RAILWAY SIGNAL AND/OR POINT CONTROL EQUIPMENT

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FIG. 1.

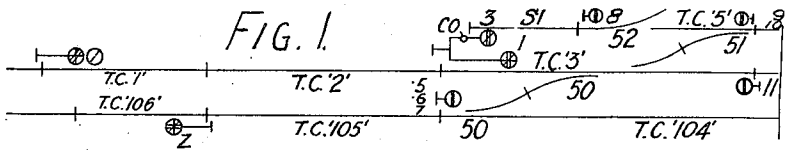


FIG. 4.

No. ①	RELEASED BY ②	RELEASES ③	CONFLICTING ROUTES ④	T.C. CONTROLS CLEAR ⑤	T.C. CONTROLS OCCD. ⑥
1			3. 4. 5. 6. 10. 11. 15. 16	3 4 7	
2			4. 11. 15. 16.	7. 8. 9	
3			1. 5. 6. 8. 9. 10. 11. 15. 16 { MAIN / SUBS.	3. 5. 6. / 3. 5.	— / 2&6 }
4			1. 2. 9. 10. 15. 16.	7. 8. 9.	
5			1. 3. 6. 8. 9. 10. 11. 12. 13. 14. 15. 16. 20.		
6			1. 3. 5. 10. 11. 12. 13. 14. 16. 20		
7	12 OR 13				
8			3. 5. 9. 10. 15.		
9			3. 4. 5. 8. 10.		
10			1. 3. 4. 5. 6. 8. 9. 11. 12. 13. 14. 16. 20.		
11.			1. 2. 3. 5. 6. 10. 12. 13. 14. 20.		
12		7	5. 6. 10. 11. 13. 14. 20		
13		7	5. 6. 10. 11. 12. 14. 20		
14			5. 6. 10. 11. 12. 13. 20.		
15			1. 2. 3. 4. 5. 8. 16		
16			1. 2. 3. 4. 5. 6. 10. 15		
20			5. 6. 10. 11. 12. 13. 14	102. 103. 104. 105. 106	

No. ①	T.C. CONTROLS ②	SET BY ROUTE SWITCHES ③	POINTS ROUTE SWITCHES REVERSE ④
50	3. 104 (103 W20 REV)	N. R. RESTORED POINTS 5. 6. 10. 11.	5. 6. 10. 11.
51	3. 5	N. R. RESTORED POINTS 3. 5. 10.	3. 5. 10
52	5	N. R. RESTORED POINTS 8. 9.	8. 9.
53	103. (102 A.T.R.)	N. R. RESTORED POINTS 13. 14.	13. 14.
54	7	N. R. RESTORED POINTS 4. 15.	4. 15.

FIG. 5.

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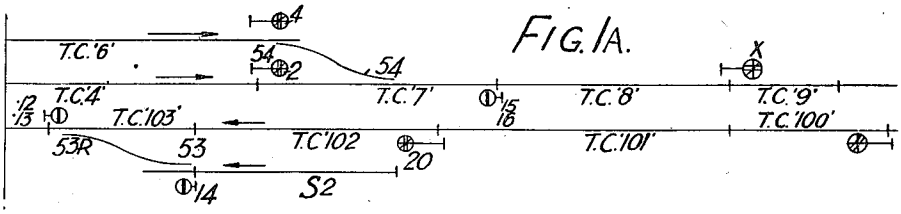


FIG. 1A.

DETECTION		BACKLOCKING		CONTROLS BY SIGNAL AHEAD (11)
N (7)	R (8)	BY T.C. OCCO. (9)	RELEASED BY T.C. OCCO (10)	
50.51		1. 2.	3	(G) REQUIRES 2 AT Y OR G
54		(3W5IN) 4	7	(G) " X " Y " G
50-52	51	1. 2.	3	
	54	6.	7.	(G) " X " Y " G
52	50.51	105. 104	3	
51	50	105. 104	3	
50		105	104	
51	52	WHEN OPERATED	5	
51	52	6	5	
52	50-51	5.6	3	
51	50	4	3	
53		104	103	
	53	104	103	
50	53	WHEN OPERATED	103	
	54	8	7	
54		8	7	
50.53.		100.101.102	103	(G) REQUIRES Z AT Y OR G

FIG. 4A.

LOCKING POINTS NORMAL (5)	LOCKS (6)
1. 3. 7. 20	53
1. 6. 11.	52.
	51.
12. 20.	50
1. 2. 16.	

FIG. 5A.

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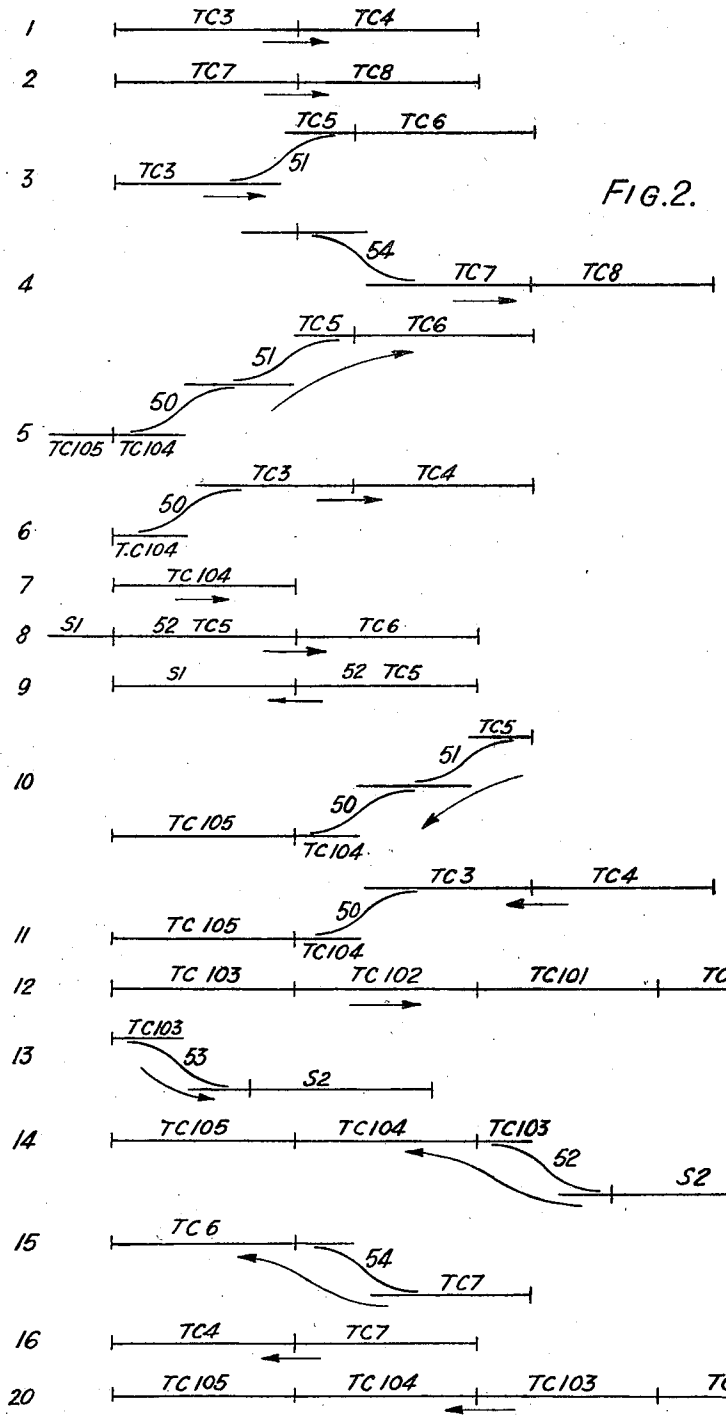


FIG. 2.

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FIG. 3.

ROUTE (1)	S/S (2)	(3)	R1 (4)	R2 (5)	R3 (6)	R4 (7)	R5 (8)
1	3	1	1 2 3 4	2 3 4			
2	2	1	4				
3	3	2	1 2 3 4	3 4		1 2	
4	2	2	3		1	2	
5	1	1		3 4	1 2	1 2	
6	1	2		4	1 2		
7	5	1	7/4				
8	4	1	1 3	3	2		
9	4	2	1 3	2	2		
10	1	3		2 4	1 2	1 2	
11	1	4		1	1 2		
12	1	5					
13	1	6					
14	1	7					
15	2	3	1		1 2	1	
16	2	4	1 2 3		1 2		
20	1	8					

