Extension of Color-Light Signaling on the Bombay, Baroda & Central India Railway

Additional electrification of Bombay Suburban lines have color-light running signals, position-light subsidiary signals for switching movements and route indicators

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The broad gauge section of the railway starts from Bombay and runs along the west coast for a distance of approximately 200 miles. It then turns north east and terminates at Delhi about 850 miles from Bombay. The long distance terminal is at Bombay Central, a modern station opened in 1930 and replaced an old, out of date terminal at Colaba, some four miles west and near the tip of Bombay island. The line from Bombay Central to Borivli is four-track, two tracks being reserved for long-distance trains and the other two for the local electric suburban service. The local lines extend westward beyond Bombay Central to serve the city area and terminate at Churchgate which is in the heart of the business district. All tracks are electrified from Churchgate to Bandra and from Borivli to Virar. Between Bandra and Borivli the local tracks are electrified, steam power being used on the express tracks. Fast electric "non stop" trains run on the express tracks between Bombay Central and Bandra during the peak periods, in addition to the long-distance steam trains. Bandra station is a reversing point for certain electric trains and also for electric trains from the Great Indian Peninsular Railway's Victoria Terminus which joins the B.B.&C.I. from their Harbour Branch at Mahim.

The overhead system of electric supply is in use at 1500-volts d.c. and is obtained from the Bombay City hydro-electric system. Eight coach multiple-unit trains were run when electric traction was introduced in 1927.

*Ed. note: See also "Color-Light Signaling in India," *Railway Signaling*, September, 1937, p. 517.

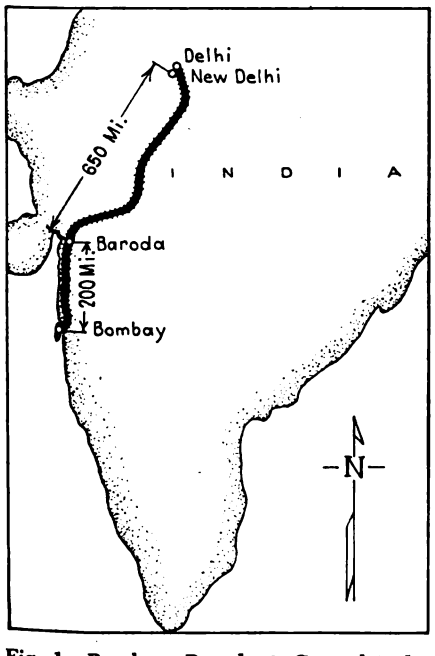
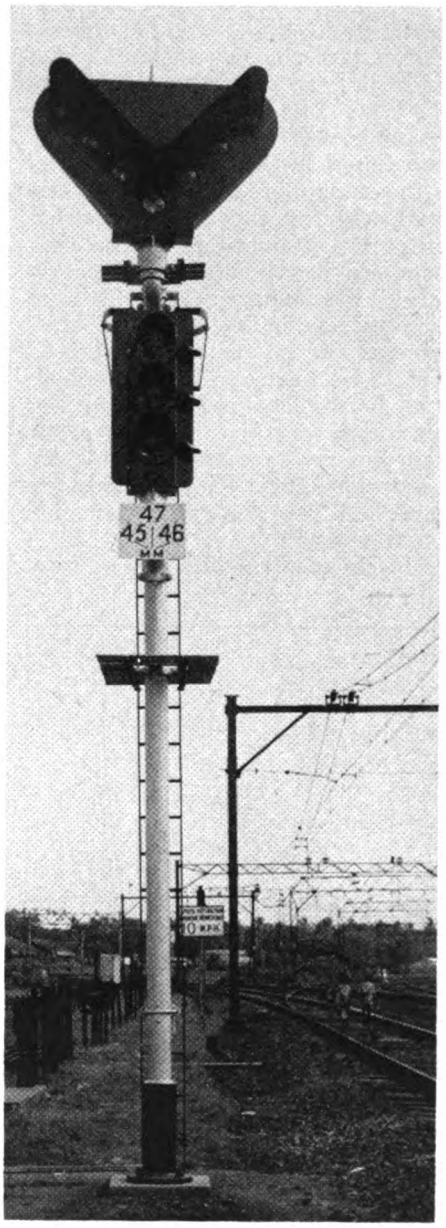


Fig. 1—Bombay, Baroda & Central India

Color-Light Signals

Three-aspect color-light signals were first installed in August, 1928, and were situated at Marine Lines and Charni Road on the Churchgate-Bombay Central section. They were originally controlled from miniature lever frames in the station master's offices as it was necessary to train the traffic staff in the working of the absolute block system by means of continuous track circuits, this being the first installation of its kind on the railway. After a few months they were converted to straight automatic signals.

