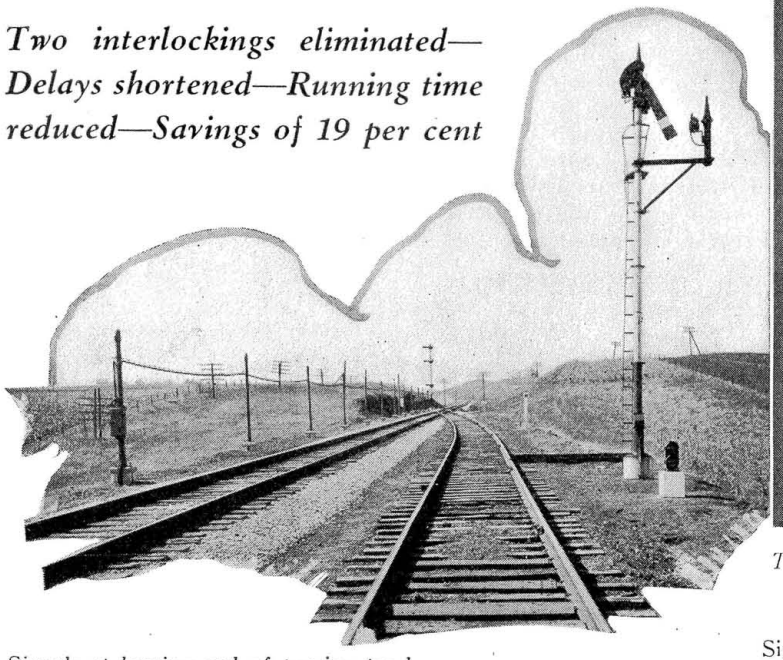
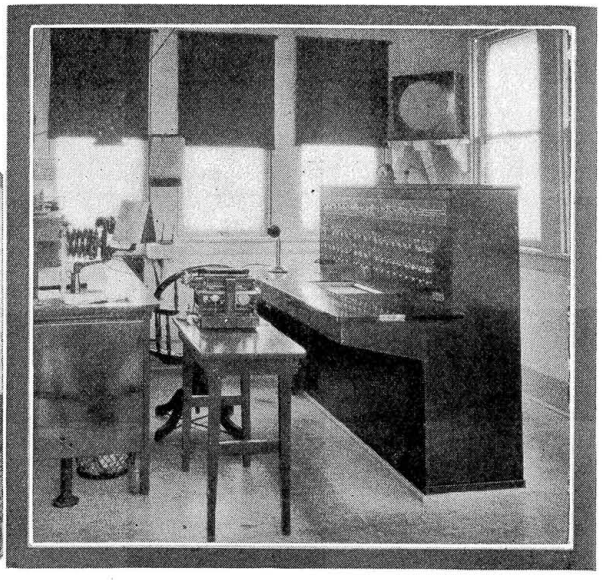
# *Burlington Completes* Centralized Traffic

***Two interlockings eliminated—Delays shortened—Running time reduced—Savings of 19 per cent***



*Signals at leaving end of passing track*



*The control machine at Red Oak*

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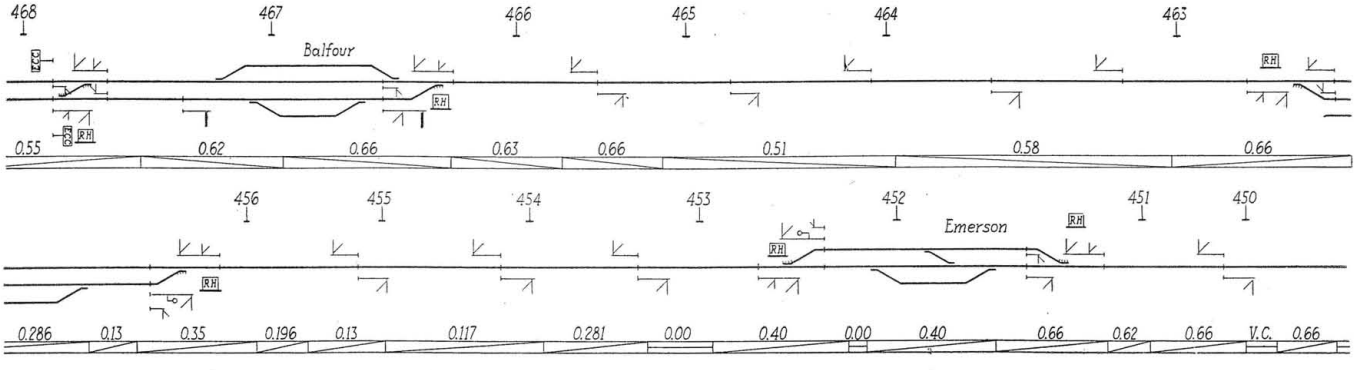
THE natural growth of railroad traffic produces a series of problems, one of which relates to the most economical, safe, and efficient method of handling present and anticipated traffic. Each problem requires individual analytical study in order to develop efficient facilities. The most common of these problems are found on pieces of single track located between ends of double track, such single track causing congestion of traffic at a point where adjacent facilities have doubled the capacity for handling traffic. Ordinarily this congestion is not constant, but occurs at certain periods in the year when seasonal business is at its height. Therefore the justification for second track is not pronounced. However, such a piece of single track does lend itself nicely to the application of a centralized traffic control system.

