2 Layout and Use of Signals

2.1 General

Signals are provided to control the movement of trains and to inform the driver whether it is safe to proceed. Their location is dictated largely by the track layout, the relevant Government Department's minimum requirements and, to some extent, by the frequency of train movements. Coupled with this are the variations in practice that occurred from company to company. At one end of the scale there were companies that provided signals for every conceivable movement while others only used the bare minimum required by routine work. When a special movement was required, companies supplemented the fixed signals with oral or written instructions and hand signals.

Modellers basing their layouts on prototype locations can, with a little research, find out the positions and types of signal used including changes that may have occurred over the years. Where the layout is a 'might have been' the following notes can give initial guidance to correct signal location. However, for the layout to be fully authentic it is necessary to study the practices of the company being portrayed. Luckily, there is a considerable amount of information available in railway literature and from specialist societies, particularly the Signalling Record Society.

2.1.1 Signal box interior layout

When a lever frame is fixed in a box there are two positions that it can occupy:

- With the signalman facing the running lines so that he can see the points and signals while operating the levers. This has a disadvantage in that the signal levers, track diagram, block instruments, etc. tend to obstruct his view. In addition, he only has access to the windows at either end of the frame for giving instructions to drivers or shunters.
- With the signalman having his back to the running lines so that by turning round he has an uninterrupted view and access to all windows overlooking the line.

There are no hard and fast rules but the latter method was more often adopted when planning new frames in early BR days. Where signal boxes are shown on track diagrams their orientation is indicated by representing the frame by a thick line and the signalman by a dot. In Figure 2-1 the frame is shown between the signalman and the track. Locating the frame in this position has an effect on the numbering of the equipment controlled by the box.

2.1.2 Lever numbering

The levers in a frame are arranged in a straight line and numbered consecutively with number 1 always on the signalman's left as he faces the frame. The normal position of the levers is back in the frame and when a lever is pulled it is said to be reversed. As far as possible the layout numbering is arranged so that, for the commonest train movements, the levers are pulled in numerical order.

The normal practice is to number the levers in the same order that the equipment controlled 'lies on the ground'. In Figure 2-1, down line trains approach from the left, hence the down line signals occupy the low numbers. Similarly the up line signals occupy the high numbers. The crossovers and their associated ground signals are located in the middle of the frame and provide a physical separation between the two sets of running signal levers.

In addition to their numbers, levers are also identified by their colours which indicate the particular function that they perform. The standard colours are:-

Distant signals	Yellow
Stop signals	Red
Points	Black
Point locks	Blue
Detonator Placers	Black with White chevrons
Spares	White

2.1.3 Facing point locks and fouling bars

Facing points on running lines carrying passenger traffic are required to be fitted with facing point locks. The lock mechanism consists of a bar fitted between the point blades that has either one or two holes in it. Where passenger traffic used only one of the facing roads and only non-passenger traffic used the other road, it was the practice to provide a one-hole lock bar. However, it has now become general practice to provide a two-hole lock bar locking facing points both normal and reverse, regardless of traffic considerations. A sliding bolt, connected to a locking lever in the signal box, fits into the holes locking the points. In modern prac-

Compiled by A. Garraway, J. R. Hadwin,
D. Strivens, M. H. Walshaw.
Drawings devised by K. Sheale
Artwork by Kensington Graphics

tice when a facing point lock lever is normal in the frame, the points are unbolted and free to be moved. When the lever is reversed the bolt is inserted and the points are locked.

To reverse a set of facing points, the signalman first restores the locking lever to normal to unbolt the points. He then reverses the points and reverses the locking lever. This inserts the bolt into the second hole in the stretcher bar locking the point in the reversed position.

To prevent points being moved under a train, mechanically worked points are fitted with a fouling bar. This consists of a bar longer than the longest vehicle wheelbase (usually some 16m, or 50ft, in length) which lies alongside the inside edge of one of the running rails and is connected to the facing point lock mechanism. Unbolting a facing point lock causes the fouling bar to rise into the flangeway. Should a train be passing, the fouling bar would be prevented from rising and, in turn, prevent the bolt from being withdrawn and the points moved. In modern practice, particularly with the advent of long modern coaching stock, the fouling bar has been replaced by electrical locking using the track circuits.