The signaling at Bombay Central for the local and long-distance lines is controlled from a 119-lever power interlocking machine. The switches are electro-pneumatic, and the signals are two-aspect and three-aspect color-light. The home signal has an optical type route indicator. Signaling at Mahim and Bandra is controlled by a 50 and a 101-lever frame respectively, and switches are operated by electric switch machines. Alternating current continuous track circuits are in use with impedance bonds and reactance fed units.



Junction indicator at top of signal

Towards the end of 1936, electrification of the main line from Borivli to Virar, a distance of 12 miles, was completed. Virar is considered to be the last station on the suburban section and apart from heavy residential traffic. Milk for Bombay city also comes from this place. Before the extension of electrification it was necessary to change from the electric train terminating at Borivli and embark on a steam local for Virar. All long-distance trains are hauled by steam locomotives.

Semaphores Removed

The initial signaling alterations entailed with the opening of the extension was the conversion of d.c. track circuits, in station yards, to a.c. type. The original semaphore signaling was retained but it was soon found to be unsuitable, owing to the semaphore arms being interfered with by the overhead structures. At certain times of the year there are heavy mists, particularly during the monsoon season, from June to September, and the cross bracings of the structures were liable to be mistaken for semaphore arms in the lowered position. For this reason semaphore signals on the main lines were changed to two-aspect color-lights. These signals are controlled from the existing manual signal towers.

This installation left a gap, from Santa Cruz, just north of Bandra, to Borivli, where semaphore signaling was still in use. This was converted to color-lights in 1938 and 1939, the signals being controlled from existing manual interlocking machines. Train signaling on all lines from Churchgate to Andheri, a distance of about 16 miles, is on the absolute block system, by means of continuous track circuits. Beyond this it is done by lock-and-block telegraph instruments, the advanced starting signals being interlocked with the "Line Clear."

Work is now being undertaken with extending the electrification on the express lines from Bandra to Borivli which will enable fast suburban trains to run on these lines without overtaking and being checked by the slow local electric trains stopping at all stations. It was anticipated that by this year the lock-and-block instruments on the section north of Andheri would be replaced by continuous circuits but owing to the enormous increase in the cost of all imported material this has had to be put into abeyance for the present.

On the B.B.&C.I. suburban section, there are several signal towers which are normally closed, and only manual in cases of emergency. At Parel Junction there is a double crossover between the Up Express and Up Local tracks and Down Local and Down Express tracks. This installation is worked from a small electric slide control in the station master's office which is locked up by a King lever for automatic working. Color-light signals are in use and the main line running signals, when working automatically have an illuminated "A" visible. There is a similar installation at the next station, Elphinstone Road, where an exit siding from the car shops joins the Down Local line.

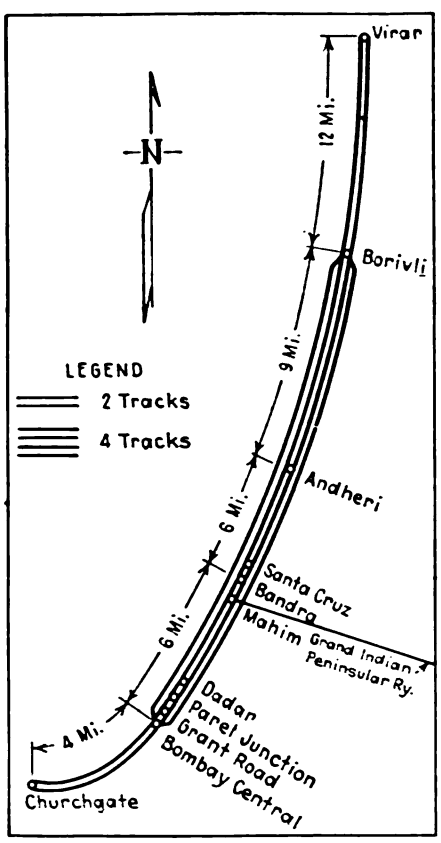
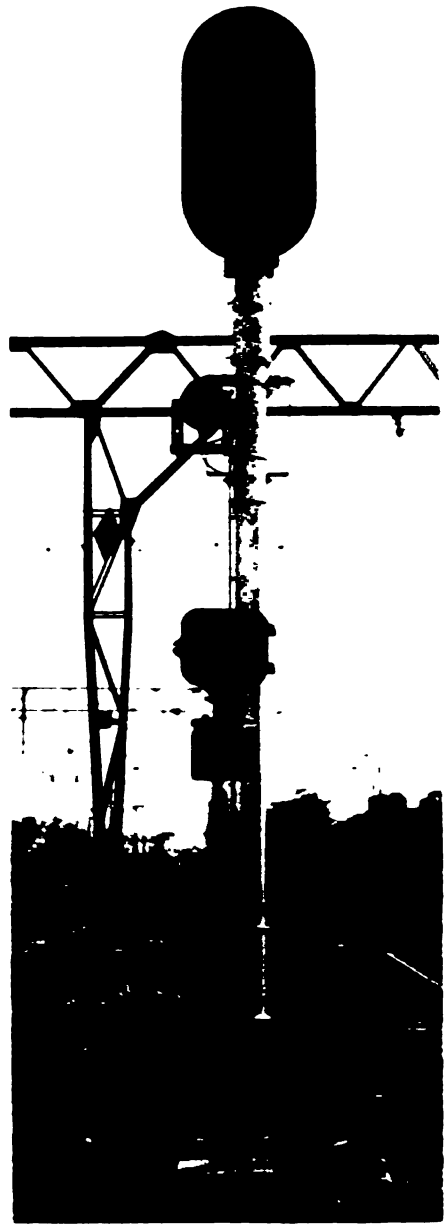