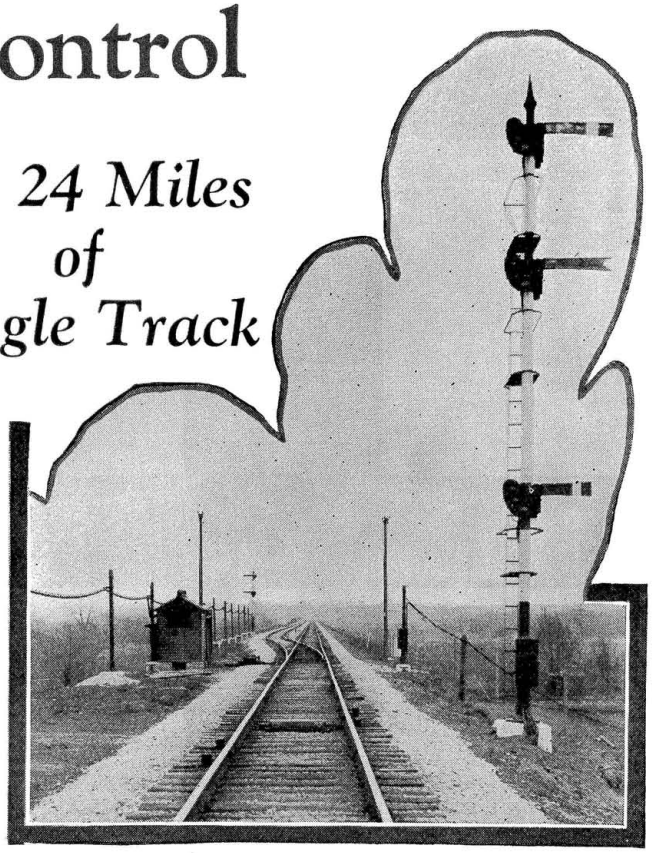
Such a situation existed on 24 miles of single track between Red Oak, Iowa, and Balfour, on the Chicago-Denver main line of the Chicago, Burlington & Quincy. The traffic in this territory consists of 16 passenger trains and 23 freight trains each 24 hours, a majority of the freight trains being of the time-freight class, operated at high speed. The handling of these trains naturally resulted in many meets and the resultant delays caused by train crews being required to handle the switches, obtain train orders, and negotiate the prevailing grades, increased the time which trains spent between Red Oak and Balfour. A thorough analysis based on both present and anticipated traffic, and checked against train sheets, resulted in the railroad's decision to install a centralized traffic control system. The type selected was the Union Switch & Signal Company's time-code relay system with the control machine located at Red Oak, the east end of this territory.




**Track and signal**

At Red Oak there was a mechanical interlocking plant handling the end of double track as well as side-track switches. At Balfour, the west end of the

# Control on 24 Miles of Single Track



*Typical controlled signal*

territory, there was another mechanical interlocking plant handling the end of double track. At both Red Oak and Balfour there was an advance passing track. Between Red Oak and Balfour each station was equipped with a long passing track on one side of the main track. In the center of each passing track there was a set of crossovers dividing it into the equivalent of two passing tracks, each approximately a mile in length. These crossovers were located in the vicinity of the station so that the switches could be handled by the operators, but the far switch in each direction from the station was handled by trainmen.

