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The

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THE DEVELOPMENT OF THE S.E.50 SELECTOR

*W. R. ROSE**

Introduction

Prior to the second world war, two principal designs of two motion selectors

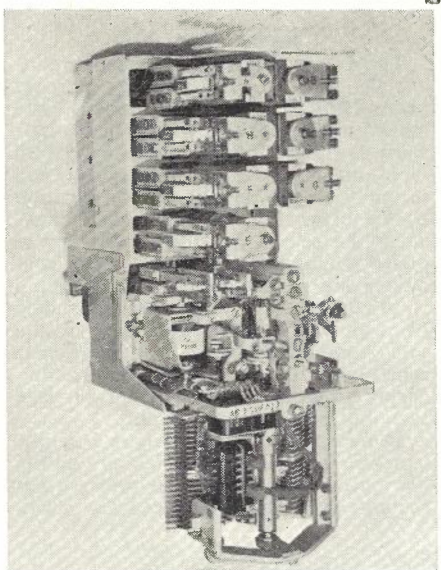

Fig. 1.—SE 50 Selector.

were in common use. The Strowger selector was the older of the two, and had survived with very little change since its inception. The other was a more recent design standardised by the British Post Office in 1937, and designated B.P.O. type 2000 selector. Both of these selectors are well known in Australia. Throughout the service life of these selectors a great deal of relevant information on the operational performance had been obtained. In addition, a considerable amount of development and research work had been undertaken to meet the ever increasing demands for the continually expanding requirements of automatic telephony. From a careful review of the data obtained, a reasonably complete picture of the state of two motion selectors was established.

In general, the existence of two designs tended to emphasize the deficiencies of each, and the General Electric Co. Ltd. was compelled eventually to give careful consideration to the introduction of a new design of selector. A project of this magnitude could not be undertaken lightly, and, after a great deal of detailed discussion over the problems involved, it was decided to proceed with a new design in which maximum reliability was to be the predominant factor. Allied to this was economy in space, the reduction of maintenance to the absolute minimum and a uniform system of adjustments to obtain the maximum metal to metal engagements on parts subject to wear, all correlated to a carefully defined easily accessible and reliable datum to ensure these fundamentals were obtained at the lowest possible cost.

The new S.E.50 selector (see Fig. 1) developed by the General Electric Co. retains all the well known, tried and proved Strowger principles and a detailed description of its characteristic features, its outstanding points of interest, the many constructional advantages and the ease and accessibility of adjustments follows. For comparison purposes Fig. 2 shows the Strowger selector and Fig. 3 the B.P.O. type 2000 selector.

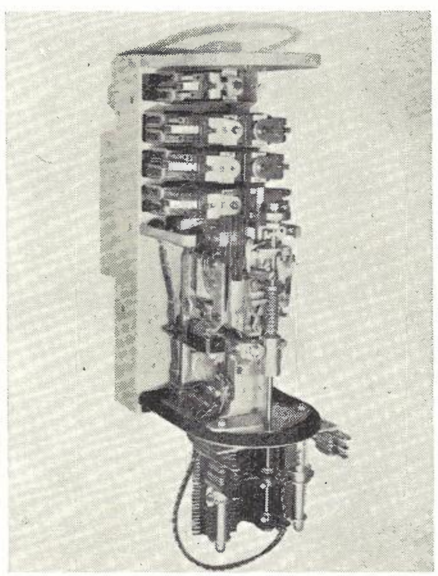

Fig. 2.—The Strowger Selector.

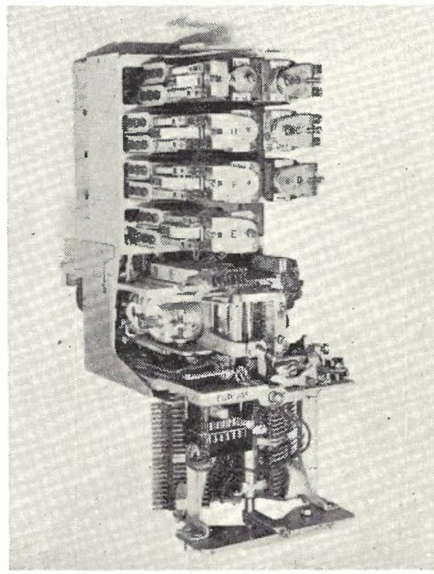

Fig. 2.—B.P.O. Type 2000 Selector.

A radical departure has been made from the generally accepted procedure in use for assembling mechanisms of this character, in so much that the principle of using assembled, adjusted and tested sub-units in place of the usual assembly of individual parts, has been introduced. This is not only a big advantage for flow line assembly, but can be most useful for administrations where the quality of maintenance is not of a particularly high standard. The maintenance staff can be trained to adjust these sub-assemblies correctly, leaving detail adjustments to a central depot where a highly trained man can deal with them.

The first sub-unit is the frame and frame column assembly, the base on which all the remaining sub-assemblies are associated.

Frame

The frame has been designed to accommodate in the most effective manner the sub-assemblies that collectively make up the complete switch. See Fig 4. It is produced as a pressure die-casting from an aluminium silicon

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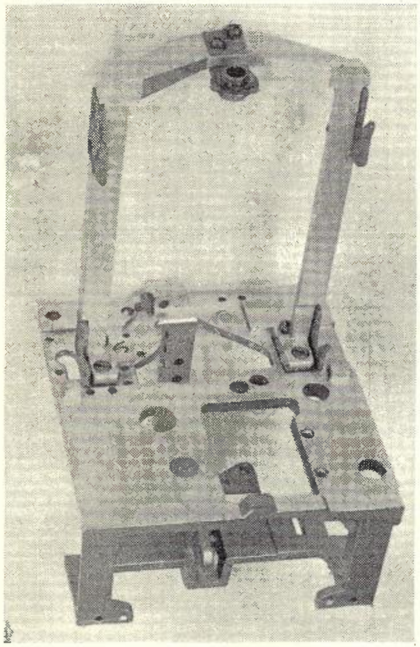


Fig. 4.—Frame and Frame Column Assembly.

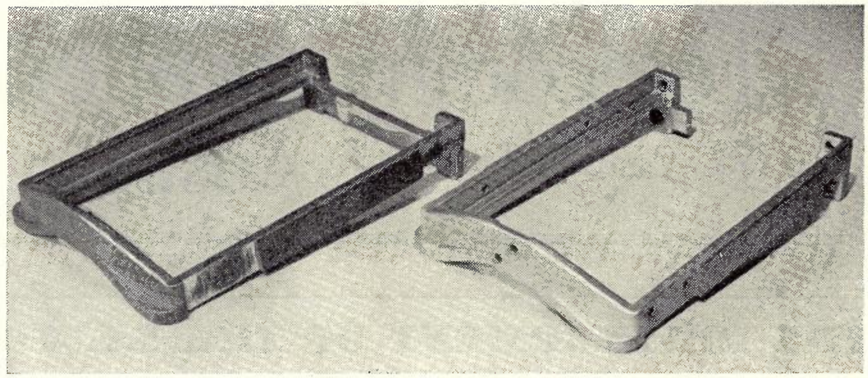


Fig. 6.—Frame Column. (a) Pressure Die Casting, (b) Machined and finished.

alloy giving the minimum weight consistent with strength and rigidity. The cold chamber process used ensures a casting of excellent form, free from porosity, capable of absorbing all impacting blows to the best advantage, and it also gives satisfactory dimensional accuracy and structural permanence of a high order. It is so proportioned that when the fixing of the associated sub-assemblies is accomplished, no distortion of the frame occurs. Well defined and easily produced datum faces are provided integral with the more robust parts of the frame structure.

Machining has been reduced to the absolute minimum and where machining is necessary, faces are provided where cutters of simple outline can be used in simple planes of operation. The first machining process is applied to the base of the casting. The datum faces on which the selector rests when located in the cradle, and the faces on which the frame column is mounted, are machined using a combined face cutter and end mill, one single simple operation, thereby ensuring an exact dimensional and planary relationship. The locating faces for the rotary magnet and the vertical magnet, are machined from the faces thus produced, thereby ensuring an accurate and consistent co-ordination of the surfaces necessary for easy and exact assembly.

Tapped holes, a potential source of scrap in manufacture and maintenance have been reduced to 11 and these provide only for permanent clamping positions or are used in association with details not normally included in the category of adjustments. See Fig. 5.

Frame Column

The frame column is a most important detail of the selector, its purpose being twofold. Firstly it aligns and maintains the position of the main shaft squarely in two planes with the datum faces on the base of the frame, and secondly it ensures the correct relation of the main shaft to the contact banks when the selector is fitted in its appropriate mounting. To ensure these conditions are met adequately, the column is produced as a single member made from an aluminium silicon alloy by the cold chamber process, this particular constructional form giving it stability during transport and adequate carriage assembly returning to normal.

