L M Ericsson's Traingraph

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L M Ericsson's C.T.C. system was described in an article in Ericsson Review No. 4, 1954. One of the items of indicating equipment referred to in a C.T.C. office was the traingraph. The present article deals with L M Ericsson's traingraph, which admittedly was designed primarily for use with C.T.C. but can also be employed for the recording of train movements in other connections.

Introductory Remarks

The recording of train arrival and departure times at the various stations is considered a necessity in most forms of railway operation. The usual method of recording is to make a written note of "Train Arrived" and "Train Left" in the station's trainbook and, where a train despatcher's office exists, of delays, laying on and cancellation of trains etc. on graphic time tables. These records form a general part of the safety program and are an aid to train despatchers. They also enable conclusions to be drawn regarding the regularity of train movements.

When a railroad is equipped with centralized traffic control–which implies that all orders to trains are given by signals which, like the rest of the signalling system, are remote controlled and indicated in a C.T.C. office—the need still exists for recording of train movements. In fact, the need may even be said to be greater, since the C.T.C. operator requires not only a visual picture of the present positions of trains but must also have a knowledge of train movements during the hours immediately preceding—not to mention movements that are planned for the hours that follow. This visual picture of present train positions is obtained on the C.T.C. indication panel. Recording of train movements could, of course, be done by hand, but this would obviously be extremely impractical. Nor would manual recording give

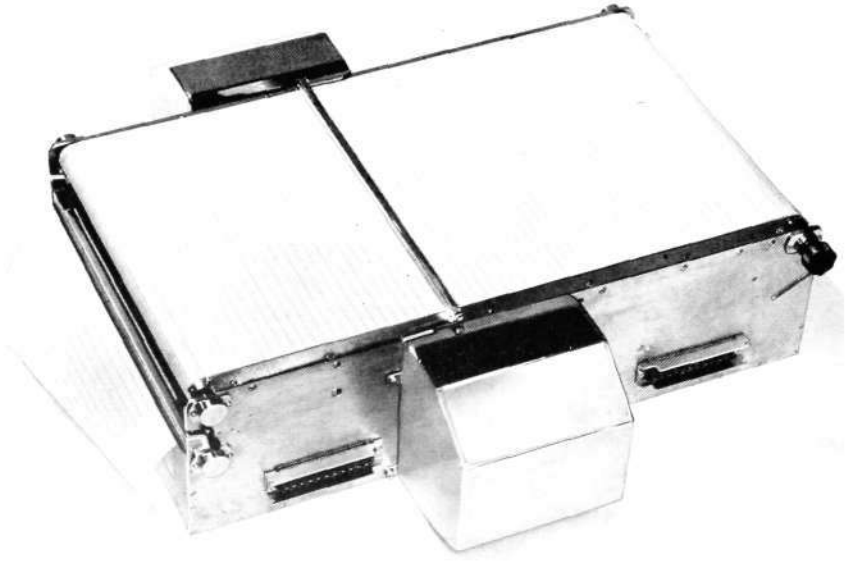


Fig. 1 X 6966

L M Ericsson's traingraph with guide and driving rolls at ends, colour ribbons in magazines under covers on the sides, and a rule running between the covers.

The chart, which runs from right to left, is 352 mm wide

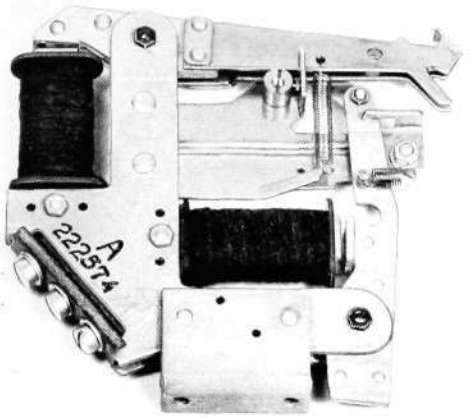


Fig. 2 X 2134

Stamping unit with two hammers (top right) and two control coils

the clear picture that is needed in the C.T.C. office. Fortunately, the data normally received in the C.T.C. office can simultaneously be utilized for automatic recording of train movements in a simple way by means of a traingraph. An apparatus of this kind, designed by L M Ericsson, has a number of new features that should prove of great value under operating conditions.

