1 General Principles

LINKED SECTION CONTROL

by L. E. Carroll

DURING the last couple of years two methods of model railway control have received a good deal of publicity, but although both have undoubted merits they also have their shortcomings. These two widely accepted systems—both forms of " cab control "—might be described as

(1) Allocated section control
(2) Selected section control.

In type (1), any section can be allocated to any one of several controllers by means of multi-way switches on a central switchboard. This gives complete flexibility of current distribution with no risk of short-circuits due to two controllers being connected to the same section. But it does mean that, if through-running is fully used, every train movement must be made the subject of a special request to Traffic Control. Not very realistic, and a bit of a nuisance if, as usual, the Traffic Controller is trying to run the most complicated section himself. . . . Even more of a nuisance if the said T.C. is operating single-handed at a station remote from the main switchboard ! But the wiring is simple and mainly localised at the switchboard, and I have used this scheme myself for several years.

Type (2) is much more ambitious, and is designed to enable each operator to select for himself, without reference to headquarters, whatever sections he needs for a particular operation—provided, of course, that no one else has booked them already. But unless there are full-time signalmen this system is, once more, not very railwaylike. Furthermore, if it is to be made foolproof with cut-outs, priority switch-gear or relays and possibly indicator lights to show which sections are already in use, the wiring, already extensive, becomes quite fantastic, especially if more than two cabs are required. And what a problem to the stranger is the impressive array of switches needed at every cab!

Faced with these alternatives, I cast about, when planning a modification of my existing layout, for a different system of section control that would

i. be comparatively simple to instal,
ii. permit realistic and interesting running of a varied nature,
iii. be equally capable of operation by one, two or three people,
iv. be easily grasped by casual visitors.

Now I take the view that no model railway is worthy of the name—or will long hold one's interest —unless it can be operated as a *railway*—not as a toy or a mere testing track. It must therefore be capable of being worked on block-section lines, and must be signalled—if at all—in prototype fashion. Yet the signals, to be worth while, must not be merely decorative—to be used or not at will ; they must be an integral and indispensable part of the railway. Thinking on these lines, I began to explore the possibility of using the signal levers, rather than a set of characterless knobs and switches, as a means of current distribution as well as indicators of the state of the line.

After toying with various ideas I did finally hit on a method—which might be termed linked-section control—that seems to me ideal for the average-sized layout. It appears to possess most of the good points of systems (1) and (2) with none of their bad ones, and to have special attractions of its own. The idea may not be new, but, as I have never seen or heard it mentioned before, it may be as novel to many readers as it was to me.

The basic system is this. As in real practice, the whole layout is controlled through a number of " block-posts " (usually at stations) and each of these is linked electrically to three sections on each track—" block-section in rear," " station limits," and " block-section in advance." Each block-post (under the control of one operator) is equipped with a controller, a reversing switch, and a signal-box containing the levers for the signals and any points in the area. That is all. *But*, each home or starter signal lever also actuates a 2-way switch—see *H* and *S*, Fig. 3—so that when the signal is pulled off, the track which it protects is linked electrically to the track immediately in rear of it.

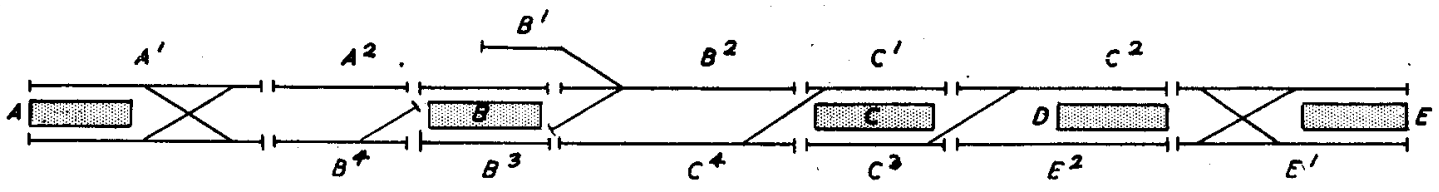


FIG. 1 TYPICAL SECTION DIAGRAM

A glance at the diagrams will help here. Fig. 1 shows a simple end-to-end double-track line on which stations *B* and *C* are typical block-posts and *D* is a station without a block-post. The termini *A* and *E* have merely token trackwork shown.

Fig. 2 shows the very simple electrical arrangements at *A*—or any other double-track terminus—wired for split potential or individual supply. The block-section A^2 is permanently connected to the *A* controller, but the whole terminal section A^1 is linked either to A^2 (when the home signal is " on ") or to the last up section, B^4 (when the home signal is " off "). This arrangement enables the operator at *A* to accept an up train on another driver's controller as soon as his own previous down train has cleared the advanced starter. The latter signal need not in this particular case, be used for switch operation, but it can be mechanically interlocked with the home signal—which would, in point of fact, be the terminal " outer home."

Fig. 3 shows the switchgear for one track of a typical double-track station such as *B*. There are four possible settings of signals *H* and *S* on this track, and the switches operated by them therefore give four standard " links," which will crop up again and again. They are :—

(a) *Home off, starter on.* B^1 linked to A^2 and hence to *A* controller. B^2 linked to *B* controller.
(b) *Home on, starter on.* B^1 dead, B^2 linked to *B* controller.
(c) *Home on, starter off.* B^1 and B^2 linked to *B* controller.
(d) *Home off, starter off.* B^1 and B^2 both linked to A^2 and hence to *A* controller.

A study of the above in relation to Fig. 3 will show that, as in the case of Fig. 2, normal railwaylike use of the signals will give the power distribution that is most convenient for realistic working.

In order to see more clearly just how well the system functions let us consider how the operator at *B* would employ the four standard links to deal with various problems. Fig. 4, showing station *B* in more detail, should be referred to here.

Stopping Trains

On receiving " is line clear for ordinary passenger train ? " from the terminus *A*, " B " (as we will call him for short) checks that the block section A^1 is unoccupied and then gives " line clear." As soon as possible he pulls off his home signal, leaving the starter still at danger—link (a). " A " can then drive his train right into the down platform road at *B* on his own controller. " B " now restores the " home," thereby isolating the stationary train from both *A* and *B* controllers—link (b). This leaves him free to attend, if need be, to traffic on the up line, for which—as in real practice—he is also responsible.

Before the down train is ready to proceed, " B " gets " line clear " from " C " and pulls off the down starter—link (c)—thereby bringing the train on to his own controller for the next stage of the journey. As soon as the tail lamp has passed the starter he restores it and carries on driving towards the next

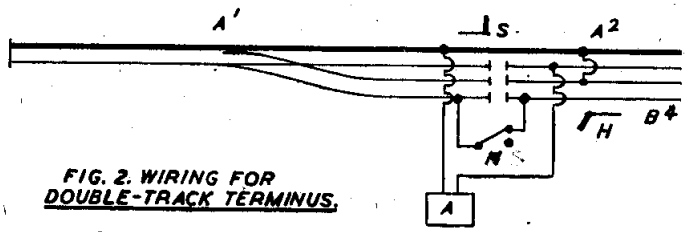


FIG. 2. WIRING FOR DOUBLE-TRACK TERMINUS.