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RAILWAY SIGNAL AND/OR POINT CONTROL EQUIPMENT

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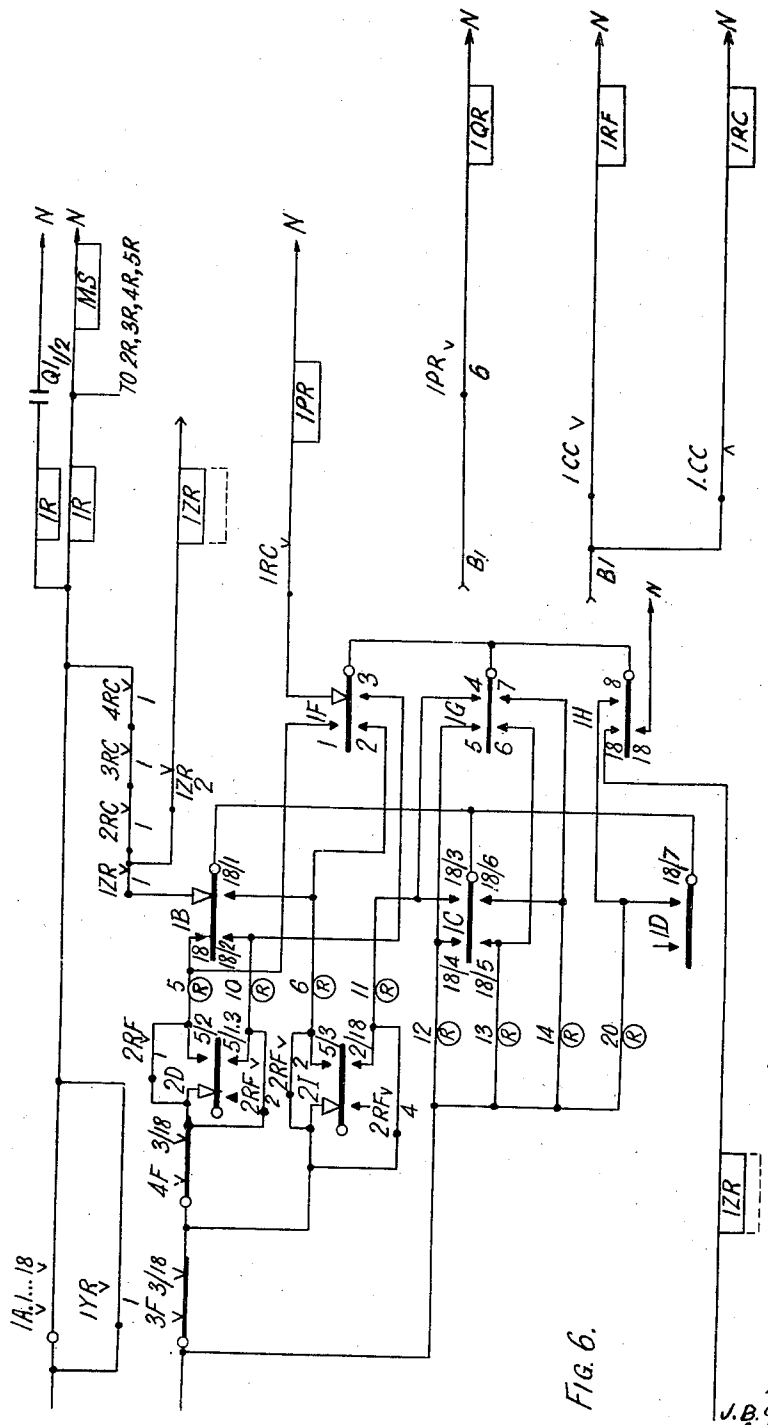


FIG. 6.

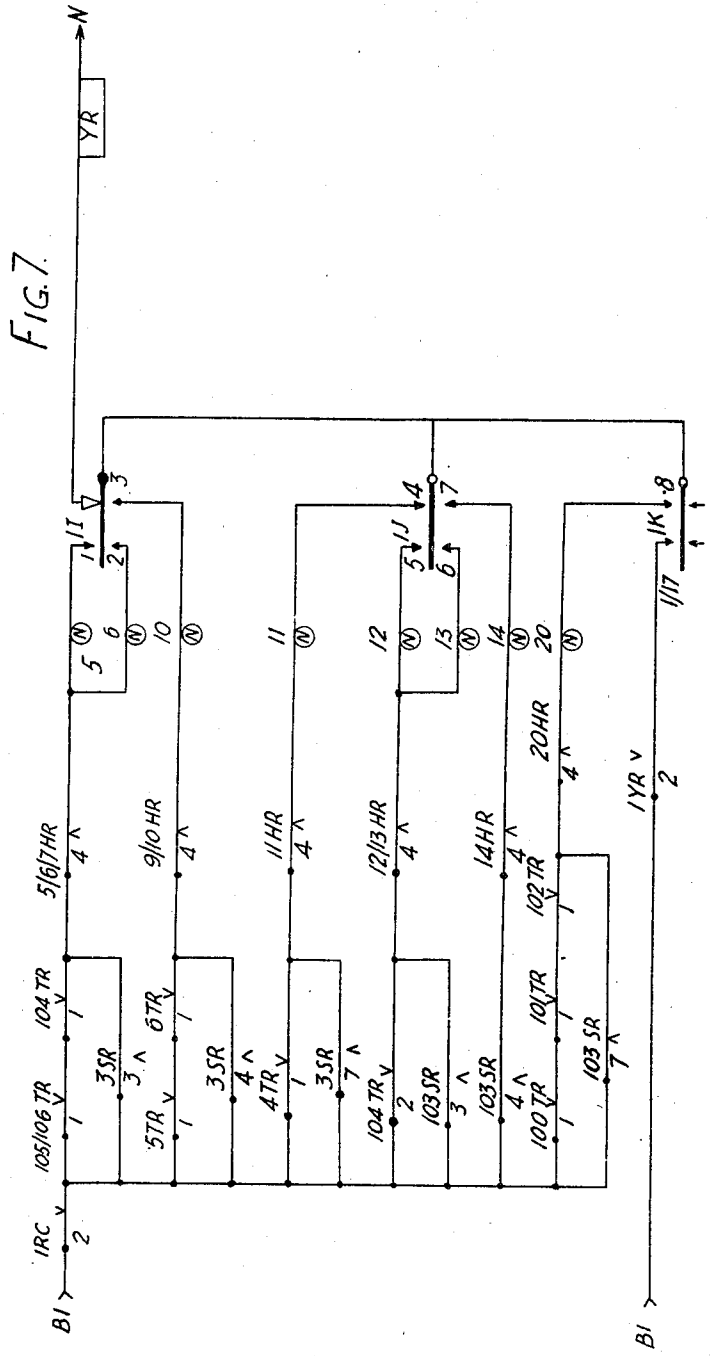
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FIG. 7.



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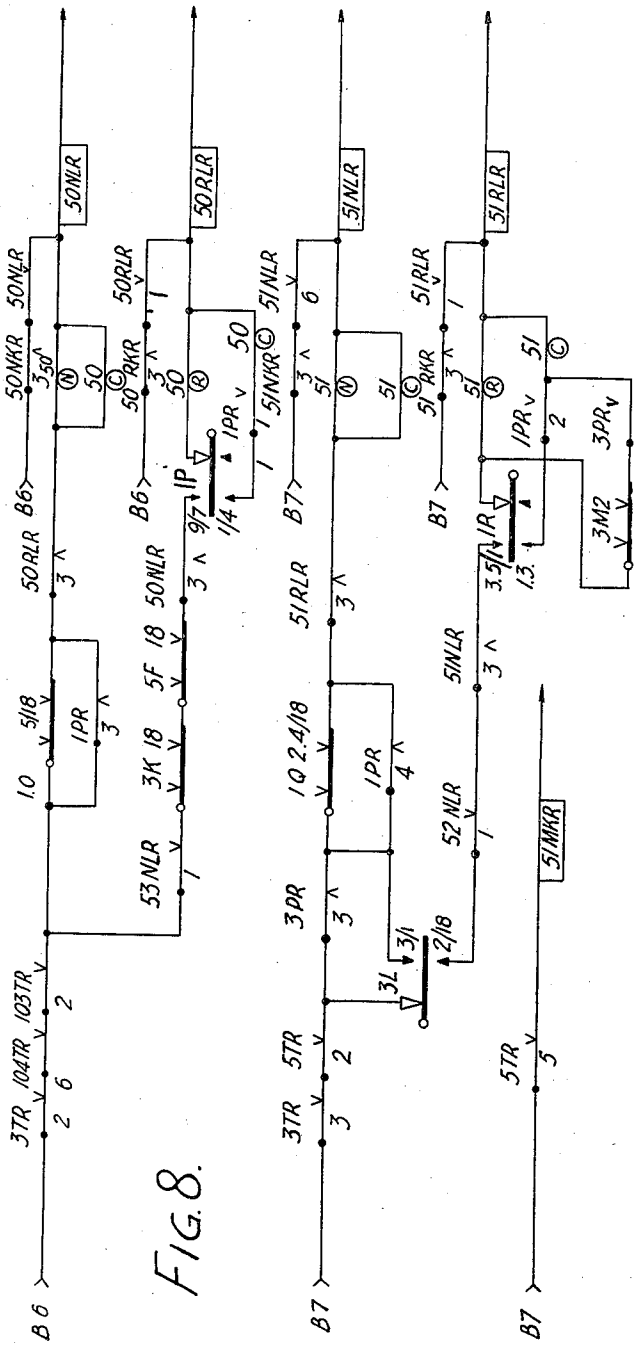


FIG. 8.

