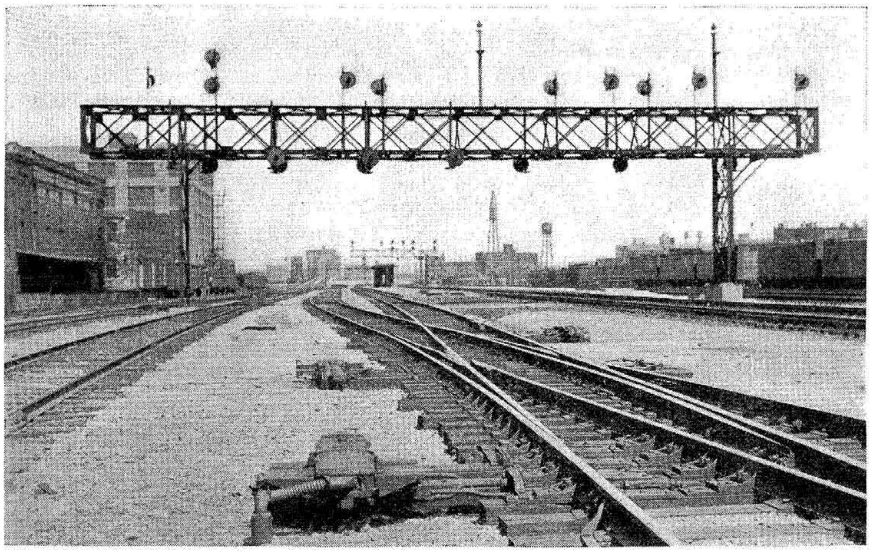
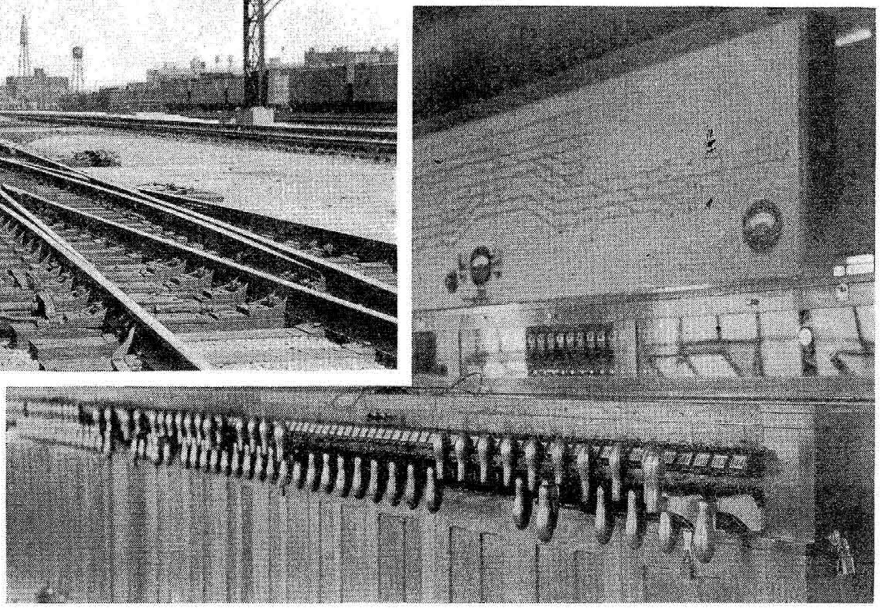
Burlington Installs Extensive New Electric Interlocking



Left—Searchlight signals on signal bridge
Below—Interlocking machine in tower



By W. F. Zane
Signal Engineer, Chicago, Burlington & Quincy

Solves train operation problems at important track layout in terminal area

THE all-electric interlocking plant installed recently by the Chicago, Burlington & Quincy near Union avenue, Chicago, handles a new and extensive track layout, which, in brief, includes not only numerous yard and transfer connections but also the crossover layouts involved in the eastern end of the four-track line with the connections to the two passenger tracks extending into the Chicago Union station. The rearrangement of tracks in this vicinity was brought about primarily by the straightening of the south branch of the Chicago river and an important grade separation project west of the river near 16th street, whereby the St. Charles Air Line and the Baltimore & Ohio main line were elevated over the main tracks of the Burlington and the Pennsylvania.