2.1.4 Electric depression bar

This device consists of a bar which lies in the flangeway level with the running rails. It is fitted with electrical contacts which are activated when the bar is depressed by the weight of a locomotive or other vehicle. It is found at the end of bay platforms and is used to remind the signalman of the presence of a locomotive or vehicle standing there. It is often provided where, due to deposits on the rails, the track circuiting is erratic in operation. It provides an indication in addition to, or in place of, track circuiting.

2.2 Typical Through Station Layouts

2.2.1 Semaphore signalling at a through station

Figure 2-1 shows the mechanical signalling that might be planned for a through station with two main crossovers and a siding connection. The signals have been numbered and their functions could be described as follows:

1. Down distant
2. Down home
3. Down starting
4. Down advanced starting
5. Call on to down platform
6. Shunt ahead down line
7. Shunt, up line to down platform
8. Crossover, up line to down platform
9. Shunt, down platform to up line
10. Shunt, up platform to down line
11. Crossover, up platform to down line
12. Shunt, down line to up platform
13. Shunt, down sidings to down line
14. Crossover, down sidings exit
15. Shunt, down line to down sidings
16. Call on to up platform
17. Up advanced starting
18. Up starting
19. Up home
20. Up distant

Note 1: The shunt ahead signal (6) only needs to be provided if the distance between the siding points and the advanced starter (4)

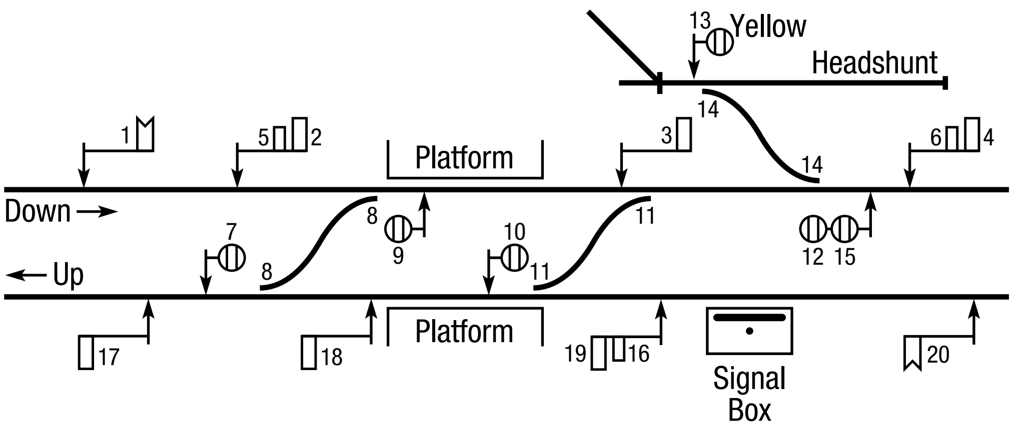

FIGURE 2-1
Typical Through Station with Semaphore Signalling.

is less than the normal length of train that uses the siding.

Note 2: If a train standing on the down line in the rear of advanced starter (4) was regularly required to back into the down platform as far as ground signal (9), a third ground signal, in addition to (12) and (15), would be needed to cover this movement. However, some railways, notably the SR and the MR (prior to 1906), used a single ground signal to cover all three routes on the principle that the driver knew where he wished to go and could see the lie of the points. Again, company practice needs to be checked.

Note 3: Although not shown in the figure, a two aspect green /yellow colour light distant was sometimes used (from the 30's to date) to replace a semaphore distant when renewals were required, particularly where the signal was some distance from the box.

2.2.2 Colour light signalling at a through station

Figure 2-2 shows a form of three aspect colour light signalling that might be found at a through station similar to Figure 2-1 above. Some early two aspect colour light installations tended to be copies of their semaphore predecessors and include green/yellow distants. However, these were generally transitory arrangements and, where the volume of traffic demanded it, the introduction of three and four-aspect track circuited block installations, often controlled from a central power box, became the norm. As a result, the colour light distant signal as a separate entity has virtually disappeared. (Section 1.7 covers these changes).

