Mr. Shaw: In regard to clause 89, shall longitudinal girders be riveted to the face of the column?

Mr. Snow: It is specified that the girders shall be riveted either to the face of the column or to a big gusset, which forms a constituent part of the column head of the gusset. That is, that the girder is to be riveted up and down to some substantial part of the tower frame.

Mr. Shaw: That would necessitate bending the column or cutting it or splicing it. I don't see how it is possible to rivet that to an integral part of the column without cutting it and splicing it to the vertical members.

Mr. Schneider: If this clause is ambiguous, which I think perhaps it is, it really doesn't say anything, and if the committee will agree we will leave out that clause.

Mr. Snow: The committee will accept that and strike out clause 89.

Clause 90 was adopted.

The President: That ends the consideration of this report in detail.

Mr. Robinson: I move that part 1 of the general specifications be tentatively adopted as a whole, subject to future changes.

Mr. Loweth: I am not in favor of this association adopting these specifications, even tentatively. I move to amend as follows: "That part 1 of these specifications be received as a progress report, be referred back to the committee, and the specifications as revised, with the discussion of the convention, be printed."

(The question on the amendment was put to a vote and carried.)

Mr. Berg: I would like to state my understanding. This vote means that part second of the general specifications covering materials, etc., is in proper shape for publication in the manual, but that part 1, covering the design, will not be reproduced in the manual.

The President: That is my understanding of the vote as taken. We will dismiss this committee with our thanks.

SIGNALING AND INTERLOCKING.*

From the geographical location of its members it seemed expedient to carry forward the work in two divisions, both divisions meeting occasionally to review the work of each.

The eastern division, of five members, namely, Vice-Chairman W. C. Cushing, C. L. Addison, A. H. Rudd, Lawrence Griffith and J. E. Taussig, gave its special attention to "Telegraph Block and Controlled Manual Block Signals;" and the western division of five members, namely, J. C. Mock, chairman; Thomas S. Stevens, Charles Dunham, F. H. Alfred and W. A. D. Short, having the general subject of Specifications for Interlocking Plants, confined its attention to the question of "Standard Arrangements of Signals at Interlocking Plants."

The subjects are presented separately for clearness, and conclusions under both heads are submitted.

Many excellent articles relating to signaling and interlocking have been published in the technical papers since our last report.

Interlocking work has been specially active in Texas, due to the requirement by the railroad commissioner of that state that all grade crossings be interlocked. We note with satisfaction a remarkable increase in the number of power plant installaitions during the past two years; especially is this true of the "all electric." We believe the power plant is an advance step in this art. At many mechanical plants, power-operated distant signals are being installed.

Automatic block signaling is becoming more and more popular for double-track roads having heavy traffic, as is evidenced by the large additions to the mileage of this equipment. The installations of automatic block signals on the North Shore Railroad of California and the New York City Interborough Rapid Transit System are interesting as the first applications of alternating current to track circuits.

Standard Arrangement of Signals at Interlocking Plants.

It is desirable that signals be arranged to give full information. So long as the track layouts were confined to single and double track junctions and crossings it was a comparatively simple matter to arrange signals so that the engineer would know what route was clear. The method of giving this information was not uniform; some roads gave the top arm for the route, diverging to the right, the second arm for the route next to the left, the third arm for the route still further to the left, etc.; other roads gave the top arm for the straight route, the second arm for the route diverging to the right, and the third arm for a route diverging to the left; if there were one diverging route only, the second arm governed it. It is obvious that with a strict adherence to either of the above arrangements the top arm would in some cases govern a low speed or switching route, and the lowest arm the highest speed route. This would require the engineer to have an intimate knowledge of each situation to run with safety.

As three, four and six track combinations were developed, the effort to give a separate signal indication for each route resulted in a multiplicity of signals confusing to the engineer, as many as six arms being required in some cases. Practice has demonstrated that the spacing should be not less than six feet to properly distinguish signals at a distance; this would require a mast of such great height that it would be dangerous unless of very expensive construction, and under many weather conditions the top arm would be out of sight of the engineer, especially if such mast were located on a signal bridge. Furthermore, it is a proved fact that while enginemen, when running at a high speed, may know at once the indications at a three-arm mast, they are confused when confronted with more than this number of arms. Even were it practicable to give a separate signal for each route, they should be arranged to signify permissible speed at which each route may be run.

The practice on some roads is to distinguish between freight and passenger tracks by placing the signals higher for the passenger track than for the freight; but as tracks are now used interchangeably for passenger and freight service this method is objectionable.

From the above we conclude that an arrangement of interlocked signals that shall give the number of routes and the direction of divergence from a main or nominally straight route is in many cases impracticable and insufficient when practicable, unless the signification of the speed at which movements may be made over each route is added.

This speed signification is made as clear as possible and at the same time logical; easily understood and easily explained to enginemen, by locating the signals governing the high speeds high on the masts, and the signals governing low speeds low on (or near) the masts. This places the high-speed signals where (under nearly all conditions) they are most conspicuous, and keeps the low-speed signals as much as possible out of the way; a very desirable arrangement, especially where both high and low indications must be given from the same point.

While the addition of a third high-speed arm under certain conditions may be desirable, your committee is unanimous in its opinion that as a rule only two high-speed arms should appear on one mast. The third arm may be useful, under the condition that all three lines are of equal importance and all operating high-speed trains; the top arm would then relate to the straight track and would be (nominally at least) the highest speed route; the second arm would relate to the route diverging to the right, and the third or bottom arm would relate to the route diverging to the left; each arm would have its separate distant signal. Such an arrangement gives the enginemen information as to which of the two diverging routes is set, and this might prevent trouble if the operator made the mistake of setting the wrong route; but the engineer is supposed to take the route given him, because at such points trains are sent upon a particular route by the tower operator under orders from the dispatcher or under fixed rules. A mistake of this kind is not likely to occur, because the engineer must stop and investigate if he should be given other than his regular route without having previously received orders. A mistake that might result in a collision cannot be guarded against by the addition of signals, unless the responsibility for accepting a route is placed on the engineer; this is obviously impracticable. So is any effort to give signal indications for more than the general subdivision of high and low speed diverging routes. Your committee discussed the question of providing an indication for intermediate speeds, such as tonnage trains are required to make in a movement from main line to passing sidings, in order to avoid stalling, and to get out of the way of passenger trains promptly. This condition is provided for in this way: If the siding is provided with a long, flat turnout it should be signaled as a high speed diverging route, otherwise it must be governed by a low signal. It has become recognized as necessary to have long, flat turnouts for important branch lines and long, flat crossovers for the passage of trains from one main track to another main track in order to run around slower trains. We are of the opinion that one arm is sufficient to govern all diverging routes of this character, but they should be made with some restriction in speed, and the lower arm implies this; the top arm always refers to the highest speed route.

The signals for low speed routes should be low and of dwarf construction, because it is not intended or desirable that they should be conspicuous at any great distance, and one arm is sufficient for all low speed routes signaled from one point. Conditions calling for an exception to this rule are so rare that they serve only to prove the rule. According to the present practice, low signals are used for all low speed routes, except the ones where they are most needed, namely, movements from a main line in the established direction to a siding or spur or to another main line against the established direction; many accidents have resulted from the present practice of giving a high arm for this movement. We believe it is correct to govern every low speed route with a low signal.