The casting is produced as a box like structure primarily for rigidity during the machining processes, to preserve the accurate relationship between the mach-

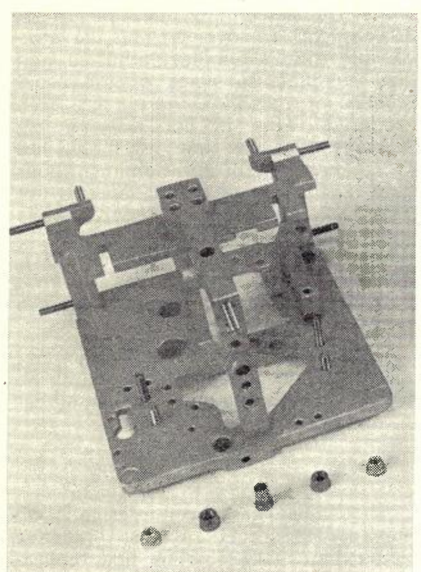


Fig. 5.—Frame, showing position of the 11 tapped holes.

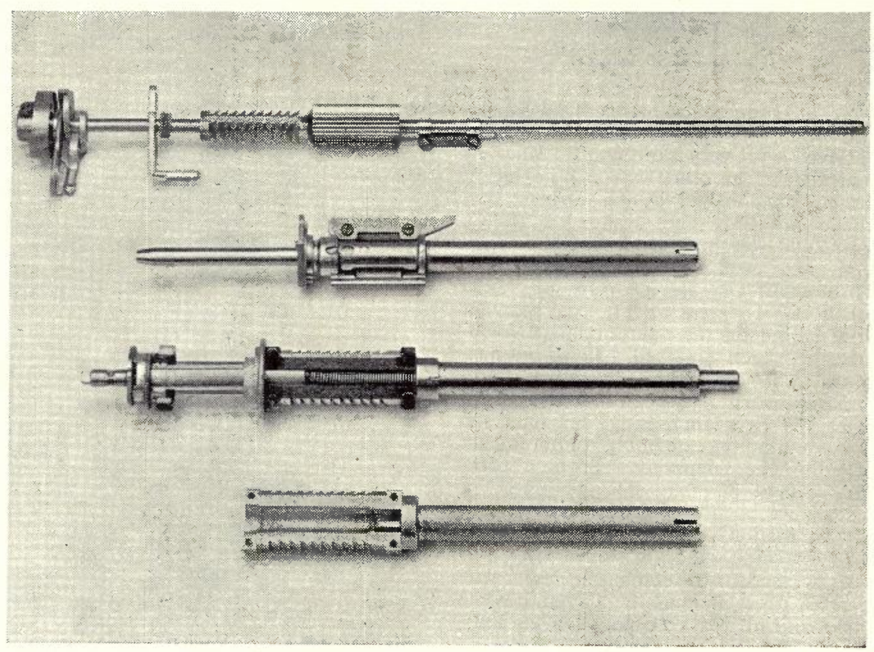


Fig. 7.—Vertical and Rotary Ratchet Assembly. (a) Strowger Selector, (b) P.P.O. 2000 type Selector, (c) SE 50 Selector.

ined locating surfaces and the drilled holes. After machining the surplus metal of the bracing rib is removed. See Figs. 6 (a) and (b).

Main Shaft—Rotary and Vertical Ratchets

The vertical and rotary ratchet combination on the Strowger selector consists of a single ratchet unit on the upper part of which the vertical teeth are machined, with the rotary teeth machined on the lower part. The ratchet is secured to the shaft by a pin, consequently the complete system moves during rotary and vertical stepping. The application of the rotary drive, via the rotary pawl, is approximately midway between the shaft bearings, a condition giving optimum deflection of the shaft for a given pawl pressure at the completion of the forward movement of the armature.

The vertical and rotary ratchet combination on B.P.O. 2000 type selectors consists of a rotary ratchet on the side of which is attached a hardened vertical ratchet. A tube for carrying the wipers is common to this assembly and the complete system moves during rotary and vertical stepping. This combination differs fundamentally from the Strowger combination, moving as it does over an independent shaft. The application of pawl pressure being nearer to one end of the fixed shaft, the deflection introduced by the pawl pressure is reduced.

The S.E.50 selector has an entirely different vertical and rotary ratchet combination. The principle of using an independent shaft is maintained, this giving comparable operating conditions for each wiper assembly, and uniformity of the relation between the individual wipers and associated contacts in the banks. See Figs. 7 (a), (b) and (c).

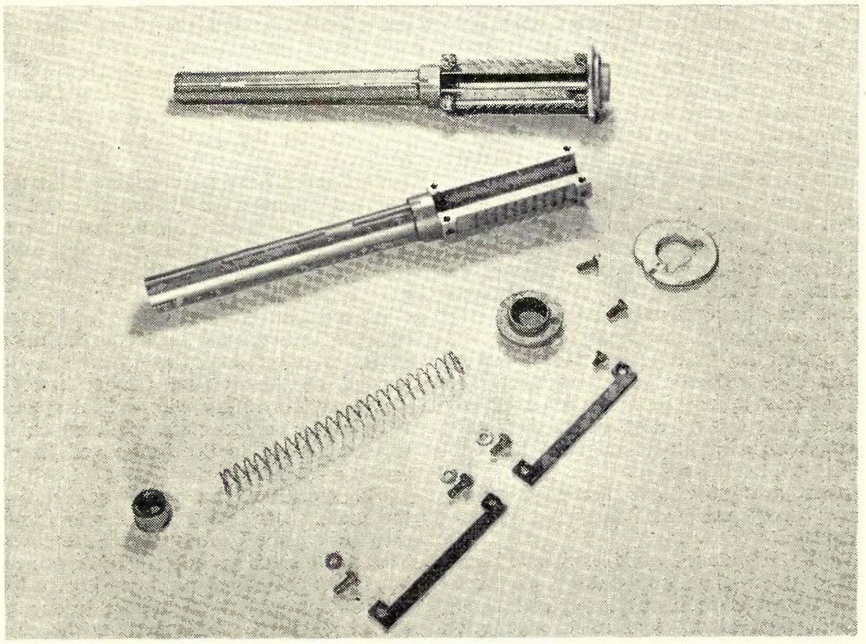


Fig. 9.—Vertical Ratchet Assembly and Details.

The reduction of wiper carriage flexure to the lowest practical minimum during rotary stepping ensures that the full advantage of the independent shaft is realised. To ensure this condition the rotary ratchet has been located so close to the frame, that the applied pawl pressures do not give shaft deflection.

The location of the rotary ratchet consistently close to the frame throughout the full range of vertical stepping, has been achieved by a ratchet construction entirely different in principle to those in use on the selectors described above. The rotary ratchet has no vertical movement, and is retained by means of "U" links engaging an annular groove in the shaft. It has a long bearing embracing the shaft, giving a free rotary movement with a minimum of play.

The rotary return coil spring functions directly between the lower end of the rotary ratchet bearing and the shaft. This direct application restricts the effect of the spring pressure to the return of the rotary ratchet, without imposing any load on the sliding surfaces between the rotary and vertical ratchets.

The rotary ratchet is made from a high grade aluminium bronze, which life tests have proved to have adequate wearing qualities. This material is the same as that used for uniselector ratchets. The teeth are produced by the hobbing process, a method providing advantages in accuracy and ease of production over the single cutter or shaping processes. This type of ratchet gives a uniformity of position of the wipers, irrespective of the vertical level on which they operate.

The combined rotary return and rotary travel limiting stop, the shaped cam for direct operation of the rotary off-normal and 11th row spring sets are accurately located on the top face of the rotary ratchet with sealed dowel screws. The periphery of the spring operating cam is ground in position after assembly to ensure uniformity of spring set operation. Fig. 8 shows the assembly of the rotary ratchet.