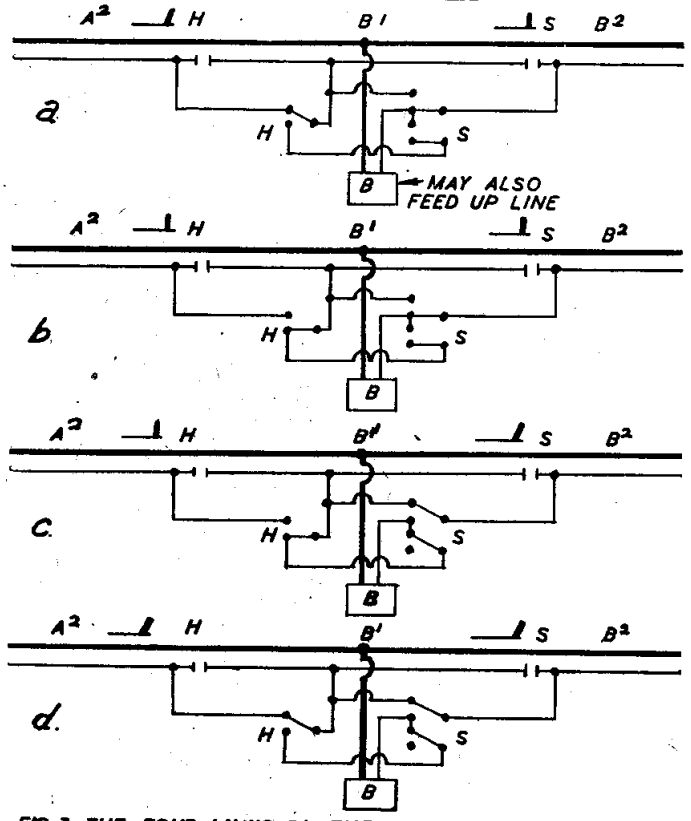


FIG. 3. THE FOUR LINKS ON THE DOWN LINE OF STATION B.

station, looking out for the home signal there and regulating his speed accordingly. In the meantime he can, after giving " out of section " set up link (a) again in order to accept another train from *A* on " A's " controller. Thus very close working is possible. When " B's " train reaches station *C* the operator there will restore the home signal behind it and in due course give " out of section " to " B," who is then free to deal with the next down train requiring his attention.

Through Trains

If " A " calls " is line clear for express ? " " B " will, as soon as possible after giving " line clear," get " line clear " from " C " and then pull off both his home and his starter signals—link (d)—thus enabling " A " to drive the express right through sections B^1 and B^2. Meanwhile " C " has endeavoured to get " line clear " from " E." If " C " can set up link (d) in turn and " E " pulls off his home signal the chain will be completed, and " A " can drive the express right up to the buffers at *E*. The co-operation of everyone is thus needed to secure a clear road, and " A " has to keep his eyes skinned all the way.

Of course a train booked to stop at *B* may then be fast to *E*, so " B " also gets a chance of exploring

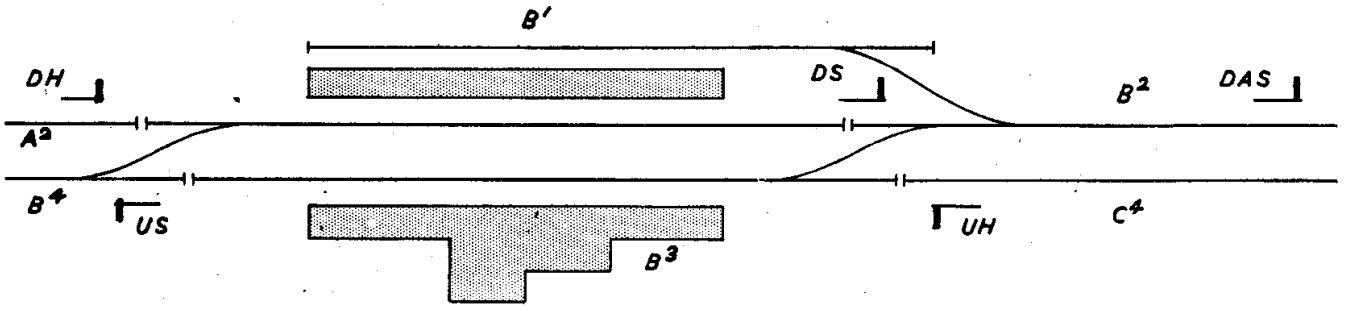


FIG. 4. TRACK LAYOUT SECTIONS AND SIGNALS AT STATION B.

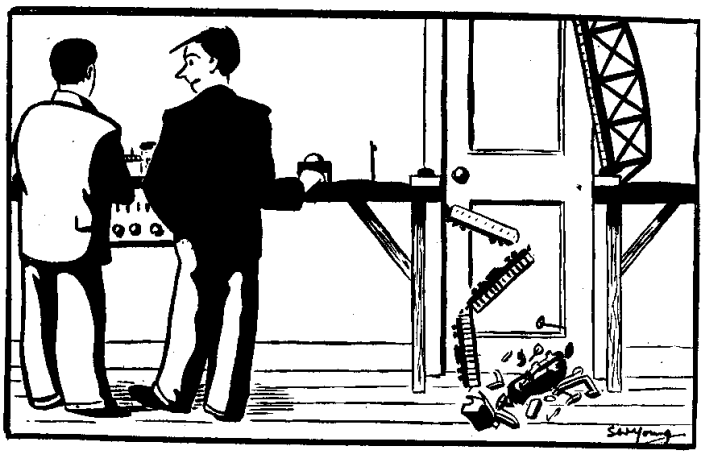
" foreign parts." Similarly, on the up line, " E " and " C " have opportunities of express driving in between their turns with locals, freights and so on.

On a prototype line the setting up of link (d) at any block-post would be indicated to the driver by a distant signal. On the model the distant signals would play no part in the section switching, but they should be included if correct prototype working is to be followed.

Shunting

At *B* there is a token goods yard, with crossovers to enable both up and down freight trains to be worked into it. With a down train this is straightforward enough, but when an up freight is involved " B " will need to occupy both up and down roads at once so that the locomotive can run round its train before hauling it through the " down " cross-over on to the down line. To do all this he sets up link (c) on both tracks. The home signals protect the movement, whilst the current is fed through the up and down starter signal switches to the platform roads and the tracks beyond. It will be seen that (on this double-track line) the points at the " starter " end of each platform are actually in the block section, but at the " home " end they are within " station limits."

To be correct, advanced starter signals should be installed so as to permit the use of B^2 and B^4 for local shunting without getting " line clear " from the boxes ahead. These signals, however, would not play any part in the section-switching of a double-track line.



" *How many bells for 'Train out of Section* ? "

Since the down crossover and the yard points are beyond the down starter it would, at a pinch, be possible to accept a stopping down train on link (a) while the shunting was being completed. All this " messing about " will tend to create just the amount of havoc required to keep everybody on their toes, for several other trains may have to be passed through while it is going on. If necessary (to avoid losing too much time) even stopping trains can be worked through *B* on link (d), thus enabling " B " to keep busy on the other track.

Visitors

Although basic block-working is simple enough if we use the signals only (omitting the instruments), many modellers—and most non-modellers—are not altogether *au fait* with it. In order to' 'temper the wind," therefore, we may give a visitor only one track to start with, preferably at the simplest station, and operate the other track on link (d) from the box in rear. As soon as the stranger has got the hang of things—and with only two levers, that shouldn't be long—he can take over the complete box. This facility enables a newcomer to start right in with time-table operation from the word " go." The fact that the semaphore signals give continuous indication of what has been done is a great help in avoiding mistakes.

Shortage of Staff

If there are not enough operators to man block-post *B* it is extremely easy to close the box down and transfer its functions to the boxes immediately in rear on each track, i.e., *A* on the down line and *C* on the up. As in the prototype, we merely pull off all the signals and shut up shop after advising our neighbours accordingly (link (d) on both tracks). Station *B* is thereby relegated to the status of *D*. In the same way, if there were only two operators *C* could also be closed, leaving only the termini manned, with one long block-section between them.

Single-handed operation is also quite practicable if (i) the two termini are in fact fairly close together in the room or (ii) certain levers and the power supply to the distant terminus can be remotely controlled.

From the above notes it will be seen that for all concerned life is pretty full, for in addition to driving his own trains in obedience to other people's signals —so much more satisfying than obeying his own— each operator also has the duty of acting as signal-man in relation to the trains of other drivers ;

(*Continued on page* 196)

LINKED SECTION CONTROL

(*Continued from page* 193)

the best of both worlds, in fact, and all in very railwaylike fashion. Except for one thing. . . . In the case of a through train the intermediate signals must remain " off " until the train reaches its booked stop. But this is far from being a serious handicap. The initial starter can always be restored immediately, and as the non-stop journey time after passing the first intermediate home is rarely more than half a minute, the delay is of no great consequence. Moreover, there can be no possible danger, since obviously the driver of the non-stop cannot send another train down behind it until he has " shed " the first one.

