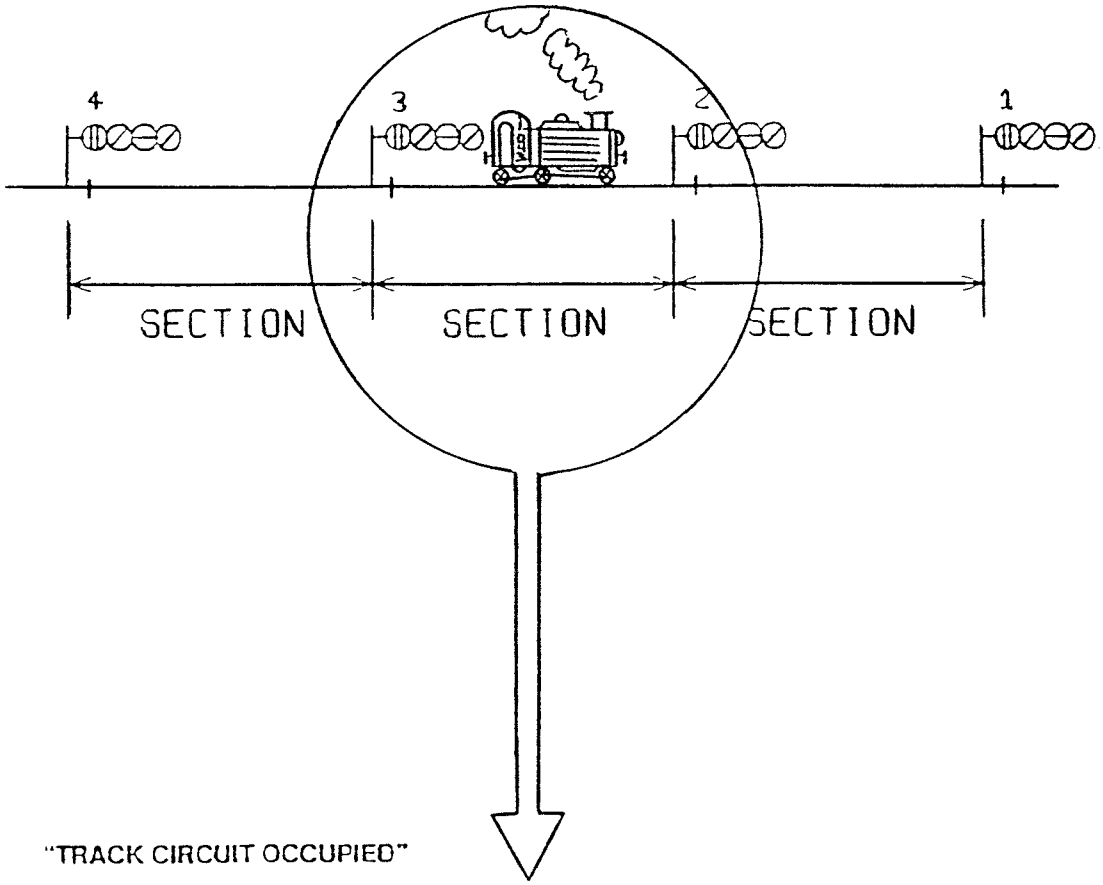
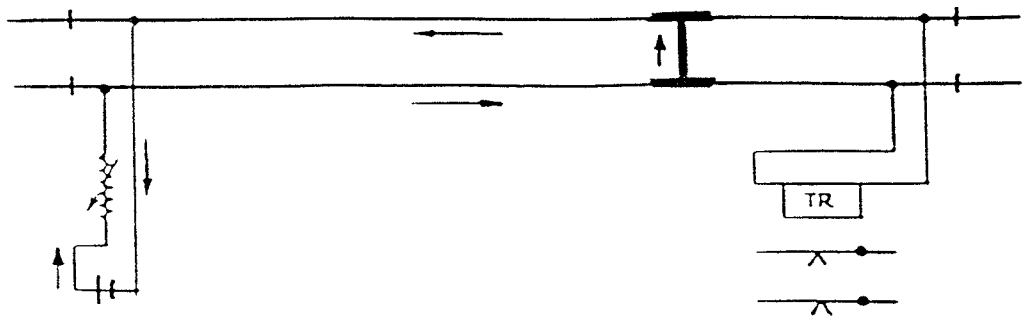
DIRECTOR OF S & T ENGINEERING.
WEST MIDLANDS PROJECTS GROUP.

