

The control panel at Leeds West tower

## Relay Interlocking at Leeds\*

THE power signaling recently completed at Leeds New station on the London & North Eastern is an indication of a trend which has been growing of recent years in England, the important first step towards which was taken in 1929, when the Southern installed at North Kent East Junction the first locking frame in Great Britain to have no mechanical locking. A stage further was reached in the centralized traffic control installed in 1932 on the Stanmore branch of the London Passenger Transport Board by the operation of switches and signals from a control panel instead of a locking frame, and this was followed in 1933 by a much larger panel, with relay interlocking, in the northeastern area of the L. & N. E. at Thirsk. At Leeds the principle of relay interlocking was applied to a large city station, where the traffic necessitates a considerable amount of switching.

The first part of the resignaling of Leeds New station was recently placed in service. The existing inter-

locking frame of 75 levers in the east signal tower was disconnected, and all the existing switches connected to a new 25-lever mechanical frame. For the control of the signals, a combined control panel and illuminated diagram, with small thumb switches, has been installed over the locking frame. Interlocking between switches and signals is accomplished electrically, and no mechanical interlocking of any kind has been provided. A combined lever lock and circuit closer is fitted to the mechanical levers, and the thumb switches control the appropriate normal and reverse interlocking relays.

### Types of Signals

All running signals are of the d-c. searchlight color-light type. Where a fourth aspect is required, a supplementary multi-lens unit is provided on the top of the searchlight signal. All subsidiary signals, whether for "backing," "shunt ahead" or "call on" movements, are the position-light type. Where these are fixed under the color-light running signals, only an

"off" indication is given, no light being shown for the "on" position, as the red of the color-light signal provides for it. In the case of other position-light shunt signals, the stop indication is given by two horizontal white lights, and the proceed indication by two white lights at 45 deg. to the horizontal in the upper left-hand quadrant.

Color-light signals governing over more than one route are provided with route indicators of the "theatre number" type, having an amber colored glass fixed in front of the lamps. The indications are always given when the color-light signal displays a proceed aspect, and are also shown with the subsidiary signal when this is "calling on" into an occupied platform. In all other cases, the subsidiary signal is given without the route indicator.

The new mechanical frame and signal control panel economize space to such an extent that they can be accommodated in one end of the existing tower, the portion now no longer required having been demolished. The original length of the tower was 53 ft

\*Information abstracted from the Railway Gazette, London.

## All-relay interlocking completed on the L. & N. E. indicates recent trends

and this has been reduced to 19 ft. The whole of the tracks controlled by the east signal tower have been track circuited, and all the switches are locked by the track circuits, sectional release route locking being used wherever necessary, to afford the maximum freedom in resetting a route behind a train. The track circuits are of the a-c. reactance feed type, supplied through a small step-down transformer for each track from the 110-volt mains.

The switches are electrically detected at 100 volts a-c., and are indicated on the control panel. Apart from the detection and track relays, and repeat relays of these functions, all relays are wound for d-c. operation at 12 volts. The relays are housed in the under portion of the signal tower on open racks of angle iron and teak, with the flame-proof internal wiring on the front of the racks. The main cables for controls, indications, and feeds are oil-impregnated, and paper insulated, with lead covering and single-wire armoring; the cables from the disconnection box to the signals, detectors, tracks, etc., are lead-covered and armored. The power supply is obtained from two feeders of the Leeds Corporation network, and an automatic changeover switch has been installed to guard against loss of supply if an interruption should occur on either feeder.

### Opening of New West Signal Tower Completes Installation

On Sunday, April 5, 1937, the re-signaling of Leeds New station was completed by placing in service the new west signal tower. At the east end of the station, the new signaling has been in use since June, 1936. In that case, mechanical switch operation was retained, the signals being controlled by thumb switches on a panel diagram over the ordinary levers; the old east signal tower, which was 53 ft. long, has been shortened to 19 ft. and partly rebuilt.