Since it is the function of distant signals to give preliminary information regarding home signal indications, so that the speed of trains may be governed accordingly, a separate distant signal should be provided for each high speed home signal. The present practice is to install distant signals for the highest speed only; with this arrangement trains given high speed diverging routes are required to run "prepared to stop" at the home signal, and the value of the high speed home signal is thereby decreased. Enginemen who are accustomed to get a high speed route regularly disregard this rule and interpret the caution indication relating to the highest speed to mean the "diverging high speed route is clear;" this is dangerous and the value of the distant indication is decreased, whereas in this day of high speeds the value of the distant indication should be increased and rigidly observed.

Our sixth recommendation in regard to the color stop indication and the position stop indication for all home signals is inserted here because there has developed recently a tendency to depart from the present almost universal practice. Your committee believes that red is so firmly established as the "color stop indication" and the horizontal position of the arm as the "position stop indication" that they should not be disturbed. Blue has been used as the color stop indication for low speed dwarf signals, governing movements from one sidetrack to other sidetracks or a main track, and has been suggested for all signals governing low speed diverging routes. The argument for this is:

(a) That it will not be mistaken for a non-interlocked switch displaying a red light (the switch light does not necessarily mean stop).

(b) That it would serve to better distinguish between high speed and low speed signals, and between interlocked signals and automatic signals. It would also reduce the number of red lights that high speed trains would pass.

Some recent designs for automatic block signals show the vertical position of the arm for the stop indication. The American Railway Association has prescribed what the stop indication shall be, and we consider it proper to endorse their ruling and at the same time discourage any tendency to depart from it. There should be only one color and one position of the arm to mean stop.

While it is believed to be impracticable to present to the enginemen a mark of distinction conspicuous and easily memorized for all the various signals encountered on a division equipped with interlocking plants, station signals, train order signals and automatic block signals, yet it seems very necessary to distinguish between home automatic signals, past which at the stop indication trains may proceed under restrictions, and other home signals requiring a stop until signal is cleared. Most roads have some sort of distinguishing mark for this purpose—for example, several use the automatic disk signal; this gives a decided contrast with the semaphore arm interlocked signals; one road points the ends of arms on automatic signals for contrast, with square end on interlocked signals; another depends on a conspicuous number plate and the difference in general outline between the automatic signals and the interlocked signals. The above examples are sufficient for day time (or night, when fortunate enough to have the aid of headlight); but on four-track roads,

* Abstract of report presented at the annual meeting of the American Railway Engineering and Maintenance of Way Association, Chicago, March 21, 22 and 23, 1905.

with signals located on bridges, the headlight does not assist and the difference in outline no longer serves, since automatic designs are now used extensively for interlocked signals. One road has a system which requires every high interlocked signal to display two arms and two lights (the lower arm is frequently a "dummy"—not operative—since at many points there is only one route to be governed; in such cases it always displays a stop indication). This arrangement serves as a mark of distinction and reduces the chances of accidents due to an extinguished signal light. While this has its advantages it falls short of a final solution of the question, because a broken glass will result in a proceed indication, where white is so used, and one light out obliterates the distinction between it and one-arm automatic signals. Where green is used for "proceed," yellow for "caution," and all automatic signals carry two arms (one home and one distant), this method has only two bad combinations in the possible total of 18: (1) Red above green, which for an interlocked signal means "proceed" at second highest speed; such a combination at an automatic signal means stop (the distant arm is stuck at clear). (2) Two green lights mean "all clear" for automatic signals. But for interlocking signals two green lights indicate that both distant arms are clear through some derangement.

One road has put on the automatic signal post an illuminated letter "A" as a distinguishing mark; the disappearance of this mark converts it into an absolute stop signal. It is presumed that lights at interlocking plants being under constant supervision and within the visual range of the leverman, an extinguished light is immediately discovered; for this reason the additional lamps should be carried by the automatic signals instead of the interlocking signals. Levermen frequently extinguish lights through rough handling of the levers and fail to notice it. A great many accidents have occurred at interlocking plants because of extinguished lights. A compromise suggestion to put an illuminated letter on all interlocked signals, locating it in such a way that it would not be mistaken or could not substitute a signal, was discussed by your committee, but failed to receive approval of the majority, so that while we recognize the importance of a distinguishing mark and of having this mark uniform for all roads, your committee has failed to agree on a specific recommendation, submitting a general one and pointing out the present variety in practice, hoping that the discussion may bring out one that can be adopted as standard.

Interlocked signals relate to the use of track within the limits of an interlocking plant. Where a block system is in force there should be signals placed at or near these limits to give permission to proceed beyond into the block. There are interlocking plants located between block stations that have no connection with them, being simply for the purpose of governing a local condition. But it is a coming practice to have block stations at such interlocking plants, and advance signals are installed. This facilitates traffic by permitting the use of the interlocking plant as soon as the train has cleared the advance signals. Where advance signals are omitted trains are liable through misunderstanding to enter a block; for example, when they receive the "proceed" indication from a low speed signal.

The association has adopted the principle of continuous light for arm castings. This requires signal arms in the "proceed" position to be very close to the prescribed angle. From the Railway Signal Association's investigation of the subject of wire connected signals it is shown that they are not safe when operated more than 2,000 feet from levers, as it is then found impossible to get reliability and accuracy in varying temperatures with wire connected signals. Electric signals are coming to be extensively used for distant interlocking signals. Since the distant signal is used only in connection with high speed routes, they are required to be located 3,000 or 4,000 feet from the interlocking tower. At this distance the operation by means of pipe line would be very difficult and expensive. All high speed signals that are operated mechanically should have pipe connections. The low speed signals are usually not far from the operating levers and the movements they govern being secondary and slow, nothing serious can result from a varying of the stroke.

Where clear indication is received from a distant signal it means that trains may proceed at a high rate of speed, which should therefore insure that all home signals are clear as far as the next distant signal, or when a train receives a cautionary indication at the distant signal it should mean that he may encounter a signal at the stop indication before passing out of the limits of the interlocking plant.

Many plants have been installed without providing signals for reverse movements; so that when such movements are made, hand signals are required. This is incomplete signaling, and has led to many derailments. To be perfectly safe, every movement made at an interlocking plant should have an interlocked signal to govern it.

A continuous light arm casting is used extensively by many roads for automatic block and interlocking signaling. The majority of the committee believe that such a design is demanded to reinforce the one adopted by the association for train order signals, also used in automatic and interlocking signaling for roads using the 90 degree sweep of the arm. It will be necessary, before detail drawings can be submitted, to have the association decide on the sweep of the arm. This should be either 60 or 70 degrees. Circular 35, shown in our last report, gives the 60 degree angle a plurality. The committee recommends that the angle travel be again submitted to the railroads for vote in case the suggestion is acceptable to the association.

Conclusions.

First.—That, inasmuch as interlocking signal plants were introduced to make the passage of trains safe at speed over track layouts more or less complicated by crossovers, turnouts and crossings, the first object in arranging interlocking signals is to indicate routes for trains, and, secondarily, as a necessary consequence, speeds for trains.

Second.—That high speed movements be governed by high signals, and low speed movements be governed by low signals.

Third.—That only two high speed signals be displayed on one mast, the top arm to govern the unrestricted speed, and the lower arm to govern all other high speeds.

Fourth.—That all low speed movements be governed by one-arm low signals of dwarf construction.

Fifth.—That a distant signal be provided for each high speed home signal.

Sixth.—That "red" be the "color" stop indication, and that the "horizontal" position of the arm be the "position" stop indication for all home signals.