The use of a fixed position rotary ratchet with its dependent vertical ratchet introduces the necessity of a sliding mechanical joint between the two, to meet operational requirements. The design adopted was the result of a careful analysis of the functional, mainten-

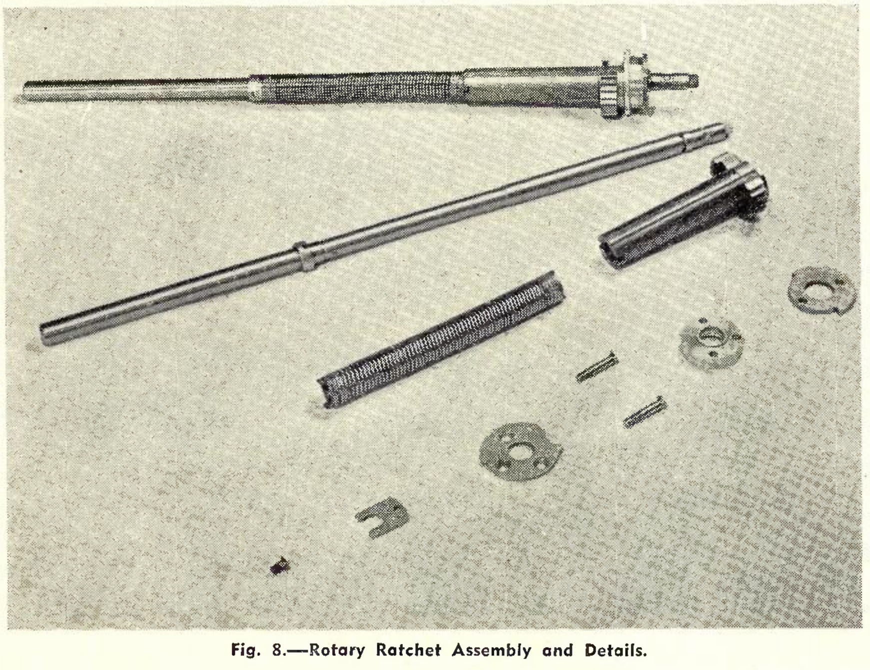


Fig. 8.—Rotary Ratchet Assembly and Details.

ance and manufacturing characteristics of a variety of constructions applicable to a mechanical problem of this nature. The essential requirement of operational accuracy and efficiency, coupled with comparative ease of manufacture have been realised in the design adopted. The fundamental condition of consistently accurate alignment between the vertical and rotary ratchets at each bank level was established by the use of comparatively simple mechanical constructions. The rotary relationship between the two ratchets was achieved by accurately grinding the external diameter of the long bearing of the rotary ratchet, and reaming the hole in the top bearing associated with the vertical ratchet. The vertical relationship was achieved by machining a parallel spline on the rotary ratchet in axial alignment with the bearing hole. In combination with this spline, two adjustable hardened guides are accommodated on the vertical ratchet.

The left hand guide is located and fixed by a close fitting dowel screw in the upper position, the lower end of the guide has lateral adjustment, and after the ground face of the guide has been set in axial alignment, the guide is fixed in position by the screws. The vertical ratchet is now associated with the rotary ratchet and the right hand guide is brought into sliding contact with the spline. In this position the guide is secured firmly to the vertical ratchet by means of the fixing screws and an accurate sliding joint is secured. The slotted ends of the guide plates have serrations on the surface, to ensure firm fixing, and the screws are made from high tensile stainless steel. Fig. 9 shows the assembly of the vertical ratchet.

Life tests have proved reliability of this construction, and the following extracts taken from a life test report on a S.E.50 selector after 6,000,000 calls, in terms of rotary play in the spline shaft, (average 5 steps each vertical and rotary) show.

Selectors as received from production —less than .002″
1,150,000 calls —less than .003″
2,150,000 calls —less than .003″
3,000,000 calls —less than .005″
As this stage spline play was adjusted to less than .002″
6,000,000 calls —less than .004″

The design of the vertical ratchet was a problem of great interest, not only in its physical structure, but also its relation to the ratchet assembly as a whole. To obtain the maximum degree of accuracy, it was considered desirable to use a material hard enough to ensure satisfactory wearing qualities in service, without running the risk of distortion likely to arise from a heat treatment process, yet not too hard to produce difficulties in the machining processes. The most suitable material for meeting the somewhat onerous conditions is aluminium bronze, the material used for the rotary ratchets.

The ratchet is made from a turned blank, with the short faces of the ratchet teeth undercut to give the best operating conditions, and the short faces of the rotary guide teeth square with the axis, to obtain maximum wearing qualities in relation to the vertical and fixed detents. Flats are provided on one side for carrying the guide plates already referred to.

The upper bearing, engaging with the external diameter of the rotary ratchet tube, and the vertical off normal operating cam are accurately located and fixed with sealed screws on the top face of the vertical ratchet.

A vertical return spring is housed between the carriage tube and the main shaft, to ensure satisfactory return to normal of the vertical ratchet system. The complete rotary and vertical system is mounted on the main shaft, which in turn is located in the frame and frame column assembly.

The constructional design of relating the main shaft to the frame and frame column assembly, has novel features. The main shaft is not rigidly clamped, but freely positioned with a spring loaded plunger situated in the upper bridge of the frame itself. This permits the easy adjustment of rotary spring pressure by the simple expedient of applying an 8 BA spanner to the square on the upper end of the main shaft.

Movement of the shaft in an anticlockwise direction (looking from above the selector) increases the return spring pressure, without any disturbance of any other part or of any other adjustment on the selector.

The direction of the pressure applied by the plunger, coincides with the direction of pressure from the rotary pawl at the completion of the armature stroke, with the rotary pawl fully engaged with the front stop thereby eliminating the effect of shaft "knock".

Since there is no rigid connection between the lower end of the main shaft, and the bracket carrying the adjustable gland screw (fixed to the base of the frame column) the vertical return to normal of the wiper carriage does not disturb the location of the main shaft, and the effect of any bounce is not transmitted to the main shaft, thereby eliminating the danger of upward shaft reaction breaking the support at the top of the frame.

The gland screw provided at the base of the frame column, permits easy vertical adjustment of the normal position of the wiper carriage, at the same time maintains parallelism between the lower face of the lower bearing in the carriage assembly and the upper face of the adjustable gland screw.

In general the rotary and vertical ratchet system comprises a main shaft, carrying the rotary ratchet and its directly associated return spring. The rotary ratchet is free to rotate on the main shaft but is located and restrained from vertical movement by the use of a "U" link engaging in an annular groove in the main shaft.

Rigidly associated with it are the combined rotary return and rotary travel limiting stop, the concentric cam for direct operation of the rotary off normal (NR) and 11th row (S) spring sets. The vertical ratchet is free to slide in a vertical direction, relative to the rotary ratchet, but is restrained from relative rotary movement by two hardened adjustable guides engaging a spline on the rotary ratchet. Rigidly associated with it are the upper bearing, which slides on the external stem of the rotary

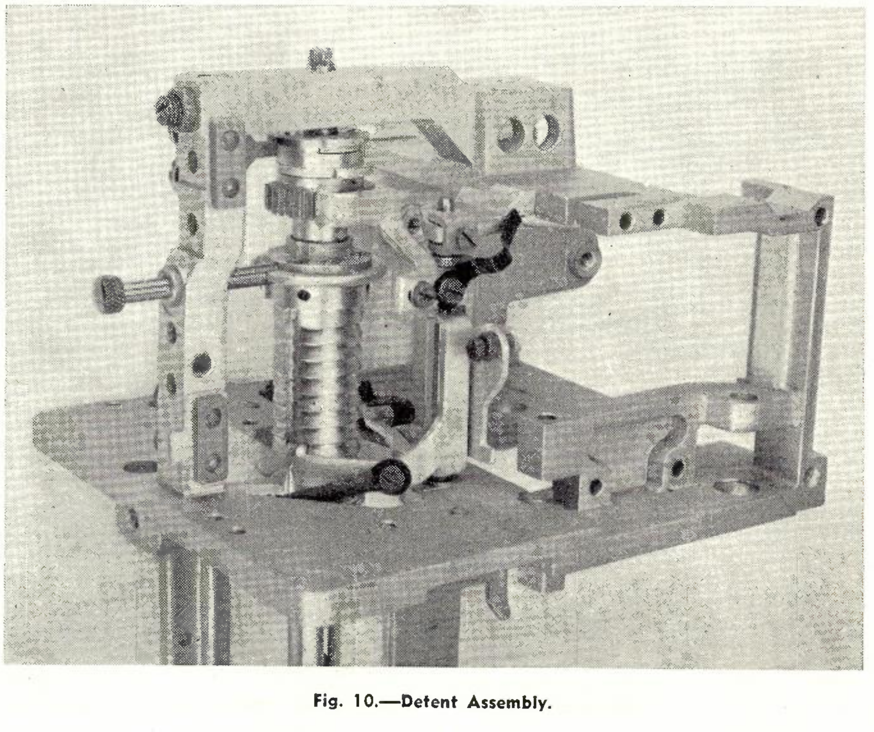


Fig. 10.—Detent Assembly.

ratchet, a cam for operating the vertical off normal (N) spring sets and the level spring (NPA and NPB) spring sets, and the wiper carriage tube, carrying at its lower end a bearing bush functioning on the main shaft. An independent vertical return spring is fitted between the vertical ratchet and the shaft.

The main shaft forms a complete sub assembly which can be assembled, adjusted and tested prior to assembly into the frame and frame column assembly.

Detents

The correct location of the vertical and rotary ratchets after each step is controlled by detents, the assembly of which is shown in Fig. 10. The design and disposition of the detents must be such that the ratchets are located easily, definitely and accurately and the restraining forces applied to resist the pressure of the "return-to-normal" springs. They must have the maximum metal to metal contact, to ensure maximum service life, and this condition must be easy to obtain.