The introduction of three and four aspect signalling using automatic block working would often require the new signals to be located in different positions to the semaphores that they replaced. These changes occurred where the new block sections differed in length and/or to improve signal sighting for the drivers benefit. In addition, many of the subsidiary signals have been eliminated, for example in some areas the main signal is used to control Shunt Ahead movements.

A variation that has been used for the Shunt Ahead and Calling On signals is shown in the drawing. In place of the single yellow or the two diagonal white lights described in Section 1.9, some areas make use of a modified standard colour light ground signal bracketed out from the post below the main signal. The normal aspect is with all lamps out. When the signal is pulled 'off' all three lamps are illuminated. The bottom right and top left show a white light, replicating the two diagonal lamps, while the bottom left shows the letter S or C depending on the signal's function.

The signals in Figure 2-2 have been numbered and their functions could be described as follows:

1. Down distant
2. Down first home
3. Down second home
4. Down starting
5. Call on to down platform
6. Shunt ahead down line
7. Shunt, up line to down platform
8. Crossover, up line to down platform
9. Shunt, down platform to up line
10. Shunt, up platform to down line
11. Crossover, up platform to down line

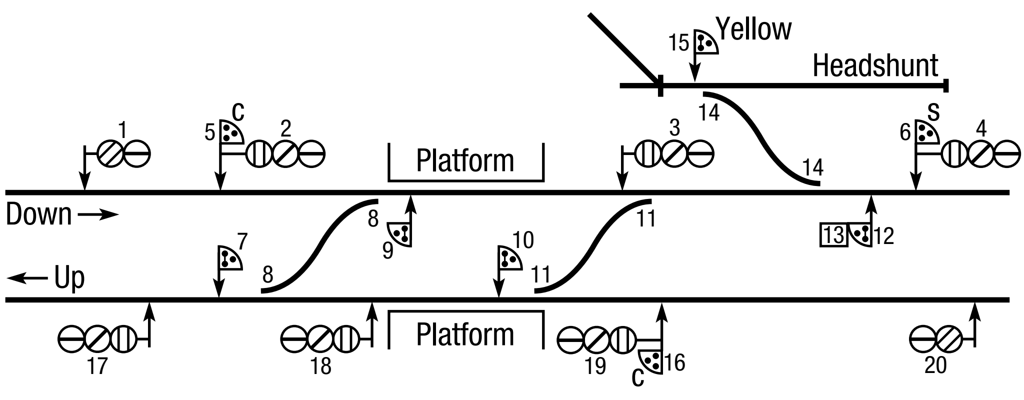

FIGURE 2-2
Typical Through Station with Colour Light Signalling.

12. Shunt, down line to up platform or down sidings
13. Route indicator (see note)
14. Crossover, down sidings exit
15. Shunt, down sidings to down line
16. Call on to up platform
17. Up starting
18. Up second home
19. Up first home
20. Up distant

Note: Modern practice is to use a single ground signal (12 in the above diagram) with a route indicator (13) to indicate movements from the down line to the up platform or the down sidings. The route indication is automatically selected in accordance with the lie of the points.

With the growth in the use of multiple unit passenger stock, the use of push-pull working for main line trains and the virtual elimination of local freight working, the need for the second crossover to allow running round is lessened. Rationalisation of the layout in Figure 2-2 could see the right hand crossover eliminated together with ground signal 10 and route indicator 13. Unless passenger trains terminated and lay-over, the sidings could go as well. If needed for passenger stock lay-over they would most likely be served by a facing cross-over which would be protected by facing point locks.

2.3 A Typical Branch Line Terminus

Few modellers have the space to portray a busy main line, the majority have to make do and select a prototype that they can house and which in many cases is some form of single track branch line terminus. Even here the traffic volume can vary considerably: from the outer suburban branch with a relatively frequent passenger and regular freight service to the almost moribund rural line with, at most, three or four passenger trains each day and a twice weekly freight service. The former would need to be fully signalled whereas in the latter case the signalling could be minimal or non-existent.

