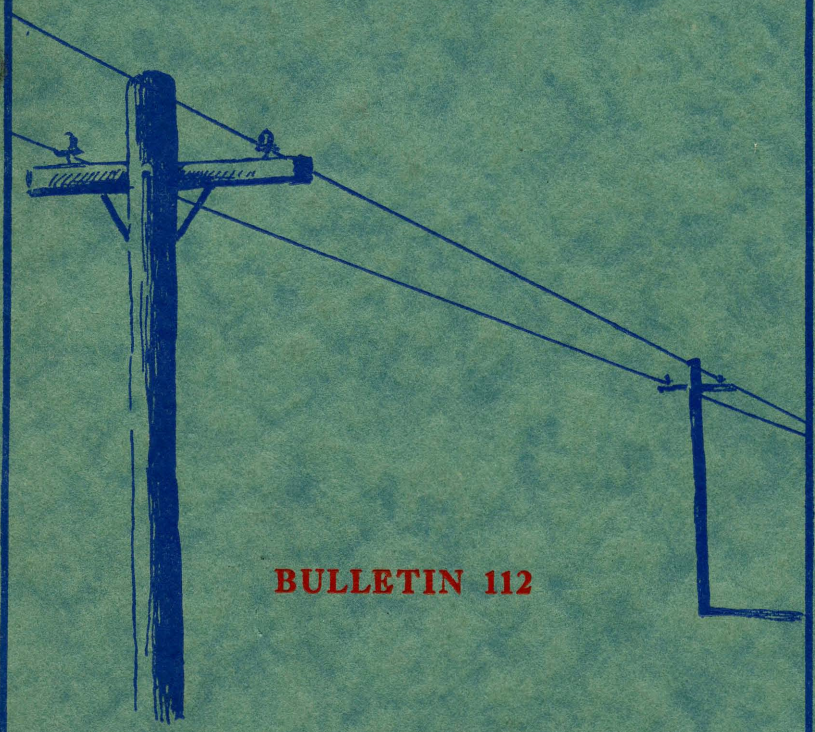
A story of two wires



BULLETIN 112

Union Switch & Signal Co.
SWISSVALE, PENNSYLVANIA

Zachary Gillihan

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DN: cn=Zachary Gillihan, o=ZCG Utility Scrap, ou, email=zachary.gillihan@gmail.com, c=US
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A Story of Two Wires

Wherein Train Operation is simplified and made more economical by means of the "Union" Dispatcher Controlled Signal System

BULLETIN 112

JUNE · 1927

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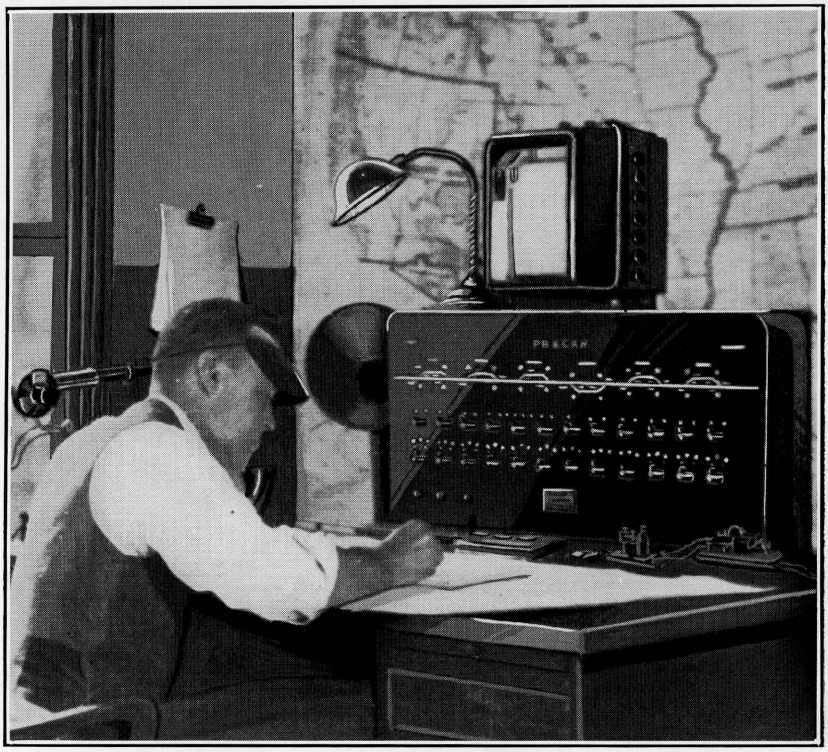
Union Switch & Signal Co.

SWISSVALE, PA.



The Dispatcher's Office Showing Control Board for Six Sidings

A Story of Two Wires

The Dispatcher Controlled Signal System for train operation by signal indication, as developed by the Union Switch and Signal Company, places the entire control of all train movements in a given territory directly in the hands of a train dispatcher or an operator working under instructions from the dispatcher. Thus written train orders are eliminated and the services of operators at unimportant stations are dispensed with. Other factors entering into the system also help reduce operating expenses as well as further to increase the safety of train operation.

No new or undeveloped principles are incorporated in the system. Consequently, just as reliable service may be expected from the use of the "Union" Dispatcher Controlled Signal System as is obtained from the present telephone train dispatching system in conjunction with the automatic block signal system. The co-ordination of the two present systems, resulting from the use of the "Union" Dispatcher Controlled Signal System, places in the hands of the dispatcher a centralization of control over train movements which he is unable to exercise under the present methods governing train operation.

The dispatcher's responsibility is in no wise lessened through the use of this system. However, his work is lightened as there is no necessity of transmitting written train orders. An error or lapse on the part of a dispatcher or operator through the use of written orders which might cause disastrous results is automatically checked against by the

functioning of the "Union" Dispatcher Controlled Signal System.

Time is saved in the dispatcher's direction of train movements through his ability to transmit orders directly to the train crew by means of signal indications at the point where they are to be acted upon. He receives a visual indication of the position of the signals at each end of the passing siding at each station. He also receives a visual indication showing him whether the track sections at each end of the passing sidings are clear or occupied. These indications permit him to follow his train movements over the entire territory.

An added advantage of this system is that an Automatic Train Graph can be made a part of it. Through the use of the train graph, the exact time at which a train passes each end of a passing siding is recorded in ink on the graph sheet. The advantages of the Automatic Train Graph over the present method of "OSing" trains is evident.

Flexibility is another important element of the "Union" Dispatcher Controlled Signal System. Traffic over the entire territory under the jurisdiction of the dispatcher may be controlled by this system just as easily as over a short section; or the control board may be installed at some station where operators *must* be kept on duty, permitting them to handle train movements at unimportant stations, releasing the operators at these places for other duties. In such an installation the operators would handle that particular territory under instructions from the dispatcher. The use of the Automatic Train Graph gives the operator accurate information for "OSing" the trains to the dispatcher for his record on the train sheet. The system is applicable to single track, manual block, controlled manual block or automatic block signal territory as well as to multiple track working.

