Centralised Traffic Control

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Automatic equipment on railways has in recent years become more and more extensive, both for ensuring safety in traffic and reducing the cost of operation; for many years level crossings and such places have been protected by warning signals, and use has been made of automatic line blocking, etc. The strong competition which railways have to meet from motor transport has compelled railway authorities to direct more and more attention to measures which, while reducing operating costs, do not in any way neglect the demand for safety. A factor in these efforts to bring down operating costs while maintaining safety is provided by the centralised traffic control developed by L.M. Ericssons Signalaktiebolag and known as the CTL system.

The CTL system provides for ordering the tracks and operating the signals for the control of train traffic from a central office where a control operator is stationed, without the addition of blocking in the accepted sense of the term, *i. e.*, an interlocking of points and signals and of the signals between themselves. This interlocking is carried on as at present by the interlocking plant and the automatic line blocking.

With the CTL system the control operator can get into connection with any desired station along the controlled track section and operate the devices for regulation of traffic within that station area, movements of points, signals, etc. The control operator receives indications of the positions of trains along the line as also of the setting of the points and signals, on an illuminated diagram which has small lamps which light up and go out on the stretch of track there reproduced. At the central office a responsible control operator is stationed. It is his duty to operate and control the traffic on the line concerned. This is done from a central control board by operation of control switches mounted on the board, each switch when turned actuating the various devices in the CTL unit connected with it. Combined with the control switches are order lamps which indicate the last order dispatched. The control operator can follow on the illuminated diagram all train movements on the tracks, check the positions of the points, the setting of signals, etc. Immediately there is any change in a train's position, etc. indication of same immediately goes in to the control operator. If required, the installation can be supplemented by an apparatus which automatically records the times during which trains occupy the different sections.

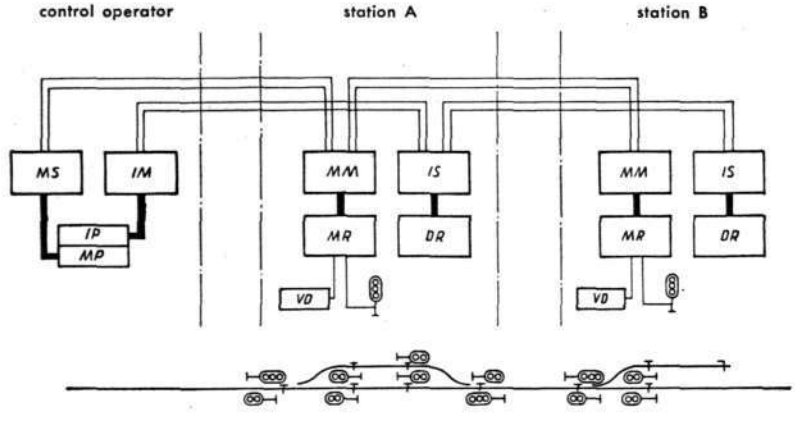

Fig. 1 X 5284

Diagram for centralised traffic control, CTL system

DR operating relays
IM indication-code receiver
P illuminated diagram
IS indication-code transmitter
MM order-codereceiver
MP order panel
MR operating relays
MS order-code transmitter
VD point machine

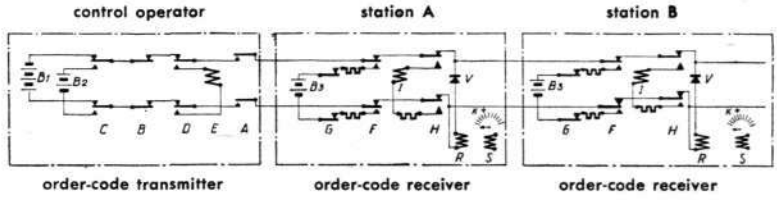

Fig. 2
Order circuit diagram

X 5285

Ordinary telephone lines — overhead or cable — are used for the transmission of signals. Along the line two wires are required for order giving and two for indication, only four wires in all. The system is built up of constructive parts such as are employed by Telefonaktiebolaget L. M. Ericsson in their different automatic telephone systems. The devices used have all proved their reliability and safety in actual practice. To a great extent therefore this system constitutes an application to railway signalling of the knowledge and experience already gained in automatic telephony.

Under normal circumstances, *i. e.*, when employing ordinary telephone cable for the transmission of signals, it should be quite possible to operate up to 20 CTL units distributed over a distance of 30 km from the central office. By special measures, such as raising the operating tension or improving line resistance and leakage resistance, it is possible to extend the above distance considerably.

