Technical Meeting of the Institution
held at
The Institution of Electrical Engineers
Wednesday, March 17th, 1954

The President (Mr. T. AUSTIN) in the chair

After the minutes of the Technical Meeting held on February 17th, 1954, had been read and confirmed, the **President** introduced to the meeting Mr. D. T. Bland and Mr. W. Bernard who were present for the first time since their election to membership.

The President announced that in connection with the International Railway Congress, there would be an exhibition at Willesden which would include a display of signal and telecommunications equipment. It would be open for pre-view by members of Technical Institutions between 11 a.m. and 2 p.m. on Wednesday, May 26th. Admission would be by ticket obtainable from the Hon. General Secretary.

It then gave him great pleasure to introduce Mr. E. A. Webster and call upon him to read his paper entitled "Route Indicators."

Route Indicators

By E. ALAN WEBSTER (Associate Member)

Diagrams—Inset Sheets Nos. 16-19

1—Introduction

Before we look too deeply into the subject of Route Indicators perhaps it would be advisable to try first and define exactly what is meant by the term and what its general function is. As its name implies it is an indication to the man on the footplate of the route set and the passage his train is to take. It seems, therefore, that the route indicator of today may well be defined as a visual indication, being the same both day or night and used in association with a signal which is required to read two or more ways and by the nature of the complete indication displayed, indicates to the driver the necessary action he is to take. The route indicator to the driver must have been one of the greatest advancements in signalling as not only has it reduced the number of signals a driver must commit to memory but also has made it possible for signals

to be placed adjacent to the line to which they apply, thus saving any ambiguity. Without any exaggeration forests of signals have disappeared from large termini and junctions with the introduction of this system of route indication.

2—Historical Types

(i) *Saxby & Farmer Disc.* Fig. 2

As far as can be traced the idea of displaying a character to inform the driver into which platform he is running or which route he is taking was first suggested by a late signal superintendent of the London & South Western Railway around 1878 and the first type to appear was at London Bridge in 1881, designed by Messrs. Saxby & Farmer. Earlier types may have existed abroad but this is doubtful. With this indicator the route disc was normally concealed behind a blanking plate and as the particular route was selected, the disc dropped down and the arm operated. The characters were black on a white enamelled ground and were floodlighted by an oil lamp. If a large number of routes were required, two magazines of discs were used, one vertically above the other.

2 (ii) *Annett's Mechanical.* Fig. 1

Then followed this indicator which was the first one of any size and was patented in 1902. In this arrangement the characters were mounted on a wire mesh frame, for reasons of lightness, and held concealed in a box by a cross-bar arrangement, dropping into view when the route had been set and the arm cleared. Which one dropped was decided by the route lever operated, as when one was reversed it operated, by means of a rod connection a cam driven releasing lock which freed the slide ready for dropping. A separate blinder plate which normally covered the aperture cleared when the arm operated, at the same time dropping the slide into view. On the signal arm returning to danger, the blanking plate was lowered and the slide frame rose carrying with it the route slide, and when the route lever was again restored the releasing latches were normalised. The maximum number of indications displayed was nine and the illumination was at the rear showing the characters in silhouette.

One of the greatest drawbacks to this indicator was that the arm and indication were of necessity some distance apart. Many variations of this type quickly followed but it was Annett who did

the pioneer work and made the first indicator of any engineering quality.

2 (iii) *Thompson's Revolving Vane (L.N.W.)* Fig. 3

This type of route indicator was designed to be used solely in conjunction with solenoid operated signals and was first installed about 1903. It had a maximum of three indications in addition to the normal; the latter being painted vermilion. In cases where more than three indications were required, the indicators had to be reproduced side by side. The screen, which was about five feet in height, consisted of sixteen vertical channel section members in the form of revolving vanes, each vane carrying a pinion which was driven from a rack. The rack could be driven by any one of three solenoids, the degree of turning being decided by which solenoid was operated. The stroke of the solenoid remained the same but the travel of the rack was varied by the length of the arm of the operating crank.

The vanes moved through 90, 180 or 270 degrees depending on which solenoid was operated and when the feed to any one was interrupted, gravity returned the vanes to normal. Only when a route indication was fully displayed could the signal solenoid be operated. The indications were illuminated by hooded reflected light during the hours of darkness.

2 (iv) *McKenzie & Holland Electro-Pneumatic*

In 1905 this electro-pneumatic route indicator was produced which was somewhat similar in design to the Annett indicator. Here the slides were electrically selected and detected, a standard E.P. motor mounted immediately below drawing down the free slide to show in the aperture. Four years later this design was improved upon and then consisted of a self-contained motor frame in which the character was rigidly suspended by wires between two small tubes which formed part of the E.P. motor. These indicators were electrically detected and illuminated.

2 (v) *Sykes Electrical.* Fig. 4

The year 1910 brought Sykes original route indicator which was in actual fact an indication in silhouette added to the No. 1 banner signal as shown in fig. 4 and as the banner signal was wound off the character swung up into view. For characters to swing clear of the arm they had to be kept small and since in the

first instance these indicators were only used in connection with shunting moves, this was not detrimental. In the same year a complete new housing was designed to take this route indication; this one, housing a nine inch character and normally indicating no more than seven routes. Again this was only used with shunt signals. When required to be used with main line signals the demand came for a larger indication and the fifteen inch character was adopted. It is worthy of note, however, that the principle of operation today differs but little from the original movement apart from some minor improvements, as dealt with elsewhere in the paper.

2 (vi) *Acfield and Cooke Mechanical.* Fig. 5

In order to bring the indication into closer relationship to the arm, this indicator was designed in 1913 by two engineers of the ex Midland Railway and in fact was first used at St. Pancras the terminus of that railway. This indicator was mechanical and had a capacity of four indications. The slides travelled horizontally each in its own guide, but there was no means of interlocking between the slides. Usually the characters were in silhouette and in their normal position were stowed behind a screen. The slides were worked from counter-balance levers in preference to direct control from balance levers in order to minimise rough operation of the slide. In some instances to obviate the need for repeating the mechanisms, this indicator has been provided with backlight screens which move with the indicator slide to obscure or uncover the indication as required. Illumination can be by oil or electricity and the complete indicator has in a few instances been adapted for power operation.

2 (vii) *Leakes' Position Light*

This was designed in 1916 being of the most interesting indicators because it indicated the route set without the semaphore arm being provided. The route was indicated by various combinations of electric lamps arranged in three rows and having three lamps in each row. Each combination of lamps corresponded to a route number in the same way as characters are disposed on a playing card. Each particular group was operated by its appropriate route lever and the lamps illuminated to a definite pattern. For instance route one would be given by the centre lamp only ; route two by the top and bottom centre lamps and route four by

the top and bottom outside lamps Other variations have since been tried to use this principle sometimes using white, red and green lights but have not generally met with much success.

2 (viii) *Moore & Berry.* Fig. 6

In 1916 two signal engineers of the ex Lancashire & Yorkshire Railway introduced an indicator similar in type to the Acfield but which had the added advantage that it could be adapted for mechanical, electro-pneumatic or motor operation. As can be seen from fig. 6 the slides in this indicator travelled horizontally thereby enabling the indication to be in close proximity to the signal arm. The slides were suspended on lugs from " tee " section angle iron runners, which extended the entire length of the indicator. To safeguard the possibility of two slides travelling together, they were interlocked mechanically by means of each slide having to travel through a trough containing metal balls. When one slide had been operated the balls were pushed into contact and therefore prevented any further slide from being operated from the normal. Each slide carried its own selector gear and as the common carriage was operated for each route lever, it " clutched " electro-magnetically the selected slide and carried it in both directions. When the selected slide had completed its full movement, the route was illuminated internally and the signal arm cleared.

2 (ix) *British Power Railway Signal Company*

In 1907 the British Pneumatic Railway Signal Company introduced the Annett's route indicator in a varied form operated by low pressure pneumatic principle, being first installed at Wath Concentration Sidings. The general appearance of the route indicator is identical with that shown in fig. 1 with the exception that the cam slides are actuated by a pneumatic cylinder instead of rods.

About 1920, a multi-lamp indicator was designed using a gridded screen, first being used at London Victoria and about five years later at Cambridge. The height of the character in this case was 20 inches. The indicator was normally placed above the housing containing the control gear and was illuminated by " sign type " commercial lamps of varying voltages but usually about 25 watts. Each individual lamp was fitted with a beak type shield to reduce glare and improve distinctiveness of the

character. A stippled glazed screen usually covered the lamps, but later when used with colour light signals a blue tinted glass was used.

