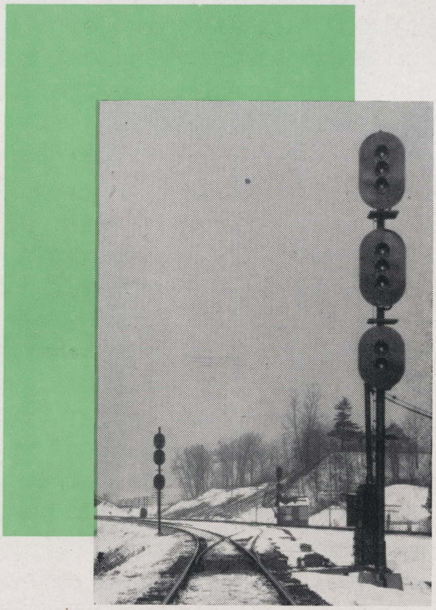
REMOTE CONTROL

BULLETIN No. 152

UNION SWITCH & SIGNAL CO. ...... SWISSVALE, PA.

A. J. Grobach

REMOTE CONTROL



BULLETIN No. 152
AUGUST, 1937

UNION SWITCH & SIGNAL CO.
SWISSVALE, PENNSYLVANIA

FOREWORD

THE modern trend toward higher speed passenger and freight trains accentuates the need for the elimination of train delays in order that schedules may be maintained and traffic of all classes moved with the maximum flexibility. Modern signaling is playing an important part in keeping trains moving so that the very high-speed passenger trains encounter no interference from other train movements and, in turn, do not unduly interfere with the efficient movement of the other traffic which must be moved over the same rails.

Signaling of entire divisions with Centralized Traffic Control, while desirable on account of improved operating conditions and economies, cannot always be accomplished because of budget limitations. There are, however, such signal improvements as the remote control of switches and signals which can be made at a small initial cost and result in operating savings sufficient to pay for the installation within a few years. These installations can be made at specified points on the division and form the nucleus of the ultimate signaling scheme for the entire division.

This bulletin lists some of the accomplishments of remotely controlled signal systems in the improvement of railway operation. It should prove interesting to operating officers, who may find a similarity between a problem they now face and a like problem which was solved elsewhere by the use of signals.

CONTENTS

History and Scope of Remote Control

THE term "Remote Control," as applied to railway signaling, refers to the operation, from a station or office, of signal appliances, located at some distance beyond the local limits of the station. Remote controlled signals generally govern movement only through the local limits of the layout, movement beyond being

Remote Control Installation Governs Movements Over Gauntlet Track at Osgood, Pa.—*B. & L. E.*

subject to the authority held by the train in accordance with the rules, timetable schedule, special instructions or train orders. Installations are made in automatic block signal territory or in territory not so equipped.

Early applications were largely confined to installations of single power-operated switches and signals at ends of passing sidings and double track, or at junctions. The development of modern methods of control has greatly increased the number of functions which can be advantageously operated from a distant location and has very materially increased the economic range of remote control.

While the first remotely controlled outlying switch installation was made on the Pennsylvania Railroad as early as 1901, it was not until considerably later that this type of signaling came into general use. Remotely controlled train order signals were first used in 1909 by the Erie in double track territory to authorize trains to proceed or to take siding. Use of a low voltage switch machine to operate an outlying switch, remotely controlled, was first made on the Northern Pacific at Bozeman Pass tunnel, Montana, in 1914. The first railroad to use remotely controlled switches extensively was the New Haven, which installed 28 remotely controlled switches in 1918.

On January 1, 1937, according to statistics compiled by the Interstate Commerce Commission, remotely controlled signal installations were operated from 559 control points on more than 60 railroads and involved the operation of 762 single switches, 316 crossover switches and 3091 signals. The greatest number of remote control installations on one railroad system is on the Pennsylvania, which has 104 installations comprising 144 single switches, 69 crossover switches and 581 signals. Other railroads with a large number of installations include the A. T. & S. F., B. & O., B. & M., C. & O., C. & N. W., C. M. St. P. & P., G. N., M. P., N. Y. C., C. C. C. & St. L., N. Y. N. H. & H., and the S. P. The complete I. C. C. table of installations is included as Appendix "B" of this bulletin.

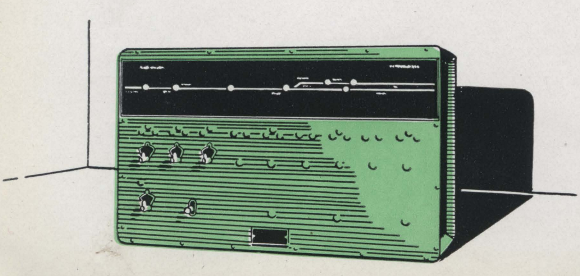
Switch Location, Remote Control Installation near Terre Haute, Ind.
C. M. St. P. & P—C. & E. I.

Applicable to a Variety of Conditions

WHILE the first remote control installations were made for the purpose of operating single switches and controlling signals located at some distance beyond the local limits of an interlocking, the modern practice has made it possible to control a group of signaling functions from almost any desired point where the services of existing employees can be utilized. Control points for these installations are now located in dispatcher's offices, train order or manual block stations, interlocking towers, yard offices, watchmen's cabins and other designated points. They are operated without interfering with the other duties of the local employee.

The remote control principle has been applied to the economical solution of signaling problems under many conditions, from the control of a single signal to the control of extensive interlocked layouts involving a large number of single switches and crossovers. Greatly simplified control machines are making it possible for these larger layouts to be controlled with almost as much ease as the smaller installations. Among the various uses of remote control as a means of expediting train movements, are the following:

1. Outlying switches and associated signals at
   - (a) Ends of sidings.
   - (b) Yard entrances.
   - (c) Ends of double track.
   - (d) Junctions.
   - (e) Crossovers.



Remote Control Layout on Four Track Line Near Pittsburgh, Pa.—*P. R. R.*

2. Signals and switches for the protection of
    (a) Tunnels.
    (b) Gauntlets.
    (c) Railroad crossings at grade.
3. Interlockings composed of combinations of the above
    (a) Where interlockings are consolidated.
    (b) Where operating point of an interlocking is changed to a distant location.

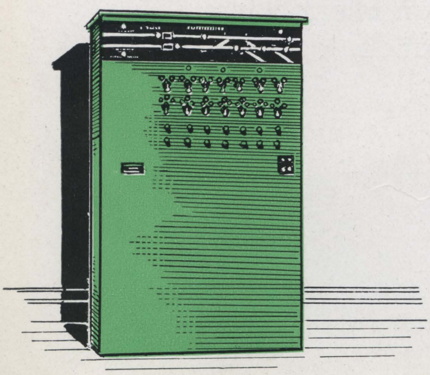
4. Series of remote controls, co-ordinated with traffic locking, to provide for movement of trains, over entire operating districts by signal indication.

5. Signals governing movement of trains
   (a) Train order signals.
   (b) Train order signal indicators.
   (c) Manual block signals.
   (d) Controlled manual block signals.
   (e) "Take Siding" signals.
   (f) "Leave Siding" signals.
   (g) "Hold Out" signals.

6. Highway crossing signals
   (a) For complete manual control.
   (b) For part-time manual and part-time automatic control.

7. Miscellaneous
   (a) Yard track indicators.
   (b) Train starting signals.
   (c) Other special purpose signals.

Some of the more important applications of remote controlled signaling listed above are discussed and illustrated in following portions of this bulletin.



Train Entering Yard Over Remote Controlled Switch, Chillicothe, Ill.—*A. T. & S. F.*

Economic Aspects of Remote Control

THE use of remote control in the operation of signal and interlocking devices results in both capital and operating savings. The installations are often less costly than other methods of achieving the same signal protection, their operating cost is lower, and the operating savings as great or greater.

Remote control installations are frequently made at a lower first cost than if the same functions were controlled from a locally operated machine. This is because of the saving of the cost of a tower building and because of the use of a small and compact control machine. The present tendency to use modern control circuits, which require a very small number of wires, has greatly increased the economical control distance of remote control from the standpoint of first cost.

Typical Remote Control Layout
A. C. L.

Operating savings resulting from installation of remotely controlled signaling are brought about by:

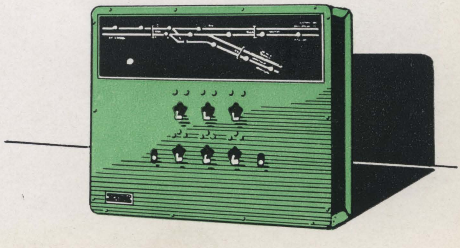
1. Lower cost of maintenance than attended plant.
2. Cost of operation is practically negligible because the remote control is handled by an existing employee with other duties.
3. Train stops to open and close switch are avoided.
4. The combined control of interlocked functions at various adjacent points will often result in greater efficiency in directing train movements.

Train Stop Savings Important

The most important contribution of remotely controlled switches to improved train operation is the elimination of train stops to enter and leave sidings. The amount of time saved and the monetary value of the stop eliminated will vary with local conditions but usually the elimination of one stop per day will pay for the signal installation, where the switch is located at a critical point.

A summary of time savings per train stop eliminated as compiled by Committee I of the Signal Section, A.A.R., from various published sources appears on page 149 of Volume XXX of the Proceedings of the Signal Section. This summary shows that the average saving in 39 cases on a number of railroads was 11.9 minutes per freight train stop saved by remote control installations. The range of time savings was from 5 to 27.6 minutes depending upon a variety of conditions, such as train tonnage, grade, etc. Time saved on passenger trains averaged 2 to 5 minutes per stop avoided.

