WHAT'S THE ANSWER?

Protecting C. T. C. Switches

"What signaling protection and what electric locks are desirable or necessary for infrequently used main-line switches in centralized traffic control territory where the use of power switch machines is not warranted?"

Signal Control Circuits Are Selected Through Independent Track Circuits

By A. H. Rice
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In answering this question, the involved question arises, "What is to be considered an unfrequently used main-line switch? On our installation of centralized traffic control, we feel that adequate protection has been provided at all hand-operated main-line switches by the installation of independent track circuits which are controlled through the switch-circuit-controller, the HD controls for the protecting signals being broken through the relay on these independent track circuits. As additional information to the control operator, we have broken the approach indication circuits through the independent circuits as well as through the main-line track circuits.

We believe that, where it is improbable that a train will enter and cause the established set-up direction to be cancelled, the above mentioned signal protection surrounded by operating rules is all that is necessary. At hand operated switches, where it is probable that a train will enter and nullify the established direction, such switches should be equipped with a derail that is pipe-connected to the main-line switch; further, such switches should be electrically locked, and telephone communication with the control office should be provided.

Safeguards Should Equal Those Provided Under Timetable and Train Order System of Operation

By W. M. Post
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As authority for the movement of trains in centralized traffic control territory is given by signal indication, and as the signal indications supersede time-table superiority and take the place of train orders, the safe movement of a train to the main track at a hand-operated switch should be surrounded with safeguards at least equal to those provided by time-table and train-order operation.

An electric lock could be provided, but should be so controlled that the switch could not be unlocked when the home signals at controlled points on either side of the switch are cleared to admit a train to the main track between the controlled points, or when a train is approaching the switch from the controlled point, except when a short releasing track circuit ahead of the switch is occupied. With this protection a conductor or engineman could request an unlock when ready to enter the main track, and if he received this, it would be safe to throw the switch and leave the siding and proceed on the single track in either direction. If the expense of providing this protection is not warranted, adequate instructions governing the entrance to the main track at the hand-operated switch should prove satisfactory.

Where it is practicable to prohibit the clearing of trains at hand-operated switches, it should be done and such switches should be designated in the instructions. Where trains may clear the main track at hand-operated switches, the following governing instructions are submitted:

1. When a train clears the main track at a hand-operated switch, the conductor or engineman must so report to the operator at the control point.
2. The control operator must record this clearance on the train graph.
3. A train must not enter the main track at a hand-operated switch without a train-order authorizing it to do

To Be Answered in a Later Issue

(1) Often, after a direct-current relay has been in service for a considerable number of years, residual magnetism develops in the cores, armature and yoke, thereby greatly altering the operating characteristics of the relay. What methods are used to determine when these parts need to be renewed?

(2) Under what circumstances are you using "take-siding" signals? What are the operating benefits? What type of signal and control is used?

(3) Does your road conduct a consistent educational program for the benefit of its signal maintenance forces? If so, what sort of program is followed?

(4) What form of protection is recommended for railroad grade crossings where the traffic is heavy on one line and extremely light on the other?

so, and, in addition, permission from the control operator, neither of which supersedes time-table superiority, unless the train order specifically so states.

4. A train must not be authorized to enter the main track at a hand-operated switch if a train, moving toward that switch, is between the switch and the home signal at the controlled points on either side of it, or if such a movement has been authorized.

5. When a train has been given permission to enter the main track at a hand-operated switch, the control operator must know that it has entered the main track before admitting any other train to the main track at or between the controlled points on either side of the hand-operated switch.

6. The conductor or engineman of a train entering the main track at a hand-operated switch must advise the control operator when the movement has been made.

7. The control operator must record on the train graph the time a train enters the main track at a hand-operated switch.

Under the above instructions a train entering the main track can safely proceed in either direction.

Signal Protection Alone Considered Most Satisfactory

By R. D. Moore
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The operation of centralized traffic control systems being fundamentally a matter of running trains on signal indications, the proper observance of signals is recognized as being of supreme importance, and trainmen are educated to regard them so. Therefore, it seems proper to use signals to govern movements to the main track from industry tracks as well as at other points, and to rely upon trainmen to respect such signals properly.

On these tracks we install derails at the clearance point to insure against the possibility of trains or engines fouling the main track without proper authority, but these derails are not equipped with electric locks. A light-type dwarf signal is installed at the derail, this signal can indicate "Proceed" only when the route is clear and the signals on the main track are in position to protect the train movement. Authority to make the movement to the main track must be obtained from the dispatcher, by telephone.