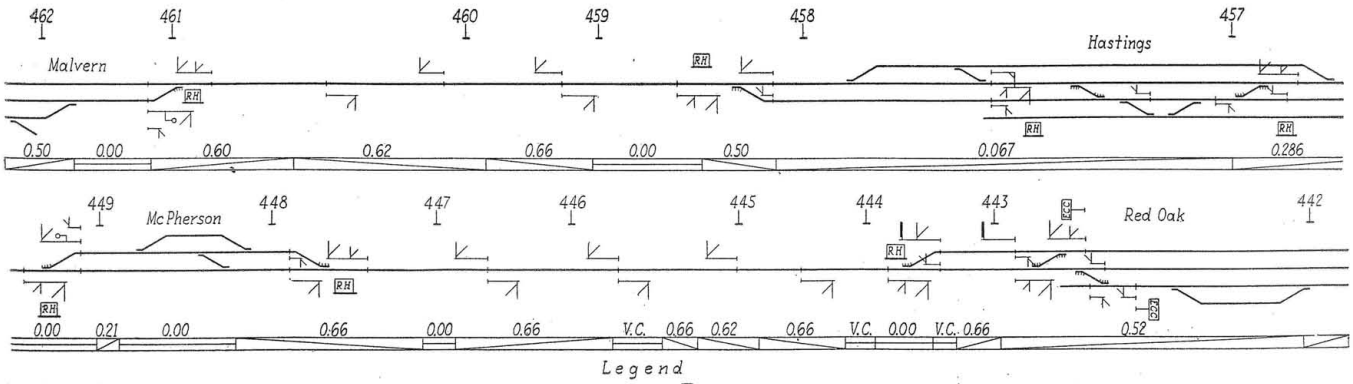
When installing the centralized traffic control several changes were made in the track arrangement. The intermediate crossovers at the several stations were removed which resulted in single passing tracks about two miles in length in each case. An exception to this was at Hastings where the intermediate crossovers were left in and placed under control. The advance passing tracks at both Red Oak and Balfour were rebuilt and made a part of the double-track system, but the crossovers forming the original end of the double track were left, which permits running one train around another, or using this track as a pièce of second main track. The passing tracks at intermediate stations were rebuilt so as to bring them to main-line standard. Number 15 turnouts were installed in place of the original No. 11 turnouts at all controlled switches so as to permit a maximum speed of 25 m.p.h. for trains heading in or out of the side tracks.

As the single track was originally protected by an intermittent inductive train control system and an A. P. B. signal system of the semaphore type, it was necessary to move the starting signals to the fouling point on the main line. Head-in signals were added to the station approach signals and color-light dwarf signals were placed on the passing tracks to serve as heading-out signals. At both Red Oak and Balfour the mechanical interlocking plants were retired and electric switch machines installed, being controlled from the centralized traffic control machine.

The old interlocking tower at Red Oak was utilized for housing the control machine, as well as the relays and other apparatus. This arrangement permits the men handling the machine to have the entire second floor for their exclusive use. The control machine is of the Union Switch & Signal Company's standard type with complete illuminated indication.

In order to provide for the most efficient operation of trains with the new installation, a complete system of indications was included as part of the control machine. A record of all train movements is made automatically by the automatic train graph which is part of the control machine, an "OS" point having been established at each controlled switch. The occupied or unoccupied condition of the track is indicated by lights on the track diagram, which is a part of the control machine. The position of all electrically-operated switches is checked on the control machine by normal and reverse light indicators. Information as to the position of the controlled signals at ends of sidings is indicated on the control machine by the use of light indicators which show whether the signals at a controlled location are at "stop," cleared for eastbound moves or cleared for westbound moves. This furnishes the men operating the machine with complete information, obtained at all times from the field.