On page 174 of the same volume will be found a tabulation of the values ascribed to the train stop saved. The values depend upon grade, curves, weather conditions, size and number of locomotives, number of cars in train, tonnage, per diem, overtime wages, total minutes delay time, and other local factors. They range from \$1.00 to \$6.25 for freight train stops and from \$0.50 to \$1.50 for passenger train stops. Many of these stop values were calculated with the time saved as a basis, others calculated from dynamometer car tests.

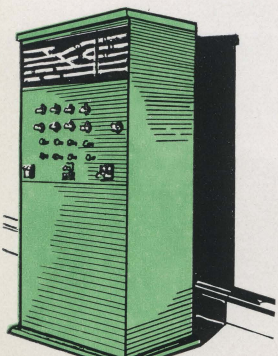


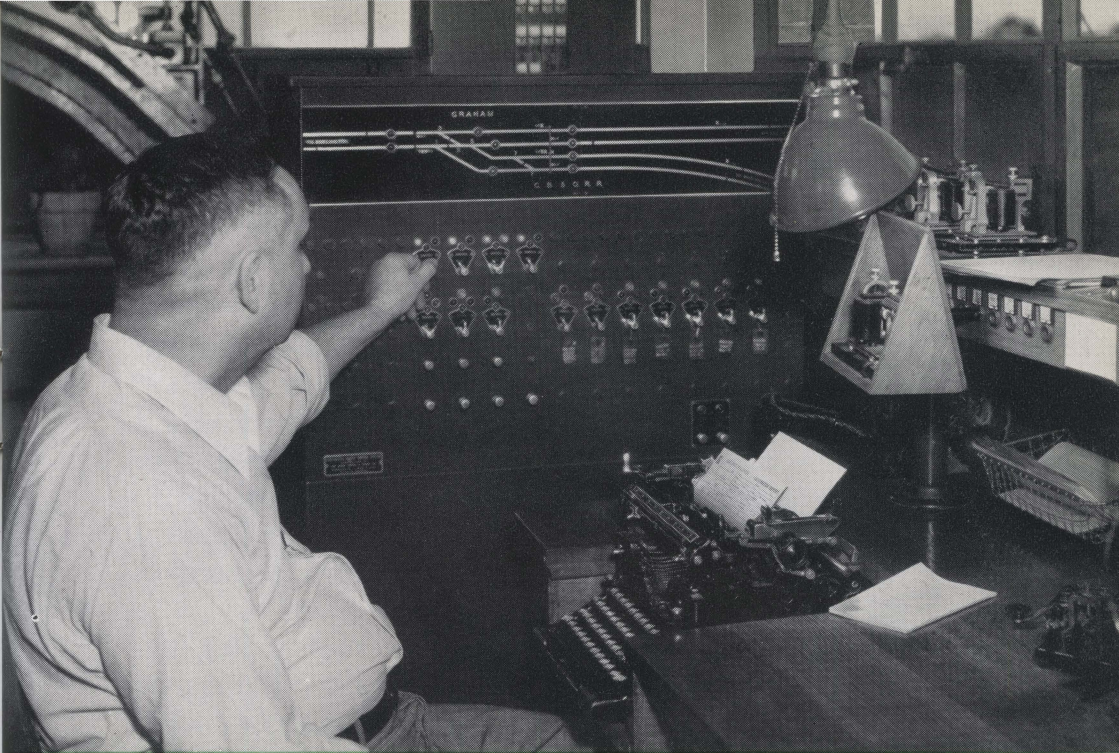
Economic Details of Typical Installations

Appendix "A" consists of a table which shows in summary form the savings on a number of remote control installations which have been described in various publications. These installations are typical of many throughout the country and serve to show the high rate of return on the investment which is possible from the application of the principles of remote control to the signaling problems of a railroad.

Variations in the costs of installations shown in this table are due to many factors and do not bear a direct relationship to the number of switches controlled. The chief differences are due to variations in the amount of signaling involved, and the extent to which existing signaling is used in connection with the remote control installation. In most cases the cost of the installation includes that of all the signals. This is particularly true of the installations made at points not previously equipped with interlocking facilities, as well as where mechanical interlockings are replaced.

Savings from the various installations vary, depending largely upon the number of train stops saved, or the facilities replaced. The rate of return on the investment, after allowances for interest and maintenance charges, is sufficient to pay for the average installation in less than three years out of operating savings.





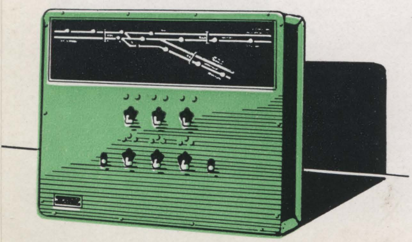
Remote Control Panel in Interlocking Tower, Galesburg, Ill.—*C. B. & Q.*

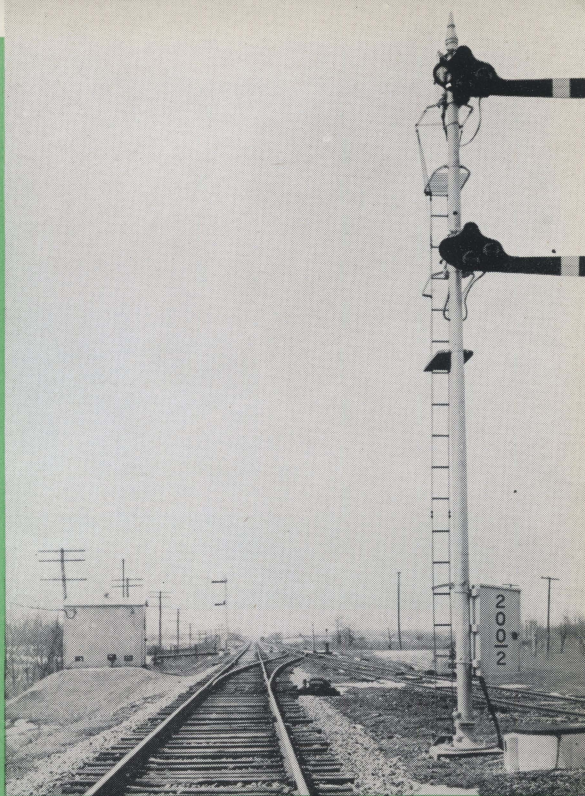
Modern Remote Control Simple to Operate

REMOTE control systems of today are designed to provide for simplicity and accuracy of operation with the utmost safety. The simplicity of design is particularly evidenced by the type of control machines which are now available for operation of the simplest turn-out or the most extensive interlocked groups of switches and signals. These machines are all self-contained units which can be furnished with track diagrams, indication lights, illuminated indication sections, or with recording devices. They are designed to occupy a minimum of space and can be furnished for desk or floor mounting.

Operation of the most extensive remote control installation is made simple because of the arrangement of switch and signal levers with respect to the track model. The simplicity of the control machine makes it possible for even the most inexperienced operator to handle movements efficiently. The time required to instruct an employee in the manipulation of the control machine is negligible because the arrangement of operating parts is practically self-explanatory. The modern machines are used on even the simpler layouts because they afford a simple and definite means of manipulation with a constantly visible check, through the position of the levers, of the conditions at the switch.

While the control machines have been designed to simplify the operation of the remote control from the standpoint of the operator, the dual-controlled switch movement has been designed to simplify operations from the standpoint of the trainman who may, under certain conditions, be required to operate a power switch by hand. The dual-controlled mechanism has made it possible to install remote control at those points where it is sometimes desirable to hand-operate a switch for switching movements, or where part-time remote control of an outlying switch is all that is required. Thus it is possible to control a switch from a one or two-trick office without making it difficult to use the switch when the control office may be closed.





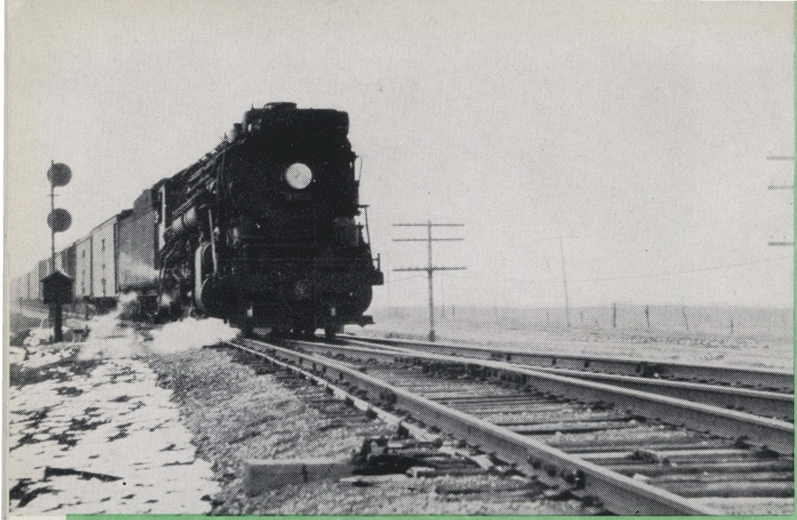
Typical Remote Control Layout
—*Wabash*

Applications of Remote Control

A DISCUSSION of some of the more important applications of remote control as used to solve a variety of signaling problems on a railroad follows.