Because of this wide variation it is only possible to suggest some basic rules for signal location. These include:-

- Where passenger trains have a choice of route the splitting signals must have full sized arms. (See Section 1.2.6). They need to be positioned in the rear of the facing points, which would be fitted with facing point locks. As the fouling bar is typically 16m (50ft) long, the splitting signal would need to be installed at least 16m (14ins in model terms) in the rear of the point blades to allow sufficient clearance for the fouling bar.
- Converging junctions and turnouts must be protected by stop signals, either situated 400m (440yds) in the rear of the fouling point (as per Section 1.2.7) or just clear of the fouling point.

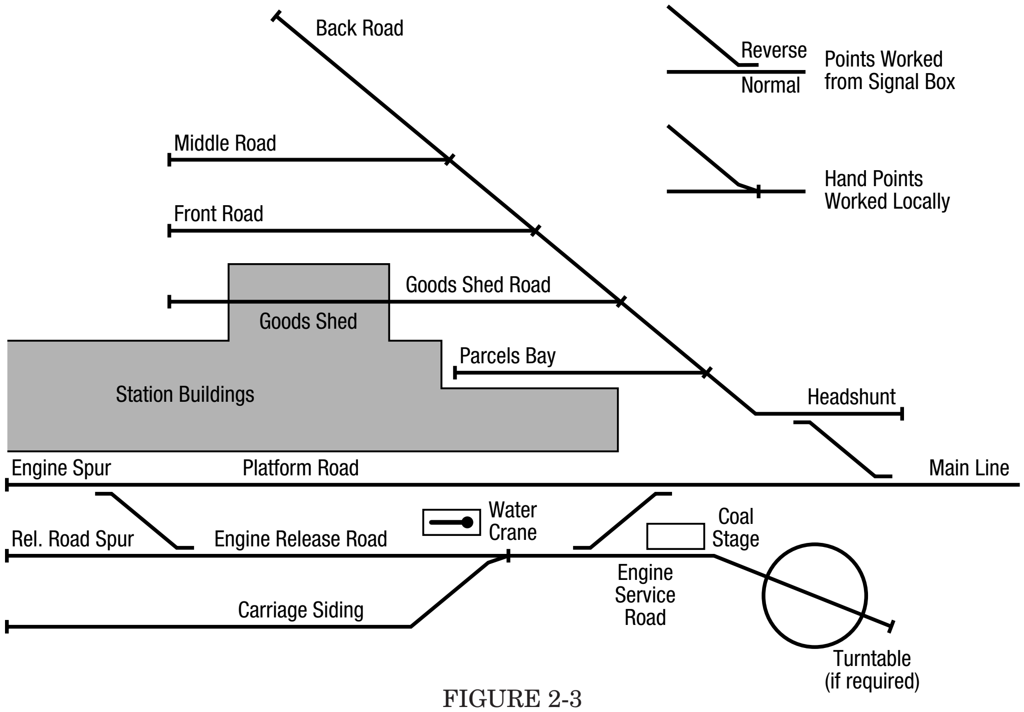

FIGURE 2-3
Typical Single Track Branch Terminus.

An example of the latter case would occur where adjacent platform roads with their attendant starters converge onto a single main line

- Generally there is a starting signal at the end of a platform, but it must be clear of the fouling point of any turnouts in advance of it.
- Other signals are installed, as necessary, as described in Section 1.

Assuming the maximum traffic requirements, Figure 2-3 is a typical branch line terminus which might have been found up to the mid-late 60s.

The first step is to determine the types of train that would use a terminus of this size. On the passenger side the regular service would be between the terminus and the junction with the main line or the nearest large town. The equipment used could be as simple as a push-pull set which just shuttles back and forth or it could be a local carriage set hauled by a separate locomotive. In the latter case there would need to be provision to run round the train. In addition, depending on the size and importance of the locality, there could be a daily working to and from a major city using corridor stock and a main line engine. This latter could require the engine service road to be supplied with a turntable.

A goods yard as shown would probably only require a daily trip working from the junction. Because the goods yard has no provision for the locomotive to run round the train this would take place using the platform road and the engine release road. This also means that the goods train timing needs to be integrated with a slack period in the passenger timetable to avoid blocking the passenger train's path.

