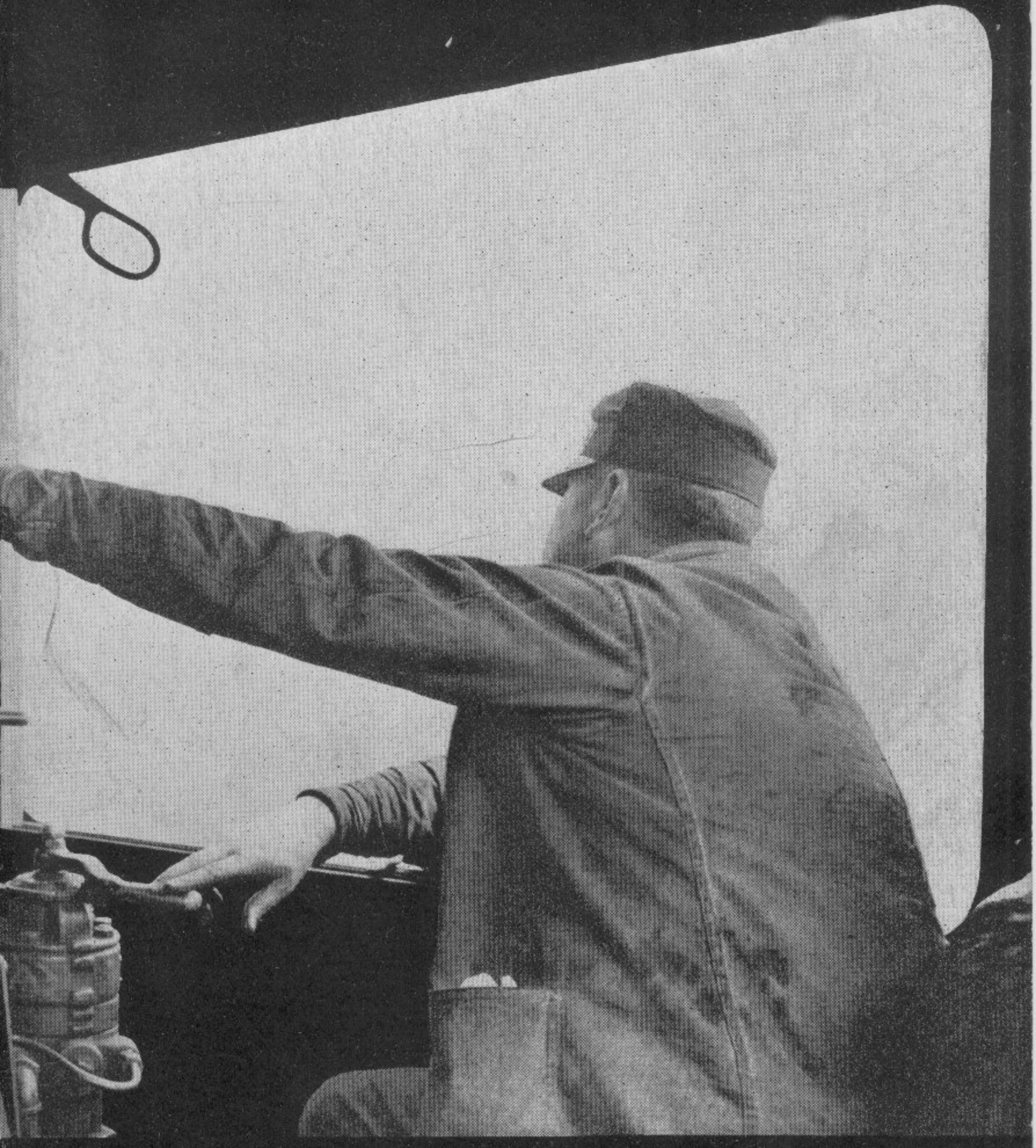
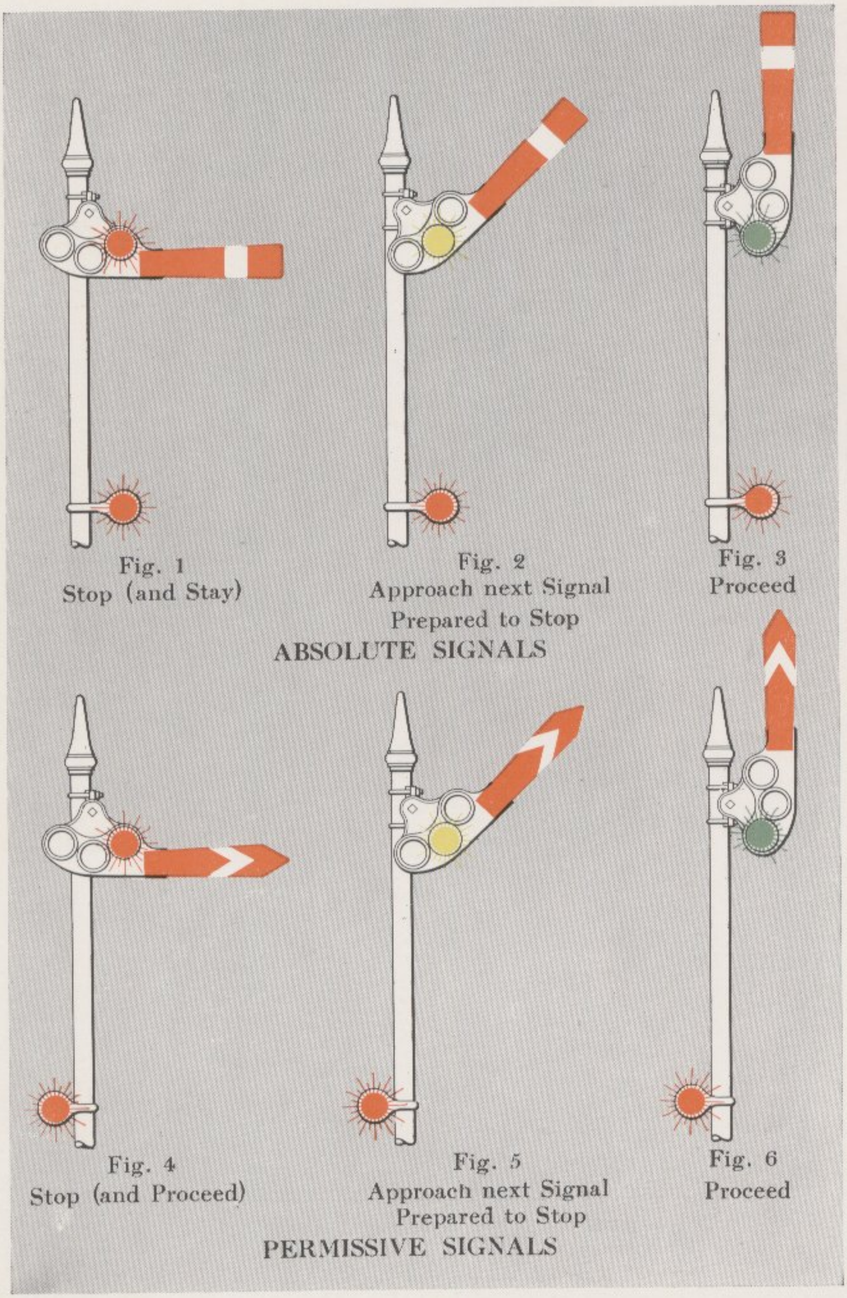