Remote-Controlled Outlying Switches

While outlying siding switches, ends of double track, junctions and yard switches may be operated manually by trainmen, switch tenders or other desig-



Train Entering Siding, Terre Haute-Pana Installation—*C. C. C. & St. L.*

nated employees, without signal protection, the remote control method of operation generally shows the lowest annual cost and the greatest saving in train time.

The economic value of power-operated outlying switches by the remote control method is dependent upon the savings from the avoidance of stopping and starting trains that could pass over the controlled switch without stopping. It becomes profitable to control remotely such a switch, or group of switches, when the cost of stopping and starting trains, or the payroll cost for operating the switch by another method, is greater than the maintenance, operation and fixed charges resulting from the remote control installation.

The following tabulation shows the comparative costs, on one railroad, of five methods of operating an outlying switch 5,000 ft. from an existing station, as reported by the Signal Section, A.A.R., in its 1923

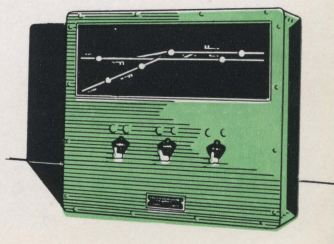
Proceedings (Vol. XXI, p. 145). While there would be a variation in absolute amounts depending upon local conditions, the relation between the various methods would be about the same in most cases.

Methods of Operating Facing Point Switch

Switch Operated by:	With	Total First Cost	Total Annual Cost
Trainmen.	No signals	. . . .	$7,300.00
Switchmen.	One distant signal	$1,806.00	5,467.00
Switchmen.	One home and distant signal	3,356.00	5,976.00
Mech. Interlocking.	Five signals	7,308.00	7,182.00
Remote Control. . . .	Five signals	11,191.00	2,397.00

The preceding tabulation indicates that, at the density of traffic where the cost of operating an outlying switch by trainmen amounts to $7,300.00 per year, any of the other schemes would be productive of savings, but the relative superiority of the remote control method is clearly indicated. It is also apparent that the remote control method of operation would be profitable at a density of traffic substantially below that of any other method of handling the switch.

The cost of installing the remotely controlled switch will vary considerably depending upon local conditions and the amount to be saved by eliminating the stops will vary in a wide range depending upon the physical conditions and the density of traffic involved.



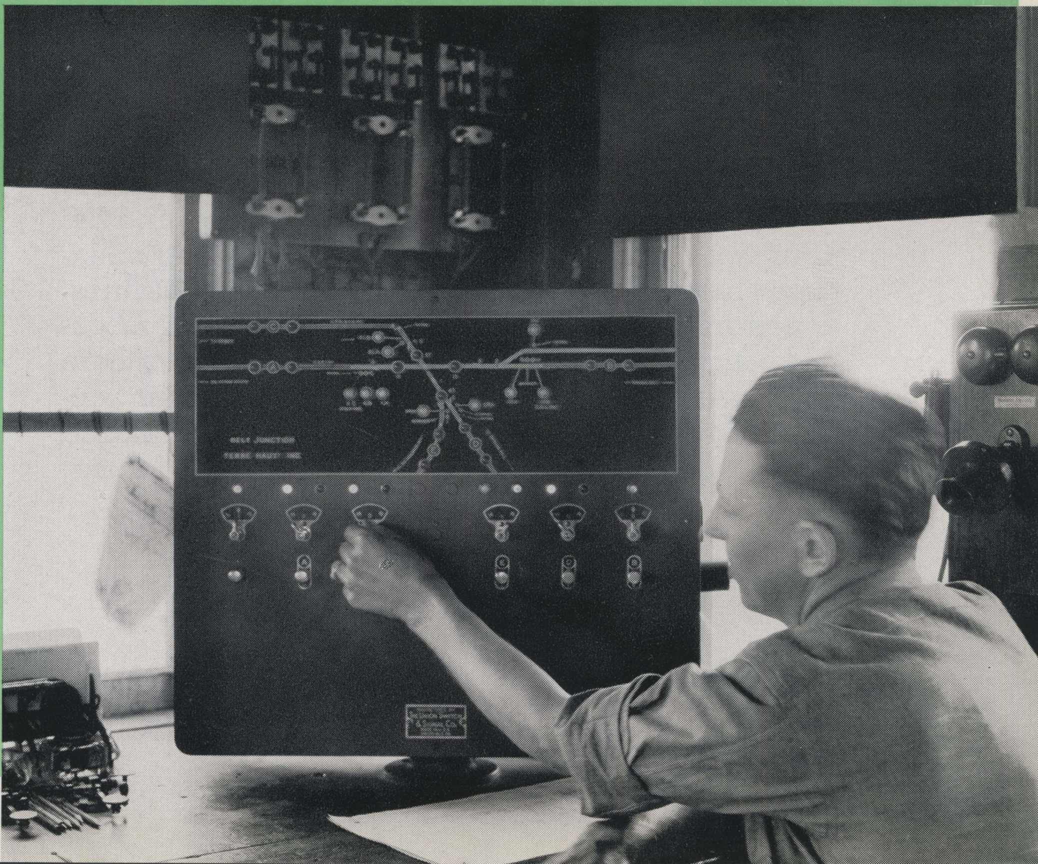
Crossover Location Near Toledo, Ohio—*N. Y. C. & St. L.*

Remote Control of Interlockings

The development of the idea of remote control has made it possible to control crossings at grade and other facilities which previously were unsignaled because it was thought that the density of traffic did not warrant the cost and expense of operating an attended plant or where, for some reason an automatic plant could not be used. Many such layouts are now controlled by a simple signaling arrangement under the control of an employee relatively near the crossing, or they may be controlled from an interlocking from one to five or more miles distant.

Actuated by the necessity of making every possible saving in operating expenses without interfering with the expeditious handling of trains, many railroads have used remote control to combine the operation of two or more interlockings in a single station. Such installations have made important savings, not only in the cost of operation and maintenance, but also in the conservation of capital which would be needed to replace very old interlockings in kind with attended plants.

Ordinarily this form of consolidation of interlockings is accomplished by the installation of an independently operated control machine of simple design in the interlocking station from which the layout is to



Control Machine is Simple to Operate

be operated. Some form of traffic locking between the remote control and local interlocking is provided if the nature of the plants require it, or if it is desired to arrange for signal indication operation between all units of the combination. In some cases a modern control machine replaces all the interlocking machines involved in the consolidation, thus affording greater simplicity of operation.

Generally the control of the group of interlockings is established in the larger or more important station, although it is possible to locate the control point at any desired station or office. The remote control of interlockings has to a large extent been confined to the operation of relatively small layouts where existing facilities were in need of replacement or where the cost of operation was considered too high to warrant an attended plant. The vast improvement in control wire utilization provided by modern remote control circuits has made it possible to remotely control much larger layouts economically, so that it is now possible to effect interlocking consolidations where comparatively large interlocking layouts are involved.

The savings accomplished by controlling one interlocked group of switches and signals from a remote station results from reduced cost of operators and the maintenance cost of interlocking machine and buildings. Inasmuch as, even in attended interlockings, operators depend to a large extent upon track model indications for detecting the approach of a train, there is no sacrifice in efficiency of operation when adequate approach sections and indicators are installed with the remotely controlled interlocking facilities.

End of Siding Showing Power-operated Switch
B. & O.

Series of Remote Controls Affording Signal Indication Operation

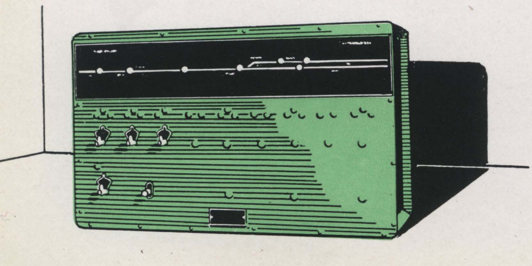
There have been several extensive installations of remotely controlled switches and signals where a number of adjacent remote controls have been operated in such a way as to provide for the movement of trains by signal indication over an extended territory. These installations require the co-operative action of operators controlling the adjacent remote controls in order to display signal indications for the movement of trains without train orders. The operators are under the direct supervision of the train dispatcher. With this method of operation, many of the advantages of a Centralized Traffic Control System can be secured.

Among the outstanding installations of this type, which have been described in published articles, are the following:

Railway	Track Miles	Number Remote Switches	Reference
B. & O.—Rosemont-Parkersburg, W. Va.	89.2	56	Railway Age, Aug. 31, 1929
C. of Ga.—Carman-Terra Cotta, Ga.	23.6	2	A.A.R. Sig. Sec. Proceedings, Vol. XXV, p. 819
C. C. C. & St. L.—Terre Haute-Pana, Ill.	98.5	16	Railway Age, July 20, 1929
M. P.—Leeds, Mo.-Osawatomie, Kan.	50.1	12	Rwy. Signaling, Feb., 1926
S. P. Co.—Bena-Tehachapi, Calif.	32.7	11	Railway Age, Jan. 12, 1929

Remote Control of Gauntlet Track and Tunnel Protection

While a number of signal installations for the protection of train movements over gauntlet tracks and through tunnels have been of the automatic type, there have been a number of instances where operating conditions have made it desirable to place control of the traffic in an operator under the direction of the dispatcher. Remote control of the signals has provided the economical solution. In other cases remotely controlled signals have replaced the electric train staff system to provide greater flexibility and more economical operation without the sacrifice of safety. An



Signals Govern Movement Through Single Track Tunnel—*C. G. W.*

example of such an installation is that on the C. G. W. between Rice and Winston, Ill., where remote control of a 1.6 mile section of single track, involving tunnel protection, resulted in expedited train movement and a reduced cost of operation.

