LOCOMOTIVE TRAINEE TO LOCOMOTIVE ASSISTANTS COURSE

LESSON 3

SIGNALLING:

In the expression "Signalling system" is included the whole of the means whereby the movements of trains are controlled.

The weight and speed of rail traffic make sudden stoppages impossible. Various kinds of traffic such as fast and slow trains, goods and passenger trains, have to be run on the same track and if the track is to be utilised to its fullest extent, the discrepancies arising from varying speeds have to be balanced. Traffic is not only of various kinds but may be of considerable volume, added to which complications arise from the presence of converging and diverging routes. Finally the traffic has to be conducted under varying conditions such as by day and by night and during adverse weather conditions and it is a combination of all these varying factors and the necessity for traffic to be worked with regularity and safety that renders a signalling system essential.

STATION YARDS:

Station yards are laid out to provide for the crossing of either opposing or following trains and for shunting movements. The number of lines provided depends on the amount of traffic or work necessary at any particular station. The through line entering the station at one end and passing through the station to the next station in advance is the most important and is called the "Main Line". Alongside the main line is laid a parallel line called the "Loop Line". Sometimes other lines called "Sidings" are provided. Points are used to permit trains to run from one line to another and to suit the lay-out of any particular station.

Main and loop lines are called "Running Lines" in that they are generally used for the purposes of berthing or crossing trains and are protected by fixed signals, also different types of points so that movements on these lines are safeguarded from other fouling or converging movements and thus prevent collisions.

INTERLOCKED SIGNAL BOX:

Fixed signals and points provided to protect the running lines at stations are controlled from a centralised point called a signal box and the member in charge is called "the Signalman". The older type of mechanically operated signal box is provided with frame levers which in turn are connected to the signals by means of steel wires and to the points by means of rods for manual operation. The latest type of signal box is electrically or power operated and the movement of the levers makes or breaks electric contacts which, in turn, operate relays in the case of signals and motors in the case of points. The levers which have two positions "normal" and "reverse" are so interlocked with each other that they safeguard the signalman from moving the wrong levers such as operating two signals to permit conflicting movements. When any lever is

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upright or vertical in its frame it is said to be in "normal" position so that the signal or points which it controls would also be in normal position, that is all signals within station limits would be in the "Stop" position. Points such as turnouts, cross-overs or scissors would be set for the straight lines, trap points in the derailing position, and catch points set for the runaway siding. When it is necessary to operate either the signals or a set of points, the respective levers would have to be moved or pulled over to the "reverse" position.

DOUBLE AND SINGLE LINES:

Where the density of traffic warrants it double main lines are provided between stations so that trains may run more frequently and they run on the left hand set of lines in the direction of travel therefore there is no danger of collisions between trains running in opposite directions.

Where single main lines only are provided between stations the trains run in either direction on the same set of lines so the danger of opposing movements has to be safeguarded against. This is done by signals in some areas and in others by what is known as the "Electric Train Tablet System".

POINTS AND CROSSINGS:

Points and crossings are provided to permit vehicles to move from one line to an adjacent running line. Points consist of two short rails from twelve to twenty feet in length. These rails are known as the blades, or switches of the points. Each switch is tapered to a point which is called the Toe, the opposite end is known as the Heel and this portion of the switch is attached to the running line by two fish-plates arranged to give a hinged effect. The purpose of the tapered toe is to direct the wheels of a vehicle on to the diverging track when the points are reversed and to effect this it is essential that the toe fits closely to the inside of the running rail. The switches are joined laterally at the toe and at short distances throughout their length by rods called "Spreader bars". This ensures that the switches are kept to the correct gauge. The foremost rod is coupled either to the points lever or to the rodding of the interlocking apparatus, by which means the points are operated from the signal box as the occasion requires.