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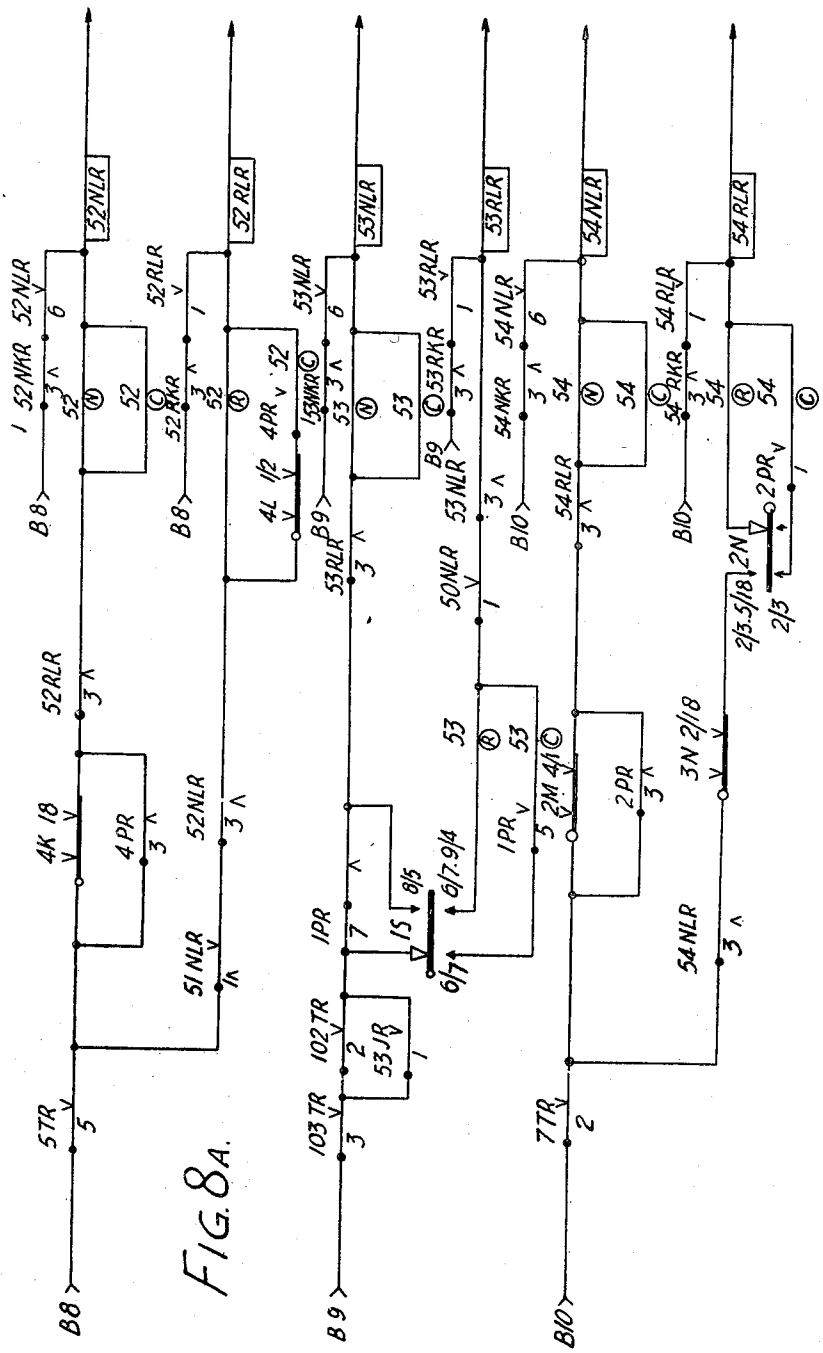


FIG. 8A.

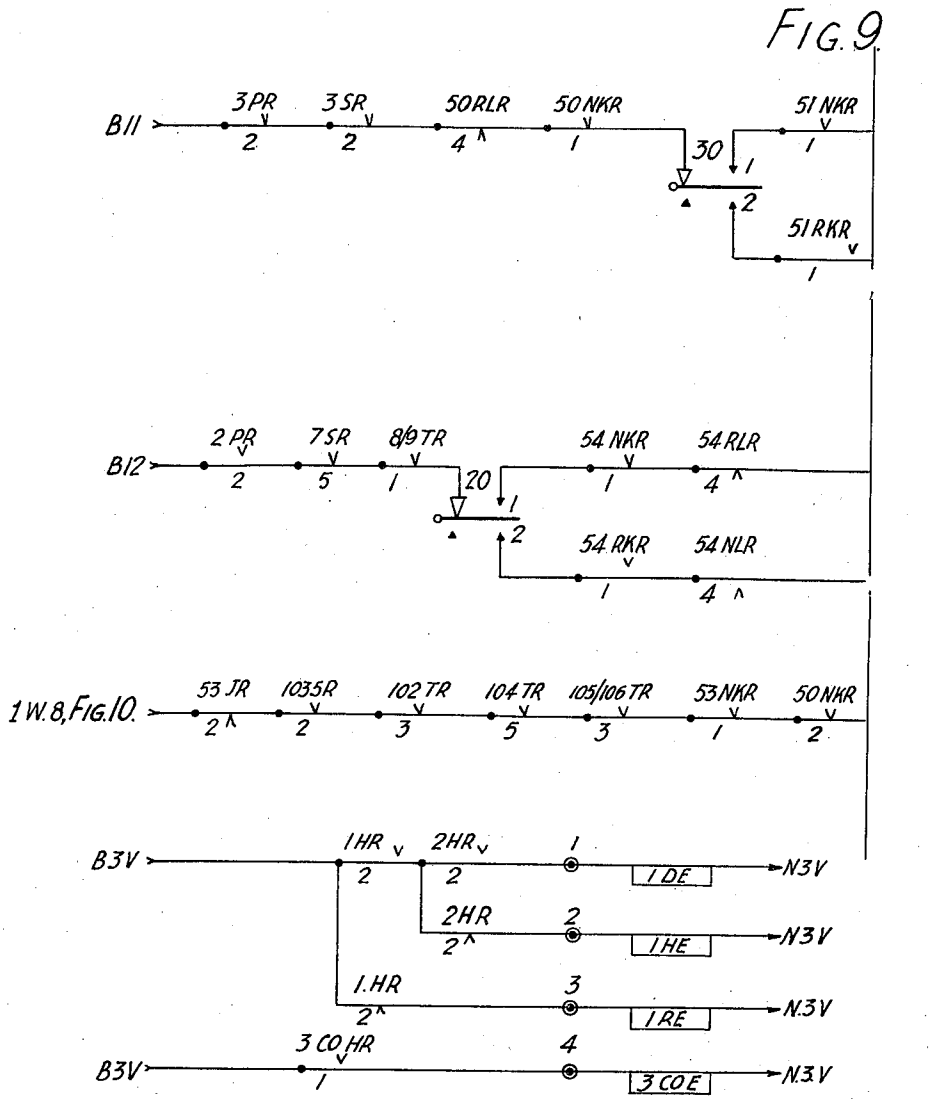
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RAILWAY SIGNAL AND/OR POINT CONTROL EQUIPMENT

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FIG. 9.



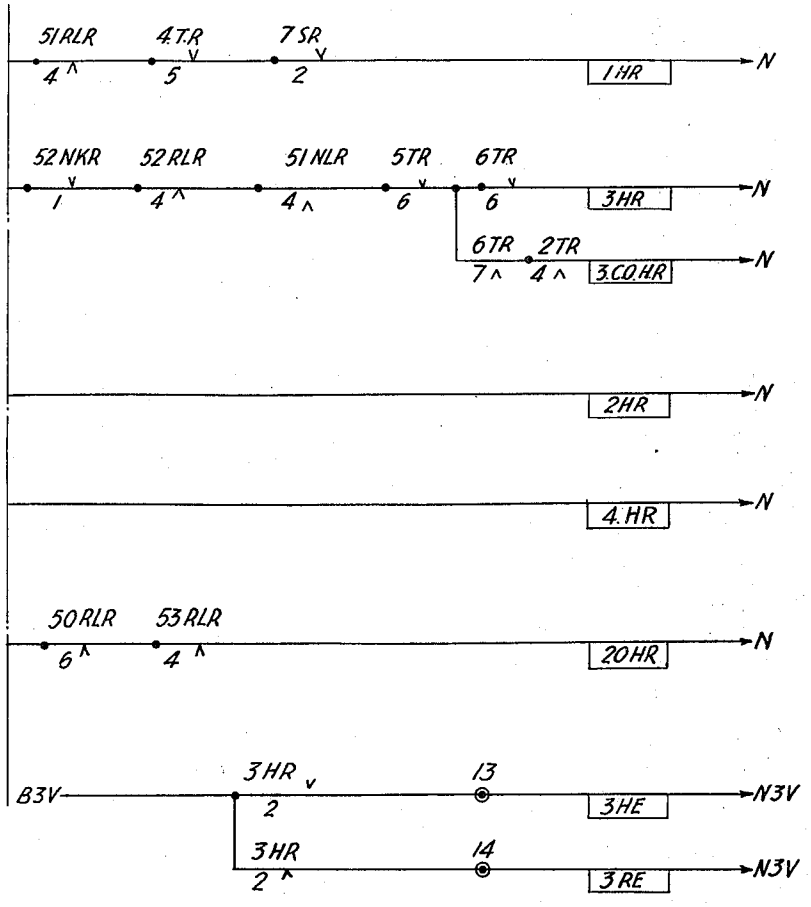
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FIG. 9A.