The installation at the west end of the station is much larger and one new signal tower takes the place of three old ones, Station, West, and Canal, which together contained about 250 mechanical levers. This new installation is worked entirely by power, con-

trolled from a panel diagram in a new signal tower, with relay interlocking. This is the first time such interlocking has been applied to a large city station having considerable terminal traffic and which is, moreover, rather difficult to operate. The approach tracks from the east, quadruple from Cross Gates where the Wetherby route comes in, are reduced to two over the last mile from Marsh Lane, while at the west end all tracks converge to a bottleneck over the canal bridge. Leeds is the terminus for a considerable local traffic, to and from Harrogate, via both Arthington and Wetherby, and on the London, Midland & Scottish Western division route. There are also express services from Newcastle, York, Hull and Liverpool terminating there and through cross-country services between Liverpool and Newcastle to be dealt with. The seasonal traffic to the Yorkshire coast resorts, Bridlington,

Scarborough and Whitby, however, provides the most difficult operating problems.

### The Relay Interlocking

As the traffic necessitates a very large number of shunting and light engine movements, it was decided to operate all switches and signals worked by the West tower from individual thumb switches located at the geographical positions on a triple control panel, although careful consideration was given to the possibility of using the route-setting principle which was adopted at Thirsk, the pioneer installation of relay interlocking on the London & North Eastern. The switches are colored, red being used for color-light signals, white for the position-light signals, and black for the switches. This panel covers some 4½ track miles and operates 33 main

Bracket with three-aspect searchlight signals, and subsidiary signals



running signals, 20 calling on signals, 35 shunt signals and 64 switches. It is constructed in three vertical planes, of which the center and largest measures only 7 ft. long by 4 ft. high, and is painted a dark olive green, finished dead matt to avoid any chance of confusion due to shine or reflected light; against this background the indication lamps stand out well. Each track circuit is indicated by two white lights; red is used for the danger aspect of all signals; for the clear position, green lights are used for main signals and white for subsidiaries. The position of each switch is indicated by white lights, marked N and R for normal and reverse, respectively. The whole of the interlocking is what is known as relay or, more correctly, circuit interlocking and all the thumb switches are free to be turned at any time, but no signal will display a proceed aspect and no switches will move unless it is safe for them to do so.

### Releases

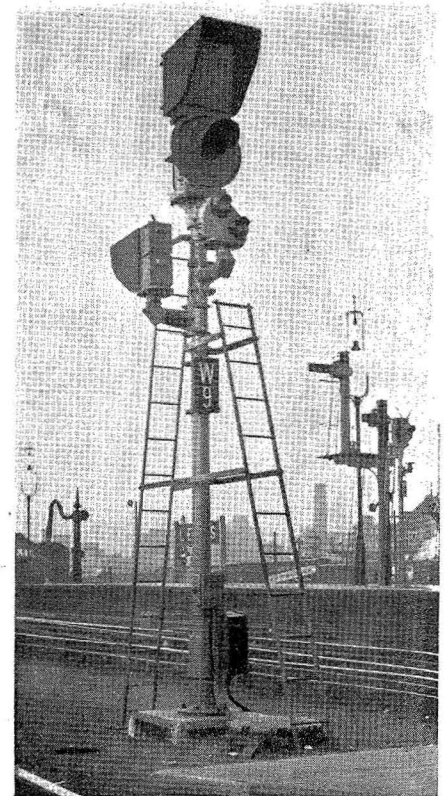
Information as to whether trains leaving in the direction of Manchester are routed via Dewsbury or the Heckmondwike loop is sent to Farnley Junction by a two-way thumb switch on the panel. The East and West tow-

ers are connected by slotting, but before initiating a movement, the East signalman has to obtain a release from the West tower. All running signals are approach locked, and it was thought desirable to provide time releases, operated by push buttons housed in a small cabinet at the right-hand end of the main panel, with mechanical interlocking to prevent more than one being depressed at a time.