ABSOLUTE PERMISSIVE BLOCK SYSTEM

Absolute Permissive Block system
means
Automatic Protection Between sidings



Signal Aspects and Indications used in
Automatic Block Signaling

A-P-B
Absolute Permissive Block System

for Single Track Railways

Bulletin 128A

March, 1916

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GENERAL RAILWAY SIGNAL COMPANY
ROCHESTER, N.Y.
U.S.A.

A-P-B System on the Toronto, Hamilton & Buffalo Railway. Trains 73 and 78 meeting at Grassies, Ont. This road was the first to install the A-P-B System

INTRODUCTION

AUTOMATIC Block Signals were in use on 50,000 miles of track in the United States on January 1, 1916. This is an increase of over fifty per cent in five years.

This increase is significant, and may be taken as evidence of the value of the Automatic Block System as a means for protecting and facilitating traffic.

The *Railway Age Gazette* in its issue of December 31, 1915, makes the following statement on its editorial page:

"The salient fact in the annual statistical review of the block-signal situation on American railways, published in this issue, is the continued testimony to the superiority of the automatic to the manual block system, as shown in the large investments being made to substitute the one for the other."

One hundred and sixteen steam and electric railways in the United States are using Automatic Block Signals.

The Absolute Permissive Block System is a system of Automatic Block Signals adapted to meet the exacting requirements of single-track signaling.

The favorable recognition that this system has been accorded is shown by the fact that it is now in use on twenty-one railways. As further evidence the following is quoted from the *Railway Age Gazette* of December 31, 1915, from an article, "Signaling Progress in 1915," by President W. J. Eck, of the Railway Signal Association:

"Single-track automatic signaling is receiving an increasing amount of attention and the mileage installed during the year greatly exceeds that on double track. It has been only a few years since railway officers believed that automatic signals on single track would hinder instead of facilitate movements. Particularly since the so-called "absolute permissive block" has been developed has this idea given way to a realization of the safety and aid that the system affords. In the A-P-B System for single-track signaling the trains are given an absolute block from passing siding to passing siding for opposing trains and a permissive block for following trains. This system has been almost exclusively installed during the past year."


452

REQUISITES OF AN AUTOMATIC BLOCK SIGNAL SYSTEM

An Automatic Block System must fulfill certain fundamental requirements in order that it may safeguard and facilitate railway traffic.

On double track, train movements on the same track are in the same direction. The fundamental requisite of double-track signaling is to so arrange the signals as to provide a space interval between trains corresponding to a given time interval.

For example, if the maximum traffic consists of trains operated at one-minute intervals and at a speed of sixty miles per hour there would be a space interval between trains of one mile (less the train length). This space interval is divided into block sections, so arranged as to permit trains to follow each other under adequate signal protection.

On single track, train movements are in *both* directions. The fundamental requisites are two, one for following movements as in double track and the other for opposing movements. To accommodate following train movements, the block sections are arranged to permit trains to follow as in double-track signaling. For opposing train movements the block sections must be arranged to prevent the display of signal indications that would permit opposing trains to enter the same block section at the same time. These block sections should extend from one passing siding to the next. This, however, is not a feature of the ordinary type of automatic signaling, but is one of the important features of the A-P-B System.

Another requisite is that a reliable caution indication be displayed for each stop indication. This is a vital point at passing sidings where opposing trains approaching each other must have ample warning of a signal in the stop position.

SINGLE-TRACK OPERATION

In single-track operation where block signals are not in use, trains on the main track are operated and passing points are fixed upon the authority of time-tables and train orders.

The problem is to safely move the maximum number of trains in both directions on the same piece of track and to so fix their passing points as to cause the minimum amount of delay. In general, the movement of trains is made from one passing siding to another, as for example, a train would be given the right to run from Siding A to Siding B.

