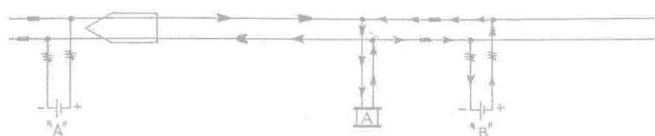


would be when the train shunt is poor and battery *A* current tends to flow by the train, thus reducing the voltage at relay *A*. Poor train shunting is a very undesirable condition in any event and should be remedied but not by transposing the track circuit polarities.

I do not know of any improper operation due to this cause but I do know of a few cases where a



Track circuits with same polarities at adjacent rails to illustrate foreign current action on relay *A*

train approaching a signal shunted the track relay on the other side of the joints due to leaky or broken down joints and thereby tripped the signal in the face of the train. It seems remote that any improper operation that might result from leaky or broken down joints, would be overcome by transposing the polarity of adjacent track circuits. Hence, the benefit derived from transposing the polarity of adjacent track circuits, at the expense of simplicity and uniformity, is questionable.

Albany, N. Y.

F. X. REES,

Circuit Engineer, New York Central

Transposed Polarities Enable Maintainer to Check Condition of Insulated Joints More Easily

AMONG the benefits derived by transposing the polarity of adjacent track circuits, the most important is the check on broken down insulated joints at the signal location. The transposed polarity gives a maintainer an easy check on the condition of the insulation in the joints. By placing a jumper around the insulated joints (first one, then the other) it is possible for him to detect broken down insulation, because if both joints show a leakage or breakdown the signal will display a restrictive indication.

Should both insulated joints break down at the signal, it will give a stop indication if a two-position track relay is employed and with three-position polarized circuits, the signal will show a caution indication. This feature in itself has proved the necessity of providing transposed polarity of circuits at all automatic signal locations.

St. Augustine, Fla.

W. A. HOFFMAN,

Signal Engineer, Florida East Coast

How Many Signal Aspects and Indications?

"What is the distinction between signal aspects and signal indications? How many are needed for efficient operation?"

Lackawanna Employs Six High and Two Dwarf Signal Aspects for Interlocking and Automatic Signal Indications—Cab Signaling Requires Fewer Aspects and Indications Than Wayside Signaling

THE distinction between signal aspect and signal indication is best shown by the following definitions of these terms:

Signal Aspect—The appearance of a signal conveying the indication as received from the direction of an approaching train.

Signal Indication—The information or command conveyed by the aspect of a visual signal.

We are primarily concerned with the safe, and secondarily with the expeditious, handling of trains. To this end (1) Signal aspects and indications should be limited to the minimum necessary for conveying the required information; (2) An aspect should have but one indication; (3) Both aspects and indications should be developed along a line of logical reasoning so as to be easily comprehended by enginemen and trainmen, and easy to fix clearly and indelibly in their minds.

Color-light signals have been used for any extensive installations on the Lackawanna since 1920. Six high and two dwarf signal aspects serve for both interlocking and automatic signal indications, as indicated by the accompanying chart. There is one apparent inconsistency in that, aspect 2 without number plate means

THE DELAWARE, LACKAWANNA AND WESTERN RAILROAD COMPANY					
COLOR LIGHT SIGNALS					
NAMES, ASPECTS AND INDICATIONS					
FIG.	COLOR GIVEN BY	INTERLOCKING HIGH SIGNALS		AUTOMATIC BLOCK SIGNALS	
		NAME	INDICATION	NAME	INDICATION
1.	One Red Light	Stop Signal	Stop		Legend ● Red ◐ Yellow ◑ Green
2.	Red Light over Yellow Light	Slow Speed Signal	Proceed at Slow Speed Prepared to Stop	Stop and Proceed Signal	Stop and proceed (under limitation given in Book of rules)
3.	One Yellow Light	Approach Signal	Approach next signal prepared to stop	Approach Signal	Approach next signal prepared to stop
4.	Yellow Light over Green Light	Approach Restricting Signal	Approach next signal at restricted speed	Approach Restricting Signal	Approach next signal at restricted speed
5.	Red Light over Green Light	Clear Restricting Signal	Proceed at restricted speed		
6.	One Green Light	Clear Signal	Proceed	Clear Signal	Proceed
SLOW SPEED SIGNALS					
7.	One Red Light	Stop Signal	Stop	NOTE:—An automatic block signal is distinguished from an interlocking signal by a number plate.	
8.	One Yellow Light	Slow Speed Signal	Proceed at slow speed prepared to stop		

Chart giving names, aspects and indications of color-light signals on D. L. & W.