So much, then, for operation. But before leaving Part 1 let us take another look at the wiring. It will be seen from Fig. 3 that an intermediate box is linked by just one wire per track to the feed rails at either end of the short B^1 section. Apart from the controller supply-leads the only other wiring needed is that between the signal switches and the nearby controller and reversing switch. We require no central panel—except possibly for instruments—no local switchboards, no elaborate track diagrams with knobs on. Even local current-switching to sidings and spare platforms can, especially in 2-rail, nearly always be done through the points and signals in the normal course of route-setting. The fewer the controls, the less risk of confusion. If at any time extensions should be required, or new stations on the existing track, only local additions or changes are needed in the control system. There is no need for untidy appendages to a beautifully planned control board.

In linked-section control, then, simplicity is the keynote. In Parts 2 and 3, I propose to show in detail how the basic principles can be applied quite easily to any layout that has been designed for operating by block-section methods. Single lines, ovals, junctions, triangles, return loops—all can be tackled with surprisingly little difficulty. In operation, section-linking will give simplicity coupled with as much operational flexibility as the average modeller needs ; in construction it gives the best possible value for the time and money involved. No more need for festoons of wire under the baseboard or cables as thick as your thumb. Just a prefabricated signal-box screwed on to the baseboard where required, a few connections to the adjacent track, and away you go !

(*To be continued*)

2 Single Lines and Ovals

LINKED-SECTION CONTROL

by L. E. Carroll

IN Part I of this article I discussed the general principles of linked-section control, and illustrated its application to a simple end-to-end double-track layout. In Part II, I shall deal with its adaptation to two other basic forms of layout—the single-track end-to-end line and the oval—whilst in Part III, I propose to cover the treatment of main line junctions and return loops and in Part IV to give some notes on the practical side of the wiring.

For each basic track-formation I shall give diagrams similar to those in Part I, but they will henceforward show only one particular setting of the signals. Those who are interested in any special diagram should make an indelible tracing from it and then, armed with pencil and rubber, try out the various other settings for themselves. The diagrams have been arranged so that in every case a switch arm is shown horizontal when its actuating signal is "on" and inclined upwards when the signal is "off." In designating signals a simple code embodying the following letters has been used :—

D down	*U* up	*A* advanced
H home	*S* starter	*O* outer
M main	*B* branch	

The diagrams will be generally drawn as for 2-rail, but of course the same—or simpler—arrangements would apply to 3-rail or stud-contact. I have assumed that individual supply or split-potential will be used, since on a layout involving a number of switches the wiring is thereby greatly simplified. For single supply one would have to double-up the switches and feed wires throughout.

Single Lines

The block section working described for double track may be—and in some places is—also used for single lines. The switchgear required for section-linking a two-way single line is—perhaps unexpectedly—actually simpler than for a double track. In the first place, since our block-post stations will normally have passing loops, we can isolate a train in the station by means of the points instead of the signals. This enables us to run a direct feed to the station on link (*b*). In the second place we do not need to provide for the block-section ahead to remain on our own controller on all links except (*d*). Indeed, we have to arrange, deliberately, for the two adjacent block-sections to be linked, as required, to our own controller or to either of the neighbouring ones.

FIG. 5. TYPICAL SINGLE LINE

To make this clearer let us now take a look at Figs. 5 and 6. The former shows a simplified single line layout comprising two termini, *F* and *J*; an intermediate block-post station *H*, with passing loop; and two halts, *G* and *I*. Either halt could, of course, be omitted without affecting the wiring in the least. Fig. 6 shows in detail the switchgear required at *F* and *H*, *J* being merely a replica of *F*.

The terminal wiring is arranged to permit the following links with the four possible signal settings :

(*a*) *Home off, starter on.* *F* linked to *G*, for accepting up trains on *H* controller.

(*b*) *Home and Starter on.* *F* linked to *F* controller, for local shunting.

(*c*) *Home on, starter off.* *F* and *G* linked to *F*, for dispatching down trains.

(*d*) *Home and starter off.* A false setting which merely links *F* to *G*, as in link (*a*). Notice that the interposition of the home switch *FH* in the starter circuit prevents the threatened "short" between *F* and *H* controllers.

At station *H* it will be best for the two points to be operated simultaneously by one lever. Independent movement would be needed only if it were desired that two trains should arrive or depart at the same time. But as the former is contrary to proto-

NOTE: In Fig. 2 (Part 1, p. 192, MODEL RAILWAY NEWS, September, 1953) the free terminal of switch *H* should have been linked to the feed wire to section A^2.

type regulations and the latter impracticable on our single controller, we can happily dispense with the added complication. One other thing : we should place the section break far enough beyond the points to allow a loco and two or three vans to draw ahead of them without entering the next electrical section. An unswitched shunt arm below the starter would cover this movement.

The standard signal settings at an intermediate block-post enable an operator on setting up link

(*a*) to accept a train from either direction on the dispatcher's controller by pulling off the appropriate home signal (at the same time, if need be, holding a train on the other track.)

(*b*) to carry out shunting or running-round in his station without affecting the adjacent block-section.

(*c*) to dispatch a train in either direction on his own controller (still holding another on the other track if required), and to drive it all the way to its next booked stop by getting " line clear " and favourable signals in the usual manner.

(*d*) to pass " through " trains or, by pulling of all signals, to close the box, leaving the loop set to the platform where the principal offices are. Sections *G*, *H* and *I* would then be linked into one section, isolated from the *H* controller but capable of being linked to *F* and *J*.

With box *H* closed either " *F* " or " *J* " can secure control of the entire line as far as the last home signal merely by pulling off his starter. Single-handed operation from *F* is quite feasible, but unless *J* were within easy reach of *F* it would be necessary to have remote control of the *J* home and starter. Naturally, as in other sectioning schemes, auto-uncouplers and the remote control of the two points would be needed for running-round trains at *J*.

The only source of potential short-circuits is the pulling-off of the starter at one box while that at the box ahead is also off for a train in the opposite direction (!), thus linking the same piece of track to two controllers. Simple electrical interlocking would prevent this, but I doubt if it is worth while, because :—

(i) the operator at *H* should not pull off his starter until receiving " line clear " from *F*.

(ii) " *H* " would not ask for " line clear " if he had just given it to " *F* " himself.

(iii) " *F* " would hardly pull off his starter if he had just given a " line clear " to " *H*."

(iv) Even if the starter *were* off, the pulling off of his home signal for " *H*'s " train would, as already shown in the terminal wiring, nullify the effect of his starter.

(v) If the " short " did occur the overload cut-out would trip and draw immediate attention to the error.

The interlocking of certain points and signals at *H* could easily be arranged, but as the possible errors are not serious it is hardly worth troubling about—especially as it would impede the closing of the box.

Fig 5, of course, shows only the bare bones of the layout ; extra platforms can be added to termini, and extra sidings to any stations, without affecting the signal-box wiring at all.

Ovals

Having now covered the basic principles as applied to both double and single track, let us now try them out in relation to one of the most common types of layout, the oval. This formation has come, of late, to be somewhat despised as a layout form, but it certainly has advantages for exhibition and testing purposes, and it does allow a good length of run in a small space. Moreover, it cannot be denied that the oval has prototypes in real practice, though perhaps with rather more numerous stations. It has, however, the great failing that it is apt to pall rather sooner than a more realistic line. That is where section-linking is of help, giving each operator a real twofold task and introducing signals that are an integral part of the operational, as well as the scenic, side of the layout.

It is just possible to run block signalling—and hence linked-section control—on an oval with only two block-posts (as was done on the Gainsborough M.R.S. track at the Kings Cross Centenary Exhibition), but this does mean receiving your up trains back again from the same box to which you have just passed them on—and the same applies to your down trains. The use of bell code could disguise this shortcoming, and some sort of scenic break between the two halves of the oval would also help, but the addition of a third block-post would be much better.

