Time-Table Supervision for Trams and Trains in Local Traffic

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For local traffic with short running intervals it is a necessity both for the passengers and from the point of view of operating economy that the time-table should be maintained to the greatest possible extent.

Supervision of the running times, arrival and departure times, as well as the periods of waiting at terminal stations, is generally carried out by inspectors stationed at various points, a method which is both expensive and unsatisfactory.

Telefonaktiebolaget L. M. Ericsson has therefore worked out a system with the aid of which it is possible to record automatically at a central point, e. g., at the operation office of the traffic administration, the arrival and departure times of cars at convenient places in the network.

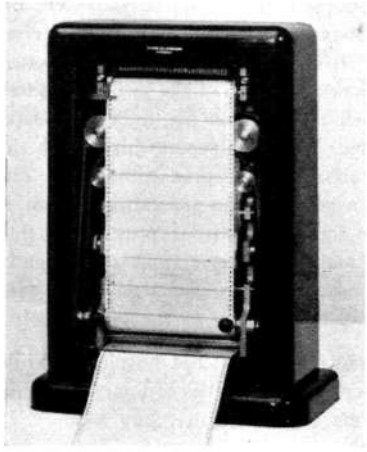

Fig. 1 X 3513
Recording apparatus

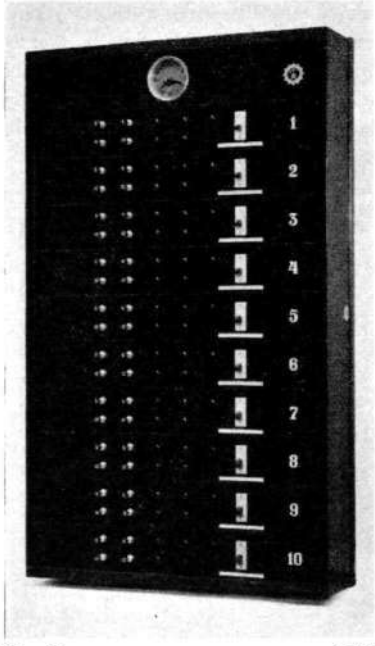

Fig. 2 X 3512
Control apparatus
Each panel contains apparatus for control of one checking point; the upper panel contains a secondary clock for setting and starting

A time-table supervision installation consists of a recording apparatus, Fig. 1, and a control apparatus, Fig. 2, both located in the operations office, together with contact devices in the overhead wires and operating relays located at the checking points in the tramway network. The relays may be connected to the apparatus in the office by means of circuits in existing telephone cables.

The recording apparatus consists of a number of stamps with a paper strip moved along by impulses from a master clock. The time spaces on the strip consist of horizontal rulings and the strip moves along at a speed of 120 m/h, or 2 mm/min. The diagram strip is divided into 30 columns, for each of which there is a stamp. The stamps are actuated by impulses from the driving relays placed in the network and they mark a horizontal stroke to indicate the passage of a car. There is one column for each checking point. The apparatus can thus be used for recording from 30 checking points.

To facilitate the reading of the diagram the control apparatus is used. This consists of a set of selectors and relays for each checking point, these being set in accordance with the time-table in force for each service. Setting is by means of switches marked 5—6—7—8—9—10—12—15— or 20 min and the functioning is such that when a car passes a checking point in accordance with the time-table the recording is normal in the respective column. Should, however, the car pass too early or too late, an extra registration is recorded in the thirtieth column. With this arrangement the reading of the diagram is limited to taking note of the records in the last column and then referring in the other columns to that which bears a mark in line with it, see Fig. 3.

Another form of recording is shown in Fig. 4. This system requires two columns for each checking point. In the first column the apparatus stamps the time-table time and in the other the actual time of arrival or departure. The control apparatus may be set in such a way that it records discrepancies from the time-table only if the actual time of arrival or departure deviates from the time-table by, *e. g.*, one minute either way, so that unavoidable variations in running are not recorded. Should a line during certain periods of the day have different running times, for example, 6 min during some periods, and 10 min during others, changes to suit may be carried out by means of the switches mentioned above. Switching to cover varying services for a whole day may also be arranged by means of a special switching clock.