Then in 1932 the stencil indicator was introduced which consisted of a number of stencil indications on a circular disc which could be revolved. The disc was stepped round by a telephone type selector gear until the selected position was found. In this position and provided that the arm was " off," the indication was transmitted on to a forward glass screen. This indication was not a great success although the idea was adapted for other uses.

From then onwards followed numerous adaptations of previous types which were frequently introduced by various Signal Engineers but no great advancements were made worth recording.

3—**Present-day Types**

Under this heading we shall consider not only indicators which are manufactured today but also those which, although not marketed, are still to be seen frequently in large numbers and cannot therefore at this stage be termed historical.

3 (i) *Mechanical Slide*

Until recent years these indicators were still being installed for goods and passenger lines generally, but owing to its massive construction the time has come when the cost of a suitable structure to carry this indicator is out of all proportion. The mechanical slide type is normally only used with semaphore signals, but cases are known where they have been used with colour light signals. Many types are in existence today but their principle and operation is much the same. Maintenance on this type of indicator is heavy and the indication is not considered to be good, also constant adjustment is necessary to keep good full indications. Types usually cover various numbers of routes and the slot arrangements designed accordingly. The number of slot levers depends on the number of routes, and when each route lever is operated it actuates a miniature lever or bridge common to all routes which in turn operates the arm. Usually it should be possible to obtain full movement of the slide at about 70 per cent of full stroke. Characters are either in stencil, silhouette or painted black on a white screen and the type of illumination depends on the form of character chosen. In the cases of the

smaller number of routes, slides are housed in a magazine to one side or below the indicator but when a larger number of routes is required, magazines are found on either side of a centre aperture. A later refinement introduced on most Regions was that of a blanking plate which did not clear until the arm was fully " off." This feature was particularly useful when the signal concerned had an additional slot control.

3 (ii) *Roller Blind Indicator.* Figs. 9, 24

The roller blind indicator like so many more types is still to be seen on many large installations but is now considered out of production and although it is far from historical, is unique in principle and well worthy of recording one or two salient features.

This indicator was first used in 1922 at King's Cross and was last used to any large extent on the Liverpool Street resignalling. As its name implies the indications are portrayed on a rotating blind and can be to a maximum of twelve ; six forward, six reverse, the normal position displaying a blank. The characters appear white on a black background and with single characters attain a height of fifteen inches, though with double characters this is proportionally reduced. The indications appear behind a plate glass screen and can be double sided if required to obviate repeating, and at night are internally illuminated by low wattage lamps, the actual rating depending upon the physical position of the signal, but one salient feature of the indicator is that we had an indication which was as near perfect as possible in daylight and bright sunlight.

Briefly its function is as follows. On clearing the respective route, a feed is put on the selector switch via the particular route contact and one of the motor relays becomes energised which in turn completes the motor circuit and drives the selector gear forward until the correct indication is displayed. In this position the motor contacts are broken and the blind ceases to rotate. Consistent arresting of the blind is ensured by a mechanical brake which is held off whilst the selector gear is moving. To normalise the indicator it is necessary to energise the other motor circuit and again when the blind is fully normal, the motor ceases to run. Each complete correct route is proved before the aspect clears and the normal indication proved in the normal checklock circuit.

Although the roller blind indicator is somewhat of a weighty indicator it has the advantage that all the associated equipment

is at hand. Maintenance on this indicator is high as compared with other types, the main difficulty being overrunning and keeping correct adjustment of the blind. It is also advisable to keep a constant voltage for operation and this is done by trickle charged secondary cells. Another advantage with this type is that additional indications can be added with comparative ease.

3 (iii) *Projector Type—Optical Unit.* Fig. 18

This form of route indicator is a type on its own and was first produced in 1926. Hitherto route indicators had been a maze of complicated mechanisms and this projector type was of the utmost simplicity and cheap in maintenance. Although the projector unit is also attractive from the point of view of low consumption it certainly does not give the necessary range for working in the open and this ultimately led to its restriction to places such as covered stations where sunlight was not an adverse factor. Again there are many in use today but it is no longer in production.

The optical projector unit has no moving parts as it is briefly the optical projection on the forward glass screen of the character exhibited. Thirteen routes can be projected with the eleven inch letter using low voltage lamps but with the eighteen inch letter high voltage lamps were found to be necessary, and the number of routes reduced to seven. It was found difficult to overcome fringing of the indication due to the fact that all the light projected could not be paralleled. Its limited use, coupled with the fact of the costly lens system, soon brought about the cessation of production of this unit.

The author feels that the optical system of route indication is still in its infancy and that with fluorescent lighting and the introduction of Perspex, good transmission without complicated lens systems may be possible.

3 (iv) *Junction Directing Route Indicator*

It is more than probable that the first idea of the use of this indicator came from the Pennsylvanian Railroad where the position light signal was used in preference to the colour light signal for speed signalling. These indications were rows of white lights impinged on the centre. The earliest type of this indicator to be found on British Railways, however, appeared in 1933, being patented by Mr. A. E. Tattersall, the then Signal Engineer

at York. This took the form of a Neon strip light and was originally added to a signal at Thirsk, as shown in fig 7. The fact that in this case the indication was below the aspect was entirely incidental and was due to sighting difficulties. In this form the indication did not prove to be a success owing to the deep orange hue and also the high voltage necessary, and thus it was not long before it was unanimously agreed that lunar white should be used and this time the indication took the form of five individual lights in a row completely offset from the centre line of the main aspect itself. The first installation to use this principle of indication in any number was the Waterloo-Hampton Court Junction, which was brought into use in May, 1936, but in this instance only three lamps were used in each indication which was of the centre pivot type.

Much controversy arose in early days as to whether the straight route should be indicated for reasons of consistency but it was unanimously agreed that for British Railways the indication for the straight route could be suppressed. It is worthy of note. however, that this indication was usually demanded by overseas signal engineers but it is understood that nowadays it seems that the tendency is to follow British practice. Retaining the straight route has the added advantage that it gives the driver immediate location at night which formerly obtained when splitting signals were in use. Ignoring the straight route, the maximum number of routes which can be indicated is six, three either side of the vertical, arranged at 45 degrees to the latter and each route being given by the angle it makes with the vertical. The indications are geographically correct and are so designed that additional routes can be added to the indicator *in situ*.

Since the early days of junction indicators, the method of illumination has varied from Neon tube, non focussed lamps and more recently focussed lamps. Throughout the ultimate aim has been to produce a bar of light in association, but at the same time distinct from the aspect. The type of lamp used in colour light installations is usually S.L. 33 (110 volt 25 watts) but low voltage lamps are found in some cases. Moreover, one Region is experimenting with the use of the S.L. 18 which is claimed to give a better indication than the S.L. 33. The number of lamps required to give this indication is generally speaking five, although four and three spaced at other intervals are considered satisfactory by some signal engineers. Two main forms exist, the pivot and

the non-pivot. With the former indication we always find the three lamp pattern and generally the four and five lamp, although the latter two types are sometimes of the non-pivot type. Some manufacturers do not favour the pivot type and in fact one Region prefers to manufacture their own indicator which has a series of five lamps completely divorced from the centre line of the aspect by some eight inches and at a radial distance of some two feet from the nearest aspect in order, it is claimed, to give a good distinct indication at 800-1,000 yards. Furthermore, with the five lamp type unit it is generally an accepted fact that the proving circuit remains intact as long as any three lamps remain burning. This leads to the question are three lamps sufficient for a good indication and if so, what is the most advantageous positioning ?

The junction directing indicator usually consists of a focussed lens system, which is of high transmission blue in order to give a true lunar white indication. It is the opinion of the author that in addition to individual focussing much could be gained from having the units adjustable for sighting, in fact one manufacturer has designed an indicator where each individual lamp housing is adjustable on a ball and socket mounting.

Although generally speaking this indicator is used with elevated signals, extreme cases are known where they are used in miniature form on ground signals and this usually compels the use of a three lamp unit.

Figs. 10 and 11 show two examples of the pivot types and fig. 12 the non-pivot type.