"Proceed at slow speed prepared to stop;" and with number plate means "Stop and proceed" (under limitation given in book of rules). There is no hazard to traffic due to misinterpretation of this indication, in fact, it is expected that eventually the automatic and interlocking indications will agree and be "Proceed at slow speed prepared to stop." On new installations aspect figure 1 with number plate will have the automatic signal indication as shown for figure 2.

An entirely new factor must now be considered as it has a material bearing on signal aspects and indications—cab signals are being adopted very generally in connection with automatic train control of the continuous type. It is desirable that these agree both in indication and aspect with wayside signals, except the interlocking stop and slow speed signals which need not be reproduced in the cab. When speed control is automatically enforced, the cab signal indication must necessarily be confined to action required on the part of the engineman as soon as received.

A slight rearrangement of D. L. & W. standard

aspects and indications for cab signals which may also be used for wayside signals follows:

Former Figure No.	Aspect	Indication
2	Red light over yellow light	Proceed at slow speed prepared to stop
3	One yellow light	Proceed at restricted speed prepared to stop at next signal
4	Yellow light over green light	Proceed at restricted speed
6	One green light	Proceed

It is probable that aspect and indication No. 3 will be eliminated for cab signals.

High speed trains are operating on very close headway in heavy traffic territory on the Lackawanna using the indications of wayside signals shown in the accompanying chart. It will be noted that these do not differ materially from those presented by Committee X at the stated meeting of the Signal Section, A. R. A., in September. These aspects and indications are used on multiple-track with reverse-traffic operation, through a considerable number of interlockings where there are not only through traffic but also switching operations. By the simple expedient of a "light-out" relay, protection is secured against a less restrictive indication being given due to a burned out lamp.

Hoboken, N. J. J. E. SAUNDERS,
Signal Engineer, Delaware, Lackawanna & Western.

Effective Operation Is Greatly Facilitated by the Use of Ten Signal Indications Although Those Relating to Medium Speed May Be Dispensed With Under Certain Physical Conditions

SIGNAL aspect may be defined as the appearance of the signal, as a whole, as viewed by an engineman when approaching such signal. In other words it is the distinguishing feature of the signal. For example, the aspect distinguishes between the so-called "stop and stay" signal and the "stop and proceed" signal. Other aspects indicate various other kinds of signals such as manual block, train order, distant switch, etc. Even a layman can distinguish by its aspect the distinction between a tilting target signal and a color-light signal but the layman would not know the meaning of the indication given by such signals.

The signal indication is the information conveyed to an engineman by the signal. The aspect has a bearing on what action the engineman should take, for example, the indication of the signal may be "stop" and if it is a "stop and stay" signal the engineman knows by the aspect of the signal that such is the case. If it is a "stop and proceed" signal he knows by the indication that he must stop and by the aspect that after stopping he may proceed.

The number of aspects and indications needed for effective operation is dependent upon traffic and physical conditions on a railroad and it is also dependent upon what is meant by effective operation. If by effective operation is meant economic operation and if this carries with it the assumption that for economic operation a railroad must be fully signaled then but two aspects are required, namely, the "stop and stay" and "stop and proceed." For roads not fully equipped with automatic block signals, other aspects are required such as for a manual block signal, distant switch signal, tilting target signal, railroad crossing gate signal, etc. The needed indications are as follows:

"Stop," "Stop then proceed at restricted speed," "Normal speed," "Reduced speed prepared to stop at next signal," "Reduced speed prepared to pass next

signal at medium speed," "Medium speed," "Medium speed prepared to stop at next signal," "Slow speed" and "Restricted speed." In naming the indications I have used the definition of the indications as given by Committee X in the advance notice of the 1927 stated meeting as follows:

Medium speed—30 miles an hour
Slow speed—15 miles an hour
Restricted speed—Proceed prepared to stop short of train, obstruction or anything that may require the speed of a train to be reduced.