TRACK CIRCUIT BLOCK



"TRACK CIRCUIT OCCUPIED"



INTRODUCTION

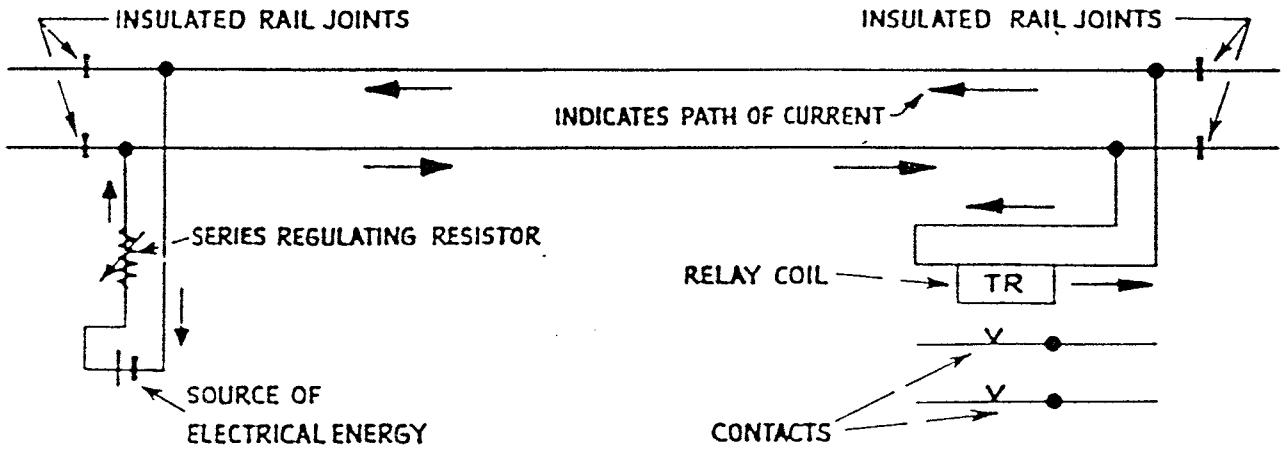
As its name implies **"TRACK CIRCUIT BLOCK"** operates using track circuits.

An understanding of track circuits is required before discussing the method of operation of track circuit block.

For the purposes of this subject we will take a very simplified look at the operation of a track circuit. A track circuit is a simple electrical circuit which incorporates the rails, a power source (battery), and a device called a relay, which monitors the circuit. In Figure 1 we have shown two examples to show how it works. Under normal circumstances, when there is no train, the circuit is complete and so the relay is referred to as **"energised"**.

FAILSAFE

FIGURE 1A.



"TRACK CIRCUIT CLEAR"

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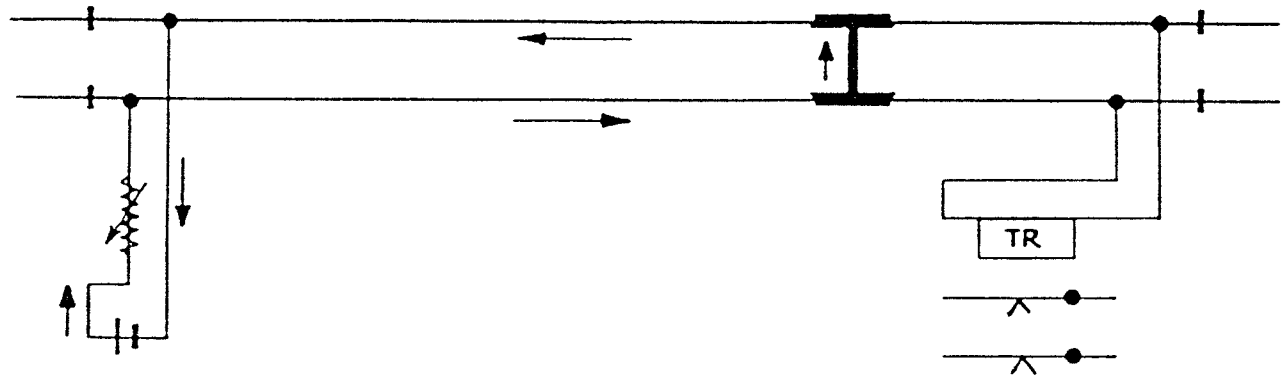
When a train "stands" on the rails it causes a short circuit across the rails and this "**de-energises**" the relay.