It should be emphasized that the use of a traingraph is not limited to the recording of train movements in conjunction with C.T.C. It can be used for recording the passage of trains at single or a number of consecutive stations, provided that line wires exist between the traingraph and the respective stations. Nor, of course, is it necessary that the impulses to the traingraph should come from track circuits. Any form of device that can give a remote indication of the passage of trains can be used equally well.

Description of Traingraph

The dimensions of L M Ericsson's traingraph are: length 660 mm, width 640 mm and height 182 mm (fig. 1). The width of the chart is 352 mm.

The traingraph consists of an aluminium frame in which are mounted rolls, magazines and feed mechanism for the chart, electromagnetic stamps, and arrangements for feeding the colour ribbons and changing from one colour to another. An impulse generator and one or more relay sets are required for operation of the traingraph.

Chart Feed

The chart is carried across the traingraph from a magazine on the right-hand side via a number of guide and driving rolls. The upper rolls are equipped with teeth which coincide with the perforations along the edge of the chart. The right-hand roll is driven from an impulse motor which, in normal coupling, gives the roll a peripheral speed of exactly 1 mm per min. The left-hand roll rotates freely. The chart thereafter runs between two rolls, of which one rotates freely and the other is driven from an impulse motor which normally gives the roll a peripheral speed of 3 mm per min. The chart is thereby held under tension across the recording surface of the traingraph with a force of about 200 p. If the chart should curl up, the slack is quickly taken up by the rapidly rotating left-hand rolls. The paper may tend to bend up when an adjustment is made in the timing of the chart by means of the knob on the right-hand roll, or if the normal tension of the chart is disturbed—by its being temporarily pressed against the recording surface, as in the writing of notes. Two springs, which press the paper against the roll at the right-hand end of the traingraph, thereby prevent it from sliding over the guide pin on the roll.

The chart magazine is secured in such a way that the perforations are kept in the proper position relative to the guide tooth of the feed roll, even if the width of the paper should extend by up to 3 mm owing to an increase in humidity.

Station Designations etc.

Immediately under the chart are two white enamelled cover plates–one to the left and one to the right of a *rule* which serves as countercheck for the hammers. The cover plates are marked with the designations of the stations in the form of black lines and letters. The station designations can be read through the transparent chart. The rule, which is made to fold up, is placed so that the visible stamped portion of paper on the left of the rule represents the four preceding hours and the unstamped paper on its right the six succeeding hours.

To facilitate the reading of the timing of the chart, a red arrow is marked on the cover plate 60 mm to the left of the rule at the perforated edge of the chart. The chart should thus be adjusted so that the red arrow is exactly opposite a point on the paper which–at normal paper speeds–is precisely 1 hour in advance of the stamping time.

Stamping

Stamping is done with electromagnetic stamps of the type that has been used in L M Ericsson's centralographs for many years (fig. 2). Every stamping unit comprises two hammers, each with its control coil. The traingraph can be equipped with a maximum of 56 stamping units, and thus 112 hammers.

The stamping units are placed on rails across the traingraph under the cover plates and opposite the rule (fig. 3). Thus stamping is done on the underside of the chart but is readily visible on its upper side.

Feed of Colour Ribbons and Change of Colour

The colour ribbon in the traingraph is fed automatically forwards and backwards between two magazines placed on the sides of the traingraph. The magazines are continuously driven, each by its impulse motor, in a direction such that both magazines tend to wind up the ribbon. The transmission between the motor and each magazine includes a friction clutch. One or the other of these friction clutches is replaced by a fixed coupling and the change-over takes place when a magazine has become full. The magazine that is coupled to the motor at that time via the friction clutch slips and so causes the ribbon to be kept under proper tension.

The ribbon magazines and their reeling arrangements (fig. 4) are placed on the ends of a spindle running straight through the traingraph. The energization of a colour-change magnet causes the spindle to rotate through a few degrees; the spindle is restored to normal by a helical spring. The rotation of the spindle causes the ribbon to be moved sideways across the hammers of the stamping units. If a two-colour ribbon is used, the same hammer can be employed for stamping with the two colours alternately.

The ribbon does not run parallel with the row of hammers, but slightly oblique to it. By this means the entire width of the ribbon is utilized.

Care and Maintenance

Normal care and maintenance of the traingraph comprises changing of charts and ribbons and certain lubrication.