3 (v) *Multi-Lamp Route Indicator*

This indicator is so named as it requires a number of lamps illuminated to build up an indication. Until the junction indicator was designed this was the only so-called long range indicator. This indicator is widely used today and although it is often thought to be of fairly recent invention, records show that as early as 1903 models were made but could not be put into service as few places had the necessary power supply. This indicator appears in many forms too numerous to mention individually, but in principle they are all similar. The main types are high voltage using 110 volts 15 watts or the low voltage using 12 volts 4 watts or 6 volts 12 watts, and whether the lamps are wired in series or parallel depends on individual requirements. Basically the system of indication is the same for all although the number of

lamps differs for each type being usually either 35 or 49 lamps. In earlier days each lamp had its individual lens cover but nowadays it seems the policy to use diffusing glasses to give a merge of indication but at the same time the angle of spread increases as can be seen from polar curves and its usefulness is therefore questionable. Nearly all types are available with front and back indication and can be supplied to take double characters. Without doubt the ideal position for this indicator is surmounting the aspect unit although in certain cases owing to sighting difficulties it is found fixed to one side. It seems that the question of back indication should be studied carefully in view of the additional expense and should be reviewed, bearing in mind the possible use of a stencil back indicator. Stencil back indicators are admissible for cases where engines regularly stand ahead of the platform starting signal, but the question of solely providing double sided multi-lamp route indicators for protection of men on the line should be reviewed carefully, especially in view of the fact that no back indications are provided for junction indicators.

Many adverse comments are made in connection with the series lamp indicator owing to each indication having a varying feed voltage because of the number of lamps used. Having a non-standard transformer for each signal may appear a drawback on larger schemes, but usually for a small additional outlay a type can be designed to suit all cases thus making one standard item. The greatest advantage of all is that with this type, lamp proving is rendered simple as with a failure of any one lamp, the indication is extinguished, which seems preferable to distorting the indication under failed conditions or elaborate section lamp proving which is sometimes employed with parallel wiring. To the maintenance man it would appear that tracing faulty lamps is no easy matter, but as the lamps are usually under-run, lamp failures are not common. Some operating superintendents have expressed a wish that they prefer that the whole indication should not be extinguished, but this depends also on how the route is controlled.

3 (vi) *Sykes Electrical Indicator.* Figs, 16, 17

As already emphasised the design of this present form of indicator differs but little from that of the prototype of 1910, in fact the selector movement design is identical. With the indicator normal, a blanking plate covers the aperture and when a route is cleared, the armature is rotated and the blinder is swung down,

at the same time swinging the selected route into position. Each different route is selected by selector coils which normally stand de-energised, and on a route being selected the appropriate selector becomes energised and locks the selector slide from moving forward. The armature still rotating drives all the remaining selector slides forward and the selected one being now locked from travelling forward is forced to rise in a simple link motion carrying with it the route indication. Since there is no mechanical interlocking between selectors, adequate proving springs are provided to enable all routes to be proved on and any one " off," depending on individual requirements.

This indicator is suitable for oil or electrical illumination and can be operated from a.c. or d.c. supply.

3 (vii) *Stencil Indicators*

Without doubt this is the simplest form of route indicator and was first used at Birmingham Snow Hill by Siemens Bros. in 1910. There are various designs marketed today and some Regions prefer to manufacture their own. The stencil is a close-up indication and is not discernible much above 50 yards and in bright sunlight less than that. The size of letter used seems to vary between five and eight inches according to type and most are available with the double sided feature. The usual type of this box-type indicator is such that it can be grouped into any number to suit requirements. It is used with semaphores, and is in great use with the small yellow aspect, back indicators for multi-lamp indicators and also with subsidiary signals.

Various types of screen have been used for this indicator, the earliest being the stencil with an opal glass in the rear. and illuminated internally when the signal cleared. This was soon followed by an indication which was etched on the glass and once again it was only illuminated when the signal cleared. Hitherto, all indications were visible in daylight whether illuminated or not, but even when the route was illuminated it was not easy to discern. The greatest change came when it was decided to suppress the indication until illuminated. This was affected by placing in front of the stencil or etched glass a glazed cover of flashed-opal-on-pot-blue which both prevented any phantom indication and also gave a perfect lunar white clear-cut indication when illuminated. These indicators are illuminated with commercial type lamps, the wattage depending on physical conditions

of location. The chief difficulty in earlier days was to secure uniformity of illumination which is essential for a clearly defined character and in most cases a reflector proved essential.

The lunar white indication has recently given way to the orange tinted screen although the back indication has remained lunar white. One of the inherent disadvantages with this indicator appears to be that the lamp is a fixture no matter what portion of the screen is being used by the character and it would appear in many cases that we are not using the total lumens available unless the lamp housing is made adjustable.

4—Application

Owing to signalling being an inexact science due to variances of opinions and interpretation, it is still difficult even today to dogmatise with regard to the application of the route indicator as so much depends on individual circumstances, sometimes even consistency with what exists today and the varying demands of the operating department. Many examples could be quoted but even then they might not be applicable to the particular problem in hand. As a general guide and bearing in mind some accepted conventions some typical applications are quoted and where possible, alternatives given.

Broadly speaking we can divide our route indicator applications into three main groups :—

(*a*) Junctions between parallel lines on the same route, such moves as Fast to Slow, etc., through junctions into and out of stations.

(*b*) Shunting moves :—
  (i) With normal flow of traffic ;
  (ii) Facing direction of traffic.

(*c*) Junctions at which the routes diverge into two or more routes to which we can give the name of Geographical Junction.

4 (i) *Multi-Lamp Indicators*

The multi-lamp route indicator or as it is more colloquially known, the music hall or theatre type, is in common use today, usually found mounted on elevated signals. (The term multi-lamp will be used throughout for reasons of clarity). This indicator usually covers all cases under 4 (*a*) above and in certain cases is used with item 4 (*c*) owing to sighting difficulties in station

precincts. It is used where the speed of all routes does not exceed a nominal 25 miles per hour, and perhaps its most common use is into and out of stations where its application is usually confined to platform and bay lines, but is seldom used for carriage lines or engine lines as discussed later. To cover all the former cases one signal is sufficient with the appropriate route and would cater for all arrival and departure movements. Where permissive working is authorised the same indicator would be used with the calling-on signal. With platform starting signals the question often arises whether a multi-lamp indicator is necessary and as most moves start from rest the stencil type indicator might be used. If there are any through running moves the multi-lamp type is recommended but for starting signals from bay platforms a stencil indicator will usually suffice although on large installations consistency is still an integral factor.

Multi-lamp route indications are found used with both semaphore and colour light signals but usually when providing this type of indicator it is often a better proposition to renew the signal in colour light form.

4 (ii) *Stencil Type*

The stencil type covers all cases under the heading 4 (*b*) and in fact is the cheapest form of indicator in use today.

(*a*) *Running Movements*

These indicators normally occur on Goods Lines, Reception Roads and between Goods Lines. All movements made with the stencil are regarded as being at a low speed usually between 10-15 miles per hour but definitely below 25 miles per hour. Where there is a permanent speed restriction into a terminal station, the stencil can be used sometimes, thus showing an enormous saving financially. Whereas in the past the mechanically slide type was used on goods or subordinate lines we can safely replace this by the stencil, being a cheaper signal, better indication and far less maintenance. As already mentioned the stencil can be used for any movements from rest for passenger working. In daylight the indication is not legible at much more than 50 yards and somewhat less in bright sunlight. In cases where a subsidiary semaphore is used below a main line arm carrying a stencil and a distant arm is also provided, it is sometimes found necessary to give the indication

below both the main and the subsidiary. This of course does not arise with colour light signals.

The stencil indicator is found in common use with the small yellow aspect reading into no-block roads such as loading docks and engine roads at terminal stations especially when the routes are of vastly varying length ; if they are of identical length and importance no route indication is necessary, Moves from passenger lines to carriage sidings are frequently provided with a stencil route indicator and all routes with the small yellow carry the customary delayed clearance and apply as far as the line is clear.

(*b*) *Shunting Movements*

Before the route indicator was used with the shunting signal or ground signal it was a common sight to see three and four arm ground signals, but nowadays by the use of the route indication, these grotesque signals have been much simplified. Where shunt or set back moves are all to one side of the main running lines and are all of equal length from the last splitting point it is usually unnecessary to have more than one signal or indication. Should, however, moves necessitate crossing the main lines, then any such moves should be routed separately. Where moves are made in facing direction of traffic up to a limit of shunt indicator, not only should this route be indicated separately but prefixed by an identifying letter. Recently it has been the practice to arrange stencil indications geographically reading from top to bottom or top left to bottom right, but this is not usually considered to be of great importance. For ground shunt signals, the stencil indicator is normally used when the signal has two routes or more. This indication is used both with disc type and other mechanical signals and also the position light signal.

