

rheostat and the 1.5-volt battery is a single flashlight cell. Test leads are connected at terminals X and clipped across the contact to be tested; then by adjusting the rheostat R1 the desired current flow is indicated by the ammeter and the contact resistance may be read directly on the scale of the voltmeter.

In accordance with Ohm's law, when a current of 1 amp. is indicated on the ammeter, the resistance may be read directly on the voltmeter with a range of 0-1 ohm. If the rheostat is adjusted for 0.5 amp. the voltmeter

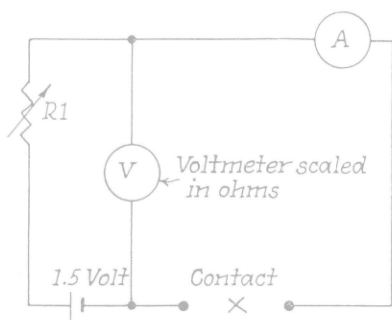


Fig. 1

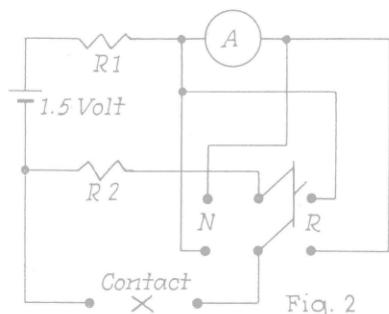


Fig. 2

Figures 1 and 2 illustrating the drop-of-potential method and comparative-current method

will read 0-2 ohms, with 0.1 amp., 0-10 ohms, and with 0.05 of an amp. 0-20 ohms. The scale on the voltmeter was drawn so that the resistance could be read over any of the above ranges.

When a contact of rather high resistance and carrying a comparatively heavy load is checked, the normal voltage drop across the contact will sometimes actuate the voltmeter slightly before the battery is turned on at the rheostat. In such cases it is necessary to reverse the test leads to make another reading, and to use the average of the two readings to secure the correct resistance of the contact. This scheme has proved very useful for this type of test, particularly at interlocking locations where a large number of relays must be covered and speed is essential.

Figure 2 shows a circuit for making comparative tests. Although this method does not give the exact resistance of the contact, it determines

if it is within the maximum allowable limit. The principle of this arrangement involves the measurement of the current flowing through the contact in multiple with a known resistance of the prescribed maximum value. In the circuit diagram, R2 is this resistance, while X is the terminal pair across which the contact is connected. R1 is a limiting resistance of approximately 1 ohm. If the maximum contact resistance allowed is 2 ohms, R2 should be of this value.

With the d.p.d.t. switch at position N, the circuit is completed with the current flowing through the limiting resistance R1 in series with the contact and in multiple with the known resistance R2. The ammeter at this time measures the part of the current flowing through the known resistance R2. By reversing the posi-

tion of the switch to R, the ammeter indicates the portion of the current flowing through the contact. Inasmuch as the current divides between the two multiple paths inversely proportional to the respective resistances, the portion of the circuit carrying the higher current is that of the lesser resistance. By merely comparing the two readings, it can readily be determined whether the contact resistance exceeds that of R2. Thus if the current reading when the switch is in position R is higher than it was in position N, the contact resistance is lower than that of R2 and comes within the allowable limits.

This scheme provides, therefore, a simple method for rapidly determining whether a contact has a resistance above or below the required maximum provided by the standards of the road.

Importance of Warning Whistle

"What is the relative importance of the warning whistle with respect to the cab signal in a continuously-controlled automatic cab-signal installation?"

Whistle and Cab Signal Are Both Essential

S. N. Mills

Assistant Director, Bureau of Safety,
Washington, D. C.