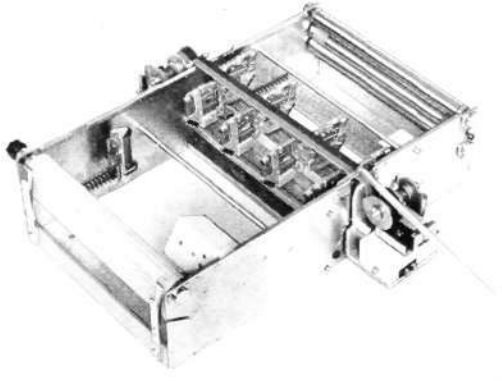


Fig. 3 X 2135

The stamping units are placed on rails across the timegraph. In the illustration only eight stamping units are mounted.

One reel contains about 47 metres of paper which–at a normal paper speed of 1 mm per min.—suffices for one month of continuous operation. Change of paper is done by folding up the rule, turning the spring arms on the right-hand toothed roll downwards towards one another, and removing the right-hand magazine and the centre roll on the left. After a new chart has been inserted in the magazine and the traingraph has been reassembled, the fine adjustment of the timing of the chart is effected by rotating the right-hand toothed roll and possibly the left-hand centre roll as well.

Since the wear on ribbon is proportional to the frequency of stamping, which in turn is dependent on the number of hammers and the headway, it cannot be stated definitely how often ribbons should be changed. Even with the maximum number of hammers and close headways, however, it should not be necessary to change more often than roughly every third month, when operating at normal paper speed. To change a ribbon, the rule is folded

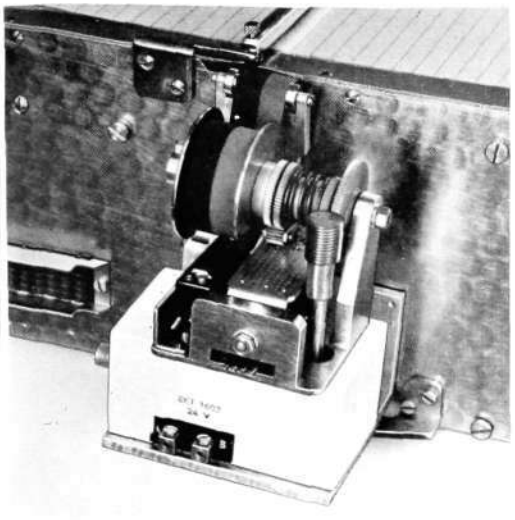


Fig. 4 X 2136

The colour ribbon magazines, which are driven from impulse motors, are mounted on the ends of the spindle. The spindle can be revolved a few degrees, so that either the red or the blue part of the ribbon comes above the hammers.

up and the magazine covers are removed, after which the magazines can be released. Change of ribbon is best done in connection with the insertion of a new chart.

Every third year, and preferably in conjunction with the changing of a ribbon, the worm gears of the colour-change mechanisms should be cleaned and oiled.

Impulse Generator and Relay Set

The impulse motors of the traingraph are driven by external impulses. At normal paper speeds one impulse per second is required, which is supplied from an impulse generator, for example an L M Ericsson master clock.

If there is a master clock installation providing second impulses in the vicinity of the C.T.C. office or other position at which the traingraph is installed, the impulses can be utilized for the traingraph. If a master clock installation only provides minute impulses, it can be arranged that the impulse transmitter of the traingraph is automatically regulated by the master clock installation. If a higher paper speed than normal is desired, the impulse frequency should be increased by means of an intermediate relay set.

To avoid exactly simultaneous stamping by too many hammers, which would place too heavy a load on the relay contacts, the incoming stamping impulses are stored in the relay set and spaced in time so that a maximum of five hammers strike simultaneously. When using two-colour ribbon, the relay set must also ensure that stamping takes place during the correct colour period. At normal paper speeds the colour is changed every fifteenth second.

Accuracy of Stamping etc.

At normal paper speeds–1 mm per minute–the interval between two stampings with the same colour is about 30 secs. (The interval may vary between 15 and 45 secs. owing to the spacing in time described in the preceding paragraph.) This accuracy of time indication should be entirely satisfactory for practical purposes. In fact, when employed with C.T.C., a higher accuracy would be pointless in view of the fact that the impulses from the line may be delayed owing to the line being busy. Such delays should admittedly not be more than a few seconds in normal cases, but may occasionally amount to as much as half a minute. The normal paper speed should be suitable for all kinds of railroad traffic, even with very close headways. Headways up to 10–15 trains per hour and direction will thus be clearly recorded.

