SIGNALING & INTERLOCKING

- The purpose of signaling and interlocking is primarily to control and regulate the movement of trains **safely and efficiently**.
- Signaling includes the use and working of signals, points, block instruments, and other allied equipment in a **predetermined** manner for the safe and efficient running of trains.
- **Signaling** enables the movement of trains to be controlled in such a way that the existing tracks are utilized to the maximum.

- In railway terminology signaling is a medium of communication between the **station master or the controller** sitting in a remote place in the office and the driver of the train.
- The history of signaling goes back to the olden days when two policemen on horseback were sent ahead of the train to ensure that the tracks were clear and to regulate the movement of the trains.
- In later years, policemen in uniform were placed at regular intervals to regulate the movement of trains. Railway signaling in its present form was introduced for the first time in England in 1842, whereas interlocking was developed subsequently in 1867.

OBJECTIVES OF SIGNALING

- (a) To regulate the movement of trains so that they run safely at maximum permissible speeds.
- (b) To maintain a safe distance between trains that are running on the same line in the same direction.
- (c) To ensure the safety of two or more trains that have to cross or approach each other.
- (d) To provide facilities for safe and efficient shunting.
- (e) To regulate the arrival and departure of trains from the station yard.
- (f) To guide the trains to run at restricted speeds during the maintenance and repair of tracks.
- (g) To ensure the safety of the train when it comes in contact with road traffic at level crossings.

Table 31.1 Classification of signals

Characteristics	*Basis of classification*	*Examples*
Operational	Communication of message in audible or visual form	Audible: Detonators Visual: Hand signals, fixed signals, etc.
Functional	Signalling the driver to stop, move cautiously, proceed, or carry out shunting operations	Stop signals, shunt signals, speed indicators
Locational	Reception or departure signals	Outer, home, starter, and advanced starter signals
Special characteristics	Meant for special purposes	Calling-on signals, repeater signals, speed indicators, etc.

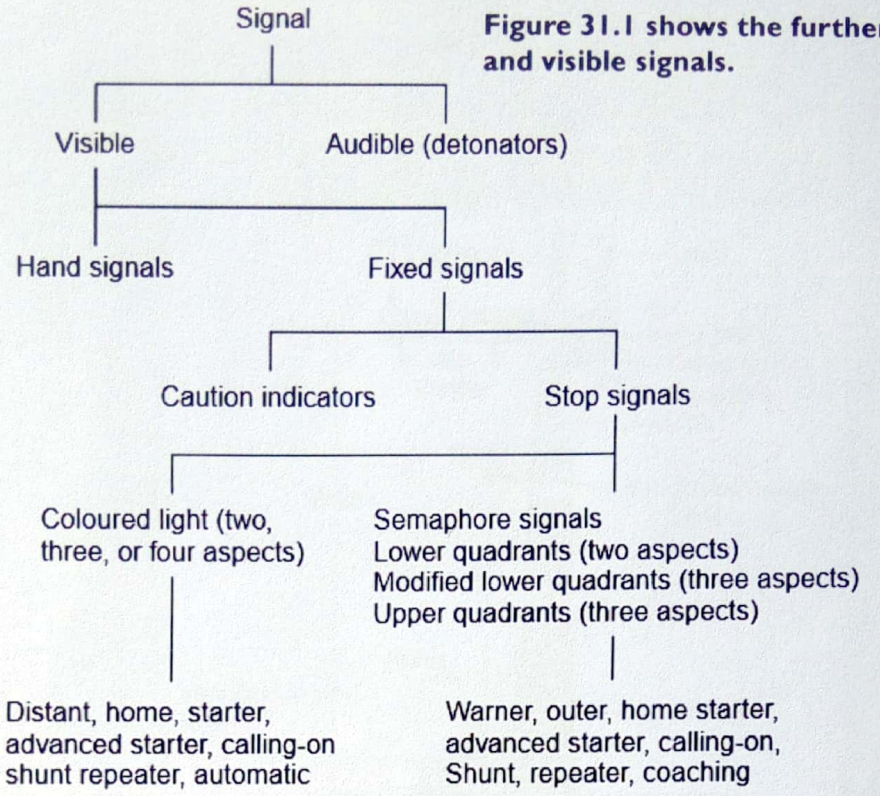


Figure 31.1 shows the further classification of audible and visible signals.

Fig. 31.1 Classification of signals

lists the minimum signal requirements of various classes of stations.

Table 31.2 Signals required at stations

Classification of station	*Minimum requirement of signals*	*Remarks*
A class	Warner, home, and starter	An outer signal can be provided after obtaining special permission
B class	Outer and home	In multiple-aspect upper quadrant (MAUQ) areas, distant home and outer signals are provided
C class	Warner and home	In MAUQ areas, the warner signal is replaced by a distant signal

Semaphore signals

- The word 'semaphore' was first used by a Greek historian. 'Sema' means sign and 'phor' means to bear. A semaphore signal consists of a movable arm pivoted on a vertical post through a horizontal pin as shown in Fig. 31.2.