FIGURE 1B.

"TRACK CIRCUIT OCCUPIED"



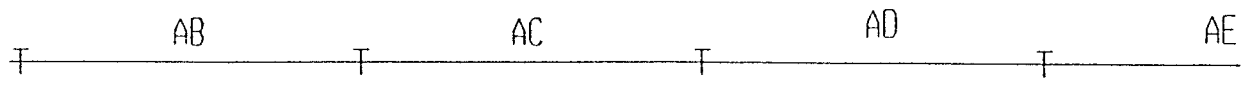
Basically when there is no train on the track circuit it is referred to as "**CLEAR**" and when the train is standing on the track it is referred to as "**OCCUPIED**".

So we use the track circuits to ensure there is no train on a particular piece of railway line before we allow another train onto that same piece of line.

Figure 2 shows a piece of railway line between two points "X" and "Y" which has been split up into sections of individual track circuits "AB", "AC", "AD" and "AE".

FIGURE 2.

"X" "Y"



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DEFINITIONS

A document held in the project office and called:-

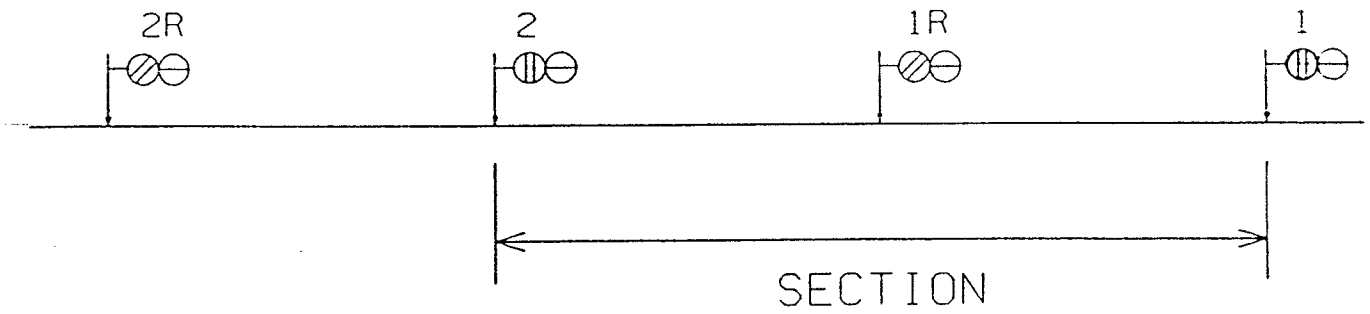
"REGULATIONS FOR TRAIN SIGNALLING BY THE TRACK CIRCUIT BLOCK SYSTEM"

gives us definitions which we need to know when talking about "Track Circuit Block".