Fig. 7 shows a small two-station single track oval. The main line is the absolute minimum, but the addition of goods and carriage sidings (which do not complicate the sectioning) enables quite varied and interesting running to be obtained. Two trains can be operated at once on the main line, and they can be

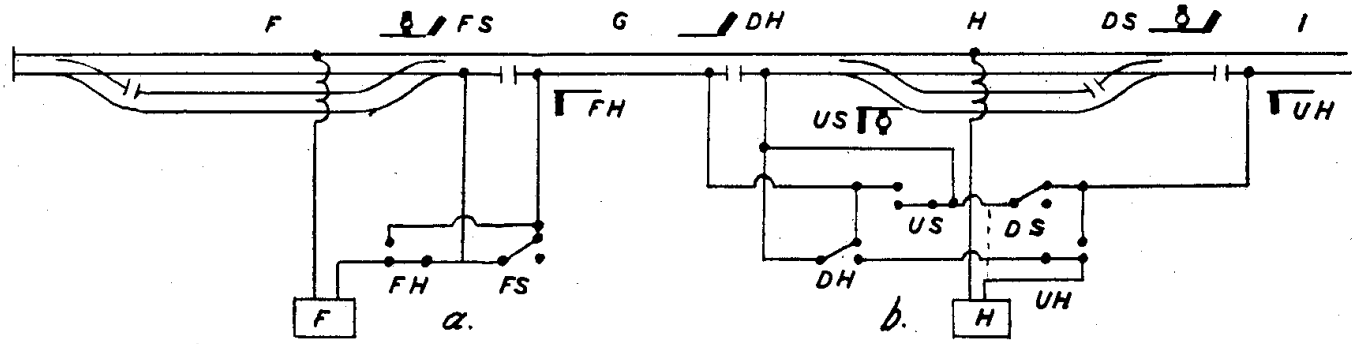


FIG. 6. SINGLE LINE WIRING

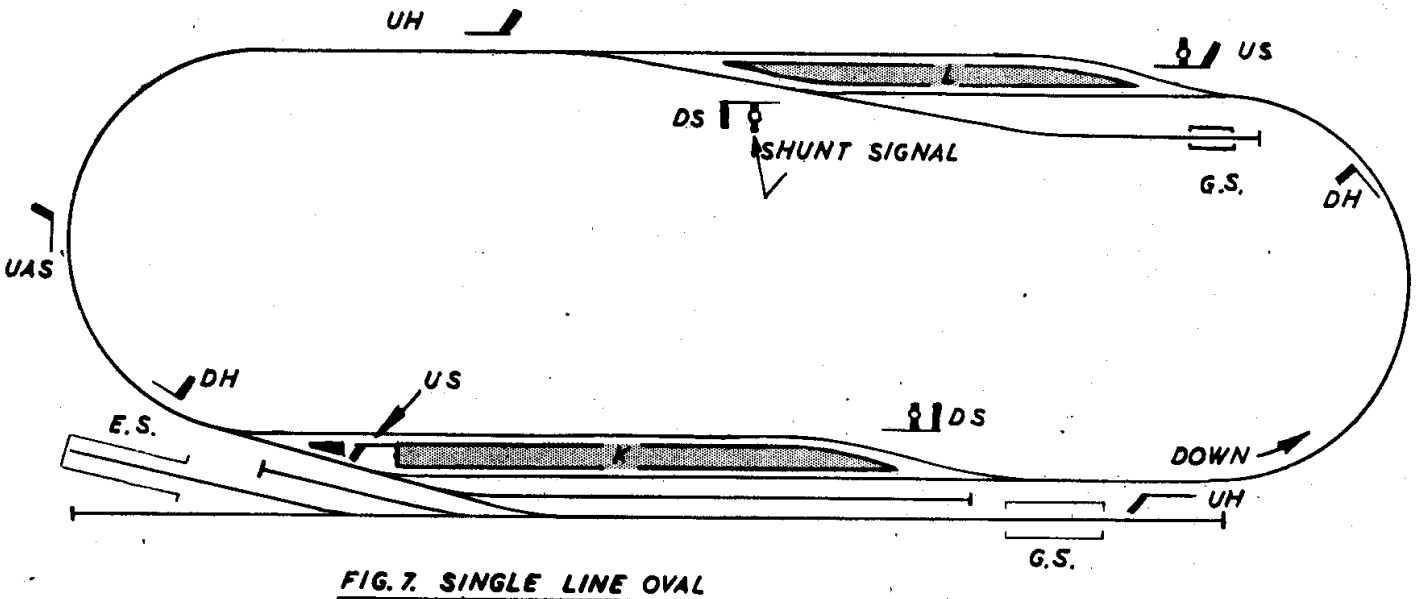


FIG. 7. SINGLE LINE OVAL

terminated at either station. At *K*, the principal station, either up or down trains can be reversed or taken out of service, whilst at *L* odd wagons can be dropped or picked up, and local trains reversed.

On such a small layout realistic time-table operation will not be achieved unless all trains stop at both stations on each journey, but nevertheless continuous running is bound to be needed at times for testing, or for amusing the uninitiated who can see no interest in proper working because it looks so slow. But if, using the wiring given in Fig. 6, we were merely to set up link (*d*) at both stations, we should have an "After you Cecil" state of affairs—a floating chain of control with no connection to either controller. To overcome this snag we must make a slight change in the wiring at the principal station, from which any single-handed operation will be carried out. As shown in Fig. 8, the feeds through the starter signal switches are connected not to the station feed as usual, but direct to the controller, thus anchoring the "floating chain" to the principal controller when either starter is pulled off.

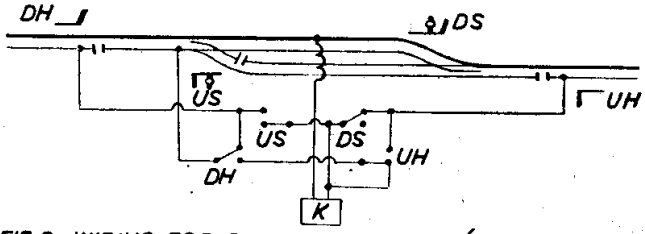


FIG 8. WIRING FOR OVAL MAIN STATION (COMPARE FIG 6b)

For single-handed operation, the box at the smaller station is closed in the usual manner, and—given remote control of the three points, and three auto-uncouplers—the normal service could still be run without leaving one's seat. The shunting possibilities of station *K* would also greatly add to the interest.

Since up to 3 ft. of track to the left of the yard points at *K* will be needed for shunting purposes it will be advisable to instal an advanced starter, and we can use this instead of the starter for operating the switch. The starter itself would be operated from a separate lever, but interlocked so that it would not clear unless the yard point was normal. Note that the advanced starter technique for single-line is different from that for double-track owing to the fact that all siding points are now brought within station limits.

A double-track oval could be operated in a very similar fashion, and here the short headway permitted on double track would be of great help on a small layout. The wiring and sectioning would be on the lines of Figs. 1 and 3 in Part I, but with the modification given by Fig. 8 to permit continuous running. Crossovers would, of course, be needed, but as both tracks at any station can be brought simultaneously on to the controller there, no complication arises.

To the basic track forms so far dealt with we can naturally add branch lines, and the treatment required for operating these and the necessary main-line junctions will be the next object of our attention.

(*To be continued*)

FOR THE BOOKSHELF

Titled Trains of Great Britain, by Cecil J. Allen. (Hampton Court: Ian Allan Ltd.). 224 pages, size 5½ in. by 7½ in. Price 15s. net.

First published in 1946, this book has now reached its third edition. Seven years ago, there were but 70 titled trains to describe; in 1947, the number had increased to 97, while in 1953 it is 108. Consequently, this book has grown to its present size in three distinct stages

A coloured frontispiece depicting the "Golden Arrow," hauled by the B.R. Pacific engine *William Shakespeare*, at Chelsfield adds a welcome illustration to the large number of halftones printed on art-paper inserts.