Points are called "facing" or "trailing" according to the direction of movement over them. If the vehicle is moving from toe to heel, they are termed facing points; and if from heel to toe, trailing points. In a facing points movement, the switch must be close up to the running rail in order that the wheels are led safely in the new direction. A slight gap between the rail and the switch would almost inevitably result in a derailment. When the points are interlocked a locking bar device operated by the signalman ensures close fitting of the switches but in hand operated points, through the presence of dirt or the lack of lubrication, the danger of their not closing perfectly is ever present and it is important that close attention be paid to the condition of the points at all times.

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If points are not correctly set in trailing movements, the wheels of the vehicles will force them into the correct position and no damage will result in the case of hand operated points, but with interlocked points, considerable damage will result and the switches and rodding will be bent. This would probably disorganise traffic and cause delay to trains.

PROTECTION OF WAGONS STANDING IN SIDINGS:

When wagons are left standing in sidings, some method of securing them must be provided to prevent them from accidentally fouling the running lines. Methods adopted to effect this, viz., "Stop Blocks", "Trap Points" and "Safety Points".

"Stop Blocks" are used in sidings to prevent wagons moving out and fouling the running lines. They are also used in station yards to protect through shunting roads. A stop block consists of a block of hardwood hinged to a sleeper in such a manner that it straddles one rail. Across the top of this block is bolted a short piece of railway line set diagonally. Should a vehicle strike the block, the wheels would mount it and, coming into contact with the diagonally placed piece of rail, be thrown clear of the running line. Staples and eyebolts are provided and the block may be locked in either of two positions, i.e. "off" or "on" the rail. It is important to see that the stop blocks are removed before shunting operations are commenced and it is equally important to see that they are replaced when the shunting operations have been completed. The normal position of stop blocks is the "On" position which is the derailing position.

"Safety Points" which are double ended, are placed between running lines and sidings and when set in normal position any movement over them would proceed into a backshunt or dead end clear of the running line.

"Trap Points" which consist of a single switch or half of an ordinary set of points are placed on sidings and in the normal position the points are in the derailing position with the result that any runaway vehicles passing over them would be derailed clear of the running line. It is therefore necessary for the signalman to operate these points to the reverse position and give authority by means of a fixed signal or where a fixed signal is not provided, a hand signal from the Signalman or Shunter must be received before the running line can be entered or used.

1|2|3 - authorities to travel over Trap points

"Catch Points" consist of a single set of points also provided for protection. They are placed on the main line at either end of a station to prevent runaway trains or vehicles from entering the station and colliding with another train. They are generally used on or at the foot of grades and are normally set for a runaway siding to divert the uncontrolled train clear of all other lines. See Page 33 of Rules and Regulations.

A "Points Indicator" works in conjunction with the trap points and it gives two indications. When the trap points are in the open or derailing position, a red square target is exhibited; when they are reversed, a square purple target is visible. Page 36 Rules and Regulations.

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SHUNTING SIGNALS:

For the control of traffic within the limits of an interlocked station yard various signals are provided. Broadly speaking, these fall within two main groups, viz.,

1. "Points Indicators" which indicate the position in which the points are lying but which do not, of themselves, authorise movement.

2. "Shunting Signals" which, by the indications they display, direct shunting movements also on the desired routes.

The rapid evolution of signalling equipment in recent years has resulted in the development of several different types of shunting signals, consequently in different localities varying installations will be found. Once the purpose of the signals is understood the student should find little difficulty in interpreting the various types of signals.

POINTS INDICATORS:

Points indicators are provided for indicating the position in which points are set and may be of the following types :-

1. Two Position Mechanical Indicators.

2. Illuminated Arrow Light Indicators.

3. Two Position Colour Light Indicators.

1. Two Position Mechanical Indicators

These indicators are provided to indicate the position of trap points. They are set at ground level adjacent to trap points and consist of a frame carrying two square targets, one Red and the other Purple. In the centre of each target is a similarly coloured light. When the trap points are in the normal (derailing) position, the indicator exhibits a Red target in the facing direction by day or a Red light by night. When the trap points are in the running position, the indicator exhibits a Purple target in the facing direction by day or a Purple light by night. Viewed from the trailing position, a White light is visible when the trap points are in the derailing position, but when in the running position, this light ceases to be visible.