IDEAL BLOCK SYSTEM FOR SINGLE TRACK

The ideal Block System for single track should provide for the movement of trains in accordance with the general method that is followed under time-table and train order operation, except that it should add to this the protection of block signals. Such a system would divide the track between passing sidings into a number of block sections for following train movements, the length of these sections dependent upon the time interval for trains in the same direction. For opposing train movements the track between passing sidings would be made one block section so that a train moving from one passing siding to the next would hold opposing trains at the next siding, and thus have the right to run regardless of opposing trains and governed only by the indications of the signals of the block section for following trains.

This method permits the same facility of operation between passing sidings as in double-track operation for the reason that the direction of traffic is established by the train that first enters the main track. *Trains may then follow as if the main track were one of the two main tracks of a double-track line.* Each of these trains must pass out of this section between sidings before the signal indications will permit a train in the opposite direction to enter. This train will then in turn establish the opposite direction of traffic and trains may follow it with the same facility as in the first case.

The ordinary Automatic Block System provides protection for following movements, but for opposing movements it fails to meet the requirements of an ideal system for the reason that the block for opposing movements does not extend from siding to siding, an inherent defect in the system.

INTRODUCTION OF A-P-B SYSTEM

The General Railway Signal Company perfected and introduced an Automatic Block Signal System for single-track railways designed to overcome the inherent defects of the ordinary system. Steam and electric railway officers soon perceived the advantages of this improved system and as a result 2323 miles of the A-P-B System have been installed in the past five years on twenty-one railways. This is in itself substantial evidence that the A-P-B System has more than met the exacting requirements of single-track signaling.

THE A-P-B SYSTEM

In the A-P-B System the block for opposing movements is from siding to siding and the signals governing entrance to this block are in all cases *absolute* or *stop-and-stay* signals, hence the term "Absolute" in the name of the system. For following movements the block between sidings is divided into two or more sub-blocks, as traffic conditions may require, and movements into these sub-blocks are governed by intermediate signals which may be absolute (stop-and-stay) or permissive (stop-and-proceed) signals. Ordinarily, intermediate signals are *permissive* or *stop-and-proceed* signals as used on double-track, hence the term "Permissive" in the name of the system.

THE A-P-B CIRCUITS

The control circuits used in the A-P-B System are both unique and ingenious and do not require any appliances other than those ordinarily used in automatic block signaling.

The circuits are as simple as those used in the ordinary single-track system. They require fewer line control wires. For polarized line control only three wires are required between sidings and five within siding limits. For neutral line control five wires are required between sidings and seven within siding limits.

The control circuits of the A-P-B System are so arranged that the system restores itself to the normal position as soon as the block is clear, and conditions are safe for an approaching train, regardless of whether a preceding train or trains have passed through the block or not. If a train enters an intermediate spur or siding, and stands clear of the fouling point, the system restores itself to the normal position so that another train could leave the passing siding at either end of the block. When the train leaves the spur or siding, it establishes its direction on passing the first intermediate signal; the signals governing movements in the direction established display proceed or stop indications, depending upon condition of the blocks in advance; and signals governing opposing movements display stop indications.

THE A-P-B SYSTEM MEETS ALL REQUIREMENTS

The system is flexible and can be easily arranged to provide for the special requirements of any railroad, as for example the overlap for following train movements.

THE CHIEF ADVANTAGES OF THE A-P-B SYSTEM

1 *Opposing* train movements are governed by absolute signals, the block extending from siding to siding. (Page 16.)

2 *Following* train movements are governed by permissive signals, the block extending from signal to signal. (Page 18.)

3 At meeting and passing points maximum signal protection provides an efficient check against any failure to observe meeting and passing points. (Page 20.)

4 Flagging is reduced to a minimum, as following trains operate as in double track.

5 A reliable caution signal indication is displayed for every stop indication.

6 The minimum distance is reduced 30 per cent between following trains running under clear signals as compared with the ordinary system. (Page 18.)

7 Due to the protection against opposing trains "tonnage" signals, so called, may be used to eliminate the stoppage of tonnage trains on ascending grades where it would be difficult to start them. (Page 25.)

8 Signals are restored to normal position as soon as the block section is clear, regardless of any sequence of movements.

9 Minimum number of signal appliances required.

10 Minimum number of line wires required.

RAILWAYS USING THE ABSOLUTE PERMISSIVE BLOCK SYSTEM

March 1, 1916

Steam Railways	Mileage
Buffalo, Rochester & Pittsburgh Railway	150
Chicago & North Western Railway	280
Chicago, Indianapolis & Louisville Railway	140
Chicago, St. Paul, Minneapolis & Omaha Railway	22
Great Northern Railway	234
Lake Erie & Western Railroad	49
Lehigh & Hudson River Railway	72
Lehigh Valley Railroad	59
Louisville & Nashville Railroad	267
New York Central Railroad (west of Buffalo)	20
Northern Pacific Railway	627
Oahu Railway & Land Company, Honolulu, H. I.	23
Southern Railway	17
Toronto, Hamilton & Buffalo Railway	54
Total Mileage Steam Railways	2014
Electric Railways	
Ft. Wayne & Northern Indiana Traction Co.	50
Indiana Railways & Light Co.	6
Lehigh Valley Traction Co.	4
Puget Sound Electric Railway	20
New York State Railways (Rochester Lines)	74
Terre Haute, Indianapolis & Eastern Traction Co.	74
Union Traction Company of Indiana	81
Total Mileage Electric Railways	309
Total Mileage Steam and Electric Railways	2323

AUTOMATIC BLOCK SIGNALS FOR SINGLE-TRACK

The A-P-B System Compared with the Ordinary System

Figs. 7 and 8, A-P-B System, show a typical arrangement of signals for comparison with the ordinary system.

Fig. 9, ordinary system, shows the same number of signals as in the A-P-B System.

The difference between the A-P-B and the ordinary system is in their respective methods of signal control.