It is simple to operate. And *but two wires* are required to control a number of locations. These two wires will control the operation of switches and signals; in addition they provide a path over which the proper visual repeater indications on the control board are received.

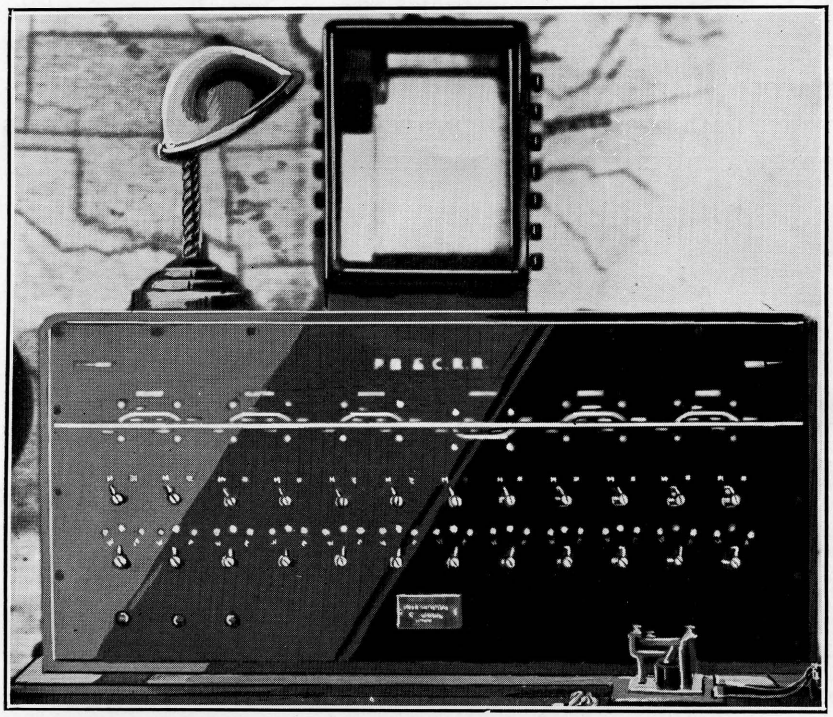
The Component Parts of the System

The "Union" Dispatcher Controlled Signal System consists of the control board, the automatic train graph, the signals, the power operated switch machines and the track circuits. While certain items may be omitted from the complete system, as listed above, the maximum utility may be secured with an attendant reduction in operating costs only through the installation of the complete system.

The Station Equipment

The control station equipment consists of a control board similar in character to the present telephone selector cabinet on the dispatcher's desk. Across the top of the control board is a miniature track model with track indicators of the light type. The switch levers are in a horizontal row below the miniature track model. The signal levers are located in a horizontal row below the switch levers. Signal repeaters of the light type are a part of each lever unit. The signal repeaters guarantee the integrity of the switch points. One repeater will show green when the westward signal is clear; another shows green when the eastward signal is clear, while the third repeater shows red when the signals controlled by this lever are at "stop."

The miniature levers on the control board are similar to those in use on "Union" power operated interlocking machines. Only one signal lever is required to control a group of conflicting or converging route signals, as at the ends of



The Control Board Showing the Automatic Train Graph at the Top

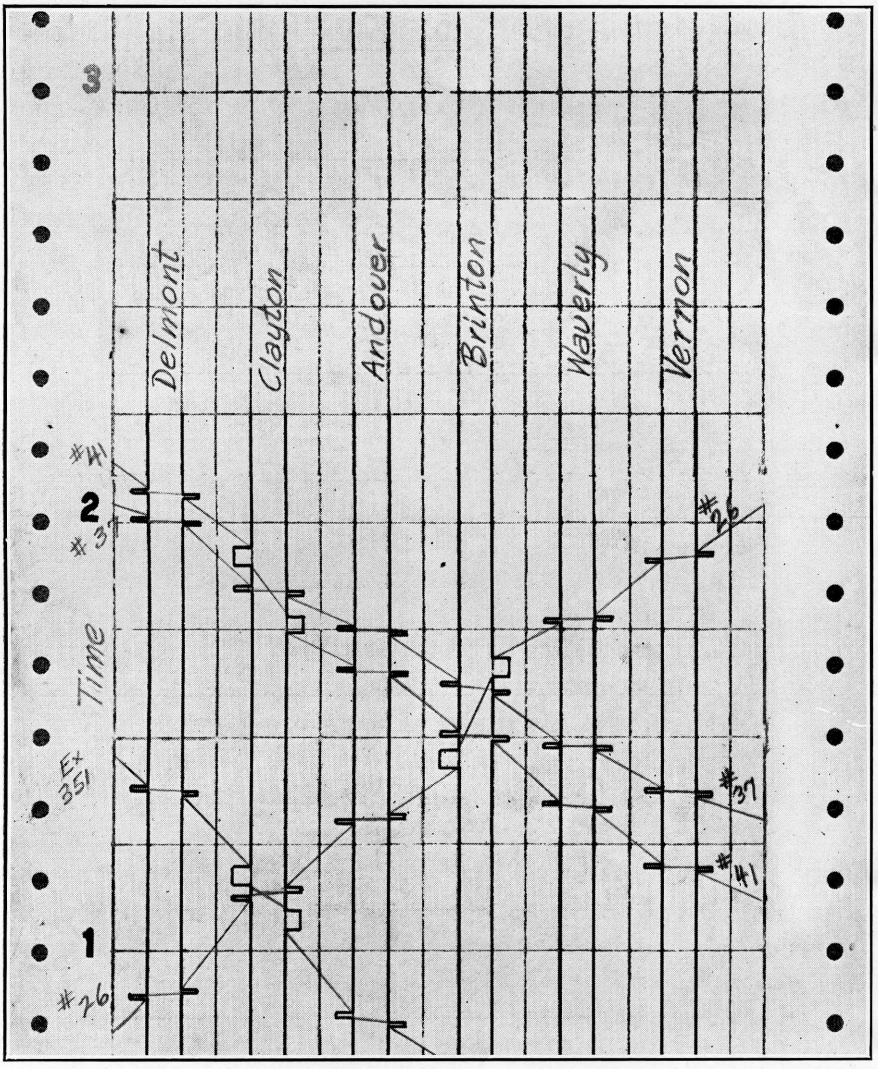
passing sidings. Signal levers stand normally in the center or vertical position; movement to the right controls the clearing of a signal for traffic in the corresponding direction; and movement to the left causes the proper signal in that group to clear for the opposite direction. Thus a number of signals are safely controlled by the manipulation of one lever. It is understood, of course, that signals at the end of passing sidings are semi-automatic and depend on the track in advance being unoccupied and the switches properly set before they may be cleared. Switch levers stand normally at the left of the center position and are moved to the right to effect the control for a reverse switch movement.

The Automatic Train Graph

An Automatic Train Graph is shown in the illustration of the control board. This is not the position in which it will be mounted ordinarily. The generally accepted location will be with the top of the graph level with the top of the dispatcher's table; this permits the dispatcher or operator to make notations regarding train moves etc., directly on the graph sheet. The dispatcher or operator has before him a graphic record of every train move over his territory. He knows whether a train is losing time, running on time or making up time because it automatically "OSes" itself on the graph sheet as it proceeds over the division. There is no delayed time in the receipt of the "OS," as occurs when the dispatcher must depend upon an operator to "OS" the train.