As has already been stated, the function of the indicator is to indicate the position of the points but does not authorise movement on the part of the Enginedriver.

2. Illuminated Arrow Indicators

These are placed adjacent to the points to which they refer. The indicator consists of a metal box with a glass front over which is placed a hood to render visible by day the illuminated arrow by means of which the indication is given.

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(a) On one type of indicator the arrow is inclined either to the right or the left according to the way in which the points are lying, i.e. for the siding or the through road.

(b) On the other type of indicator a fixed inclined arrow is illuminated when the points are set for the siding but is invisible when set for the through road.

These indicators are generally placed at points which lead from interlocked to non-interlocked areas.

N.B.: When the arrow light indicates that the points are set for the siding or backshunt, shunting movements over them are controlled by hand signals from the shunter, but when the points are set for the interlocked area, no arrow light is showing. Shunting movements are now controlled by the fixed shunting signal placed alongside the indicat This fixed signal is operated by the signalman. Before a signalman can reverse the points, a small switch has to be operated in the signalbox. This extinguishes the arrow light and starts a time release which provides for a specified delay before the points lever is free to move. Time releases are extensively used in signalling, the general purpose being to afford a period of warning between the changing of a signal and the altering of the points to which it refers.

3. Two Position Colour Light Indicators

Where "Illuminated Arrow Indicators" are placed at the facing end of points, as previously described, "Two Position Colour Light Indicators" are also provided to control shunting movements in the trailing direction. Both indicators work in conjunction with one another and are controlled by the same switch.

The "Two Position Colour Light Indicator" consists of a box containing two coloured lenses arranged vertically. The upper lens is coloured Red and the lower, Yellow. Two indications are shown, thus:

(a) A Yellow light by day or night indicating that the points are in the normal position and that shunting movements may proceed over the points in the trailing direction under control of the shunter.

(b) A Red light by day or night indicating that the points are reversed, or the signalman wishes to stop any movement being made over them.

Where "Illuminated Arrow Indicators" or related Colour Light Indicators are provided, their normal indication indicates that the interlocked points are correctly set for the movement. All movements past such indicators must be controlled by a hand signal from the Shunter.

Two and Three Position Colour Light Ground Shunt Signals

Two and three position Colour Light Shunt Signals are

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used to control the passage of trains and shunting movements within station limits.

The "Three Position" type consists of three coloured lenses arranged vertically in the unit, the top being Red, the middle, Yellow, and the lowest Green. The signal unit is mounted at ground level and hoods are fitted to shade the lenses as in other colour light signals. The three indications given by day and night are :-

(1) Red light indicating "Danger - Stop".

(2) Yellow light indicating that the points are correctly set. "Caution - Low Speed"; proceed at low speed being prepared to stop as the line may be occupied.

(3) Green light indicating that the points are correctly set. "Clear - Low Speed"; proceed at low speed, the line is clear and unoccupied up to the next signal in advance which is showing a Low Speed, Medium Speed or Normal Speed indication.

The "Two Position" type consists of two coloured lenses arranged vertically in the signal unit, the Red being at the top and the Yellow underneath. It is similar to the three position signal.

Two indications are given by day and night :-

(1) Red light, "Stop".

(2) Yellow light indicating that the points are correctly set. "Caution - Low Speed"; proceed at low speed being prepared to stop as the line may be occupied.