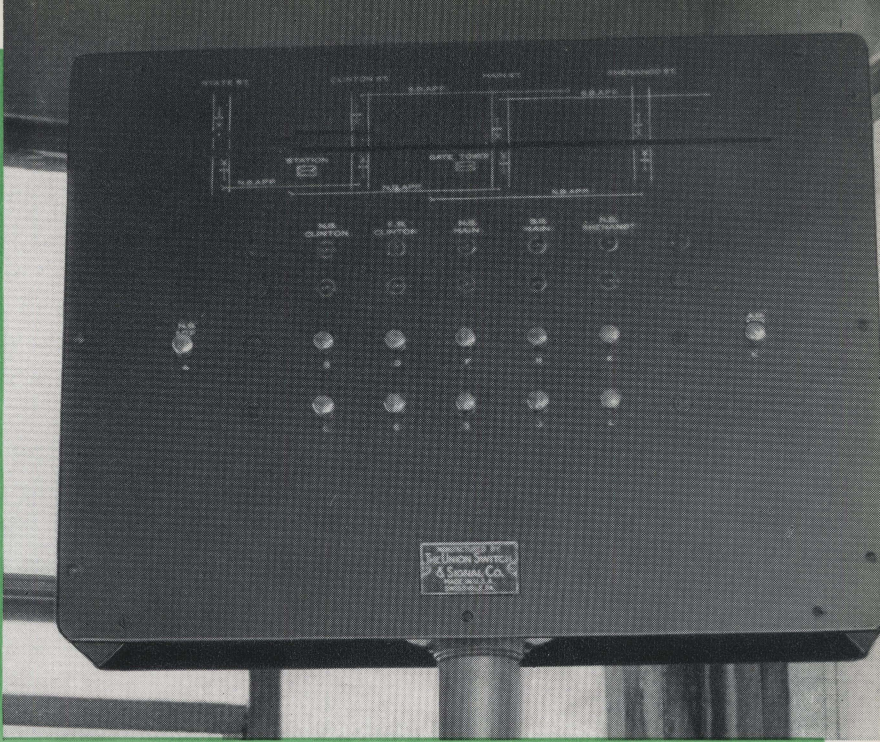
Remote Control of Manual Block Signals

There have been several installations of remotely controlled manual block signals where the situation to be met involved a possibility of controlling the indications of the signal from an adjoining manual block station. A number of these installations were made by one railroad principally for the purpose of providing a "middle order" signal at an intermediate siding so that the siding could be used for meets of all classes of trains without establishing a manual block office.

One road placed a combination of remotely controlled manual block and a spring switch arrangement in service to control movements at an end of double track, thereby eliminating an interlocking which was also a three-trick manual block station. This installation provided for control to the next open manual block station beyond the end of double track, and was controlled from a block office on the double track portion of the territory.

Remote control of controlled manual block signals has been achieved in a few instances. Each case where this has been done has involved a special set of circumstances revealed by study of operating conditions.

Remote Controlled Manual Block Signals—*C. C. C. & St. L.*



Typical Control Panel for Remote Control of Highway Crossing Signals

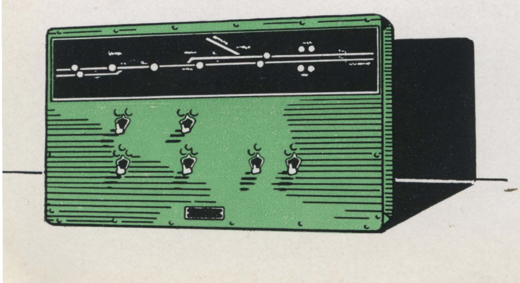
Remote Control of Highway Crossing Signals

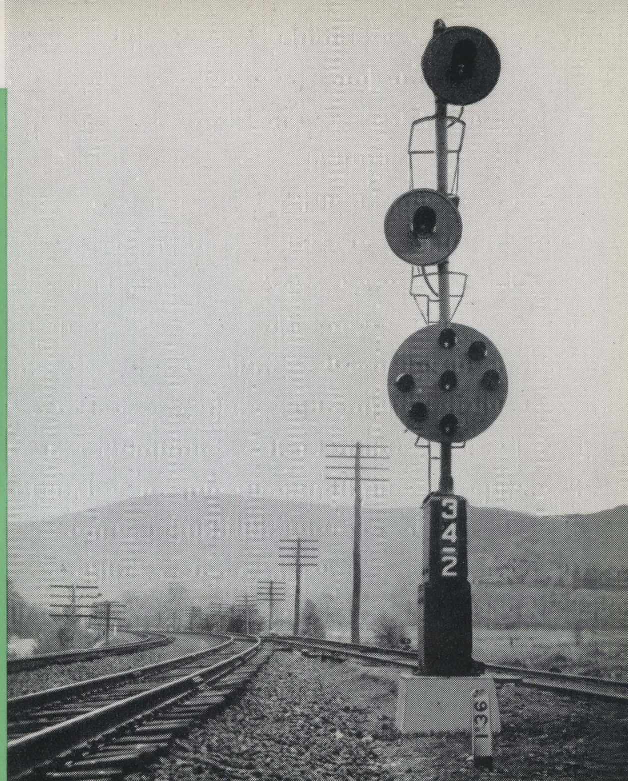
In those cases where the nature of train movements is such as to preclude full automatic control of highway grade crossing signals, a number of such signals may be controlled from one location. This remote control takes the place of local operation at each crossing in the group, and involves the operation of modern flashing light signals. In some cases controlled operation is required part time only, because of the traffic requirements, and the signals may be restored to automatic operation during the balance of the day.

The cost of protecting crossings, is reduced to a minimum and the type of protection afforded is better than that afforded by individual control. This method of controlling highway crossing signals provides the protection when needed and does not result in the unnecessary closing of the crossing to highway traffic when the switching movements involved do not affect certain of the crossings. The remote control of the crossing signals concentrates the control of these protective devices so as to provide not only lower cost of operation, but also the minimum delay to highway vehicles and a maximum of safety at the crossings.

The following table refers to several installations of manually controlled highway grade crossing signals where the remote control principle of operation is employed. The savings indicated are those over the previous method of operation, but do not take into account the increased cost which would have been incurred with 24-hour protection at each crossing.

Railway	Location	Number of Crossings	Net Annual Saving	Per-cent Saving	Reference
B. & L. E.	Greenville, Pa.	5	$3,000	15.6	Rwy. Signaling Feb., 1932
B. & M.	Hudson, Mass.	9	4,255	27.0	Rwy. Signaling May, 1934
C. M. St. P. & P.	Oconomowoc, Wis.	6	4,758	33.4	Rwy. Signaling Sept., 1931
I. U. T.	Indianapolis, Ind.	23	15,984	33.3	Rwy. Signaling Oct., 1928
M. K. T.	Clinton, Mo.	11	3,300	28.7	Rwy. Signaling June, 1930
Wabash	Wabash, Ind.	13	7,800	40.0	Rwy. Signaling Jan., 1929





Position Light Type Train Order Signal is Mounted Below Automatic Block Signal—*Erie*

Remote Control of Train Order Signals

The Erie was the first railroad to make use of a signal on double track that could be used in place of a written train order authorizing trains to proceed disregarding following superior trains, to direct trains to take siding, or to stop and hold main track. These signals are remotely controlled from the nearest continuous train order office. They were first used in 1909 in connection with the installation of automatic block signals on a double track division, and proved so

Crossover Location Showing Power Operated Switch and Controlled Signals—*P. R. R.*

successful as a means of expediting train movements over the division, that their use has been extended wherever possible on this railroad.

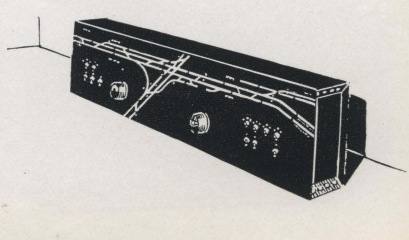
These signals are handled by operators at the various train order offices in accordance with the instructions of the train dispatcher and are a considerable factor in keeping freight trains in motion in all cases where they can be moved with little or no delay to superior trains. They are so interconnected with the automatic block signal system that the display of the train order signal in a restrictive position causes the automatic block signal at the same location to assume its most restrictive indication. The type of signal used by the Erie for this purpose on the early installations was of the semaphore type, but those installed in recent years have all been of the position-light type.

Remotely Controlled "Take Siding" and "Leave Siding" Signals

Remote control of "Take Siding" signals has been used for many years on single and double track lines. Functionally, this type of signal has much in common with the remotely controlled train order signal previously described. The signal itself, ordinarily located at the entrance end of the siding governed and controlled from the dispatcher's office or from the nearest train order office, may be semaphore, color light, position-light or any other type of signal. The indications displayed are auxiliary to other methods of directing train movements.

"Leave Siding" signals have long been used in single track automatic block signal territory where it has been found advisable to control the departure of trains from sidings or switching tracks from an adjacent office under direction of the dispatcher. These signals are generally used where the train has other authority to move beyond the control station, but where it is desirable to hold the train in the clear on a siding until it can pass through the station area without delay. They may also be used to authorize a train to leave a siding prepared to pick up Form 19 train orders where the train order office is beyond the end of the siding.