Under the present method of written orders some time may elapse before the dispatcher knows where a train is, if for example it is night, and no operators are on duty at small intermediate stations. By the use of the Automatic Train Graph in connection with the "Union" Dispatcher Controlled Signal System, the dispatcher knows immediately when a train passes the closed stations. This allows him to plan meets much better with a resultant saving in running time. If, for any reason, a train is losing time and it becomes necessary to change the meeting point with another train, this is accomplished in the time needed only to throw a lever on the control board. No orders have to be annulled or new orders put out to make a change in a meeting point.

Under present operating conditions a dispatcher may figure on a close meet provided a train working at a station gets away at a specified time. The conductor may tell an operator he can get away on or before the specified time

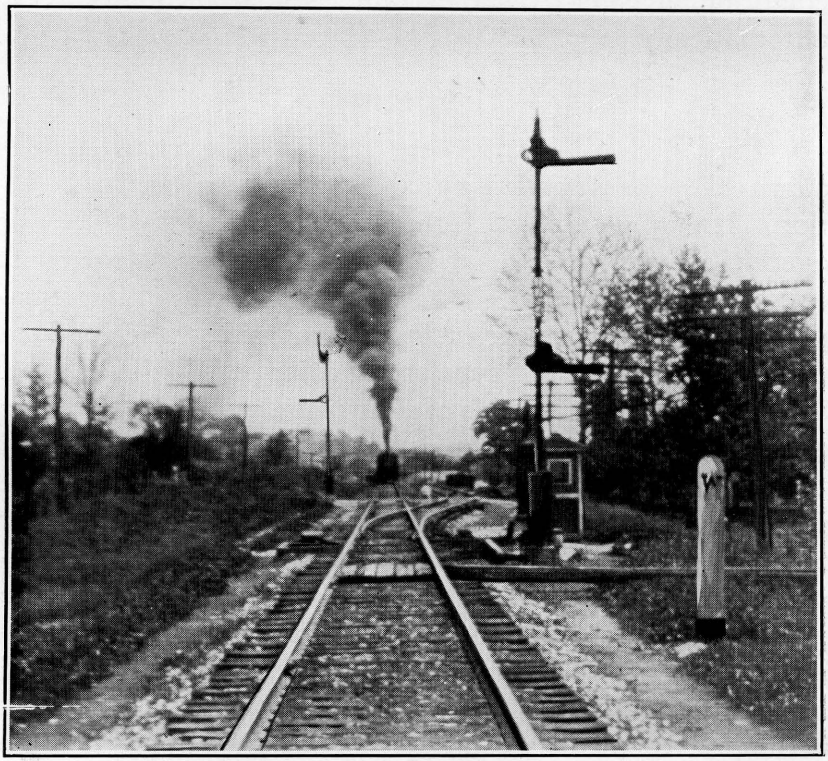


The Graph Sheet Showing Opposing and Following Moves as Made by the Automatic Train Graph

but finds he will require three or four minutes more to complete his work. He asks the operator to "OS" him out at the specified time to prevent the dispatcher holding him at that station. Consequently, an added delay occurs in making the meet. The Automatic Train Graph corrects such a condition, inasmuch as the train itself sends in its "OS" automatically.

The Signals

The "Union" Dispatcher Controlled Signal System is adaptable to any existing signal system or proposed installation. It may be used with the absolute permissive block or overlap system of automatic signals or with manual block or controlled manual block. The signals may be of the semaphore type, either upper or lower quadrant; the color-light type; the position-light type or the color-position-light type. Signals located at the ends of sidings are semi-automatically controlled, that is, they may be placed at danger at any time either by the dispatcher, or by a train occupying the governing track circuit; but to be cleared, the dispatcher must operate his levers and the track circuits must be unoccupied. These signals in turn indirectly control the position of the intermediate automatic signals between sidings. For example, when the siding signals for a westward move are set up by the dispatcher, all opposing eastward automatic signals between sidings automatically assume the "stop" position. Directional control is thus established.



The Train is Approaching the East End of the Siding

The Switch Machine

The switch machine used to operate the siding switches is the well known "Union" Style M, electrically operated switch movement. This movement is particularly well adapted to the electrical operation of outlying switches and derails because it is economical in its power requirements, certain in operation and will work satisfactorily through long periods of time without attention.

The Track Circuit

The track circuit has made possible the present high development of modern block signaling. Its essential feature is the insulation of each section of track from the adjoining sections. The conditions of the track circuits at the sidings is repeated on the operating board in the dispatcher's office by means of the track indicators, which show whether these track circuits are occupied or unoccupied. It is through the medium of these track circuits that the trains automatically "OS" their passage by both ends of every siding.