The design and construction of the detent system used on the S.E.50 selector consists primarily of a rotary detent bracket, mounted on a bearing having a very fine adjustment in the vertical plane. This bracket has an extended member on the lower end to engage the lock out spring; an extended member at the upper end to carry the hardened adjustable rotary detent and detent return spring; two extended members at the side, one carrying an adjusting screw and lock nut, for controlling the operating relation between the rotary and vertical detents; the other engaging with a projection on the sliding member operated by the release armature.

The vertical detent located on the same bearing, carries an extended member at the upper end in line with the adjusting screw on the rotary detent bracket; and the detent arm engaging with the vertical ratchet guide teeth carries its associated return spring. The rotary detent bracket, and the vertical detent are retained in constant vertical relationship by a small adjustable collar.

After the completion of a call, the S.E.50 selector, in common with the Strowger selector, first returns to rotary normal, and then to vertical normal, and the withdrawal of the detents, by the operation of the release magnet, follows the same sequence. This design of divided detents, operating in the same release sequence as the selector, has two distinct advantages:—

(1) The repeated operations of the vertical and rotary stepping does not disturb the rotary and vertical detents respectively thereby reducing wear to the minimum.

(2) In conjunction with a simple interceptor magnet, rotary release only can be effected, thereby permitting rapid access to consecutive levels without return to vertical normal.

The bearing, identical with the bearing used for the normal post operating gates is, after adjustment, locked in position with a "U" clamp, a construction giving maximum security without disturbing the adjustment. The effect of any wear in the detent bearing holes is reduced to a minimum by extending the distance between the lugs to the maximum limit permitted by the height of the frame.

Assembly of Ratchet Unit and Detent Unit to the Primary Unit (Frame and Frame Column Assembly)

The assembly and adjustment of the ratchet unit to the frame and frame column unit is comparatively simple. The adjustable gland screw at the base of the frame column is removed, the lower end of the main shaft projected downward through the hole in the gland screw plate and then after the three fibre washers and the gland screw have vertical and rotary normal positions, the vertical and rotary stepping positions.

In the front column of the frame, an accurately reamed bush is inserted, the centre of the reamed hole intersecting the centre line of the main shaft, and the centre line of the vertical off normal operating cam. In the vertical plane the centre of the reamed hole coincides with the centre line of the vertical off normal cam, when the vertical ratchet unit is raised eight vertical steps.

The datum pin is a sliding fit in the reamed hole, and has two diametrically opposed slots accurately machined in the end. The width of the slots, and thickness of the throat agree respectively with the thickness of, and the width of the slot in, the vertical off normal operating cam. See Fig. 11. A fundamental

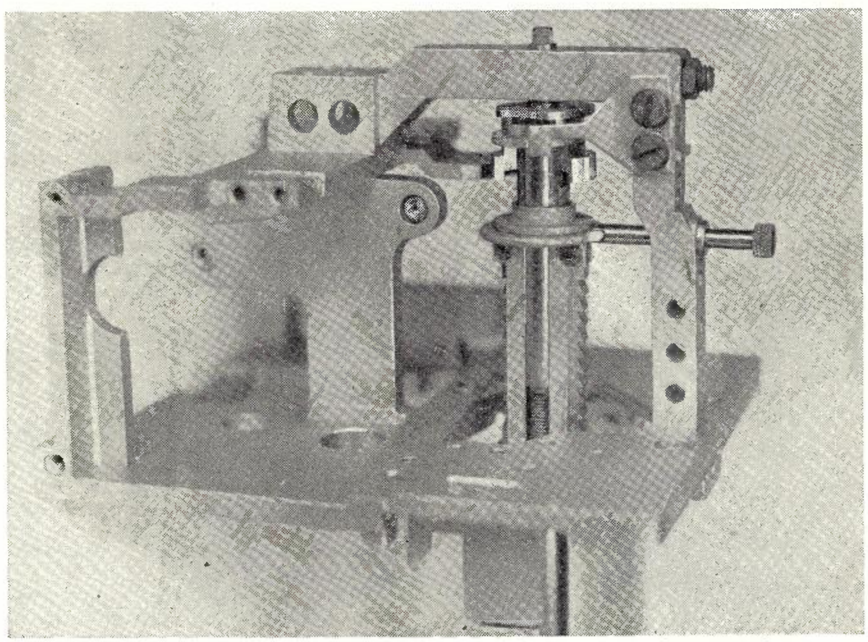


Fig. 11.—Datum Pin in position preparatory to making the four primary adjustments.

been assembled on the shaft, moved upward until the reduced diameter enters the bearing hole in the top of the frame.

The spring loaded plunger, spring and adjusting screw are assembled and adjusted to permit rotation of the main shaft, when the head of the plunger is in contact with the end of the adjusting screw. The adjusting screw is locked in this position with the lock nut. The pressure of the spring forces the plunger into one of the six counter-sinks provided in the main shaft, and this pressure is sufficient to retain the main shaft when moved to any one of the location positions. The gland screw is restored to the plate and temporarily held in position with its associated nut.

The detent bearing is projected through a tapped bush in the base of the frame, through the vertical detent, the rotary detent bracket, the "U" clamp and frame. It is now possible by means of the datum pin to establish with certainty and accuracy the four primary adjustments of the selector, namely, the basis for adjustment is established when the datum pin is positively engaged with the vertical off normal cam, and the four primary adjustments referred to previously can now be easily and precisely made.

1. **Vertical Normal.** The gland screw in the base of the column is adjusted until the gap between the lower bearing in the carriage assembly, and the upper surface of one of the three fibre washers pressed down on the upper face will accommodate the setting gauge (1″ long) provided for this purpose. The gland screw is fixed securely in this position with a lock nut underneath the gland screw plate.

2. **Rotary Normal.** The rotary back stop, on the left hand side of the frame column, is now placed in position with the rear end of the stop in close contact with the front face of the rotary ratchet return stop, and clear of the rotary ratchet spring operating cam, then fixed in this position with two hexagon headed screws.

3. **Vertical Stepping Position.** The detent bearing is adjusted upward by means of a screwdriver until the vertical detent engages the guide tooth in the vertical ratchet assembly, and locked in position with the "U" clamp.

4. **Rotary Stepping Position.** The rotary detent is moved along the extended member of the rotary detent bracket and locked in the position which gives full metal to metal engagement between the short faces of the detent and the ratchet tooth.

These four primary adjustments can be made without any bending of the parts (an indifferent operation unless correctly done), with the most accurate relation of the surfaces subject to normal wear. This maximum metal to metal contact ensures reliability of operation, minimum wear and consequently longer continuity of service.

The use of the datum pin, not only gives a carefully defined starting point for adjustment during manufacture, but enables an accurate assessment of the condition of a selector at any period of its service life. In the event of any maintenance service, the selector can be returned easily to the basic datum, and any adjustment necessary can be related correctly to a consistent and uniform standard.

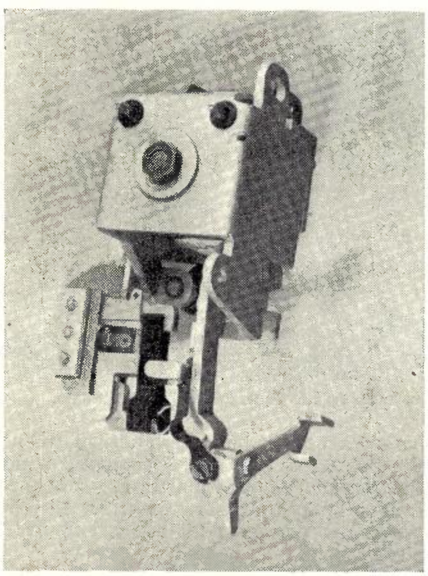


Fig. 12.—Vertical Magnet Assembly. Side view.

Rotary and Vertical Magnet Systems

The electro-magnets with the coil located in a box shaped yoke, were proved to be superior to other designs under most rigorous life tests and exacting service conditions in the single coil uniselector. This method of construction was adopted for the S.E.50 magnets.

A core of large diameter, with bakelite cheeks staked at each end provides adequate accommodation for a heavily insulated wire winding giving satisfactory insulation resistance, which in turn, reduces to a minimum the liability of coil breakdown due to short circuited turns.

The wound coil is mounted on the base of the coil box having three upturned sides. With the armature in position this construction gives a magnetic circuit of low reluctance. The electro-magnets are capable of operating the selector at appropriate speeds, with an adequate reserve of power. See Fig. 12 for the vertical magnet assembly.

The lightweight armatures, mounted on hard phosphor bronze bearing pins, are sufficiently rigid to effectively operate (via the pawls) the rotary and vertical ratchet system, yet sufficiently flexible to arrest the momentum of the ratchet systems, quickly but with the minimum of shock at the completion of each step.

The application of pawl pressures to the ratchets is direct and applied in a manner calculated to give the maximum propulsive forces.