Mr. Allen's descriptions are always interesting to read, and in many cases, he gives particulars of high-speed work performed by well-known trains. The book is a valuable addition to popular railway literature.

3 Junctions and Return Loops

LINKED-SECTION CONTROL

by L. E. Carroll

THE main line junction is a piece of trackwork that features in many layouts, and it can, of course, take a number of different forms. In all the diagrams in this Part (except Fig. 12) a station is assumed to occur just before the junction itself, (the actual *home* signal protects the junction in every case), an " outer home " protecting the down platform road and actuating the first switch.

Fig. 9 shows the simplest junction of all—a single branch joining a single main line. The problem is dealt with quite straightforwardly by applying the techniques already used: it is merely necessary to add an up and a down home for the branch junction, together with the switches actuated by them, and a pair of starters without switches. Assuming that the branch terminus has its own controller, it will be possible for the operator there to drive trains not only to the junction but also any distance along the main line for which the signals are clear. Conversely, down trains may be driven on one controller from any main-line station right into the branch terminus.

It would also, of course, be possible to run a push-pull service up and down the branch, using a bay road at the junction, the bay signals being switched so as to leave the push-pull under the control of the branch terminus in both directions. This would allow the push-pull to be run into the bay at the same time as the main-line train with which it was to connect was arriving at another platform on a main-line controller.

A double-track junction, as shown in Fig. 10, needs no more operative signals than a single-line junction—namely six—but here certain switches have to be double-pole, as in other double-track work. The three block-sections used by trains leaving the station are all fed (except on link (*d*)) from the same controller, but since only one train will be departing on link (*c*) at any one time there is no risk of having two trains on the same circuit at once. If, however, the junction starters are placed a train's length beyond the points it will be possible to hold a train at the branch starter while the next down main is worked through—the first part of the branch being made dead by having the points set against it. This facility can be used on the other junctions, as indicated by the dotted lines. The same through-running arrangements are available as in Fig. 9.

Fig. 11 shows a hybrid—a single-line branch joining a double main line—and includes a cross-over to enable down trains to reach the branch. The wiring here is very similar to that in Fig. 10, but the following differences should be noted :—

(i) The controller feed is omitted from the " upper " half of the D.P.D.T. switch for signal *DBH* so that the branch may be controlled from its terminus when an up train is being run.

(ii) A special switch *CR* is added, by means of which a small portion of the up line is included in the branch circuit when the crossover is reversed for down trains. This switch is

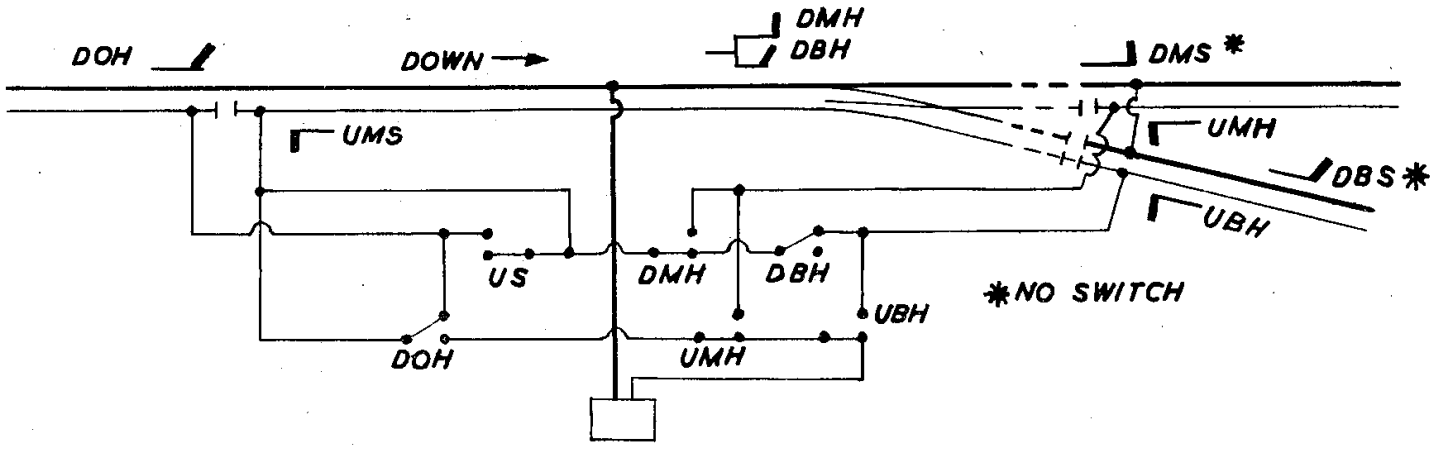


FIG. 9. JUNCTION OF SINGLE BRANCH WITH SINGLE MAIN LINE

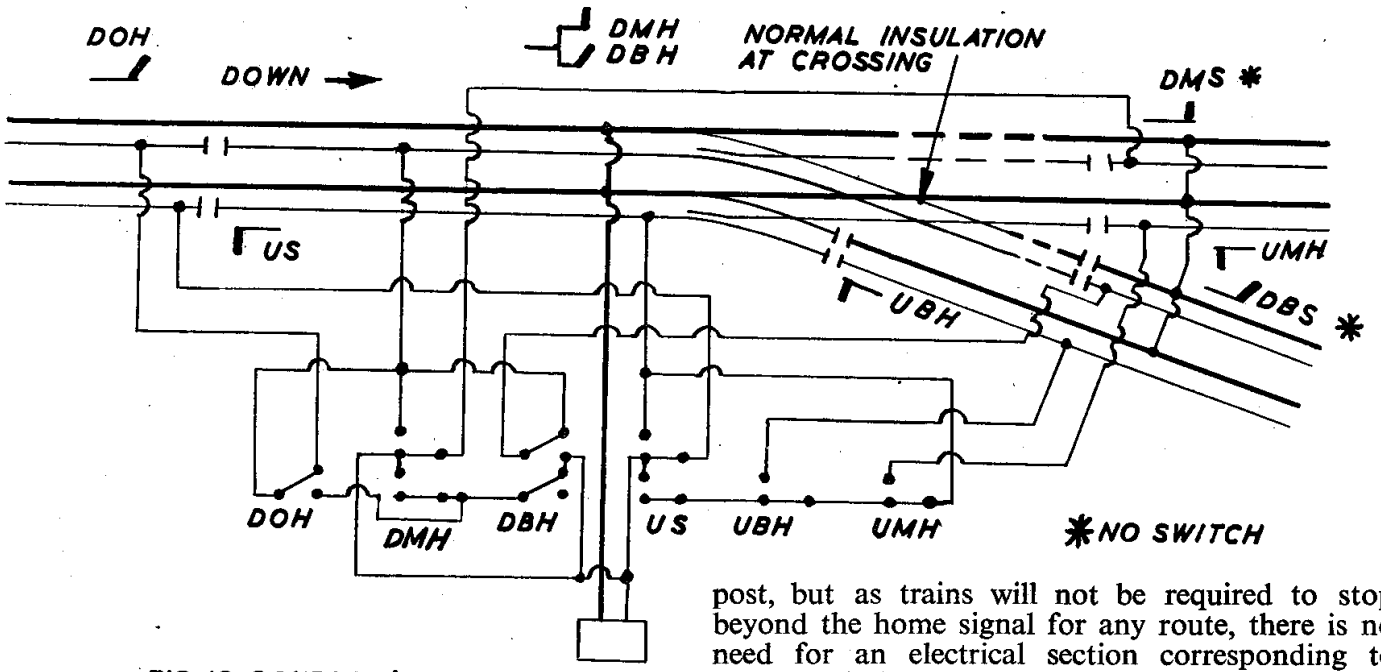


FIG 10. DOUBLE JUNCTION

actuated by the point lever which operates the crossover.

(iii) The leads from signals *DBH* and *UBH* are both taken to the branch feed rail.

In this example, too, through running on link (*d*) is provided for.

