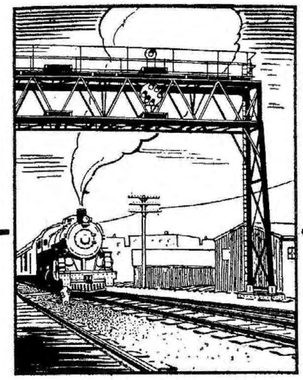
What's the ANSWER?



Contact Pitting

"What causes pitting of relay contacts, especially in flasher relays, and how can these effects be reduced?"

A Study of the Circuits

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Since the adoption of the flashing-light signal as the standard for highway crossing protection there has been considerable argument about the most suitable method of wiring the flasher relay and lights so as to minimize contact pitting. Some of this discussion has been directed toward the idea that if the current to be interrupted by the flasher contacts can be maintained at low levels the pitting effect will be correspondingly low. Even though this is true, erroneous conclusions may be arrived at, if other factors are not also considered. For example, the voltage around the contact after it has been opened must also have some bearing on the matter.

In order to avoid technicalities so far as possible, the discussion can be confined to direct-current and non-inductive circuits. With this in mind, consider what happens when a current of two amperes is interrupted by the opening of a relay contact. To begin with, a voltmeter connected around the contact will read zero before opening, and maximum, say ten volts, after opening. On the other hand, an ammeter in series with the contact would read two amp. and then zero. Just how these changes take place depends upon the characteristics of the circuit, the contact and its speed of operation, a matter to be determined by an oscillograph. But it is certain that during a fraction of a second, a voltage and an amperage simultaneously exist and these values if known, can be multiplied and summed up against time to obtain watt-seconds, that is to say, energy, dissipated in the form of heat. Also, if the voltage is high, any arcing effect will persist longer than if it is low, doing more damage.

The principle may be stated, therefore, that the local heating effect at the point of contact opening is the primary cause of contact burning and pitting and that this is determined by watts and time, not current only nor voltage only. This may be demonstrated further by considering three

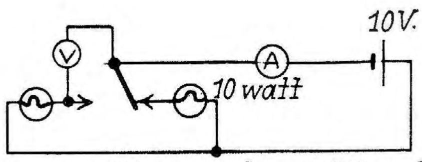

Fig. 1 Make and Break

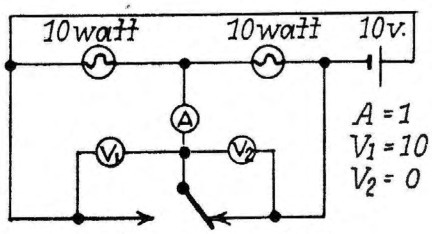

Fig. 2 Shunt

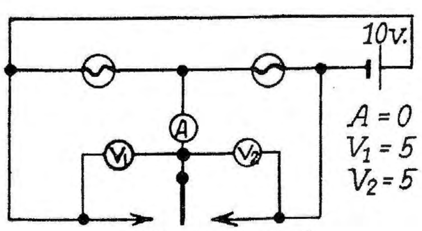

Fig. 3 Shunt

Diagram of tests

large knife switches in parallel circuit, each carrying 10 amp. Opening one or even two switches could hardly be expected to produce an arc, because the voltage across all three remains substantially the same as long as one remains closed. Opening the third switch would surely produce a spark as a voltage and current would then exist for a short interval. If the voltage be relatively high, a destructive arc would occur. Conversely, in a 110-volt series circuit passing only 2 m. a., no arc could reasonably be expected when the circuit is opened.

We have been told that the shunt method of wiring flashers, shown in Fig. 2, increases contact life by re-

To Be Answered in a Later Issue

(1) What are the advantages and disadvantages of each of the two following named methods for connecting flasher relay contacts to feed flashing light crossing signals: (1) To make and break the lamp circuit; (2) Connect the lamps in series and shunt the lamps alternately?

(2) What is the most practicable arrangement of scales for a d-c. volt-ammeter to be used in field testing of d-c. relays, slot coils, electric locks, etc.?

(3) How do you test the various types of lightning arresters in use on your railroad to determine whether they are in condition to operate when needed?

(4) How far will a train, traveling at the rate of 65 miles per hour, enter a block in automatic permissive block territory, before the signal at the opposite end of the block will display stop indication?

If you have a question you would like to have someone answer, or if you can answer any of the questions above, please write to the editor.

ducing the current to be interrupted. This explanation is hardly adequate for the following line of reasoning. In Fig. 1, it is obvious that the ammeter indicates the full lamp current of 1 amp., and the voltmeter the potential across the open contact, which will be nearly 10 volts. Therefore, the contact interrupts maximum current across maximum voltage, causing local heating and contact deterioration.

In Fig. 2, the ammeter must read practically the same as in Fig. 1, because the resistance of one lamp, 10 ohms, is so great in comparison with that of one contact, about 0.1 ohm, that approximately 99% of the current chooses the path of lesser resistance. However, in Fig. 3, showing the contact in the center position, the voltage indicated by the meters can never be greater than 5 volts instead of 10, because the two lamps in series each account for 5 of the 10 volts available from the battery, and a change of only 5 volts has been made in the circuit. Therefore, the product of the volts, amperes and time, that is, energy to be gotten rid of as heat, must be lower than with the other circuit. This accounts for most of the improvement in contact life. If current can be reduced without an increase in voltage, it will also improve the situation, but the benefits are due to the reduction in voltage.