The relation of the pawls to the ratchet follows the general principles applied to the detents, that is, maximum metal to metal engagement with the ratchets and the pawl front stops, thereby ensuring minimum wear, with the consequent long service life. The operating faces of the pawls are ground after hardening, consequently any slight variations in dimensions due to the heat treatment process, slight damage due to transport and any irregularities of finish are removed. The electro-magnetic units are self-contained, insomuch that the armature back stops, the screw for adjusting the return spring pressure of the armature, and the interrupter spring set are associated with the units.

The principle of unit design, on which the S.E.50 selector is based, permits easy assembly, adjustment and testing of the electro-magnetic units prior to mounting in the selector. This leaves the minimum of adjustment, that is, the relation of the pawls to the ratchets, to be effected when the units are mounted in their respective positions in the frame. The various advantages of the unit principle of construction, are emphasised by the fact that it does not in any way restrict individual adjustment of the component parts should this be necessary.

This design of interrupter includes a central member carrying a moulded plastic toggle arm and its associated bias spring; contact springs of substantial thickness and length to facilitate easy adjustment and consistent stability of contact pressure. The toggle arm is of the fulcrum type which eliminates the use of a bearing pin.

When the interrupter spring set is fitted to the rotary or vertical electro-magnetic units, the operational forces are applied in the most efficient and direct manner, that is, the operating forces are applied to the toggle arm in its normal plane of operation, thereby reducing frictional losses to a minimum.

Release Coil and Associated Components

The operation of the S.E.50 selector follows precisely the original Strowger principles, that is, the wipers traverse the same path on release as on operation, consequently a release magnet is fitted to withdraw the rotary and vertical detents after the completion of a call. The release electro-magnetic unit is located directly below the rotary electro-magnetic unit, and is secured to the frame with two screws. A form of box type construction is employed with the armature fixed and controlled by a single flat spring.

Associated with the release electro-magnetic unit, is a manual release extension, carrying an adjustable detent operating bar. This unit is secured with two screws to the left hand side of the platform on which is mounted the rotary electro-magnetic unit, and located with a guide at the front of the selector. The detent operating bar is used to establish the correct operating position between the release armature and the detent unit.

Provision is made by using an interceptor magnet for rotary release without vertical release, whereby the wipers return across a level to rotary normal, then stepped to the next level for further hunting, an invaluable feature for large P.B.X. groups. Fig. 13 shows the release coil and associated unit.

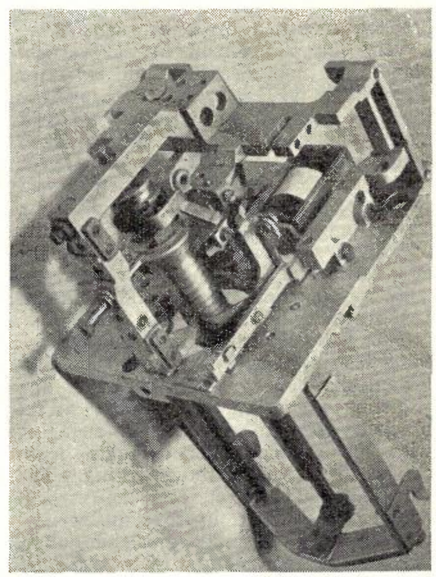


Fig. 13.—Release Coil and Associated Units.

When required, the interceptor magnet is introduced in the place of the front guide, using the same fixing screws. When energised in series with the release magnet, an extended lug on the armature is interposed between the yoke and the lug on the end of the manual release extension, thereby limiting the travel of the release armature to the position where rotary release only is effected.

The interceptor unit is quite small, designed to use the armature as the interceptor, consequently a minimum amount of current is required for its operation

For digit absorption, operation of the release magnet under normal conditions will, after vertical stepping, return the selector to normal.

Spring Sets

The use of standard type of spring sets, such as those used on standard relays has so many obvious advantages from the construction and maintenance point of view, that the design problems were reduced mainly to one of adaptation. The amount of room available limited the choice of spring set to the buffer block type used so successfully on the well-known 600 type relay. The elimination of contact bounce during stepping and return to normal; adequate accessibility for wiring; simple forms of location with accessibility for adjustment and the necessity of retaining the general principle of unit construction have been adequately solved. The elimination of contact bounce involved reducing the operational linkage systems to a minimum, and absorption of the vibrations set up during operation of the selector.

The V.O.N. (N) spring set operates at the first vertical step and remains operated until the selector returns to normal. It is firmly located in a slot at the left hand side of the selector frame and the mode of operating it is described later.

The R.O.N. ("N.R.") spring set operates at the first rotary step on any level and remains operated until the selector returns to rotary normal. It is mounted on the platform forming part of the bridge between the centre web and the front column of the frame.

The use of a slotted mounting plate, and fixing screws with captive washers, permits ready removal of the assembly when the associated relays are mounted on the mounting plate.

The operation of the spring set is direct from the cam fitted on the top of the rotary ratchet. The 11th row ("S") spring sets operate only on the 11th rotary step on all levels and release immediately from that position when the selector returns to rotary normal. It is mounted on the opposite side of the platform on which the R.O.N. spring set is mounted, and under the same conditions.

The level springs (NPA and NPB) operate at a prescribed level or levels during vertical stepping, and remain operated during the associated rotary stepping at that particular level. They remain operated during the return to rotary normal, and until release is effected (from single or consecutive cams) by return of the selector to vertical normal. The independent spring sets NPA and NPB are separately operated from cams on the swinging brackets and mounted on a bracket firmly located in a slot at the right hand side of the selector frame. The mode of operating it is described later.

The release armature springs "Z" operate and release when the release magnet is operated and released. It is mounted in place of the guide or interceptor magnet, and operated by the manual release extension. The interrupter springs (V and R) operate at the forward stroke and release at the return stroke of the armatures. Adjustments of the break and make periods which are not coincident, permit positive operating and release strokes of the armature when the springs interrupt the magnet circuit directly.

Spring Set Operation.

Vertical Off-Normal Springs (Circuit abbreviation "N"). The V.O.N. springs are actuated by a carriage-cam-operated roller, mounted on an arm pivoted on an adjustable mounting bracket. On return of the selector to vertical normal, the cam fixed on the top of the vertical ratchet engages the roller, and communicates the operational movement via the arm to a lever, the lever dome engaging the auxiliary armature of the V.O.N. spring set.

The spring set is operated when the selector is at vertical normal, and the diameter of the roller is such that release of the spring set is effected at the completion of the first vertical step. The design follows the general principle of unit construction and is arranged to permit easy removal of the vertical electromagnetic unit. The replaceable lever bearing pin is identical to the bearing pins used for the vertical and rotary pawls.

Level Springs (circuit abbreviation NP, NPA, NPB). The level springs are actuated by the carriage cam which, at the prescribed level or levels, engages the level cams attached to swinging brackets mounted on a bearing pin used for the detent assembly. The movement of the swinging brackets is transferred to the individual auxiliary armatures of the N.P.A. and N.P.B. spring sets via links adjustable by means of eccentric bearing pins.

Single level cams, and consecutive level cams are available. These can be used individually or in combination. Vertical stepping of the vertical ratchet assembly brings the cam fixed on the top of the ratchet into contact with level cams located on the swinging brackets, thereby operating the appropriate spring sets.

Rotary Off Normal Springs (Circuit abbreviations "N.R."). The rotary off-normal springs are actuated directly by a lobe of a concentric cam (fixed to the top of the rotary rachet) which engages a lug on the auxiliary armature at the first and any succeeding rotary steps.

11th Step Springs (Circuit abbreviation "S") The 11th step springs are actuated directly by an individual lobe on the same concentric cam used for operating the rotary off normal spring, which engages a lug on the auxiliary armature at the eleventh rotary step.

Vertical and Rotary Interrupter Spring (Circuit abbreviation "V" and "R"). These spring sets are directly associated with the vertical and rotary electro-magnetic units, and are described with those units.

Release Armature Springs (Circuit abbreviation "Z"). The release armature spring set (see Fig. 14) is located in place of the front guide, using the same fixing screws. It is actuated by the lug on the end of the manual release extension. The movement of the lug is transmitted to the moving spring of the spring set via a plastic operating cam, mounted vertically on the base of the spring set unit. The design of this unit follows the general principle of unit construction, where the unit can be assembled, adjusted and tested before assembly on the selector.

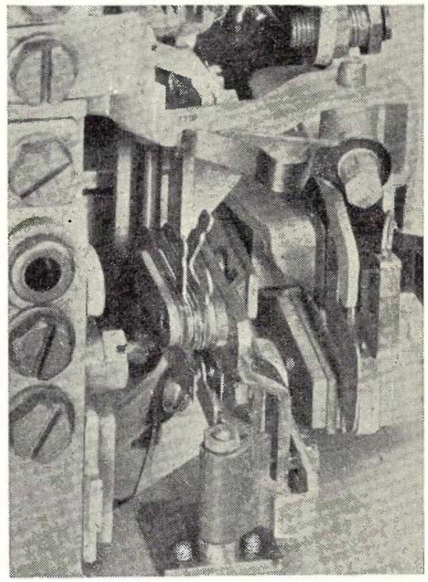


Fig. 14.—Release Armature Spring Set "Z".