Seventh.—That a mark of distinction be made between automatic block signals and all other home signals, whether interlocking, train order or manually operated block signals.

Eighth.—That home block signals be provided at all interlocking plants used as block stations.

Ninth.—That all mechanically operated high speed signals be pipe connected. (Low speed signals may be wire connected.)

Tenth.—That one distant signal only shall be provided for a high speed route, and when "clear" it shall mean that all high speed home signals along that route through the interlocking plant, including the home block signal, are "clear."

Eleventh.—That every movement within the limits of an interlocking plant shall be governed by an interlocking signal.

Telegraph and Controlled Manual Block Signals.

The requisites of installation of a telegraph block system, as given in the standard code of the American Railway Association, are as follows:

REQUISITES OF INSTALLATION.

1. Signals of prescribed form, the indications given by not more than three positions; and, in addition, at night by light of prescribed color.
2. The apparatus so constructed that the failure of any part directly controlling a signal will cause it to give the normal indication.
3. Signals, if practicable, either over or upon the right of and adjoining the track upon which trains are governed by them. For less than three tracks, signals for trains in each direction may be on the same signal mast.
4. Semaphore arms that govern, displayed to the right of the signal mast as seen from an approaching train.
5. The normal indication of home block signals—stop.

ADJUNCTS.

The following may be used:

(A) Distant block signals interlocked with home block signals; normal indication—"caution."
(B) Advance block signals interlocked with distant block signals if used; normal indication—"stop."
(C) Advance block signals interlocked with home block signals; normal indication—"stop."
(D) Repeaters or audible signals to indicate the position of signals to the signalman operating them.
(E) The automatic release of signals to give the normal indication.
(F) The interlocking of switches with block signals.
(G) Bell circuits for signaling between a block station and outlying switches.
(H) The interlocking of telegraph keys with block signals.

Where the semaphore is used, the governing arm is displayed to the right of the signal mast as seen from an approaching train, and the indications are given by positions:

Horizontal as the equivalent of "stop."
Vertical or diagonal as the equivalent of "proceed."
Diagonal as the equivalent of "proceed with caution."

The requisites of installation of the controlled manual block system, as given in the standard code of the American Railway Association, are as follows:

REQUISITES OF INSTALLATION.

1. Signals of prescribed form, the indications given by two positions, and, in addition, at night, by lights of prescribed color.
2. The apparatus so constructed that a failure of any part directly controlling a signal will cause it to give the normal indication.
3. Signals, if practicable, either over or upon the right of and adjoining the track upon which trains are governed by them. For less than three tracks, signals for trains in the same direction may be on the same signal mast.
4. Semaphore arms that govern, displayed to the right of the signal mast, as seen from an approaching train.
5. The normal indication of home block signals—"stop."
6. The apparatus so constructed that the failure of the block signal instruments or electric circuits will prevent the display of the "clear" signal.
7. The relative position of the home signal, and track instrument, or releasing circuit, such as to make it necessary that the rear of a train shall have passed ———— feet beyond the home block signal before the signal at the preceding block station can be released.

ADJUNCTS.

The following may be used:

(A) Distant block signals interlocked with home block signals; normal indication—"caution."
(B) Advance block signals interlocked with home block signals and with distant block signals, if used; normal indication—"stop."
(C) Track circuits.
(D) Repeaters or audible signals to indicate the position of signals to the signalman operating them.
(E) The automatic release of signals to give the normal indication.
(F) The interlocking of switches with block signals.
(G) Bell circuits for signaling between the block station and outlying switches.
(H) Unlocking circuits between a block station and outlying switches.

Where the semaphore is used, the governing arm is displayed to the right of the signal mast as seen from an approaching train, and the indications are given by positions.

Horizontal as the equivalent of "stop."
Vertical or diagonal as the equivalent of "proceed."

For convenience in presenting and analyzing the statistics given in its annual reports on railways, the Interstate Commerce Commission has divided the United States into ten groups, illustrated by a map. It seemed to your committee a wise thing to adopt the same grouping, and, through the kindness of the Commission, they have received permission to use the same map for illustrating the territorial groups.

By reference to Table "A," it will be seen that there were in the United States on June 30, 1902, 200,155 miles of railway line based on single track mileage only, and that the answers received represented 103,435 miles, or 51¼ per cent. Of the miles reported only 15,937 miles, or 15¼ per cent, were being operated under the telegraph block system, and 942¼ miles, or nine-tenths per cent, under the controlled manual block system.

The information given about the block rules was not very complete, as the table will show, but nevertheless the operations are generally conducted under the "Standard Code of Block Signal Rules" of the American Railway Association, adopted April 25, 1900, showing how influential that association has become in a few years. One railroad uses this code almost verbatim; others adhere very closely to it, while others again have made quite extensive modifications.

It has been impossible to prevent the overlapping of the lines in different groups because the reports were not made in sufficient detail, but the committee hopes that these divisions may be more accurately made in future statistics. Footnotes in the table explain where these overlays occur.

From Group No. 1, embracing the New England States, and from Group No. 9, embracing Texas, Louisiana and half of New Mexico, no information on the telegraph block system was received, although

14.9 per cent of the mileage of line in the first and 19 per cent in the second group reported.

The railways of the Atlantic Coast States (except New England), and the middle and northwestern states, represented by Groups 2, 3, 4, 6 and 7, are the most extensively operated under the block system in question. These groups can apparently be subdivided a second time according to the method of operating a "permissive block system." The Atlantic Coast States and Middle States, Groups 2, 3 and 4, give the permissive indication by the fixed signal arm, while the Northwestern States, Groups 6 and 7, give permission by "caution" or "permissive" cards. To this latter subdivision is also added Group 10, the Pacific Coast States.

While the replies from Group 5—Kentucky, Tennessee, Mississippi, Alabama, Georgia and Florida—and from Group 8—Missouri, Arkansas, Kansas, Colorado, Oklahoma and Indian territories—represented a large mileage, 32 per cent in the first case and 63 per cent in the second, yet the use of the telegraph block system is quite limited.

There are but four roads in the table which employ the telegraph block system on more than 50 per cent of their line. Of these the New York Central has the largest mileage, 1,881, or 65 per cent, while the Norfolk & Western has the largest percentage, 76, or 1,280 miles. The third is the Wabash with 50 per cent, or 1,044 miles, and the fourth, the Lehigh Valley, with 50 per cent, or 668 miles. Other roads, however, have a large mileage operated under this system—the Pennsylvania, 1,287 miles, or 25 per cent; the Lake Shore, 1,008 miles, or 37 per cent; the Chicago & Northwestern, 1,505 miles, or 25 per cent; the Chicago Milwaukee & St. Paul, 2,463 miles, or 37 per cent; the Santa Fe, 1,045 miles, or 13 per cent.

Of course it must be borne in mind that some roads which are weak in the telegraph block system are strong in the automatic block system, which is not under consideration at the present time.

On account of its bearing on the requirements which a telegraph block signal has to meet it will be interesting to note some differences from the standard code of block signal rules.