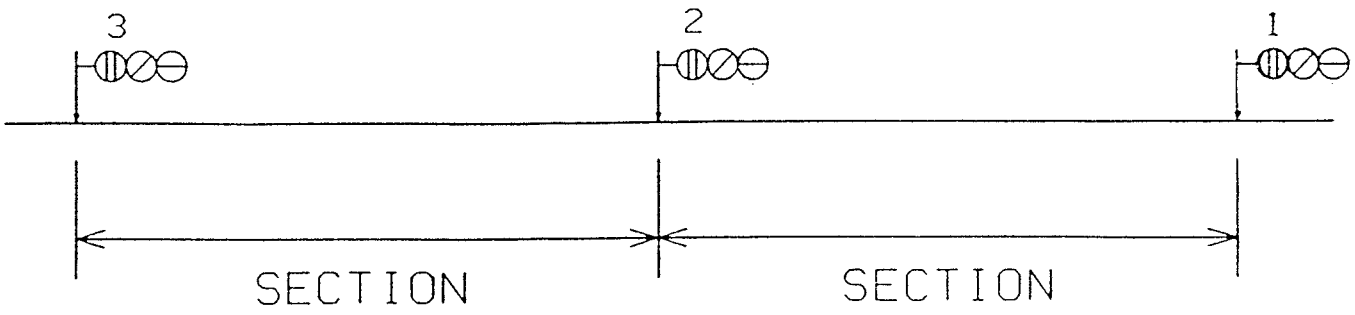
1. The term **"SECTION"** refers to the line between two stop signals irrespective of whether these are within the area of control of one, or two, signalboxes.

FIGURE 3.

2 ASPECT SIGNALLING



3 ASPECT SIGNALLING



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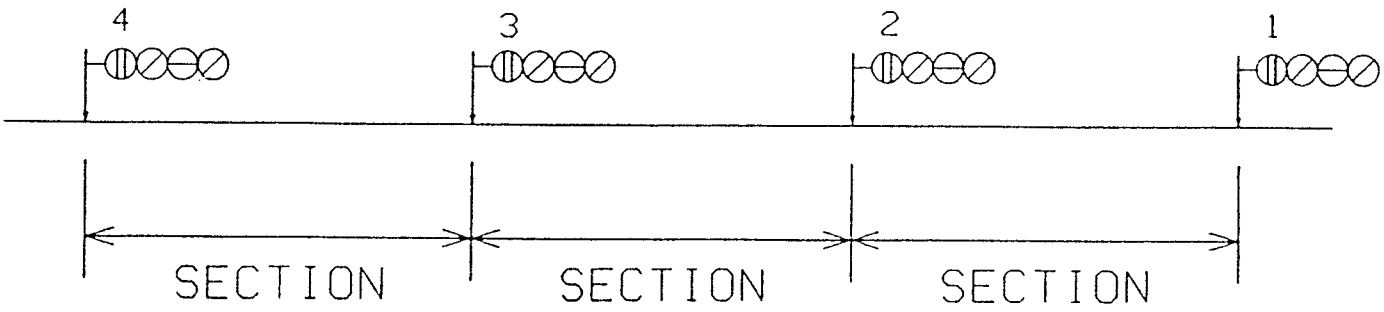
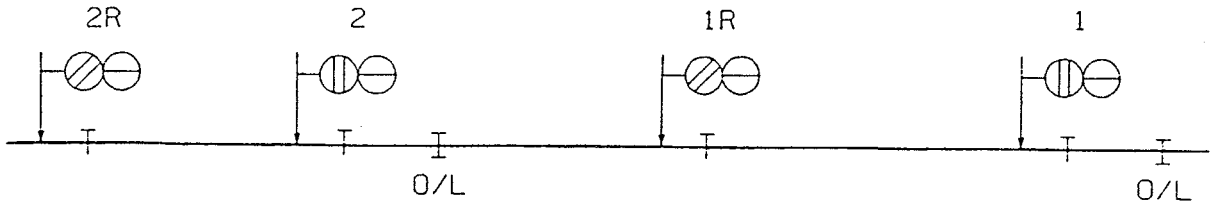
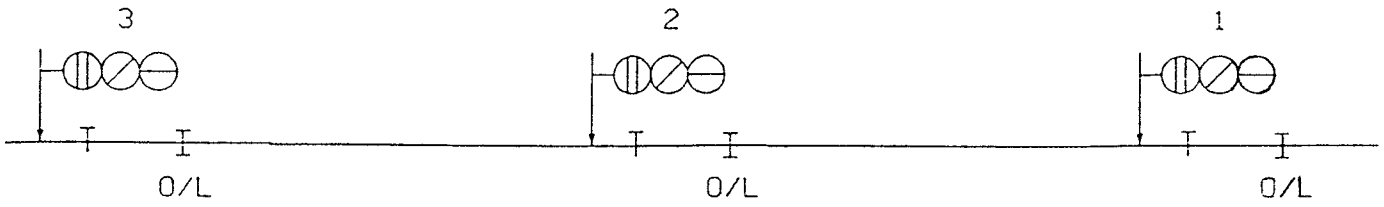
4 ASPECT SIGNALLING