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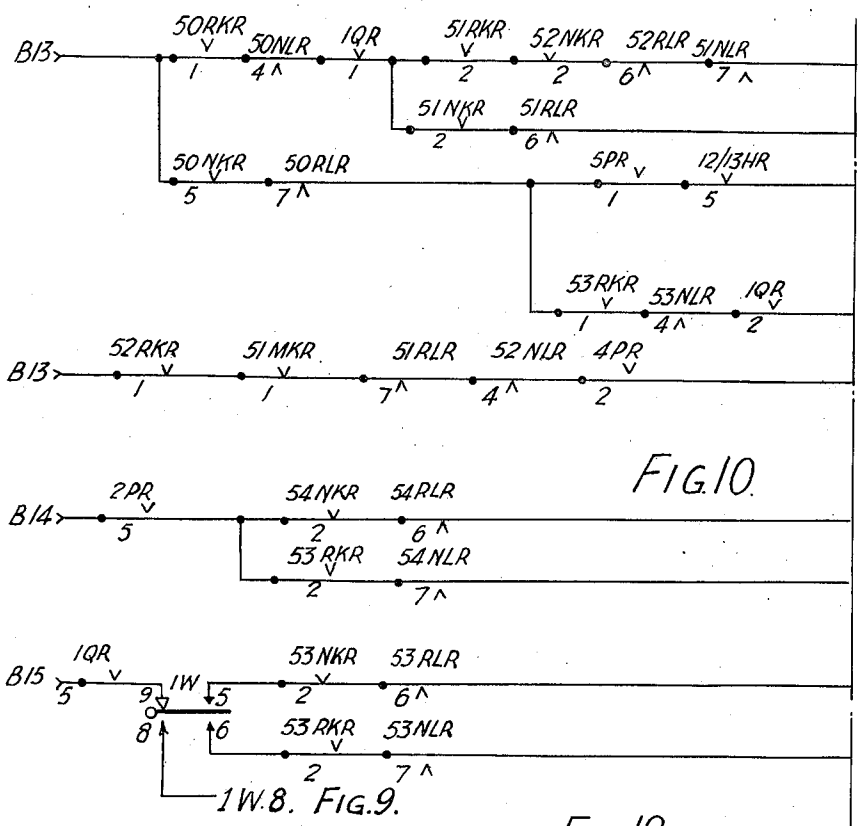
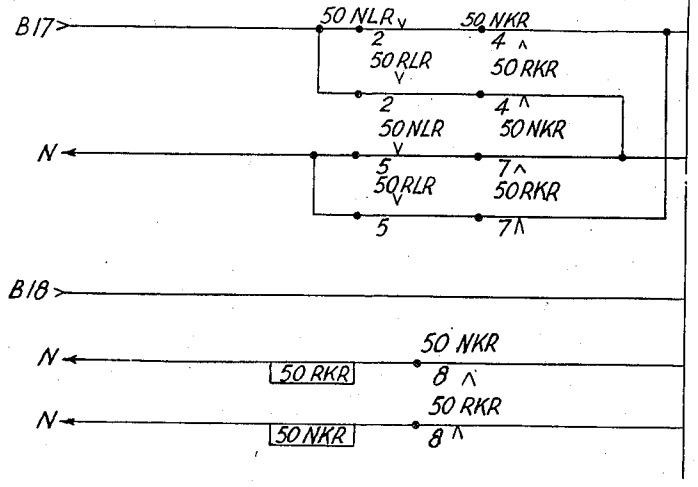


FIG. 10

FIG. 9.

FIG. 12.



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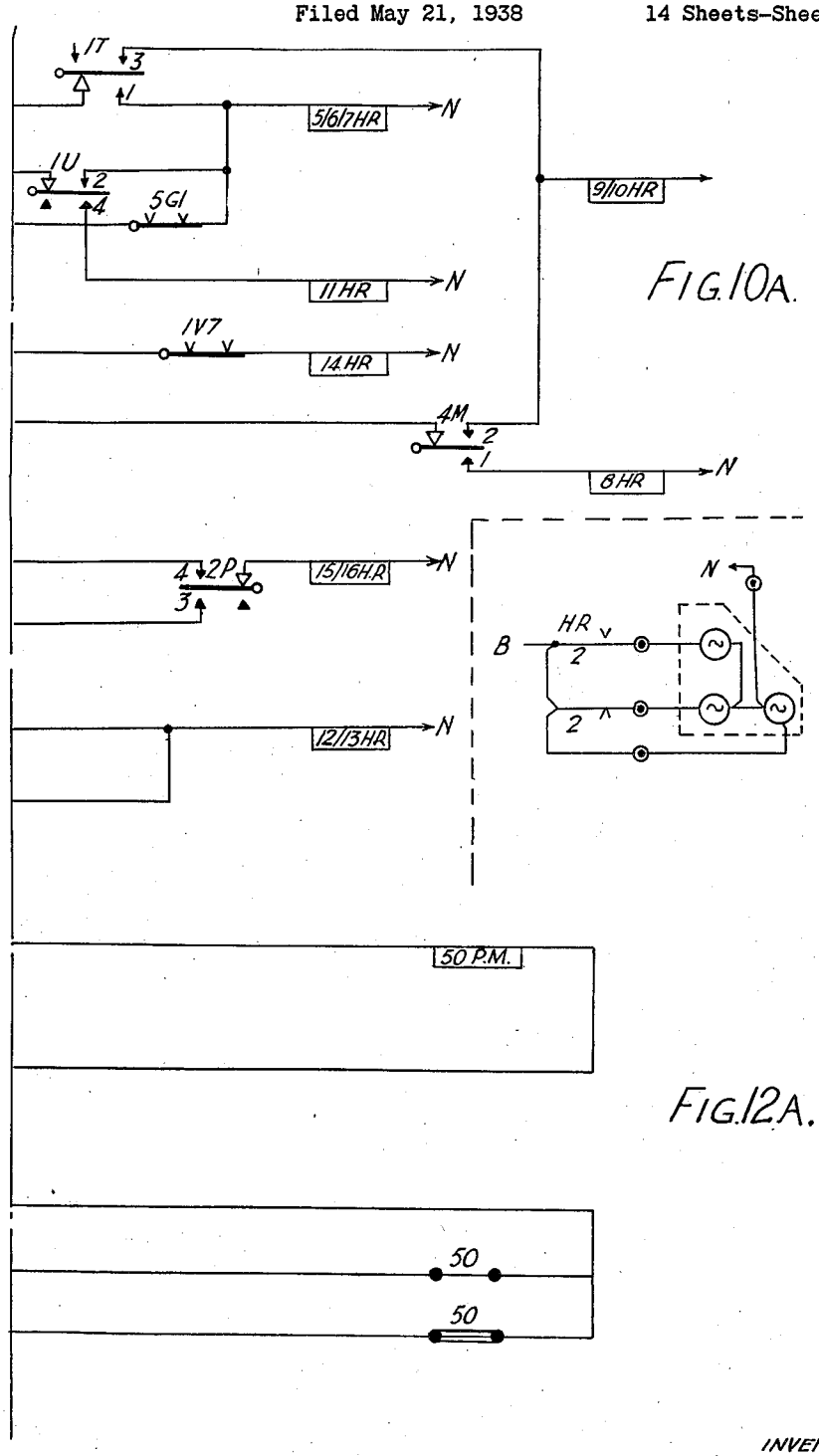


FIG. 10A.

FIG. 12A.

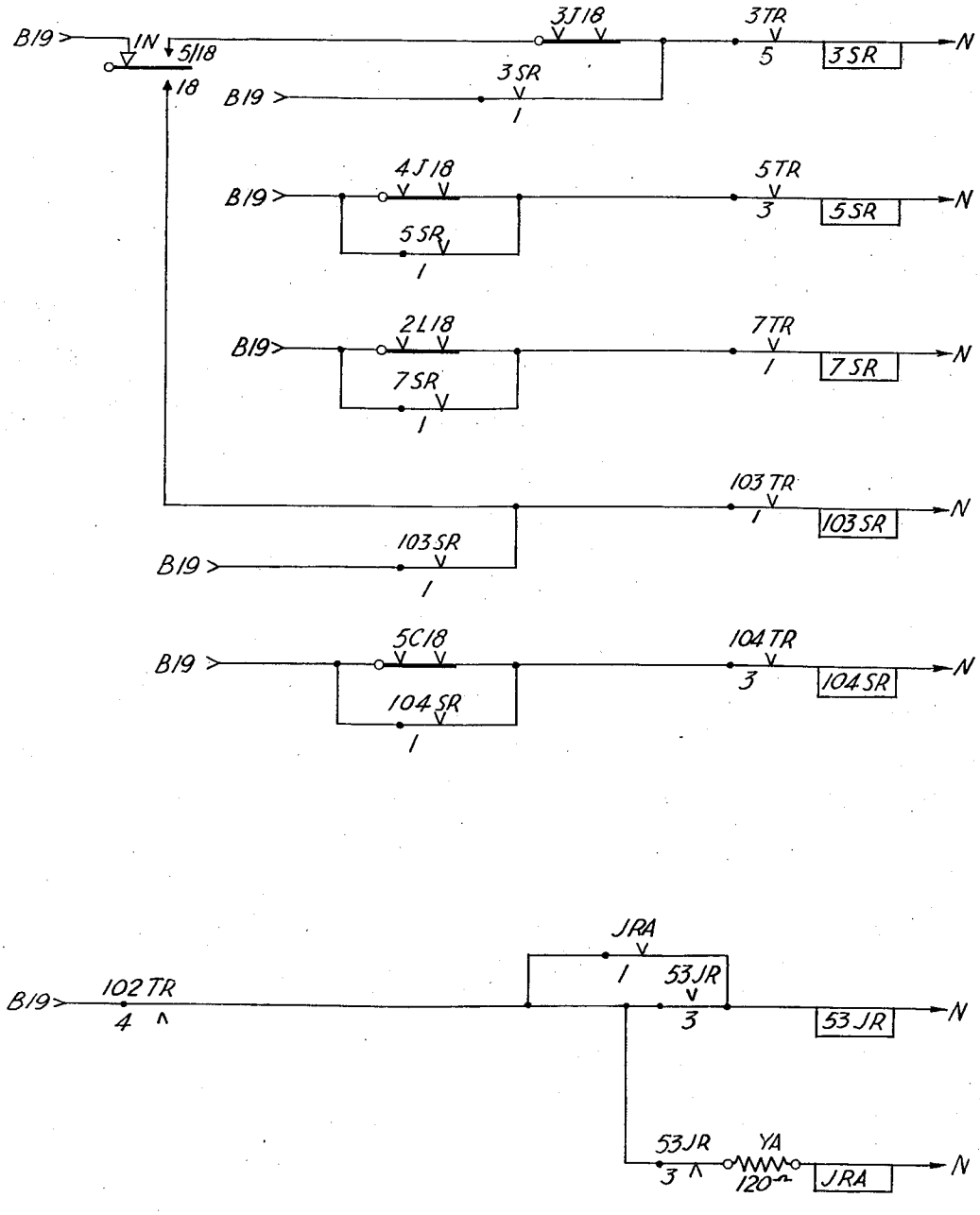
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RAILWAY SIGNAL AND/OR POINT CONTROL EQUIPMENT

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FIG. 11.