Note: With rationalisation of the services in later years, assuming that the line had not been axed, the passenger service would probably be some form of DMU service requiring only the platform road to be retained. If the goods yard were also retained it would probably be used for a specialist product and be reduced to two or three sidings only but provision for running round would still need to be available.

Figure 2-4 is a repeat of the previous figure with the minimum number of signals needed to control train movements within the station area.

2.3.1 Arrival movements

A down train arriving would first pass a fixed distant signal requiring it to reduce speed as it approached the terminus. The next signal sighted would be the home signal (1). In the case of a passenger train, the platform road should be clear and the home signal would be pulled off in readiness to

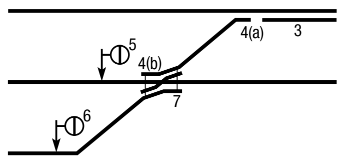

FIGURE 2-5
Double Slip Variation.

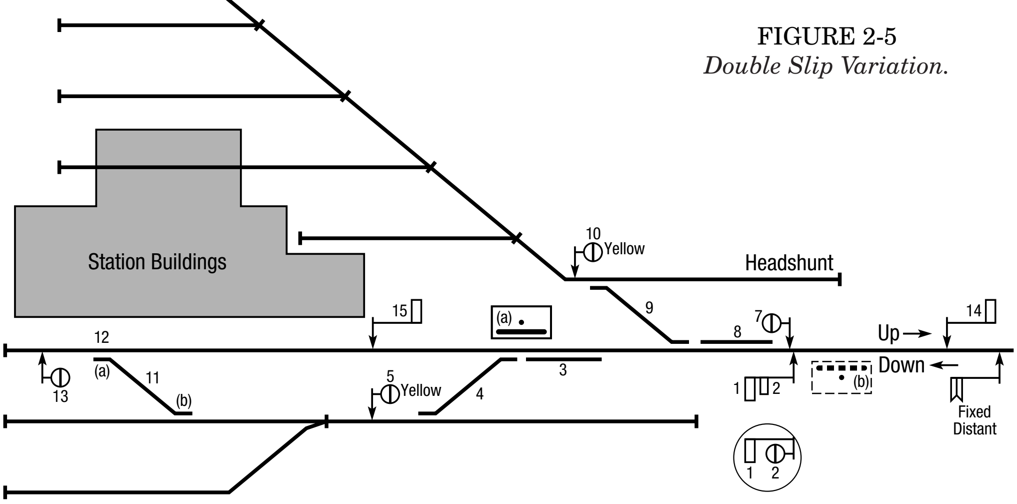

FIGURE 2-4
Basic Signal Layout for Small Terminus.

allow the train to continue at reduced speed into the platform. On arrival in the platform road, with the train held clear of the engine release crossover fouling point, the engine would be detached and run forward to the engine spur ready to run round the train.

In the case of a goods train approaching the terminus, particularly in the days of loose couplings and unbraked stock, it would commence slowing once the fixed distant was sighted. The home signal (1) would remain on until the train had almost come to a stand to ensure that it was under control before the signal was pulled off admitting it to the platform road.

If arriving goods trains were required to enter the engine release road on a regular basis, a miniature arm (2) could be set below the home signal. Alternatively, if this movement only occurred infrequently, a ground signal (2) would normally control the movement. (See inset).

2.3.2 Movements within station limits

Running round

The first movement after arrival is to release the locomotive to allow it to either run round its train or go to the engine service road. Having been uncoupled it would draw forward to the engine spur clear of the release crossover (11). The control of this crossover can vary depending on local circumstances.

As shown the points and ground signal are numbered as though operated from the signal box. However, because of the cost of rodding from the signal box, it is possible that the engine release crossover (11) and its associated facing point lock (12) would be controlled by a local ground frame. This could also be due to the distance involved as points are not allowed to be mechanically worked by rodding over a distance greater than 325m (350yds).

The frame would be unlocked from the signal box by the signalman and the local levers would then be operated by a member of the train crew. The frame would normally have two levers, one controlling the crossover and one the facing point lock. Where the movement is under the direct controll of the train crew, the ground signal (13) would not normally be installed. A modern variation is to have a further lever on the local frame which when released electrically from the signal box, unlocks the frame mechanically when pulled. This is required to prevent the signalman 'taking back' his release until the use of the ground frame is completed.