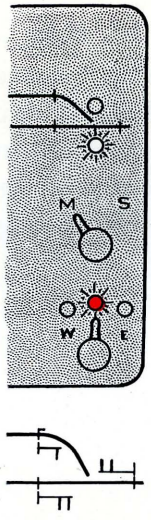


Fig. 1

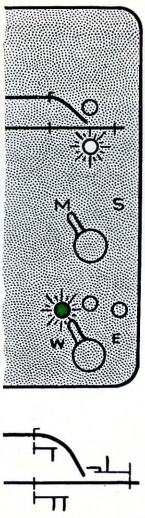


Fig. 2

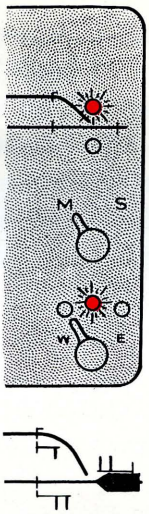


Fig. 3

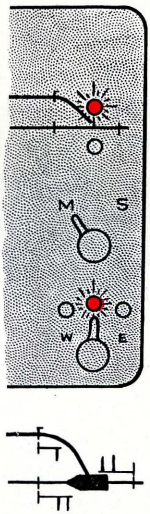


Fig. 4

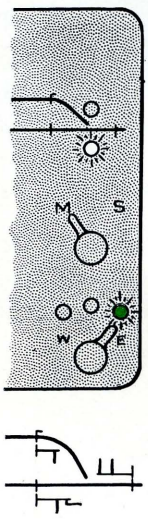


Fig. 5

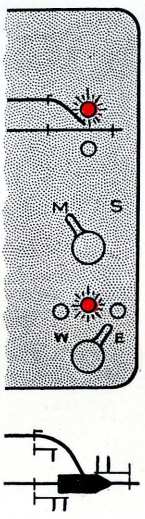


Fig. 6

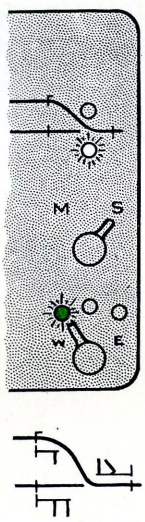


Fig. 7

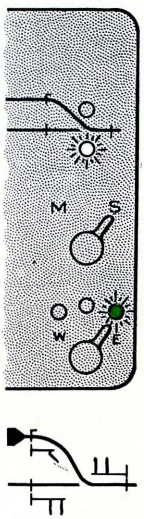


Fig. 8

The Track and Signal Indications Received on the Control Board

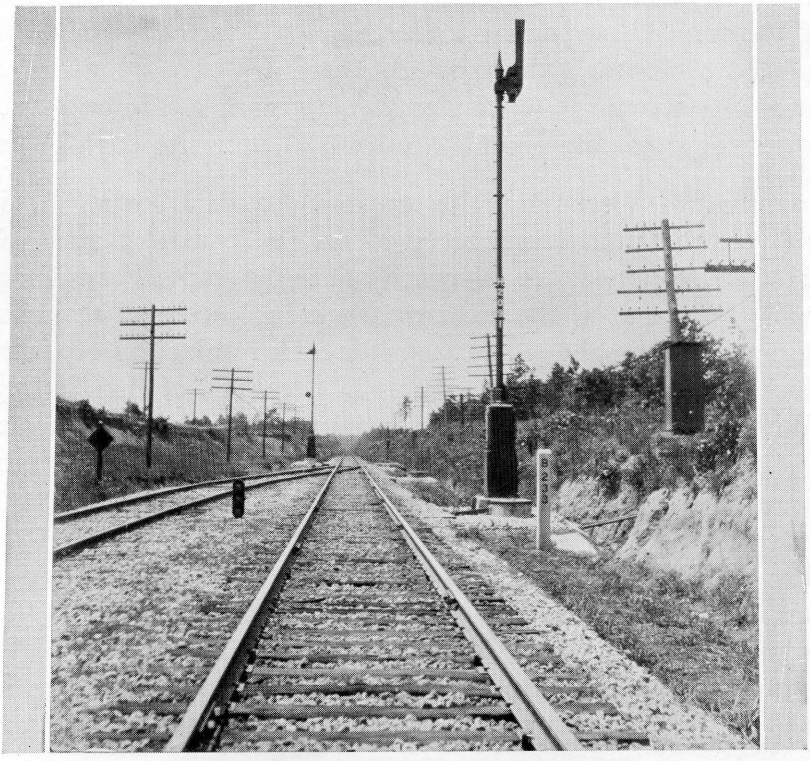
Operation of the System

For the purpose of illustrating the way in which the "Union" Despatcher Controlled Signal System is operated, two opposing trains are shown in the diagrams making a meet at an intermediate siding. A following move, with the second train passing the first at the intermediate siding will also be described. The diagrams show the progress of the trains and the respective positions of the signals in this territory. It will be observed from the diagrams that there is but one pair of intermediate signals between Delmont and Clayton. These signals are staggered; but they may be placed opposite, if desired. As there are two sets of intermediate automatic block signals between Clayton and Andover the opposing signals are located opposite each other.

Before discussing the opposing and following train moves, the indications received on the control board will first be explained. A reference to the diagrams Figs. 1 to 8 will show that there are two track indicators of the spot light type, one above the other for each track circuit located between opposing block signals at each end of each siding. When the track section is unoccupied, the lower or white light is burning. If a train is on this section, the white light is out and the top or red light is lit. Three spot light indicators are used for the signal lever, which is the bottom lever. When the dispatcher has moved the signal lever to the left and no train is on the track section governing the signals controlled by this signal lever, the signal repeater shows green when the signal is clear. In a similar way, the right hand signal repeater light will show green if the move is in the reverse direction or towards the east.

Assume that the signal is clear at one end of a siding for a westward move and the white track indicator and the

proper green signal repeater lights show with the signal lever to the left; when a train enters the track circuit, the white track indicator goes out and the red indicator is lit. The green signal repeater light is also out and the red signal repeater shows red which indicates to the dispatcher that the train has accepted the clear signal, is on the track circuit and that the signal has assumed the stop position. As long as it is normal, the signal repeater will show red.



Signals at the end of Passing Siding

Advantages of the "Union" Dispatcher Controlled Signal System

The "Union" Dispatcher Controlled Signal System for train operation by signal indication calls for immediate action on the part of the engineman when he observes the signal indication. *Train orders call for deferred action on his part.*

A centralization of control over train movements is placed in the hands of the dispatcher—such control is not part of the present train order system.

The dispatcher's work is lightened through the elimination of written orders.

Greater safety of train operation is provided because:

Errors or lapses on the part of the dispatcher or operator will automatically be checked by means of the signal system.

The train crew is not required to remember a number of train orders with a possibility of their contents being forgotten or overlooked.

The dispatcher does not have to depend upon a second party to deliver his orders to a train.

Running time is saved through the dispatcher's ability to transmit orders to the train crew directly by means of signal indications. The use of power operated switches eliminates stops, with a resultant saving.

The dispatcher knows at all times just where the trains are and whether they are losing time or holding to schedule.

The services of operators may be dispensed with at unimportant stations without interfering with the dispatcher's record of train movements because these movements are automatically "OSed" on the Automatic Train Graph.