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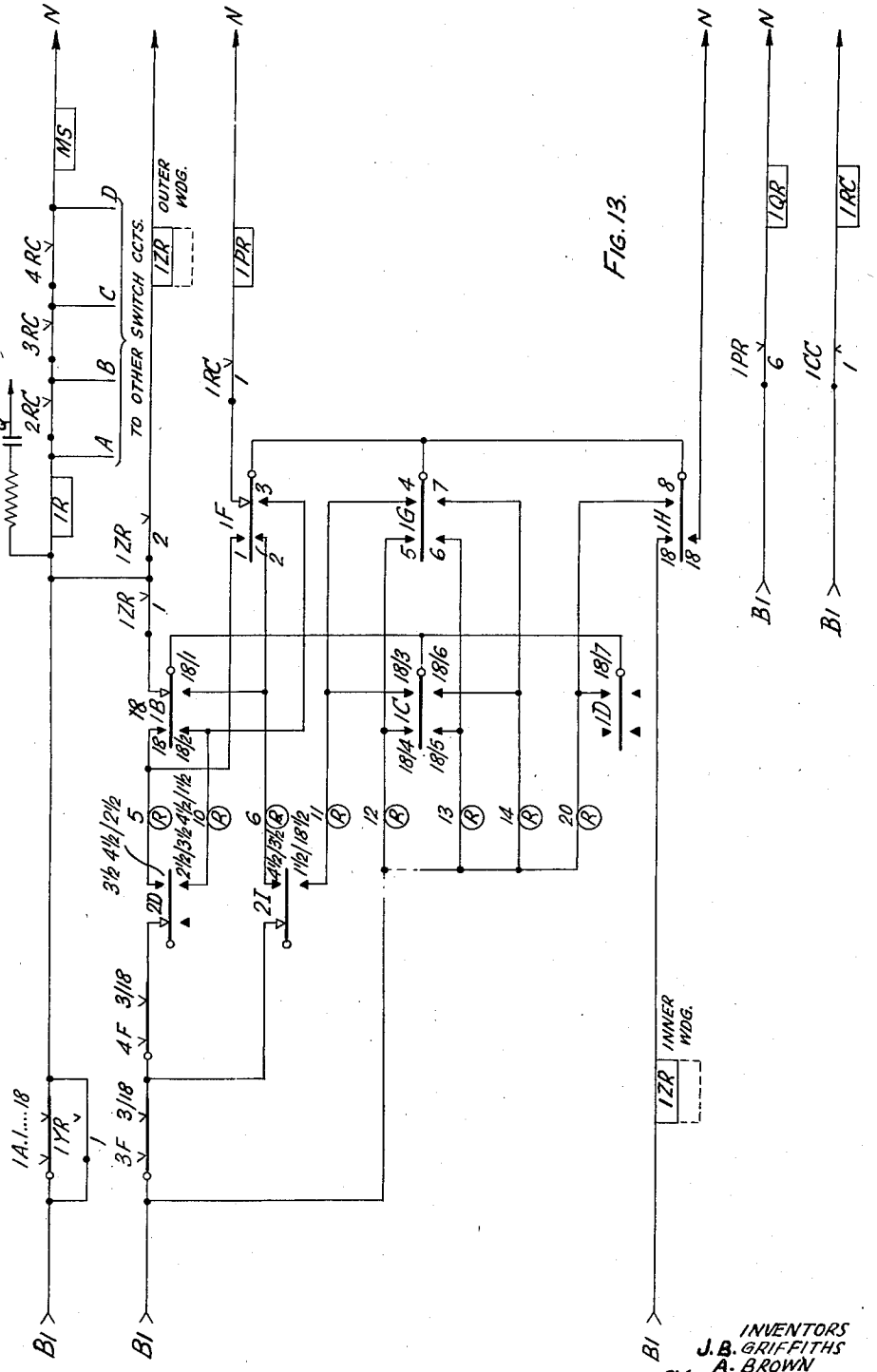


FIG. 13.

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Patented May 13, 1941 2,241,906

UNITED STATES PATENT OFFICE

2,241,906

RAILWAY SIGNAL AND/OR POINT CONTROL EQUIPMENT

John Balmain Griffiths and Andrew Brown, London, England, assignors to International Standard Electric Corporation, New York, N. Y.

Application May 21, 1938, Serial No. 209,198
In Great Britain May 31, 1937

10 Claims. (Cl. 246—134)

This invention relates to railway signal and points control equipment.

In railway signal and switch or points practice, it is necessary to provide stringent checks between the various signals and switch points in order to determine, when setting up a route and freeing it to oncoming traffic, that all signals and points switch which are inter-related with those directly concerned in setting up the route are in such positions that no other conflicting route is simultaneously set up and freed, and that no other possible source of interference or trouble exists.

For this purpose it is present practice to provide large numbers of massive relays each controlling a multiple contact spring pile-up. Complex checking circuits are formed via the relay contacts and each of these circuits may comprise contacts of many relays if the signal and point switch system to be controlled is in any way complex.

The present invention relates to control equipment of the kind in which a multi-position switch device is used to control the setting up of a group of inter-related routes, each switch being essentially unable to set up more than one route at a time, as it is physically unable to be in more than one position at the same time. It is, of course, impossible, in many instances, to select groups of routes, that is, of signals and switch points, entirely unrelated to other routes, and the setting up of routes in certain positions of one control switch may therefore be dependent on the setting of another control switch or switches. The switches used are preferably sequence switches of the type used in the Rotary System of Automatic Telephony. The well known sequence switch is of the general type illustrated in the patent to Reynolds 1,127,808, February 9, 1915, and may consist of a plurality of discs or cams rotatable with a driving spindle and cooperating brushes. The discs or cams may be of metal separated by insulation, the metal parts being cut away in part so that in certain positions the brushes associated with a particular disc do not close a circuit. The switch spindle is rotated to a number of positions corresponding to desired settings and in each position will complete selected ones of the circuits associated therewith. In the preferred arrangement each switch is provided with a magnetically controlled clutch for coupling the spindle to a motor for securing the desired drive. Wiper switches of telephone type may also be used but it is to be understood that the actual switches although operating in the same way as the telephone switches may be of more robust design in keeping with railway switching practice.

The invention will be clearly understood from the following description of two embodiments of the invention shown in the accompanying drawings, in which:

Figs. 1 and 1A arranged together show the layout of the tracks over which pass twenty routes to be controlled;

Fig. 2 shows the twenty different through and shunting routes which can be set up;

Fig. 3 shows the positions of five sequence switches S/S in which the different routes are set up and the interlocking necessary between the sequence switches;

Figs. 4 and 4A together show a table giving full information regarding the routes and their relation to the other routes, the track circuits, signals, and switch points;

Figs. 5 and 5A together show a table giving similar information regarding the points;

Figs. 6 and 7, of which Fig. 7 should be placed below Fig. 6, show the control circuits of sequence switch No. 1 and its associated relays;

Figs. 8 and 8A, with 8A placed below 8 show the switch points operating and locking circuits;

Figs. 9 and 9A together show the running signal operating circuits;

Figs. 10 and 10A together show the shunt signal operating circuits;

Fig. 11 shows the track stick relays and their circuits;

Figs. 12 and 12A together show the switch points control and detection circuits for points No. 50. Similar circuits are provided for points 51, 52, 53 and 54;

Fig. 13 shows a modified form of the circuit shown in Fig. 6 by means of which the circuit of Fig. 6 is simplified.

As far as possible the symbols for "written circuits" in accordance with British Standards Specification 376–2 have been used.

A brief explanation of the conventions used in the circuit diagrams will serve to simplify a following of the description. Because of the complexity of the circuit simple diagrams using straight lines are used where possible to facilitate a following of the system. The contacts controlled by the various relays are shown by open arrow heads, those above the line indicating front contacts and those below the line indicating back contacts, those contacting the line indicating that the contacts are normally closed and those spaced therefrom indicating the con-

tacts are normally open. The relay armatures are separated from the relays in order not to unduly complicate the following of the circuit and are generally designated by small letters corresponding to the upper case letter designating the corresponding relay.

The five sequence switches are designated by numbers 1, 2, 3, 4 and 5, the switch cams by a letter following the number as 2A, and the contacts at which the cam closes are designated by numerals following the letter associated with the brush indication where several brushes are shown.

Referring to Fig. 6, 1B is a cam B on sequence switch 1, the right hand top contact shown as an outline triangle touching the cam represents a wiper making continuous contact with the cam, while the left hand bottom contact represents a wiper making continuous contact with the cam from position 18 to position 2. If the left hand bottom contact represented a wiper making contact in positions 18, 1, 2, but not between positions, it would have been numbered 18.1.2.

The connections between cams 1B, 1C, 1D represent connections between the cams by brass separators whereby these cams are connected together.

The cam marked 3F 3/18 represents a cam F of sequence switch 3 via which a circuit is made in positions 3—18 of the switch.

The cam 1A 1—18 is the positioning cam which is cut so that the switch can stop in every position 1—18, but not between positions.