Wipers

In an automatic exchange the selector wiper constitutes an important link in the provision of a high quality service, and demands very exacting mechanical and electrical standards. The corelation of a number of interdependent and often conflicting requirements to give the best possible overall performance under the comparatively wide range of conditions, makes wiper design a major problem. To ensure maximum

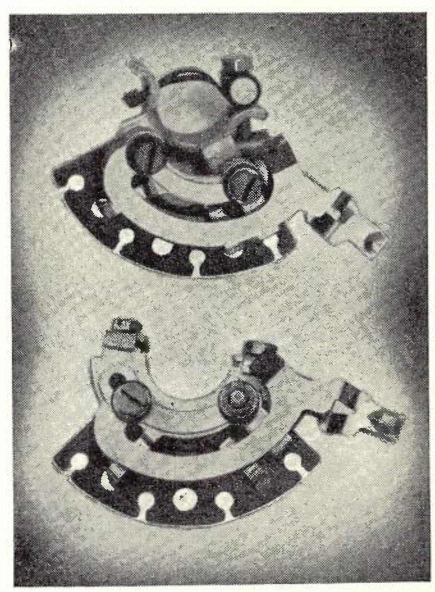


Fig. 15.—SE 50 Wiper Design. (a) Plain Tube, (b) Splined Hube.

reliability in service, every condition involved, from the initial clamping of the wipers, to the final location of the wipers on the selector bank, has received careful attention.

A large number of wiper designs have been tested in an endeavour to meet all the foregoing requirements. The latest designs shown in Fig. 15 are believed to represent a considerable advance in wiper design which will stand comparison for robust construction, wearing qualities and service life with any other available type of wiper, While these wipers are the present standard development, improved designs which may supersede them are now being designed and tested.

Miscellaneous Details

Replaceable Bearing Pins. The practical difficulties in fixing and testing bearing pins made from hard materials into comparatively soft materials such as aluminium silicon are well known, and indicate the need for easily replaceable bearing pins. The bearing pins on the S.E.50 selector are easily replaceable, a feature preventing the distortions possible under rivetting processes. Two similar bearing pins are used for the detent brackets and normal post operating brackets respectively; two similar bearing pins are used for the vertical and rotary armatures respectively and three similar bearing pins are used for the rotary pawl, vertical pawl and V.O.N. spring set operating lever.

Vertical Marking Bank and Wipers. Two types of vertical marking banks and wipers have been designed for the S.E.50 selector. In the type suitable for line finder systems the wiper is rigidly attached to the wiper carriage and leaves the bank during rotary stepping. The vertical bank is adjustably mounted on the right hand side of the frame column, with wires directly connected to the plug at the rear of the selector via a small hole in the front platform of the frame. This particular arrangement, designed specifically for line finders, permits assembly and adjustment of the selector and vertical bank as a complete unit. See Fig. 16.

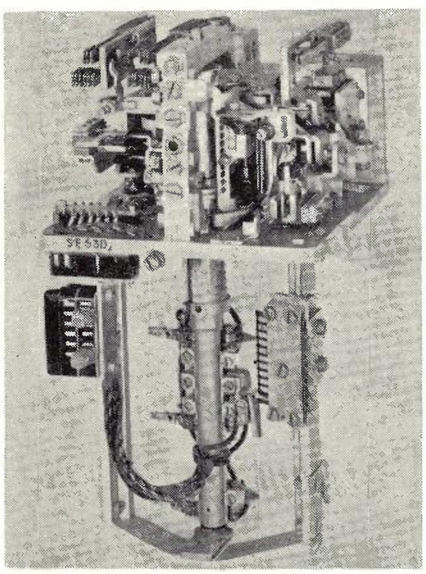


Fig. 16.—Vertical Bank and Wipers for Line Finders.

The bank is a standard type, mounted on a suitable bracket, but with this particular combination one row of bank contacts only is available for use. The wiper is comparatively long and flexible, with a flared tip. The wiper is tensioned against a back stop in its free position, thereby ensuring that when the wiper comes into contact with the bank, with a slight clearance from the back stop, the appropriate wiper pressure is obtained. The stop also damps down oscillatory movement of the wiper during rotary stepping.

The second type of wiper follows the traditional lines where the wipers remain in contact with the bank during vertical and rotary stepping with the vertical bank assembly mounted on the cradle and bank assembly. See Fig. 17.

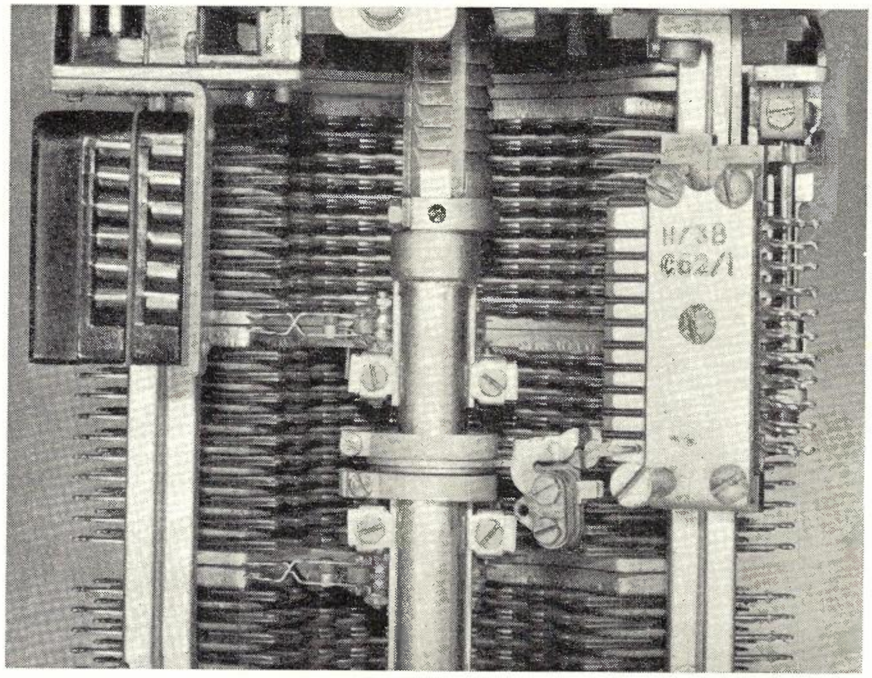


Fig. 17.—Standard Vertical Wiper.

The mounting bracket, attached to the cradle and bank assembly is an aluminium silicon die casting of robust construction. A standard type of bank, mounted on a swinging bracket is used. The swinging bracket is associated with the mounting bracket by means of a bearing pin, giving critical vertical adjustment relative to the wipers. Two spring location slots are provided on the swinging bracket, and these are used for the engaged and disengaged positions, in association with a stiff spring located between the "U" clamp and the lug on the mounting bracket (in which the bearing pin is located).

The wipers, designed on the same principle as the line and private wipers, are fixed to a bracket free to rotate on the wiper assembly mounting. This mounting is fixed to the wiper carriage by a clamping ring, which locks the mounting on the splines (or alternatively on the plain tube). The wiper bracket rotates on the upper portion of the wiper mounting and is positioned by a clamping ring (similar to that used for locking the mounting), which also serves as an adjusting device to limit the vertical play in the wiper bracket to a minimum.

S.E.50 selectors with vertical wipers can be used on existing cradle and bank assemblies but the adjustment of the relationship of vertical wipers to vertical banks is a little more difficult, due to the absence of an easy and accurate vertical adjustment.

Test Jack. The standard test and lamp jack has been modified to give improved accessibility to the wiper assembly adjacent to the vertical ratchet and improved visibility of the bank contacts when the selector is mounted.

Conclusion

These are the salient features of the design of the S.E.50 selector, one piece of mechanism in the vast and complicated system of the automatic telephone system. The development has not been easy, hopes have alternated with frustrations and good ideas have been rejected because they could not be woven in the fabric of the overall design. The fundamental aim in the design was reliability and, when a decision had to be made between reliability and cost, the balance was turned in favour of reliability. The materials employed in the construction were chosen carefully to give the best performance, and the simplest means of obtaining and retaining the maximum metal to metal contact between parts normally subject to wear, were adopted throughout.

Although the design of a selector may be adequate from the mechanical viewpoint it will not be successful if it does not meet the exacting requirements of the various circuits with which it must work. Furthermore the selector can only be as good as the circuit into which it is built. The original selectors supplied to Australia were wired to circuits designed by the General Electric Co. Ltd. but recent work, particularly on the group-selector circuit, which has been carried out by A.P.O. Engineers, should result in the greatest possible use being made of the new selector design.