Triangles

All the junctions considered so far have occurred at stations, and have therefore come under the jurisdiction and control of the station block-post. Junctions of all types can, however, occur elsewhere, and in these cases a somewhat different treatment is needed. Any such junction must—in correct working—still be under the protection of a block-post, but as trains will not be required to stop beyond the home signal for any route, there is no need for an electrical section corresponding to "station limits." The triangular junction in Fig. 12 is a specimen of this type and is shown in a common position—namely on the outskirts of a terminus.

In full-scale practice such a triangle would be a great deal larger than a scaled-up version of the model, and would consequently be considered as three separate junctions. On the model, however, we can safely treat it as one, and place it under the control of the "North Box" of the nearby Terminus *R*. Sections *N* and *P* are block-sections between the junction and the adjacent main-line stations *M* and *Q*, whilst section *R* is the approach to the terminus, being actually the block-section between the North and South boxes there. Each of the three sections *N*, *P* and *R* is equipped with splitting homes protecting the junction, so that there are six signals and

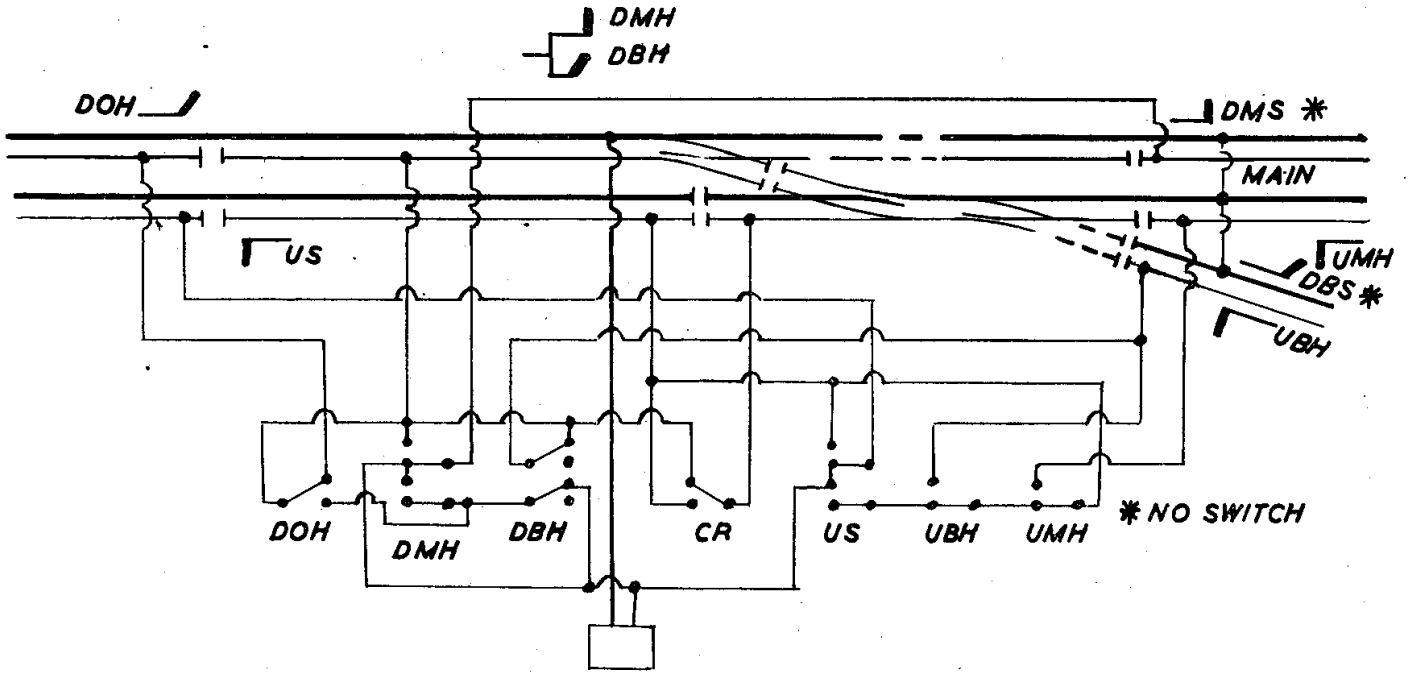


FIG. 11. JUNCTION OF SINGLE BRANCH WITH DOUBLE MAIN LINE.

three points altogether. Point *a* has a lever to itself, but points *b* and *c* can be operated simultaneously by a single lever with no inconvenience—indeed, the reverse.

For 2-rail the set-up is slightly complicated owing to the change of polarity required in Section *R*, depending on which arm of the main line is to be linked with it. Fig. 12 shows the arrangement for 2-rail in full, and includes three switches. The first is actuated by either of the levers operating signals 2 and 4. It is a double-pole switch, and when up trains are due to arrive at the terminus it disconnects both rails of section *R* from the *R* controller and links them only to the poles of the second switch. The latter is closed by the *b* and *c* point lever whenever these points are set for a route into or out of the terminus. In the closed position the *b-c* switch is linked to the poles of D.P.D.T. switch *a* which, being operated by the *a* point lever, changes over the polarity of section *R* to correspond with that of the main-line route for which the point is set.

When not accepting an up train, section *R* will remain linked to its own controller, which will, through the switches, also feed the main-line sections *N* or *P* if points *b* and *c* are set for a down train. When the points *b* and *c* are set for the continuous main line the short section *O* joining their frogs will link sections *N* and *P* together via their point blades, thus converting *N*, *O* and *P* into a single electrical unit.

In the 2-rail set-up it would also be possible to instal some interlocking, but the protective dead sections in the triangle, coupled with the simultaneous action of points *b* and *c*, make it impossible to " burst " the trailing points. The actual operation of the junction is just as simple in 2-rail as in 3-rail.

In 3-rail or stud-contact there is no special problem. Signal levers 2 and 4 both actuate a " home " switch that links *R* to the main line, and signals 5 and 6 both actuate a switch linking sections *N*, *O*, *P* and *R* to the terminal controller. The actual wiring is identical with that at the terminus *F* in Fig. 6, and that at the neighbouring main-line stations *M* and *Q* also follows normal single-line practice. Mechanical interlocking will prevent any of the levers 2, 4, 5 or 6 from being pulled until *b* and *c* have been reversed.

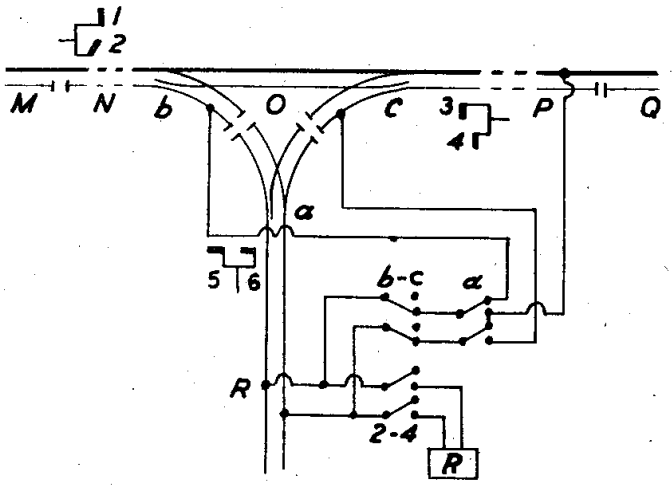


FIG 12. TRIANGULAR JUNCTION (2 RAIL)