DEFINITION OF INDICATIONS

"*Stop*" and "*Stop; then proceed at restricted speed*"—These indications are self-explanatory. They are given when it is required that the train be stopped.

"*Normal speed*"—This indication is self-explanatory. It indicates movement of train at normal speed and it is given when the signal in advance is in position other than "stop" or "stop; then proceed" and there is stopping distance between the first signal in advance and the next signal in advance.

"*Reduced speed prepared to stop at next signal*"—This indication can best be explained by saying that it is the old-time distant signal indication. It is given when the next signal in advance is at "stop" or at "stop; then proceed with restricted speed."

"*Reduced speed prepared to pass next signal at medium speed*"—This indication is given: (1) When the second block in advance is shorter than stopping distance at normal speed. (2) When movement at next signal is over a crossover which will permit a speed of 30 miles an hour; this may be in four-track territory or in double-track territory where the two tracks are signaled for movements in both directions.

"*Medium Speed*"—This indication is given where movement is made over a crossover which permits of a speed of 30 miles an hour and where the next signal indicates other than "stop" or "stop; then proceed at restricted speed." This indication, like the previous one, is for use in four-track territory and on double-track signaled for running in both directions. It may be said that this indication can be dispensed with by placing the signal governing the movement into the block immediately in advance of the interlocking and using the slow-speed or restricted-speed indication for movement through the interlocking plant. The use of the slow-speed and restricted-speed indications for such movements in my opinion is not conducive to effective operation as it has a tendency to slow up train movements. The section of track governed may be short. Speed restrictions however apply to the entire train and although the signal in advance may indicate "normal speed" the engineman is not permitted to so proceed until the rear of his train has passed the signal in advance of the interlocking plant governing movement into the block.

"*Medium speed prepared to stop at next signal*"—This indication is used similarly to the indication "medium speed." It merely conveys the additional information that the train must be prepared to stop at the next signal. It may also be used for movement on to sidings, if the turnout will permit of a speed of 30 miles an hour. The siding, of course, would have to be of sufficient length and have full train length track circuit protection.

"*Slow Speed*"—This indication is used at interlockings and governs movements that may be made at slow speed. This indication involves track circuit protection as it may be given only for movements into an unoccupied section of track.

"Restricted Speed"—This indication is given generally at interlocking plants and is used primarily for shifting movements; it may also be used for advancing a train into an unoccupied block and for advancing a train into the block in case of failure of the signal giving block protection.

"Reduced speed prepared to pass next signal at restricted speed"—This indication has been referred to recently and it is intended to indicate to engineer that he may pass the next signal at restricted speed. It is said that such an indication will facilitate movements at the entrance to yards where such movements are made under the restricted speed indication. The economical operation of trains and the importance of clearing the main track promptly seem to warrant having such an indication. It is of advantage where visibility of the restricted speed signal is low as it permits movements into the yard without trains coming to a stop. The adoption of this indication would be in keeping with the following which is taken from the report dated May 7, 1927, of the Joint Committee on Utilization of Locomotives.

"The length of blocks, whether automatic, manual or manually controlled systems, should be studied with a view of obtaining the fullest utilization possible and with the least interference. It is important that facilities such as interlocking plants, adequate signaling, etc., be given careful consideration and provided as they may be needed as these facilities have a decided influence on the number of locomotive hours required to move a train from the initial to the final terminal. Delays in yards or on line of roads due to failure of signaling or interlocking facilities interfere with the fullest use of the locomotive."

The above ten indications are conducive to effective operation, although on some roads they may not all be required as physical conditions may permit the elimination of those which relate to medium speed. However, before concluding that the indications relating to medium speed can be dispensed with, a careful study and analysis should be made of the entire system, keeping in mind the shortening of the blocks approaching terminals which may necessitate the installation of three-block indication, and consequently the use of the indications relating to medium speed. The other indications are essential and cannot be dispensed with.

Cleveland, Ohio.

F. B. WIEGAND,

Signal Engineer, New York Central.