As is always the case with a new design, improvements in some features resulted in relative failure in others. The exacting requirements have only been met by permitting no evasion of the simple and difficult problems which arise naturally in a project of this nature. The ideals and ambitions which formed the basis of the design have now been translated into actual production, and selectors are steadily coming from the flow line production for despatch to all parts of the world. It is felt that the S.E.50 selector is a useful contribution to the industry which Sir Ambrose Henry described as "The high water mark of creative endeavour".

CHANGES IN BOARD OF EDITORS

It is with considerable regret that the Postal Electrical Society has accepted, within the past few months, the resignations of two members of the Board of Editors. They are Mr. C. J. Griffiths, to whom reference is made elsewhere in this issue, and Mr. J. L. Harwood who has resigned following his promotion and transfer to the Department of Supply, Salisbury, South Australia. After a number of years' service in South Australia, Mr. Harwood was transferred to Central Office as a Divisional Engineer in 1949, and was in charge of the Telephone Equipment Section Circuit Laboratory for most of the ensuing period. He was appointed a Sub-Editor of the Telecommunication Journal in 1951 and after three years' service in that capacity, joined the Board of Editors. In addition to Mr. Harwood's valuable service in the editorial field, he contributed several articles to the Journal. Mr. Harwood's promotion has resulted in a loss both to the Postmaster-General's Department and to the Postal Electrical Society, and the Society joins with the Board of Editors in wishing him every success in his new sphere.

Messrs. A. N. Hoggart and E. J. Bulte have kindly agreed to undertake the editorial duties in place of Messrs. Griffiths and Harwood, and the Society is very pleased that it has been able to secure their services. Mr. Hoggart is a Supervising Engineer, attached at present to the Central Office Lines Section, and Mr. Bulte is a Sectional Engineer in the Central Office Telephone Equipment Section. Both have had many years of varied engineering experience in the Victorian and Central Administrations, and have contributed a number of articles to the Journal. This experience, together with an understanding of requirements from the point of view of the reader, will be invaluable in their future work on the Board of Editors.

H. G. A. SANSOM

Mr. H. G. A. Sansom, Superintending Engineer for South Australia, retired from the Department on October 1, 1954, after 44 years' service in the Engineering Branch spread over three States.

Mr. Sansom entered the Commonwealth Service in Victoria in 1910, and was appointed a Divisional Engineer in Melbourne in 1914. Following experience in metropolitan lines, country districts, and country equipment installation and workshops in Victoria, he was promoted Assistant Superintending Engineer, Perth, in 1935, transferring to a similar position in South Australia in 1937, to become Superintending Engineer in that State from 1943 to the date of his retirement. During this latter period he acted as Director for South Australia on several occasions. He was an Associate Member of the Institution of Engineers, Member of the Faculty of Engineering at the University of Adelaide and a Past President of the Institute of Public Administration.

In his early service years he was actively associated with the formation of the Professional Officers' Association. He was a foundation member and the first General Secretary of the Association, and was in the forefront, with other stalwarts, in the presentation of the case which led to the first award for Professional Officers made by Justice Higgins in 1918. He is a Past President of the South Australian Branch of the Association.

Mr. Sansom's knowledge of engineering and science fundamentals was soundly based and he had an excellent grip on all technical activities of the Engineering Branch. This, combined with his great energy, imagination and inventiveness, served him well during his administration of the Branch.

During the war, in addition to the responsibility of meeting the communication needs of the Services, Mr. Sansom was the Controller of Communications Air Raid Warnings for South Australia, and did a fine job in this field.

The Woomera Project crystallised in the post-war years and the Department undertook the responsibility of providing communications within the area. Mr. Sansom took a keen personal interest in this responsibility and undertook much of the preliminary planning himself, involving several trips into this arid area under hard travelling and living conditions.

An awareness of the need to place on lasting record epic feats of Departmental activities in the early days of the colony led to his conception, organisation, and the erection, in the year of his retirement, of a memorial in the Northern Territory at the joining point of the North and South sections of the Overland Telegraph line, in memory of the engineers and workmen responsible for the erection of the line.

He has the personal characteristics of good humour, generosity to a worthy cause, optimism, enthusiasm, and an awareness and appreciation of the value of human relationships.

At a large and representative staff gathering in Adelaide, Mr. Sansom was farewelled by his colleagues. The function which was presided over by the Director, Mr. S. Fountain, was attended by Mr. R. E. Page, Acting Engineer-in-Chief; Mr. A. P. H. Oke, Public Service Inspector; Dr. C. E. Bareford, Chief Superintendent of Long Range Weapons; Mr. W. T. Haslam, Director of Works; Mr. C. C. Wicks, South Australian Manager, Australian Broadcasting Commission; Professor E. O. Willoughby, Professor of Electrical Enginering of the University of Adelaide and Mr. J. S. Lacey, General Secretary of the Professional Officers' Association.

INSTALLATIONS IN AUSTRALIA OF THE BRITISH POST OFFICE SPEAKING CLOCK MARK II

E. F. SANDBACH, B.A., B.Sc.

Introduction: Prior to the introduction of speaking clocks, "time-of-day" in Sydney and Melbourne was announced manually by a telephonist reading directly from a clock driven by one-second impulses from a source of Standard Time. The service provided for the time to be announced to a number of subscribers simultaneously. Time announcing was a very monotonous task for which frequent relief of the telephonist was necessary, and this difficulty among others led to the decision to install B.P.O. Speaking Clocks which, as well as saving the cost of continuous staffing, are providing a more accurate service with improved intelligibility. The design and manufacture of the speaking clock equipment have been described in earlier articles in this Journal (1, 2 and 3). This article describes the installations in Australia and gives details of the performance since installation.

Sydney and Melbourne Installations: In Sydney the speaking clock has been installed at the General Post Office building in the heart of the city. With a view to minimising ambient temperature variations with their consequent effect on the diurnal accuracy of the clock, the control equipment, together with the time-announcing machines and the time-signal generators, were located in a room on the third floor with no wall forming an exterior wall of the building. The general layout of the equipment in this room is illustrated in Fig. 1. The special power plant for the clock has been installed in an adjacent, existing power room.

At Melbourne, the clock equipment proper is located on the first floor of "City West" automatic exchange, which is being air-conditioned, a general view of the installation being given in Fig. 2. The special power plant is installed in the exchange power room in the basement of the building.

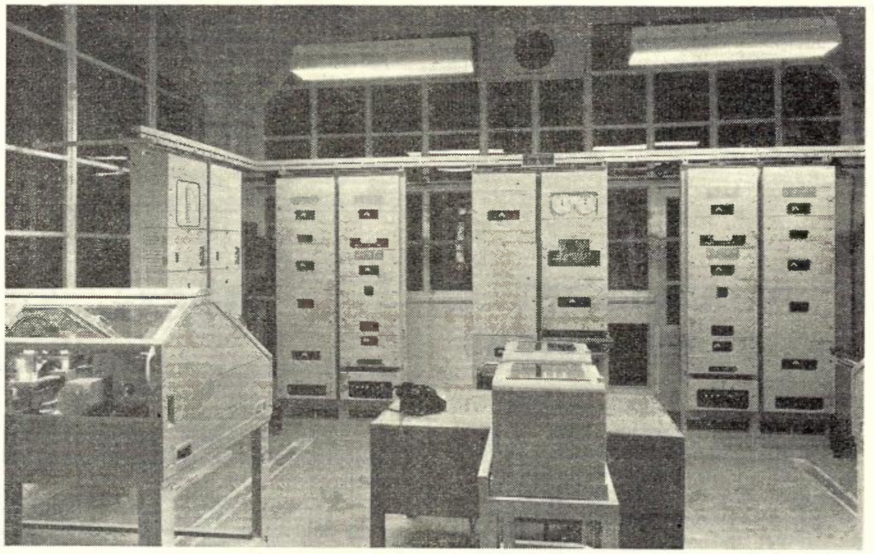


Fig. 2.—Speaking clock installation 1st floor City West Exchange, Melbourne.

The distribution of the speaking clock announcements to the telephone network via relay sets is effected in Sydney at City North automatic exchange situated less than a quarter of a mile from the General Post Office. Because of the relatively high speech level transmitted from the clocks to the relay sets, two special cables, one working and one stand-by, have been provided in the tunnel connecting the two localities. In Melbourne the relay sets are located at City West exchange, on the same floor as the clock equipment and only a few yards distant.