These facilities add to operating flexibility, and because of the very low cost of their installation need only eliminate a small amount of train delay to economically justify their installation. They illustrate some of the many ways signaling facilitates train operation.



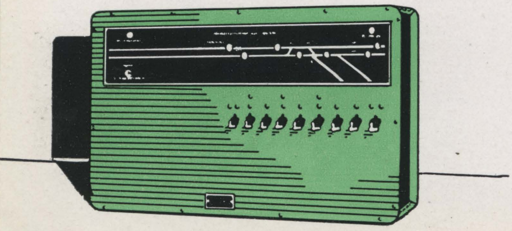
Train Order Indicators

In order to reduce delays in single track automatic block signal territory, one road installed, on the mast of the automatic block signal at a siding switch farthest from the telegraph office, a train order indicator consisting of a single unit color light type signal equipped with a green lens. The circuit to the indicator is interconnected with the block signal circuit so that the indicator cannot show "green" unless the block signal to which it is connected is in the clear position, thus avoiding any opportunity for the engineman to mistake the indicator for a clear block signal. Passage of a train automatically extinguishes the indicator light.

This signal is controlled from the train order office in advance of the signal and is used to facilitate train operation by providing an indication to a train, whose right or class would normally require it to take siding, to proceed on the main track prepared to pick up a Form 19 train order, at the train order office, which confers additional rights to the train.

Train Starting Systems and Signals

Remote control of train starting signals for facilitating the departure of trains from passenger terminals and freight yards has been installed in a number of cases with satisfactory results. In general they are controlled by a train director or operator at an adjacent interlocking in co-operation with the dispatcher, the station force and the train conductor. Such systems, especially at passenger stations are designed to con-



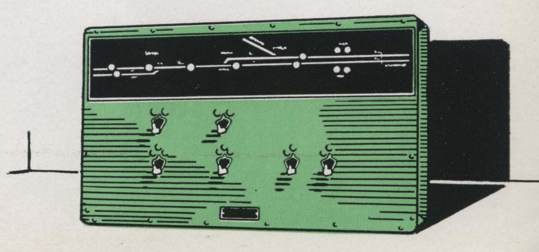
vey information, by means of a signal, which would otherwise require issuing other forms of instructions. Where signals are used, a definite but simple act is required on the part of those concerned with the final departure of the train from the terminal.

Control of Signals for Special Purposes

Remote control of outlying signals is often the means of facilitating meets and eliminating delays for switching movements adjacent to yards and terminals. Sometimes a remotely controlled outlying signal can be used to hold trains out on the main until it is advantageous to permit them to enter a terminal or station area. Often this type of control is achieved by giving an operator control over certain aspects of an automatic block signal, and sometimes by the addition of a separate signal. Signals may be installed for any purpose where the indications of a signal can take the place of other means of communication and they may be remotely controlled from any designated point. There is a distinct advantage in displaying information by means of an easily understood light or semaphore signal rather than depending upon hand signals, telephone instructions, etc.

Yard Track Indicator

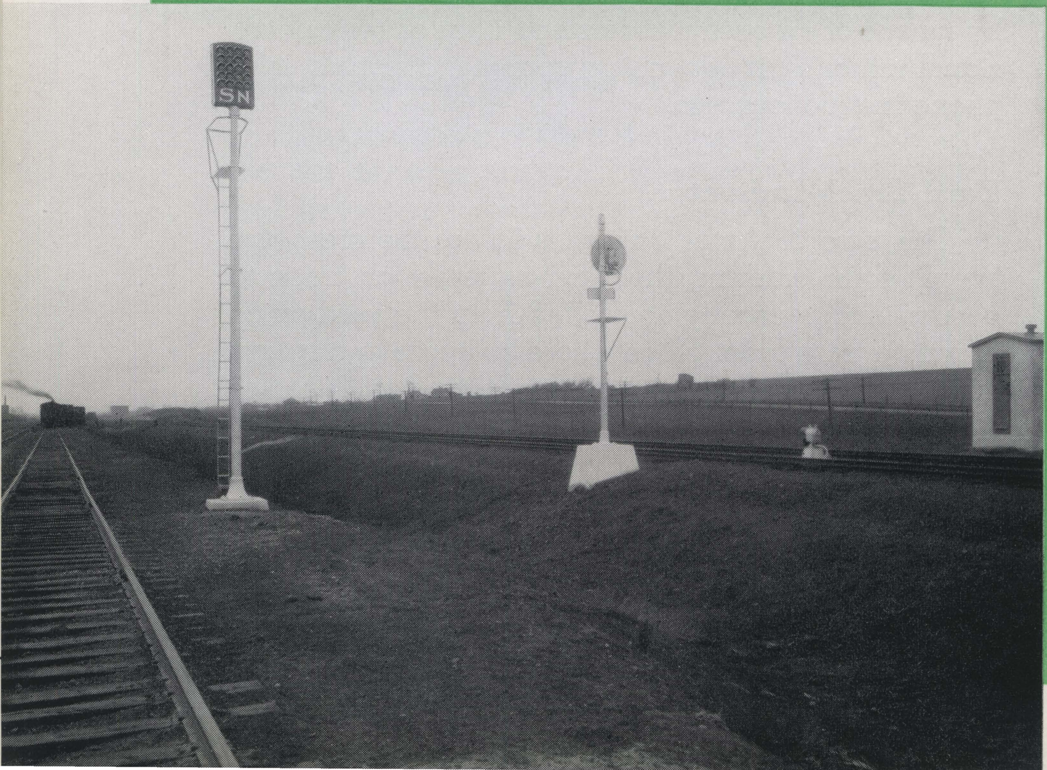
This type of signal is used to advise the crew of a freight train entering the yard as to which track to occupy and is usually controlled from the yard office or from a train order office where an operator displays the indication requested by the yardmaster. It serves



to eliminate delays in communicating the information to the train crew and, because of the fact that it is operated sufficiently in advance of the arrival of the train, insures a greater freedom from error in designating the track a train is to occupy.

On some installations the use of special train orders or messages issued to the train at the last open train order office before reaching the yard are eliminated. These orders are often the cause of confusion at the yard because of changed conditions after the order is sent, in any case they are apt to cause delay to the train picking them up. Installation of these yard track indicators eliminates delays encountered by trains stopping to telephone the yard office for instructions.

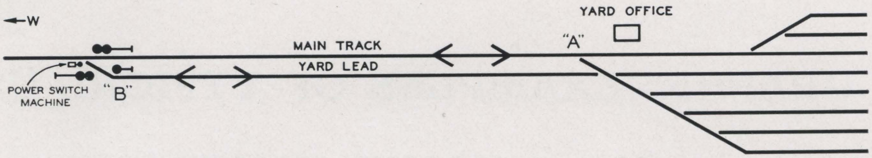
Yard Track Indicator—*A. T. & S. F.*



GRAPHIC EXAMPLES OF TYPICAL USES FOR REMOTE CONTROL

NOTE: The diagrams in this section for the most part show only the controlled signals.

Other related automatic block signals and distant signals are not shown.



Conditions:

1. Yard lead on single track railway, equipped with automatic block signals, and having a moderate traffic volume.
2. Traffic does not warrant switchtenders at "B" although considerable delay is encountered when train crews operate switch. Full utilization of the yard lead is not possible for westward trains because it is often more desirable to permit them to depart at "A" where switchtenders are on duty.

The Problem:

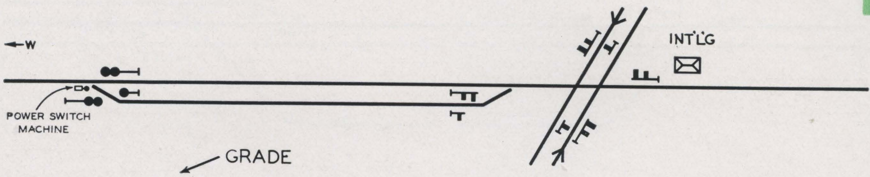
To provide for maximum utilization of the lead track and improve the flexibility of freight train movements.

The Solution:

Remote control and power operation of the switch at the west end of the yard lead—operated from the yard office.

Results:

1. Lead can be used for either eastward or westward trains.
2. Upon advice from the dispatcher that a freight is approaching the yard, yardmaster can permit it to enter lead switch or to proceed on main track as conditions warrant.
3. Train stops and delays eliminated.
4. Permits closer moves with respect to passenger trains by creating a usable meeting point at end of the yard.



Conditions:

1. Crossing of double and single track line with one end of siding controlled by the interlocking at the crossing.
2. Full advantage of the interlocked switch at east end not being taken because the siding is a difficult point to make a meet on account of an adverse grade at the west end of the siding which causes trains to lose a great deal of time in the hand-operation of the switch at that point.

The Problem:

To make this siding available for a greater number of meets and passing moves and thus facilitate handling of trains over the district.

The Solution:

A power-operated switch, with associated signals, at the end of the siding farthest removed from the interlocking, controlled from the interlocking tower.

Results:

1. A more flexible arrangement for handling trains by changing a "bad" meeting point to a good one.
2. Elimination of train stops to enter or leave siding.