If the traingraph is used on suburban underground railways, where the headway may be as close as 40 trains per hour, the paper speed must be trebled or quadrupled. A higher accuracy in time indication will likewise be required, and at the increased speed of recording the accuracy will rise proportionately.

Irrespective of the paper speed, the stamping on the chart will be so clear and so "continuous" that the resulting graphic train movement diagrams need not in any way be supplemented by pencil notes or the like.

The best way of using the two colours of the traingraph is to reserve a given colour for a given track. On a single-track line all stampings between stations will then be blue (or all red). Trains passing stations on the main

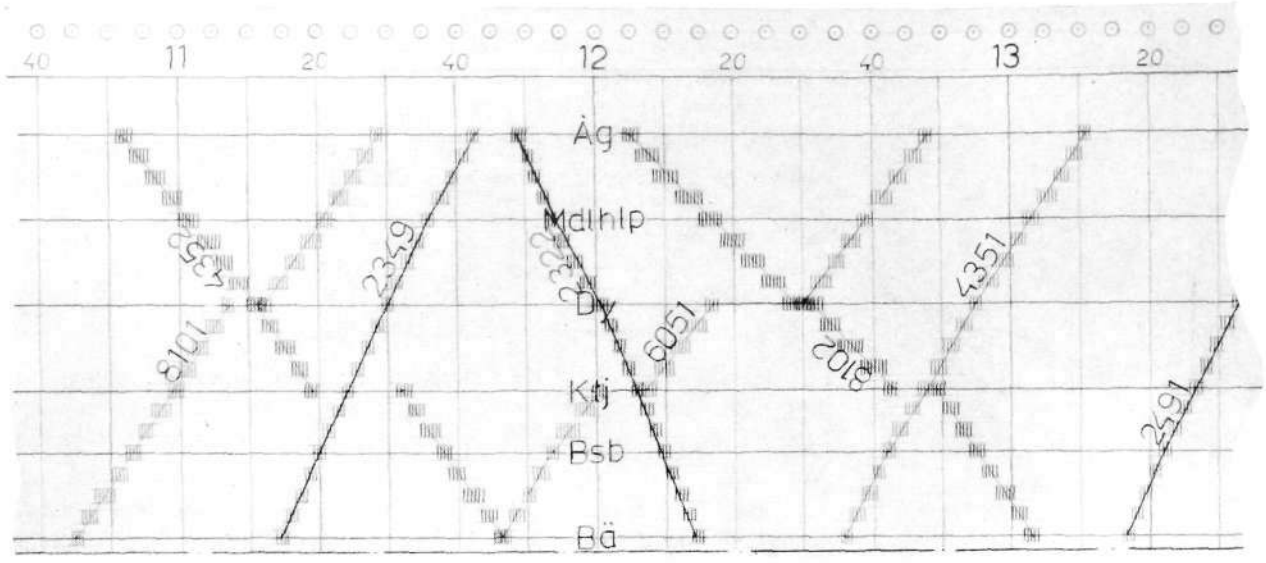


Fig. 5 X 7693

Section of traingraph chart from single track operation.