On the Long Island Railroad the time which a train must wait at a block station before proceeding past the signal at danger in case the signalman is absent or incapacitated so that instructions cannot be obtained is three minutes; on the Pittsburg Cincinnati Chicago & St. Louis Railway it is five minutes, and on the Chicago & Northwestern and Southern Pacific it is 10 minutes. A bell code is used in place of the prescribed telegraph signals on the Long Island Railroad and seems to be about the best submitted. It is as follows and almost exactly the same as the bell signals prescribed under the controlled manual block system rules of the American Railway Association:

Ring.
2. All right. Yes.
3. Is block clear? Answer by 2 or 5.
4. Train has entered block. Answer by 2.
5. Block is not yet clear. Answer by 2.
6. Is there a train coming to me? Answer by 2 or 2-1.
1-2. Clear. Train has passed. Answer by 2.
2-1. No.
5-5-5. Obstructions. Danger signal. Stop all trains approaching this station. Answer by repeating.
3-3-3....3-3-3. Train proceeding toward you has broken apart. Answer by repeating.
4-4-4. Cars running away on wrong track and proceeding toward you. Answer by repeating.
4-6-4. Cars running away on right of track and proceeding toward you. Answer by repeating.
2-3-2. Train passed without markers. This signal to be given station in advance. Answer by repeating.
5-2-5. Train passed without markers. This signal to be given to station in rear. Answer by repeating.
1-4-1-4. Stop and examine train. Answer by repeating.
3-3. Train is on siding. Clear of main track. Allow train to enter block under caution card C. T. 89 B. Answer by repeating.
5-5. Train crossing over to opposite track. Answer by repeating
2-2-2. Previous signal given in error. Answer by 2.
6-6-6. Testing. Answer by repeating.
1. (Long stroke.) Answer telegraph call.
Note.—(....) signifies pause between beats.
Note.—All signals must be repeated until answered.

On the Mohawk and Western divisions of the New York Central trains on three and four track systems, if preceding train has not cleared the block, are held for 15 minutes and then given a caution card, unless the block clears before the 15 minutes have elapsed. On the Pennsylvania division freight trains arriving at block station, the block in advance not being reported clear, must be held five minutes after the departure of preceding freight train and then given a green or caution signal. A red and green blade on the same mast are used, the latter for permissive blocking of freight trains, but not for passenger trains. A passenger train following a passenger train must be held ten minutes after the preceding train and, when following a freight train, five minutes after its departure, unless the block section is reported clear before that time; but if the section is not reported clear it may only proceed with a caution card. The standard code is not used by the Pennsylvania division.

The rules of the Chicago & Northwestern are based on the "standard code," but are quite differently arranged. They emphasize by a rule that "block signals are to be used to control movement of trains upon main track and must not be accepted by trains on sidetracks." Trains are only permitted to pass a block signal at danger under "proper authority," which consists of

(a) A caution card and release.
(b) A release stamped "block is clear."
(c) Train order stamped "block is clear," or
(d) Train orders and caution card.

In blocking trains a telegraph code of signals different from the "standard" is used.

The block rules of the Chicago Milwaukee & St. Paul are not entirely the same as the "standard code." Trains can only pass a block signal at danger with "clearance" or "permissive" cards, and when they have a "permissive" card they must also have a "clearance" card. At certain block stations a permissive arm, painted green, placed below the block arm, is used for moving trains permissively. When a block station is closed the block light must be left burning, which is the contrary of the standard code rule and the general practice of other roads, the theory being that the absence of a signal from its usual place is a danger signal.

The Wabash rules are not arranged like the "standard code," and different telegraph signals are used. Trains are moved "permissively" by the use of clearance and caution cards.

The block rules of the Atchison Topeka & Santa Fe are not in the form of the standard code. A clear block signal indicates that the block is clear to a point 1,000 feet before reaching the next home block signal. Permissive blocking for freights is allowed, but not when a passenger train is in the block.

The Southern Pacific (Pacific system) operates under the "standard code," but the telephone is used instead of the telegraph. This naturally leads to bell signals between stations, and the code employed is closely similar to that already quoted for the Long Island Railroad. The operations are conducted under "absolute block," except that caution cards are used for failure of the block signal apparatus and permissive cards to allow trains moving in the same or opposite directions to meet at a non-block signal station with "(31)" orders to do so.

Reference to Table "A" will disclose the fact that the same form of fixed signal that is used for train orders is almost universally employed for a telegraph block signal. At the present writing your committee knows of only one exception, the Philadelphia & Reading Railway. Their train order signal is illustrated in Vol. 4, p. 305, Fig. 12. The signals, which were illustrated in Vol. 4, pp. 300-305, have not been reproduced, and new designs only have been shown in the present report. Figs. 1 to 7, Table A, explain in one column where the illustration is to be found in Vol. 4. There is, as usual, wide variance in the design, for which there seems to be no good reason. It seems quite plausible to your committee that the members of the association can ultimately agree upon a standard plan, an action to be desired by both the railways and the signal companies. Present practice would indicate that at least the train order and telegraph block signals can, without dimculty, be of the same design.

There are reported 11,248 miles of single track, 4,806 miles of double track and 825 miles of more than two track line as operated under the telegraph block system and controlled manual block system, and this requires the use of 3,426 signals for single track, 3,534 signals for double track and 2,142 signals for more than two-track line, a total of 9,102 signals.

The Baltimore & Ohio uses a double-arm semaphore on a single mast (Vol. 4, p. 302, Fig. 6), located at the passenger station or on block stations (Vol. 4, p. 306, Figs. 14 and 17). The arms have a sweep of 90 degrees and are not slotted, but at interlocking plants, where signals are convenient for block purposes the arm is operated by two levers, the first reversed giving the "caution" indication, while the second reversed completes the movement for "clear." The plan insures the correct indication of the arm, but does not actually prevent the operator from giving a "clear" indication instead of a "caution." It economizes in signals and pipe run, only one line of pipe being used.

Since the Long Island train order signal was illustrated in Vol. 4, p. 300, that company has added a spectacle to carry a green glass on account of having adopted green for "proceed" and yellow for "caution." The signals are placed on the block station or alongside the track (Vol. 4, p. 307, Figs. 17 and 20). Whenever the view is obscured a distant signal is added. The block signals are pipe connected.

The New York Central has a two arm signal on a single mast with distant signals 6 feet below on the same mast, which is placed on the block station (Vol. 4, p. 307, Fig. 17).

The arms are two position, with a sweep of 60 degrees, and are operated by a table machine.

The Philadelphia & Reading uses a two arm three position signal on one mast, the arms of which are pipe connected and have a sweep of 45 degrees for "caution" and 75 degrees for "proceed." It is placed either on the block station or alongside the track (Vol. 4, p. 306, Fig. 14, and p. 307, Fig. 20). The reason for using a different form for train orders was not given.

The Pittsburg Cincinnati Chicago & St. Louis (Pennsylvania Lines) has been using the form shown in Vol. 4, p. 302, Fig. 7, placed on the block station (Vol. 4, p. 306, Fig. 14), but is now making renewals with, and using in new work, the universal casting recommended at the fourth annual convention and illustrated in Vol. 4, p. 311, and Plate 13, and places the mast alongside the tracks (Vol. 4, pp. 306-308, Figs. 17, 20 and 21), or on bridges over the tracks. The face of the blade is painted yellow and the back black, similar to the Baltimore & Ohio. This style of painting is now uniform on the Pennsylvania System east and west of Pittsburg. At tunnels the block signal arm is slotted, goes to "danger" as the train passes and is held there by means of the track circuit until it has passed out of the block, the block being absolute. Three position signals are pipe connected.

The Lake Shore & Michigan Southern Railway is unique in the style of block signal used; it is called the Gravit signal. While it is a semaphore signal, it is used to give some indications at variance with the usual indications of the semaphore arm. It is not used on any other railway. A lamp travels up and down inside the mast with the movement of the arms and gives the correct night indication through properly colored glasses fixed in the mast.