4 (iii) *Junction Directing Route Indicator*

Perhaps it can be argued that since all routes of this indicator are not displayed, it cannot be included as a true route indicator, the straight route as far as British practice is concerned being indicated only in a negative sort of way. This indicator generally covers all uses under 4 (*c*) and is also at times used in item 4 (*a*). (The colloquial terms for this indicator being route arm, direction indicator or horn indicator). The junction indicator is usually

used where the allowable speed over a junction is more than 25 miles per hour, but conversely because a junction is fitted with this type of indicator it does not mean that any existing speed restriction should be ignored, in fact many cases exist where the permissible speed is only 15 miles per hour. Where this indicator is used there is usually one more route than the number of route arms, or as is stated in the Rule Book ". . . for movements along the straight route no junction indication will be exhibited." This indicator can be clearly seen at 800-1,000 yards in daylight and is the only long range indicator.

Where a geographical junction, simple turnout, or any running move necessitates a reduction in speed from the main route, through the diverging route a single unit with a junction indicator is sufficient. At a junction say of five routes, two of which are equal and both greater than 25 miles per hour, separate signals would be used and the indications taken off these as required. Furthermore at junctions where speeds are equal and above 25 miles per hour, in the past it has been the practice to provide two equistepped signals, but today in the light of economics and to eliminate a driver passing a signal at red, the tendency has become to use a single unit with two route arms; that is the straight route not being used unless for sighting reasons this cannot be done. Also in cases where a splitting distant indication has to be combined with the aspect for the junction ahead then it is usual to leave separate units. Under normal circumstances it should be rarely necessary to exceed two units and the first consideration should be to endeavour to keep it to a single unit and a route indicator.

5—Characters and Lights

With the multi-lamp or the stencil indicator a major problem is to ascertain what characters must be exhibited. Apart from some of the more obvious ones which the signal engineer can decide himself the more uncommon ones usually require the co-operation of the Operating Superintendent, especially when a second qualifying letter is required. It is a question whether the more common ones could not be standardised to obviate the anomoly of "T" with a multi-lamp meaning "Through" but with a stencil meaning "Turntable," necessitating vastly different action by the driver.

Furthermore, now that both these types are widely used today, it would appear the time has come to standardise on some size and form of character and also the dimensions of the screen to be for single or double character. With the multi-lamp type even today some amazing hieroglyphics can be seen, yet on the other hand, one Region considers it necessary to go the additional expense of designing each character individually, not using a gridded screen, in order to obtain a perfect artistic letter. It seems fairly obvious that a happy mean should be sought and so long as a character is clear and distinctive that is all that is necessary, as the main consideration should surely be economics without ambiguity. Some very reasonable letters can be obtained on a 7×7 lamp gridded screen for the multi-lamp and also the characters on the stencil type could be standardised to an eight inch letter, although these indications are usually quite legible. It is standard practice today to use common lamps for characters although until comparatively recently one Region used non-common lamps thus necessitating extremely wide screens.

It seems very desirable that shunt moves which are made in facing direction of traffic should immediately present to the driver a different character which can be given by an " X " or " Z." The former has been used on one Region for a considerable number of years, although it is open to question whether it is necessary to define this route even though there be only one possible facing move. A further question then arises at larger stations where there is an alternative route from a platform, a considerable part of which is made in a facing direction but finishes on the right line with normal flow of traffic ; should this alternative route be distinctive from the normal route ? The " MX " has been used in such instances but it is considered that the " X " should always be the prefix in such cases.

A number of variations seem to occur with regard to the colouring of the indication given by the multi-lamp or the stencil indicator. In the early days of the former, considerable research was made in order to render the inherent yellow tinge a true lunar white comparable with that of the junction indicator, this being achieved by placing a pale blue diffusing screen in front of the lamps. Today, however, there seems to be a tendency to use the orange diffusing screen for a front indication and a white for the rear and this practice has now spread to the stencil type. From the author's experience there have been few complaints from

the lunar white of the multi-lamp or stencil and I venture to suggest that the introduction of this orange hue in the driver's view is a retrograde step, and could easily lead to confusion.

6—Route Proving and Repeating

Both these items are without doubt the most controversial problems in the study of route indicators and before it is considered how we can carry out both these requirements, let us first see when and why it is necessary for the various types of indicator.

6 (i) *Junction Directing Indicator*

It is an accepted practice today that since the straight route or high speed route of this indicator has no route indication, it is essential that in all diverging routes, the route indication must be proved intact before the aspect can clear, this proving being normally done in the HR or similar circuit. With the five lamp route indication two lamps are allowed to fail before the lamp proving relay drops away, the remaining three lamps being considered sufficient of a good indication to the driver. With the three or four lamp type, however, the proving relay is adjusted to drop away when two lamps or less are alight. Assembled proving units can be used as manufactured or can be built to individual requirements. This unit is usually designed to work under dimmed conditions in addition to normal.

Generally speaking the route indication is repeated indirectly over the HR or series indication used, the actual indication appearing in the form of " OFF " for all routes.

6 (ii) *Stencil Indicator*

When stencil indicators are used with semaphore signals it is customary to prove the arm has completed two-thirds of its movement and that the respective slot lever is " off," before the indication is illuminated and if the arm is repeated no further repeating is necessary. On major colour light schemes the tendency has been to prove the stencil in the aspect although in isolated cases it may not be considered necessary. The question of proving a route before the signal clears is not of vital importance in the case of the stencil indicator owing to the relative low speeds, although it would appear that in the case of signals reading up to a limit of shunt or a turntable additional cost of proving is warranted.

6 (iii) *Multi-Lamp*

In cases where the multi-lamp indicator is used in conjunction with semaphore signals the arm is always proved " off " before the route appears which would appear to be a relic of the stencil proving, and although without doubt it is the cheapest form of control it is open to question whether it is correct. Admittedly each route has an indication but it would still appear essential to prove a route before an aspect clears otherwise at night a driver could lose all sense of location and seeing a green aspect alone could be a possible source of danger. In colour light installations this is comparatively easy but it is questionable whether it would be acceptable to the Operating Superintendent if a series lamp indicator were used. Proving the route in the aspect in this case would certainly bring it into line with the junction indicator. Route proving with lamps in series is an easy matter but where lamps are wired in parallel, lamp proving is more of a problem since a high percentage of lamps must be out before the proving relay will drop away, but of course this still has the added advantage that it is a distorted indication, and drivers would approach under cautionary speed.

The most serious case of route proving occurs in the case of the parallel type of multi-lamp indicators which at a station can read into both Platform 3 and Bay 8, amongst many others. It seems essential that in such cases we must guard against the possibility of a sufficient number of lamps being out in the " 8 " indication thus incorrectly displaying a " 3." In other words the route is set for Bay 8 but the indication shows 3, the former being only half the length of the latter. This can be overcome by having an additional section lamp proving relay circuit proving two lamps alight in the left hand side of the top loop of the eight and two lamps in the left hand side of the bottom loop (viewed from front) and should any one of these four burn out the proving relays drops away. This proving relay would in turn control the UKR or selector unit as the case may be. Similarly in the case of " P " and " B " again a number of lamps in the lower half of the " B " are proved before the bay line route can be cleared. It is considered that this section lamp proving should also be extended to prove at least a portion of the " X " intact in a " XM " indication, before we can set up the " M " and once again the complete indication proved in the aspect, which would also include the limit of shunt illuminated.

If all routes into a station are of equal length it is usually not considered necessary to prove a partial character but still the route should be proved before the aspect clears. Taking this to its logical conclusion, if all the platforms are of the same length and equal importance is it essential to inform the driver into which platform he is about to arrive? In other words, would not an aspect with a stencil, say, Nos. 1-6, be sufficient or is this too revolutionary?

When multi-lamp signals are used with selected signals it is considered that each route ought to be indicated in the signal box or route checking plungers should be used depending on the size of the scheme.

7—Individual Signal Renewal

The choice of route indicator on a large signalling installation is usually comparatively easy compared with that for the individual signal renewal. The junction indicator can easily be dispensed with as it is rarely that wire working is maintained, but with the multi-lamp and the stencil these are both found to be used with semaphore and colour light signals and it seems largely a matter of opinion whether the mechanical detection can remain but from a long term policy it is the author's view that it is usually a more economic proposition to provide electrical detection and renew the signal in colour light form. If electrical detection is provided and the semaphore signal maintained, arm proving has to be introduced on the necessary signals to effect the converse of the electrical detection and this in itself can be an expensive item.