The graphic time table is pre-printed on the paper

Fig. 6 X 7694

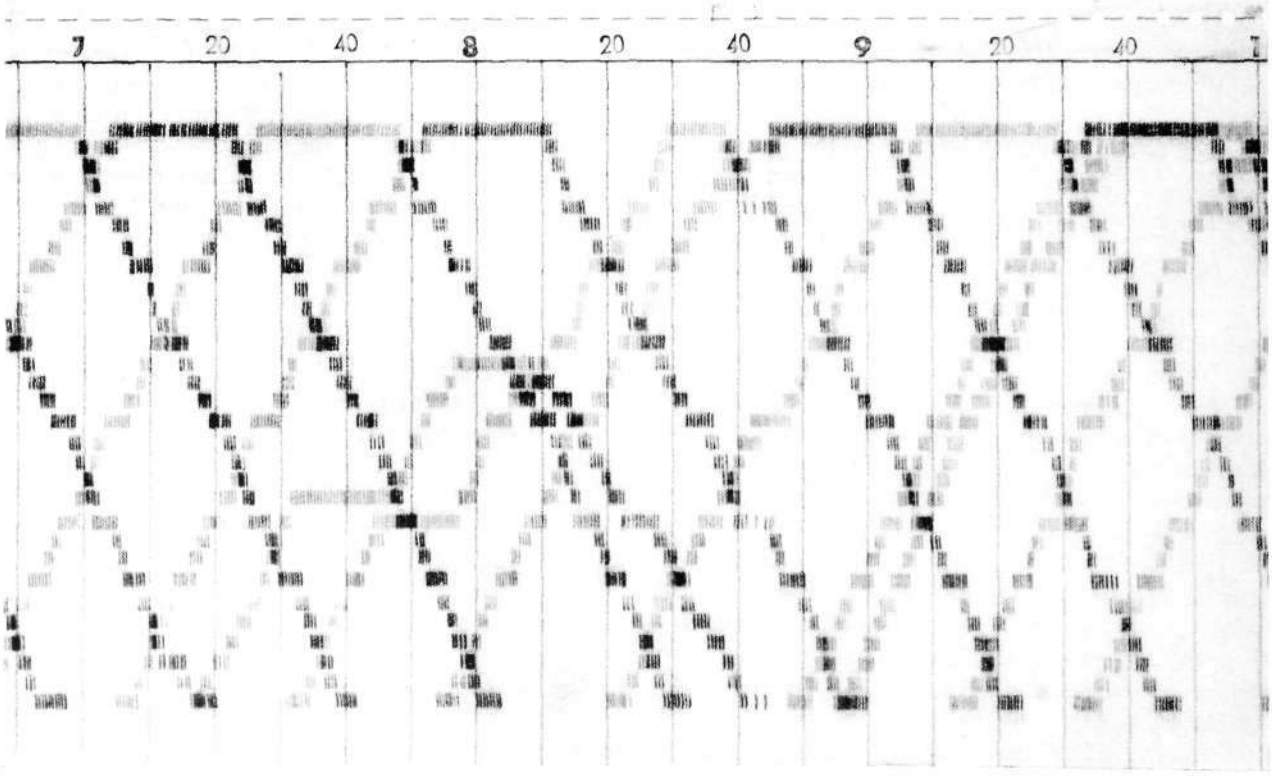
Section of traingraph chart from double-track operation.

The chart is not pre-printed. Train passages on one track are stamped in red (the faint marks on the photograph) and on the other track in blue.

route will be stamped in blue, and on the siding in red, whereas passages over other tracks will not be stamped at all. For single tracks the traingraphs can be coupled to a maximum of 112 passage transmitting devices (fig. 5).

On double-track lines the passage of trains may be marked in blue on one track and in red on the other. Trains passing over stations' sidings are not recorded. On a double-track line the traingraph can be coupled to a maximum of 224 passage transmitting devices (figs. 6 and 7).

If desired, a colour can be used to indicate direction of movement instead of track. Directional relays are employed to ensure that the stamping takes place during the correct colour period.