Due to the separation of the grades between the Burlington, B. & O., and St. Charles Air Line, the general operating conditions were greatly improved as it eliminated the only railroad grade crossing on the Burlington's main line between Chicago and Earlville, Ill., a distance of 72 miles, and on the main line to St. Paul and Minneapolis it eliminated all railroad grade crossings between Chicago and Shabbona, Ill., a distance of 67 miles.

This grade separation permitted the Burlington to rearrange its tracks and facilities in the entire area from 12th street to Racine avenue, about 3 miles. Two main tracks owned 100 per cent by the Burlington connect with the Chicago Union station layout at 12th street and from that point extend south to 16th street where they turn west under the Canal street viaduct. Just west of Canal street two additional main tracks from the 14th street passenger yard and the central freight house combine with the two main tracks before-mentioned to form a four-track system which extends continuously to a point west of the Chicago city limits, about 6.9 miles. Also, at Union street, the double-track main-line connections of the St. Charles Air Line diverge from this four-track system. In addition to the main tracks referred to, there are numerous yard tracks and transfer tracks connecting with the Pennsylvania railroad; also wye facilities for turning not only Burlington but also Pennsylvania and Chicago & Alton passenger trains.

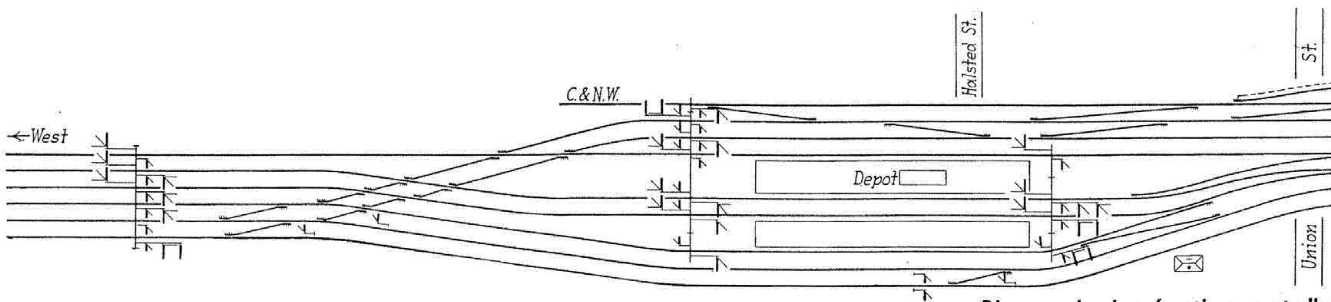


Diagram showing functions controlled

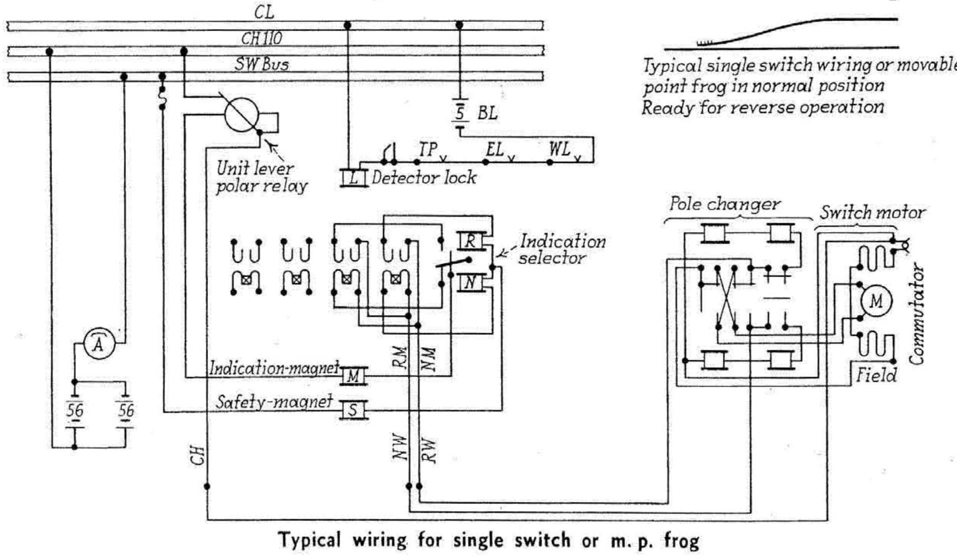
Furthermore, this new Union Avenue plant includes a well-placed arrangement of crossovers and slip switches which are grouped at the east and at the west of the Halsted Street station. No derails are used on any of the through main tracks; in fact, the only derails used in the plant are the Hayes derails on the St. Charles Air Line, which were placed there because of the descending grade and also because this is a freight line.