In our opinion, the use of electric locks in addition to the signal would create unjustifiable additional complications and expense. The use of electric locks, without a signal to govern the move—which would be one way of taking care of the problem—is not entirely satisfactory. The signal is needed to transmit the "Proceed" authority directly to the engineman, and for this reason we have chosen the signal, without the use of electric locks, as the most satisfactory method of protection.

Electric Locks for Switches Where Signals Are Under Control of Dispatcher

By H. J. Foale
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Intermediate main-line switches such as spur tracks, and unimportant passing tracks which are not desired to be under the control of the dispatcher, need no protection other than that afforded in A. P. B. circuits. To lock these switches electrically would mean the installation of lock control circuits from the nearest location housing C. T. C. equipment. In some cases, an additional storage unit would have to be added and the cost would be excessive. Further, no trouble has been experienced with switches of this nature which were not locked, as operating rules explicitly require communication with the operator before throwing the switch.

However, considering an installation of C. T. C. where the ends of the passing track are hand thrown, but where it is desired to have the signals governing them controlled by the dispatcher, I believe that the signals should have the same aspects and same relative location as at the end of a passing track where a controlled switch is installed. Such switches as these should be locked electrically with indications to show when the "unlock" is effective. These locks would be handled with existing C. T. C. equipment at most locations.

It would seem to be necessary to provide indications such as "enter siding," "leave siding" etc., in order to prevent unnecessary communications. Such an indication would inform the trainmen that the electric lock was unlocked, that the switch could be hand-thrown and that the train was to enter or leave the siding.

For example, the dwarf signal would have, besides the standard three indications, an auxiliary indication which would indicate "leave siding." This would inform trainmen to hand-throw the unlocked switch, and, when the switch was reversed and locked, the dwarf signal would indicate Proceed. The "leave-siding" indication could be stored under the passing train and would be effective as soon as the train cleared the "OS" section.

No Electric Locking or Special Signal Is Needed

By B. J. Schwendt
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The question does not make clear what is meant by "infrequently-used main-line switches." I assume that if the switch is used once every other day, it will come under this classification. Such infrequently used switches in C. T. C. territory may be of two kinds—switches of passing tracks, or switches of industrial and storage tracks, etc.

The question suggests that the so-called infrequent uses in itself indicates that power operation cannot be justified. In an economic sense the answer to this question depends upon whether the freight-train time that will be saved justifies the expenditure that is necessary to produce the saving. Infrequent use is not necessarily the same as insufficient economic justification; for instance, an industrial spur in automatic block signal territory may be used four or five times or more daily (considerable use) but still be a nuisance if power-operated because little or no time would ordinarily be saved by power operation; in fact, it would interfere with the necessary switching to be done at such locations and thereby cause a loss of time. On the other hand, assuming that the passing-track switch is used four times daily (1,460 times per year): In the published returns of the A. R. A., Committee-I, a tabuation of over 150 installations of power-operated switches, shows that the time saved per train was something like 10 min. Thus, 1,460 operations per year would amount to 243 train hours, and, at $20 each this would amount to a saving of $4,860 per year.

In C. T. C. territory such a hand-operated passing-track switch would probably be provided with at least the equivalent of home signals, controls, and O.S. track circuits, etc., so that it would cost only about $1,000

more to power-operate it, and on this basis, the returns would be about as follows:

	Gross saving	Additional maintenance, renewal and interest	Net saving	Percentage return over and above interest charges
4 Trains per day	$4,860	160	$4,700	470%
3 " " "	3,650	160	3,490	349
2 " " "	2,430	160	2,270	227
1 " " "	1,215	160	1,055	105
1 Train every other day	607	160	447	44

From the foregoing it will be seen that if a traffic of one train every other day is to be construed as "infrequent use," the time saved will ordinarily provide a return of 44 per cent on a system of power operation. Therefore, no electric locks or special signaling other than mentioned are involved and this disposes of case No. 1. If this does not cover the case, it should be treated in case No. 2.