2. The term **"OVERLAP"** is the distance ahead of a stop signal up to which the line must be clear before the signal next in rear can clear.





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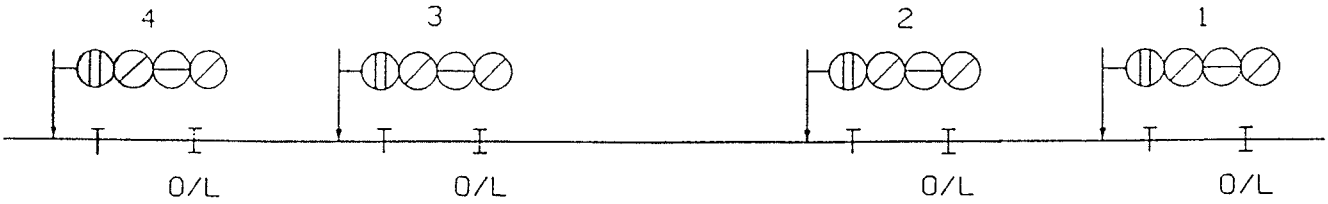


The overlap is a nominal distance which may be regarded as a protection for the driver against overunning in foggy weather or when the rails are slippery, assuming of course that a brake application had been made at or before the train passed the first warning signal.

In colourlight signalling territory the overlap length is 200 yards for "running signals" on passenger lines but may be reduced as necessary on account of line speed.

Standard Signalling Principle 20 states:-

"1. Separate overlap track circuits to be provided except at automatic signals where the berth and overlap track circuits may be combined."

The "Regulations for Train Signalling By the Track Circuit Block System" goes on to say

"2.1.1 Track Circuit Block signalling permits a signal to exhibit a proceed aspect when all track circuits in the line ahead are clear up to and including the overlap beyond the next stop signal and all necessary points within that distance are set in the proper position for the safe passage of the train.

2.1.2 Where a restricted approach arrangement is permitted a signal may exhibit a proceed aspect when the line is clear to the next signal ahead or to a specified point within the overlap of that signal.

2.2 Signals may be either:-

(1) Controlled-operated directly by the signalman or

(2) Automatic-operated by the passage of trains over the track circuits.

Certain controlled signals can be set to work automatically."