Conditions:

1. A single track tunnel between sections of double track, through which trains are moved by means of the "Staff System."
2. Delays involved in the operation of the staff system and cost of its operation are undesirable, also the system is in need of extensive overhauling.
3. In this instance it is necessary to select the train to be given preference by class, rather than by direction, which makes it undesirable to install an automatic interlocking.

The Problem:

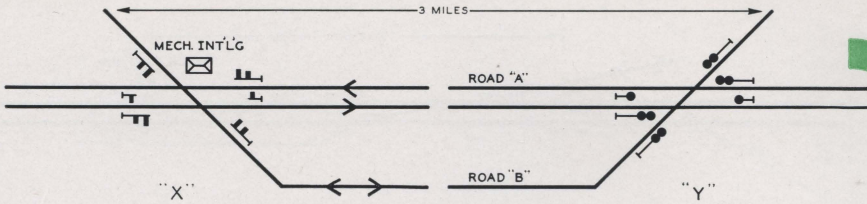
Reduce operating expenses at this point and eliminate train delays.

The Solution:

Installation of power-operated switches and signals, remotely controlling the arrangement from an adjacent office, which has 24-hour attendants.

Results:

Expedited train movements and reduced operating expenses.



Conditions:

1. Road "A" crosses road "B" at X and again at Y—both crossings are protected by mechanical interlockings. The interlocking at X controls several functions other than the crossing and is in good condition, having been recently overhauled, while the interlocking at Y controls only the crossing and is in need of replacement or extensive overhauling.
2. The nature and volume of traffic makes it undesirable in this case to install an automatic interlocking at Y.

The Problem:

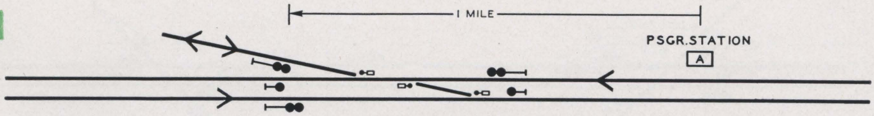
To provide interlocking protection to replace that in service at Y, at the lowest cost consistent with conditions, and to reduce operating expenses.

The Solution:

Installation of remote control machine in the tower at X for the operation of the functions at Y.

Results:

Maximum economy in installation and a substantial reduction in annual operating costs.



Conditions:

1. Junction of single track branch line with double track main line. All switches at the junction operated by train crews in making moves to and from the branch.
2. Rearrangement of traffic has caused a larger number of trains to be routed via the branch, causing some delay in getting to and from this single track line, but not enough to warrant an attended interlocking. There is a continuous train order office at the passenger station at "A" which serves as the register point for the single track line.

The Problem:

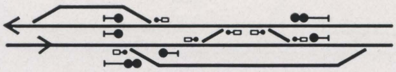
Elimination of delay at the junction to branch line trains, with a minimum capital expenditure.

The Solution:

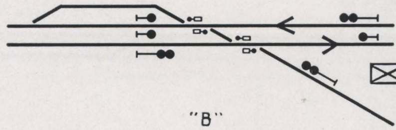
Power operation and remote control of the junction switch and the crossover, to be controlled by the operators at Station "A."

Results:

1. Elimination of delays to branch line trains.
2. Quicker clearing of main line by branch line trains, thus avoiding delays to main line trains.
3. Better protection at junction and crossover because of interlocking.



"A"



"B"

Conditions:

1. Electro-mechanical interlocking at "A" destroyed by fire.
2. Traffic over this double track line is heavy and it is essential that the functions at "A" be interlocked.

The Problem:

To restore the operation of the functions at "A" in the most economical way.

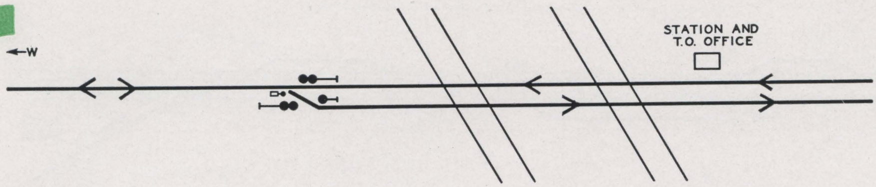
The Solution:

Installation of modern remote control machine in the tower at "B" to operate the switches and signals at "A" by remote control. Machine designed to provide for the future control of another interlocking 4 miles west of "A."

Results:

1. A saving of nearly 70 per cent per year on the additional cost of installing remote control over the cost of replacing the facilities at "A" in kind.

2. A noticeable operating improvement resulting from control of these adjacent interlockings from one location.



Conditions:

1. Junction of double and single track with train order office located in passenger station about 1000 feet from E. D. T. switch.
2. Normal position of switch is lined for eastward movements, requiring all westward trains to open and close switch.
3. Traffic not considered sufficiently heavy to warrant an attended interlocking, and spring switch not satisfactory because the switch is used for some switching moves.

The Problem:

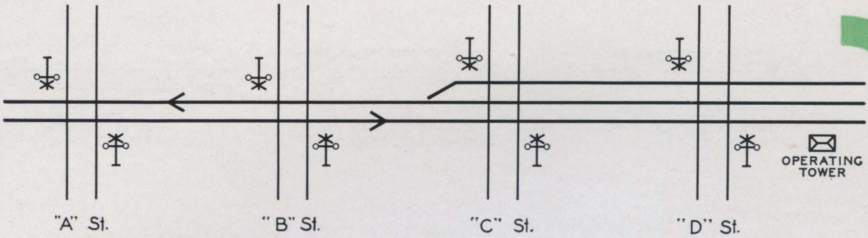
An economical means of operating the switch in order to avoid train stops.

The Solution:

A simple remote control installation which would provide for power operation of the E. D. T. switch from the passenger station.

Results:

1. Elimination of the stop to operate switch by westward trains.
2. Westward trains clear street crossings sooner and thus eliminate complaints of local authorities, regarding blocked crossings.
3. Eastward trains have signal to move over the facing point switch, thus can move at higher speed with greater safety.



Conditions:

1. Double track railroad over which through moves as well as switching moves are made. The latter only during daylight hours. Protection at one crossing 24 hour flagman service, at others, 16 hour flagman service.
2. Switching moves make automatic crossing signals impractical during daylight hours.

The Problem:

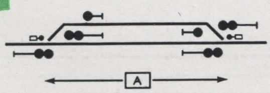
To provide adequate protection and to satisfy municipal authorities by avoiding unnecessary delays to street traffic and at the same time to reduce the cost of protecting the crossing by watchmen.

The Solution:

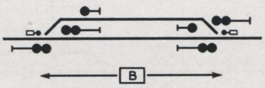
A combination of automatic and manual control of flasher light signals. Operation of crossing signals to be controlled remotely from an operating tower near "D" street for the time of day when switching moves are made. Operation switched to automatic control for the period of the day when only through moves are made.

Results:

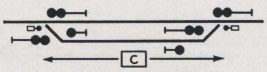
1. Lower operating cost of protection.
2. Full 24 hour protection at all crossings, instead of part-time protection afforded by watchmen.
3. Local authorities satisfied because the installation does not unduly delay highway traffic.



ENDS OF SIDINGS
CONTROLLED FROM A



ENDS OF SIDINGS
CONTROLLED FROM B



ENDS OF SIDINGS
CONTROLLED FROM C

Condition:

1. Busy single track railway with automatic block signals and some remotely controlled ends of sidings.
2. Traffic heavy during certain hours of the day and some delay brought about by operation under the timetable and train-order method of operation.

The Problem:

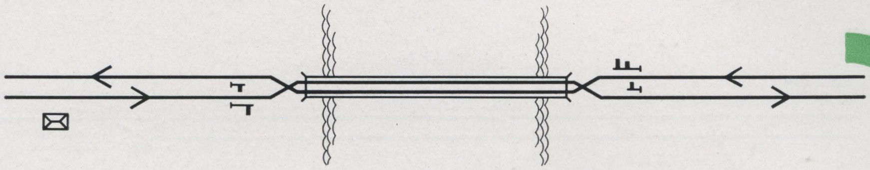
To further increase the facilities for moving trains with a minimum of delay due to meets and passing moves.

The Solution:

Equip balance of ends of sidings with power operated remotely controlled switches and to provide for co-operative action between control stations, under the direction of the dispatcher, so that trains may be moved by signal indications without written train orders.

Results:

1. The advantages of train operation by signal indication without train orders.
2. Power-operated switches and controlled signals so located that all that would be required would be to change the controls if and when it would be decided to change to C. T. C. operation from one control point.



Condition:

Gauntlet track over bridge protected by an interlocking which formerly had other functions which are now discontinued. Automatic control not practical because of nature of traffic.

The Problem:

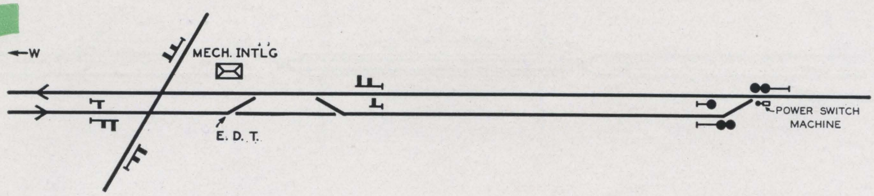
To avoid the expense of operating a three-trick interlocking merely for the purpose of controlling this gauntlet.

The Solution:

Remote control of this layout from another interlocking several miles distant.

Results:

Reduced operating expenses.