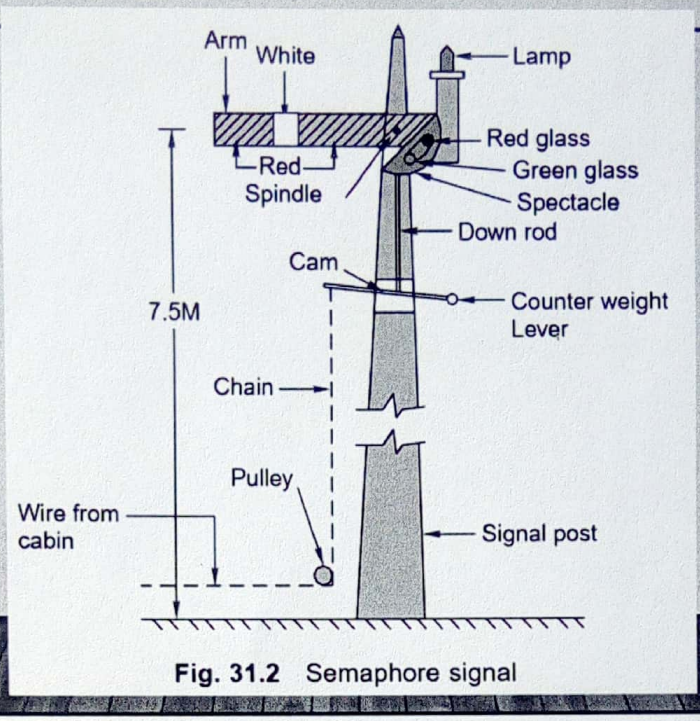


Fig. 31.2 Semaphore signal

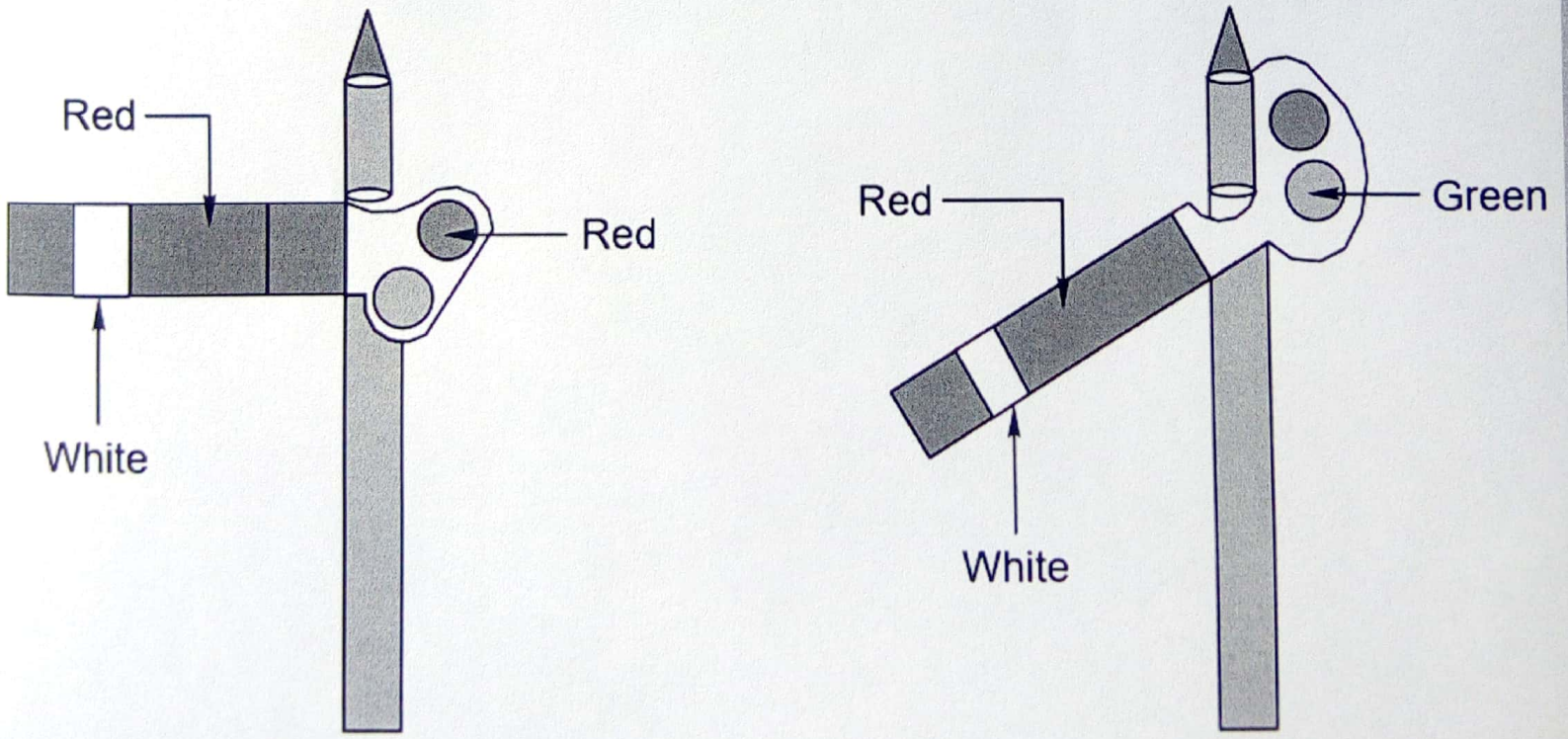


Fig. 31.3 Positions of semaphore signals

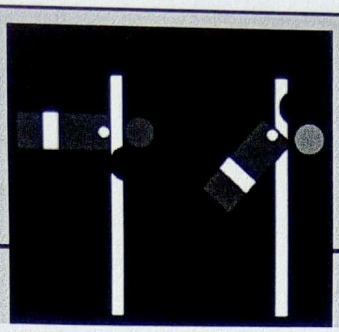


Fig. 31.3 Positions of semaphore signals

Table 31.3 Indications give by a semaphore signal

Position of signal	*Position of arm*	*Colour during night*	*Indication*
On	Horizontal	Red	Stop or danger
Off	Inclined 45° to 60° below horizontal	Green	Proceed or line is clear

Colored light signals

- These signals use colored lights to indicate track conditions to the driver both during the day and the night.
- In order to ensure good visibility of these light signals, particularly during daytime, the light emission of an electric 12-V, 33-W lamp is passed through a combination of lenses in such a way that a parallel beam of focused light is emitted out.

Colored light signals can be of the following types.

- (a) Two-aspect, namely, green and red
- (b) Three-aspect, namely, green, yellow, and red
- (c) Four-aspect, namely, green, yellow (twice), and red.