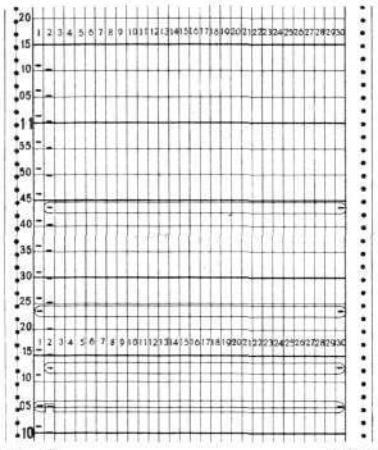

Fig. 3 X 3519
Record strip
On this strip all times differing from time-table (ringed round in the figure) are signalled by repetition in the last column

Fig. 4 X 3518
Recording strip
On this strip all times differing from time-table (ringed round in the figure) are signalled by comparison with time-table times

The requisite devices for each checking point are mounted together on panels which are placed in a cabinet. The top panel, see Fig. 2, contains a clock for the setting and starting of the other panels. This clock, like the recording apparatus and the control apparatus, receives its impulses from a common master clock. It is advisable to use the same time impulses for the operation of clocks located at terminal stations and possibly at places along the tracks. In this way uniform time is ensured for the whole transport system and the drivers may set their watches to agree with the time shown by the recording apparatus, so that all disputes concerning correct time may be avoided.

A complete diagram of a time-table supervision installation is shown in Fig. 5. It is assumed that there is a certain section with checking point *I* to be checked. It is further assumed that the time-table provides that a car shall leave the checking point every fifth minute with a tolerance to the driver of one minute, *i. e.*, that he may leave the checking point at any moment during, say, the fifth minute. Finally, it is assumed that the day's service begins operation at 7.05 a. m.

The first duty of the supervisor is to connect up the time-table supervision installation at 7 o'clock prompt, by means of switch *O*, at the same time pressing switch T_5 which corresponds to one car every fifth minute. There is then obtained a current circuit for one minute impulses from the master clock contact *C* through the driving armature *M* of the installation. As a result the contact organ now begins to move forward one step for each impulse, so that at 7.05 a. m. it is in fifth position. If the car departs during the fifth minute after 7 o'clock, the relay *r* is first actuated. This closes a circuit for relay *R*. Relay *R* is attracted and, over its contact, connects plus potential to the contact bar in the contact group *a* and, as the contact device is in fifth position, the plus potential is connected to the wire connected to this contact. As, however, this contact has no issue, no fault is recorded via relay *K*. But the contact bar in the contact group *a* is connected also direct to the stamp C_1 in the recording apparatus and a record of the exact time of starting is made there.

If the driver starts too early, *e. g.*, during the fourth minute or 7.04 a. m., a circuit is closed over contact *g* of switch T_5 through relay *K*. This relay attracts and actuates the fault stamp C_{30} of the recording apparatus.

If the start is late, say during the sixth minute, the process is as follows: as the contact device gets to the sixth position, from the positive pole on contact bar *b* over contact *h* of switch T_5 there is closed a circuit through