Fig. 2—Bombay suburban lines

Dadar Interlocking

The latest installation of this type was opened at Dadar in April, 1951. This consists of an emergency interlocking, normally closed, for operating a new cross-over between the Down and Up Local lines. Two-and three-aspect color-light running signals are in use and subsidiary signals, of the position-light type, are installed for switching. This is the only station, except Churchgate, where position-light signals are in use on the B.B.&C.I., but they will be installed in all new works in the future. The crossover is worked by electric switch machines.

The signal tower is a single story structure of brick faced with rough cast cement finish. The operating



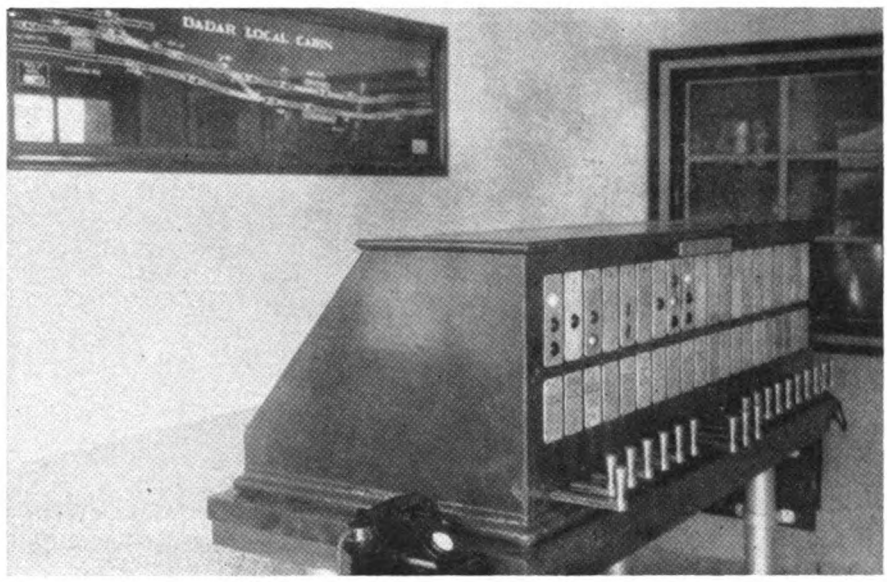
Illuminated "A" indicates signal is on automatic operation

portion of the tower is on the same level as the relay room but divided by a wall, and both rooms have fluorescent lighting. An electric interlocking machine, mounted on cast-iron pillars, occupies the central portion of the operating room. The slides control running signals, crossover and subsidiary signals. There is a King lever or slide for automatic operation of signals when the plant is closed. The aspects of all signals are repeated by colored visuals set into the description plates at the back of the slide handles. The slide control was fabricated in the signal shops, and circuit controllers and electric locks on the slides were obtained from a firm of signal contractors.