The Chicago & Northwestern standard is the Sanborn signal (Vol. 4, p. 304, Fig. 11), placed in front of the block station (Vol. 4, p. 307, Fig. 18). The mast is made of two rails, with the bases riveted together and spread at the top to receive the lamp. It is two arm and two position.

The Chicago Great Western block signals are two arm and two position, and placed at the passenger stations (Vol. 4, pp. 306 and 307, Figs. 14, 15, 17 and 18).

All of the signal blades above described have the square end, but that of the Chicago Milwaukee & St. Paul has a spearhead end. The signals are two arm, two position, wire connected and placed either opposite the station or at one end.

The Atchison Topeka & Santa Fe telegraph block signal also has a spearhead blade and is double arm, but three position. The "caution" indication, however, is given in an entirely different way from any of the others described, viz.: 45 degrees upward. The "proceed" position is 45 degrees downward (Fig. 26). The mast is placed in front of the block station.

The Southern Pacific uses a two arm two position signal (Vol. 4, p. 301, Fig. 4), the sweep of the arm being 60 degrees or more for "clear." The mast is placed in front of the block station (Vol. 4, pp. 306-307, Figs. 14 and 17).

It will be seen from the foregoing that the location of the telegraph block signal is generally on the block station and that the arms for both directions of traffic are on the same mast. This arrangement serves the purpose very well for single or double track lines, but the indications become confusing for lines of more than two tracks. The increase in the number of tracks takes place in a regular way and according to a plan of evolution. The same should be the rule with the block signal. The rules for signaling should be based on well-defined principles, so that the plans for a special case will work themselves out naturally by reason of the basic principles. It should not be necessary to make a new plan to fit every condition that arises. According to our present practice we started in with a two-arm signal on a common mast for single track, and continued it in service for double track, but when we were confronted with a larger number of tracks our signal was incapable of expansion and we were obliged to adopt the one-arm signal on a single mast for each track. It seems to your committee that we should begin with the mast and arm for each track, and the arrangement is then capable of indefinite

growth. The natural position for such a signal is alongside the track used by the trains it is intended to govern and on the righthand side, which is one of the requisites of installation of the American Railway Association.

The location of the signal on the block station is awkward, because when the block station is in the passenger station trains are often obliged to run by it at danger when coming to the station or doing work in its vicinity. The one arm one mast signal can be placed a few hundred feet in advance of the station and the train makes its stop before reaching it. When allowed to proceed the arm can be cleared for it without it being necessary to issue a clearance card. This saves work and time. This location for train order signals was approved by the association at the fourth annual convention in 1903, and is entirely consistent with the former action.

Permissive block signaling is recognized by the American Railway Association as good practice, and rules governing its use have been provided in the standard code. As already stated, some of the roads give the permissive indication by the caution position of the block arms; others by the issuance of caution or permissive cards and a few by the indication of a separate caution signal on the same mast with the block arm. It seems advisable, therefore, to your committee to provide a signal which can be used to give the three indications as well as two, and either method of operation at the pleasure of the company can be followed by use of the same fixed signal. In order that the several indications be clear and distinct from each other such a signal should have a sweep of arm of 90 degrees; that is, the arm would be vertical for the "proceed" indication and at an angle of 45 degrees for the "caution" indication. The arm casting is universal, and can be used for any combination of night signals in common use. It was adopted by the association for train order signal at the fourth annual convention in 1903, except that some defects in size of parts have been remedied.

It is a good plan to put an electric slot on the signal arm connection to insure the return of the arm to danger as the train passes. It is an additional safeguard and especially valuable in the absolute block system. While it does not prevent the operator from giving a wrong indication in the case of permissive blocking, it requires him to reset the signal for each train.

Only a very few of the railroad companies appear to have standard specifications for the leadouts, pipe runs and signal connections, and your committee therefore presents a set of proposed standard specifications for your consideration.

There are but eight roads in the table which use a controlled manual block system. Of these the New York Central & Hudson River Railroad has the largest mileage and largest per cent—451¼ miles, or 48 per cent. The second is the New York New Haven & Hartford Railroad—225 miles, or 24 per cent.

The bell code used on these roads conforms to that adopted in the standard of the American Railway Association.

Conclusions.

First—The best location for the telegraph, and controlled manual, block signal is on a mast alongside and to the right of the track on which are run the trains that it governs, but, in the case of more than two tracks, when it is impracticable to spread them apart for this purpose, then the best location is on a bracket post, or on a bridge over the tracks.

Second—It is good practice to make use of the electric slot to send the signal to normal position, "stop," as the train passes.

Third—The best "arm" for the "telegraph" and "controlled manual block signal," to be adopted as standard by the association, is a continuous light, 90 degree casting.

Fourth—The plan for "leadout, pipe runs and signal connections" (heretofore described) is recommended as good practice.

Fifth—The "specifications" following are recommended for approval by the association as good practice.

Sixth—The "definitions" of terms are recommended for adoption.

Specifications for Construction of Telegraph Block Signal and Connections.

GENERAL.

1. All material and workmanship must be of the best, and subject to the approval of the signal engineer.
2. All parts must be properly proportioned for strength.
3. All plans furnished by the railroad company must be considered a part of these specifications, and must not be departed from except by permission of the signal engineer.

MACHINE.

4. Operating machine must be of the lever type and of approved design.
5. Locking, when required for distant signals, must be of the latch or preliminary type. All wearing parts shall be of cold rolled steel, and all bolts with jamb nuts or cotters.
6. The machine must be placed in a suitable block station, and supported on a separate foundation, not connected with the building in any way. This foundation must be made of white oak, long leaf yellow pine, or steel.
7. There must be no difference in the size of corresponding parts for large and small machines.
8. Top plates must be made in sections for four or eight levers.
9. All the levers in a machine must have an equal uniform throw.
10. Machine levers must be numbered from left to right; generally, the levers must be placed in the machine corresponding to signal operated. Distant signal levers, when used, must be outside of home signal levers, at ends of machine.

SIGNAL CONNECTIONS.

11. Home signal connections must be made by means of pipe runs.
12. Pipe lines must be made of galvanized iron pipe, one (1) inch inside diameter, and coupled with sleeves, plugs and rivets. One end of each length of pipe must not be punched for rivet until pipe is screwed together on the ground.
13. Pipe runs must be straight, when possible, and must be placed not nearer than three (3) feet from outside of rail. They must be laid two and three-quarters (2¾) inches between centers, and so arranged that the shortest line will be next to the rail. Pipe lines must be supported on carriers placed not more than seven (7) feet apart; top of pipe lines must be one and one-half (1½) inches above base of rail, except across tracks, where they must be one (1) inch below base of rail.
14. Pipe carriers must be made of malleable iron, with sheaves not less than two and a quarter (2¼) inches in least diameter.
15. Couplings in pipe lines must be placed not nearer than twelve (12) inches to a pipe carrier when the lever is in the center.
16. Sleeves for pipe couplings must be made of wrought iron, and not less than two and a quarter (2¼) inches in length.
17. Plugs for pipe couplings must be made of wrought iron, one (1) inch in diameter and six (6) inches long. They must be drilled for quarter (¼) inch rivets, spaced four (4) inches center to center, and one (1) inch from each end.
18. Cranks must be made of wrought iron, and mounted in a cast or malleable iron stand. The top of the center pin must, in all cases, be supported. All crank stands must be provided with lugs, to prevent center pins from turning in stands. No more than two cranks shall be placed on the same center.
19. All cranks, except those used in box or vertical stands, must have arms not less than eleven and three-quarters (11¾) inches in length.
20. Solid jaws must be made of wrought iron. They must be seventeen (17) inches long from center of pin hole to end of body; opening between sides of jaws must be straight for not less than three (3) inches from center of pin hole.
21. Screw jaws must be made of malleable or wrought iron; opening between sides of jaws must be straight for not less than five (5) inches from center of pin hole, and thread in solid end must be at least one and one-half (1½) inches in length. Body must not be less than twelve (12) inches long, with thread cut half its length.
22. Bodies of all jaws must be one and a quarter (1¼) inches in diameter, with tang and thread for coupling to pipe. Tang must be four (4) inches long and one (1) inch in diameter.
23. Bends must not be made in pipe, but in cranks, jaws, or an iron rod, one and one-quarter (1¼) inches in diameter, placed in the pipe line for that purpose; the total bends must never exceed two and one-half (2½) inches between any two supports. There must be no bends made in cranks without special permission.
24. (See page 297, Vol. 4, Proceedings Am. Ry. Eng. & M. of W. Association.)