Figs. 1 and 1A show a length of railroad including four tracks via which seventeen different routes 1—16, 20 may be set up by means of switch points 50, —54. The routes are traced via the track sections TC, for each of these routes as shown in Fig. 2. Route numbers 17, 18, 19 are left spare for additions to shunting routes.

Fig. 3 shows in column 2 the sequence switch which controls the setting of the route given in column 1, and column 3 shows the position of the sequence switch allocated to the route in question. The "interlocking" columns R1 to R5 show the positions of the four sequence switches other than that controlling the route in question which are allocated to routes which conflict with the route in question and for which therefore interlocking between the sequence switches is necessary. Thus interlocking must be provided to prevent switch R3 taking up position 1 if R1 is in position 1, 2, 3 or 4, or R2 is in position 2, 3 or 4. Route 7 is given a sequence switch to itself although it might be entirely relay controlled. Route 7 can only be set up if 12 or 13 is first set up and conflicts with exactly the same routes as 12 and 13. Therefore route 1 can only be set up if switch 1 is in position 5 or 6 and the interlocking between switch 1 and switches 2, 3 and 4 obviates interlocking between switch 5 and switches 2, 3 and 4.

Figs. 4 and 4A give further information regarding the routes. In column 2 are given routes by which the route in column 1 is freed or released. Thus route 7 is freed by route 12 or 13 as stated above. Column 3 states that the setting up of the route in column 1 frees the route in column 3 for setting purposes.

Column 4 gives conflicting routes including those on the same sequence switch.

Columns 5 and 6 "T. C. controls" show the track circuit conditions which must obtain before the route in question can be set up.

It will be seen that route 3 has two alternative sets of track circuit conditions. The "main" set of conditions is for the regular signal, but signal 3 also has a "call-on" lamp CO for passing an engine, for instance, waiting in TC2, to a train standing in TC6. For lighting the "call-on" lamp the subsidiary conditions apply. This will be seen later with regard to 3HR and 3 CO.HR in Fig. 9.

Columns 7 and 8 "Detection" show the switch points positions which must obtain before the route can be set up, N being the normal through position and R the reverse or switching position.

Columns 9 and 10 "Backlocking" give respectively the routes, occupation of which prevent release of the route in question, and the routes, occupation of which allows the route to be released. The bracket in column 9 relating to route 2 means that occupation of TC3 is a factor only when switch points 51 are in normal position. "When operated" in column 9 with respect to routes 8 and 14 means that the route cannot be released while the sequence switch is off-normal, there being no track relays for sidings S1, S2.

Column 11 relates to control of signal aspect by the aspect of signals ahead. Thus for signal 1 to show green, signal 2 must show yellow or green.

Figs. 5 and 5A show the control arrangements for the points switch mechanisms.

Column 2 gives the track circuits occupation of which prevents operation of the switch points. With regard to points switch 50, the condition of track circuit 103 is a factor only when signal 20 is reversed, that is, is at yellow or green. With regard to switch points 53 track circuit 102 is always a factor, but if it remains occupied for more than a specified time period, automatic time release means removes the lock as it means that a train is standing still or moving very slowly in TC102 and the switch points can be safely changed.

Column 3 gives the manual route switch positions in which the switch points are reversed. The statement "N restored points" in regard to each set of switch points means that the switch points are arranged to restore automatically to normal when a route is restored. This is because only the middle two tracks are running routes.

Columns 4 and 5 show the positions of the manual route switches which lock the switch points in reverse and normal positions respectively, while column 6 shows the intercontrol between the different sets of switch points.

The routes are divided into groups, the routes in each of which interlock and each group is controlled from a corresponding number of positions on a motor-driven rotary switch, or sequence switch, the immediate advantage of this being that the interlocking between these routes is obtained automatically since it is a physical impossibility for the rotary switch to be in more than one position at a time.

It is not possible, however, to obtain all the necessary interlocking by this method since occasions frequently arise when, for example, two routes A and B which do not interlock with each other, both interlock with a third route C. It will be clear that the routes A and B cannot be carried on the same rotary switch since they may require to be set up simultaneously, while the route C may be controlled from the same switch as either A or B. If route C is allocated to the switch controlling A, then electrical interlocking between the two switches will be necessary to provide the interlocking between routes B and C.

It will be seen by comparison of the interlock-

ing columns of Fig. 3 with column 4 of Fig. 4, that all the routes which have been allocated to any one sequence switch are required to interlock with each other, and that in addition to this, certain routes which cannot be placed under control of the same sequence switch are electrically interlocked. This means that certain interlocking is required between the various switches in specified positions.

For example, route 5 which has been allocated to position 1 on sequence switch No. 1 is shown on the interlocking table to lock with routes 1, 3, 6, 8, 9, 10, 11, 12, 13, 14, 15, 16 and 20. Of these routes 6, 10, 11, 12, 13, 14 and 20 are automatically interlocked with 5 by virtue of their being on the same sequence switch and electrical interlocking is, therefore, only required with the remaining routes. As a result, sequence switch No. 1 in position 1 must be interlocked with switch No. 2 in positions 3 and 4 (for routes 15 and 16), switch 3 in positions 1 and 2 (for routes 1 and 3), and switch 4 in positions 1 and 2 (for routes 8 and 9).

The circuit by which this interlocking is actually obtained is shown in Figs. 6 and 7 for sequence switch No. 1. Each sequence switch clutch armature controls contacts CC in such a way that a relay such as 1RC is energised while the clutch is in normal position, and that a relay such as 1RF is energised while the clutch is energised and the switch is moving.

Let us consider the effect of the signalman operating the panel control key for route 5. Assuming that the No. 1 switch is in the home position 18, the circuit will be completed for the clutch magnet of this switch as follows:

From battery feed B1, over contacts of cam F of switch No. 3 provided that this switch is not in positions 1 or 2, cam F on switch No. 4 provided that this switch is not in positions 1 or 2, cam D of switch 2 provided that this switch is not in positions 3 or 4, contacts of the manual route switch for route 5 reversed, cam B of switch No. 1 in position 18, front relay contacts 1 of relays 1ZR, 2RC, 3RC, and 4RC, clutch magnet coil 1R, winding of motor start relay MS, to negative.

The operation of the motor start relay MS starts up the main driving shaft and the operation of the No. 1 clutch magnet will cause the No. 1 sequence switch to be rotated until the circuit above described is broken by the cam 1B moving out of position 18. The No. 1 switch will then drive on to position 1 under control of the cam 1A over the obvious circuit shown in the upper line of Fig. 6. It will be seen, therefore, that in response to the operation of route switch No. 5, sequence switch No. 1 moves into position 1 provided that the position already occupied by switches 2, 3 and 4 makes route 5 obtainable in accordance with the original interlocking chart.

The contacts 1 of relays 2RC, 3RC and 4RC, are included in the circuit above described in order that the No. 1 switch will not find a driving circuit in the event of one of the switches 2, 3 and 4 actually being in motion. This provision is necessary to cover the possibility of a moving switch, which is not in a conflicting position at the instant of test, subsequently stopping in a conflicting position. The contacts 1 of 1ZR are included to prevent a switch already stationary in one route position being moved on to another route position by the operation of a second panel key. It will be seen that relay 1ZR is operated on one winding via cam H of switch 1 when the switch is at home and thereafter locks over contacts 1ZR/2 to the main driving circuit for the clutch magnet, so that when the switch moves out of position 18, the relay 1ZR will remain operated until that switch comes to rest in the chosen route position, whereupon relay 1ZR will be released and cannot subsequently operate until the switch returns to its home position. Any further operation of route switches will be ineffective in driving this sequence switch since opening the contacts 1ZR/1 breaks the common feed from all such circuits.

The only circuit by means of which the clutch magnet can be energised to restore the switch to its home position is over contacts 1YR/1, the relay 1YR (Fig. 7) being operated in conjunction with the back locking requirements as described later.

Having operated the sequence switch to the desired route position, it is necessary to prove that this is actually a correct and safe route before operating any switch points or signals. To obtain this proof relay 1PR is included. Contacts of this relay are used in conjunction with the sequence switch cams for the actual setting up of the desired route.

When the sequence switch No. 1 is in position 1 it will be seen that the relay PR can only be operated if the switches 2, 3 and 4, remain in positions which do not conflict with route No. 5 and if the panel control key No. 5 remains in the reverse position. In other words, the relay PR operates if, and only if, the present position of the corresponding sequence switch agrees with the setting of the control panel and, furthermore, is safe in relation to the other sequence switches. The circuit for 1PR is via front contacts 1RC/1, contacts of cam F of sequence switch 1 in position 1, reversed contacts of manual route switch 5, cam D of switch 2, cam F of switch 4, cam F of switch 3, to B1. Relay 1PR operates its repeater relay 1QR by closing contacts 1PR.

Having positioned the sequence switch 1 and operated the proving relay 1PR it is possible for one of the other sequence switches to drive to a non-conflicting position, but, before reaching that non-conflicting position, it may pass momentarily through a conflicting position. It is undesirable that this momentary condition, which in any case cannot set up the conflicting route, should be permitted to interrupt the circuit of the PR relay which might have the effect of unnecessarily flashing the danger signal in the face of approaching traffic and, therefore, in cases where a sequence switch carries conflicting as well as non-conflicting routes, the interlocking contacts are by-passed by contacts of the corresponding relay RF which are closed while the switch is actually in motion. As previously explained relay 1RF is operated all the time the sequence switch clutch is in the energised or driving position just as relay 1RC is operated while the clutch is in its normal position. For instance, in the circuit which we have just described, switch No. 2 conflicts with route 5 in positions 3 and 4 but not in positions 1 and 2, so that cams 2D and 2I are shunted out by contacts of the relay 2RF while switch No. 2 is in motion.