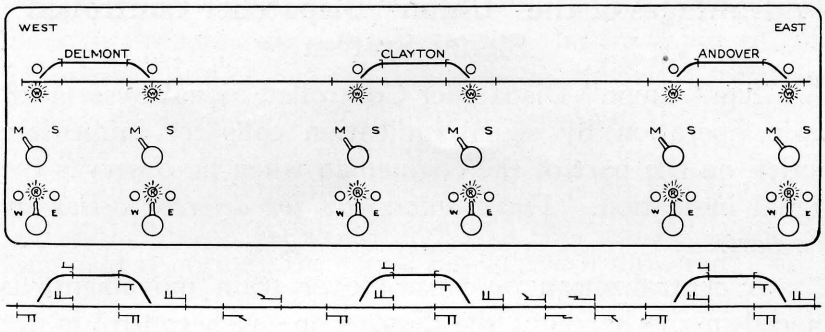


Fig. 9

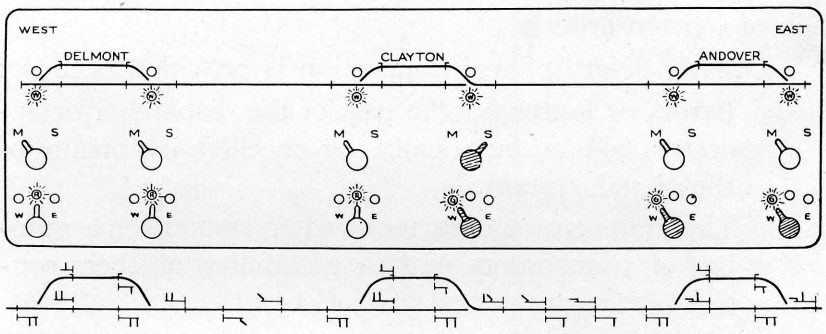


Fig. 10

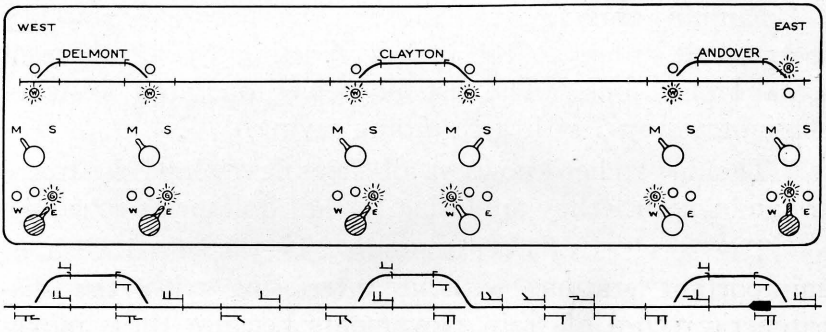


Fig. 11

Line up of Switches and Signals for Opposing Moves

Making an Opposing Move

The opposing move will be described first. Referring to the diagrams, Figs. 9 to 18 the dispatcher has a westward "extra" train approaching Andover and an eastward "time" freight at the next station west of Delmont. From the running time of the eastward "time" freight, the westward "extra" can make Clayton siding in time not to delay the eastward train. The dispatcher accordingly establishes directional control for the westward extra from Andover to Clayton in the following manner:

The switch lever for the switch at the east end of Clayton siding is reversed and the signal levers between Andover and Clayton are set to the left for a westward move. This sets all westward signals between Andover and Clayton at clear except the "take siding" signal at Clayton which assumes the caution position as indicated in Fig. 10. When the signal lever, controlling the signals at the west end of Andover, is turned to the left, all opposing eastward automatic and semi-automatic signals between Andover and Clayton assume the stop position. Directional control has now been established for the westward "extra" train to move from Andover to Clayton.

The dispatcher next proceeds to establish directional control from the west to the east for the eastward "time" freight by moving the signal levers controlling the eastward signals from Delmont to Clayton to the right. When the signal lever, controlling the signal at the east end of Delmont, is turned to the right, all opposing westward signals between Delmont and Clayton assume the "stop" position. When the signal lever, governing the signals at the west end of Clayton, is turned to the right, the top arm of the eastward home signal clears only to the "caution" position be-

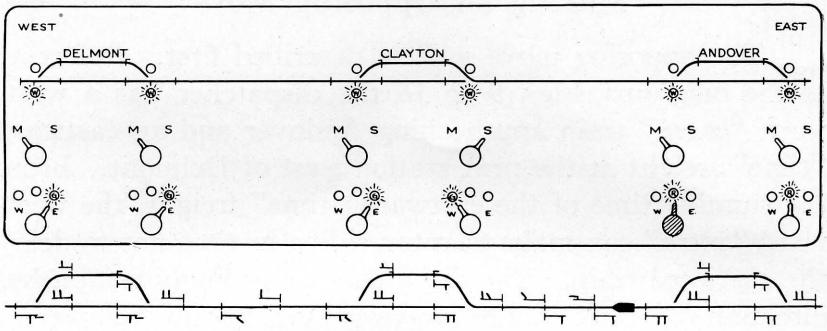


Fig. 12

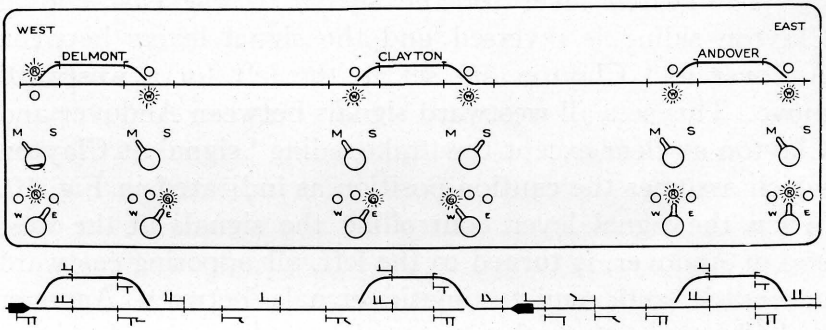


Fig. 13

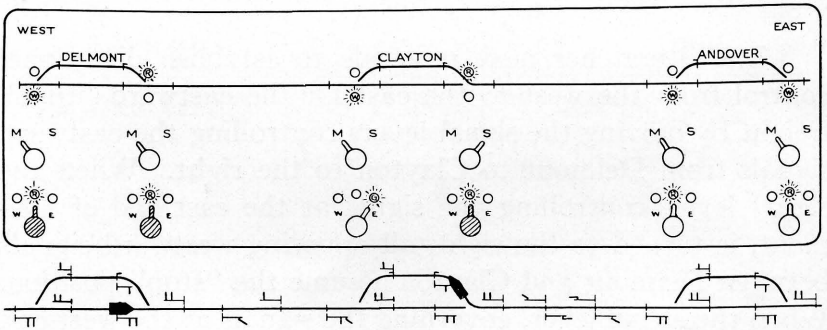


Fig. 14

Line up of Switches and Signals for Opposing Moves

cause the next eastward home signal at the east end of Clayton siding is in the "stop" position due to the switch being lined up for the westward "extra" to take siding at that point. The westward "extra" proceeds to Clayton and into the siding.

In the meantime the eastward freight is approaching Clayton. As soon as the westward "extra" is in the clear this is indicated on the control board by the track indicator changing from red to white. The green signal repeater goes out and the red comes on. The dispatcher then places the signal lever for the east end of Clayton in "center" or "normal" position and operates the switch lever for the east end of Clayton to the normal position, after which he operates the signal lever to the right thus clearing the eastward home signal at the east end of the siding at Clayton. The eastward home signal at the west end of Clayton siding then automatically goes from "caution" to "clear". When the signal lever for the east end of Clayton is operated to the right all opposing signals for a westward move between Andover and Clayton automatically assume the "stop" position. The dispatcher next operates the signal levers, controlling the signals at the westward and eastward end of Andover siding. The line up is now complete for the eastward "time" freight to proceed over the territory.