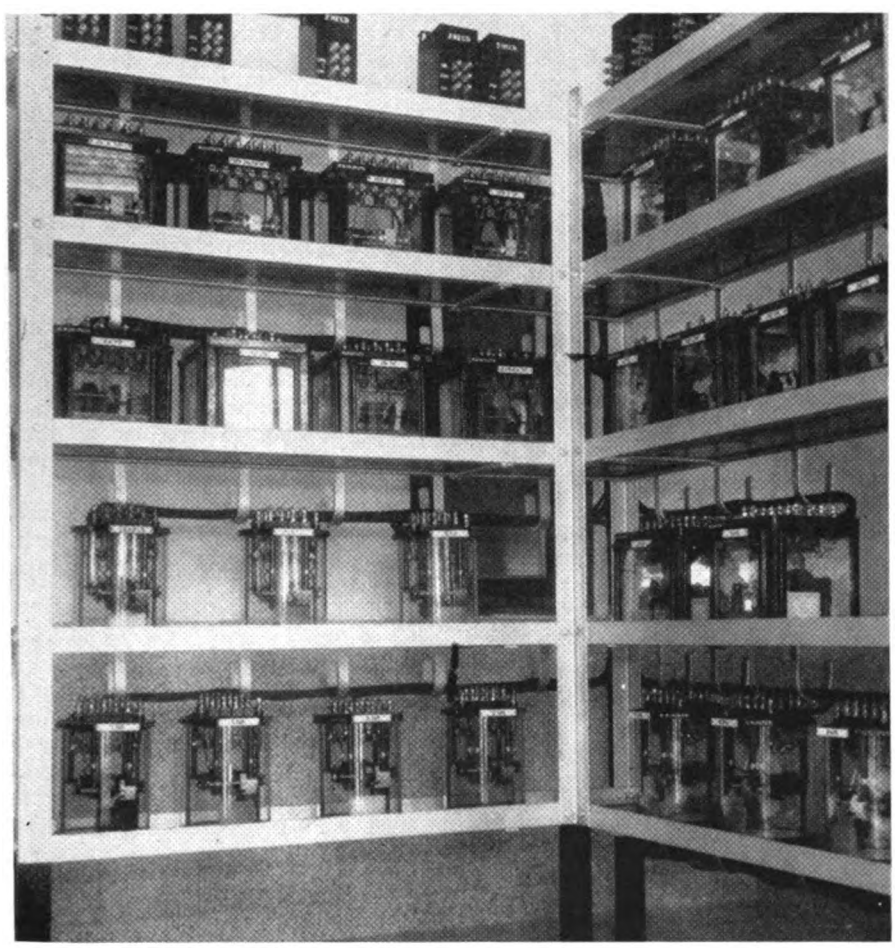
The illuminated track diagram is set into the partition wall dividing

the operating and relay portion so that only the front can be seen. The back portion protrudes into the relay room. An electric clock is set into the wall over the track diagram. A feature of the operating portion of the tower is that the only wire that can be seen is the flexible cord for the telephone. All other wiring is concealed. The wires going to the back of the diagram are in the relay room, and the wires for the slide control run inside the pillars. B.B.&C.I. standard signal department armoured cables are used having wires of 1/.064 in composition of 12 core, 7 core and 5 cores.

All the work was undertaken by the B.B.&C.I. railway signal staff. This emergency signal tower has been provided as a relief in case of monsoon flooding. These floods may occur after several days of heavy rain and co-incident with high tide when the line in the Grant Road and



Control room in the Dadar tower showing slide control handles and indicating lights on the interlocking machine



Metal hangers keep wiring straight on relay racks

Parel areas becomes unworkable. Before the installation of the new emergency crossover, when these places were flooded, trains coming from Borivli and Virar in the outer suburbs, had to be reversed at Bandra, some ten miles from Bombay. They can now be reversed at Dadar which although not the city's business center, is nevertheless a very busy station serving the textile and other industrial areas.

Junction Indicator

The B.B.&C.I. was the first railway in India to use the junction indicator signal, now extensively used by British Railways. Where four or five color-light signals are placed on one post it has been found that when one signal is changed from red to yellow or green the other red lights tend to diminish the brilliancy of the aspect. The red aspect is always the more powerful.

The British Railways have been aware of this difficulty, and during the past few years have developed the direction indicator signal (junction indicator). Only one signal is used irrespective of the number of divergencies.

If the switches are set for the main line, and the next signal ahead is showing yellow or green, a green aspect is shown which informs the engineman that he can proceed at full speed. Should the switch be set for diverting the train left or right on to another line, the yellow aspect only is displayed and the direction of the diversion left or right, is indicated by a line of lunar white lights at the top of the signal. In the case of a switch being set so that a train is to be diverted to the left, the lights would appear at an angle of 45 deg. leaning to the left, and vice versa for a right-hand diversion. The electrical circuits are so arranged that the yellow light cannot be illuminated unless the lunar white lights are displayed.

With this type of signal, enginemen can observe the conditions of approaching junctions from a far greater distance which enables them to regulate the speed of their train accordingly. We propose to use this type of signal on all new works and where signal alterations have to be carried out and it can be applied.