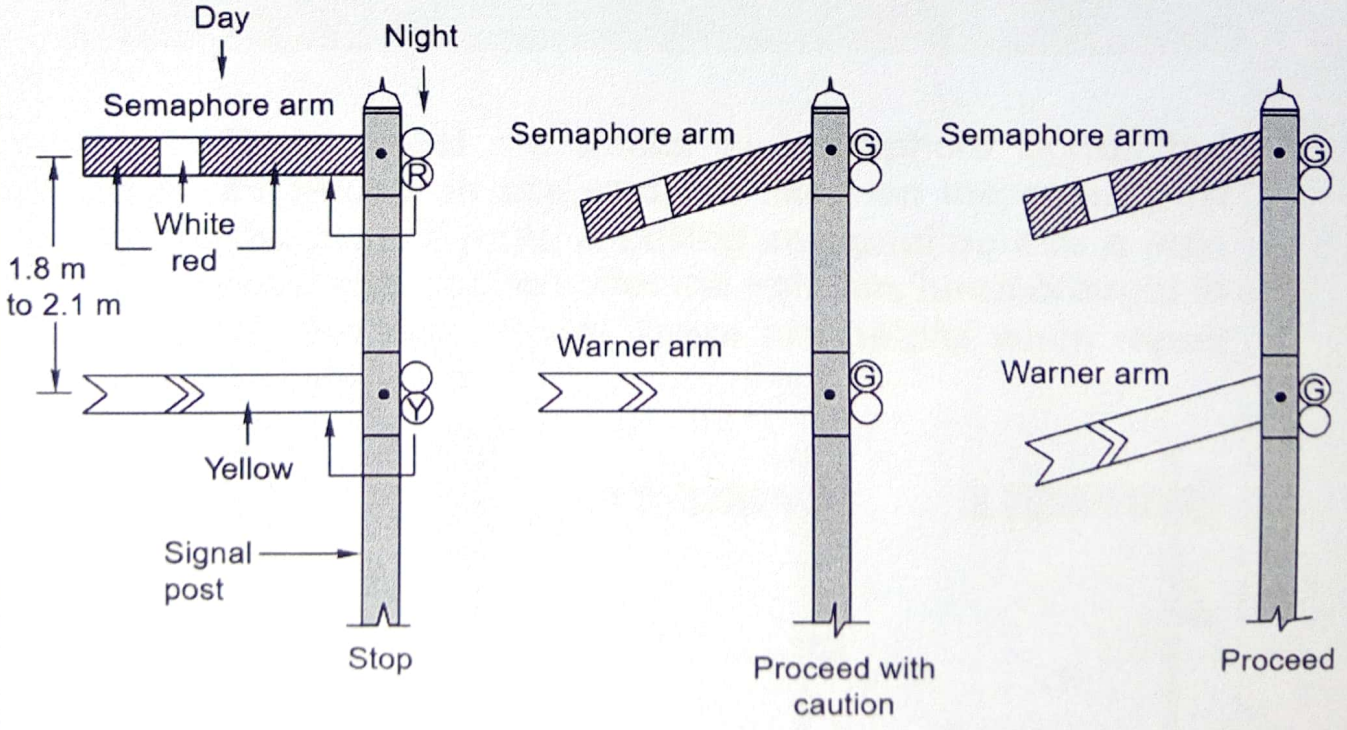
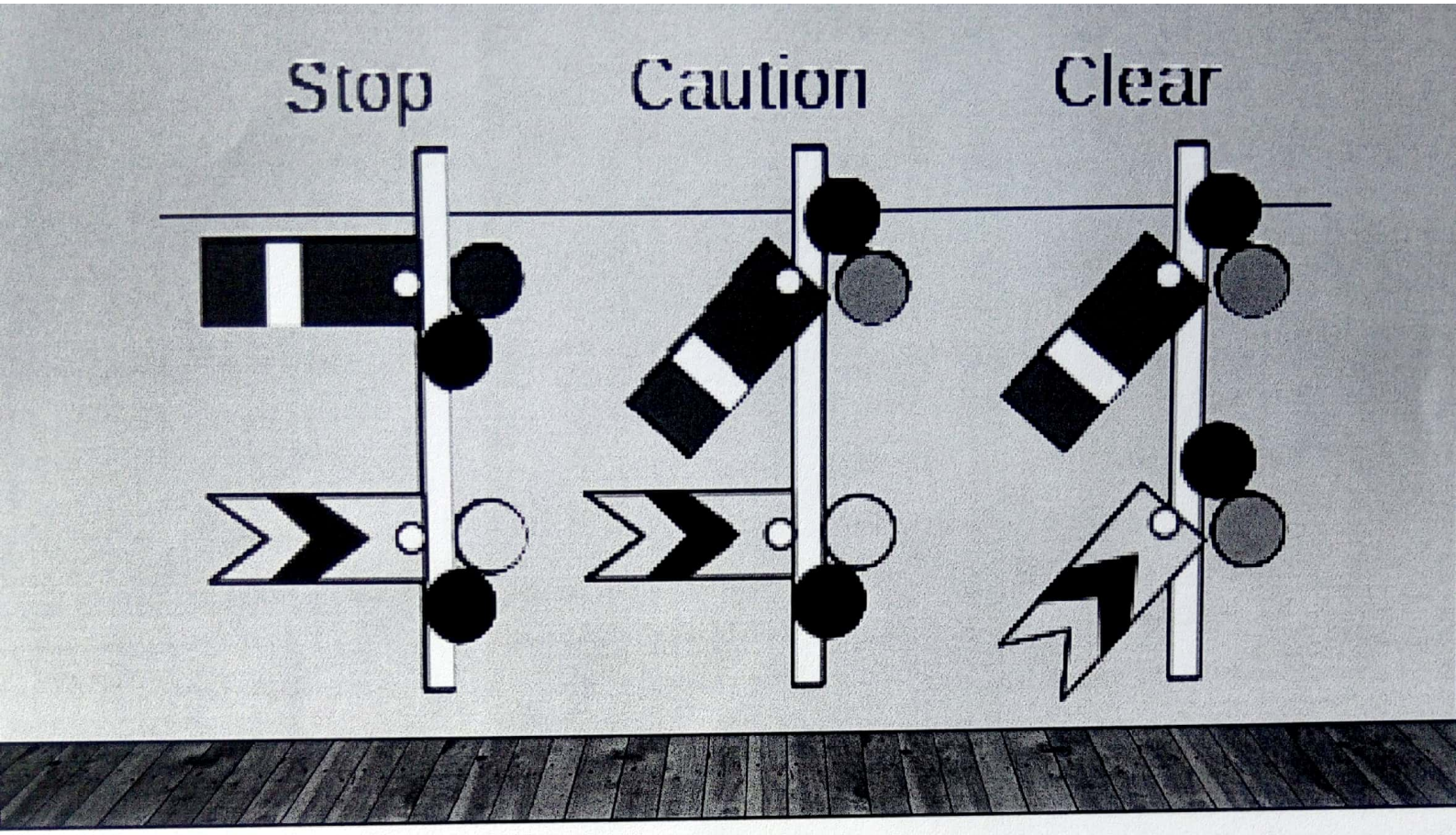
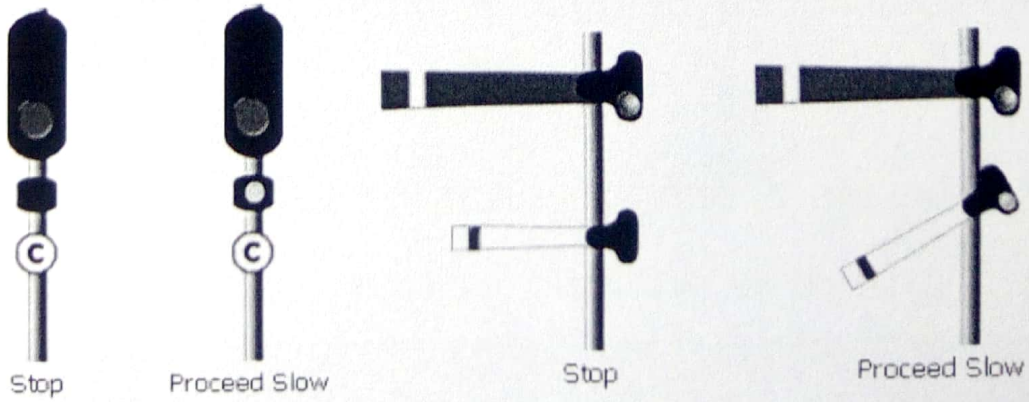


Fig. 31.4 Warner below an outer signal



CALLING ON SIGNAL

These signal are similar to semaphore signal, but they are smaller in size and are fixed on the same post below the main signals. A calling on signal permits a train to proceed with caution after the train has been brought to a halt by the main signal. These are helpful when repair works are going on.