After the eastward "time" freight has cleared the track section at the west end of Clayton, the dispatcher can then place his signal lever at that point "normal" after which the switch lever is reversed so as to set the switch for a movement from the siding to the main line. The corresponding signal lever then is also turned to the left and the dwarf signal on the siding goes to the "caution" position, indicating to the train crew that the "extra" may proceed westward. At the same time that this signal lever is reversed, all opposing

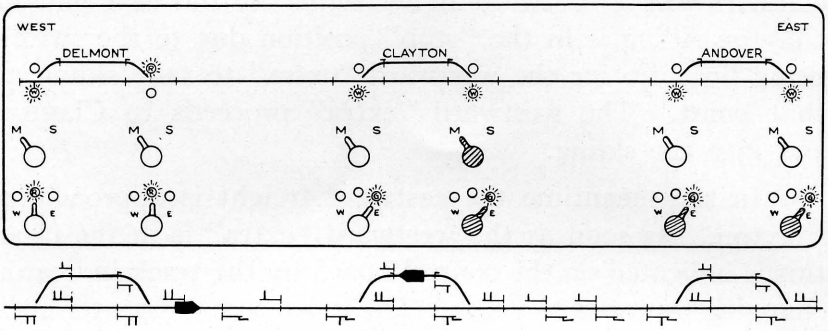


Fig. 15

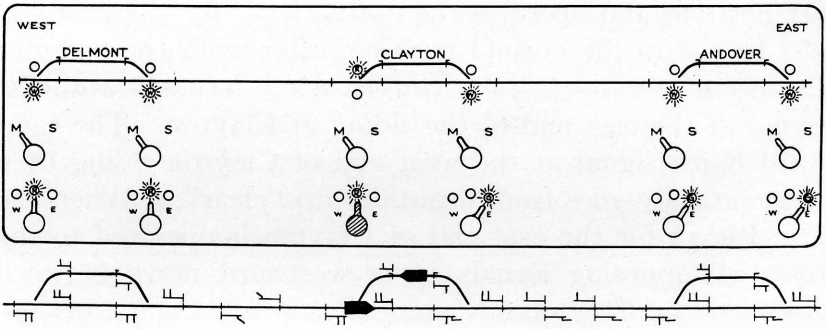


Fig. 16

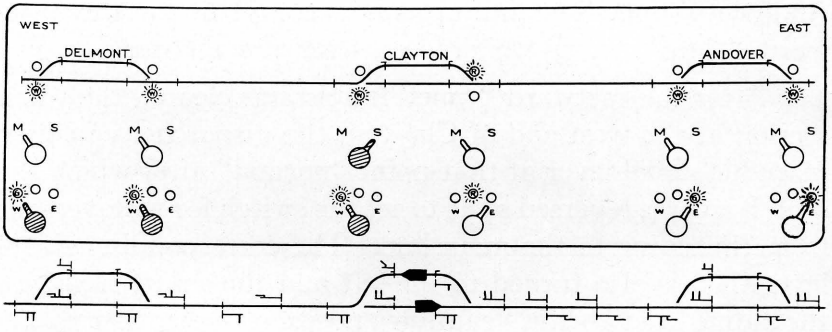
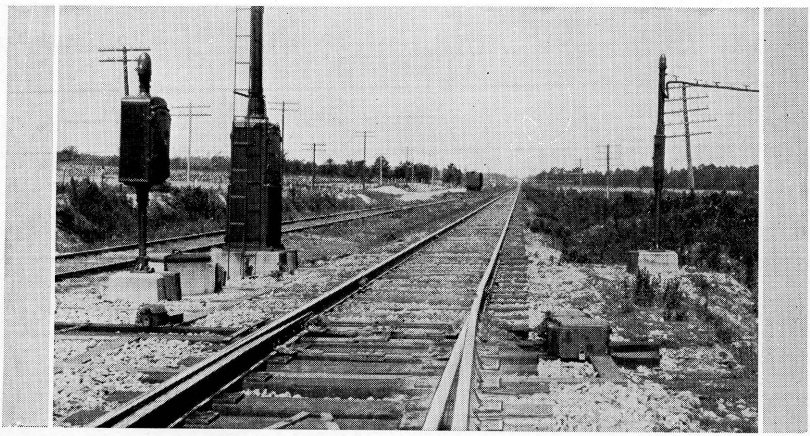


Fig. 17

Line up of Switches and Signals for Opposing Moves

eastward signals between Delmont and Clayton are automatically put to the stop position. The signal lever, controlling the signals at the east end of Delmont, is next turned to the left and also the signal lever for the west end of Delmont is operated to the left, the corresponding westward signal clears and the westward "extra" can proceed by Delmont. The dispatcher can, of course, operate the switch at the west end of Clayton to the normal position for a main line move immediately after the westward "extra" has cleared the track circuit at that point. The signal levers can be restored to their normal position at the pleasure of the dispatcher.



Style M Remotely Controlled Switch Movement at the end of Passing Siding

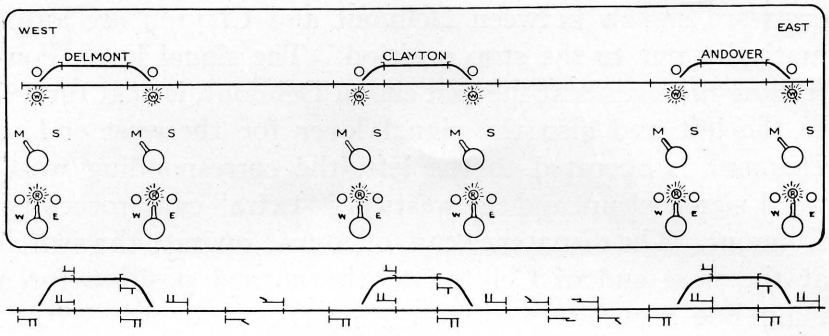


Fig. 18

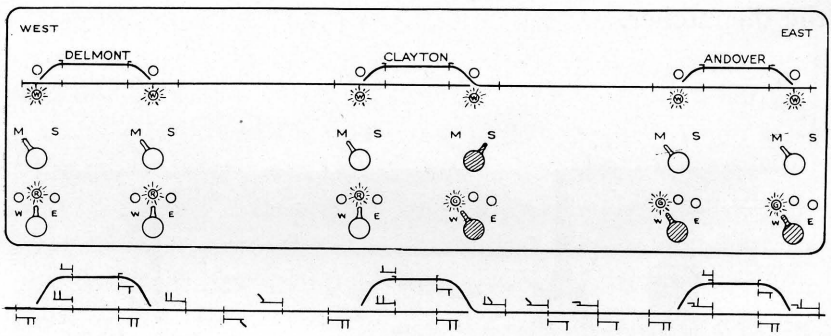


Fig. 19

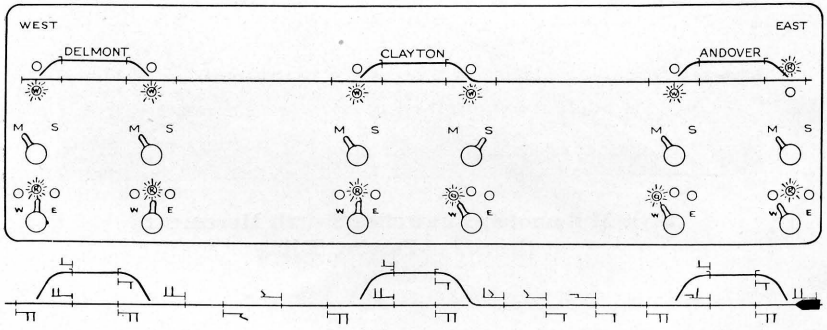


Fig. 20

Line up of Switches and Signals for Following Moves

Making a Following Move

The following move will next be illustrated by means of diagrams, Figs. 18 to 26 showing a westward "extra" proceeding from Andover to Clayton and "taking siding" at Clayton for the following train to pass, after which the westward "extra" then proceeds on its way. The dispatcher accordingly establishes directional control for the westward "extra" from Andover to Clayton as follows:

It is assumed that all signal levers on the control board are normal. The signal levers are operated from their normal position to the left. After the two signal levers at Andover have been operated to the left for the westward move to Clayton, the dispatcher next reverses his switch lever controlling the switch at the east end of Clayton siding, thus lining up the route for the westward "extra" to take siding. The signal lever at the east end of Clayton siding is then operated to the left which causes the lower arm, or "take siding" signal, to move to the "caution" position. As in the description of the opposing move, when the signal lever, controlling the signals at the west end of Andover is turned to the left, all opposing eastward automatic signals and semi-automatic signals assume the "stop" position.