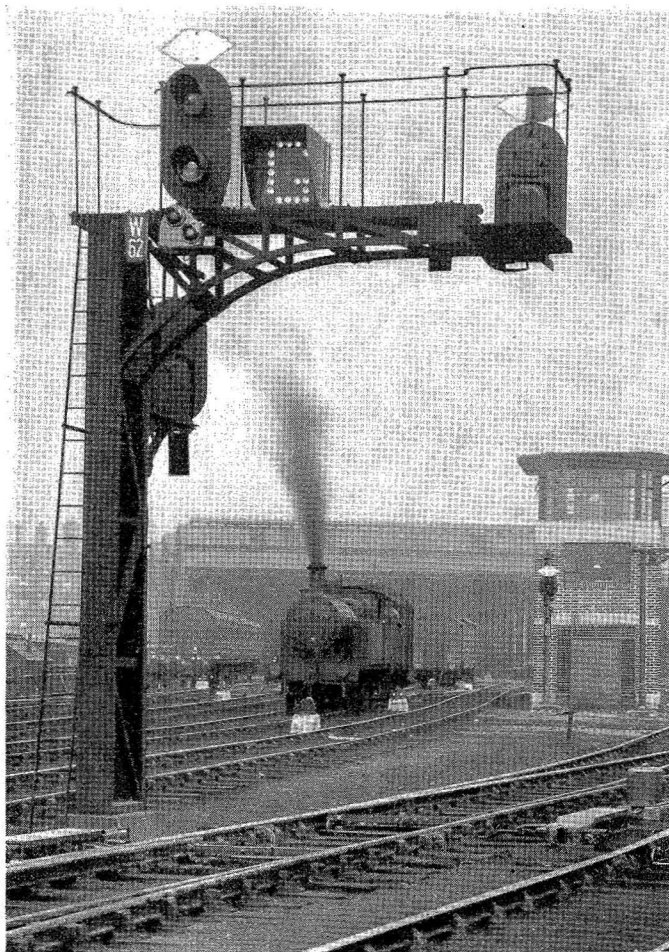
### Signals

Long-range day color-light signals of the single lens, or searchlight, type are used for all running movements. The majority exhibit three aspects, but in one or two instances a fourth aspect is necessary on account of limited braking distance. This has been provided by an auxiliary light unit mounted above the main lens, to give the double-yellow indication when required.

Shunt and subsidiary signals are of the position-light type. Subsidiary signals show a single aspect only, consisting of two white lights arranged diagonally, mounted at a distance of 2 ft. below the main signal lens to which they refer, and are normally dark. Shunt signals are mounted on the ground and exhibit two horizontal



Signals mounted on mast



Bracket with four-aspect searchlight signals, multiple lamp route indicator, and subsidiary signal

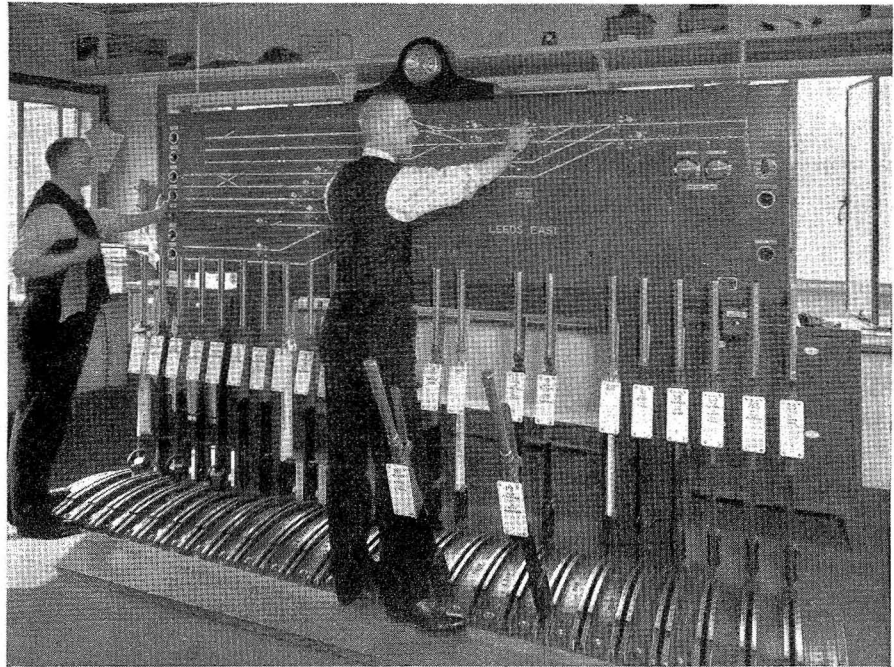
lights for danger, and two diagonal lights for clear; they have back lights, and the danger aspect of those reading over trap points includes one red light. Standard high-voltage lamps are used in these signals behind a lens combination including a pale blue glass. A change-over switch is provided in the signal tower to reduce the voltage to one-half at night.