"Lazy Jack" compensators must be used. They must be made of wrought iron and mounted on cast iron stands, but no more than one compensator shall be placed on a stand or foundation. Crank arms must be eleven (11) inches in length from center to center of pin holes. Top of crank pins must be supported. All compensator stands must be provided with lugs to prevent center pins from turning in stands.

25. Means of adjustment must be provided for each line of pipe.
26. Lines to home signals must have a screw jaw in end of line next to function operated; lines to distant signals must have a screw jaw at each end (when pipe connections are used).
27. All foundations must be made in accordance with standard plans. In general, foundations should be made of concrete.
28. Leadout foundation inside and immediately outside of tower must be made of twelve-inch by five-inch oak, securely bolted to rails set in tower foundation walls.
29. Four (4) three-quarter (¾) inch bolts must be used to fasten each crank stand, or compensator stand, to its foundation.
30. Two (2) one-half by two and one-half (½ by 2½) inch lag screws must be used for fastening each pipe carrier to its foundation.
31. All pins must be made of steel, machine turned, and provided with cotters.
32. Connecting pins for jaws, cranks, etc., must be not less than seven-eighths (⅞) inch in diameter; center pins for bell cranks must be not less than one and one-fourth (1¼) inches in diameter.
33. Plate washers must be used under nuts and under the heads of bolts and lag screws, where they would be otherwise in contact with wood.
34. When required, highway crossings must be boxed with four (4)-inch oak plank.

SIGNALS.

35. High signals, where practicable, must not be closer than seven (7) feet to the outside of rail.
36. Signal blades must be made of ash.
37. Signal masts must be made of iron and set in concrete. Straight masts must be made in three sections, four (4) inches, five (5) inches, and six (6) inches inside diameter, from the top down, with shrunk joints. They must be filled with concrete for a distance of one (1) foot above the surface of the ground, and have a half (½) inch drainage hole at surface of concrete.
38. Bracket posts may be either pipe or lattice construction; the bracket, or cross-arm, must be not less than twenty (20) feet clear above top of rail.
39. All signal masts must be provided with ladders, bolted to post at top, and at bottom to a one-way pipe carrier foundation set in the ground.
40. Short uprights or stubs seven (7) feet long must be used to indicate each track that is not signaled from the bracket, and which intervenes between the bracket post and the farthest track signaled. The stub must be placed not less than six (6) feet six (6) inches from the adjacent signal mast.
41. On signal bridges, masts, for carrying signals, must be placed vertically over the right-hand rail of the track governed. Bridges must be made according to standard plans, and not less than twenty-one (21) feet in the clear from top of rail.
42. Arms must be not less than twenty-five (25) feet above the base of rail. On bracket posts, or bridges, the arm must be not less than seven (7) feet above top of bracket or bridge.
43. Blades must be four (4) feet six (6) inches in length from center of casting to outer end. They must be seven (7) inches wide at the arm grip, and ten (10) inches wide at the outer end. Stops for the danger and safety positions must be provided in the center casting.
44. Outer end of blade for home signals must be square with center line. Corners of all outer ends must be rounded to a radius of one (1) inch.
45. Six (6) three-eighths (⅜) inch by one and one-half (1½) inch elevator bolts, with head one and one-fourth (1¼) inches in diameter must be used to fasten each signal blade to casting.
46. Colored glass six and one-half (6½) inches in diameter must be placed in signal casting.
47. A lamp, made in accordance with standard drawings, must be furnished for each signal.
48. Lamp brackets must be attached by means of bolts passing through signal posts.
49. Each bracket post stub required by Article 40 must be provided with a standard lamp carrying white light. A fixed spectacle carrying a five (5) inch plain blue front-light must be attached to the stub by through bolts.
50. All ironwork must be given one coat of good priming and two coats of finishing paint. Pipe lines must be finished black. Signal masts, and the ironwork on same, must be painted according to the standards of the railroad company.
51. Levers must be painted as follows:

Home signal levers, red.
Distant signal levers, green or yellow.
Spare levers, white.

52. Signal blades must be painted in accordance with standard plans.

Definitions.