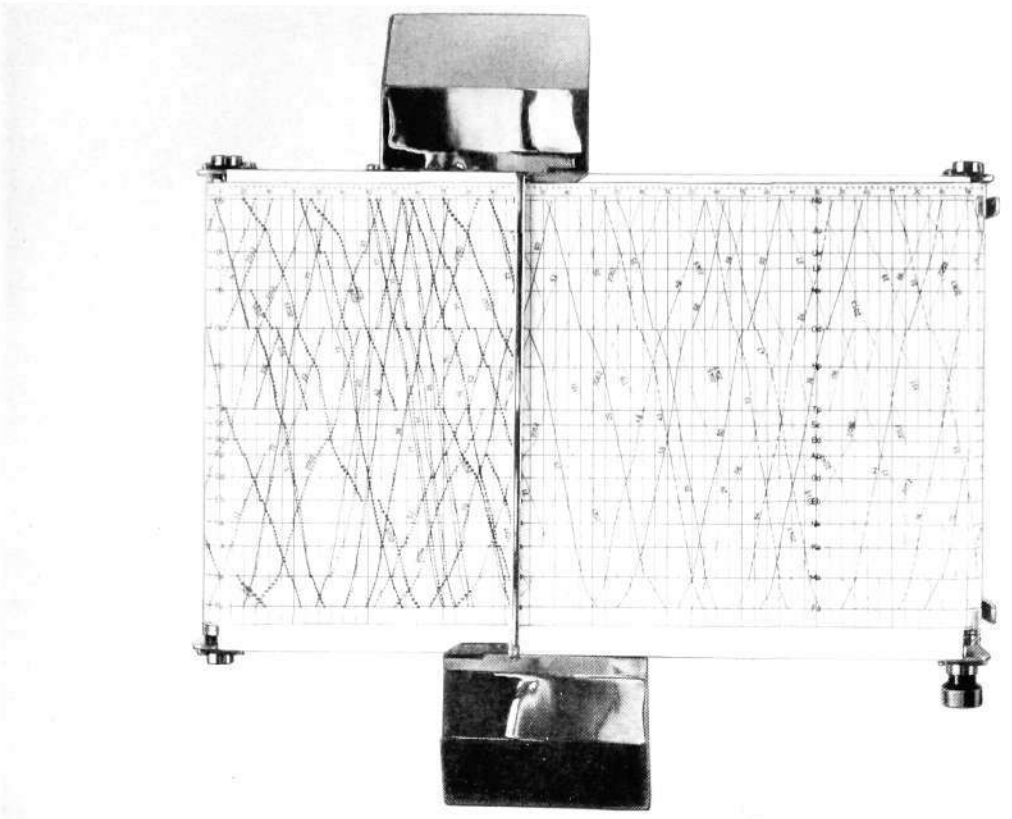
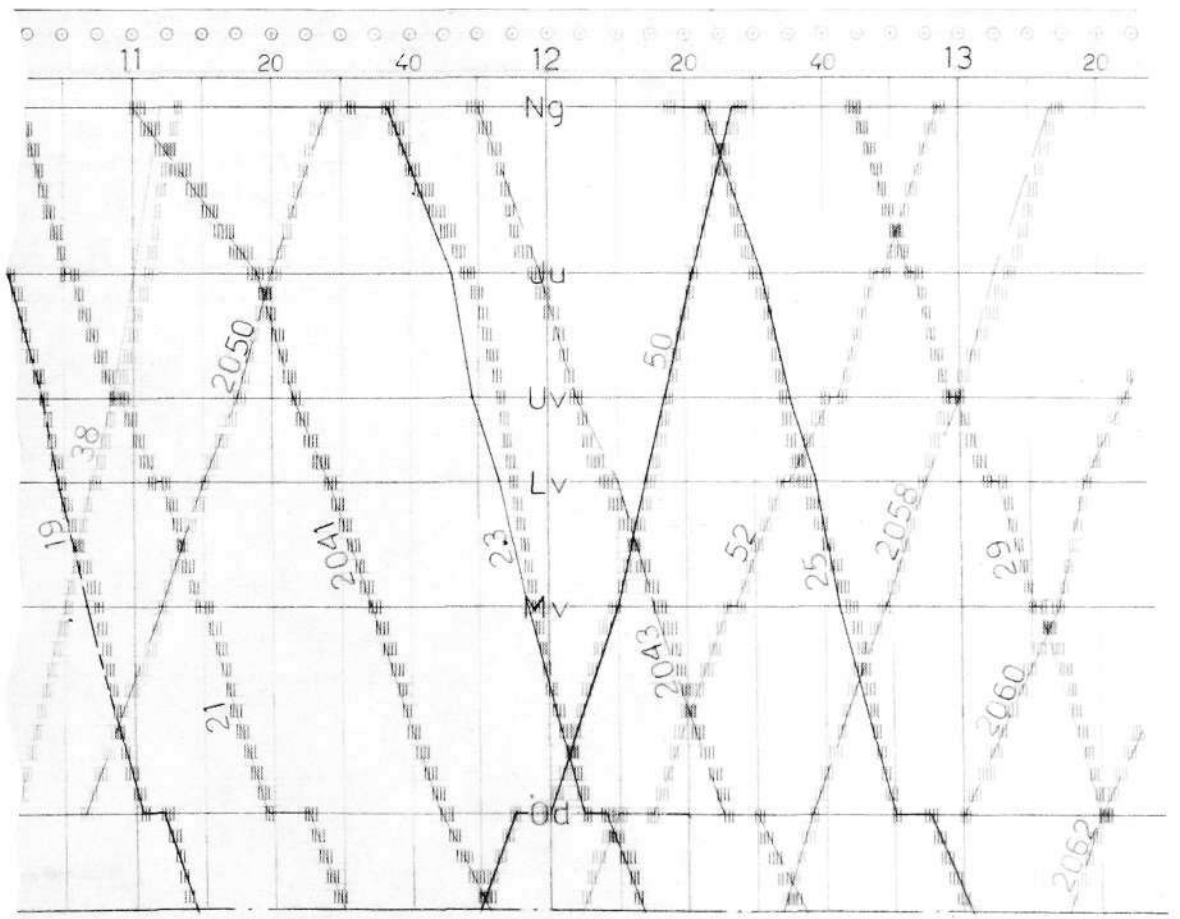