To avoid the use of slack wire working, route selectors are usually employed providing sufficient route levers are available. The selectors are generally fixed on the sleeper end and each route slide is operated by its own particular route lever. The common bridge is then connected by rod or wire to a single slot lever. Should the signal in question also carry a subsidiary signal, the problem is not so easy and in this case two 2-lever slots are used, one for the top arm and the other for the lower arm. One wire on each of the slots is connected direct to the common bridge on the selector and the second lever is controlled direct from the lever in the box, thus selecting the arm required. In each case the counter-balance is connected direct to the arm. By this means all detection is done on the route levers making use of existing

detection and should any wire breakage occur, the signal arms are returned to danger. With the route slide fully operated and the arm fully " off," the route indication is set up. Furthermore in cases such as these if convenient track circuits are available signal selectors can be utilised, thus showing an economy in levers.

This system of individual route levers is preferred, as not only is all the existing detection available but also it means very little alteration to interlocking. With this type of renewal it is also only necessary to have power supply at the signal location, as little or nothing seems to be gained by controlling the supply over the lever bands in the signal box in addition to the arm. Where, however, there are insufficient levers available to use individual route levers, selected routes have to be used over one lever although in mechanical layouts this is only resorted to when absolutely necessary. In this method it is usually necessary to provide route checking plungers which serve as a reminder to the signalman of the route set. Each plunger is either proved normal mechanically or electrically, before any one route can be operated.

It often happens in signal renewals that there is no standby available so that secondary cells have to be introduced. The greatest problem with a colour light unit and a junction indicator is to adjust a charger for a variable load, which could be anything from 2 to 12 amps., this could be covered by one of the constant voltage variable current charging sets. In these cases 12 volts 24 watt lamps are used for both the aspect and the route indication, and in the case of the multi-lamp indicator the 12 volts 4 watt lamps are used.

8—Control of Route Indicators

This heading itself could quite easily form the basis of a paper as there are so many varying opinions on what controls over and above the essentials are considered necessary and in view of this it has been decided not to quote any particular circuits but rather deal with the salient points of each indicator and to briefly describe the control gear where considered necessary.

With the junction direction indicator as already mentioned under Proving and Repeating it is essential to prove the route illuminated for each diverging route before clearing the aspect, and that this control be cut out with the high speed route. If the number of lamps in the indication is less than three the signal will

not clear. The additional control of approach clearing as a general practice must be decided for each case in question.

For the multi-lamp type indicator there are two main types of control available, the relay or the pre-selector, the latter being used on many recent signalling schemes. It is preferred by many to utilise the relay or contactor control in the form of a UKR independent of the number of routes required, and in this circuit to include the lever and route control leaving the track controls, etc., in the aspect. When a large number of routes is involved, the housing of the contactor or operating relay can present quite a problem especially if owing to the shortage of space available they are compelled to be on the signal gantry. In some indicator units these contactor relays, in a modified form, are housed in the units themselves, although in certain cases the number of routes available is only in the order of 3 or 4 largely depending on the characters to be used. With the parallel lamp type indicator it is usual to employ a contactor type relay with heavy duty contacts whereas with series lamp the standard signalling line relay will suffice. Many different ways can be found of grouping lamps which are common to various indications, but experience usually shows with parallel lamps that much can be gained by sharing the load on each relay where possible. At first sight it might appear that relay control is an expensive item on conductors, but normally with judicious positioning of relays the bulk of the wiring can be kept down to a very economic length.

With the selector type of control, generally speaking, this is adopted after three indications are required. One control wire is required for each route together with a common return and to select and illuminate a route, the appropriate control line is energised from a 50 volt supply which is preferably situated at the signal box rather than using the supply common to the unit at the location. In this system lamps are wired individually to the contact positions on the rotary type selector switches, having eight banks of contacts and five wiping arms engaging with each bank. The selector used is a specially adapted standard telephone type working in conjunction with a single contact relay. The object of this latter relay is two-fold. Firstly, it prevents illumination of all routes through which the wipers pass before the complete route has been selected, and secondly it obviates the heavy currents carried by the lamps being broken by the wiper contact themselves. The operation of the pre-selector gear is

common to many in that once the pre-selector has commenced stepping due to one of the routes being selected, it continues to travel until it reaches a position where a feed stands normally to line at which point the ratcheting magnet is shorted out and the motion ceases.

If required, indication can be given back to the signal box by a proving relay in the a.c. feed to the lamps. Provided that the correct group of lamps is illuminated for the correct route set, this relay will be energised and will connect an indicating resistance across the control relay thus increasing the current in the control line, which value finally reaches three times normal and is sufficient to illuminate series indication corresponding to the route set-up Consumption figures for the selector types are perhaps worth noting and are :—selector mechanism 10 watts and 15 watts for each lamp assuming 110 volt 15 watt lamps are used.

It is now common practice to use the selector unit which is remote from the indicator itself, and this has the added advantage that when routes are amended a new selector unit can be merely plugged in the location, or even for servicing, the plug-in unit is found extremely advantageous.

For the stencil indicators used with the colour light signals the indication is usually controlled over the H.R., but if used with a semaphore signal and the controlling lever is fitted with a normal lock, the stencil indication is controlled over the arm contact and respective slot contact since it would be difficult in this case to prove the route before the normal lock is energised. If full mechanical detection is provided, the feed to the indication need only be controlled in addition by the lever reversed, but if no detection is provided, as perhaps in goods roads, etc., something may be gained by route proving over the levers concerned.

With regard to the Sykes electrical indicator this again is similar to that control of the stencil in that it is done by an arm contact or by the H.R. in the case of the colour light signal. In the former case the control can be carried out locally at the signal location.

With the route indicators fitted to semaphore arms to prove the route before the arm is cleared does mean motor working the arm which unless already existing for normal operational purposes, it could hardly be justified for proving the route before the signal clears.

9—Shunting and Marshalling Yards

Many different types of indicator have been used to indicate the routes set up for the staff on the ground, and although perhaps their use does not immediately come to mind when mention is made of route indicators it is nevertheless an important form of route indication.

One of the earliest forms of this on record in this country is the Stevens' Route Indicator which appeared about 1892, the main purpose of this indicator being to display to the shunter that the signalman has set up the route intended. This indicator consisted of a large box housing numbers painted on plates held up out view in a similar manner to the Annett's mechanical type. The plates were freed ready for falling by energising an electric lock fixed beneath each one so that the armature was free to move. On the signalman pulling the required lever for the route—a mechanical action by rodding—the action of clasping his catch handle closed the circuit to one of the route indications through electric point detectors so that the indication was selected electrically, proving the lie of the points. As far as can be ascertained the principle was never developed on main lines.

A further interesting type was introduced by Monard in 1917 who was a signal engineer on the French Railways. This was used in marshalling yards such as Lille on the former Nord Railway. This indicator again portrayed to the man on the ground the route set by means of numbered plates which dropped into view by the operation of the respective route plunger in the control tower. The numbered plates are held concealed by electro-magnets, one always being in view depending on how the route was set. To change the indication the appropriate plunger was pressed and this lifted the number already displayed and substituted the desired one. Both these operations were controlled by a signal type motor.

10—Conclusion and Recommendations

It is hoped that this paper has shown not only the various types of Route Indicators, but also the various methods of control and application and may also in addition be a record of the evolution of the route indicator from its first inception. On reflection, however, there appear several important factors which could comparatively easily be standardised to the benefit of

both manufacturer and user, the most important of these being as detailed below :—

(1) The junction directing indicator should be standardised as regards the number of lamps to make a suitable indication, also the question of centre pivot, small off-set or complete divorcement of the indication from the line of the aspect. Also the introduction of some suitable means of adjusting the route arm for sighting, preferably each individual lamp housing.

(2) The use of a standard gridded screen for the multi-lamp indicator which would also include standardisation of abbreviations, size and shape of character to be used.

(3) On all colour light schemes of major calibre all types of electrical route indicator should be proved illuminated before the aspect clears.

(4) All route indications should be lunar white so as to be readily distinguishable from any main running aspect.

If any one of these items could be achieved it would seem that this paper had not been without some success and although it has been treated in a somewhat sketchy way owing to the vastness of the subject it is hoped to have brought to light some of the problems confronting the signal engineer.