Block.—A length of track of defined limits, the use of which by trains is controlled by block signals.
Block Station.—A place from which block signals are operated.
Block Signal.—A fixed signal controlling the use of a block.
Home Block Signal.—A fixed signal at the entrance of a block, to control trains in entering and using said block.
Distant Block Signal.—A fixed signal used in connection with a home block signal to regulate the approach thereto.
Advance Block Signal.—A fixed signal used in connection with a home block signal to subdivide the block in advance.
Block System.—A series of consecutive blocks.
Telegraph Block System.—A block system in which the signals are operated manually, upon information by telegraph.
Controlled Manual Block System.—A block system in which the signals are operated manually, and so constructed as to require the cooperation of the signalman at both ends of the block to display a clear signal.
Automatic Block System.—A block system, in which the signals are operated by electric, pneumatic, or other agency, actuated by train or by certain conditions affecting the use of a block.
Mast.—The upright to which the signals are directly attached.
[The above definitions are from Standard Code of The American Railway Association.]
Absolute Block System.—One in which only one train at a time is permitted to occupy the block. (Southern Pacific.)
Arm Casting.—That part of the arm supported by the signal mast, which, by rotation on its axis of support, gives the night signal indications.
Arm Sweep.—The quadrant of a circle defining the limits of movement of the arm.
Arm.—The movable arm pivoted to the signal mast, and by the position of which the indications are given.
Blade.—That part of the arm which, by its form and position, gives the day signal indications.
Bracket Post.—An arrangement of main post with cross-beam, upon which is placed one or two masts for carrying the signal arms, the arrangement of masts determining which track or tracks the signals govern.
Chain Wheel.—A device used for changing the direction of a wire line.
Compensator.—A device placed in a pipe or wire line for automatically maintaining a constant length of line under changes of temperature.
Crank.—A device used for changing the direction of a pipe line.
Crank Stand.—The frame in which cranks are supported.
Cross Locking.—A variable shaped block or bar running crosswise of the interlocking machine, actuated by the movements of the locking dog, and by means of which connection is effected between the levers.
Detector Bar.—A bar placed at a switch alongside of and normally below the top of rail, operated in connection with the facing point lock, or switch and lock movement, so that its operation, and consequently that of the lock, will be prevented by the presence of any of the wheels of the train.
Electric Slot.—An appliance for automatically disengaging the signal arm connection from its actuating lever, returning signal arm to "stop."
Foundation.—A fixed support, usually set in the ground, for carriers, cranks, compensators, wheels, signals and other like devices.
Interlocking Function.—Any signal, switch, derail, lock or crossing bar operated separately or in combination with any other constituent part of an interlocking system.
Interlocking Machine.—The primary operating or controlling mechanism of an interlocking plant, placed in the interlocking station, and in which the interlocking feature is effected.
Interlocking Plant.—An arrangement of switch, lock and signal appliances so interconnected or interlocked that one movement must succeed another in a predetermined order.
Interlocking Signals.—The fixed signals of an interlocking plant.
Interlocking Station.—A place from which an interlocking plant is operated.
Jaw.—A device attached to pipe line for connecting same with machine, crank, compensator, or any other device designed for pipe operation.
Leadout.—The combination of cranks, wheels, rocker shafts, etc., inside and outside of lower story of interlocking station, by which connections are made between machine and pipe runs.
Lever.—That part of an interlocking machine whose movement effects the operation of its function.
Locking.—The combination of locking dogs and cross-locking or locking dogs and tappets by means of which interconnection is effected between the levers and the order of movement determined.
Locking Bar.—A bar running lengthwise in the interlocking machine to which the locking dogs are attached.
Locking Dog.—A variable shaped block attached to locking bar and through which the interlocking is accomplished.
Permissive Block System.—One in which two or more trains may occupy a block at once. (Southern Pacific.)
Pipe Carrier.—A frame with rollers between which pipe line is supported and moves freely.
Pipe Run.—The assemblage of the pipe lines of an interlocking plant, with their carriers and foundations, in a common course.
Rocker Shaft.—A rotating shaft used in leadout for changing vertical to horizontal motion; also used at slip switches for operating several detector bars and locks.
Route.—A course or way taken by a train in passing from one point to another, especially a customary or predetermined course, or any one of several possible combinations of turnouts or crossovers by which a train may travel between two places.
Semaphore Signal.—A device consisting of a mast with movable arm attached, the indications being given by the position of the arm.
Screw Jaw.—A jaw screwed on the end of pipe line, and used to adjust the length of pipe connections.
Spectacle.—See "Arm Casting."
Tappet.—a. (In machine with vertical locking.) A bar operated directly or indirectly by the lever or lever latch, which actuates or drives the locking bars and is locked by them.
b. (In Saxby & Farmer machine.) A pivot or swing dog attached to the locking bar, and actuated or locked by the cross-locking.
Wire Carrier.—A frame with roller upon which wire line is supported and moves freely.
Wire Run.—The assemblage of the wire lines of an interlocking plant, with their carriers and foundations in a common course.

COMMITTEE.

J. C. Mock, signal engineer, Michigan Central Railroad, Detroit, Mich., chairman.
W. C. Cushing, chief engineer M. of Way, S. W. Sys., Penna. lines, Pittsburg, Pa., Vice-Chairman.
C. L. Addison, general superintendent, Long Island R. R., Long Island City, N. Y.
F. H. Alfred, chief engineer, Pere Marquette R. R., Detroit, Mich.
Chas. Dunham, signal engineer, Illinois Central Railroad, Chicago.
Lawrence Griffith, engineer M. of Way, N. Y. C. & H. R. R. R., New York.
A. H. Rudd, assistant signal engineer, P. R. R., Philadelphia, Pa.
W. A. D. Short, superintendent signals, C. N. O. & T. P. Ry., Lexington, Ky.
Thos. S. Stevens, signal engineer, Santa Fe Ry. System, Topeka, Kan.
J. E. Taussig, superintendent and superintendent telegraph, Wheeling & Lake Erie R. R., Canton, O.

Discussion on Signaling and Interlocking.

The President: It has been decided by the board of directors, in view of the situation our work is in, that we are going to set a limit on the time for the consideration of these reports. The limit on this will be one hour. We will hear from the chairman.

Mr. Mock: Since the publication of the bulletin the committee has met and made some revision of the conclusions, the definitions and the specifications.

(The secretary read conclusion 1.)

Mr. Mock: The committee have decided to add the word "primarily" after "is" in the fourth line, "the object in arranging interlocking signals is primarily to indicate routes," and the word "first," at the end of the third line, will be omitted.

(Conclusion No. 1, as revised, adopted.)

Conclusion No. 2 adopted.

Conclusion No. 3:

Mr. Mann (Signal Eng. Mo. Pac.): The committee have made a strong recommendation, that there are many places where a third arm is necessary on a high speed signal. Since it is likely that the conclusions will be the basis for specifications for interlocking plants, and as there are many places with three high speed diverging routes, I would like to move that the word "three" be substituted for "two" in that conclusion.

(A division vote was called for, without result, no one rising.)

The President: The conclusion is adopted as printed.

Conclusion No. 4:

Mr. Waite: I rise to a question about the display of a high speed signal and the dwarf signal on a different mast.

Mr. Mock: The committee did not want to decide where that should be. You could use the standard dwarf signal placed alongside of the high signal or have it operated from the same mast. It is desirable that it be conspicuous when placed with the high speed signal, the high speed signal being the prominent one, and the low speed signal being kept submerged as far as practicable. There must be no mistake that it is a signal from the same point as the high speed.

Mr. Waite: On account of the home signal being a lower signal, was the question ever brought up about making it a different color?

Mr. Mock: The committee has gone through the subject thoroughly and made the recommendation, and they concluded to leave out the question of the color of light.

(A vote was then taken on the adoption of conclusion 4 and was carried.)

(Conclusions 5 and 6 were adopted.)

Mr. Waite: I think we will all agree with the committee on No. 7, but what distinctive difference shall be made? I move that the committee make a recommendation as to what distinctive difference shall be made.

Mr. Cushing: That motion will not be necessary, because the committee has not taken up the subject of automatic block signaling, and it is intended to give this matter further consideration. The subject of automatic block signals is not up for discussion.

Mr. Waite: I move that conclusion 7 be stricken out.

Mr. Cushing: I don't know what harm the conclusion will do. It is nothing more than to call attention to the fact that train order signals, interlocking signals and block signals other than automatic, require trains to come to a stop when the signal is at "STOP" and not proceed until it is cleared. With an automatic signal a train may proceed to the signal and stop from one to five minutes and then proceed past the signal and stop.

Mr. Waite: Mr. Cushing says they did not consider automatic signals. If they did not, why make a conclusion as to comparisons?

Mr. Cushing: We want the report to show that this is the signal we are discussing here.

Mr. Mann: Conclusion No. 7, if adopted, will have a great deal of weight with a good many railroads in the purchase of signals. Therefore if the association says to the railroads that they recommend some mark of distinction they are to say what sort of distinction.

Mr. Mock: The reason it was included here was to get an expression from the association as to whether a mark of

distinction should be placed on the interlocked or on the automatic signal. If on the interlocked signal it properly comes with this report; if with the automatic signal it properly should be under the consideration of automatic signals.

The President: There is a motion before the house which we will have to dispose of.

Mr. Mann: I offer an amendment to the effect that the mark of distinction be not applied to the interlocking signals.

(Amendment lost.)

(A vote was then taken on the adoption of conclusion 7 as printed. Adopted.)

Conclusion 8 adopted.

Conclusion 9:

Mr. George W. Kittredge, Past. Prest. (Big Four):—Does that apply to distant signals as well as home signals?