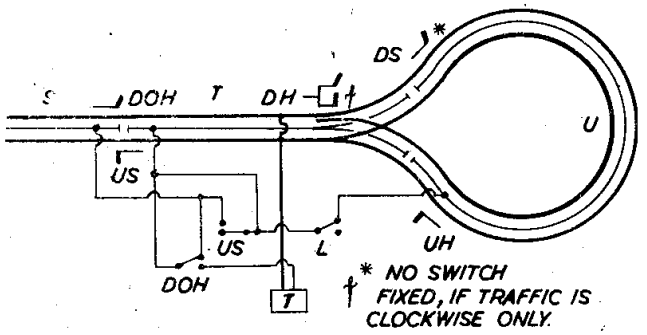


FIG 13. 3-RAIL RETURN LOOP

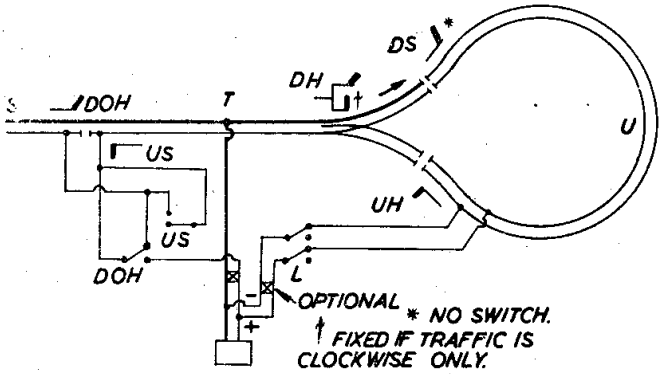


FIG 14. 2-RAIL RETURN LOOP

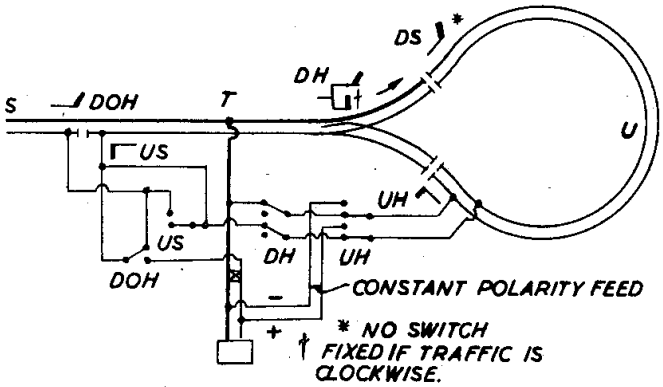


FIG 15. 2-RAIL RETURN LOOP WITH PROVISION FOR LINK (*a*)

Return Loops

The return loop is a valuable feature of any layout which is designed to be completely suitable for single-handed operation, but, like the triangle, it is a formation which is simpler to wire for 3-rail than for 2-rail.

Considering the former first, let us therefore glance at Fig. 13, which typifies any " 3-rail " system and represents the simplest kind of return loop. Here station *T* is the last on the line and *S* is the block-section preceding it. *U* is the loop itself, and is in effect the block-section in advance for down trains and the block-section in rear in respect of up trains. Both the down and up

homes can actuate the single-pole switch *L* (or two separate switches arranged in parallel), and thus link the loop to the station track if either signal is "off." If both are "on," however, the loop is isolated altogether, and another train—say a push-pull terminating at *T*, or a goods train destined for a siding there—can be accepted while the previous train is held on the loop. Fig 13 allows for traversing the loop in a clockwise direction only, but if it is desired to run trains either way round it is merely necessary to add the two additional signals ; the circuit *L*—now completed by any one of the four loop signals—will still suffice. By the simple switchgear shown, this particular loop will be fully incorporated into the normal section-linking.

Fig. 14 shows the same layout as Fig. 13, but arranged for 2-rail, and here we have to make provision for reversing the polarity of the main line while the train is traversing the loop. Section *U* is supplied through a separate constant-polarity feed from the rheostat of the *T* controller and, as before, the circuit *L* will be closed by either the *DH* or the *UH* signal being pulled off.

This is the simplest kind of arrangement for a 2-rail loop, and makes no provision for 2-way running or for linking the loop to section *S* for the through running. If trains are required to run either way round the loop, a separate reversing switch, preferably worked by the splitting home signal levers, will be needed in the feed to section *U*. On the other hand, if express trains are to run right through on to the loop on link (*d*), the *DH* and *UH* signals will each need a separate switch, as shown in Fig. 15. Trains about to emerge in the up direction are transferred from the previous controller to the constant-polarity feed by pulling off the *UH* signal. It will be seen that the *UH* switch by-passes the switch actuated by the *DH* lever, which may therefore be replaced *after* the *UH* is pulled off. This permits a train to run non-stop round the loop if required.

A useful addition to a loop of this kind is a section of double track—concealed in a tunnel or behind scenery—where trains can be interchanged and so have their actual journey time considerably increased. This feature greatly helps the illusion of a distant terminus which realistic operation of a return loop requires. The extended time-lag causes a down train to lose its identity, so to speak, before emerging again on to the layout as an up train. But apart from a single point lever no additional section-switching is involved, since the points can be made to energise only the road for which they are set. The signalling remains as before but as soon as a train runs on to the vacant track it is isolated by having the points set against it.

The extra switchgear for a 2-rail return loop is amply offset by the great advantage that with 2-rail a concealed train will always start up in the required direction, no matter which way its loco. may happen to be facing. Embarrassing moments are thereby avoided !

Other uses of the return-loop in both 2-rail and 3-rail can be dealt with on similar lines, and—as in the case of other track formations—refinements in the way of electrical and mechanical interlocking can be incorporated at will with no extra complication in the actual handling of the equipment.

Single-handed operation is readily obtained in 3-rail by setting up link (d) throughout, but in 2-rail remote control of the power supply to section *U* will be required, the *T* section being the last one linked to the terminal controller when both *DH* and *UH* are off.

* * *

Examples of all the basic track formations used in model railways have now been analysed in some detail. It would be tedious to attempt to deal at length with every possible situation, and those modellers who are ambitious enough to embark on more elaborate layouts will have no difficulty in applying to them the general principles already illustrated. It now only remains to add some notes on the practical side of signal-box construction and wiring, which will be done in Part IV.

(To be continued)

FOR THE BOOKSHELF

Western Region Allocations. Compiled and published by P. Armstrong, 44, Shelburne Road, High Wycombe, Bucks, on behalf of the Locomotive Club of Great Britain. 40 pages. Price 1s. 9d.

This little book is uniform in style with the previously-noticed "Southern Allocations." It gives the home shed of each locomotive on the Western Region, together with the principal dimensions of W.R. locomotives, a complete list of the sheds, all engine names, dates of building and thirty-two illustrations of representative types.

Copies can be obtained from the wholesalers, Eames, 24, Tudor Road, Reading, Berks.

Trains Annual 1954 (London: Ian Allan Ltd.). 96 pages, size 7¼ in. by 9½ in. Price 9s. 6d. net.

This publication has now more than firmly established itself as a popular favourite, and we find this, the eighth edition, even more attractive than any of its predecessors. Its contents contain something to satisfy every railway enthusiast who is not a hide-bound specialist in only one feature of one particular railway. Fourteen articles by various writers provide a wealth of topical, historical and reminiscent reading at a very moderate price.

An innovation this year is the substitution of art paper on which to reproduce the photographic illustrations, of which there are many, old and new, to please the reader. In addition, there are four fine double-page plates in colour, depicting some well-known modern trains.

4 Signal Boxes

LINKED-SECTION CONTROL

by L. E. Carroll

THE heart of Linked-Section Control is in the signal-boxes, and since no other control panels are needed there is every reason for bestowing upon them the time and care they deserve. For this reason I would strongly recommend that each signal-box, with its lever-frame, switches, rheostat and reversing switch, should be built up on the bench as a separate unit. This will enable it to be assembled and wired up under the most favourable conditions—and with the minimum gnashing of teeth ! The complete unit can then be screwed up under the baseboard and connected up without abortive attempts at " soldering uphill."

All the single-pole switches can well be home-made, but if cumulative voltage drop through the switchgear is to be avoided such switches must be designed with wiping contact and adequate pressure. For the double-pole switches it is possible to obtain, quite cheaply, surplus bands of push-button switches ; which can be broken down into small groups as required. If more poles are needed the 2-pole switches can be used in tandem, or the small Yaxley switches—also obtainable at very low cost—can be employed. As all this gear will be out of sight it should—once installed—also be " out of mind."