On a quiet rural line, if the crossover were located beyond the end of the platform where it normally would be clear of passenger vehicle operation, it could be manually operated by a local lever and unsignalled.

A further variation that can occur concerns the release road spur. Unless the spur is required to serve another facility like a loading bank then, in order to save on material and maintenance, a number of companies, notably the GWR, would not install it and point (11b) of the crossover would either be a simple trap point working in conjunction with point (11a) or eliminated completely.

Once on the release road the engine could either go direct to the service road to pick up fuel and water, passing the yellow permissive ground signal (5) set at on, or wait to move onto the main line.

To complete the run round movement, crossover (4) must be reversed and ground signal (5) pulled off allowing the engine to return to the main line. Because crossovers (4) and (9) are facing points on the running lines they would have facing point locks (3) and (8) with fouling bars fitted. These would require the engine (or train) to be clear of fouling bar (8) before crossover (4) and ground signal (5) are returned to normal. The home signal (1) is then pulled off, allowing the engine to back on to its train.

Ground signal (7) is shown as a separate ground signal in Figure 2-4, however, in practice it could be located on a short bracket, adjacent to signal (2), just below the home signal (1). It would normally be used to control backing movements into the goods yard. (It was not unknown for some companies to provide a disc or ground shunt signal for each possible route and, depending on the space available, they could be mounted side by side or stacked vertically. Normally this type of configuration would only occur in busy areas where shunting was carried out almost continuously rather than at the end of a single line branch).

Disposal of carriage stock.

If the train is a passenger train and is the last arrival of the evening it may need to be stabled overnight. For this movement, when the engine had run round its train the starting signal (15) would be pulled off to allow the train to draw forward clear of fouling bar (3). Once clear, crossover (4) would be reversed and the ground signal (2) would be pulled off to allow reversal into the carriage siding. The un-numbered carriage siding point would probably be manually operated by a shunter.

Disposal of freight stock

In the case of a freight train, the process of running round and drawing forward along the main line clear of fouling bar (8) follows the same pattern as described above. Reversing crossover (9) and pulling ground signal (7) off allows the train to be reversed into the freight yard. Once clear of the main line with crossover (9) restored to normal, the process of delivering the arrivals and collecting the departures can be carried out. The initial move would be to dispose of the brake van which could be parked in the end of the parcels bay road. Shunting moves into and out of the various sidings would be under the control of a shunter. To allow the engine and wagons to draw clear as required they can move into the headshunt past the permissive ground signal (10) showing on. On completion of the delivery and collection, the outgoing train would be held clear of crossover (9) until departure time.

Double slip variation

The engine release road and carriage siding converge at a single point and are followed by a crossover with movements on to the main line controlled by a ground signal (5). However, if due to space constraints the two points are combined to form a double slip, then an additional ground signal would be required for the carriage road but, because the two routes converge, both signals would be red, non-permissive versions. The slip would be operated from the signal box and require an additional lever. This variation is shown in Figure 2-5. The additional ground signal would also require an additional lever and these two, (6) and (7), would need to be located close to the existing point levers associated with the crossover. This would require the other lever numbers to be changed unless there were sufficient spare levers in the frame. (see 2.1.2 Lever Numbering).

2.3.3 Departure movements

When departure time for the passenger train is reached, on receiving permission from the box in advance, the advanced starter/section signal (14) and starter (15) would be pulled off allowing the train to enter the next section on its way to the junction.

When the freight train is ready to leave, crossover (9) is reversed, the advanced starter/section signal (14) would be pulled off allowing entry into the next section, followed by the ground signal (10) being pulled off allowing exit to the main line.

2.3.4 Signal box location

The actual position of the signal box will depend on the topography of the site but it would need to be located as close to the operations as possible, particularly if the signalman has to flag certain movements. The position (a) close to the platform end would allow outgoing passenger trains to be observed to ensure that all doors were closed correctly. However, as the line is a single track the signalman needs easy access to a token exchange platform to deliver and collect tokens controlling movements along the branch. Position (a) provides access for locomotives arriving but could require a walk to reach locomotives standing in the sidings awaiting departure. If the box were located close to the down bracket signal in position (b) it would provide an easier approach to both arriving and departing locomotives.