Signal Aspects Should be Studied Carefully with Respect to Operating Facility—Number of Indications Needed Depends Upon Character of Traffic—Desirability of Two Little Used Indications Well Illustrated

AN authorized definition of signal aspect is "the appearance as viewed by the eye" from which it is evident that a signal aspect is the arrangement and color of lights or semaphores as viewed by the engineer. Signal aspects indicate the condition under which a train should be operated. The signal indication is the information given to the engineer by the aspect.

There is no subject in the signal field more opportune at this time than the question of signal indications and aspects which is now being considered by Committee X of the Signal Section, A. R. A. The railroads as a whole have in the past looked at this subject in rather a backward manner, that is, they have determined and used certain aspects which could be given readily with the type of signal in use, rather than making a study of and adopting the signal indications which

would be helpful to operation, and then using the aspects which would best convey these indications.

There is hesitancy on the part of a great many railroad officers to use certain indications for fear that they might be too complicated for the engineer when, as a matter of fact, it is much easier for an engineer who is responsible for the handling of a train to understand and take advantage of certain indications than it is in many cases for the officers to take the trouble to study them out.

The signal indications are to an engineer, what a cane is to a blind man in going down his front steps and, as far as that goes, the engineer is in most cases blind actually as to seeing conditions braking distance ahead. It should not be expected that the engineer will design the signal indications and submit them to his management, although in many cases they call attention to the desirability of more complete indications.

The number of indications needed for efficient operation depends on the character of traffic and to an extent on the financial condition of the road, as a road whose earning capacity is low has the greatest need for economy in time, equipment and fuel. While it is true that under certain conditions of straight track and clear weather, the engineer can see a considerable distance ahead and the need for a complete system of indications is not so great, any decision should be based upon securing efficient operation with the desired safety around curves and in foggy or stormy weather.

A certain location can well be taken to illustrate the great desirability of some indications which are not generally used on the majority of American roads. A home signal gives three separate proceed indications: "Proceed on straight track unoccupied," "Proceed at medium speed for movement to another track in same direction of traffic over a long crossover" and "Proceed at slow speed over a short crossover or into siding." The approach signal is out of sight of and braking distance from the home signal.

The indications given by the approach signal are: "Stop then proceed," "Proceed" and "Prepare to stop at next signal." An engineer of a heavy freight train moving at speed, upon receiving the "Prepare to stop at next signal" indication has but two alternatives: (1) To make an automatic application of air on his train, bringing the train to a stop or (2) to take a chance on the medium-speed or slow-speed indication being given by the home signal and approach the signal without being prepared to stop, possibly getting into trouble. It is a fact, although not generally recognized, that an engineer of a medium or full length freight train will not release the automatic brakes after once applied until the train comes to a stop. Some roads specify this operation in the rules for trains over certain length, but generally the engineers will follow this procedure.

If the approach signal in addition to the indications mentioned above is arranged to give indications "Prepare to pass next signal at medium speed" and "Prepare to pass next signal at slow speed" the engineer can, by shutting off the steam, and possibly working the engine brake, control his speed so that proper and safe operation is obtained without stopping the train with incidental wear and tear on equipment, loss of time and coal waste. These losses are not imaginary or theoretical but exist on practically every railroad in the country at the present time and are due largely to lack of thorough study of conditions.

There are a number of other little-used indications

which are equally valuable and the difference in cost between providing a signal system with the indications required for efficient operation as compared with a skeleton system is not great and can in most cases be readily justified by operating savings. It is not practicable to present a complete list of the desired indications without a study of conditions on all railroads, which study can best be made by the committee to which this subject has been assigned.

Albany, N. Y.

R. B. ELSWORTH,
Assistant Signal Engineer, New York Central.

Each Signal Aspect Must Convey Only One Signal Indication

THE words "aspect" and "indication" are oftentimes used in error and sometimes considered synonymous. By reference to the standard dictionary we find these definitions: *Aspect*—Appearance as viewed by the eye. *Indication*—A prediction, a token, a sign.

The correct definition of the words would indicate the difference in their proper use. From an efficient operating standpoint, each signal aspect should convey only one signal indication to the approaching engineman, thereby reducing the number of aspects for him to memorize and facilitating his reading of them.