Fig. 7 X 7696, X 7695

(Above). Traingraph in operation on double-track line. (Below). Section of the pre-printed chart.

The blue marks appear rather more clearly than the red.



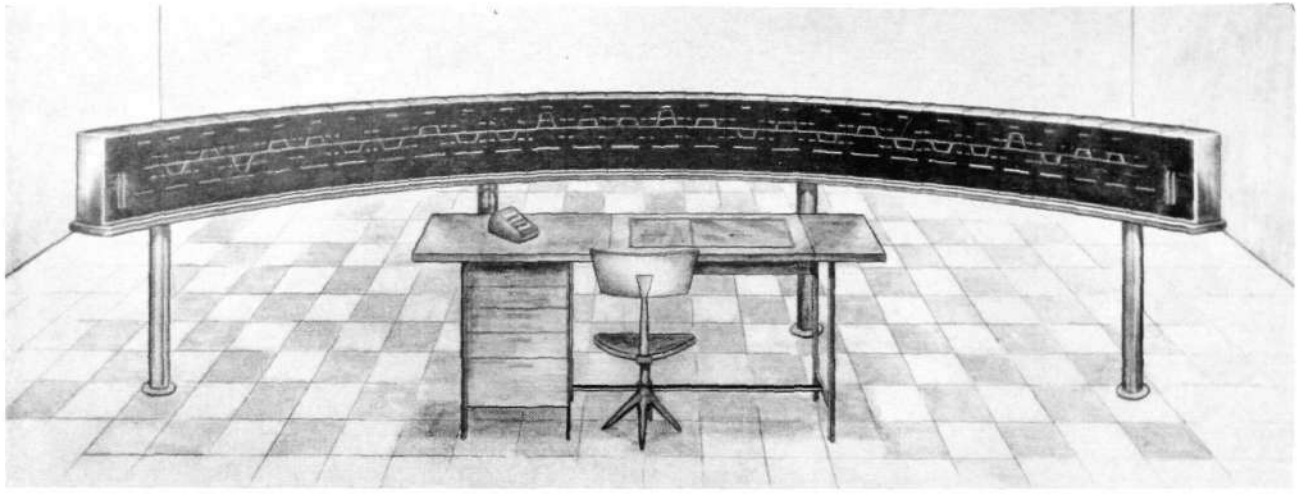


Fig. 8 X 7692

Traingraph in its proper position on the control desk of a C.T.C. office.

The traingraph is on the right-hand side of the control desk, a keyset for control of the C.T.C. system being seen on the left

Printed Charts

As mentioned under the description of the apparatus, the traingraph permits of pencil notes on the chart both immediately before and after stamping. Notes after stamping may consist, for example, of train numbers or reasons for delay. Notes before stamping may refer to the laying on or cancellation of trains, disposition of tracks etc.

If the chart is pre-printed with a graphic diagram of movements in conformity with the time table, the stampings will directly show whether trains are following the time table and the extent of deviations from it. Written notes of train numbers will only be required in the event of abnormal delays. The laying on of extra trains is facilitated, as also notes regarding train cancellations.

The traingraph can be used either with or without printed charts; the advisability of printed charts must be shown by experience in practice.

The main characteristics of L M Ericsson's traingraph, which must be regarded as complete or partial innovations, are listed below.

Large capacity in relation to size of apparatus. Maximum 112 or 224 train passage transmitting devices can be connected.

Stamping is effected in such a manner that a traffic movement diagram is obtained without need of pencil notes or the like.

Notes may be made on the chart both before and after stamping. A picture of the traffic situation is obtained for the hours immediately previous and subsequent to the train movement.

Different colours can be used for different tracks or different directions of movement.

The chart can be pre-printed with movement diagrams in conformity with the time table.

The traingraph can be accommodated on a C.T.C control desk (fig. 8).