Assuming that the box was located in position (a) and contained a standard 15 lever frame, the levers would be numbered:-

1. Home signal	Stop arm
2. Release road entry	Miniature arm or red ground signal
3. Facing point lock	Plus fouling bar
4. Release road crossover	
5. Release road exit to main line	Yellow ground signal
6. Spare	
7. Down main to goods yard	Red ground signal
8. Facing point lock	Plus fouling bar
9. Goods yard crossover	
10. Goods yard exit	Yellow ground signal
11. Engine spur crossover	
12. Facing point lock	
13. Engine spur to release road	Red ground signal
14. Advanced starter	Stop arm
15. Platform starter	Stop arm

If the box were located in position (b) the lever numbering would be the reverse of that shown above.

2.4 Other Typical Layouts

The more complex track formations that occur in prototype practice are beyond the scope of these notes but the following two examples cover track layouts that could occur in larger model railways.

2.4.1 Double junction to single track branch

The points to note about this track layout, shown in Figure 2-6, are that the Up Distant (1) would only be pulled off for travel along the main line, branch trains would reduce speed to pass it at cau-

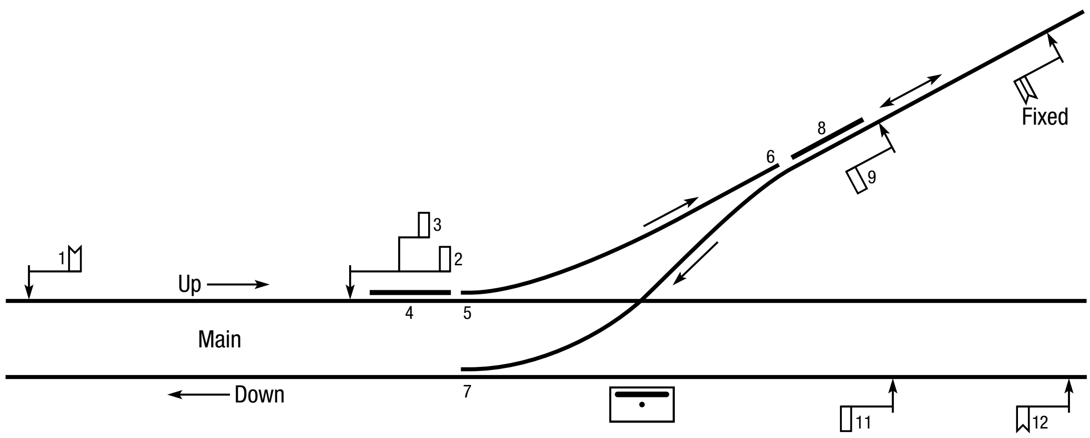

FIGURE 2-6
Double Track with Single Track Branch leading off.

tion, and points (7) can only be reversed if points (5) are also reversed. (In the event of a train over-running, the collision point is moved away from the main line, but there may be cases where this is undesirable and the two points are not interlocked). Where the diverging route does not have a severe speed restriction, a separate branch distant may be provided.

Down line signals would normally be positioned 400m (440yds) from the fouling point but may be brought nearer if traffic density warranted it, e.g. SR suburban electric services.

A box having a standard 12 lever frame would have the levers numbered as shown on the diagram with lever 10 being a spare.

2.4.2 Single track passing loop

Figure 2-7 shows a single track passing loop with a station. As illustrated there are no trap points at the ends of the loops to keep trains clear of each other. The result is that if two trains approach the loop at the same time, they would need to brought to a stand at their respective home signals (2 and 14) to ensure that they were under control and then brought into the platform independently. If trap points were provided they would work as a pair with their respective loop points (8) and (9) and, as they are on running lines, they would be protected by facing point locks and fouling bars. This would entail additional levers in the signal box.

The points at either end of the loop are set normally in the position shown on the diagram so that, in the event of a train running past signals (2) or (14) at danger, it would continue on the correct line. Point (8) is shown as having an additional fouling bar known as a clearance bar operated by the same lever. This is used to prove that a train on the up line is not foul of a train running on the down line. A train standing on the clearance bar would prevent lever 8 from being moved and so prevent point (8) from being reversed. This in turn would prevent the down line signals from being released and allow a down line train to move into a fouling position.