Conditions:

Crossover at interlocking operated as end of double track. Siding is extension of eastward track but is seldom used excepting for a few meets.

The Problem:

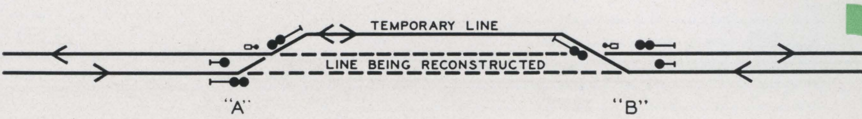
To extend official end of double track to east end of siding, which is considerably beyond the operating limits of the mechanical interlocking.

The Solution:

Power operation and remote control of the switch at the end of the siding from the interlocking tower.

Results:

1. Effectively extends end of double track and thus cuts down the distance between the end of double track and the next siding.
2. The track between the old and new E. D. T. can be used as a siding for passing moves in either direction.



Conditions:

Temporary abandonment of operation over section of double track line due to heavy grade revision work. It is only possible to construct a single track temporary line around the work.

The Problem:

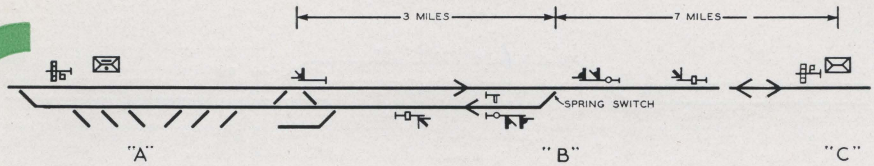
To carry the traffic of the double track line over this section of single track with the least possible delay and with a minimum of expenditure for facilities.

The Solution:

Installation of remotely controlled signals and switches which will make it possible to move trains by signal indication without train orders or a staff system. The layout at one end to be controlled from the other end, or from an adjacent interlocking.

Results:

1. Greatest possible utilization of the single track line, because of signal indication operation.
2. Use of standard devices which may be installed at some other point when the need for them at these temporary junctions is eliminated by completion of the work on the main track.
3. Saving in operating costs over the temporary line.



Condition:

Single track railway operating with manual block handling about 16 trains daily. It is desired to abandon the interlocking at the end of double track and to install a spring switch with mechanical facing point lock.

The Problem:

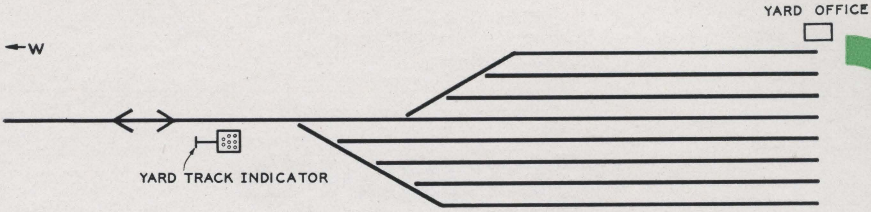
To provide the equivalent of a manual block station at point "B" where the interlocking is to be removed.

The Solution:

Control of the signals at "B," including the manual block features, from the block station at "A."

Result:

Reduced operating expenses by eliminating interlocking and attended block station at "B."



Condition:

Small yard with practically all work performed at yard office end, which is at the extreme east end of the yard. Trains entering the yard from the west must stop and call the yardmaster for instructions in order to find out which track to enter. Some delay encountered in the course of securing telephone instructions.

The Problem:

To provide means by which trains may be instructed as to which track to enter without requiring telephone or train order instructions.

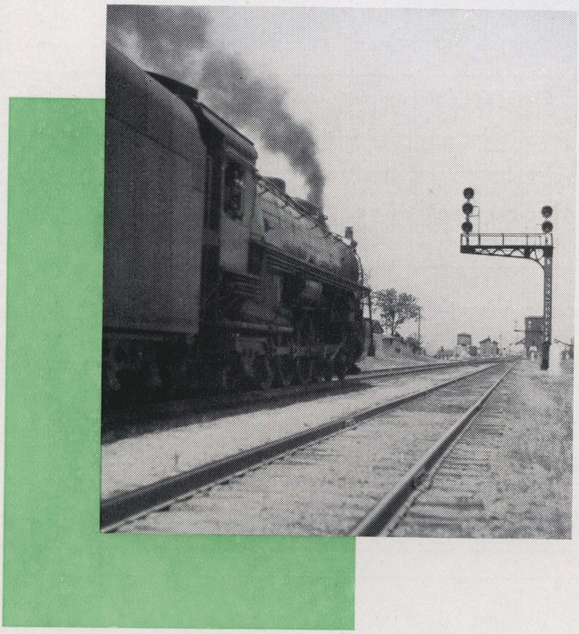
The Solution:

Installation of a yard track indicator operated from the yard office by remote control. This indicator displays the number of the track to be occupied by the train entering the yard and also indicates the wishes of the yardmaster if he desires to "main-track" the train.

Result:

Elimination of confusion on trains entering the yard, as well as delays in transmitting instructions.

APPENDICES



APPENDIX "A"

Economic Advantages of Typical Remote Control Installations

Railway	Location	Year	Type of Layout	Number of Switches	Trains per Day	Total Cost	Annual Saving	Rate of Saving Per Cent	Publication Reference
A. T. & S. F.	Neva, Kans.	1933	Junction	6	43	$22,426	$5,300	23.6	Railway Signaling, Jan., 1934
B. & A.	Brookline Jct., Mass.	1932	Junction	2	120	25,000	6,000	24.0	Railway Signaling, Oct., 1932
C. P. R.	Cobourg, Ont.	1934	Crossing	2	30	7,500	4,729	63.0	Railway Signaling, Aug., 1934
C. of Ga.	Americus, Ga.	1926	E. D. T.	4	37	10,425	3,756	36.0	Proc. S. S., Vol. XXIX, p. 23
C. of Ga.	Griffin, Ga.	1929	E. D. T.	4	35	16,306	3,997	24.5	Proc. S. S., Vol. XXIX, p. 25
C. & O.	Balcony Falls, Va.	1925	E. D. T.	1	24	11,607	8,370	72.1	Proc. S. S., Vol. XXIV, p. 103
C. & O.	E. Clayton, Ohio	1930	E. D. T.	1	13	14,570	4,774	32.7	Proc. S. S., Vol. XXIX, p. 27
C. & O.	Greenway, Va.	1932	E. D. T.	1	16	11,000	5,000	45.5	Railway Signaling, Aug., 1933
C. & N. W.	Chaldron, Neb.	1929	Junction	1	26	37,200	14,465	38.9	Proc. S. S., Vol. XXVIII, p. 388
C. & N. W.	Green Bay, Wis.	1929	Junction	4	32	27,500	31,855	115.8	Proc. S. S., Vol. XXVIII, p. 387
C. & N. W.	Boone, Iowa	1931	Yard	1	36	14,715	4,592	31.2	Proc. S. S., Vol. XXX, p. 12
C. B. & Q.	Earlville, Ill.	1918	Crossing	5	22	13,000	4,900	37.6	Railway Age, Aug. 15, 1925
C. B. & Q.	Oxford Jct., Neb.	1925	Junction	1		11,500	4,818	41.9	Railway Age, Aug. 15, 1925
C. B. & Q.	Davies, Mo.	1925	Yard	1		4,300	5,168	120.2	Railway Age, Aug. 15, 1925
C. B. & Q.	Bridge Switch, Wis.	1925	E. D. T.	1	12	9,000	4,900	54.4	Railway Age, Aug. 15, 1925
C..B. & Q.	Concord, Ill.	1928	E. D. T.	2	26	26,000	7,128	27.4	Railway Age, Dec. 29, 1928
C. B. & Q.	Lincoln, Neb.	1929	Crossing	5	28	17,664	4,396	24.9	Railway Age, Mar. 2, 1929
C. G. W.	Rice, Ill.	1931	Tunnel	2	24	18,000	7,000	38.9	Railway Age, May 30, 1931
C. M. St. P. & P.	Techney, Ill.	1933	Junction	3	40	13,272	5,234	46.0	Railway Age, Feb. 18, 1933
C. M. St. P. & P.	Bensenville, Ill.	1933	Junction	3	40	14,121	5,113	33.0	Railway Age, Feb. 18, 1933
C. C. C. & St. L.	De Graff, Ohio	1932	Sidings	8	33	36,000	6,000	16.7	Railway Signaling, Mar., 1932
G. N.	Havre, Mont.	1932	Junction	4	18	3,700	5,400	146.0	Railway Age, Mar. 19, 1932

Economic Advantages of Typical Remote Control Installations (Continued)