Since the St. Charles Air Line is owned jointly by the Chicago, Burlington & Quincy and the Chicago & North Western, and as it is now on an elevated concrete structure from the Chicago river to about Union avenue, where the Burlington has a double-track connection into it at this same point, the North Western, due to its connection with the St. Charles Air Line, is the only other railroad in this new plant having some of the functions on its rails.

The interlocking plant was installed so as to control all of the tracks from 12th street to a point near Racine avenue, the interlocking tower being located just east of Halsted street near Union avenue, which places it just east of the new Halsted Street suburban station, which was built for four-track operation, using island platforms.

A thorough operating study was made of the traffic and local conditions of this vicinity and it was decided that the two main passenger tracks from 12th street to their entrance into the four-track system would be signaled in both directions and that check-locking would be provided between the Union Station plant and the new Union Avenue plant. The two tracks leading out of the 14th Street yard and the freight house were signaled only where their entrance switches into the four-track system were interlocked. The double-track connection with the St. Charles Air Line was also interlocked, as well as numerous connections to the yard tracks. In the four-track system itself the north main track is signaled for westward moves; the two center main tracks are signaled in both directions while the south main track is signaled for eastward moves. Furthermore, check-locking is provided between the new Union Avenue tower and Kedzie Avenue interlocking, which is the next plant west. This signal arrangement follows the Burlington standard, where two or more main tracks are in use.

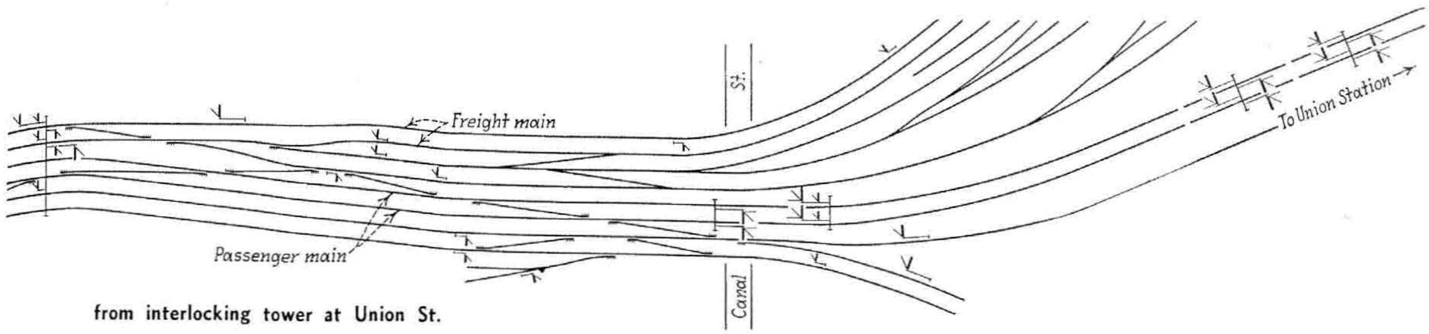
In considering this plant from an operating viewpoint, it is necessary to realize that it is in a dense-traffic zone. There are 45 westbound and 35 eastbound suburban trains and 9 westbound and 10 eastbound main-line passenger trains per day. Also, there is transferring through this plant by practically every railroad in Chicago, as well as moves due to the turning of the passenger equipment of three railroads. The average traffic through this plant each 24 hours, taken from the train sheet, is 311 eastbound and 289 westbound moves. All of the passenger moves are at high speed and, due to the frequency of these trains, there are very short intervals at any time when the main tracks are unoccupied and, as the transfer is heavy, the secondary tracks are occupied the major portion of each day.



Typical wiring for single switch or m. p. frog

All signals on main tracks and parallel tracks from 12th street to the west limits of this plant are on signal bridges, while the signals on some of the secondary tracks are of the ground type. It should be noted that the signal bridges are located so that the distances between them are reasonably short, permitting close moves to be made. All signals are the searchlight 3-position SA type.