GENERAL REMARKS ON SHUNTING SIGNALS:

The numerous types of shunting signals that have been outlined, may lead the student to view the subject as one of considerable complexity. It is therefore suggested that before attempting a detailed study of shunting signals he makes himself conversant with the principles of signalling already outlined. This will produce the necessary background of signalling practice and once this has been acquired, it will be found that all signalling procedure is based on rigid principles which may be presented in different forms but are never violated. Siding or shunting signal systems are often peculiar to the local conditions in which they exist. A knowledge of local conditions is therefore a necessary adjunct to the interpretation of the signals. The student should make himself conversant with the system which exists at his own station which he can most readily study. Once this knowledge has been acquired different systems will be more readily understood and the outline of signals already given will assist him to recognise them on sight.

Rules and Regulations Book Pages 34 to 37.

Automatic Signalling depends fundamentally on a system

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known as "Track Circuits". The line is divided into sections of any given length, according to the density of traffic, by placing insulating plates between the joints of the rails. A signal is placed at the commencement of each section. The terminals of an electric power supply are connected to each rail and a circuit is made from the power supply, along one rail of the section, through a relay and back to the supply by means of the other rail. The current thus flows continuously through the relay which it energises and the signal controlling the entrance to the section responds to the energised relay by indicating that the track is unoccupied. This gives a "Clear - Proceed" signal. If a train enters the section the current in the rails is short circuited through the wheels and axles of the vehicles. The current is cut off from the relay which immediately becomes de-energised and the signal at the entrance to the section responds by indicating that the line is occupied. A "Stop" signal is accordingly displayed and is maintained as long as the train is on the section. Once it has passed off it, however, the current is restored to the relay which again becomes energised and restores the signal to the "Proceed" indication, with this difference, the restoration takes place in two stages. Instead of assuming the original Clear-Proceed (green) indication, the first movement is to the "Caution - Proceed" (yellow). The "Clear - Proceed" (green) indication is not displayed until the train reaches two sections in advance.

Both single and double lines of railway may be operated by automatic signalling. Indeed there is no double track in our system operated by other means than the automatic system. Before we commence a detailed study of automatic signalling, it might be as well to ensure that we are clear in our own minds as to the inherent differences that exist and the problems that arise, in double and single line operation.

Where a line has been duplicated, traffic in each direction keeps to its own track. There are no problems in arranging the crossings of opposing trains. The only problems are to keep following trains spaced safely and the side-tracking of one train to allow an overtaking train to pass it. This latter problem can be solved only by removing the first train completely from the running line by placing it in a "Loop" or "Siding" at a station where staff are available to perform the operation. The spacing of following trains is effected by the Automatic Signals operated by the Track Circuits. Repeating what has already been said, a clear line is indicated by a "Proceed" signal. Once the train enters the section, the de-energised relay places the signal at Stop and holds it so, as long as the train is in the section. On entering the next section, the signal for that section is placed at "Stop" and the signal at the entrance of the section off which the train has just passed, is placed at "Proceed", first by the "Caution" (yellow) aspect and then as the succeeding section is cleared, by the "Clear-Proceed" (green) indication. Thus the Enginedriver who has a "Clear-Proceed" signal knows that at least two sections ahead are unoccupied; a "Caution-Proceed" (yellow) signal indicates that one section ahead is clear; while a "Stop" signal indicates that the section ahead is occupied. As all trains are travelling in one direction, this signal system enables

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the Enginedriver to proceed with full knowledge of the state of the line ahead of him and trains are kept spaced by the distance that separates the signals, which, we have seen, are placed according to the density of the traffic. Since "Up" and "Down" traffic run on different lines, there is no interference of opposing trains. Each line is provided with its own signals. The "Up" and "Down" signals are therefore independent of each other except at stations or other points where cross-over roads are provided and where special signals are installed to protect movement from one line to the other.