It will be appreciated that if the switch 2 is moving and cam D thereof is shunted by 2RF/1, contacts 2RC/1 will be open and therefore the circuit of 1R is never closed while cam D is shunted.

Having positioned the sequence switch in accordance with the desired route and, further-

more, having checked the accuracy of this positioning, it is now necessary to operate the relevant switch points to set the track for the desired route.

The switch point lock circuits are shown in Fig. 8. Each set of switch points is provided with a normal lock relay NLR and a reverse lock relay RLR which, in turn, control the actual switch point motors, such as 50PM, Fig. 12.

Fig. 8 shows the contacts of an individual switch point control key, e. g. 50 N. C. R. associated with each set of switch points in addition to the circuit for controlling the points in accordance with route setting. These switch point control keys have three positions N, C, R. When a switch point control key is set to normal N the normal switch point lock relay NLR will immediately be operated unless a route has previously been set up which requires those switch points to be reversed or, alternatively, unless certain track sections are occupied which prohibit the movement of the switch points. Similarly, when the switch point control key is set to reverse R the reverse lock relay RLR will be operated unless the reverse position of the switch points is inadmissible. When the point control key is set to its central position C then either the normal lock relay NLR or the reverse lock relay RLR may be operated in accordance with the setting of various sequence switches.

These switch point control switches would generally be left in the central position so that all possible train movements are at the disposal of the route control switches and the individual switch point switches would only be used in cases of emergency.

Let us consider the setting up of route No. 5 the relevant switch point switches being in the central position and sequence switch No. 1 having been driven to position 1 as described above.

Referring back to Figs. 1 and 2, route 5 involves a movement from TC. 105 across switch points 50 and 51 to TC. 6 and so necessitates the reversing of switch points 50 and 51.

The only routes requiring reversal of switch points 50 are 5, 6, 10 and 11 to which positions 1—4 of sequence switch 1, are allocated. The normal lock relay 50 NLR energizes via 50N or 50C, back contacts 50RLR/3 if relay RLR is de-energised, cam 0 of switch 1 in positions 5/13 only or back contact 3 of relay 1PR, and normally closed front contacts 103TR/2, 104TR/6, 3TR/2 of the corresponding track relays.

When route 5 is set up on sequence switch 1 and 1PR is energised, 50NLR is released, assuming that switch points 50 are in normal position and relays NLR Fig. 10 and NKR, Fig. 12 are operated, by the opening of the contacts of cam 10 and of contacts 1PR/3 Fig. 8.

Relay 50RLR operates via 50C operated contacts 1PR/1, contacts 1/4 and 9/7 of cam 1P, back contacts 50NLR/3, cam contacts 5F, and 3K both in normal position 13, front contacts 53NLR/1 proving that points 53 are in normal position, and front contacts 103TR/2, 104TR/6, 3TR/2 proving that track circuits 103, 104, 3 are unoccupied. Switch points motor 50PM, Fig. 12 is now operated to reverse the switch points; B17, front contacts 50RLR/2, back contacts 50RKR/4, 50PM, back contacts 50RKR/7, and front contacts 50RLR/5, N. Relay 50NKR, Fig. 12 is released, when the switch points leave normal, and relay 50RKR is operated when the reverse position is reached. Relay RLR is maintained operated via its holding circuit via front contacts 50RLR/1, and back contacts 50RKR/3 until the switch points are fully reversed, when 50RKR opens the holding circuit of 50RLR and stops the motor.

Similarly, when switch No. 1 moves into position 1, relay 51NLR is de-energised and 51RLR operated over contacts 3TR/3, 5TR/2, cam L on switch 3 in position 13, front contacts 52NLR/1, back contacts 51NLR/3, cam R on switch 1 in position 1, front contacts 1PR/2, contacts of the switch point switch 51 in the central position, winding of 51RLR, to negative.

It will be seen that the various track relay and switch point lock relay contacts included in the circuits for 50RLR and 51RLR correspond to the switch point locking chart shown in Fig. 5.

All the switch points shown in this particular lay-out happen to be normally restored switch points, i. e., points which return to normal unless they are definitely reversed either by the setting up of a route which requires the switch points to be reversed or by the operation of the individual point control key. Thus, in the case of switch points 50, as soon as sequence switch No. 1 is restored to normal or is moved out of positions 1 to 4 (all of which require switch points 50 reversed) relay 50RLR will be released and 50NLR immediately reoperated provided that the individual switch point control switch for switch points 50 is either in the central or the normal position and, also, that none of the tracks 3, 104, and 103 is occupied.

If any of these tracks are occupied, then a movement of the switch points 50 in either direction is prohibited.

A holding circuit for the various switch point lock relays is provided so that when a movement of switch points is once commenced it must be completed before any opposite movement of the same points can take place. Thus, in the case of relay 50RLR, when this relay is operated it locks as described above over contacts 50RLR/1 and 50RKR/3 so that even if the operating circuit is broken during the travel time of the switch points, the reverse lock relay will remain energised until the reverse movement of switch points has been completed and detected whereupon the reverse switch point detector relay RKR will break the holding circuit just described and permit the switch points to be returned to normal if desired. This holding circuit is necessary to obviate the possibility of switch points being left in an intermediate position.

A similar circuit is, of course, provided for the normal lock relay so that, once a movement from reverse to normal is commenced, it must be completed.

Having described the method by which points 50 and 51 are reversed in order to set up route No. 5 let us now consider the operation of the relevant shunt signal 5/6/7, shown in Fig. 10.

When sequence switch No. 1 is in position 1, the relay 5/6/7HR will be operated from the battery feed over back contacts 50RKR/1, front contacts 50NLR/4, front 1QR/1 (a repeat of 1PR), back contacts 51RKR/2, front contact 52NKR/2, back contact 52RLR/6, front contacts 51NLR/7, cam T of switch 1 in position 1, winding of 5/6/7HR to negative.

The operation of relay 5/6/7HR will illuminate the oblique pair of lamps on the position light signal shown in the right-hand bottom corner of Fig. 10. This signal thus displays proceed aspect to the driver of a train standing on TC.105

who may then proceed over switch points 50 and 51 to TC.6.

In a similar way it can be shown that the circuits involved in the setting up of any other route conform exactly with the original interlocking table.

In the case of running signals the circuits for the HR relays controlling the signal aspect are shown on Fig. 9. It will be seen that these correspond to the circuit described for 5/6/7HR above with the additional fact that certain track relay and track holding relay contacts are included in the circuit.

For example, in order to clear the running signal No. 1 it is necessary to drive sequence switch No. 3 to position 1 and to prove that points 50 and 51 are both normal.

On reference to the interlocking table we find that it is also necessary to prove that track circuits 3, 4, and 7 are clear. Therefore, the operating circuit for the relay 1HR shown in Fig. 9 is as follows: From battery feed, front contacts 3PR/2, front contacts 3SR/2, back contacts 50RLR/4, front contacts 50NKR/1, cam 0 of sequence switch 3 in position 1, front contacts 51NKR/1, back contacts 51RLR/4, front contacts 4TR/5, and front contacts 7SR/2. The relay 1HR when operated removes the feed from the red aspect lamp 1RE and illuminates either the green lamp 1DE or the yellow lamp 1HE in accordance with the condition of the running signal No. 2 ahead, as shown by the position of the contacts 2HR/2.

It will be noted that contacts of the relays 3SR and 7SR were included in the circuit for the relay 1HR in place of the corresponding track relay contacts.

These SR, or holding relays, are shown in Fig. 11 and their function is to register the occupation of a particular track circuit in order that a release condition which depends on the track circuit having been occupied will still be available even if the track circuit in question is no longer occupied at the time when the release condition is utilised.

For example, the relay 3SR is normally held operated over its own front contact 3SR/1 and the contact 3TR/5 of the No. 3 track relay. On the occupation of No. 3 track, this circuit will be broken down; thereafter, the relay 3SR can only be re-operated when No. 3 track is again clear and, in addition, sequence switch No. 3 is in its home position and sequence switch No. 1 is in some position other than 1, 2, 3 or 4.

Before track 3 was originally occupied one of the routes 1, 3, 5, 6, 10 or 11 must have been cleared and the positions of the sequence switches 1 and 3 included in the circuit for 3SR prove that these signals giving access to track 3 have been restored to danger.

It will be seen from the interlocking table that the routes 1, 3, 5, 6, 10 and 11 all have their back locking released by track circuit 3 occupied. This means in effect that, even if the relevant approach tracks are still occupied, the signal may be restored to danger provided that track No. 3 has been occupied. It is clear that the signalman may not restore the route while track 3 is still occupied; therefore, the holding relay 3SR is included, so that he can restore the route any time after track 3 becomes unoccupied. As soon as the route in question has been restored, the holding relay 3SR will be re-operated and the back locking will once more be effective.

Similar holding relay circuits are provided for the other tracks 5, 7, 103 and 104, which are required to release back locking of any routes.

Fig. 11 also shows the circuit for the time release relay 53JR which is required for the control of switch points 53 in conjunction with track circuit 102. The purpose of this control is to prevent movement of switch points 53 when a through train is passing rapidly over track 102 towards switch points 53 but to permit a movement of these points in the event of a train having been stationary on track 102 for a specified time—say one minute.

As soon as track 102 is occupied the thermo-element JRA is energised and, after it has been heated for the specified time, contacts JRA/1 will close and operate relay 53JR, which locks over front contacts 53JR/3 as long as track 102 remains occupied and disconnects the thermo-element JRA at back contacts 53/JR/3.