Signal control is the control of the signal by the train through the track and line circuits. The extent of this control is shown on the diagram by a line extending from the signal to the limit of its control. For example, in Fig. 7, the control of signal 18 extends to signal 12 and indicates that whenever the track between signals 18 and 12 is occupied by a train, signal 18 will indicate stop. This line also indicates the control of signals 16 and 14, as the stop control of these signals also extends to signal 12.

The stop control of *opposing* movements in the A-P-B System differs so greatly from the stop control for *following* movements that these controls are shown in separate diagrams, Figs. 7 and 8.

Fig. 7, A-P-B System, shows the stop control for opposing movements. The stop control of signal 18 governing east-bound movements from siding A and intermediate signals 16 and 14 all extend to signal 12. If a west-bound train were to enter the block between sidings A and B, signals 18, 16 and 14 would all indicate stop. Conversely, the stop control of signal 11 governing west-bound movements from siding B and intermediate signals 13 and 15 all extend to signal 17, so that if an east-bound train enters the block between sidings A and B, signals 11, 13 and 15 would all indicate stop. Signals 18 and 11 are absolute signals, as they govern train movements from siding to siding. Also signals 3 and 10 in a similar manner govern opposing movements between sidings B and C.

Fig. 8, A-P-B System, shows the stop control for following movements. The stop control of each signal extends to the next signal in advance as in double-track signaling, so that by installing a sufficient number of intermediate signals, following train movements can be spaced as closely as the traffic may require. Figs. 15 and 17 show minimum spacing for following train movements.

Fig. 9, ordinary system, shows the stop control for both opposing and following movements. There is no difference in the ordinary system between the stop control for opposing and following movements and all signals are absolute signals. As a result, traffic capacity is not as great as in the A-P-B System.

The stop control for opposing movements in the ordinary system does not extend from siding to siding. The stop control for signal 10 governing east-bound movements from siding B extends only to signal 6, and, conversely, the stop control of signal 3 at siding B extends only to signal 7. Opposing trains could therefore enter the block between sidings B and C under authority of proceed indications at signals 10 and 5, as shown in Figs. 11, 13 and 14.

For the protection of opposing movements in the ordinary system the stop control of signals is overlapped. The control of signal 16 extends to signal 12 and so overlaps signal 14. Signal 16 therefore cannot display a caution indication and operates only from stop to proceed. Likewise, signals 5, 8 and 13 cannot display a caution indication. Owing to the control of both signals 16 and 14 extending to signal 12, signal 14 cannot be found in stop position for a train passing signal 16 at proceed. Consequently, signal 14, also signals 6, 7 and 15 have no block function, but serve only as distant signals for the next signal in advance.

SIGNAL CONTROL AS USED IN THE A-P-B AND ORDINARY SYSTEMS

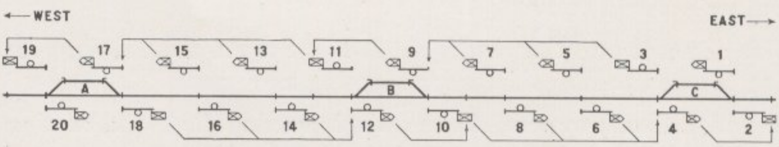

FIG. 7

A-P-B System. Signal control for *opposing* movements

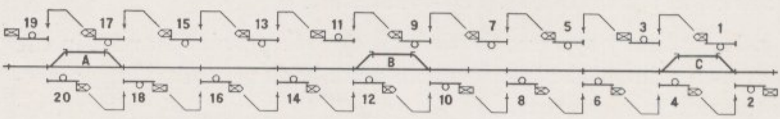

FIG. 8

A-P-B System. Signal control for *following* movements

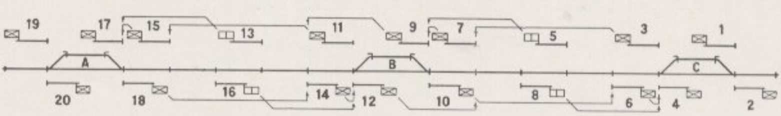

FIG. 9

Ordinary System. Signal control for *both* opposing and following movements

OPPOSING TRAIN MOVEMENTS

Opposing train movements are governed by Absolute Signals, the block extending from Siding to Siding

Figs. 10 and 12 show the A-P-B System for governing train movements from one passing siding to the next, and for comparison Figs. 11, 13 and 14 show the ordinary system.

Fig. 10, A-P-B System, shows trains 2 and 1 at passing sidings A and B about to proceed. Both trains are under full protection of signals as, for example, train 2 is protected by signals 11 and 14 at *stop* and 9 and 16 at *caution*. Train 1 is protected in a similar manner.

The block between sidings A and B is clear, therefore, both signals 5 and 12 are in *proceed* position.

Fig. 11, ordinary system, shows the same conditions.

Fig. 12, A-P-B System, shows superior train 2 entering the block, causing opposing signal 5 at siding B, also opposing intermediate signals 7 and 9, to all indicate *stop*. Train 1 is therefore held at siding B by absolute signal 5 in *stop* position. If, on the other hand, train 1 were superior and had entered the block, opposing signals 8, 10 and 12 would all indicate *stop* and train 2 held at siding A.

This demonstrates that under the A-P-B System there is absolute blocking between passing sidings for opposing movements.

Fig. 13, ordinary system, shows train 2 entering the block, causing opposing signal 7 to indicate *stop* and signal 5 at siding B *caution*. If train 1 should now enter the block on the *caution* indication of signal 5, the condition as shown in Fig. 14 would result.

Fig. 14, ordinary system, shows both opposing trains 1 and 2 in the block between sidings, the inferior train must back up under flag protection to the siding in the rear.

In the ordinary system for opposing movements the block extends from *signal to signal*, and *not* from siding to siding.