SINGLE LINE:

On single line sections, the problem is entirely different. "Up" and "Down" trains use the one line and between crossing stations it is paramount that once a train has entered a section, no other train is allowed to enter it from the other end. The signals which control "Up" and "Down" traffic are therefore not independent of each other but must be so arranged that, before a train enters a section, the signal controlling the entrance to the section from the other end must be placed at "Stop" and held in that position until the train has traversed the section. Another train may, of course, follow the first train into the section at an interval governed by the signals provided, but this second train would in turn hold the opposing signal at "Stop" as long as it occupied the section. By this means opposing trains are prevented from mutual interference.

A moment's thought will show that under this system, the vital signal is that which permits a train to enter a section between two adjacent crossing stations on a single line. It is called the "Departure Signal" and because of its importance, it receives a separate classification. If this point is understood clearly now it may save some confusion when we come to study the general classification of Three Position Signals.

Before we proceed to a consideration of the classification of Three Position Signals and their functions and arrangement, it is necessary to clear the ground somewhat regarding their general appearance.

The first development in Three Position Signalling was to eliminate the Semaphore Arm and replace it with lights visible both by day and by night. In this form, the signal consists of a case containing three lamps behind coloured lenses; one green, one yellow and one red. As the signal responds to the relays, the appropriate light becomes illuminated. This is known as the three lens form.

Another form of the Three Position Signal is a single lamp which changes colour according to the indication displayed. This is generally referred to as a Single Lens Signal or sometimes as a "Searchlight" signal, which is the term used by the makers but has not been adopted officially.

These two different forms of the Three Position Signals are all to be found in different automatic installations and the

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fact that the Rule Book must take cognisance of them may cause the student some confusion until he is thoroughly conversant with their general appearance.

There is no difference in the interpretation of the signals and when a coloured light is spoken of as the indication displayed, it must be understood as applying to either the Single, or Three, Lens Signals. In the instruction that follows, the coloured light only will be referred to, so the student must fix the difference in the appearance of the signals firmly in his mind. "Rules and Regulations" pages 139-140 should now be read, also pages 141-142, Regulation 1.

INTERMEDIATE SIGNALS - STOP AND PROCEED TYPE:

To permit trains following each other through a block section Intermediate Signals are provided. These divide the block section into a number of "Intermediate" sections. The distance at which these signals are spaced depends entirely on the amount of traffic the line has to handle. On busy lines they may be fairly close while on lines where the traffic is light none may be provided. Their function where provided, is to keep following trains safely spaced. When the line is unoccupied, the normal position of Intermediate Signals is at "Clear-Proceed" (green). When a train passes one, it changes its aspect to "Stop" (red). When the train passes the next Intermediate Signal, it changes that to "Stop" and also at the same time places the first signal at "Caution" (yellow). As the train proceeds and reaches the third signal, it changes that to "Stop", the second signal to "Caution" and the first back to the original "Clear" (green) aspect. Thus when a following train receives a "Clear" (green) aspect on an Intermediate Signal there are at least two sections ahead "Clear". When a "Caution" aspect is shown, the Enginedriver knows that there is one section ahead "Clear" and when a "Stop" aspect is shown that the section ahead may be occupied. A train may therefore follow at normal speed up to the Intermediate Section in the rear of a preceeding train. But when it reaches an Intermediate Section with the signal at "Stop" it must do so. However the Enginedriver knows that the section ahead is occupied, and after waiting ten seconds to give the train ahead a chance to clear, he may then proceed at such a speed that he is able to stop short of any obstruction. This is generally considered to be ten kilometres per hour. If the preceeding train has broken down arrangements may be made for the following train to assist it through the section and thus time is saved. Intermediate Signals are of the "Stop and Proceed" class and the above explanation will no doubt elucidate the meaning of the term.

We may now form a definition of "Stop and Proceed" signals which are Intermediate Signals placed at intervals in block sections to space following trains and, as we saw earlier, they are further classified as "Arrival" signals when they are placed at the entrance to attended and unattended stations.