Railway	Location	Year	Type of Layout	Number of Switches	Trains per Day	Total Cost	Annual Saving	Rate of Saving Per Cent	Publication Reference
M. C....................	Rochester Jct., Mich.	1930	Crossing		22	17,900	5,000	27.9	Railway Signaling, Dec., 1930
M. P....................	Cliff Cave, Mo.	1933	E. D. T.	1	25	6,500	5,500	84.6	Railway Age, Apr. 1, 1933
M. P....................	Chester, Ill.	1929	Siding	5		13,000	4,996	38.2	Railway Age, Nov. 18, 1933
M. P....................	Harviell, Mo.	1932	E. D. T.	1	25	5,100	5,000	98.0	Railway Signaling, July, 1932
N. C. & St. L.............	Stevenson, Ala.	1923	E. D. T.	1	24	6,277	8,894	141.7	Railway Signal Eng., Oct., 1923
N. & W..................	N. Roanoke, Va.	1928	E. D. T.	2	16	15,000	4,400	29.3	Railway Signaling, Mar., 1929
N. P....................	Muir, Mont.	1933	Tunnel	2	32	9,438	5,284	56.0	Railway Signaling, Dec., 1933
P. R. R..................	Birdsboro, Pa.	1929	Sidings	10	36	59,139	14,253	24.1	Railway Signal Eng., Oct., 1923
P. R. R..................	Bullis Mills, N. Y.	1929	Sidings	4	30	24,142	10,799	44.7	Proc. S. S., Vol. XXIX, p. 9
P. R. R..................	Denholm, Pa.	1929	Sidings	5	33	35,366	10,580	29.9	Proc. S. S., Vol. XXIX, p. 21
P. R. R..................	Enola, Pa.	1930	Junction	4	95	17,000	5,331	31.3	Proc. S. S., Vol. XXIX, p. 11
P. R. R..................	Rich, Pa.	1929	Sidings	2	58	20,039	4,770	23.8	Proc. S. S., Vol. XXX, p. 6
P. R. R..................	Mohican, Pa.	1931	Crossovers	6	66	23,099	5,203	22.5	Proc. S. S., Vol. XXX, p. 9
T. & O. C................	Centerburg, Ohio	1922	Siding	1	20	5,100	4,712	92.4	Railway Signal Eng., June, 1923
T. & N. O................	West Junction, Tex.	1930	Junction	2	16	13,000	5,700	43.8	Railway Signaling, Feb., 1929
Wabash..................	Peru, Ind.	1933	E. D. T.	1		8,296	5,700	62.1	Railway Age, Apr. 29, 1933
Total, 38 Installations						**$643,202**	**$259,017**		
Average per Installation						**16,926**	**6,818**	**40.4**	

Remote Controlled Power Operated Switches and Signals in Service January 1, 1937

Name of Railroad	Number of Control Points	Number of Single Switches	Number of Cross-over Switches	Number of Signals	
				Sema-phore	Light
Atchison, Topeka & Santa Fe	47	86	26	250	11
Atlanta, Birmingham & Coast	1	..	1	3	2
Baltimore & Ohio:					
Eastern Lines	27	38	14	3	127
Western Lines	6	4	2	6	12
Bessemer & Lake Erie	1	..	..	..	4
Boston & Maine	25	38	48	10	131
Central of Georgia	4	1	5	12	3
Chesapeake & Ohio	29	13	4	2	95
Chicago & Eastern Illinois	1	1	..	..	..
Chicago & North Western	14	16	16	35	73
Chicago, Aurora & Elgin	1	2	..	..	7
Chicago, Burlington & Quincy	12	32	8	60	38
Chicago Great Western	1	..	..	..	2
Chicago, Indianapolis & Louisville	1	1	..	3	1
Chicago, Milwaukee, St. Paul & Pacific	19	32	26	71	85
Chicago, Rock Island & Pacific	2	3	..	3	9
Chicago, St. Paul, Minneapolis & Omaha	3	10	..	14	1
Delaware & Hudson	3	4	2	17	6
Delaware, Lackawanna & Western	5	6	1	12	7
Erie	8	8	..	16	17
Great Northern	13	16	3	33	38
Green Bay & Western	2	1	..	3	..
Illinois Central	7	7	..	9	27
Lehigh Valley	7	8	4	5	34
Long Island	2	2	..	8	..
Louisville & Nashville	8	8	3	34	..
Maine Central	1	1	..	1	3
Minneapolis, St. Paul & Sault Ste. Marie	6	7	..	5	23
Missouri-Kansas-Texas	4	4	..	..	12
Missouri-Kansas-Texas of Texas	7	10	..	26	2
Missouri Pacific	9	17	..	8	60
Beaumont, Sour Lake & Western	1	1	..	..	4
International-Great Northern	1	1	..	..	4

Remote Controlled Power Operated Switches and Signals in Service January 1, 1937

(Continued)

Name of Railroad	Number of Control Points	Number of Single Switches	Number of Cross-over Switches	Number of Signals	
				Sema-phore	Light
Missouri Pacific Continued:					
New Orleans, Texas & Mexico	1	1	..	..	4
Mobile & Ohio	1	2	..	2	..
Monongahela Connecting	1	1	..	..	..
Nashville, Chattanooga & St. Louis	2	2	..	6	..
New York Central	25	23	30	7	94
Boston & Albany	5	8	2	15	20
Cleveland, Cincinnati, Chicago & St. Louis	27	38	12	25	144
Indiana Harbor Belt	2	1	2	..	7
Louisville & Jeffersonville Bridge	1	2	..	..	11
Peoria & Eastern	1	..	..	..	1
New York, Chicago & St. Louis	9	12	..	6	31
New York, New Haven & Hartford	12	23	2	32	30
Norfolk & Western	3	4	..	8	12
Northern Pacific	4	2	2	10	7
Pacific Electric	1	4	..	..	8
Pennsylvania	104	144	69	21	560
Peoria & Pekin Union	1	..	..	..	3
Pere Marquette	3	3	..	..	11
Reading	5	13	..	9	20
St. Louis-San Francisco	4	3	4	20	..
Seaboard Air Line	11	19	..	..	60
Southern	1	1	..	2	1
Cincinnati, New Orleans & Texas Pacific	1	1	..	2	..
Southern Pacific Co.:					
Pacific Lines	19	31	28	76	82
Texas & New Orleans	12	16	2	88	3
Texas & Pacific	7	12	..	2	55
Union Pacific System:					
Eastern District	1	1	..	2	2
Central District	2	2	..	15	..
Northwestern District	2	2	..	13	3
Southwestern District	7	8	..	22	24
Wabash	5	5	..	9	15
Wheeling & Lake Erie	1	..	..	..	4
TOTAL	559	762	316	1,041	2,050

DISTRICT OFFICES

★

NEW YORK OFFICE

Empire State Building . . . . New York, N. Y.

CHICAGO OFFICE

Peoples Gas Building . . . . . Chicago, Ill.

ST. LOUIS OFFICE

Railway Exchange Building . . . St. Louis, Mo.

SAN FRANCISCO OFFICE

Matson Building . . . . San Francisco, Cal.

MONTREAL OFFICE

Dominion Square Building . . Montreal, Que., Can.

★

AFFILIATED COMPANIES' OFFICES

ARGENTINA
Buenos Aires

AUSTRALIA
Brisbane
Melbourne

BELGIUM
Brussels

CHILE
Valparaiso

CHINA
Shanghai

ECUADOR
Quito

ENGLAND
London

FRANCE
Paris

INDIA
Bombay
Calcutta

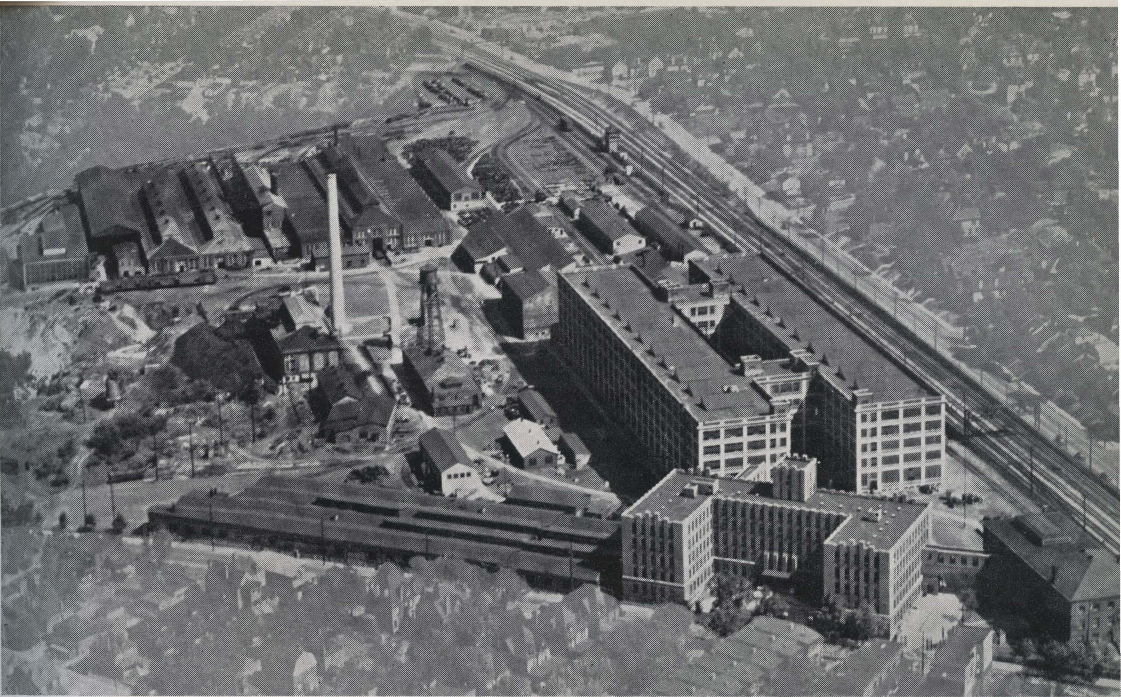
ITALY
Torino (Turin)

JAPAN
Tokyo

PORTUGAL
Lisbon

SOUTH AFRICA
Johannesburg

SWITZERLAND
Berne



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