TRAINS AT PASSING SIDINGS A AND B ABOUT TO PROCEED

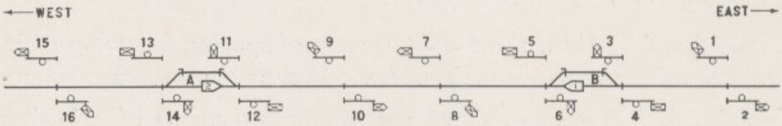

FIG. 10

A-P-B System

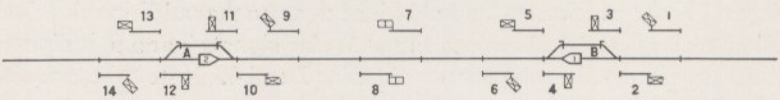

FIG. 11

Ordinary System

TRAIN 2 ENTERING THE BLOCK

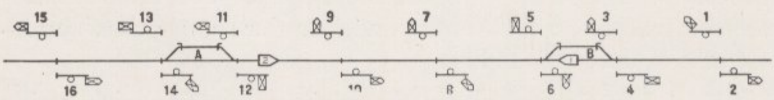

FIG. 12

A-P-B System

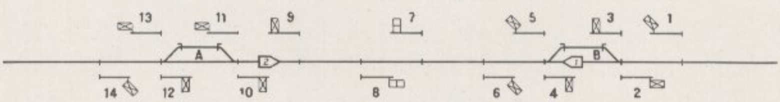

FIG. 13

Ordinary System

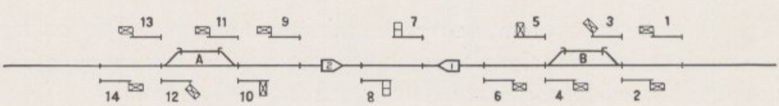

FIG. 14

Ordinary System. Opposing trains 1 and 2 stopped by intermediate signals. The inferior train must back up under flag protection.

FOLLOWING TRAIN MOVEMENTS

Following train movements are governed by Permissive Signals, the block extending from Signal to Signal

Figs. 15 and 17 show the A-P-B System of spacing following train movements, and for comparison Figs. 16 and 18 show the ordinary system.

Fig. 15, A-P-B System, shows the minimum spacing of following trains moving under caution signals. The space interval is the distance between signals plus the sighting distance.

Signal 14 is at caution and signal 16 is at clear, so that additional trains can follow trains 2 and 4. Absolute signal 5, also signals 7 and 9, indicate stop, thus protecting the movements of trains 2 and 4. Note that there is a caution indication for every stop indication.

Fig. 16, ordinary system, shows the minimum train spacing for trains moving under caution signals. Owing to the overlapped control and to the arrangement of signals, which is necessary for opposing movements, the minimum distance between trains is considerably greater than in the A-P-B System.

With the same distance between sidings and with the same number of signals the A-P-B System reduces more than 50 per cent the minimum distance between following trains running under caution signals, thus increasing the traffic capacity of the line.

Fig. 17, A-P-B System, shows the minimum spacing of following trains moving under clear signals. The space interval is the distance between two successive signals plus the sighting distance.

Signals 7, 9 and 12 go to stop as soon as train 4 passes signal 12. The first signal in the rear of signal 16 would be clear, so that another train could follow train 4 on a clear indication at this signal. Note that there is a caution indication for every stop indication, also the double caution signals 1 and 3 explained in connection with Fig. 21.

Fig. 18, ordinary system, shows the minimum spacing of following trains moving under clear signals. As in Fig. 16, the distance between following trains is considerably more than in the A-P-B System.

With the same distance between sidings and with the same number of signals the A-P-B System reduces more than 30 per cent the minimum distance between following trains running under clear signals.

In the A-P-B System when a train gets a stop indication at a permissive signal, the train stops and proceeds as prescribed by the rules. It is not necessary to proceed under flag, as there is adequate signal protection against opposing movements. In Fig. 15, for example, the movement of trains 2 and 4 through the block from A to B is protected against opposing trains by absolute signal 5, also by permissive signals 7 and 9.

In the ordinary system all signals are absolute, as they are used to protect both opposing and following train movements. A train receiving a stop indication at an absolute signal must not proceed, but must protect the rear of train with flag and wait until the signal moves to either the caution or clear position. If, however, the signal remains in stop position it will be necessary to flag the train through the block.

MINIMUM SPACING OF FOLLOWING TRAINS MOVING UNDER CAUTION SIGNALS

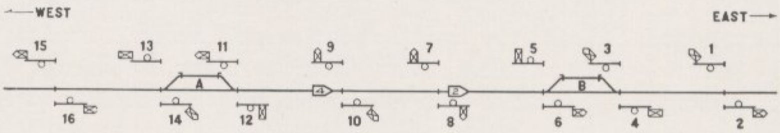

Fig. 15

A-P-B System

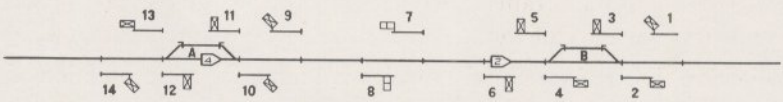

Fig. 16

Ordinary System

MINIMUM SPACING OF FOLLOWING TRAINS MOVING UNDER CLEAR SIGNALS

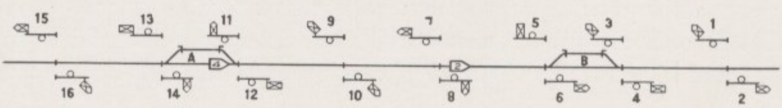

Fig. 17

A-P-B System

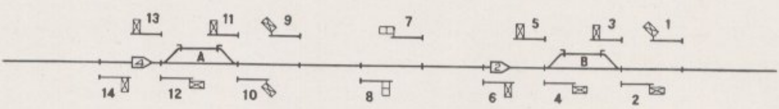

Fig. 18

Ordinary System

MAXIMUM SIGNAL PROTECTION

Maximum Signal Protection at Meeting and Passing Points provides an efficient check against any failure to observe Meeting and Passing points

Meeting and passing points are the greatest hazard in single-track operation. Trains approaching each other to meet and pass require the maximum signal protection.