Several causes other than the presence of a train can place an intermediate signal at "Stop". A broken or misplaced rail, points wrongly set or any other obstruction may be cited

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as typical examples. The Enginedriver must therefore travel at reduced speed and keep a sharp lookout for any of the above conditions as well as for the presence of a train until he has passed the signal in advance. "Stop and Stay" signals are also used for Intermediate Signals.

LOCOMOTIVE TRAINEES COURSE FOR LOCOMOTIVE ASSISTANTS

Assignment No. 3 | Questions | January 1977

Question No.		
1	What aspects shown on automatic running signals indicate: (a) Normal speed? (b) Medium speed? (c) Low speed?	A2
2	What does a Low Speed signal indicate when it is illuminated and how should the train proceed?	A2
	How would you distinguish the difference in appearance between a "Stop and Proceed" and "Stop and Stay" signal?	A3
4	When a letter "A" is illuminated on a "Stop and Stay" signal, what does this indicate?	A3
5	(a) Where are Arrival signals located and state their purpose? (b) When the "L" light is illuminated on an Arrival signal, what does this indicate? (c) What are the Locomotive Assistant's duties if the "L" light does not show when the main line points are reversed?	A20
6	What are the Locomotive Assistant's duties when a light locomotive is detained at a Stop and Stay signal at "STOP" and no "A" light is showing?	Auto. 5
	Define an imperfectly displayed automatic running signal.	A8
8	Where are Departure signals placed and what do they authorise?	A19
9	What are the three main classes of automatic running signals?	A3
10	What conditions will prevent automatic running signals going to proceed?	A13
11	Give the definitions of the following in a single line automatic signalling area: (a) Block section. (b) Intermediate section.	A18

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Question No.

12 (a) When a Locomotive Assistant is acting as a Pilotman, how is he identified as the Pilotman?

(b) If the Locomotive Assistant lost the full pilot key while acting as a Pilotman, how would he then be identified? A29

13 (a) Where is the half pilot key located?

(b) What effect does it have on the Departure signal when removed? A28

14 What are the Locomotive Assistant's duties when he has to institute pilot working from the station in advance of a defective Departure signal? A28

15 * What are the Locomotive Assistant's duties when a train is to be dispatched from the loop at an unattended crossing station (not worked under C.T.C.)? A22

16 What are the Locomotive Assistant's duties when it is necessary to:

(a) Enter and be locked in a switch locked siding?

(b) To proceed on to the main line after having been locked in a switch locked siding to return to the starting station? (Single line Automatic Signals area). A24

17 What are the Locomotive Assistant's duties when a train is disabled in a single line automatic area and the relief locomotive is to be obtained from the station in advance? A30

18 What are the Locomotive Assistant's duties when a train is disabled in a single line automatic area and the relief locomotive is available at the rear station to push the disabled train through the section to the station in advance, no following trains in the section? A30

19 When the Locomotive Assistant removes the half pilot key what are his responsibilities in the following circumstances:

(a) As soon as the half pilot key is removed?

(b) When required to pilot a relief locomotive past the Departure signal and to propel the disabled train through to the station in advance? A30

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Question No.		
20	At some stations, an illuminated "T" light or "Wanted Winker" is provided. When operated, what do these indicate to the locomotive crew and what action must be taken?	A35
21	What are the Locomotive Assistant's duties when a train is to enter the crossing loop at an unattended crossing station (single line automatic signalling area not under C.T.C.)?	A22
22	Two trains have to make a crossing at an unattended crossing station (single line automatic signalling area not under C.T.C). The train due to do so arrives first on the main line and stops short of the fouling point. What must the Locomotive Assistant do immediately and why?	A22
23	What are the Locomotive Assistant's duties when it is necessary to shunt a double line switch locked siding and the movement entails crossing the opposite running line?	A16
24	What effect on signals does the opening and closing of a switch-lock door in a double line automatic signalling area have?	A16
25	At some stations an "R" light indicator is provided; when illuminated, what does it indicate?	L.S.O.I. page 19