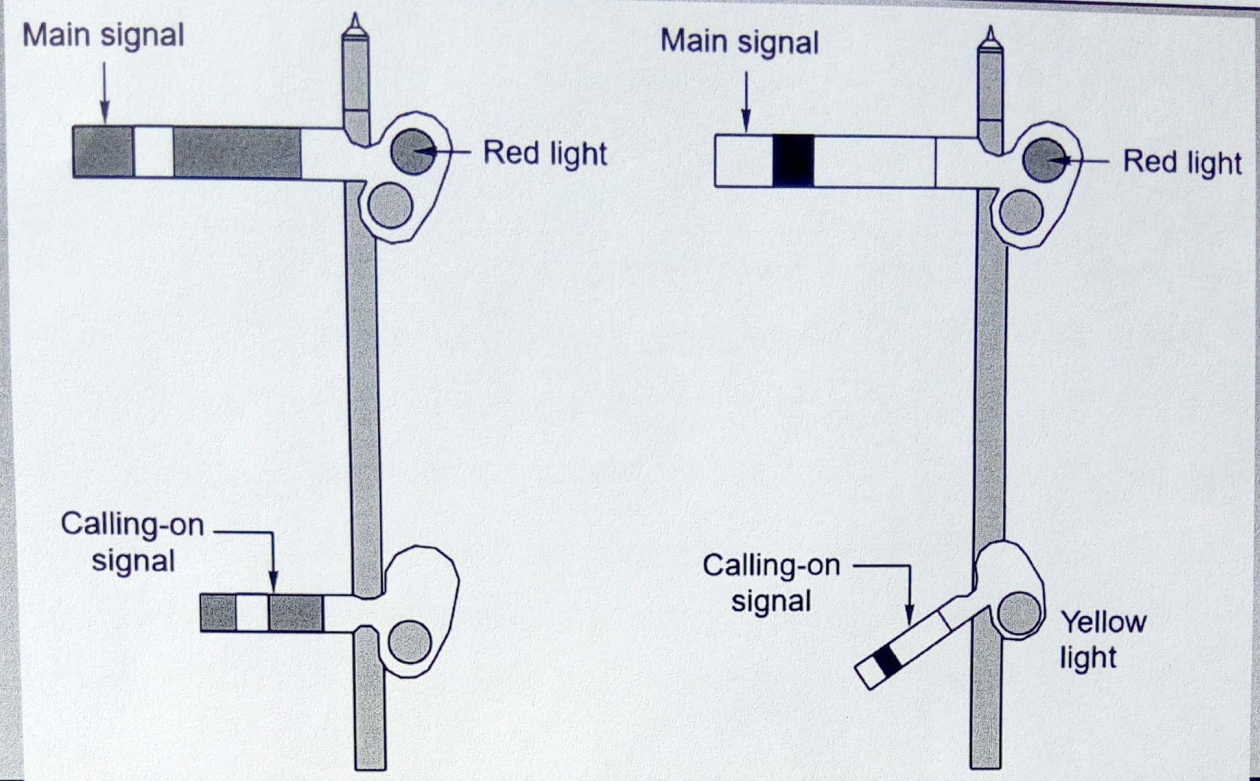


Fig. 31.6 Calling-on signal

Co-acting signal

- In case a signal is not visible to the driver due to the presence of some obstruction such as an over-bridge or a high structure, another signal is used in its place, preferably on the same post.
- This signal, known as the co-acting signal, is an exact replica of the original signal and works in unison with it.

REPEATER SIGNAL

- In cases where a signal is not visible to the driver from an adequate distance due to sharp curvature or any other reason or where the signal is not visible to the guard of the train from his position at the rear end of a platform, a repeater signal is provided at a suitable position at the rear of the main signal.
- A repeater signal is provided with an R marker and can be of the following types. (a) A square-ended semaphore arm with a yellow background and a black vertical band. (b) A coloured light repeater signal. (c) A rotary or disc banner type signal.