The A-P-B System provides absolute signals at meeting and passing points, and when they are in the stop position for an opposing train movement in place of but one caution signal being shown as in the ordinary system *two caution signals* are shown. One caution signal at the first and the other at the second signal in the rear of the stop signal.

Figs. 19 to 28 show the comparison of the signal protection provided in the A-P-B and ordinary systems for trains meeting and passing.

Figs. 19 and 20 both show train 2 about to leave siding A on clear signal 18 and train 1 about to leave siding C on clear signal 3. The signal indications are practically the same in both figures, as the block sections are clear.

Figs. 21 and 22 show trains 1 and 2 approaching meeting point siding B.

Fig. 21, A-P-B System, shows that signals 7and 9 give a *double* caution indication for absolute signal 11 which is at stop for the protection of train 2. Likewise, signals 12 and 14 give a *double* caution indication for absolute signal 10 which is at stop for the protection of train 1. This provides maximum signal protection at meeting points and insures that a train will get a caution signal if an opposing train is at or near a siding. For example, if the double caution indications were not provided, train 1 might pass signal 7 at clear and then get a stop indication at signal 9.

Fig. 22, ordinary system, shows trains 1 and 2 approaching siding B. Signals 7 and 14 are at *clear* instead of caution as in the A-P-B System, Fig. 21.

TRAINS ABOUT TO LEAVE SIDINGS A AND C

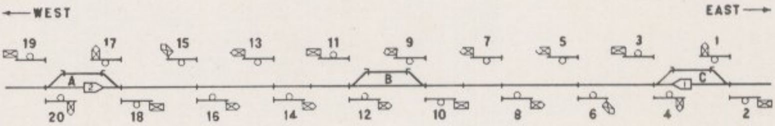

FIG. 19

A-P-B System

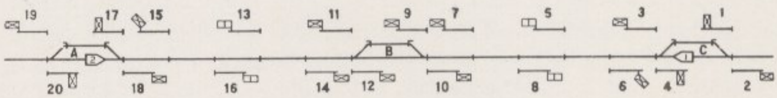

FIG. 20

Ordinary System

TRAINS 1 AND 2 APPROACHING MEETING POINT AT SIDING B

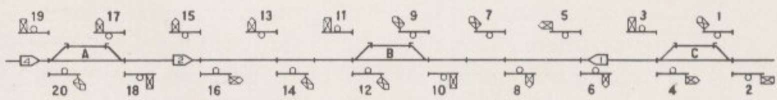

FIG. 21

A-P-B System

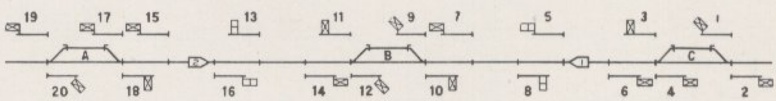

FIG. 22

Ordinary System

Figs. 23 and 24 show trains 1 and 2 at meeting point siding B, and train 4 following train 2.

Fig. 23, A-P-B System, shows that trains 1 and 2 approaching stop signals 10 and 11, both receive *two caution signals*, one caution signal at the first (signals 9 and 12) and the other at the second signal in the rear of the stop signals (signals 7 and 14). This protection is a strong feature of the A-P-B System.

Fig. 24, ordinary system, shows that if train 1 passes signal 7 under clear indication and then train 2 passes signal 14, train 1 would receive a *stop* indication at signal 9. The same conditions would obtain in the opposite direction if train 2 passes signal 14 before train 1 passes signal 7. Train 2 would receive a clear indication at signal 14 and a stop indication at signal 12. Train 4 cannot leave siding A until train 2 passes signal 14 and signal 18 goes to caution.

Figs. 25 and 26 show train 1 about to meet trains 2 and 4 at siding B.

Fig. 25, A-P-B System, shows that the block section between A and B is clear as indicated by clear signals 11 and 18, so that either an eastward or westward train could enter this block. Signal 10 will go to clear, as soon as train 1 enters the siding, so that train 2 can proceed.

Fig. 26, ordinary system, shows that conditions are practically the same as in Fig. 25 except that signals 3, 5 and 7, respectively, indicate caution, stop, and stop instead of clear, caution and stop as in Fig. 25. As soon as train 1 enters siding B, signals 3 and 10 go to clear, so that train 2, at siding B, can enter the block between B and C. Train 4 to advance to the position shown in Fig. 26 had to flag past signal 12, which was at stop for the protection of train 2.

Figs. 27 and 28 show trains 1 and 2 proceeding from siding B, and train 4 about to follow train 2.

Fig. 27, A-P-B System, shows that train 4 can proceed as soon as train 2 passes signal 8 and signal 10 goes to caution, while in the ordinary system, Fig. 28, train 4 cannot proceed on a caution indication at signal 10 until train 2 passes signal 6.