To control a station with only one siding normally requires only one CTL unit, while for larger railway stations with a number of tracks and points several CTL units are required to handle traffic; to operate crossing gates along the line, for example, one CTL unit is required at each level crossing. Fig. 1 is a diagram of an installation on the CTL system. Two railway stations are controlled from the central office. At the central office there is a control board consisting of an order panel and an indication board, an order-code transmitter and an indication-code receiver. At the stations order-code receivers and indications-code transmitters are mounted. The former are connected to operating relays for the point machines, signals, etc. The indication-code transmitters are connected to track relays, point-indication relays and other devices whose position is to be shown on the track diagram.

Order Circuit

The circuit for order-code transmission is shown on Fig. 2. When an order is to be transmitted, the circuit is connected to the order-code transmitter over contacts *A*. The circuit receives tension and all the relays *R* along the circuit are energised. Over contacts *B* a number of impulses corresponding to the number of the wanted CTL unit is transmitted. The relays *R* receive the impulses transmitted and energise the selectors *S* in such a way that these move forward as many steps as the number of impulses transmitted. The contact positions on the different selectors are so arranged that contact-making occurs for different numbers of impulses at the different stations. After the completion of the impulse series there is a switching over in the order-code transmitter, whereupon the impulse receiving relay *E* is connected over the contacts *D* to the circuit. The order-code receiver whose selector stopped at the marked contact position is connected to the circuit. All

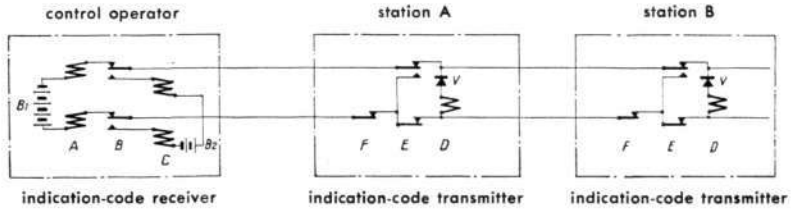

Fig. 3
Indication circuit diagram

X 5286

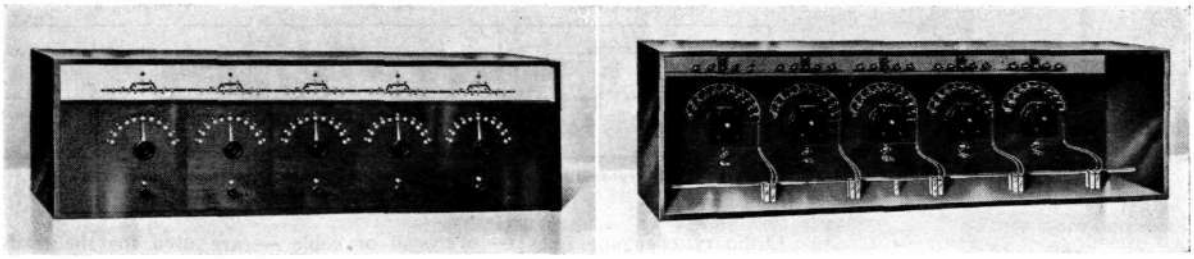

Fig. 4 X 7094
Central order board for centralised traffic control

other code receivers are disconnected. The impulse contacts G are connected to the circuit over contacts F. A control series of impulses is transmitted to the order-code transmitter and is received by relay E. The electric rectifiers V are connected in series with the relays R. These rectifiers prevent the relays R from being energised by the various series of impulses. When the transmitted and received impulse series agree it is an indication that the right station is connected. The contacts C have prepared for connection of battery B_2 in place of battery B_1. When the control impulse series is finished, battery B_3 is disconnected from the order-code receiver and the impulse-receiving relay I is connected over contacts H. Relay E is disconnected from the order-code transmitter and instead of it battery B_2 is connected in the circuit. A number of impulses is transmitted over contact B and received by relay I. The size of the impulse series over contacts B indicates what change is required at the station. When the impulse series has been received, a switching takes place both on the order-code transmitter and on the order-code receiver, whereupon a control impulse series, not shown on the diagram, is again sent. When this control series has been transmitted the order for the required signal or point movement may be sent. If the control impulse series received agrees with the order impulse series transmitted then an order lamp corresponding to the order lights up, and both transmitter and receiver are restored to original positions ready to deal with a new order. Should the order and control series transmitted not agree, then the order lamp does not light up, but an alarm signal is received, both audible and visible. The visible signal indicates the CTL unit to which the defective order has gone and facilitates fault finding.