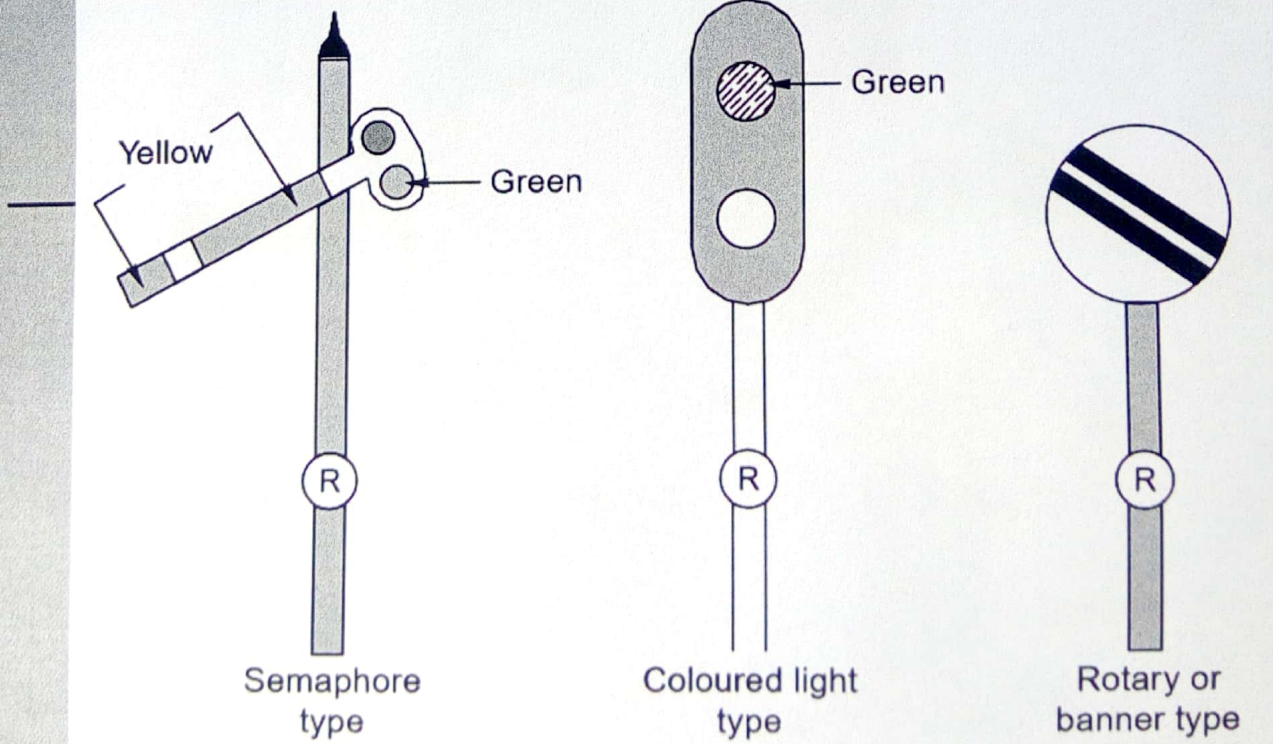


Fig. 31.7 Different Types of repeater signals

SHUNT SIGNALS

- These are miniature signals and are mostly used for regulating the shunting of vehicles in station yards.
- Unlike fixed signals, these are small in size and are placed on an independent post of a running signal post.
- In semaphore signalling areas, the shunt signals are of the disc type.

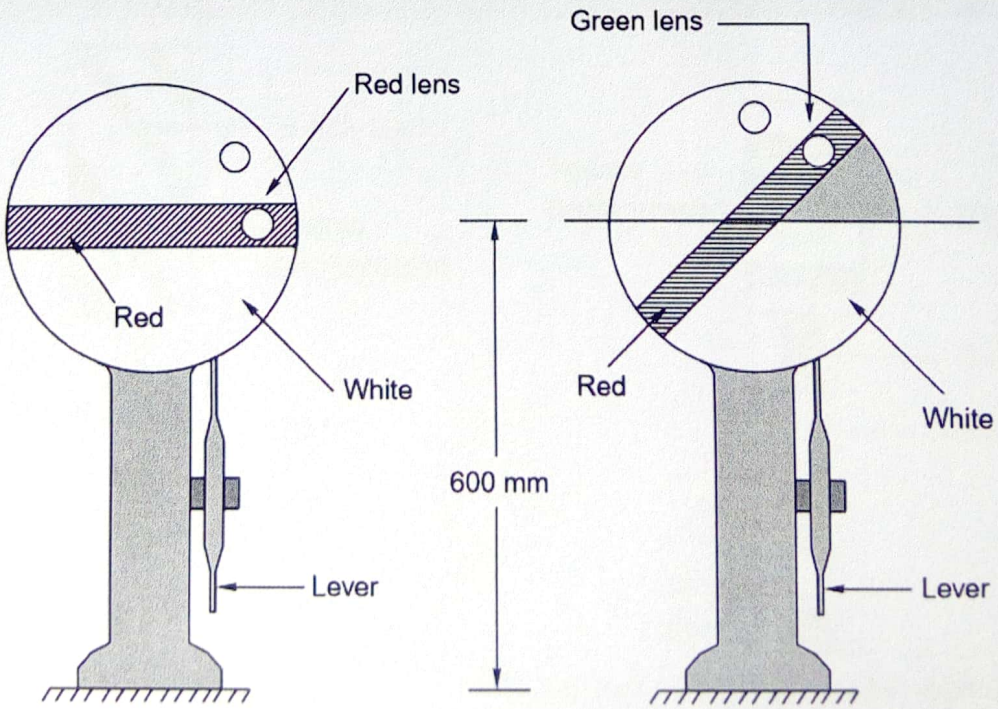


Fig. 31.8 Disc type of shunt signals

SIGHTING BOARD

- A sighting board is an indication to the driver that he or she is approaching the first stop signal of a railway station.
- The function of a sighting board is to allow the driver to estimate the location of the next stop signal from the current location so that he/she starts applying brakes in case the first stop signal is in an 'on' position.