Under the orders of the Interstate Commerce Commission, both the cab signal and the warning whistle are prescribed as essential parts, the definition of the automatic cab-signal system being as follows:

"A system which provides for the automatic operation of the following: (a) Cab signal, a device located in the cab which, when locomotive and roadway apparatus are in operative relation, displays indications of conditions in advance, and (b) cab indicator, a device located in the cab which indicates a condition or a change of condition of one or more elements of the system."

The cab signal, of course, displays the indication which governs movement of the train, and the whistle or indicator audibly calls attention to any downward change of cab-signal indication. The audible indicator is necessary for two reasons, namely, (1) because it is impracticable for the engineman constantly to keep his eyes fixed upon the cab signal for the purpose of observing any change in indication at the time it takes place, and (2) to call the attention of the fireman in case the engineman for any reason does not promptly take the re-

quired action when a downward change of cab-signal indication is received.

It is apparent, therefore, that the failure of either of these devices renders the system incomplete. In case either device fails en route and, because of operating conditions, it is necessary to continue operation of the locomotive during a part of the remainder of its trip, rules of the railroads require that special protection be provided. Either device remaining in service furnishes the engineman some information, which he otherwise would not have, and in that sense provides some measure of protection. As to the relative importance of these two devices, however, I can express no opinion.

Whistle Attracts Attention

E. N. Fox

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Boston, Mass.

For reasons stated below, I believe the warning whistle is a very valuable adjunct to the cab signal in a continuously-controlled cab-signal installation. In the first place, an engineman's attention to the track ahead should not be diverted more than is necessary, in order that he may see as early as possible conditions affecting the operation of his train such as
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flagman, vehicles or other obstructions on the track, whistling posts, speed restriction signs, etc.

Moreover, irrespective of whether the cab signal is used as an adjunct to wayside signals or in place of wayside signals, and to a certain extent irrespective of its location in the cab, the engineman's attention is certain to center more closely on the cab signal if he does not have an audible indication of a change to a more restrictive indication than it will if he does have the whistle indication.

If he has the whistle indication, it will attract his attention immediately to a more restrictive indication should he be occupied with other duties in the cab. At times, such changes of indication will occur when a train is between two wayside signals, and it is important that a change of this nature be acted upon promptly, as it may indicate some emergency condition ahead. Assuming that the whistle will sound until it is acknowledged, it also will attract the attention of the fireman should the engineman have become incapacitated.

Whistle Is Only a Reminder

G. K. Thomas

Signal Engineer System, Atchison, Topeka & Santa Fe, Topeka, Kan.

It is my belief that in every signal system there should be some definite indication which is the governing factor. The use of a multiplicity of indications is likely to weaken the system because the use of two or three indications, each of which is intended to convey the same meaning, seems almost bound to result in some sacrifice of the importance of each one of such indications. On the other hand, where only one indication is used as the governing factor, it becomes of extreme importance and is likely to be carefully observed and obeyed as well as properly maintained.

If there is a weakness in the visual cab-signal system, it is the absence of means of checking the indication outside of the locomotive cab. This objection is generally overcome by the use of a further check consisting of any or all of the following: (1) Automatic brake control, (2) wayside signals, and (3) an audible signal in the cab, generally consisting of a whistle.

Where wayside signals are used in addition to cab signals, it seems that both should be equally important although, no doubt, the wayside signal would be considered as the final governing factor and a whistle would seem to be only a reminder to call the attention of the engineman and fire-

man to a change of indication in the cab signal. Where wayside signals are not installed and where there is no automatic brake control provided, the cab signal becomes paramount and it seems desirable to install an audible signal, such as a whistle, to draw the attention of the engineman and fireman to a downward change of indication. Such whistle still remains only as a reminder and it is my opinion that the governing factor is the visual cab signal.

Whistle a Substitute for Automatic Brake Apparatus

L. C. Heilman

Secretary, Committee on Automatic Train Control, Association of American Railroads, Washington, D. C.

