ate signal in stop position, and there would be no braking distance for either, except that provided by the advance view of the intermediate signal. Therefore, in this case, trains running in opposite directions should receive caution signals at the ends of passing sidings, expecting the intermediate signals to be in the stop position. It is possible that this would slow up the movement of following trains to some extent, but this cannot be avoided if it is desired to give full protection for head-on movements.

Testing Insulation

"What is the most practicable means of testing the insulation on insulated wires and cables?"

Nomogram for Computing Resistance

CARL P. NACHOD
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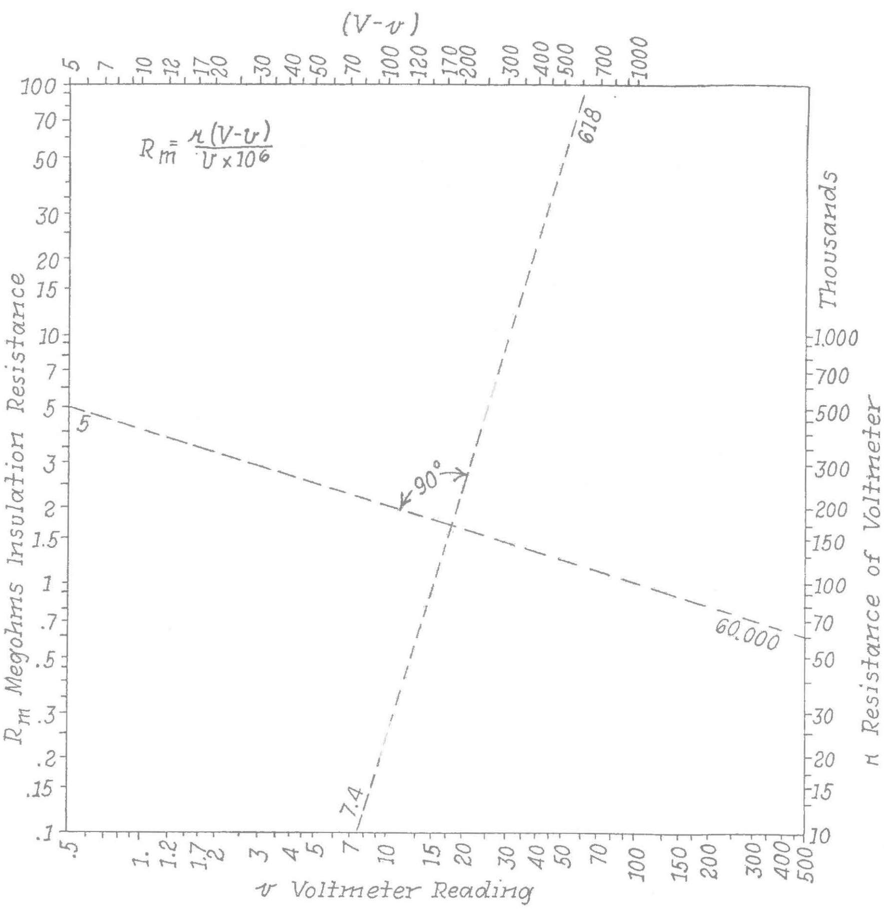
In the May, 1939, issue, pg. 293, W. R. Smith showed a method for testing the insulation resistance of a wire by the use of a direct current voltmeter. The accompanying illustration is a nomogram that will automatically compute the megohm resistance from the measurements as described below, without any arithmetical calculation.

Let V be the reading of the voltmeter when it is connected directly across the battery; in other words, the battery or line voltage. Let v be the reduced voltmeter reading when the insulation of the wire is cut into this circuit in series, in the appropriate manner. V-v is one of the quantities to be used. Let r be the resistance of the voltmeter at the particular scale that is being used, and let Rm be the required insulation resistance in megohms (million ohms); then it can be shown that $\mathrm{Rm} = \dfrac{(10)^6\mathrm{r}}{\mathrm{r}(\mathrm{V}-\mathrm{v})}$

The chart or nomogram is the solution of this equation such that any two lines at right angles will cut the four scales at values that will satisfy the equation. Therefore, at the observed values, draw a line from the scale marked V-v to the value on the scale marked v, and from the voltmeter resistance scale r draw a line at right angles to the first line, prolonging it until it cuts the megohm scale Rm, which is the required insulation resistance. It is more convenient and quicker to use as a templet a piece of tracing cloth on which two lines are drawn at right angles; if this is shifted on the chart so that three ends pass through the known quantities on the three scales, the fourth end will cut the remaining scale at the value to be found. The particular computing secants drawn on the chart show that, using a 60,000-ohm voltmeter (r) with a reading of 7.4 volts (v) with the insulation in series, and 625 volts (V) across the line, corresponding to the battery voltage, the insulation resistance, Rm, of the wire is 5 megohms.



Nomogram for computing megohm resistance from measurements

Proceeding by a Head-Block Signal

"On single track, when automatic signals are out of order and a head-block signal is indicating 'stop', what is the rule for handling a train to proceed by the head-block signal?"