Directional control has now been established for the westward "extra" train to move from Andover into the siding at Clayton. The westward "extra" approaches Andover and its passage over the track circuit at the east end of Andover siding is indicated by means of the track indicators and the signal repeaters on the control board. This train proceeds on and into the siding at Clayton. In the meantime, the following westward "time" freight is approaching Andover. Inasmuch as a following move is taking

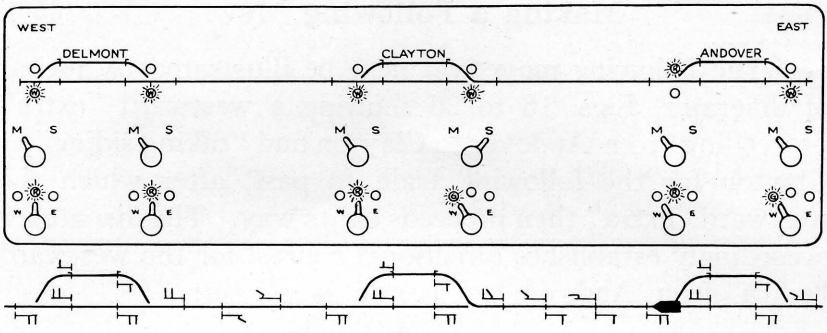


Fig. 21

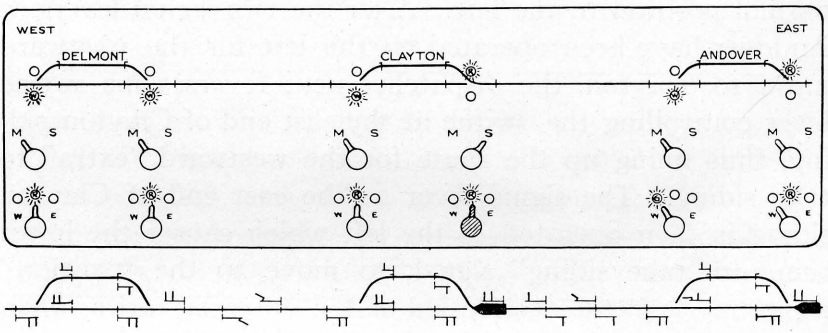


Fig. 22

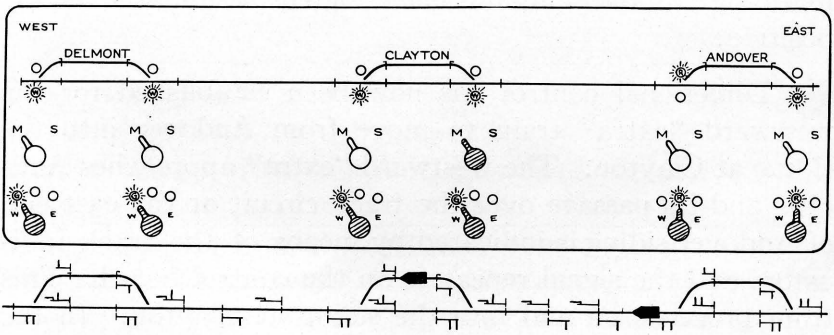


Fig. 23

Line up of Switches and Signals for Following Moves

place, it is unnecessary for the dispatcher to move his signal levers from their position for the first train movement, as all signals will clear up automatically for the following train at the proper time, as the first train passes over the territory.

After the first train has entered the siding at Clayton, which is indicated by means of the track indicators on the control board, the dispatcher next places his signal lever, governing the signals at the east end of Clayton siding, in the normal position. The next move is to restore the switch lever from the siding position to the main line, after which the signal lever is again operated to the left, which, in turn, will cause the westward main line home signal to go to the "caution" position. The signal lever, controlling the signals at the west end of Clayton siding is then operated to the left for the westward move, and when the main line signal at this location clears to the "caution" or "clear" position, the westward home signal at the east end of the siding will then go from the "caution" to the "clear" position. When the signal lever, controlling the signals at the west end of Clayton siding, is operated for the westward move, this automatically sets to "stop" all opposing eastward signals between Delmont and Clayton. The signal levers at Delmont are next operated to the left and directional control is thus established through this territory for the following westward "time" freight to proceed.

After the "time" freight has passed the west end of Clayton siding, the dispatcher then places the signal lever for the corresponding location into its normal position, reverses his switch lever and again operates his signal lever to allow the westward "extra" to come out of the siding and proceed. After the westward "extra" has cleared the track section at the west end of Clayton siding, the signal lever, having previously been restored to normal, the switch lever