The fact that the territory from 12th street, where the tracks leave those of the Union station, to the west limits of this interlocking plant, is under the control of the towermen at Union street, permits the Burlington to take its trains upon its own tracks as soon as they leave the Union Station plant and to place them under



from interlocking tower at Union St.

the control of its own towermen, and as both of the tracks between 12th street and Canal street are signaled in both directions and because of the check-locking feature between the Union Street plant and the Union Station plant, it is possible to operate parallel moves either out of or into the Union station, and, as the distance from Canal street to the Union station consists of two blocks, close following moves on either track in either direction can be made.

Upon reaching the four-track system, it will be noted that the switches and signals are somewhat bunched east and west of the new Halsted Street station. This permits of running a train which does not stop at that station around any local train making the stop; also westward trains out of Chicago can be fanned out to the four-track system by the time they reach Halsted street, and, because the two middle tracks are signaled in each direction and the trend of traffic is heavier eastward in the morning and westward in the evening, these four tracks actually function as a six-track system, due to the fact that three tracks can be used in either direction, as traffic dictates.

As it has for years been a policy to utilize all tracks and operate trains by signal indication only, thereby eliminating train orders, it will be readily seen how this interlocking plant co-ordinates with the territory from Chicago to Galesburg, Ill., a total distance of 161 miles, in which territory, when there are three tracks, the middle track is signaled in both directions; where there are four tracks, the two middle tracks are signaled in both directions; and where there is double track, each track is signaled in both directions and check-locking is used from tower to tower for the entire district. Consequently, this installation follows the standards and practices of the railroad in regard to train operation.

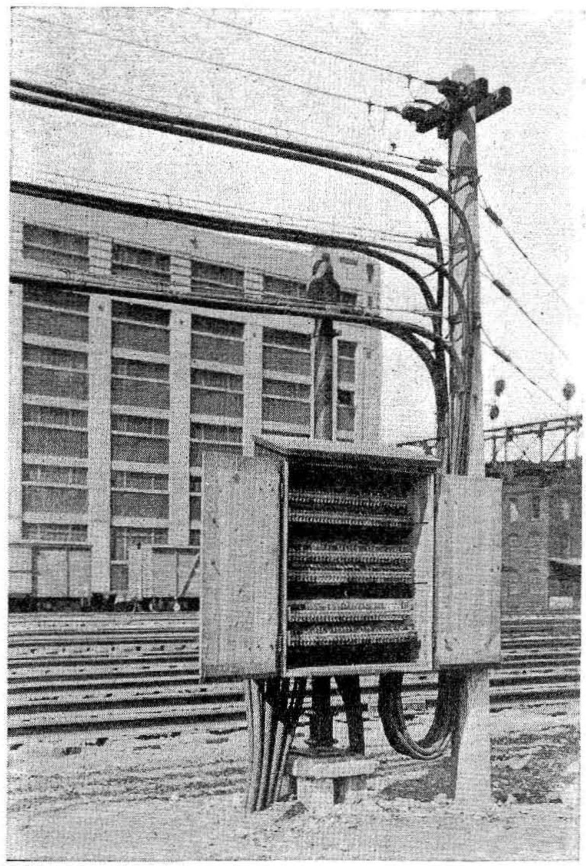
The interlocking tower is 39 ft. 5 in. by 17 ft. 5 in., of brick and concrete firep·.of construction, including a basement and two storie.. The heating plant and the battery room are located in the basement, the relay racks and battery charging apparatus are housed on the ground floor, and the interlocking machine is on the second floor.

The interlocking machine is the General Railway Signal Company's Model-2 unit-lever type with 144 lever spaces, and 140 working levers, of which 47 are for single switches, 5 for double slips, 1 for a single slip, one for a movable-point frog, 71 for signals and 4 for check-locks.

The illuminated track diagram mounted to the rear and above the interlocking machine is the Burlington's standard chart, and provides a complete picture of the entire plant layout. Augmented by well-placed telephones in the field and a loud-speaker in the tower, this chart keeps the leverman well posted at all times regarding the traffic he is handling. The check locking requires no telephoning but is asked for by push buttons and visible indications. Therefore, the towerman is permitted to devote his entire attention to the handling of the levers.