Ever since the substitution of automatic cab signals for automatic train control on a number of railroads, there has been considerable diversity of opinion among those most intimately associated with the subject, concerning the relative importance of the whistle or audible cab indicator, which forms a part of the automatic cab-signal system. Some are of the opinion that the visual cab signals, one for the engineman and one for the fireman, are the most important parts of the system, while the whistle is more of an adjunct; others, that the cab signals and whistle are equally important, while there are a few, apparently in the minority, who contend that the whistle is of more value than the cab signals.

Wording of Train-Control Specification

In the specifications and requirements for automatic train-stop or train-control devices, adopted and prescribed by the Interstate Commerce Commission in its order of June 13, 1922, the following appears under the heading "Function." "In prevailing practice the primary function of automatic train-stop or train-control devices is to enforce obedience to the indications of fixed signals. . . ." In petitions of various railroads, requesting permission to substitute automatic cab signals for automatic train-stop devices installed under orders of the Commission, it was almost universally contended that the automatic cab signals would provide equal or greater safety than automatic train control.

In an automatic cab-signal system the warning whistle is substituted for the automatic brake-applying apparatus of the train-control system, and in case of failure of the engine-

man to acknowledge promptly or to heed a restrictive indication, is designed to direct the attention of the fireman to the need of appropriate action on his part.

Loud Whistle Enforces Obedience to Cab-Signal Indication

It is obvious that an automatic cab-signal system of itself cannot enforce obedience to signal indications as is the case with automatic train control. How then, can such obedience be accomplished in an automatic cab-signal system? Obviously, through the medium of the loud warning whistle. In the case of an incapacitated engineman, the warning whistle is supposed to accomplish, through the action of the fireman, what the automatic train control does through the automatic brake-applying apparatus.

In regard to the relative importance of the whistle with respect to the cab signal, it is only necessary to recall that restrictive cab signals may be disregarded by an engineman who is not alert to the conditions obtaining, without an acknowledgement. However, with the whistle in service, his attention and that of the fireman is immediately directed to the hazard.

Necessity for Audible Alarm on Locomotive

If the whistle were cut out and the engineman should fall asleep or become incapacitated while the fireman is engaged with duties where it is impossible for him to observe constantly the visual cab signal, the automatic cab-signal device most certainly would fail to perform its intended function, upon passing restrictive wayside signals, and an accident might occur before the fireman became apprised of the restrictive conditions.

That this is not purely an hypothetical condition, unlikely to occur in actual practice, is shown by the reports of the Bureau of Safety concerning two accidents which happened in September, 1935, neither of which occurred in automatic train-control or cab-signal territory. In the first case, the report concluded that "this accident was caused by the failure of Extra 1246 West to obey a meet order, due to the engineman falling asleep, and failure of the fireman and the head brakeman properly to check the movement of their train when approaching the meeting point." The testimony brought out the fact that, just prior to the

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accident, both the fireman and the head brakeman were in the tender attempting to loosen a slide in order that coal might flow in the conveyor. The fireman stated that he was confident that the engineman would shut off steam at the proper time, and that he remained in the tender until the collision occurred, unaware that his train had passed the switch of the passing siding.

Had automatic train control been in service on this road, this accident obviously would have been prevented, since it is the very type of accident that automatic train control is designed to prevent. Had automatic cab signals been in service, the accident also quite probably would have been prevented, since upon passing the distant signal to the home signal at the passing siding, the warning whistle would have sounded, either awakening the engineman or calling the attention of the fireman that a restricting signal had been passed. On the other hand, had automatic cab signals been in service, and the warning whistle cut out, the accident quite probably still would have occurred, since there would have been nothing to call the fireman's attention to the fact that the distant signal, displaying an approach indication, had been passed, and he evidently was not in a position where he could observe the visual cab signal.