The signal line-control circuits, as well as the line wires for the centralized control system and the train control are all carried in a lead-encased insulated Hazard aerial cable. The line wires of the centralized




plan of territory

Legend

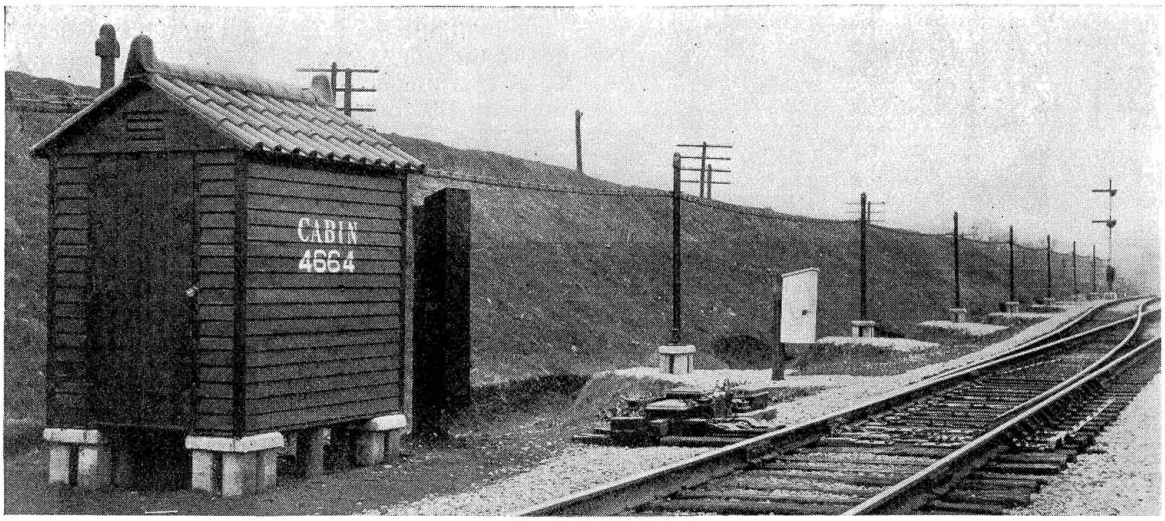
*Grade figures are approximate*
*V.C.= Vertical curve*
*RH = Relay house*
*= Marker indicating limits of centralized-control territory*
*= Power-operated switch controlled by operator-leverman*

traffic control system consist of three wires from Red Oak to Emerson and two wires from Emerson to Balfour.

The field apparatus including the code relays, battery charging units, relays, and thermal units are housed in metal houses. All circuits leading from these metal houses are carried in aerial cable supported on iron cable posts from the house to the function they control.

Exide lead-type storage batteries are provided for track, signal, and line circuits, as well as for the code system. The batteries are charged by Union rectifiers from a 220-volt, 60-cycle single-phase a-c. power line which is installed on two adjacent end pins on the track end of the bottom crossarm.

Each switch location is in reality a complete interlocking plant, all signals being electrically locked




Switch layout showing sheet metal house for instruments and batteries—Note also the aerial cable line

Track wires are in parkway cable from the metal house to the track. The aerial cable and parkway cable are of the standard Okonite design.

The switches are operated by Union Switch & Signal Company's Style M-20 dual-control switch machines with lock rods and point detectors. The switch layouts are well constructed so that there is no creeping or shifting. Three gage plates are used together with a complete set of adjustable rail braces. In addition each switch is held by straps bolted to the rail and lagged to the ties, and approximately 300 rail anchors are installed through each switch, thus anchoring the track so as to prevent creepage in either direction. Plenty of good ballast is provided and is kept well tamped under the ties.

through the medium of SS control and electric detector locking. The time-element relays are set so that a switch cannot be taken away from a train until three minutes had elapsed. In addition, the absolute permissive automatic block signal system and train control offer additional protection.

## Results Satisfactory

The cost of this installation was approximately $136,000, $36,000 of which covered track changes. The system was placed in service on April 10, at which time all train orders and classification of trains were removed and the trains have since been handled by signal indication entirely. The manual saving was the elimination of one dispatcher and nine operators making a saving in