On the Missouri Pacific

J. H. CRAIG
Signalman, Missouri Pacific, Atchison, Kan.

The rules on the Missouri Pacific covering this situation read:

"Rule 529. When a train is stopped by a stop signal, it must stay until authorized to proceed; or on information from the train dispatcher that there is no opposing train in the block it may, after filling out clearance card, Form C, proceed at restricted speed to the next signal displaying a proceed indication. In case of failure or lack of communication, it may proceed, when preceded by a flagman, to the next signal displaying a proceed indication." I am not quoting the remaining part of Rule 529 since it does not have any bearing on the question. An additional rule applying reads:

"Rule 536. A train which is to take siding at a point where the switch to be used is within 100 ft. in advance of an automatic block signal may pass such signal at 'Stop' to enter the siding, at restricted speed, providing the switch is set for the siding and the track known to be clear. In such case Rule 529 will not be effective."

Rule Quoted

E. Kimpton
Signalman, Canadian Pacific,
Toronto, Ont.

On the Canadian Pacific the following special instructions govern, and are ironclad, in single-track territory:

"When a train finds an absolute block signal indicating stop it must stop before reaching the signal, and not more than 200 ft. from it, and may proceed when the signal is cleared. If not immediately cleared, it must communicate with the train dispatcher and upon receiving advice that there is no conflicting train movement it may proceed under full control to the next signal. If unable to communicate with the train dispatcher, the train may proceed under the protection of flag to the next signal displaying a less restrictive indication than stop or stop-and-proceed."

Meter Scales for Field Testing

"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.?"

Three Voltage and Amperage Scales

F. George
Signalman, Canadian Pacific,
Weston, Ont.

A practical arrangement of scales for a d-c. volt-ammeter to be used in field testing of d-c. relays, slot coils, electric locks, etc., has proved, according to my experience, to be as follows:

A 0.03-amp. scale is useful in the testing of nearly all line relays, particularly the more commonly used searchlight signal mechanisms. Also, most of the telephone style c. t. c. relay values come within this range. Next, I would suggest a 0.30-amp. scale for those relays with higher values, such as track relays. This scale covers nearly all track relays commonly used and is particularly useful in testing relays having high ratings such as 0.22-amp., such as the 2-ohm quick-acting relay. The next higher amperage scale is more or less optional according to local requirements. Where d-c. electric semaphore signals, switch machines, electric gates, thermal relays, etc., are used, I would suggest a 15-amp. scale. If not this, then a 1.5 or 30-amp. scale, whichever is judged the more useful.

In the voltage scales, the 3-volt scale covers most of the low voltage semaphore signal, electric lock, and wigwag releases, and affords an opportunity for comparatively accurate readings. A 15-volt scale is desirable for the pickup and working values of most of the low-voltage semaphore signals, electric locks, wigwags, etc. and for general circuit checking. As to the next higher scale, it is optional; I would say it depends on local requirements. If it is to be used in a territory where high-voltage equipment such as 110-volt switch machines, semaphore signals, etc., are used, then the 150-volt scale is indispensable; but if in a territory where C. T. C. predominates, or where low-voltage switch machines are used, the 30-volt scale would be more useful.

Thus, in conclusion, you will note I have given as ordinarily required only three scales each for amperage and voltage; the more commonly required being 0.03-, 0.3- and 15-amp. and 3-, 15-, and 150-volts. But some thought must be given to the local requirements and have the scales rated accordingly. By keeping in the 3-15-30-150 ratio of calibration, the meter is very readily read on all scales which is a big factor in the testing of a group of varied values as is often the case in field testing. Of course, meters can be secured with a larger number of scales, but the above can be secured in the more ordinary meters, as the Weston Model-280.

Railroad Operation and Railway Signaling

Note: Answers to these questions are not solicited. If you have questions, please submit them to the What's the Answer department.

247-Q: *What is one of the most recent developments in the art of railway signaling?* A: The coded track circuit wayside and cab signal control system, by means of which automatic signals and other types of signals may be controlled using only the track rails as conductors, line wires, with the exception of power wires commonly provided in systems in service at present, being eliminated or appreciably reduced in number, depending upon the type of system required.

248-Q: *How do coded track circuit control systems function to control wayside signals?* A: The general principles of operation of such systems were described in 129-Q on page 46 of the January, 1939 issue of *Railway Signaling*. A typical diagram of control circuits utilized in a recent major installation of coded control for wayside signals are presented herewith in Fig. 1, illustrating single-direction running two-block automatic signal controls. In Fig. 1, a typical signal location and a typical cut section in 25-cycle electrified territory with 100 cycle coded track circuits are illustrated. One code transmitter, consisting of a continuously operating 110-volt, 100-cycle motor geared to cam-operated contacts to make and break the track circuit current 75 times or 180 times a minute, is used (if three-block signaling were provided the center cam-operated contacts, designed to make and break the feed circuit 120 times a minute would also be used, for control of the fourth aspect). The track relay, 1TR, is a direct-current relay fed from the track circuit through a resonant unit, 1RTR, tuned for 100-cycle and including a step-up transformer-rectifier unit to change the received interrupted 100-cycle alternating track circuit current to interrupted direct current.

With a train in the block immediately in advance of the signal in Fig. 1, the code-following track relay, 1TR, is de-energized, as are all other relays at this location, resulting in