The fullest possible use has been made of route indicators, to reduce the number of signal lights displayed to a minimum. They are all of the multiple lamp, or theatre-sign type, and display a letter or figure about 15 in. square. A maximum of 49 lamps are used, arranged in the form of a square, 7 a side, and with this large number of lamps, an accurately shaped letter or figure is displayed. The indicators appear if a color-light signal displays a "proceed" aspect, or if a subsidiary signal below it is cleared for an occupied platform.

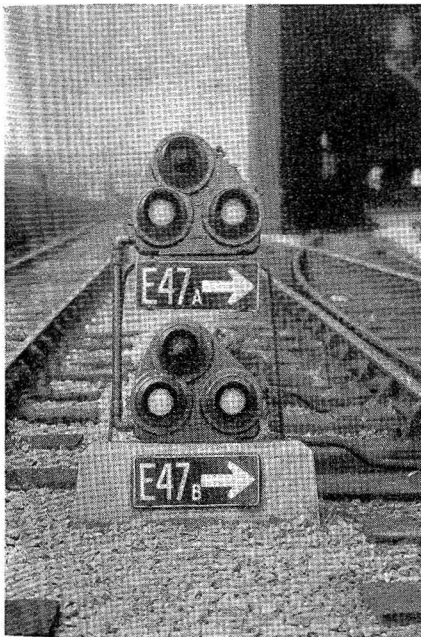
### Switches

Whereas at the east end of the station, as above explained, the switches are still worked manually, at the west end, with the exception of the cross-overs adjacent to the buffer stops on the bay platform roads, 7, 8, 9 and 10, they are electro-pneumatically operated. The switch mechanisms are of the Westinghouse standard type introduced over 30 years ago, modified only

Frame and panel located in Leeds East



in respect of the electric detector. The switch control valve, however, is of new design and is known as the "CP," by which the air supply to the cylinder is cut off the moment full operation and locking of the switch is completed. Generally the complete mechanism, including operating cylinder, escapement gear, facing-point lock, and electric detector, is carried on a single bed plate mounted in the six-foot, but in certain cases where, owing to the proximity of other tracks, this is not possible, the operating cyl-



Mounting of position-light shunt signals

inder and escapement have had to be located some distance away and a separate facing-point lock and electric detector installed in the four-foot.

### Track Circuit and Interlocking Equipment

The track circuits are of the a-c. reactance feed type, using resonated relays, supplied from feed sets housed in compact steel cases located adjacent to the rails, but the majority of the track relays are in the signal tower. There is a full switch and sectional route control throughout the installa-

tion. The track and switch indication relays are accommodated on the ground floor of the signal tower, the d-c. interlocking relays being arranged on the first floor, immediately below the control room. The interiors of the relay rooms are arranged to provide for easy access and maintenance; careful attention has been given to the placing of the windows so that no artificial light is needed during the day time for inspection purposes.

### Power Supply

The air compressor plant consists of two 6 hp. motor-driven compressor sets, only one being normally in use at a time. The set will start as soon as the pressure in the air mains falls to a pre-determined level (about 50 lb. per sq. in.) and run until a pressure of about 60 lb. has been attained. Should the pressure drop below 50 lb. the second set will automatically be switched in also, and an alarm bell will ring in the control room so that the maintenance staff may be advised. This plant is housed on the ground floor of West tower.

Power is taken from two independent Leeds Corporation supplies at 220 volts a-c., one being used as the regular supply, and an automatic contactor providing for an immediate change-over to the standby in the event of an interruption. This is then transformed down to 110 volts. From the main 110-volt bus-bars two supplies are taken, one to the West signal tower bus-bars and the other to a step-up transformer, 110/660 volts, which supplies the East signal tower 0.4 mile away. In the West tower the air compressors, each of a capacity of 25 cu.

ft. of free air per min., are fed from a separate a-c., 2-phase, 440-volt supply. The indication lamps are fed from the 12-volt a-c. bus-bars, but the interlocking circuits by 12-volt d-c., supplied from Westinghouse metal rectifiers. A diesel-driven alternator is at present being installed to provide an emergency supply in the event of a total failure of the normal supplies.



Position-light shunt signal

Paper-insulated lead-sheathed armored cable is used for all the outside wiring, and for the internal wiring in the tower flame proof compounded single conductors are used.