In conclusion, I should like to thank the numerous friends who have been of great help in compiling the historical information also the following for the loan of photographs, and slides and blocks :—Messrs. Metropolitan-Vickers-G.R.S. Ltd., Siemens & General Electric Railway Signal Company, Sykes Interlocking Company, Westinghouse Brake & Signal Co., and also the Regional Signal & Telecommunications Engineers of the British Transport Commission who have helped in so many ways too numerous to mention individually.

DISCUSSION

Mr. J. H. Currey, in opening the discussion, complimented the author on his very valuable paper, and said he would like further information with regard to a roller blind indicator he had seen at Glasgow Central. The author had mentioned the consistently good image of the roller blind type, but Mr. Currey could not agree that this applied to all. The one he had seen at

Glasgow Central seemed to be of a different make to many he knew and was the only one of its size he had seen.

He referred to the difficulty of getting suitable blue glass for stencil indicators, and said that nowadays manufacturers seemed only able to supply flashed opal glass or flashed blue glass. In the process of manufacture, the flashed blue tended to concentrate in the centre of the sheet of glass, and the flashed opal concentrated on the edges. Therefore, all round the edge of the glass was a comparatively thin blue and a comparatively thick opal. This provided not only a poor background colour, but the thick opal gave a hazy stencil image. He hoped the time would come when more thought would be given to supplanting that kind of material by some of the newer plastics. The wastage of the present type of blue glass for large indications was enormous, as the outside of the sheet of glass could not be used for any image that had to appear out in sunlight. He thought that the tendency to use amber as a background should be stopped and added that dark blue formed one of the best backgrounds. The objective was to get a good contrast between the illuminated part and the unilluminated ; a dark background against a light figure. He was a little surprised that London Transport had attempted to produce a white figure on a white background.

Referring to the theatre-type indicator, the paper spoke in favour of the series lamp indicator, as lamps did burn out, but there was equal justification for the parallel type, where there was a saving of various voltage transformers necessary for the series type. He agreed that, in general, the gridded screen should be used for that type of indicator, as being very much cheaper and simpler, but there were certain cases where an individual mounted unit was suggested, as with a large number of indications on the grid, some might not be satisfactory.

Regarding the junction indicators he thought there were arguments on both sides concerning the pivot and the non-pivot types, although there did not appear to be much to justify the non-pivot type, as it increased the size, and the pivot type would seem to give the same indication to the driver.

Mr. W. Owen said he would like to comment on Mr. Currey's reference to London Transport. What appeared to be a white ground, when the signal was not working, was really frosted or opal glass in front, but on the back of the glass was a painted stencil. When illuminated, the result was white on a black

ground. Such indicators were used in places where the light was dim, seldom in the open, because London Transport normally used theatre type route indicator, which was the multiple-light type, parallel connected.

Mr. H. Birchenhough said he was interested in the reference to a neon tube for a junction indicator and enquired why fluorescent tubes, which would seem to be an ideal medium, had not been adopted for use on theatre type indicators.

Mr. J. H. Fraser said the reason why the neon light mentioned had been discontinued was that it was one of the original vacuum discharge type and gave a bright yellow light which in foggy weather became a decided red and so conflicted with signal aspects. Also, the brightness of the light could not be easily controlled. He did not wish to argue in favour of the non-pivot indicator, which he thought was rather clumsy, but it had the advantage that it could be set up on a bench to make certain that all the lamps would be in alignment and in the same focus, whereas with the pivot type, the lamps had to be focussed separately.

He pointed out the desirability of the operating department arranging that on indicators, the same letter meant the same thing wherever it was displayed, as this would be of considerable help to the drivers.

Mr. R. A. Powell, referring to the proving of lamps in route indicators, asked whether a group of lamps in the grid was indicated, or whether the number of lamps was indicated.

Mr. F. W. Young spoke in regard to the great number of shunt signals without the aid of electrical routing devices, which existed and would presumably have to exist, and said it was a matter of approach as to how many routes were exhibited on such signals. Where movements were of equal length, the number of signal arms should be restricted. Where movements crossed a main line, he did not think it really necessary to route them separately, where the routes were of the same type and length. If drivers could be relied upon, indications could be kept to a safe and practical minimum.

Regarding the control of route indicators fitted to semaphore signals, he thought that to indicate the route before the signal

arm was set to clear, could mislead drivers, particularly at night, therefore the arm should first be set at clear.

Regarding the recommendation that all route indicators, where colour-light schemes were concerned, should be proved "off" before the signal aspect cleared, Mr. Young said that he had made a passing reference to semaphore signals. However, it might not be correct to make the comparison, as junction indicators applied to moving traffic, but multi-lamp indicators were used where speeds were low, and one was inclined to ask whether the additional proving was justified. Secondly, would it not be unduly difficult to do, except where series lamps were employed? Thirdly, was it not, in fact, undesirable to prevent the use of signal running into terminal stations where speeds were restricted, simply because a route indicator failure had occurred? Was it not possible to accept that state and allow trains to continue under signals, rather than emergency arrangements?

Mr. W. J. Sadler said that the whole story of route indicators sprang from the British practice of insisting on route signalling as distinct from speed signalling which was practised practically everywhere else in the world. He noted that the invention of the junction indicator was patented about the year 1933. At that time, railway practice in Britain was getting into rather a peculiar condition, because it was still moved by the mainspring of route signalling which then had to be operated with colour-light signals. He thought that Mr. Fraser would confirm that, in doing some of the main line work at York, they commenced with geographical route signalling. About that time, the L.M.S. Railway began to make experiments and opened the first speed signalling installation. The L.N.E.R. then experimented with their junction indicator and made a very good thing of it. The practice was now confirmed and had become standard.

It was interesting to see how the principle of route signalling as distinct from speed signalling resulted in some difficulties. At St. Pancras, when it came to the semaphore signalling there, on account of the restricted approach to that station, there was not room to get in all the mechanical signal arms to make them appear as clear indications to the driver. Therefore, they had to develop the mechanical indicator described in paragraph 2 (vi) of the paper, but it was limited to four indications. They had another, which contained nine indications, the capacity of the

machine being limited only by its weight and the tension put on the signal gantry.

Mr. J. S. Davis said that the roller blind indicator was far from perfect. Paragraph 3 (ii) of the paper stated that the consistent arresting of the blind was ensured, but later it stated that the main difficulty of the indicator was overrunning. He asked the author to clarify this point.

He thought that double-sided, multi-lamp route indicators should incorporate a back indication, especially at busy stations and junctions. It was essential that there should be some indication that the signal had been cleared. The installation at York provided for that by the use of the different coloured screen. He suggested that it was not a question of economy; it was an essential feature for the protection of staff.

Where platform starting signals were concerned, if the operating department could give an assurance that, in all cases of a train starting from the platform, the engine would be immediately on the approach side of the signal, he agreed that a stencil type indicator would serve; but if, as was the case with some stations, the train might be only a short one and there might be several yards approach run to the starting signal, he suggested that the indicator must be a long range, multi-lamp one.

Regarding individual signal renewal and the view that it was usually a more economic proposition to provide electrical detection and renew the signal in colour-light form, he suggested that it might be policy to do so, but that it was not economic.

The author had suggested that the selector type of control for route indicators was an economic proposition, once three indications were required. On first cost alone, and on annual costs, Mr. Davis thought that it did not become justified until the number of routes rose to six, or even more.

Mr. P. A. Langley, referring to multi-lamp indicators, said that no comment had yet been made concerning the author's question as to whether, if all routes into a station were equal in length, it would be sufficient to give the driver an aspect reading 1-6. He suggested that under the conditions stated there would be no need to give any direction at all.

He did not agree that it was an economical proposition to provide electrical detection where individual signal renewals were concerned. Where two or three routes were involved, the

mechanical connections were retained, and the improvement confined to the provision of an electrical indicator to eliminate a mechanical one. The provision of a lamp-type indicator was an improvement well worth while, as it eliminated moving parts, thereby reducing maintenance and renewal costs. There were many applications regarding semaphore signals with electric route indicators on goods lines and subsidiary lines, where the oil lighting of the semaphore signals could be retained and multi-lamp route indicators be provided with a stand-by power supply.

In the latter part of the paper, mention had been made that no detection would be provided in goods roads. He did not quite understand that, because where route indication was necessary, one would expect detection to be necessary.