In Figure 2-7, shunting to the down sidings

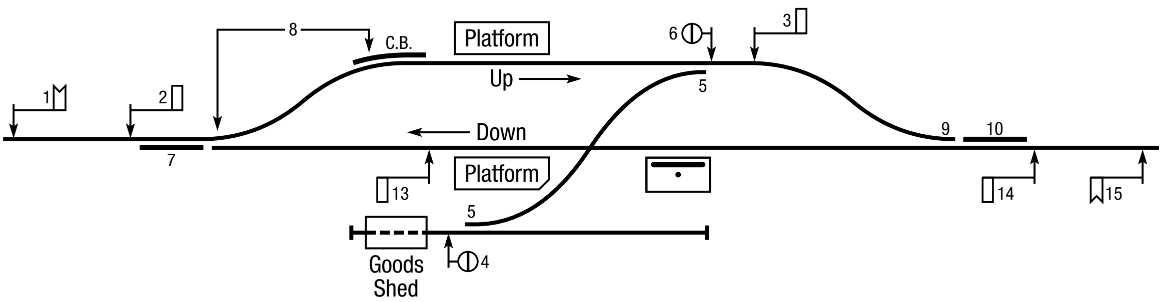

FIGURE 2-7
Single Track Passing Loop with Station and Siding.

involves access from the up line and the use of a diamond crossing, a situation that would generally be avoided but could arise due to site topography. If the local road layout required the goods shed to be located as shown, then, to minimise the number of shunting movements, a trailing connection to the up line is needed. However, the more usual arrangement would be a trailing crossover from the down line platform which would allow room for shunting while remaining within station limits.

The box controlling a track layout as shown on the diagram would need a 15 lever frame with two spare levers.

2.4.3 Level crossing

Level crossing gate locks and wicket gate locks are usually worked by the end levers nearest to the crossing so that the signalman can watch the road traffic while operating the levers. Wicket gates were a feature of some of the older gated level crossings where a pedestrian overbridge was not available. Two wicket locks were provided so that one gate could be locked behind pedestrians on the crossing and the second once they has passed clear of the track. If both gates were controlled by the

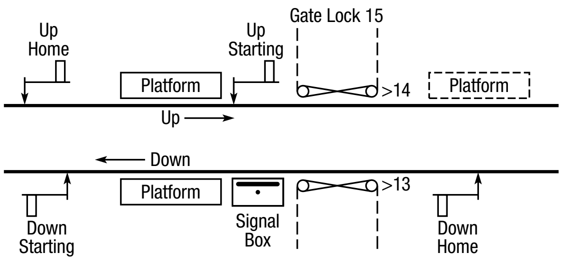

FIGURE 2-8
Through Station with Level Crossing.

same lever there would be a risk of trapping pedestrians on the crossing. The modern four arm lifting barrier follows the same principle by lowering the nearside arm against oncoming traffic before the offside is lowered protecting the other side of the crossing.

A down train could have the down home signal restored to 'on' behind it and the crossing gates opened to road traffic while standing at the platform, but an up train must depart before the up line starting signal can be restored to 'on' and road traffic restored. Where stations have been modernised, or in some instances re-opened, a staggered platform layout (shown dotted on the up line) has been adopted to minimise the delay to road traffic.

2.5 Signal Sighting and Siting

It is very important for the (Model) Signal Engineer to consider the sighting of signals by train drivers when he is deciding where to site them. For example, on curved track the signal arms should be set square-on to the driver rather than at right angles to the track. This is even more important with colour light signals because of their narrow-angle light beams. Obstructions such as overbridges have to be considered as these require the use of banner repeaters and/or co-acting signals.

On multiple tracks great efforts are made to locate the signals on the left hand side of the track to which they refer and this can often involve the use of complex brackets and gantries. Where track curves to the left, signals may have to be located on the far right side of the track to give longer visibility. For many years the GWR used right hand drive engines and as a result signals were often placed to right of the track. The position of signals in relation to the adjacent track was determined by the structure loading gauge.