In the matter of industrial or storage switches referred to in case No. 2: These should ordinarily require no special signal protection any more than other hand switches in A. P. B. territory, provided, however, that the crews are required to get permission from the dispatcher or the control operator before opening the main track after they have gotten into the clear. Our rule on this reads as follows:

"To hold the main track to do work or to operate a main track hand-throw switch, trainman must secure permission from the train dispatcher. When work is completed or train or engine is clear of main track, or when time limit has expired and switch is closed and locked, trainman must so report to the train dispatcher. (This does not apply to passenger trains doing station work)."

One company is requiring that train crews desiring to make a movement to the main track in C. T. C. territory through a hand-operated switch must copy a train order in order to establish its rights in such cases. In light of our experience, this hardly seems necessary and besides this arrangement would again introduce schedules, time-table rights, and written train orders—just the things we are endeavoring to overcome by simplification and signaling. In our C. T. C. installation, we have 32 power-operated switches and 31 hand-operated switches in main tracks. In 3 years and 10 months service to date, with over 30 trains per day, each passing 31 hand-operated switches, we have about 1,000 chances per day for trouble at these hand-operated switches, yet we have passed over 1,200 days and over 1,250,000 chances without any trouble. This should indicate that the probability of trouble occurring is quite remote and the protection against it should be largely one of training the men who handle such switches. It should be remembered, too, that electric locking, to be effective, becomes quite complicated and expensive. In my opinion, no electric locking or special signaling is ordinarily necessary in such cases.

Effective Arrangement Comprises Manually-Operated Derail, Light-Type Dwarf and Telephone

By W. E. Boland

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This question is interesting in that it brings to light what seems to be an example of the persistence of habits or policies long after the need which created them has disappeared. The question has been raised only in regard to centralized traffic control territory, but it is equally pertinent to old standard interlocking territory, of which centralized traffic control is essentially merely a modified and modern form.

There was a time when it was regarded as essential that every main-line switch within interlocking limits be connected up with the interlocking machine as an integral unit of the plant, regardless of whether the switch connected with an important branch line or with an infrequently-used industrial spur track. This probably had its origin in the days before track-circuit control was developed, and before the training of train-service employees in the observance of signals and safety rules had reached a very high plane, when it was one of the most practical ways of insuring the safety of the route governed by a clear interlocking signal. Otherwise the switch might be left open by a careless employee, or a switch engine might enter or foul the route just at the wrong time in violation of safety rules.

This assurance was, and still is, necessary within interlocking and centralized traffic control territory, since it is but human nature for the engineman to depend upon that assurance, and to relax his own vigilance accordingly, when he knows that the signal has been cleared specifically for his train by an operator who is charged with the responsibility, to a certain extent at least, for ascertaining that the route is safe before he clears the signal.

But the protection can now be gained in other ways than by actually connecting up the switch with the plant. The open switch hazard can be guarded against by equipping the switch with a circuit controller, and the fouling hazard by an indicator or dwarf signal. Electric locks are not so successfully adaptable except in the vicinity of large plants where a maintainer is immediately available to release them in case of necessity.

A very flexible and effective arrangement for switches of the kind referred to in your question, whether in interlocking or centralized traffic control territory, consists of a hand-operated derail, light-type dwarf signal and a telephone located at the clearance point. The dwarf signal control is selected through the derail and main-line switch in such a manner that it indicates Stop as soon as the derail is lined up, but changes to the appropriate indication when the switch also is lined up. The train crew is required by rule to obtain permission from the operator before throwing either the derail or the switch for the purpose of entering the main track, the dwarf signal serving as confirmation of that permission, thereby avoiding misunderstanding of instructions over the phone, and also affording the protection of an automatic block signal.

Choice of Protection Depends Upon Other Factors

By L. S. Werthmuller

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In connection with the installation of centralized traffic control, it is my thought that a study of this nature should comprise two distinct features: First, a study should be made without any thought of the installation of power switches except at points where switches are being operated either by mechanical interlocking or remote control. The merit of such an installation should be based on whether enough telegraph operators can be released to warrant the installation.

The second feature is to determine whether the use of power switches is warranted in connection with the centralized traffic control installation; that is, whether the saving made by the elimination of stops would warrant the use of power operated switches. I am satisfied

that, in a great many cases, a study would indicate that the use of power-operated switches is well warranted at some of the sidings, but that, at other sidings or junction points, power-operated switches would be used so seldom that their installation would not be warranted. At these latter locations, signals should be provided, with some sort of indication so as to indicate that trains should enter or leave these sidings or junction points in order to avoid the delays which would be caused by calling the operator at the control point, for instructions. There are, of course, outlying switches which are used by locals or switch engines for setting out or picking up cars, and I do not think that any protection, other than that afforded by automatic signals, is necessary for such layouts.