TRAINS 1 AND 2 AT MEETING POINT. TRAIN 4 FOLLOWING TRAIN 2

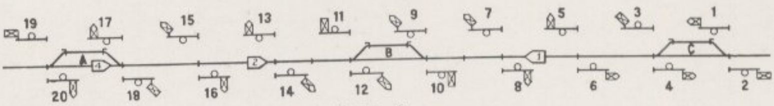
FIG. 23

A-P-B System

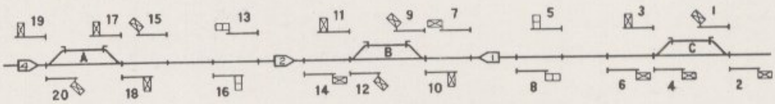
FIG. 24

Ordinary System

TRAINS 2 AND 4 AT MEETING POINT. TRAIN 1 ABOUT TO ENTER SIDING

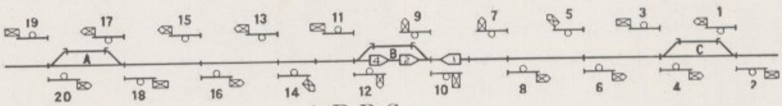
FIG. 25

A-P-B System

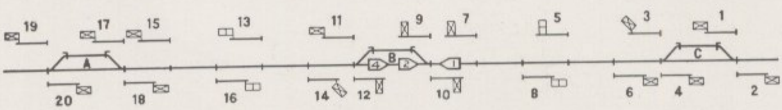
FIG. 26

Ordinary System

TRAIN 2 MOVING TOWARD SIDING C. TRAIN 4 ABOUT TO FOLLOW. TRAIN 1 HAS PASSED TRAINS 2 AND 4

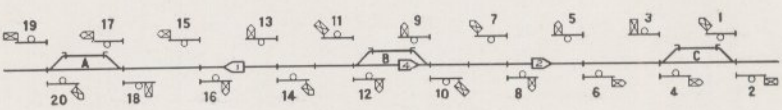
FIG. 27

A-P-B System

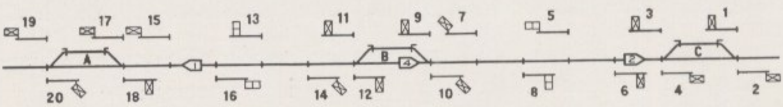
FIG. 28

Ordinary System

"Tonnage" signal used in A-P-B System to facilitate traffic on ascending grades. In the illustration the upper arm is the permissive signal; the lower arm is the "tonnage" signal

"TONNAGE" SIGNALS

Due to the protection against opposing trains, "tonnage" signals may be used to eliminate the stoppage of tonnage trains on ascending grades where it would be difficult to start them.

Figs. 29 to 33, A-P-B System, show train operation under "tonnage" signals.

Automatic block signals are often located on ascending grades where it is difficult, and in some cases practically impossible, to start a tonnage train that has stopped at a permissive signal in accordance with the rules. This causes delay and reduces the traffic capacity of the line.

Due to the protection against opposing trains, under the A-P-B System, also to the fact that movements up a grade are made at slow speed, there is practically no sacrifice of safety if trains are allowed to "close in" and pass permissive stop signals. The authority, however, to pass the stop indication must be by a secondary indication, given only when trains are following each other.

This second indication, on account of the important part it takes in facilitating the movement of tonnage trains, has been well named the "tonnage" signal. Figs. 29 to 33 show "tonnage" signals 7 and 9.

This signal comprises two moving semaphore arms. The upper arm operates in three positions, displays the ordinary stop, caution and proceed indications shown in Figs. 4, 5 and 6 (page 2), and is controlled in the same manner as other permissive signals. The lower arm operates in two positions—stop to caution, and is controlled in such a manner that it is in the horizontal or stop position when the upper arm is in the caution or proceed position. When the upper arm is held in the stop position, caused by a receding train, the lower arm operates to the caution position and indicates: "Block is not clear. Proceed prepared to stop within the range of vision."

"Tonnage" signals have been adopted and installed on a number of railways to avoid stopping tonnage trains on heavy grades.

"Tonnage" signals cannot be used in the ordinary, single-track automatic, block signal system for the simple reason that the control circuits of the ordinary system operate in the same manner for opposing as for following movements, and every signal must necessarily be an absolute or stop-and-stay signal, as the block might be occupied by an opposing train.

Fig. 29 shows a block with two "tonnage" signals on an ascending grade. All signals are in the normal position.

Fig. 30 shows train, first 91, proceeding through the block, and second 91 about to follow first 91 on caution indication at signal 5. First 91 has passed signal 7 and the upper arm has moved to stop position, but its lower arm displays the restricted proceed indication, under authority of which second 91 may pass signal 7. Opposing train 90 is held at siding A by absolute signal 12, which protects the movement of first and second 91.

Fig. 31 shows first and second 91 in the same block. Signal 5 moved to caution, when second 91 passed signal 7, so that another following train could leave siding B and could pass signal 7 under authority of the restricted proceed indication of the lower arm. Opposing train 90 is still held at siding A by absolute signal 12.

Fig. 32 shows the further advance of first and second 91. First 91 passed signal 9 with the upper arm at caution, as shown in Fig. 31, indicating that the next signal (signal 11) was in the stop position. Signal 12 remains in the stop position until first and second 91 have entered the passing siding. Signal 12 then operates to the clear position, provided that no west-bound train has left siding B, and train 90 proceeds on this indication.

Fig. 33 shows the trains proceeding in their respective directions. Second 91 can follow first 91, on caution indication at signal 13, as soon as first 91 passes signal 15. When train 90 enters the block between sidings A and B, opposing absolute signal 5, also intermediate signals 7 and 9 go to the stop position, thus protecting the movement of train 90.