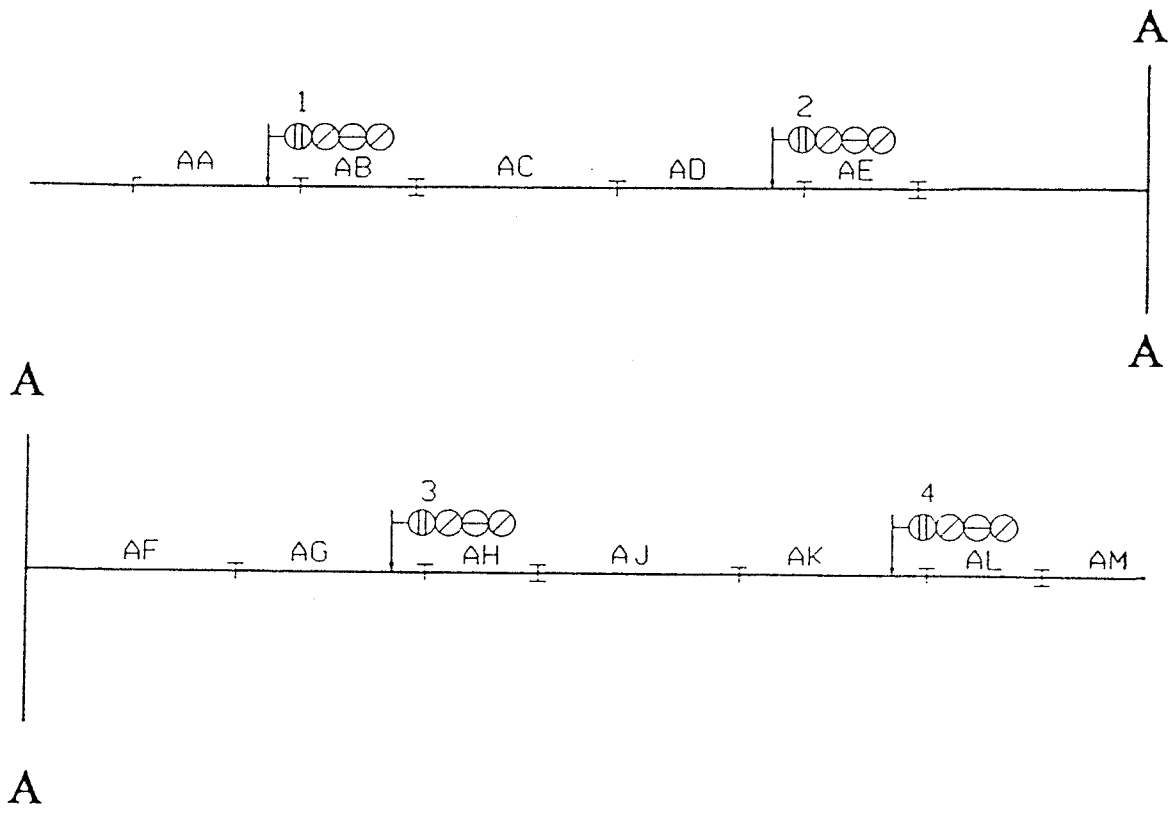
continued

Let us now apply section 2.1.1 of the "Regulations for Train Signalling By The Track Circuit Block System". After having decided what type of signalling is best suited to a layout, ie. 2 aspect, 3 aspect or 4 aspect and having given due consideration to "Braking Distances", "Headways" etc.

In Figure 4 we have a layout with four 4 aspect signals. These signals are **"CONTROLLED"** signals and so each signal must have its own separate overlap.

We have to then ensure we have track circuits between each Stop signal. Figure 4 satisfies these requirements.

FIGURE 4.



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Referring to Figure 4 attached are details of what track circuits are required to be proved clear before we allow:-

SIGNAL 1 TO DISPLAY A PROCEED ASPECT (Y/YY/G)
THIS REQUIRES "AB", "AC", "AD" AND "AE" CLEAR.

SIGNAL 2 TO DISPLAY A PROCEED ASPECT (Y/YY/G)
THIS REQUIRES "AE", "AF", "AG" AND "AH" CLEAR.

SIGNAL 3 TO DISPLAY A PROCEED ASPECT (Y/YY/G)
THIS REQUIRES "AH", "AJ", "AK" AND "AL" CLEAR.

SIGNAL 4 TO DISPLAY A PROCEED ASPECT (Y/YY/G)
THIS REQUIRES "AL" AND "AM" CLEAR.

There is one other thing we have to prove before we allow any of the signals mentioned previously to display a proceed aspect. Standard Signalling Principle 5 states:-

"If a lamp fails which should be illuminated (except the second yellow of a double yellow aspect) all main running signals authorising movements up to the failed aspect shall be maintained at RED".