Referring once more to the switch point lock circuits, Fig. 8, it will be seen that the control circuit for relays 53NLR and 53RLR are both interrupted by the release of 102TR but may be re-made after, say, one minute over contacts 53JR/1.

Consider now the effect of restoring manual route switch No. 5 to normal.

As soon as the route switch moves out of the reverse position the proving circuit of relay 1PR, Fig. 6, will be interrupted at 5.R. Relays 1PR, 1QR will release and No. 5 signal control relay 5/6/7HR, Fig. 10, will also be released.

The circuit is then provided for relay 1YR over cam I of the No. 1 sequence switch in position 1, No. 5 manual route switch normal, back contacts 4 of relay 5/6/7HR normal, front contacts 1 of the track relays 104TR and 105/106TR showing "track clear," and the front contacts 1RC/2 indicating that the sequence switch is actually at rest in position 1. The track relays 105/106 and 104 are included in the back locking circuit as prescribed by the interlocking table and, furthermore, in the event of track circuit No. 3 having been occupied the relay 3SR will be released and its back contacts 3 will provide a circuit for 1YR independently of the occupation of tracks 105/106 and 104. When the relay 1YR is operated it locks over cam 1K and front contacts 1YR/2 until the switch leaves position 17. Contacts 1YR/1 provide a circuit for the clutch magnet and motor start relay until the switch leaves position 17 when it will be driven into position 18 under control of its A cam. Similar circuits will be provided for the control of all the other sequence switches in accordance with the interlocking and back locking specified.

Instead of sequence switches, wiper switches can be used, the route control circuits for the different routes being formed via wipers of the switch and the bank contacts in the different positions of the switch allocated to the routes.

The purpose of the modification of Fig. 6 shown in Fig. 13 is to reduce as far as possible the number of relays and/or relay contacts which are required to be associated with each sequence switch. This reduction in relays is effected by reduction in the number of RC contacts and by elimination of RF relays.

In Fig. 6 the current for energising the sequence switch clutch magnet is taken from the contacts 2 RC.1, 3 RC.1 and 4 RC.1 before being fed to the clutch magnet. These contacts are included to prove that switches 2, 3 and 4 are stationary, before permitting switch 1 to move,

and so long as the contacts are placed in this position a separate set of contacts covering all switches which carry conflicting routes must be included in the control circuit of each clutch magnet.

In Fig. 13 the RC contacts are shown on the common side of the clutch magnet and by this means the same contacts may be used in the control circuits of other clutch magnets, for example, if switch No. 2 carries routes which conflict with some of the routes carried by switches 3 and 4, then the control circuit for the No. 2 clutch could be connected through the point marked "B," so that contacts 3 RC and 4 RC would serve both clutches 1 and 2.

It is estimated that on a large interlocking system, application of this principle would reduce the number of RC contacts required to about one quarter of the number required in the arrangement shown in Fig. 6.

Fig. 6 shows contacts of the relay 2 RF bridging the interlocking cams of sequence switch No. 2 in the control circuit. These contacts were included to prevent momentary interruption of the proving relay circuit, while switch No. 2, in driving to a position which did not conflict with that occupied by No. 1, might pass through a position which did conflict with that occupied by No. 1.

In the system now described, the circuit interruption occasioned by a switch driving through a conflicting position, is reduced to a minimum, and the relay PR is made sufficiently slow to release so that it will not release while the switch is driving through a conflicting position but will, of course, release in the event of a switch stopping in a conflicting position, even if such stoppage is due to a fault condition.

In order to hold relay PR operated while a switch is passing through two or more successive conflicting positions, it is desirable to complete the circuit through the switch cams while the switch is passing through the intervening position between route positions, thus the cam 2D associated with route 5 which was originally "5/2," would now be "3½, 4½/2½," so that circuit interruption extending from positions 2¼/4¾ would be replaced by two interruptions from 2¾/3¼ and 3¾/4¼ respectively.

This modification does not impose any serious timing difficulty on relay PR and in addition to the elimination of several RF relays, provides the advantage that the vital interlocking cam contacts are not bridged by any relay contacts, wiring etc., the short circuiting of which might be dangerous.

Many cases arise in practice of a set of siding switch points and signals, for instance, which are changed at infrequent intervals but for which a signal box is provided, the majority of the work at the signal box being to act as a tandem repeater for messages between busy signal boxes on either side.

Considerable economies could be achieved in systems mainly provided with local control, if control of infrequently operated switch points and signals were placed in the hands of adjacent main signal boxes.

It is now proposed to use control signals for instance, of the known constant total code type wherein each code signal comprises the same number of impulses which together total a constant sum, each characteristic of a complete set of conditions to be set up at a remotely-controlled set of signals and switch points, to set control switches of the kind described above. The proper reception of a constant total code signal—correct number of digits and correct total number of impulses—checks that no error has occurred in transmission.

The new set of conditions would be set up in response to a correctly received code and a simple signal would be sent back to inform the signalman that the code sent had been correctly received.

Alternatively an answering constant-total code signal would be returned to the control cabin on correct receipt of a setting signal, said answering signal being individual to the particular setting signal received. In this case, the setting up of the route at the controlled position would not take place until the signalman, on receipt of the check code signal, sent an operating signal.

This system may be used in conjunction with a centralised traffic indicator system such as that described in British Patent Specification No. 461,136 which is arranged to test the position of all equipment on a length of track at frequent intervals and to change the setting of an indicator at the control cabin accordingly. The change in the setting of the signals and points in response to a constant-total code setting signal would be indicated in a short time on the indicator board.

This system of remote control and indication, besides being applicable to the circumstances detailed above, is also capable of use for the remote control of a number of spaced sets of switch points and signals in tandem, for instance, by using a preliminary constant-total code signal characteristic of the set to be controlled.

What is claimed is:

1. In a railway signal and switch points control system wherein the track system involves tracks which may be set to selectively control a number of conflicting routes, an arrangement for assuring conflicting routes are not simultaneously set up comprising, a plurality of rotary control switches each control switch comprising a number of switch elements fixed on a common shaft, contacts operatively associated with each switch element in different angular positions thereof to effect closure of route setting circuits to provide interlocking between said route setting circuits associated with each switch to avoid setting up of conflicting routes, means interconnecting contacts of certain of said rotary elements on one of said rotary control switches with contacts on another of said rotary switches for providing a further interlock between said rotary switches to avoid setting up of other conflicting routes, a plurality of manually adjustable route switches, means responsive to operation of said route switches to selected route position to initiate operation of said control switches into the position indicated by said adjustment, means responsive to the condition that said selected route is not free of conflicts with other selected routes for preventing operation of said control switch and means operated with said system to prevent completion of a route setting circuit in response to the stopping of a control switch in route setting position if the setting of said control switch disagrees with the setting of the manual route switch in response to which operation of said control switch was initiated.

2. In a railway signal and switch points control system, according to claim 1, an arrangement further comprising guard devices for pre-

venting movement of a control switch directly from one route setting position to another.

3. In a railway signal and switch points control system, according to claim 1, an arrangement further comprising start circuits for initiating operation of said control switches, said circuits comprising contacts of at least one other control switch, and means for opening said last named contacts in response to the condition that said one other control switch is in motion.

4. In a railway signal and switch points control system according to claim 1, an arrangement further comprising positive guard devices to prevent the initiation of the setting up of a route due to one of said control switches passing through the corresponding route-setting position for said route during its movement towards a different route-setting position.

5. In a railway signal and switch points control system according to claim 1, wherein said last named means comprises a check relay and a circuit for operating said relay, said circuit including contacts closed only if the position of the control switch agrees with the setting of the manual route switch, further comprising contacts closed only if another control switch is not standing in conflicting route positions, and means for shunting said contacts controlled by said other control switch while said first named control switch is rotating.

6. In a railway signal and switch points control system according to claim 1, wherein said last named means comprises a check relay and a circuit for operating said relay, said control switches being of sequence switch type in which successive positions of a first control switch both correspond to routes conflicting with a single route controlled by a second control switch, and in which the check cam of the first control switch which controls contacts in the check circuit for said conflicting route position of the second control switch is cut so that the check circuit is closed while the first control switch is passing between said successive positions.

7. In a railway signal and switch points control system according to claim 1, wherein said last named means comprises a check relay and a circuit for operating said relay, said circuit including contacts closed only if the position of the control switch agrees with the setting of the manual control panel, and contacts closed only if another control switch is not standing in conflicting route positions, in which the same contacts of another control switch or switches form part of both a control switch start circuit and of the check circuit which determines that the control switch setting corresponds to the manual switch setting which initiated its movement.

8. In a railway signal and switch points control system according to claim 1, an arrangement further comprising contacts of other control switches in the start circuit of said control switch, said contacts being open when said other control switches are in motion, at least one of said contacts of said other control relays being common to the start circuits of others of said control switches, a relay associated with a control switch arranged to be operated when the switch is in normal position and remaining operated during rotation of the switch, said relay being deenergized when the switch comes to rest in an off-normal position and remaining deenergized while the switch remains in off-normal position and while it is rotating back to normal position.

9. In a railway signal and switch points control system according to claim 1, an arrangement further comprising means for preventing simultaneous movement of such of said control switches as control conflicting routes.

10. In a railway signal and switch points control system according to claim 1, an arrangement further comprising a plurality of separate start circuits for said control switches, each start circuit comprising a plurality of contacts certain of which are closed by said manually adjustable switch, others of said contacts being controlled by another of said control switches carrying contacts of a conflicting route circuit which other contacts are open when said last named switch is in conflicting route position, and still others of said plurality of contacts which are open only when said last named control switch is in home position.

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