The track lights in the illuminated diagram are white and are lighted only when the corresponding section of track is occupied. A green lamp, forming a part of the symbol for each signal is lighted when the corresponding signal is displaying a Proceed indication. The local circuit for each of these lamps is controlled through a repeater relay in the tower, which is controlled through the corresponding signal relay in the field.

The switches of the plant are controlled by the ordinary 110-volt d-c. method, using the dynamic indicating system with certain added features. An individual cross-protection relay is provided for each switch-control circuit, these relays being mounted in a cabinet on top of the interlocking machine.



Terminal case for aerial and underground cables

The switch machines are the G. R. S. Model-5 A. A rod attached to the normally closed switch point operates a switch point control selector in the switch machine. Circuits controlled by this selector operate a polarized d-c. switch position relay (KR), in the tower, through which the signal circuits are selected. The lever lamp on each switch lever is selected to battery through the respective KR relay, the lamp being normally extinguished and is illuminated only while the switch is in transit from one position to the other. If the KR relay fails to pick up, the lever light continues to burn, thus affording a ready means of check for the maintainer.

Relay Cabinet

The first floor houses all the relays required at the tower, the rectifiers, the main switch and the power switch board, as well as all terminal blocks, because all cables, both aerial and parkway, terminate on this floor. In fact, all apparatus other than the interlocking machine is located here in a convenient manner for inspection and testing. The relay rack is constructed of ½-in. asbestos transite board secured to a 1 in. by ⅜ in. angle-iron frame. This rack is so constructed that there are five shelves for relays on each side, facing the room. Each end is equipped with a door which gives access to the interior of the rack where the terminals are located, just back of the relays, and so arranged that the jumper wires pass through small holes to the relays. Wire chases of the same material as the rack run parallel to the shelves on the inside, which are equipped with hinged lids so that all wires laid in them require no pulling through ducts. All cables, both aerial and parkway, terminate inside of the rack, which produces a fireproof housing, convenient and lasting. Square-D sheet-metal duct is used for all wires running from the relay rack to the switchboard and rectifiers, as well as to the interlocking machine on the floor above and the battery in the basement.

The 1,000-ohm neutral relays are the Burlington type assembled at the Aurora, Ill., signal shop and the polar 1,000-ohm relays are Union Type DP-14. The relays are grouped on the shelves and the shelf is stencilled below each relay so that each relay can easily be distinguished.

