mary cells, several changes were suggested in the paragraph 1. Purpose, in an effort to define "light duty" service. It was suggested that an explanation be inserted to the effect that cells should be connected in multiple-series for heavy loads. However, it was decided that the paragraph as presented was adequate. F. B. Wiegand (N. Y. C.) asked whether tests had been conducted and Mr. Zane stated that members of the committee had made tests during the past two years and felt sure that the cells made according to this specification would meet the tests required in the specification. The specification was then adopted for inclusion in the Manual.

Report of Committee X—Signaling Practice

C. H. Tillett, CN, Chairman
H. H. Orr, C&EI, Vice-Chairman

F. H. Bagley, SAL
G. H. Dryden, B&O
W. J. Eck, Sou.
W. H. Elliott, NYC
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J. C. Mock, MC
R. D. Moore, SP
H. G. Morgan, IC
J. P. Muller, B&M
F. W. Pfleging, UP
W. M. Post, Pa.
A. H. Rudd, Pa.
J. E. Saunders, DL&W
E. G. Stradling, CI&L
C. A. Taylor, C&O
G. K. Thomas, San.Fe
W. M. Vandersluis, IC
F. B. Wiegand, NYC
L. Wyant, RI

The report of the Committee on Signaling Practice included descriptions of recent developments in automatic train control and cab signals, and discussions on aspects and indications for four-block signaling, signaling for increased train speeds, noteworthy changes in signal practice since the last annual meeting, possibilities of a uniform system of aspects and indications, and conditions under which trains may be operated by automatic signal indication without train orders. Abstracts of some of these reports follow:

Automatic Train Control and Cab Signals

This report gave the road and track mileage, and number of engines equipped, with automatic train control and cab signals as of July 1, 1936, and listed the number of locomotives equipped for interchangeable operation on various roads. Various tests were conducted during the year, including tests of a time-element reset designed to eliminate the reset cock on certain types of equipment, and tests of various special installations of train control and cab signal equipment designed for interchangeable operation. Attention was called to the need for service tests to determine the maximum speed at which intermittent inductive automatic train stop devices will operate to initiate an automatic brake application, under the various conditions of air-gap and offset obtaining in service.

Signaling for Increased Train Speeds

In general the problem of signaling for higher train speeds is that of increased stopping distances. A restrictive indication must be displayed not less than full stopping distance from an obstruction. The view of signals should be as good as practicable and aspects should be distinct. If necessary, signals should be moved, rearranged or provided with lights having beams of greater intensity to improve their efficiency. Short range signals such as disc signals should be replaced with modern types.

Owing to the many variables affecting stopping distance, very little definite information is available. Attention naturally focuses on the specially designed high-speed passenger trains. These trains, however, have special braking equipment. The real problem lies in the gradual stepping up of trains using standard-weight equipment.

In signaling for higher speeds it has been found generally satisfactory to use three indications with minimum block length from 6500 to 9000 feet on tangent level track. The use of a fourth indication has been found desirable in heavy traffic zones, particularly where slower speed traffic is operated on the same tracks with high-speed trains.

The results obtained by the use of three or four-block signaling are illustrated in Fig. 1 which shows the minimum distance which must intervene between the rear end of a train and the front end of a following train, in order that following train may receive a clear signal, and have 8,000 ft. stopping distance beyond the first approach signal.

There is so little advantage of a five-indication four-block system over a four-indication three-block system for spacing high-speed trains that the five-indication system has not yet been used much for this purpose. The five-indication system has been used in dense traffic areas where speeds from 45 to 60 m.p.h. are obtained. The fifth indication is being used for high-speed train operation at special locations to govern approach to high-speed turnouts.

In heavy traffic lines with short block spacing, say 5,000 ft., the change to four-indication signaling is desirable to maintain track capacity.

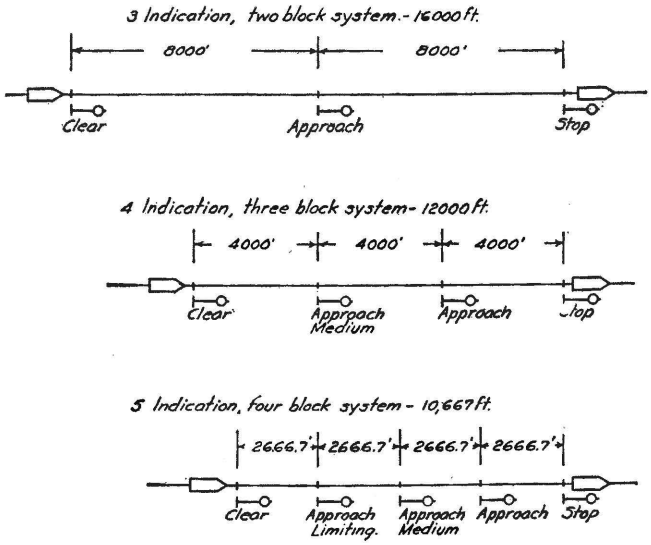

Fig. 1—Diagram explaining spacing of following trains with different types of multiple-aspect signaling all based on 8,000-ft. spacing distance

The mileage so equipped, however, has been very small.

In 1935, with 93,401 miles of track equipped with automatic block signals, only 1,059 miles were equipped with four-indication signals.

At stations and at interlockings where short blocks have to be retained, duplicate restrictive indications have been used rather than introduce a fourth indication in three-indication territory. The use of duplicate restrictive indications is objectionable because of extra delay introduced. There is also a tendency for enginemen to expect to always encounter two approach indications when approaching a stop signal, which may cause a

stop signal to be overrun at a location where only one caution signal is displayed. Overlaps have also been used at special locations where short blocks are required. Their use is objectionable because an extra stop is required. The display of a stop signal for an unoccupied block is also objectionable.