Table I—Annual Savings Based on Study of 33-Day Period

| | | 33-Day Period | Per Day | Per Year |
|---|---|---|---|---|
| WAGE SAVINGS— | | | | |
| Total saving of straight time on account of being able to advance trains by signal indication which could not have been done under train order operation | 19 trains—8 hr. @ $5.83 per hr. | $ 46.64 | | |
| Average delay of 10 min. per freight train saved on account of handling switches electrically | 60 trains—60 hr. @ $5.83 per hr. | 349.80 | $12.01 | $ 4,383.65 |
| | | $396.44 | | |
| Average savings per year in station service account eliminating nine operators and one dispatcher | | | | 14,201.00 |
| FUEL SAVINGS— | | | | |
| *Stop Meets* | | | | |
| Freight trains, 467 meets averaging 500 lb. fuel each | 116.7 tons | | | |
| Passenger trains, 15 meets averaging 200 lb. fuel each | 1.5 tons | | | |
| *Non-Stop Meets* | | | | |
| Freight trains, 14 meets averaging 500 lb. fuel each | 3.5 tons | | | |
| Passenger trains, 20 meets averaging 300 lb. fuel each | 2.0 tons | | | |
| Account delays avoided to all trains—68 hr. at 200 lb. per hr | 6.8 tons | | | |
| Total tons | 230.5 tons | $576.25 | 17.46 | 6,372.90 |
| Total Savings per Year | @ $2.50 per ton | | | $24,957.55 |

wages of $14,201 a year.

Since the system has been in service a close check of other savings, usually listed as intangible, has shown that the total yearly saving under the present light-traffic condition will amount to $24,957 annually. Table I shows a comparison of train operation for June, 1930, under centralized traffic control with June, 1929, under train order control. Table II covers 33 days operation and explains the source of other savings.

Notes made by the operator during the first month of operation show several cases where the elimination of stops, formerly required to handle passing-track switches, now permits trains to be advanced farther than would have been the case previously. For example, on April 7, it was possible to advance extra freight train No. 5502 from Malvern to Hastings five miles, just four minutes ahead of passenger train No. 14, whereas if it had been necessary to stop No. 5502 for the trainmen to handle the passing-track switches, No. 5502 would have been held at Malvern for No. 14 and No. 2, and would then have been further delayed for No. 91. On April 20, extra freight No. 5508 was advanced from Malvern to Balfour for passenger train No. 8 thus saving 30 min. for the freight, whereas under train-order operation, it would have been necessary to hold No. 5508 at Malvern. Numerous other instances such as these in which the train time saved ranges from 15 to 30 min. are common occurrences.

Table II—Statement Showing Summary of Freight Train Performance in Centralized Traffic Control Territory for June, 1930, as Compared with June, 1929

| Year | Number of Trains | Avg. Time Consumed Arrival Red Oak to Departure Balfour | Delays Meet Trains | Delays Others |
|---|---|---|---|---|
| | | *Westbound* | | |
| 1929 | 180 | 2 hr. 02 min. | 21 min. | 41 min. |
| 1930 | 174 | 1 hr. 53 min. | 12 min. | 39 min. |
| | | *Eastbound* | | |
| 1929 | 160 | 2 hr. 08 min. | 23 min. | 48 min. |
| 1930 | 174 | 1 hr. 58 min. | 13 min. | 46 min. |

Savings account reduction in time consumed Red Oak-Balfour:

Westbound—
174 trains at 9 min. per train—
Wages $152.16

Eastbound—
174 trains at 10 min. per train—
Wages 169.13

Total $321.29 per month

With seven passenger trains and from four to seven freight trains each way daily totaling 24 to 27 trains, it is evident that numerous meets must be made in this 24-mile territory; the operators' notes for the first 33 days of operation show that from 11 to 19 meets were made daily. The saving in time and fuel made possible by the elimination of train stops under the centralized traffic control system is explained in Table I.

The two-mile passing tracks with power-operated switch machines permit non-stop meets to be made frequently, for example, No. 6, the Aristocrat, and No. 12 the Ak-Sar-Ben, make a non-stop meet almost every day at Emerson. On April 13, the fourth day the installation was in service, four non-stop meets were made and on May 12, there were five, two at Emerson, and one each at Malvern, Hastings and McPherson.