In regard to the use of an electric lock, I can not see where the fact that a territory is under centralized control, makes any difference; if it is felt that a switch is of sufficient hazard to warrant an electric lock, it is just as necessary to have this electric lock in signal territory regardless of whether the operation is by train order or centralized traffic control. If the switch governs train movements into a track of sufficient length that the train may get entirely in the clear, I think it is quite important that a telephone be installed at this point so that the trainmen can release the track and later secure permission before re-entering the main line.

Oil or Electric Switch Lamps?

"What does it cost per year to operate a switch lamp electrically from primary battery as compared with oil lamps? Is constant or approach control used and how is the control circuit arranged?"

Approach Control Makes Electric Lighting Economical

By G. K. Thomas
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The cost of operating oil-lighted switch lamps depends very largely upon local conditions. Where a large number of lamps are located close together, as in yards, they can be maintained at a lower cost than the same number of lamps scattered over a longer territory, as on the main line. Investigation seems to indicate that the average cost ranges from $10 to $20 per year. Where reasonably efficient methods are used, perhaps an average cost of $12 may be used as a conservative figure for comparison purposes.

On the Santa Fe, electric switch lights using energy from primary battery are provided with approach-lighting control. The total running cost, including interest on the investment, varies from $6 to $9 per year, depending chiefly upon the method of installation and control necessary in each case. Four cells of potash battery are used, generally installed in a small concrete battery box near the switch. The lamps are rated at 3.5 volts, 1.05 watts. Parkway cable or flexible conduit connections extend from the battery box to the lamp. Approach control is accomplished by means of a back contact on the switch indicator where a switch indicator is available. At points where switch indicators are not installed, approach control is accomplished by the use of DNL-type series relays in the line control circuit of automatic signals. In a-c. territory it is generally found that 110-volt 10-watt lamps, continuously lighting, may be operated at approximately the same cost as primary battery with approach control.

Oil Operation Cheaper

By W. L. Dayton
Superintendent of Signals, Grand Trunk Western, Detroit, Mich.

We figure the cost of operating an oil lamp for one year as follows:

Fortnite oil, 1½ pt. each week—10 gal. at $0.76	$0.76
Matches and wicks	.03
Labor, 10 min. each week—9 hr. at $0.70	6.30
	$7.09

The labor item includes time for the operation of the motor car and for handling the oil. This is for continuous burning and for cleaning lamps once each week.

The cost of operating an electric lamp with a battery, for one year is as follows:

Primary battery renewal, 500-a.h., 6 at $1.16 each	$6.96
One lamp bubl 2.5-volt, 0.15-amp, at $0.54	.54
Labor, changing bulbs and inspecting, 2 hr. at $0.70	1.40
	$8.90
Credit for exhausted elements at $0.14 each	.84
	$8.06

The above assumes that a set of four renewals will operate a lamp for eight months. This is a very good average, although we have a few lamps where the battery will last one year.

In all cases we use a sun relay for controlling the lighting circuits. The life of the battery is governed by the operation of the sun relay, some of the relays are very sensitive to light and dark and can be set for very close operation, while others are not so sensitive and they have to be set to operate accordingly.

Approach Electric Lighting Is Cheaper

By P. A. Garrity
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The oil switch lamp seems to be an "orphan" among railroad men, with every one trying to dodge his responsibility and trying to put over its maintenance on the other fellow. The electric lighting of switch lamps, especially on the railroads that use them in automatic territory, seems to be the inevitable development when there is a practical and economical means of so doing. We believe that primary batteries provide this means from both a practical standpoint as well as an economical one, as illustrated in the figures.

Primary-battery electric lighting of switch lamps is accomplished either by burning a 3½-volt 0.150-amp. lamp continuously from four primary cells, or, where the railroad uses switch indicators, by burning the lamp through the back contact of the indicator only on the approach of a train.

A recent development has brought about a 3½-volt 0.150-amp. lamp which just seems to fit in nicely with a desired method of lighting signals, in that it gives a cheap installation cost and in that maintenance is brought to a very low figure. The operating details are as follows:

Average current 0.110 amp.

$24 \times 0.11 = 2.64$ a.h. per day

$$\frac{500}{2.64} = 190 \text{ days from four renewals}$$