Most of the electrical connections needed will be made within the signal-box itself, but there will in each case be two or more leads to the adjacent feed rails, and also the feed to the controller, to be connected up after fixing the box in position. These leads should be of distinctive colours. and should be taken to a simple terminal block on the appropriate side of the unit. Each wire should have an inexpensive terminal tag, and the terminal itself need be nothing more elaborate than a round-headed wood screw. The leads brought down from the feed rails should be of corresponding colours, and if they are fitted with U-tags the latter can be slipped under the screw-heads before these are driven right home.

The signal control lines may go beneath the baseboard, and these again should be in two sections—a short one running through a fair-lead on the box, and a long one from the signal. The two sections should be joined by a hook and eye, the hook being of stiff wire long enough to permit a good range of adjustment by bending it. Point rodding too can be run beneath the baseboard, as this enables everything to be overscale, and therefore cheaper and stronger. In all cases the " eye " part of the connection should be on the box end of the control line or wire.

The lever frame itself can project beyond the edge of the baseboard if space is precious, or alternatively a piece of the latter can be cut out to make room for it. The controller-knob and switch should be just below and to one side of the levers so that both hands can be used at once in a natural position—see Fig. 16. If the top of the frame is approximately flush with the baseboard the lower ends of the levers will be in a good position for connecting to the switches etc., and furthermore the visible parts of the levers will be less out of scale with the layout than is usually the case.

The distant and stop signal levers and the point levers will, of course, be arranged in the frame in the most logical order—as in prototype practice—and this will enable a stranger to learn the box in a very few minutes ; they should also be coloured yellow, red and black respectively—and spare levers being painted white. In the two-dimensional wiring diagrams in Part I, II and III, however, the switches had to be arranged in such a way that the connections could be most clearly followed. To avoid confusion during wiring up, therefore, each switch and lever should be marked with the appropriate letter code before starting work. The traced-off diagram should be turned round—or turned over—so that it corresponds most nearly with the actual layout of the switchgear as seen on the bench. If, as each connection is made, the corresponding terminal on the diagram is crossed through there will be little risk of error. A background of white card behind the tracing will make the diagram easier to read.

The signals themselves need not be elaborate at least to start with. Semaphores will be best for this scheme of operation, because their aspects are equally visible to both driver and signalman. They are also easier to make and more attractive scenically than colour-lights,

The connecting up of signals and points will obviously be much more simple—and therefore more reliable—if the whole of each " station limits " section can be kept on the same section of baseboard as the box. The use of relays has deliberately

been soft-pedalled because not everyone wants to be bothered with them, but where signals or points do have to come on adjacent bits of joinery, they are the best answer. I have been using bomb-release relays extensively myself, and they are not only reliable in action but also take only 0.3 amp.

One other point; since the current for through trains has to flow through the rails all the way, it is important that the bonding between them should be fully up to standard, and that a good path should be provided at all point blades. Otherwise the risk of voltage-drop will be greater than if the track were fed at intermediate points. In the case of longer-than-average layouts it is in any case desirable to install special feeder wires, but for the general run of " OO " layouts this will be quite unnecessary if the recommended precautions about switches and bonding are followed—see Fig. 17.

Many owners of block-sectioned layouts, for which Linked-Section Control is expressly designed, may feel that they should go further and install bells—and perhaps rudimentary block-instruments too, but it is necessary to consider whether the additional satisfaction obtained is really worth the complication involved. For only three stations, for example, one would need four bell circuits, and each additional station would require a further pair of circuits. Moreover if only one operator were missing the whole system would break down unless further wiring were introduced. I do not suggest that all this would not be most intriguing, but for the ordinary modeller, running the railway is more of a social occasion than a serious business. On my own layout the bell-push holes so far remain unused; we are still cheerfully calling up in " plain language," and liking it !

The various aspects of Linked-Section Control have now been covered fully enough to admit of its installation with confidence, on any type of layout for which it is appropriate. It will be recalled that, in first working out the system I had in mind the need that it should :

(i) be comparatively simple to install ;
(ii) permit realistic and interesting running of a varied nature ;
(iii) be equally capable of operation by one, two or three people (or more of course !),

and (iv) be easily grasped by casual visitors.

Those readers who have followed the whole series of articles will, I think, agree that it does in fact fulfil those requirements quite handsomely.

I do not insist that it is entirely suitable for the very *long* layout, where voltage drop and the running of through trains from end to end would offer special problems; but even there the merits of the scheme would warrant a compromise whereby expresses would normally call at the principal intermediate station, or be taken over at full speed by an intermediate controller—merely by restoring a signal behind them. Again, the type of operation described would only be practicable where the size and design of the layout enabled all signals and stations to be seen from every control point; but for other layouts the scheme could be put " in reverse," so that " B " would, for example, drive a train from *A* to *B* instead of from *B* to *C*, or otherwise adapted.

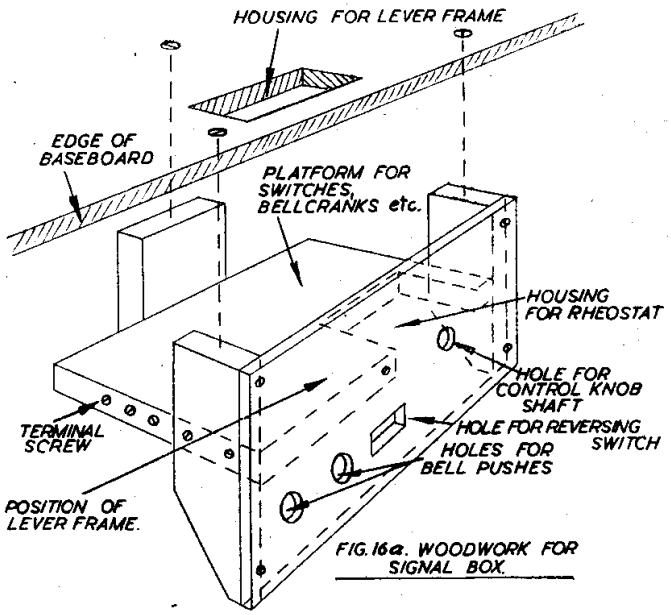


FIG. 16a. WOODWORK FOR SIGNAL BOX.

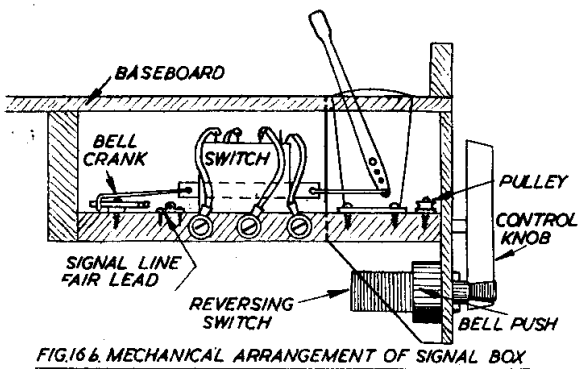


FIG. 16b. MECHANICAL ARRANGEMENT OF SIGNAL BOX.

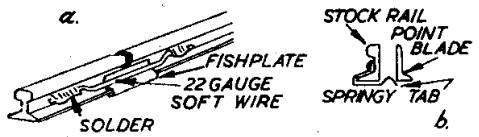


FIG. 17. DEVICES TO AVOID VOLTAGE DROP.

But for the average-sized layout, designed for operation on railway-like lines, Linked-Section Control does seem to be a most satisfying method of electrification. It permits the owner to handle the layout single-handed when required, yet—paradoxically—each additional operator has a full-time job that makes him feel indispensable to the successful operation of the line; an interesting and varied job, too, since he is a driver in respect of some trains and a signalman in respect of others at one and the same time. In both characters, moreover, he is acting in a truly railway-like capacity, using his regulator on the one hand and his lever-frame on the other—and no messing about with a " mighty Wurlitzer " that suggests a telephone exchange rather than a model railway !

It is my hope, therefore, that Linked-Section Control, with its all-round simplicity, may greatly enrich the hobby by enabling the owner of even the modest layout to get from it the lasting satisfaction that comes from " running a railway " rather than just " playing trains."