What this means is that before we permit Signal 2 to display a proceed aspect we must prove that there is a lamp alight in Signal 3. The relay used to achieve this is generally called the "ECR".

continued

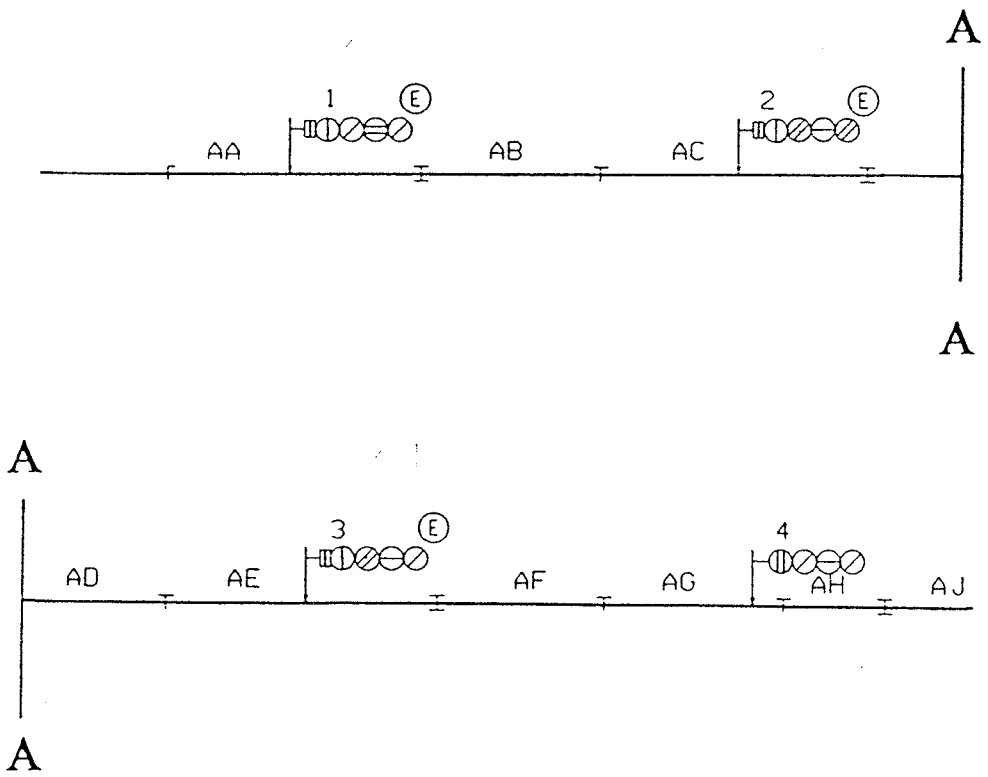
ASPECT SEQUENCE CHARTS

Aspect sequence charts are prepared for multiple aspect signalling schemes to show the circumstances under which each signal will display each of its possible aspects.

Because the chart gives a complete picture of the aspects displayed, it is invaluable in the testing of aspect sequences during commissioning of the scheme.

For each signal a full set of aspects is written down. To establish the conditions for a particular aspect to be displayed the line towards the signal in advance should be followed to its conclusion and it will include any aspects of signals in advance and the overlap required.

FIGURE 5.



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For example in Figure 5 we have:-

One "CONTROLLED" Signal No. 4 and Three

"AUTOMATIC" Signals, No's 1, 2 and 3.

As we know a controlled signal generally displays a red aspect under normal conditions because the lever is usually normal in the frame or the route is not set.

Automatic signals are different and as we have said previously the aspect displayed is dependent upon the passage of a train and also the aspect of the signal ahead.

Now look at Figure 5, there are no trains on the layout.

Because Signal 4 is at **"RED"**

Signal 3 will display a **"SINGLE YELLOW"** aspect

Signal 2 will display a **"DOUBLE YELLOW"** aspect and

Signal 1 will display a **"GREEN"** aspect.

Why do they display these aspects?

Remember what the aspects mean to the driver as specified in section C.3 of the Rule Book:-

"A RED LIGHT" means "Stop"

"ONE YELLOW LIGHT" means "Be prepared to stop at the next signal"

"TWO YELLOW LIGHTS" means "Be prepared to find the next signal exhibiting one yellow light"

"A GREEN LIGHT" means "Next signal exhibiting a proceed aspect."

Figure 5 was a simple example so now let us take a look at a more realistic example and on this one we will introduce some trains.

Figure 6 shows an aspect sequence as two trains follow each other through a series of 4 aspect automatic signals.