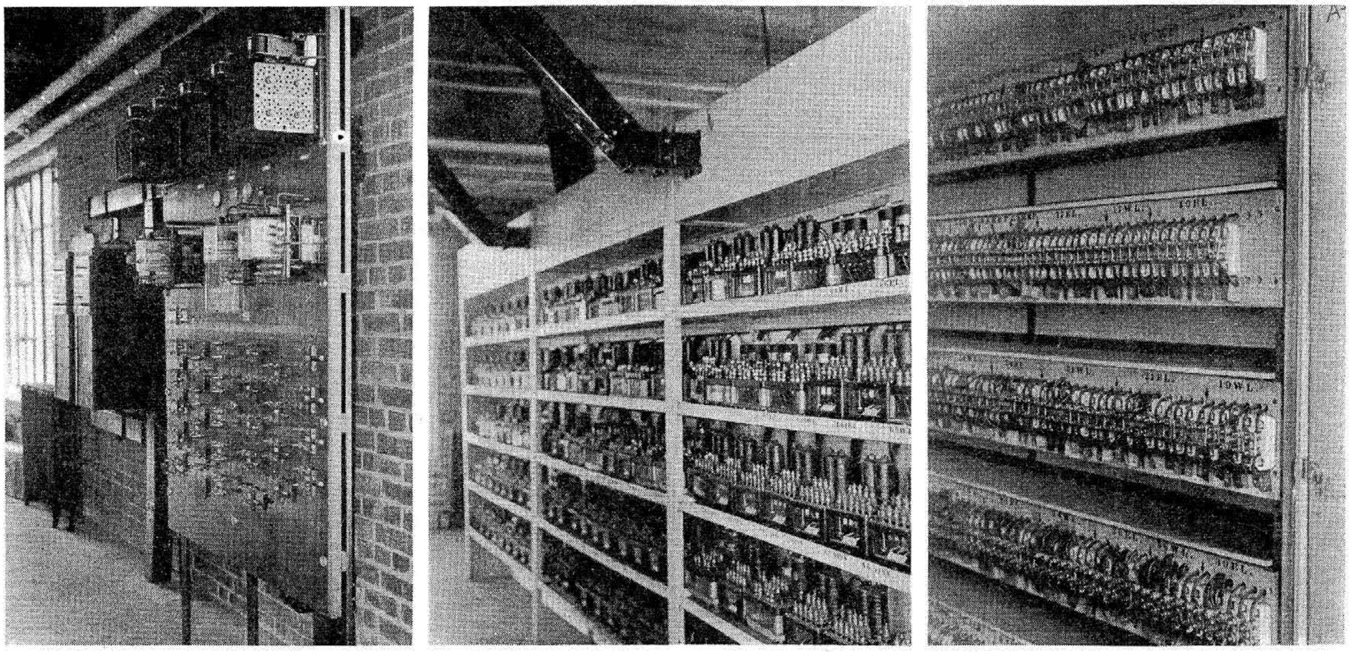
Power Supply

The 110-volt main battery for switch operation includes 56 cells of Exide EMGO9 cells of 224-a. h. capacity. A similar set of battery is provided as a standby and is used alternately so as to be kept in proper condition. Each set of operating battery is on floating charge through a union RP81 rectifier, these rectifiers being mounted on the front wall in the relay room.

So far as line-control feeds are concerned, the plant is divided into three sections, a separate set of 5 cells of Exide KXHS 78-a.h. cells being provided for each, while a similar set of battery is used for the lock circuits, and a fifth set as a standby. Each battery is on floating charge through a union RT21 rectifier.

These low-voltage rectifiers, switches and meters are mounted on a large oak board as shown in one of the illustrations. Knife switches are so arranged that the emergency battery can be used in place of any of the other four, and likewise the emergency rectifier can be used to charge any one of the batteries. The meter switches, which are of the make-before-break type, can be used to take readings on any of the batteries.

The track circuits are fed in groups, there being a set



Power and relay equipment in the tower

of three cells of storage battery located at central points about the plant for each group, each group being on floating charge through a Union RT42 rectifier. All of these rectifiers are the Union Switch & Signal Company's dry-plate type.

Wiring Distribution

The wiring is distributed from the tower to junction boxes over the plant in aerial cable suspended from stranded messenger run on reinforced concrete company-built poles about 15 ft. high, as shown in one of the illustrations. Where necessary to clear tracks or other obstructions, high cedar poles were used. These aerial cables terminate on porcelain based terminal in junction boxes from which underground parkway extends to the switches, relays, cases, etc. Aerial cable extends from relay cases to the signals on the bridges. Parkway cable is standard Okonite with a lead sheath and steel tape and at the switches the parkway cable is brought up through a piece of 3½-in. pipe 2 ft. long, set vertically, the joint between parkway conductor and the single-conductor wires extending to the machine being located in this pipe riser, after which the pipe is filled with parolite. A coupling is placed on top of the pipe and a two-inch flexible metal conduit extends to the switch machine. All insulated wire and cables are of Okonite manufacture. *(Continued on page 196)*

run by signal indication with the switches and signals power operated and controlled by the dispatcher. Time for station work, taking coal and water, and for other unavoidable delays was assumed to be the same in either case; also, the running time allowed between stations was the same. The difference in elapsed time for a train through the territory represented that saved in opening and closing switches, waiting for orders or meets, and stopping and starting at switches.

To this graph chart were added lines for five additional eastward and five additional westward through freight trains. The running time between stations, for trains of various tonnage, was obtained from the chief dispatcher. These running-time figures, which allowed for grades and curves, were used for plotting the extra-train lines on the chart. This graph showed the running of 40 trains, or a 33 1/3 per cent increase to an already heavily taxed track capacity, and, judging by the presence of open spots in the chart, I do not doubt that by careful dispatching 10 more, or a total of 50 trains and an increase of 66 2/3 per cent, could be handled without increasing the average elapsed time.

By this study of the particular conditions and requirements on this 93-mile section of track, and by plotting the trains by this graph method, it developed that, with the installation of the centralized traffic control system and power operated switches, the capacity of this track could be increased to a maximum of approximately fifty trains daily, handled under practical conditions without an increase of elapsed time.