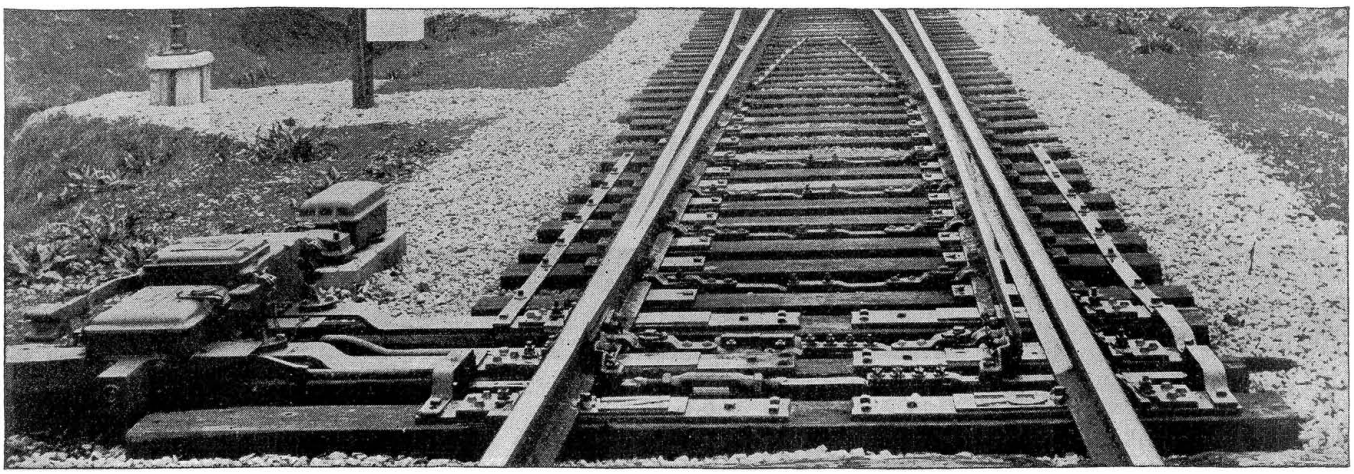
## Operating Rules

Operating trains by signal indication only and without train orders is an old practice on the Burlington. Consequently, the necessary rules had been established as a part of the operating rules, and when the centralized traffic control system was placed in service it was necessary only to cover by bulletin the 16 special instructions concerning the handling of the dual-control machines. These instructions were placed on the inside of the telephone box at each OS location in plain view of trainmen when talking to the operator at the control station.

The only change necessary in the book of operating rules was to insert four definitions covering: (1) Centralized traffic control (2) Dual control switch (3) Dual control switch machine and (4) Governing signals.

Upon the completion of the installation, trains were operated on train orders for a brief period, after which a bulletin was issued which removed train orders and placed the operation of this territory upon signal indication without classification. The bulletin is as follows:

"Effective 12:01 a. m. Thursday, April 10, 1930, between Red Oak, Iowa, and Balfour, trains will be operated by controlled signal system of train operation. Trains will move by signal indication. Signal indications will supersede the time-table superiority of trains, but will not dispense with the use of observance of other signals whenever and wherever they may be required. Trains having work to do on the main line, must obtain permission to use it from the operator-leverman at Red Oak, and must have an understanding as to the length of time that main line can be used.



The switch layouts are well braced

Trains working at stations, must be in the clear at the time specified, or arrange with operator-leverman for additional time. Trains must not use the crossover switches at McPherson, Emerson, Malvern, or use any track connected with the main line at any point in controlled signal system territory, the switch of which is not operated by remote control, without permission from the operator-leverman."

The special instructions included in the bulletin are as follows:

(1) Switches must not be operated by hand without authority from the operator who will authorize all movements through the plant.

(2) Plant limits are the routes between home signals.

(3) Upon finding a route signal showing the most restrictive indication, the conductor will call the operator on the telephone provided for that purpose.

(4) When switches are in the wrong position, it will be necessary, after receiving authority from the operator for the conductor to operate them through the medium of the dual-control attachment on the power switch machine.

(5) The dual-control attachment is a part of each power switch machine located at each controlled switch.

(6) When authorized by the operator, the conductor will unlock the switch lock, then throw the switch lever (the one farthest from the track) to correspond to position of the switch normal or reversed; then throw the selector lever (the one nearest the track) to the position marked "Hand." If unable to throw the selector lever to full hand-throw position, then raise the switch lever to the point where the switch and lever inter-connect, then handle as any other hand-operated switch. If unable to latch the switch lever, the switch point must be spiked. Tools will be found in the box marked "Tools," adjacent to the telephone box.

(7) All switches in a route to be used must be operated through the medium of the dual-control attachment.

(8) After handling all switches by the dual-control attachments in the route, then flag the train through interlocking plant.

(9) After a train has cleared a plant, place the switches in the position originally found through the medium of the hand-throw lever and place the selector lever in the position originally found and lock it with the switch lock.