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TRACK CIRCUIT BLOCK

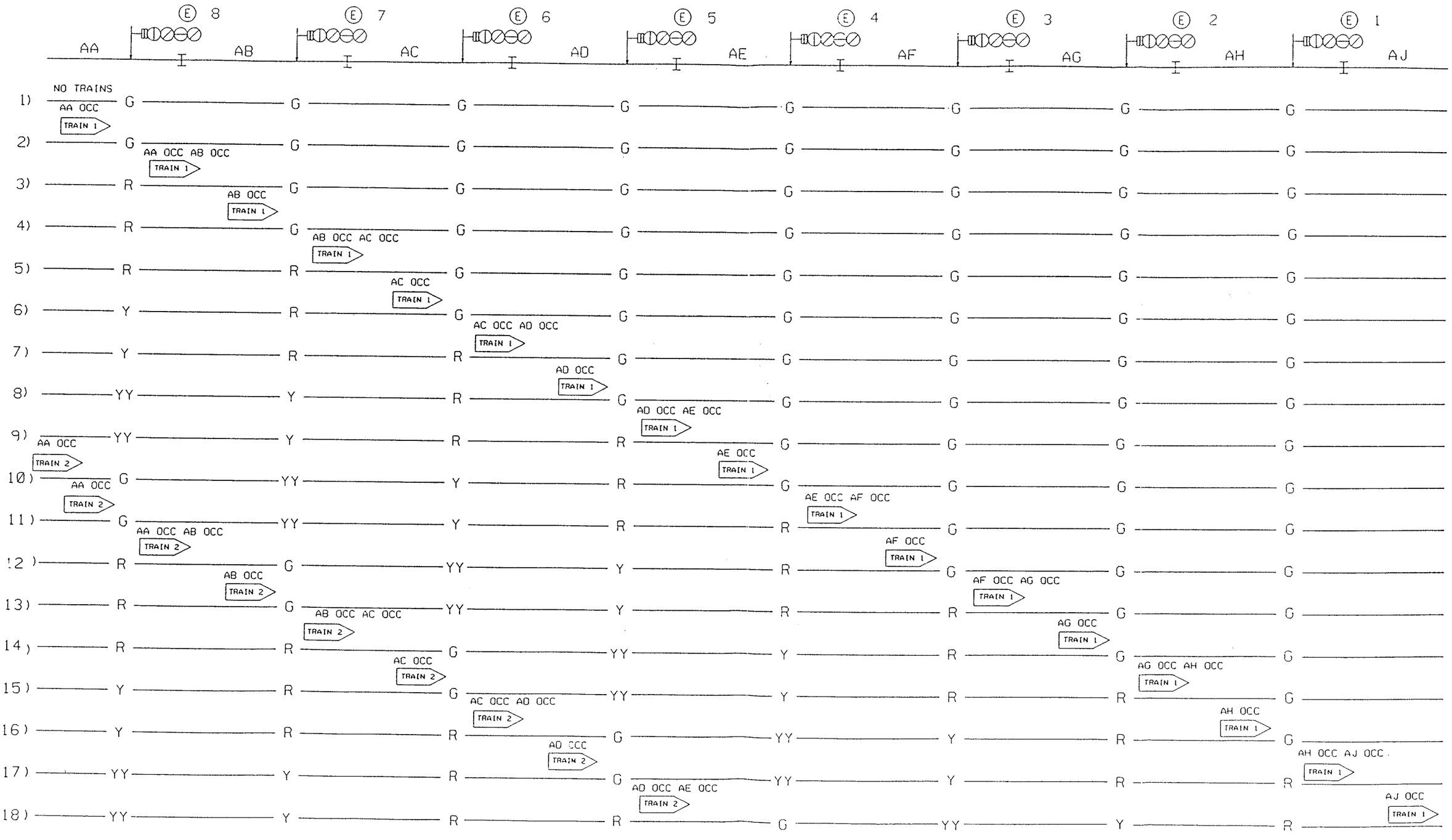

FIGURE 6.

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