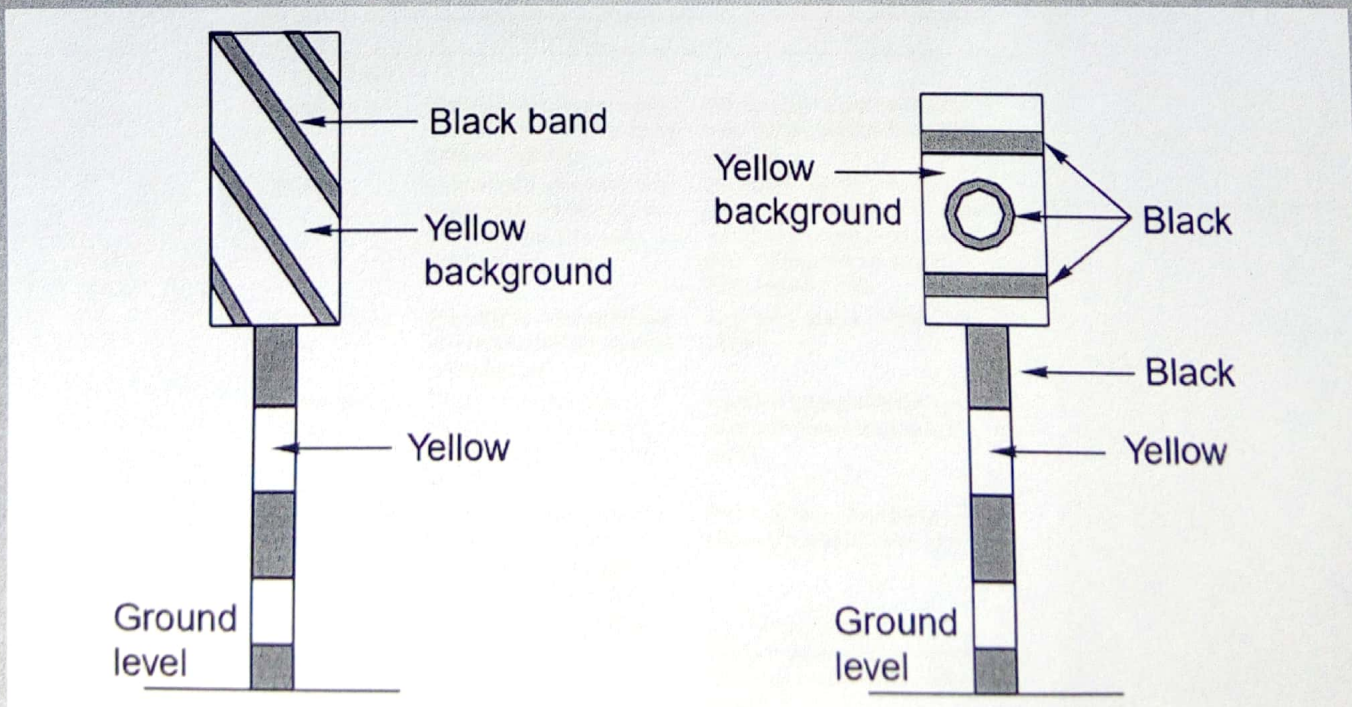


Fig. 31.11 Sighting board

SIGNALLING SYSTEMS

- The entire signalling system can be classified into two main categories. **(a) Mechanical signalling system (b) Electrical signalling system.** In addition to these two main categories of signalling systems, a solid-state signalling system is also in use. Each system of signalling comprises four main components.
- (a) Operated units such as signals and points (b) A transmission system such as single- or double-wire transmission or electrical transmission (c) Operating units such as levers and press buttons (d) Monitoring units such as detectors, treadle bars, and track circuiting