The results developed by this particular study do not imply that this percentage of increase would be correct for any section of single track. The answer must be developed from a study of the factors which influence the traffic on the particular section of track under observation, and if the study for each train is developed in a practical manner a fairly accurate estimate of practical maximum capacity should be obtained.

Local Conditions Greatly Influence Capacity

C. R. Hodgdon
Signal Engineer, Canadian Pacific, Winnipeg, Man.

This question is so broad, and there are so many different angles entering into it, that an opinion on the subject is more or less of a guess. For instance, much depends upon the length and type of passing tracks, the type of trains, facilities for taking coal and water and whether there are pusher grades on the territory in question.

Each territory has its own peculiarities and should be studied accordingly. A year or so ago, we carried out a study on a 125-mile section of single track on which there were three pusher grades, with the idea of adopting the C.T.C. system without the use of power-operated switches, allowing trainmen to operate switches by hand. At that time trains were being handled by train orders and an automatic block signal system. We found that before anything definite could be arrived at, a speed curve had to be graphed for the whole territory, which would give a basis to work on. With the use of train orders and the automatic block system, the local officers figured that 13 freight trains and 2 passenger trains each way daily were about the maximum that could be handled under that system of operation, while a study showed that with the use of the C.T.C. system we could increase the number of freight trains to 24 each way with two passenger trains.

Another answer on this subject will be published next month.

Burlington Installs Interlocking

(Continued from page 172)

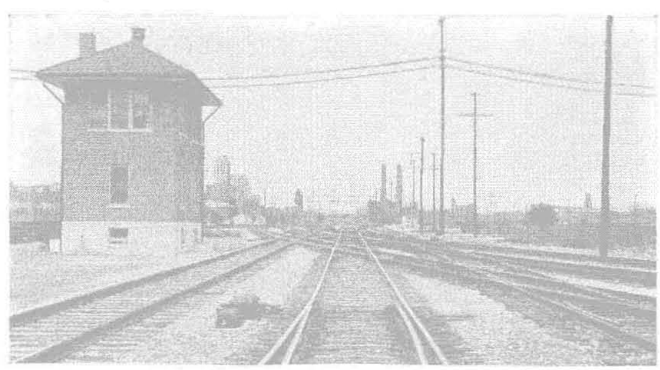
The signals are the G. R. S. searchlight Type-SA, the high signal operating to three positions and the dwarf to two positions. Signals are normally lighted continuously from the a-c. source and in case of a power failure are cut over by power-off relays to d-c. battery.

The construction of this plant is in every essential of C. B. & Q. standard, the design and construction having been handled by signal department forces.

Operation of Plant a Success

The new Union Street plant controls territory that was originally, when operating under the old track layout, handled by two interlocking plants, a mechanical plant at Canal and 16th streets and an electric interlocking plant at Ashland avenue. Both of these latter plants were taken out of service when this new plant was placed in operation and in addition two sets of switch tenders required for handling intermediate crossovers were relieved. Thus the increase in territory that a modern plant is capable of handling, as compared to the territory the older plants were installed to handle, can readily be seen. The new plants, without doubt, operate more efficiently, economically and safely.

The actual engineering and installation of a plant of this size is efficient only after a thorough preliminary study of ground conditions, operating conditions and the traffic, both present and future, has been made. This plant now has been in service for three months, and the results justify the time given by operating officers and the signal department in making a thorough study and analysis previous to the designing of same by the signal department, and as business conditions improve and traffic increases, without doubt the economic value of this installation will increase proportionately. Also, due to the fact that the method of construction was based upon a plant that would last for years without showing the effect of any natural deteriorating agency, the maintenance will remain low during its life. The present maintenance force is one man on each of the first two tricks, and it is not expected that there will be any necessity for increasing this force even though traffic increases up to the full capacity of the tracks. As the tracks in this vicinity are now all on permanent elevation, there is no likelihood that there will be any radical track changes within the near future and as this interlocking plant is only one unit of a large program which had its beginning with the river straightening, it has produced on the east end of the system a modern and flexible combination of facilities.



Crossing of the Southern, the Alabama Great Southern, and the Louisville & Nashville, in Montgomery, Ala.