Indication Circuit

The line connection of the indication circuit is seen on Fig. 3. When the system is idle all the relays D along the circuit are attracted by current from battery B_1. Relay A, which has a very low resistance as compared with relays D, does not attract for the supervisory current flowing through these latter relays. If there occurs a change which is to be communicated to the central office, the indication-code transmitter for the apparatus affected by the change comes into operation, provided that the circuit is not busy with another indication, *i. e.*, provided relay D is energised. If the circuit is free when the change occurs, the current to relays D, for that transmitter and those lying behind it, is cut off and the relays are de-energised. At the same time the relays D of transmitters in front are short-circuited and call is made to the indication-code receiver by relay A which then connects instead the impulse-receiver relay C to the circuit over the contacts B. Relay C is connected to battery B_2 so that the current in the circuit becomes the reverse of the normal supervisory current. From the indication-code transmitter there is transmitted over contact F a number of impulses corresponding to the transmitter's number, and these are received by impulse receiving relay C and recorded. Thereupon the indication-code transmitter tests the position of all apparatus connected to it and transmits information about same to the indication-code receiver. The markings on the track diagram change to agree with the incoming indications. After that the indication-code transmitter

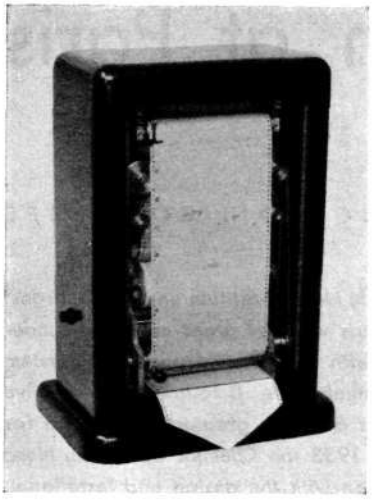

Fig. 5 X 3334
Apparatus for automatic train recording

and the indication-code receiver are restored to original position and all the relays *D* are again energised. The devices are then once more ready to record a new change of position along the line.

Central Order Board

The central board consists of an order panel and a track diagram, see Fig. 4. Numbers of order switches, press buttons and lamps are mounted on the order panel. For each order unit there is a switch with the requisite order lamps, a fault lamp and a starting switch. A number of switchings can be carried out by the order switches and each switching represents a change required at the unit concerned. The order lamps at the order switches indicate the switchings last made. The starting key below each order switch is used to start the transmission of an order code. The fault lamp indicates that an incomplete or defective order-code transmission has taken place and facilitates the localising of the fault. The order panel is moreover provided with two lamps, one of which lights when order-code transmission is going on and the other when indication-code is coming in. To economise current there is a switch to cut off current to all signal lamps on the central board during that part of the day when supervision is not required. Another switch is used to clear the blocking of the order-code transmitter arising in conjunction with the lighting up of a fault lamp. The audible signals obtained in connection with fault signal are also stopped by this press button.

On the track diagram there is a miniature lay-out of the track stretch which is operated from the central order board. All the important track sections and other devices along the line which require supervision are marked on the diagram by small lamps. The lamps indicate whether rolling stock is on the track sections concerned, as also the position of the apparatus they represent.

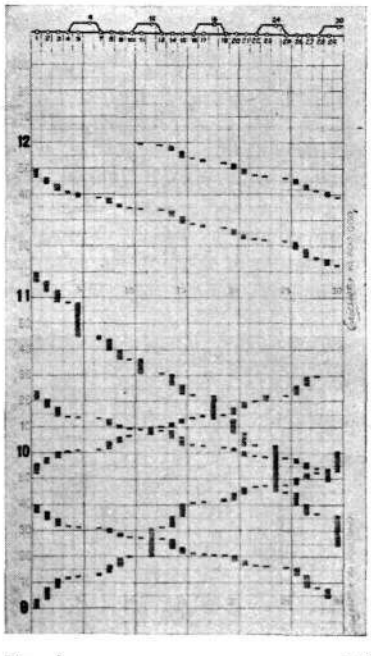

Fig. 6 X 8576
Train movements record

The relays, selectors and condensers required for order-code transmission and indicating-code receiving are mounted on a steel rack which is enclosed in a frame and provided with lockable apertures which close dust-tight to the frame. The order-code receiver and the indicating-code transmitter are made as separate units. Each unit consists of a relay rack in a wood cabinet with lock, which is fixed on the wall. The relay rack in the cabinet can be swung out, making both back and front easily accessible. Both central order board and relay rack are delivered ready connected up and tested, so that only local connections require to be made.

Power supply required for these devices consists of 24 V batteries. A current feed of about 100 V is employed, both for the selection of the stations when transmitting order-code and for supervisory current on the indication circuit.

Automatic Train Recording

An important accessory to the system described above is the automatic train movement recorder. For this a special apparatus, Fig. 5, is used, which registers on a paper strip running at a fixed speed how long a train occupies the different track sections. This automatic record of the movements of trains is of great utility to the control operator. If delay occurs it is immediately apparent on the diagram, see Fig. 6, and the control operator can take any measures necessary.