Mr. Mock: Distant signals as well. We do not recommend the connecting of the signal by wire, and if you must have a mechanically connected signal we ask that you connect it with pipe. At present we prefer to put it in as a tower operated signal, with motor or gas or electricity or pneumatic signal.

(Conclusion 9 adopted.)

Mr. Waite: Conclusion 10 and conclusion 5 do not seem to agree.

Mr. Mock: The intention is wherever one home signal gives the entire route, it must have a distant signal. If we find it necessary to repeat the home signal and have a train order and advance block signal, their position must be indicated by one, and only one, distant signal.

(Sections 10 and 11 adopted.)

The President: We will now turn to page 33 and take up the conclusions. The committee desires to make a change in the first conclusion by striking out "28 and" at the end of the third line, making it read "as shown in figure 29."

(As changed, the first conclusion was adopted.)

The President: The committee desires to insert the word "block" before the word "signal" in the second line of the second conclusion, making the second conclusion read as follows: "It is good practice to make use of the electric slot to send the block signal to normal position, 'stop,' as the train passes."

(The second conclusion was adopted as changed.)

Mr. W. G. Berg (L. V.): Had we not better use the word "recommended" in the place of the word "adopted" on the second line of the third conclusion?

(The third and fourth conclusions as amended were adopted.)

Mr. Berg: It would be impossible, with the time at the disposal of the meeting, to adopt the specifications complete. It would be better to postpone the further consideration of the report, and I make a motion to that effect.

Mr. H. G. Kelley: Before Mr. Berg's motion is put, I move to reconsider conclusion No. 5. The conclusion as passed reads: Fifth. That a distant signal be provided for each high-speed home signal. Some of the signal engineers present consider that that conflicts with the meaning of the tenth conclusion, and ask that conclusion No. 5 shall be amended to read: "In all cases where a high-speed home signal shall be used it shall be under the protection of a distant signal."

(The motion to reconsider was put and carried.)

Mr. Mock: I would prefer it to read: "A distant signal shall be provided for each high-speed route, substituting "route" for "home signal."

(The amendment was adopted.)

Mr. Mann: I suggest that the committee reconsider the ninth conclusion to do away with possible misunderstanding as to the recommendation that all mechanically operated distant signals be operated by pipe, which I understand the committee does not intend.

Mr. Mock: It reads: "If you have a distant signal, mechanically operated, it must be pipe connected."

Mr. H. M. Waite: I understand that the question is raised by Mr. Mann because Mr. Mock stated that if it was required that the distant signals should be pipe connected it would force the use of a power signal for the distant signal.

Mr. Mock: There are places where the distant signal may be nearer the operating lever than the home signal. For example, where a tower is located 1,500 feet from an interlocked crossing.

The President: There is a motion before the house that we discontinue the further consideration of conclusions 5 and 6, on page 33, and the specifications and definitions which are part of these conclusions 5 and 6, for the reason that the association is not now in position to take up these specifications in detail.

Mr. Mock: The committee desires to be able to recommend a drawing for a semaphore casting next year, unless it is the wish of the association to make a 90-degree sweep of the arm as standard, in which case plate B will answer for all signals.

The President: The committee announces this matter, and it is expected that the proposition will be submitted to the members, to be voted upon by letter ballot.

Mr. George W. Kittredge: I ask if it would be proper at this time for the members to give expression to their opinions on the point Mr. Mock has just stated, to be followed later, possibly, by a letter ballot?

Mr. W. C. Cushing: I am not in sympathy with the chairman of the committee in this matter, because I cannot appreciate the necessity of a sweep of the arm at 70 degrees meaning clear for one kind of a signal and 90 degrees for another. I think the sooner we recognize the fact that one position of the arm means clear, no matter what kind of a signal it is, the better.

The President: It is understood that these specifications as far as adopted will be put in the manual. The committee has the thanks of the association.

YARDS AND TERMINALS.†

The special subject of this report is the consideration of summit (or hump) and gravity yards. In addition to this, however, your committee has, by request of the board of direction, compiled and revised a list of definitions and conclusions for adoption by the association and incorporation in the Manual of Recommended Practice.

(1) Definitions.

TERMINALS.

Terminal.—The facilities provided by a railway at a terminus or an intermediate point on its line for the purpose of handling its business.

*Freight Terminal.—The arrangement of terminal facilities for the handling of freight business.

*Passenger Terminal.—The arrangement of terminal facilities for the handling of passenger business.

YARDS.

Yard.—A system of tracks arranged in series, within defined limits, provided for separating and making up trains, storing cars and other purposes. Movements not authorized by timetables or by train orders may be made over these tracks, subject to prescribed signals and regulations.

Receiving Yard.—A yard for receiving incoming trains.

Separating Yard.—A yard adjoining a receiving yard, in which cars are separated according to district, commodity or other required order.

Classification Yard.—A yard adjoining a separating yard, in which cars are classified or grouped in accordance with requirements, preliminary to forwarding in trains.

Departure or Forwarding Yard.—A yard in which cars are assembled in trains ready for leaving.

Cluster or General Yard.—An arrangement of yards in series for the separation, classification, assembling and storage of cars.

Gravity Yard.—A yard in which the separation or classification of cars is aided by gravity.

Assisting Grade.—The inclination given to one or more tracks of a yard to facilitate the movement of cars in separating or classifying.

*Summit or Hump Yard.—A yard in which the movement of cars is produced by pushing them over a summit, beyond which they run by gravity. The movement from the base of the summit may be facilitated by an assisting grade.

TRACKS.

*Body Track.—Each of the parallel tracks of a yard upon which cars are switched or stored.

*Drill Track.—A track connecting with the ladder track and used for movements in yard switching.

Open Track.—A body track reserved for movements through a yard.

*Running Track.—A track reserved for movements through a cluster or general yard.

*Crossover Track.—A track connecting two adjacent tracks.

Your committee also recommends the adoption of the following additional definitions for publication in the Manual of Recommended Practice, superseding those previously submitted to the association and adopted as a report of progress:

Switching District.—That portion of a railway at a large terminal into which cars are moved and from which they are distributed to the various sidetracks and spurs to freight houses and manufacturing establishments served from this district, by yard or switching engines.

Rail and Water Terminal.—A terminal where freight is transferred from railway cars to vessels (or vice versa).

PIERS.

Lighterage Pier.—An open or covered pier at which freight is loaded directly from cars to vessels (or vice versa).

Export Pier.—A covered pier in which freight is unloaded and stored, mainly for shipment on ocean or coasting steamers.

Station Pier.—A covered pier having no rail connections, and where freight is received and delivered by car floats.

Coal Pier.—An open pier where coal is transferred from cars to vessels or barges.

(2) Conclusions.

The recommendations submitted are considered to embody the general principles to be followed in yard design, although local conditions as to site or operation may frequently necessitate a deviation therefrom.

Body Tracks.—These should be spaced 11 feet 6 inches to 13 feet centers, and where they are parallel to the main track or other important running track they should be spaced 15 feet, center to center, from said track.

Ladder Tracks.—These should be spaced 15 feet, center to center, from any parallel track, and a No. 7 frog is the minimum number recommended for yard use.

Lead Tracks.—For safety the connections of these tracks with

†Abstract of report presented at the annual meeting of the American Railway Engineering and Maintenance of Way Association, Chicago, March 21, 22 and 23, 1905.

*Definition practically as previously adopted by the association; slight changes made in wording so as to improve same; no change recommended.