(10) Notify the operator on the telephone when the train has cleared the interlocking limits and when all dual-control hand-throw levers are in the position originally found and locked.

(11) To operate switches by hand for switching purposes, trainmen must obtain permission including time and working limits from the operator and handle the switches and dual-control attachments as outlined in instruction No. 6.

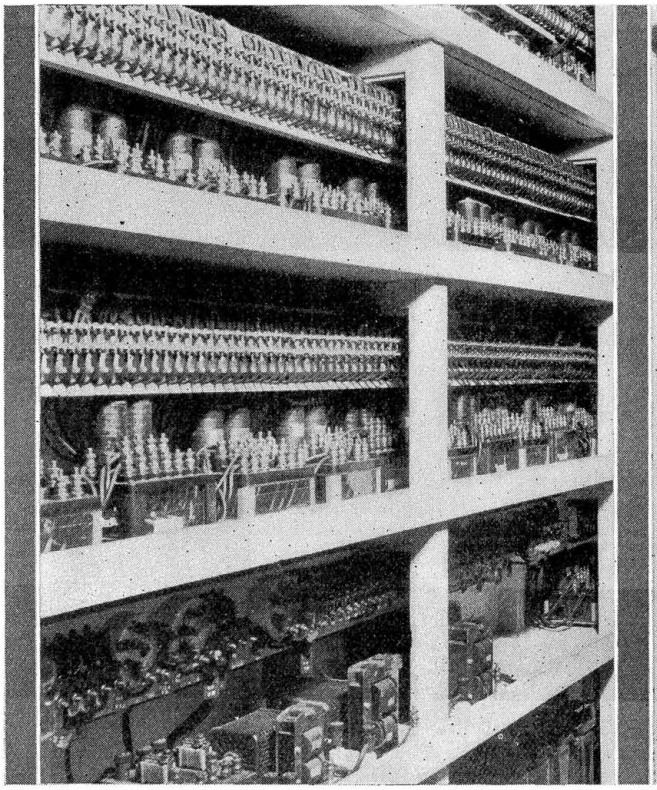
(12) When work is completed or time granted has expired, a train must be in the clear and dual-control attachments in their normal position and locked as outlined in instructions No. 6.

(13) The permission granted by the operator to the trainmen to hand-operate a dual-control switch does not authorize any parts of the train or engine to move beyond the designated limits for which permission is given to operate in.

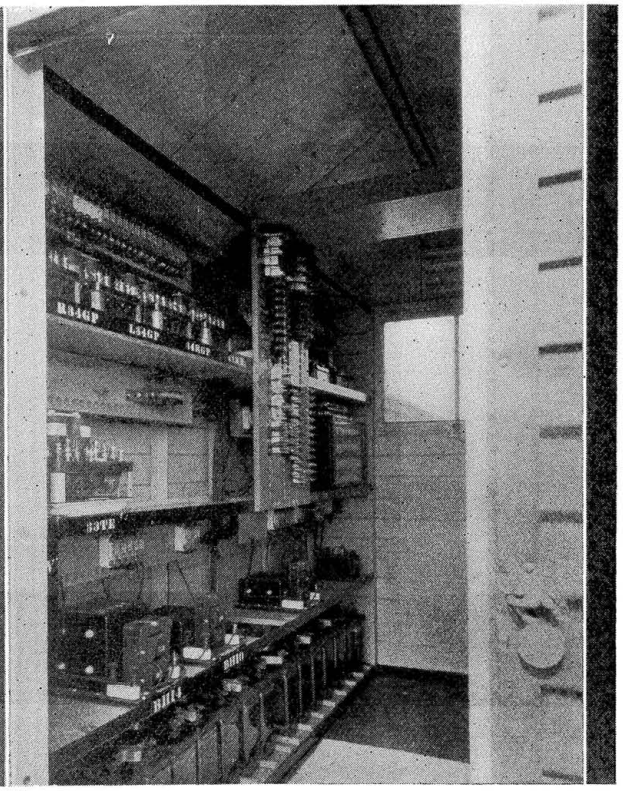
(14) When work is completed and the train or engine is in the clear or when the time limit has expired and switch is closed and locked, trainmen must so report to the operator.

(15) If additional time is needed, trainmen must, before the time limit has expired, report to the operator for instructions.

(16) If unusual delays occur, trainmen must notify the operator.



Instruments at control station



Interior of an instrument house