There is an apparent inconsistency in the American Railway Association standard rules dated October 18, 1915. In a manual block system, the arm in the 45 deg. position, yellow light, indicates "block is occupied." The same aspect in automatic block rules indicates "block is clear" but next signal is at stop. An efficient operating system can be designed using a total of only 14 aspects.

Cincinnati, Ohio.

E. T. AMBACH,
Assistant Signal Engineer, Baltimore & Ohio.

What Type of Highway Crossing Signal Should Be Used in Cities?

Should the Signal Section, A. R. A. standard highway crossing signals be used exclusively within corporate limits of municipalities as well as at highway crossings? Does the "traffic type" signal offer advantages because of uniformity of indications within city limits?

Does Not Believe Traffic Type Signal Offers Safety Advantages Because It Destroys the Uniformity of Indications Which Is the Thing Really Desired—At Grade Crossings a Proceed Green Light Should Never Be Displayed

THIS proposition is more involved than the question would indicate. I believe ordinarily the highway departments do not have jurisdiction in the cities; their maintenance stopping at the boundaries of the city or borough, unless perhaps, in some cases, where an important state highway extends through the town and, by some local arrangement, the state has taken over the maintenance.

I believe we should make every effort to have the highway crossing signals recommended by the Signal Section installed on all the highways, preferably, in my opinion, on the right side of the road where the other signs are placed. In city streets where it is the custom to locate the traffic signals or the traffic policemen in the center of the street, it seems to me the signals indicating the approach of a train should also be so located, and that the Signal Section standard should be used.

I do not believe that the "traffic type of signal offers advantages because of uniformity of indications within city limits." The city signals are used for stopping vehicles at street intersections. If they are also used to indicate the approach of a train, they tend to destroy the uniformity we are attempting to obtain, namely, to segregate the recommended standard to indicate the approach of a train and nothing else and, conversely, prevent the use of the recommended standard except where it does indicate the approach of a train.

A proceed green light should not be displayed in cities when no train is approaching, as it is not so displayed at other crossings. We provide red lights on gates to stop traffic; when the gates are raised, a green light is not displayed to highway traffic. A crossing watchman displays a red light to stop traffic; he does not display a green light when no train is coming. Our standard signals wig-wag or flash alternately on the approach of a train and do not display a green light when no train is approaching.

On the other hand, the municipal authorities may insist on the use of the city standard, and frequently compromises must be made. If such authorities will guarantee police protection and enforcement of the requirement to stop, it may be the part of wisdom to make such installations.

Philadelphia, Pa.

A. H. RUDD,
Chief Signal Engineer, Pennsylvania.

Proper Use of Traffic Signals Is No Reflection Upon Signal Section, A. R. A. Standards

IN deciding on the type of protection to be given each highway crossing, the local conditions must all be taken into consideration and while I believe that the Signal Section A. R. A. standard highway crossing signals should be used wherever possible, it seems to me there are places where it is better, in fact absolutely necessary, to use other means.

In our experience we have found places where any signal other than the highway traffic signal, as used by the municipalities, would cause confusion and in such places it is, in my opinion, perfectly proper to use such traffic signals and when we do it is in no sense a reflection on the A. R. A. Signal Section signal standards. I do not believe however that we are as yet to the place where we should recommend the use of traffic signals exclusively in the municipalities.

Chicago.

J. A. PEABODY,
Signal Engineer, Chicago & North Western.

Automobile Drivers Show More Respect for A. R. A. Grade Crossing Signals Than for Traffic Signals on City Streets

IT is my opinion that highway crossing signals should be the same for both city and country crossings, except, of course, for the very few special situations where there are important city street crossings immediately adjacent to the railroad crossing. These few situations have to be handled individually.

It has been my experience that automobile drivers respect city traffic signals only to the extent that they are forced to do so by the activity of the respective police departments. Pedestrians do not respect these traffic signals at all. On the other hand, it has been my experience that a majority of both automobile drivers and pedestrians seriously check up on the traffic on a railroad before they disregard a railroad crossing signal indicating stop. We should foster, in every way possible, this special respect for railroad crossing signals.

There seems to be a propaganda effort on the part