Mr. S. Williams referred to difficulty encountered in the past with what was known as the "music hall" type of indicator. He recalled one case where the speed was not in excess of 25 miles an hour and where there were seven platforms leading to five routes, all of which began with the letter "S," "Stafford," "Shed," "Slow," "Salop," and so forth. They had to put in another intermediate signal, a little ahead of the junction indicator. In those days, they were not permitted to use junction indicators; they used a subsidiary indication, consisting of two white lights. When it came to a stencil indicator, they decided to use the first two letters of each word, to get over the difficulty. With the stencil indicators, there were two distinct types, one which told the driver where he was to go, and the other was intended to tell him how he should go. One was a route indicator; the other was a warner, calling-on or shunt ahead. There was one case of a stencil indicator working with a subsidiary and the letter "S," where the operating department wanted the letter "S" on the arm signal to tell the driver he could shunt ahead.

He referred to a scheme in which white letters were used on a dark ground to show where the driver was to go, and black letters on a white ground to show how he should go.

Some advocated a 3-lamp junction indicator, and others a 5-lamp indicator; and he suggested that four was simply an effort to strike a happy medium. With the 3-lamp indicator, a position light subsidiary signal was adopted. The 5-light indicators were proved, with the pilot light in and any two of the

others. In other words, to get the signal "off," there must be three lights in the junction indicator.

The **Author**, *in reply to Mr. Currey*, said that he was not familiar with the type of roller blind indicator at Glasgow Central and was therefore unable to give the required information. With regard to the difficulty in obtaining a suitable blue glass for stencil indicators, he had experimented with plastics, and found certain troubles, such as warping. As to the theatre type indicator, he agreed that the gridded screen did not always meet requirements, but thought that in almost all cases it could be used; square letters were satisfactory as long as they were clear and distinctive. As to pivot and non-pivot types of junction indicators, in 1935 the signal committees in Britain had agreed that the pivot junction indicator should radiate from the centre line of the aspect which was understood to mean that the pivot was the correct type. He believed that that was also approved by the Ministry of Transport at that time.

He was interested to hear from Mr. Owen that the parallel lamp type of multi-lamp indicator was used on the London Transport Executive.

The query raised by Mr. Birchenhough regarding the neon tube installation at Thirsk had been answered by Mr. Fraser. Owing to the higher voltage, they did get a certain amount of leakage across the surface in damp weather, which stopped the tube striking in; and vibration was also another important factor.

He noted that Mr. Fraser was not very impressed with the individual focussing for each lamp housing for the pivot type of junction indicator. The junction indicator did get blamed for bad lights and sometimes the Regions experimented with different types of lamp, yet by using the focussing of each individual housing, they might better the indication.

In reply to Mr. Young, who did not like the idea of the route clearing before the semaphore arm. It was a matter of opinion and could be argued at length. He (the author), preferred to see the route clear before getting the aspect, as he considered that if a driver saw an aspect and not a route, it could lead to a dangerous feature.

In reply to Mr. Davis, who had referred to the comment in the paper that the roller blind indication was perfect, whilst later on, it was stated that perhaps a partial, and not a perfectly true,

indication was given. That might be so, but the design was such to give full indication. Regarding the double-sided, multi-lamp route indicators, it would double the cost, if front and back indications were given. The use of stencils was a far cheaper method. He could not agree that multi-lamp indicators were, in all cases, necessary in platforms. What he had in mind were short bay lines with a long run up to the signal.

He noticed that Mr. Langley also agreed with Mr. Davis's views over individual signal renewals. In answer to Mr. Langley's comment on detection in goods roads, he explained that there were still goods lines in the country with goods sidings without protection.

Regarding Mr. Williams' remarks on the 3- and 5-lamp junction indicators. The original aim was to get a bar of light and in his opinion, the best way to do that was with a 5-lamp indication. With three lamps the space between was increased, and if only one lamp failed the aspect was lost, whereas with the five lamps, two could fail without destroying the indication.

Mr. J. S. Davis (*in a written communication*), gave some interesting particulars in regard to an early type of route indicator signal installed probably about 1870 on the Talk o'th' Hill branch near Stoke. It was in the form of a semaphore arm, working at the top of the post, and moved an equal amount on each side of the vertical centre. It was fitted with white and purple spectacle lenses. The arm indicated the closed switch, that is, when the arm was lying to the left, the road was set for the right.

The branch was closed to all traffic in 1933 and the signal is now in the charge of the B.T.C. Curator at the Historical Records Department.

The President proposed a very cordial vote of thanks to the Author for his excellent paper, which was carried with acclamation.

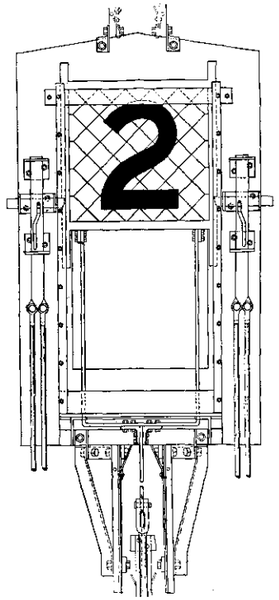

Fig. 1
Annett. Showing Operating Mechanism

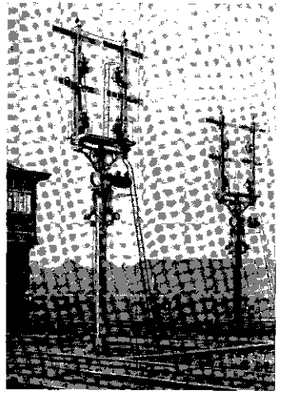

Fig. 2
Saxby and Farmer Disc

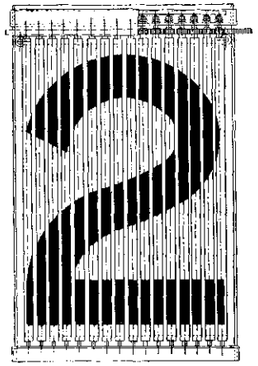

Fig. 3
Thompson's Revolving Vane

Fig. 4
Indiciaton Added to Banner Signal

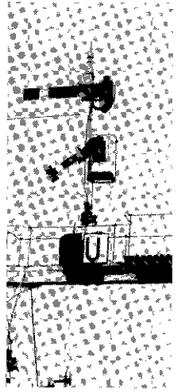

Fig. 5
Acfield and Cooke

Fig. 6
Moore and Berry

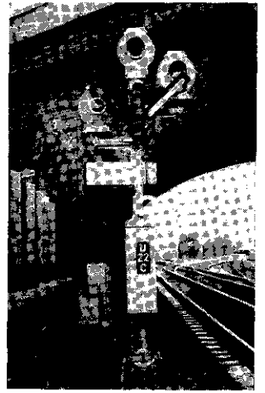

Fig. 7
Original Neon Indicator as used at Thirsk (N.E. Region)

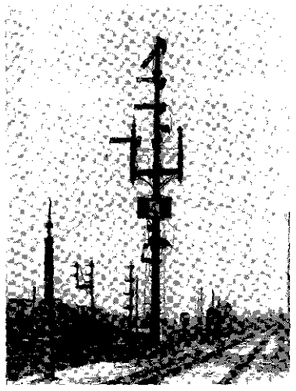

Fig. 8 Ex Great Eastern Mechanical Indicator

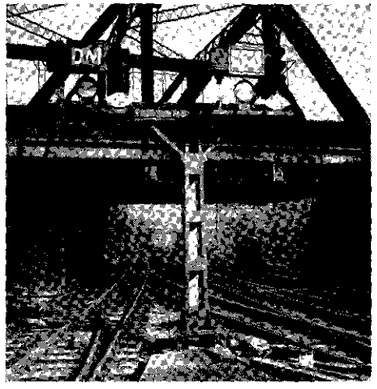

Fig. 9 Roller Blind Indicator

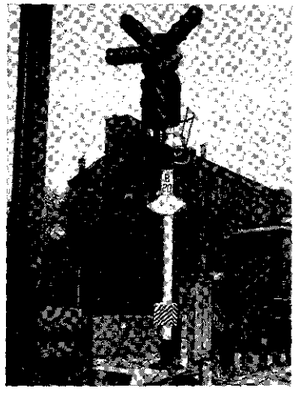

Fig. 10 Junction Indicator 5 Lamp Pivot

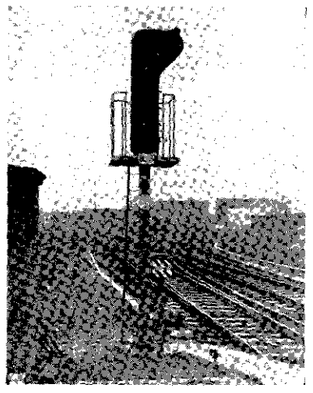

Fig. 11 Junction Indicator 3 Lamp Pivot (Southern Region)