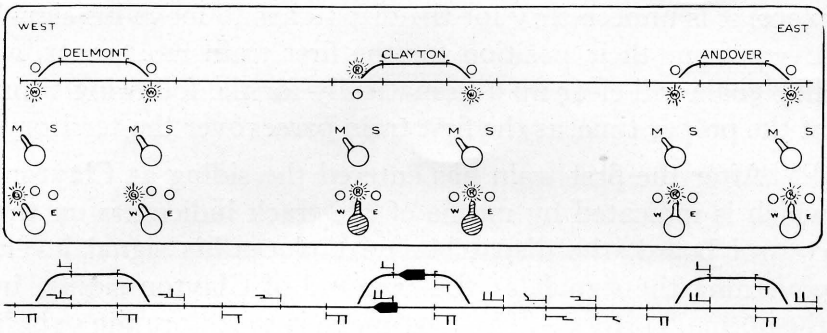


Fig. 24

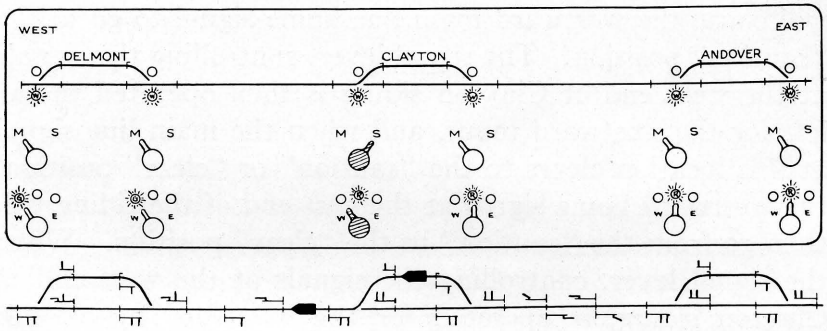


Fig. 25

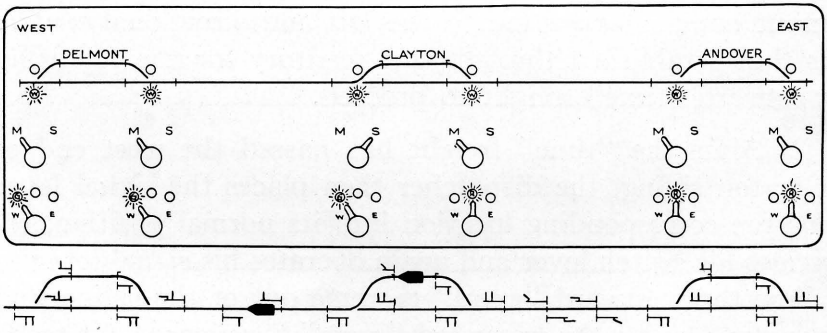


Fig. 26

Line up of Switches and Signals for Following Moves

is operated to line up the switch for main line movements. After the trains have proceeded out of the territory or after they pass the respective ends of the passing sidings, the dispatcher may restore his signal levers to their normal position preparatory to other moves.

In describing the operation of the levers on the control panel for the foregoing moves the most natural sequence has been followed. However, this sequence may be varied at the whim of the operator. However, in order to make a move from a siding to the main line or from the main line to the siding after the main line route has been set up, it is necessary first to place the signal lever normal before reversing the switch lever.

Principles of Train Dispatching

J. J. Turner in his book on "The Telegraph as Applied to Train Movement," set forth years ago very clearly the principles of train dispatching. These principles very fully cover the present method of train operation, and in order to illustrate the advantages of the "Union" Dispatcher Controlled Signal System, the following comparisons are itemized:

Present Method	How the "Union" System Functions
"*First.* That to prevent conflicting instructions and to insure safety, no more than one man can dispatch trains on the same track at the same time."—Complied with by a rule to that effect.	*First.* Conflicting instructions cannot be issued or occur as no intermediate person is involved in taking and delivering orders.
"*Second.* That the dispatcher be kept fully advised of all delays, present or prospective, and the position of every train on the road."—Complied with by reports from stations and terminals.	*Second.* Dispatcher is kept fully advised of all delays and the location of every train on the division by means of the Automatic Train Graph.
"*Third.* That orders must be so clearly expressed as to render a misunderstanding of their meaning impossible." — Complied with by the use of rules and forms of the standard code.	*Third.* The orders, as given by signal indication, are clearly expressed by means of a few simple indications.
"*Fourth.* That the dispatcher must know that they are in the hands of some reliable party for delivery."—Complied with by the acknowledgment of the operator giving his initials and office call.	*Fourth.* No second party is required to deliver orders.

Present Method	How the "Union" System Functions
"*Fifth.* That it is as near certain as anything human can be, that the party who is to deliver them will stop the train to which they are addressed."—Complied with at each train order office, by the use of a fixed signal which shall indicate "stop" when trains are to stop for train orders.	*Fifth.* The functioning of the signals are much more accurate than when the human element is present, inasmuch as but one thing is expected of the signals.
"*Sixth.* That when delivered to trainmen, they read just as they did when sent by the dispatcher."—Complied with by the receiving operator, who repeats the completed order to the dispatcher for verification.	*Sixth.* The orders received from signal indications are read in line with the action desired by the dispatcher.
"*Seventh.* That the instructions given to both trains are identical."—Complied with by the use of the duplicate order system.	*Seventh.* The instructions given by signals are checked by the track circuit.
"*Eighth.* That the train whose rights are extended must not be moved against the train whose rights are curtailed, without notice to the latter."—Complied with by sending the order first to the train whose right is restricted before completing the order to the train whose right is extended.	*Eighth.* A train, whose rights are extended, may be moved against a train whose rights are curtailed without notice to the latter.

Present Method	How the "Union" System Functions
"*Ninth.* That men who are to act upon orders, acknowledge their receipt."—Complied with by rules relating to "31" and "19" orders.	*Ninth.* Train crews, acting upon signal indications automatically acknowledge receipt of order by means of the Automatic Train Graph.
"*Tenth.* That men using them know that they are doing so with the full knowledge and authority of the dispatcher."—Complied with by the response "correct" from the train dispatcher.	*Tenth.* The train crews, accepting the signal indications, know that they are doing so with full authority of the dispatcher.
"*Eleventh.* That trains running against other trains under special orders must be able to recognize each other."—Complied with by giving the number of the engine of every train mentioned in the order, or by train number indicators.	*Eleventh.* Trains running against other trains will not cause harm in case of failure to recognize each other, as the signal indication is their authority at all times to proceed, stop or take siding.
"*Twelfth.* That a complete record be kept of each transaction."—Complied with by use of the dispatcher's order book.	*Twelfth.* A complete, permanent record is kept of each train move by means of the Automatic Train Graph.

Economics of Remotely Controlled Switch

The Economics Committee of the A. R. A. (Signal Section) show that the average annual saving made by the installation of remotely controlled switches is $6787, as determined from 84 installations on 17 railways. In the "Union" Dispatcher Controlled Signal System, remotely operated switches together with their attendant signals, fit in naturally, and afford an opportunity for reaping greater benefits than have been obtained in scattered, isolated installations. Dispatcher control, in a sense, consolidates the control of all of the outlying switches, thus eliminating considerable controlling equipment with assurance of the same degree of precision in operation.

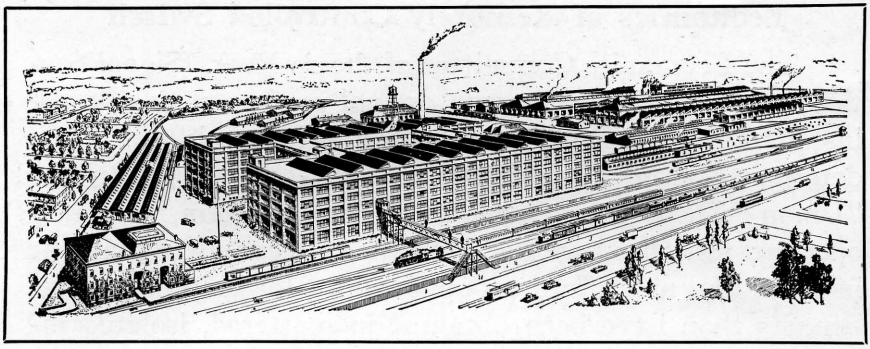
In Conclusion

Two wires are all that are needed to control a number of the passing siding switches and signals, normally included in what is termed the "Union" Dispatcher Controlled Signal System. These same two wires provide for:

1. The control of all signals at the passing sidings;
2. The control of passing siding switches and derails;
3. A means of illuminating the track indicators to show occupancy or non-occupancy of track circuits at passing sidings;
4. Reception of light indications above signal levers to show whether corresponding signals are "clear" or at "danger"

These two wires make the control board, in effect, an animated model which shows the dispatcher at a glance what the conditions are, over the entire section controlled.

The engineers of this Company will gladly make a study of your operating conditions and make a report without obligation on your part.



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