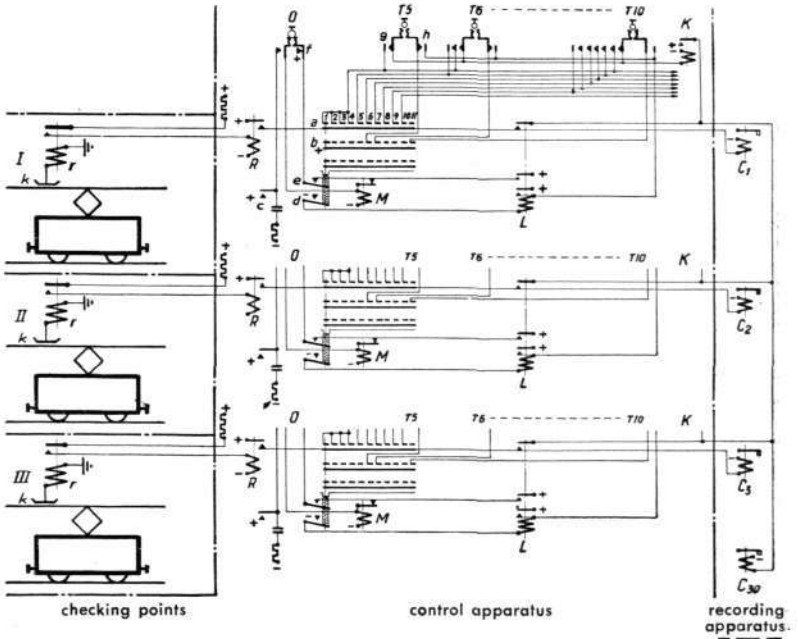

Fig. 5 X 5246
Diagram of time-table supervision installation

C_1—C_{30} stamps
K fault-recording relay
k trolley contact
L restoring relay
M driving magnet
O switch
R switching relay
r operating relay
T_5—T_{10} time-setting buttons

restoring relay L and over contact d which last closes immediately the contact device starts from position 1. The relay L is attracted and in its turn closes a circuit through armature M and a self-breaking contact on same. The recording device therefore moves forward rapidly until position 1 is once more reached, when contact d is broken. If during this restoring moment the impulse caused by the departure of the car arrives, a circuit is closed over a contact on relay L through the fault recording armature C_{30}. Should, however, the start take place after the contact organ has returned to position 1, a connecting process corresponding to that described for departure during the fourth minute is obtained. The same connecting process occurs, even should the driver start the car during the second or third minute.

The time-table supervision apparatus continues working in unbroken cycles as described above during the whole time of traffic, or until the supervisor at the central post disconnects it by throwing over svitch O. When the switch-over is made, the contact organ is restored to position 1 over contacts e and f and self-breaking contact of magnet M.

Traffic density can of course be altered at any desired moment by restoring switch T_5 and pressing any other switch T_6—T_{10}. From the preceding it is clear that supervision of traffic at one checking-point is quite independent of the checking at other points. Traffic at these points may therefore be arranged according to a time-table quite different from that applying to the first supervision point.

A time-table supervision installation has now been in operation for nearly a year on the tramway lines in Malmö, Sweden, see Fig. 6. The recording apparatus with the control equipment is installed in the traffic department of the head offices and is connected to the relays at the different checking points by telephone circuits. In addition to the recording and control apparatus, all the clocks in the tramway offices, sheds and workshops, as well as the time-recorders for the staff, are driven from the master clock.

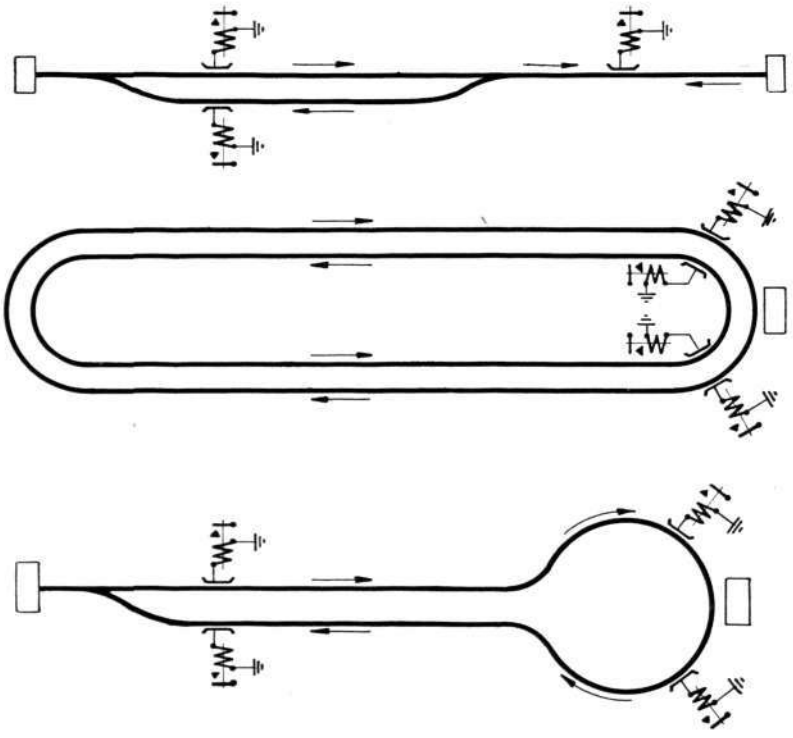

Fig. 6 X 5247
Time-table supervision, adapted to tramway lines of various types