Fig. 12 Juction Indicator 5 Lamp Non-Pivot

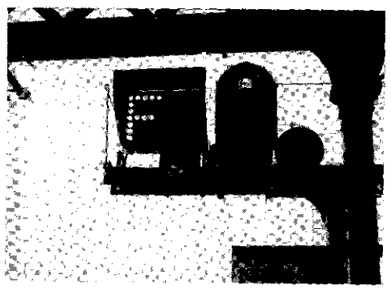

Fig. 13
Multi-Lamp Indicator
(L.M. Region)

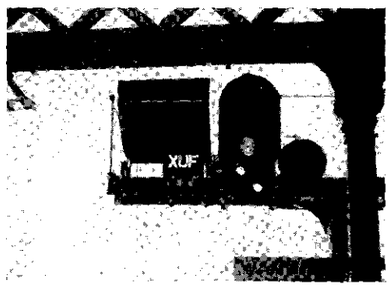

Fig. 14
Stencil Indication for Shunt in Facing
Direction of Traffic (L.M. Region)

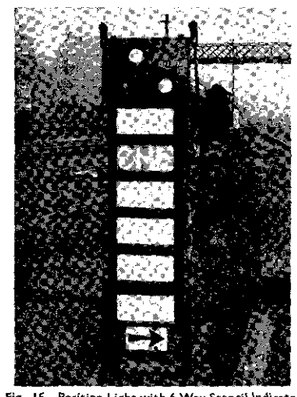

Fig. 15 Position Light with 6 Way Stencil Indicator
(L.M. Region)

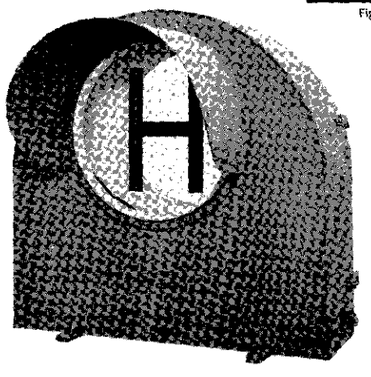

Fig. 16 "Z" Armature Operated Indicator

Fig. 17
Control Mechanism for "Z" Type
Armature Indicator

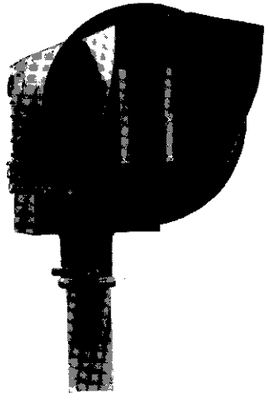

Fig. 18 Optical Projector Unit

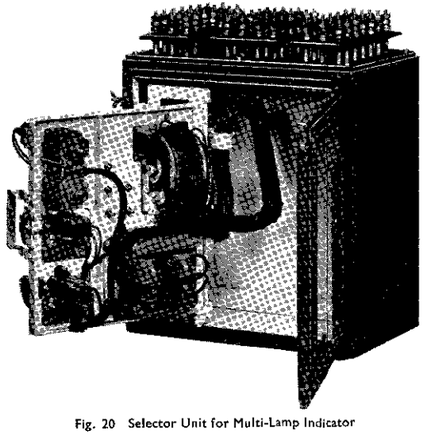

Fig. 20 Selector Unit for Multi-Lamp Indicator

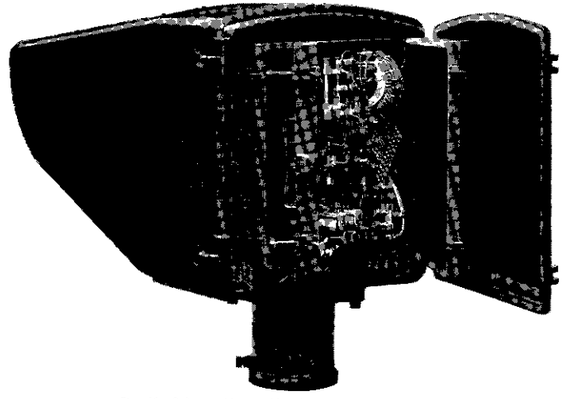

Fig. 19 Selector Unit in Housing of Multi-lamp Indicator

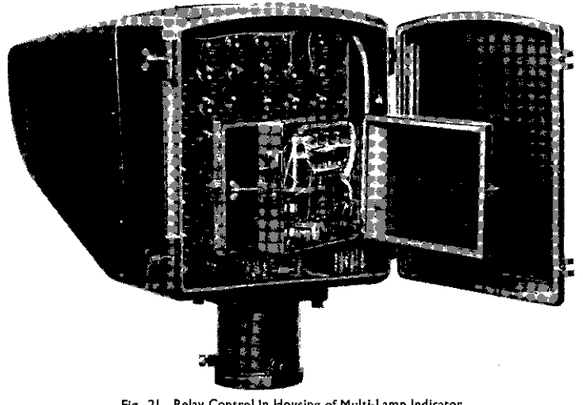

Fig. 21 Relay Control In Housing of Multi-Lamp Indicator

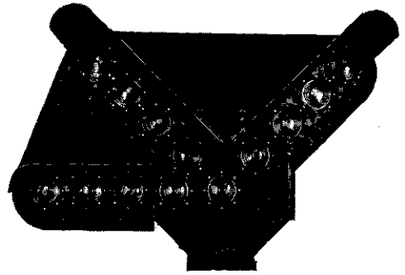

Fig. 22
Junction Indicator 5 Lamp Pivot

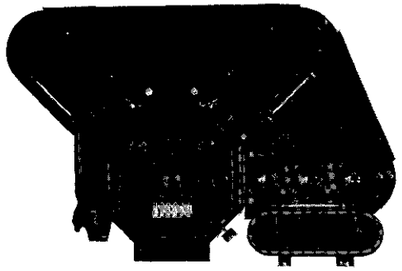

Fig. 23
Rear View of Fig. 22

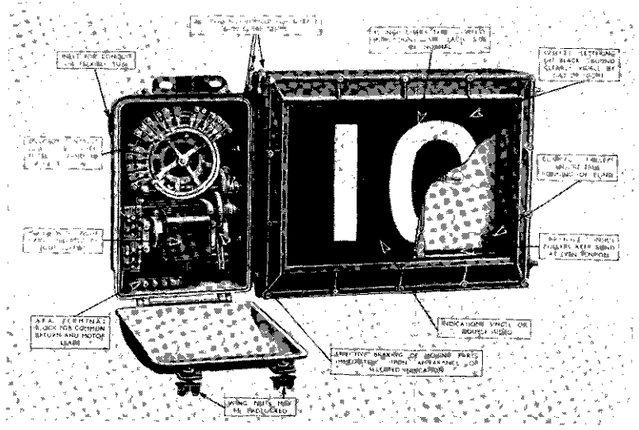

Fig. 24 Roller Blind Indicator Showing Operating Mechanism

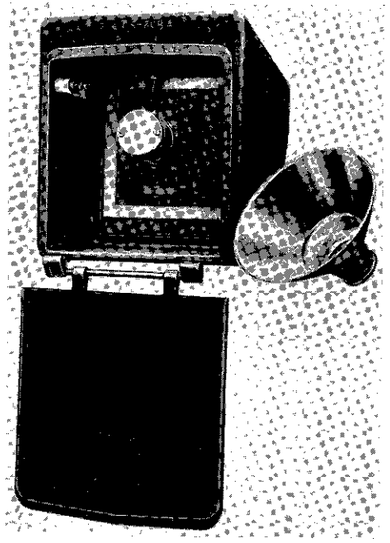

Fig. 25
Single Unit Stencil Indicator with Reflector Removed

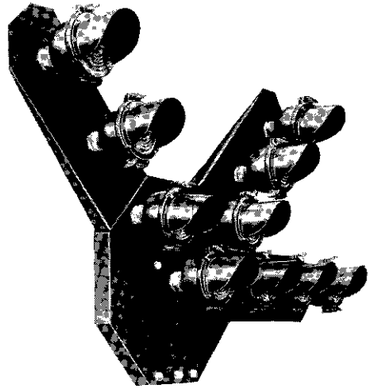

Fig. 26
Junction Indicator 4 Lamp Pivot Showing Adjustable Lamp Housing