Table 31.8 Comparison of signalling systems

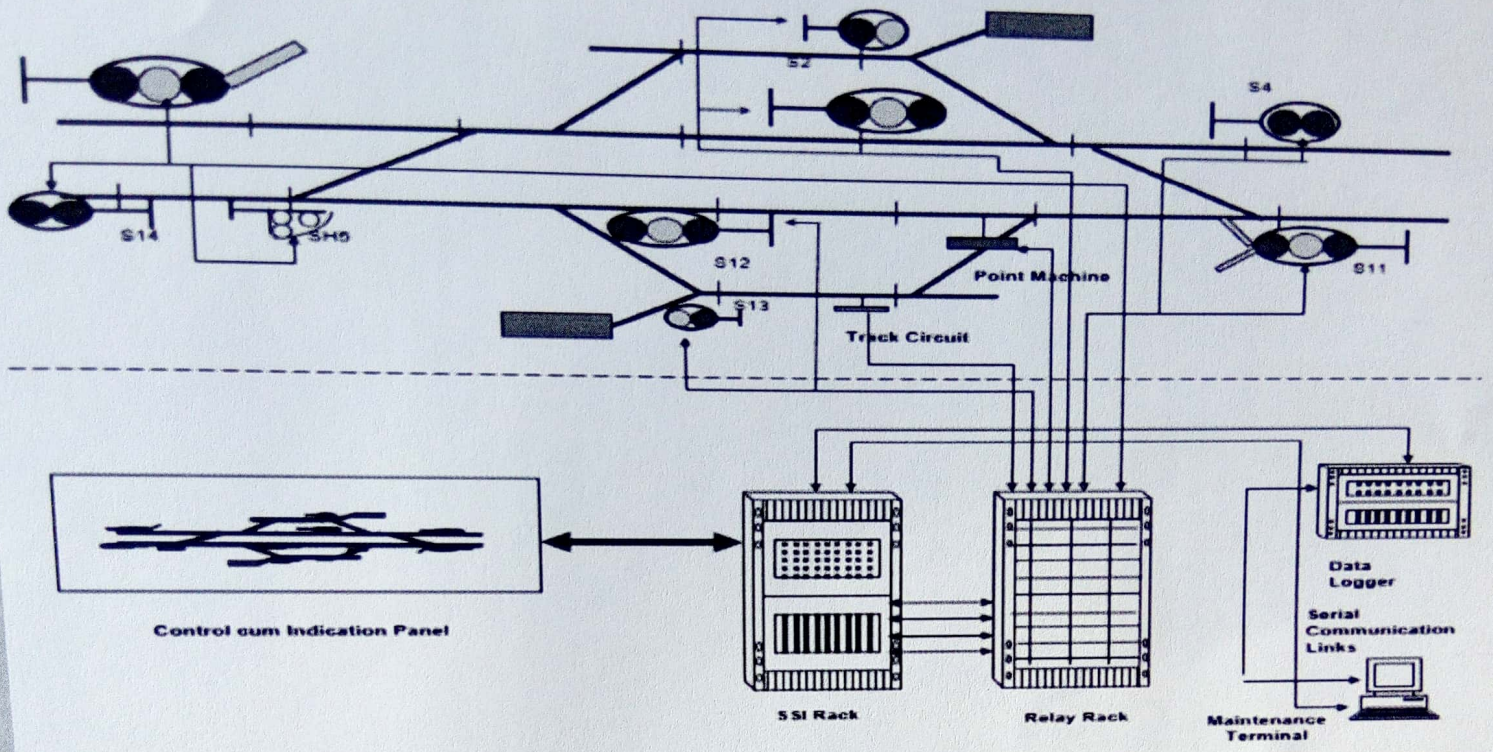
Component	*Mechanical*	*Electrical*
Operated units		
Signals	Mechanically operated signals as per lower quadrant or upper quadrant signalling	Coloured light signals with two-aspect, three-aspect or four-aspect signalling
Points	Mechanically operated points; locking with the help of point locks, stretcher bars, and detectors	Electrically operated points (by converting the rotary movement of electric motors into linear push or pull); locking with the help of slides and solid rods.
Level crossing gates	Manually operated swing leaf gate or mechanically operated lifting barriers	Electrically operated lifting barriers
Transmission systems	Single- or double-wire transmission to the requisite points by means of rods or double wires	Electrical transmission through overhead wires or underground cables
Operating units	Hand levers with a range of 500 to 2000 m used in collaboration with single-wire or double-wire lever frames	Push buttons, rotary switches, or electrical signalling equipment
	Mechanical interlocking with tappets, etc.	Interlocking through electromagnetic switches known as relays or solid-state switching devices
Monitoring units	Monitoring of points with the help of detectors; monitoring of the passage of trains using a treadle, which is an electro-mechanical device	Monitoring with the help of direct current track circuits, alternating current track circuits, electronic track circuits, axle counters, etc.

INTERLOCKING

- Interlocking is a device or a system meant to ensure the safety of trains.
- With the increase in the number of points and the signals and introduction of high speeds, it has become necessary to eliminate human error, which would otherwise lead to massive losses of life and property.
- The points and signals are set in such a way that the cabin man cannot lower the signal for the reception of a train unless the corresponding points have been set and locked. The signal is thus interlocked with the points in a way that no conflicting movement is possible and the safety of trains is ensured.

- Interlocking can, therefore, be defined as an arrangement of signals, points, and other apparatus so interconnected by means of mechanical or electrical locking that they can be operated in a predetermined sequence to ensure that there is no conflicting movement of signals and points and trains run safely.
- The signal and interlocking system is so designed that the failure of any equipment results in the turning on of the signal, thus ensuring train safety.

RAILWAY INTERLOCKING



SPACE INTERVAL METHOD