Another advantage of the shunting circuit shown in Fig. 2 is that contact resistances are not very important, since it is only necessary to shunt the lamp enough to darken it. On the other hand, good operation cannot be expected in the make-and-break circuit with high contact resistance without an increase in voltage, which would further tend to increase arcing. Contact pitting due to mechanical wear or abrasion, of course, may be expected with any kind of circuit.

Controlling Four-Aspect Automatics

"What practical circuit arrangement can be used to control a four-aspect signal by using neutral track circuits and one two-wire line control circuit?"

Two Typical Circuits

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The accompanying diagrams show details circuits for such an arrangement. Figure 1 is the detail of both line and local signal circuits. For the four signal aspects, I have used: Red, yellow, yellow over yellow, and green.

As some may not prefer these aspects, I have enclosed Fig. 2. The aspects used in Fig. 2 are: Red over red, yellow over red, yellow over green, and green over red. It will be noted that the line plan is the same; only the local signal circuit need be changed. I have, however, on this plan, shown a slow-release relay, repeating the polar relay, and used in place of the polar line relay itself; this makes a better circuit and would be preferred in almost every case. I have applied this circuit to color-light signals, but it will work very well with any type of signal if the local circuits are properly rearranged.

In some instances it might be desirable to use a line relay which would repeat the various track section relays in a particular block, and which would be line controlled through switch circuit controllers. This could be done

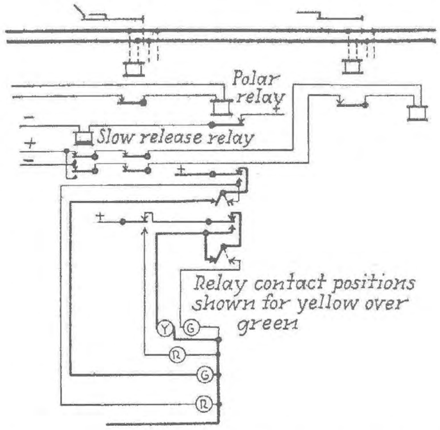

Fig. 2—Circuit using slow-release relay

without any change in the present circuit, the only difference being that the added line relay would take the place of the track relay in the present arrangement.

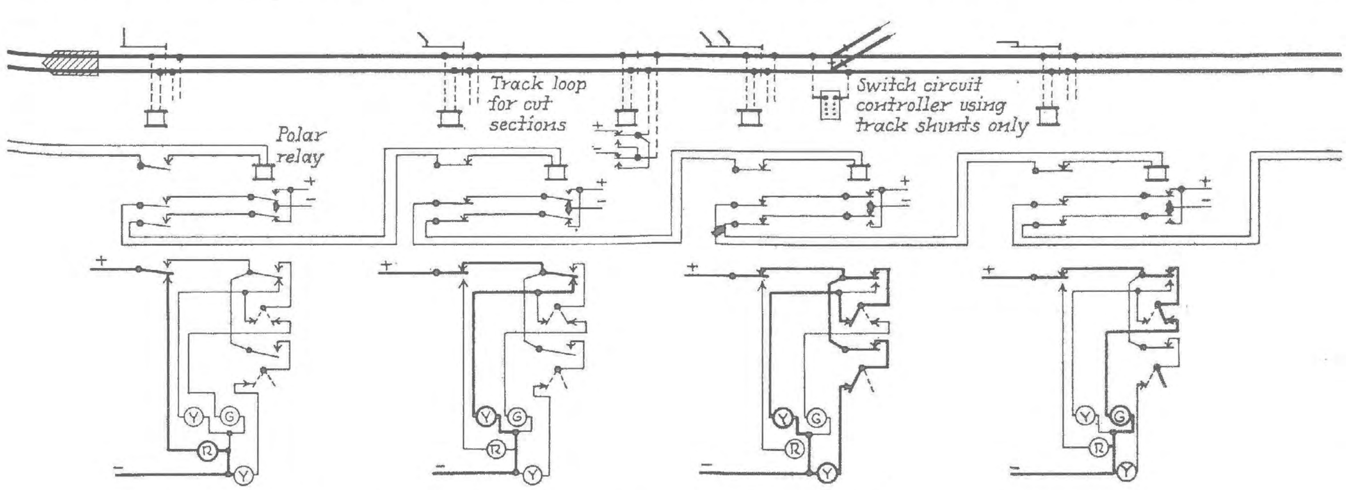

Fig. 1—Circuits for four-aspect signaling using neutral track circuits and one 2-wire line circuit

Polar Line Circuit

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I have assumed that the four-aspect signal mentioned in the question is one that is to be used in three-block, four-indication signaling. On the accompanying sketch, therefore, signal circuits for double-track, three-block, four-indication signals of the searchlight type are considered. The track circuits will have neutral relays located at the end of the circuit where traffic enters, or at the signal governing the use of the block. If the signals are located too far apart for the efficient operation of a single track circuit between them, it may be necessary to