The above statements apply to multiple-track signaling. On single-track automatic block signaling, overlaps have to be used for opposing movements and they must be extended to take care of increased speeds. The use of duplicate restrictive indications is also necessary in order to take care of opposing movements.

Discussion

H. G. Morgan (I.C.), when presenting the report, explained that information received since the Advance Notice was printed, indicated that during 1936 four block signaling was installed on 240 track miles using 205 signals, which figures, together with those for isolated sections previously in service, brings the total to 456 track miles using 345 signals.

Aspects and Indications for Four-Block Signaling

Under present conditions, the necessity for four-block indication exists to a limited extent. Where such indications are installed, it is probable that disc signals and semaphores would not be used, and, therefore, in considering aspects, position-light signals, color-position-light signals and color lights should be provided for. In its report at the 1936 annual meeting, the committee recommended an additional signal: Name—Approach-Intermediate; Indication-Approach next signal at not exceeding intermediate speed; this signal to be placed between the approach-medium and the approach signal. This intermediate signal should be placed between the clear signal and the approach-medium in high-speed territory and called approach limiting.

The Standard Code leaves it up to each railroad to define medium speed and slow speed. It is recommended that another definition be added, i.e., "Limited Speed"; each road to determine what this speed is to be; that the rule should be numbered 281a; Name —Approach Limiting; Indication-Approach next signal at not exceeding limited speed. Position-light signal will display for this purpose the same aspect as for the approach-medium, with a marker light above the existing aspect. The color-light and color-position-light signal may be treated in the same way. With color-light signals, a consistent scheme for accomplishing this aspect would be to use yellow over green, in which case it would be desirable to use yellow over yellow for the approach-medium aspect. The committee recommends that if this report is approved by the Signal Section, the Committee of Direction request that the new rule recommended be included in the Standard Code.

Discussion

A. H. Rudd (Penna.), when presenting the report, explained that since the report was printed further progress has been made in developing improved aspects which will be explained in a future report.

E. N. Fox (B. & M.) brought out the point that certain automatic signals serve also as approach signals for interlockings and, therefore, that aspects for both applications should be considered as a unit. On the B. & M. the signal controlling a train movement over a slow-speed turnout, No. 10, is directed by an aspect of red, over red, over green, name of signal "clear-slow," the aspect of the signal in approach being yellow over yellow, the name of the indication being "approach-slow."

F. B. Wiegand (N.Y.C.) stated that the standard code includes an aspect of yellow over red, over green, to give an indication equivalent to the B. & M. "approach-slow." Mr. Fox contended that the use of yellow over yellow permitted a better use of colors to secure a distinctive aspect.

Mr. Tillett stated that since the report was printed, word had been received that a move had been started to revise the standard code, and that the committee would no doubt have an opportunity to advance suggestions for changes in aspects and indications.

Noteworthy Changes in Signal Practice

A description was given of roller bearings for switches, tests of which show reduced power requirements of approximately 60 per cent. The device provides for the support of practically the entire weight of the switch on roller bearings, while in transit. However, when a train travels over a switch equipped with this device, the switch is supported by tie plates in the usual manner. It utilizes a multi-leaf cantilever spring secured to the stock rail which engages with the roller mounted in a bracket bolted to the switch rail. The spring is so proportioned as to provide a yielding support for practically the entire weight of the switch rails which rest on the roller bearings. The power requirement variations are particularly noticeable where the lengths of switches have been increased to 45 ft. with a corresponding increase in the weight of rail to 131 or 152 lb. Dragging-equipment detectors have been developed to actuate the signal system so that enginemen are informed of low-hanging equipment on their trains. (For description of dragging-equipment detectors, see *Railway Signaling* for November 1936.)

Discussion

W. M. Post (Penna.), in presenting the explanation of the roller bearings for switches, explained that for power-operated switches using 45-ft. points, two bearings are used under each point. On one switch about 1,500 ft. from a tower, and operated by a mechanical plant, three bearings were used under each point.

W. H. Stilwell (L. & N.) inquired as to what special signal aspects were used to indicate to an engineman that a dragging equipment detector had been operated, so that the engineman would know that the signals had been set by the detector. Mr. Post explained that no special aspects had as yet been developed for this purpose, but that the necessary information was conveyed to the engineman. In cab signaling territory the wayside signal ahead of the train indicates "approach" and the cab signal, "caution-slow speed." This unusual combination of aspects indicates detector control. Outside of cab signal territory the wayside signal indicates "stop." In all of the installations the towerman gets an indication that the detector has operated and he instructs the train crew to inspect the train for dragging equipment.

Report of Committee VIII—Highway Grade Crossing Protection

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W. M. Post, Pa., Vice-Chairman

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W. J. Eck, Sou.
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A. H. Rudd, Pa.
J. E. Saunders, DL&W
C. F. Stoltz, Big 4
G. K. Thomas, San.Fe
C. H. Tillett, CN
E. P. Weatherby, T&P

The report of the Committee on Highway Crossing Protection included a specification submitted primarily for use in preparing a specification for the installation of highway grade crossing signals in connection with the federal program for protection of grade crossings, and a revised set of requisites for highway grade crossing signals, being the present requisites revised to make them comply with present requirements. The revised requisites have enlarged sections covering "mounting," range and spread, and lenses or roundels. The flashing light range and spread requisite, as proposed in this specification, reads "Each flashing light unit shall provide a front indication having a beam candlepower of uniform intensity at any angle up to 15 deg. on