A-P-B SYSTEM "TONNAGE" SIGNALS

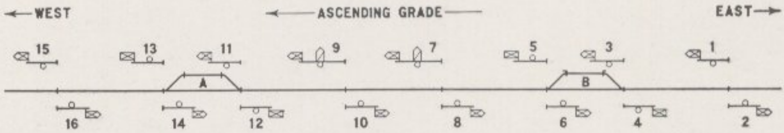

Fig. 29

No trains in block sections—signals in normal position. Signals 7 and 9 are "Tonnage" signals

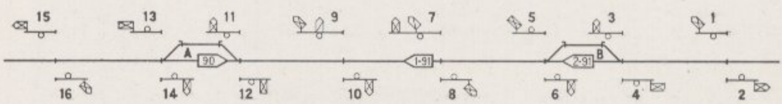

Fig. 30

Train 90 held at siding A by absolute signal 12. First 91 moving toward siding A. Second 91 about to leave siding B

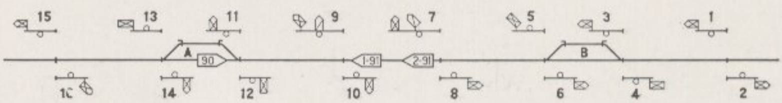

Fig. 31

Second 91 "closing in" on first 91 under authority of "tonnage" signal 7

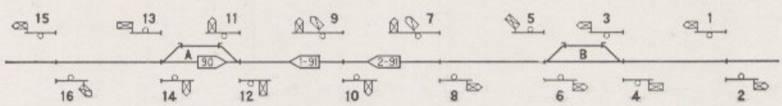

Fig. 32

Train 90 still held at signal 12. First 91 approaching permissive signal 11 under control in order to enter siding A. Second 91 following first 91 under authority of "tonnage" signal 9

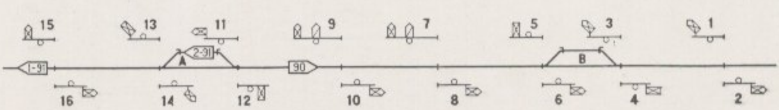

Fig. 33

First 91 has passed siding A. Second 91 has now reached siding A and is about to follow first 91. Train 90 is now moving toward siding B

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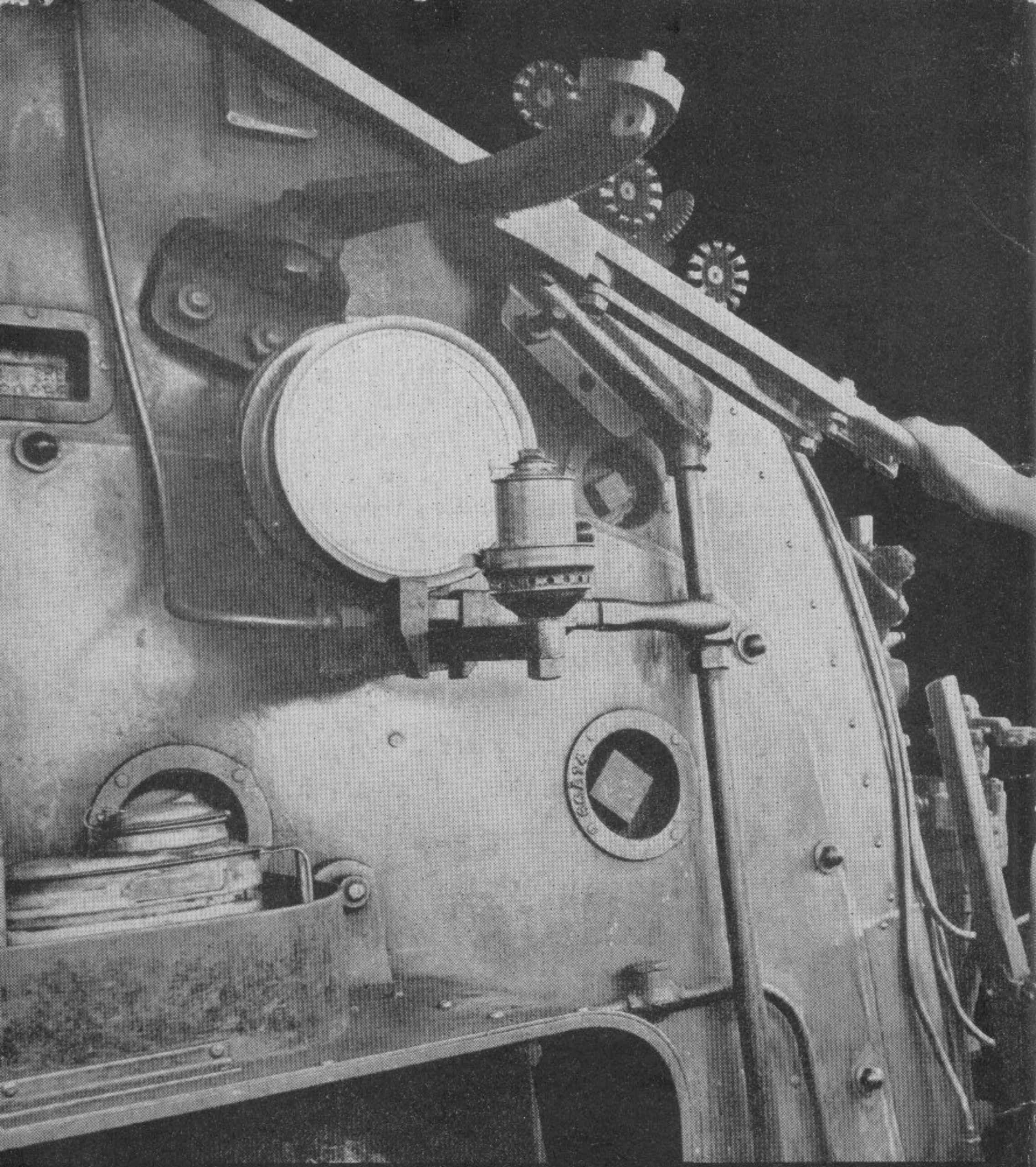

ABSOLUTE PERMISSIVE BLOCK SYSTEM