Warning Whistle Might Have Prevented Accident

In the second accident, which was caused by failure of the engineman properly to observe and obey signal indications, the testimony showed that the engineman had passed an approach signal, a stop signal and a flagman before colliding with the train ahead. This train was drawn by three electric motors. When the train passed the approach signal, both the fireman and head brakeman were in the second motor, and consequently did not observe the indication of the signal. The report states that "it appears that Engineman . . . experienced a temporary lapse, possibly fell asleep momentarily, having been on duty 14 hr. 7 min., and did not awaken until very near home signal 12-F, at which time he immediately shut off power, applied the air brakes in emergency and sounded the whistle, but it was then too late to avert the accident."

This is also the type of accident which automatic train control is designed to prevent and it undoubtedly would have been prevented had an

automatic train-control device been in service. At the same time, an automatic cab-signal system probably would have prevented the accident, but an automatic cab-signal system with the warning whistle cut out would have been no more effective than the automatic wayside signals, in preventing its occurrence.

Enginemen Have Many Duties

R. A. Sheets

Signal Engineer, Chicago & North Western,
Chicago

An audible warning signal to sound when a cab signal changes from a clear indication to a restrictive one is of real value in a continuously-controlled automatic cab-signal system. The practice of requiring an acknowledgment of such a change, in order to silence such audible warning, is also of real value.

Enginemen cannot continuously center their attention on the cab-signal indicators, for they have many other attention-distracting duties to perform. Although a change in the cab-signal indication would probably be quickly observed under ordinary circumstances, it appears that correct operation is greatly safeguarded by the use of an audible signal to attract attention.

Even though cab signals may be so located that they may be observed by other employees, those employees are less liable to be in a position to observe continuously the indications. The audible indication is of special importance in calling attention to a change of cab-signal indication which might otherwise go unnoticed, with the consequent loss of the check of one engine employee upon another.

Equally Important Under Rules

J. E. Saunders

Signal Engineer, D. L. & W.,
Hoboken, N. J.

On the Lackawanna, the visual cab signal and the cab whistle are given equal weight insofar as their proper functioning is concerned. Our operating department Rule 686d states: "Cab signals and whistle must not be cut out in cab-signal territory without direction of the superintendent. . . ."

Our timetable instructions referring to Rule 686 state: "When conditions require, the following instructions will be applied on authority of superintendent—(A) Cab signal or cab whistle inoperative."

Following this are detail rules of

procedure. Naturally each serves its function, the cab whistle to call attention to the cab signal and the cab signal to give authority to proceed or to run at restricted speed as conditions may require.

Audible and Visual Signals of Equal Importance

D. W. Richards

Signal Engineer, Norfolk & Western,
Roanoke, Va.

In our opinion, an audible signal, or whistle, is a very important adjunct to a cab-signal system. The duties of an engineman are many and the addition to a locomotive of any device that requires additional attention on his part should function in such a manner as to enable him to attend to these duties with minimum effort.

An installation of cab signals, without the audible indication, would require the engineman to be continuously alert to any change in indication. However, with the combination of visual and audible signals, as is the practice on the Norfolk & Western, he can attend to his other duties, confident that any change in cab-signal indication will be quickly and forcibly brought to his attention. Therefore, the audible signal is considered equally as important as the visual.

Effectiveness of Cab Signal Depends Upon the Whistle

C. H. Morrison

Signal Engineer, N. Y., N. H. & H.,
New Haven, Conn.

It is a well known fact, of course, that the locomotive engineman gives his entire attention to the roadway and the signals located along the wayside. He seldom gives any attention, except momentarily when necessity requires, to anything inside the cab.

Even though the cab signal is of great importance, an engineman must watch the roadway and consequently cannot keep his eyes on the cab signal; hence, the value of the cab signal is only assured by an automatic warning whistle that is sounded whenever a more restrictive indication appears upon the cab signal.

The relative value of the warning signal is to a large extent the value of the cab signal, so far as restrictive indications are concerned. The cab signal, of course, is of great value in that it relieves the restraint upon the engineman when the way is clear and a less restrictive indication is displayed.