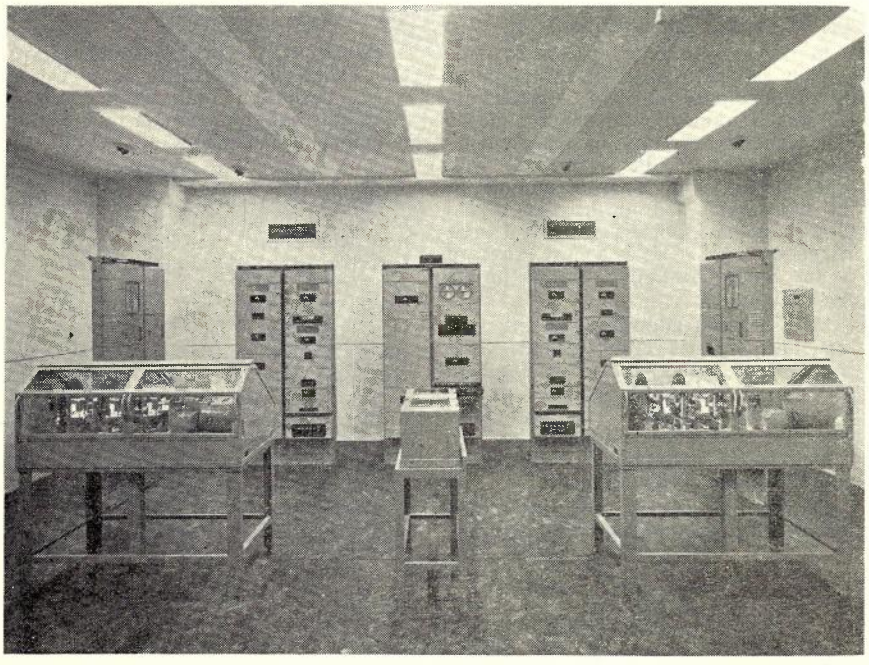


Fig. 1.—Speaking clock installation 3rd floor G.P.O. Sydney.

Interconnection of the Sydney and Melbourne Speaking Clocks: In addition to the reserve facility at each installation of a second announcing machine operated from a different power supply, and as an extra precaution against complete failure of the service in either city, provision has been made to select and connect by manual switching a suitable trunk circuit between the Sydney and Melbourne clocks.

Timing Correction System: Time determination in Australia is the responsibility of the Commonwealth Observatory located at Mt. Stromlo near Canberra which measures, each working day, one second pulses from a particular standard quartz clock maintained at the P.M.G. Research Laboratories, Melbourne. The results of these measurements are in turn used, as explained later, in the timing correction system of the speaking clocks to ensure that the announced time closely follows Eastern Standard Time as determined by the Observatory. The correction system depends for its operation on the comparison at specified times each day of correction signals generated at the Research Laboratories with signals produced by the clocks themselves.

The type of correction signal used in Australia consists of a series of pulses of 2500 c/s tone of 100 milliseconds duration repeated at one-second intervals, the start of each minute being

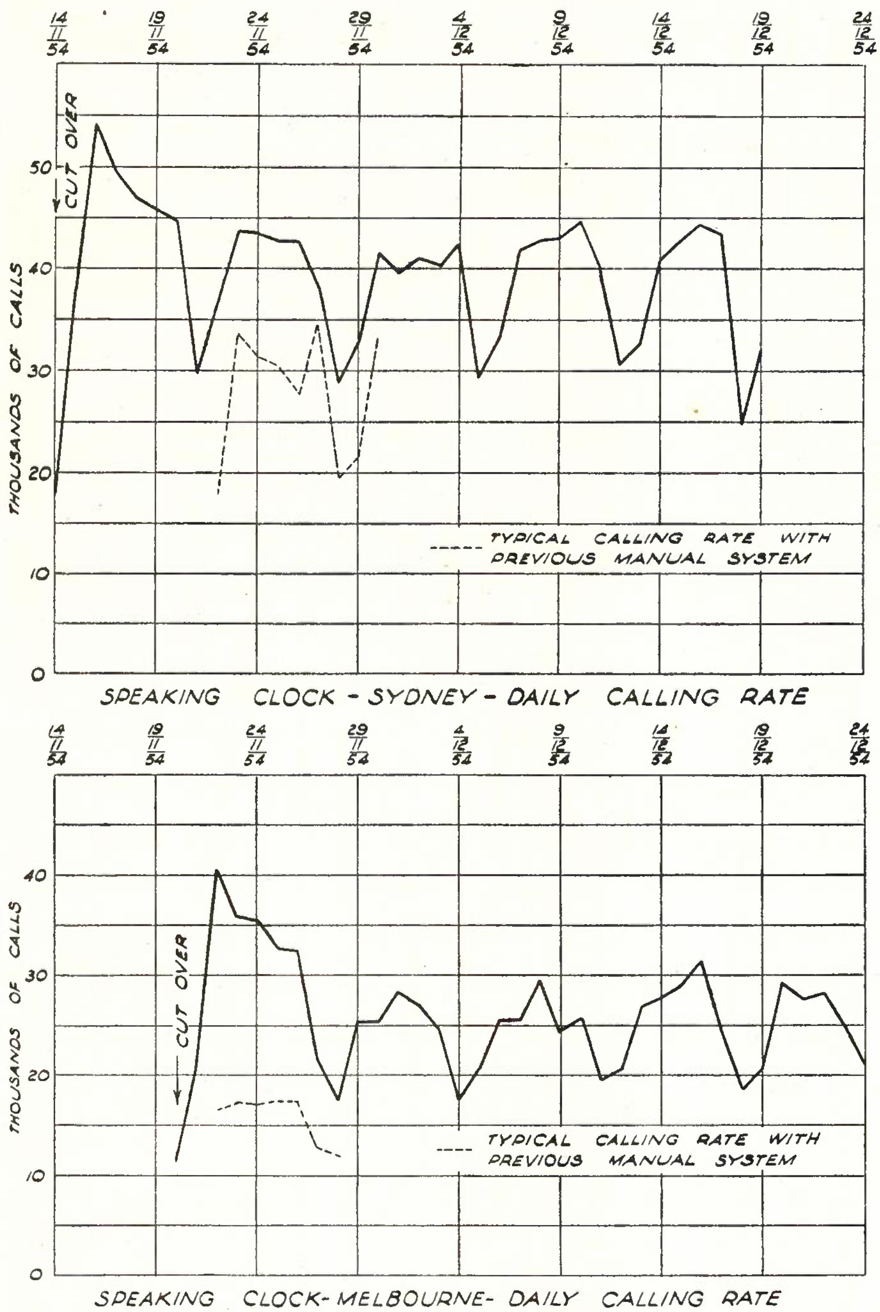


Fig. 3.—Daily calling rates.

marked by a longer pulse of 500 milliseconds duration. These signals are produced continuously by a correction signal generator coupled to a phonic motor driven by one of the frequency standards, which can be maintained within a few parts in 100 million of its nominal frequency of 100 kc/s. Timing adjustment to the correction signals, to take account of the Observatory measurements mentioned earlier, is carried out by means of variable phase-shifters. The maximum daily adjustment is normally 3 milliseconds. The correction signal generator is provided in duplicate and continuous automatic comparison of the outputs is carried out to detect any time difference greater than 6 milliseconds or the failure of one of them. In the event of either non-standard condition arising, the correction signal is automatically disconnected from the line and an alarm operated.

The correction signals are available continuously at the speaking clock in Melbourne and also at the Melbourne Trunk Exchange, which is in the same building. Sydney obtains the signals by direct dialling, normally using one of two selected trunks. The transmission times of the correction signals over a number of representative trunk circuits from Melbourne to Sydney were measured and it was found that as long as the choice was restricted to any one of those on a 12-channel carrier system, the difference between channels was negligible. When setting up the Sydney clock, allowance for this transmission delay was made by advancing the phase of the pulses an appropriate amount relative to the synchronising track on disc 3.

Correction impulses are switched into the speaking clock equipment at a pre-set time each day during a silent period in the correction signal transmission sequence, in Sydney just before 8.55 a.m. and in Melbourne a few seconds before 9.55 a.m. Signals derived at one-second intervals from the synchronising track of the clock are compared with the correction signals and it is determined whether, at the instant of comparison of the first pair of pulses, the clock is slow or fast. If the clock is found to be slow then it is advanced by an interval of 1 millisecond; alternatively, if fast, it is retarded by the same amount. This correction is performed automatically and is completed before the next pair of pulses arrive for comparison. The one-millisecond corrections continue to be applied at one-second intervals, until it is found that the correction signal and the clock signal differ by less than 1.5 milliseconds when the examination ceases until the next correction check on the following day.

Speaking Clock Traffic: The fact that there was already a well-established "time-of-day" service in both Sydney and Melbourne made more difficult the estimation of the expected increase arising from the introduction of the speaking clocks. Provision was therefore made, by supplying one hundred relay sets for Sydney and fifty for Melbourne, to handle a little over twice the traffic

Table 1
Comparison of British and Australian Calling Rates for the Speaking Clock

Centre	No. of Subscribers	No. of calls per week	No. of calls per sub. per week
Sydney	252,526	269,805	1.1
Melbourne	220,339	172,687	.77
London (Holborn & Museum areas)	830,378	665,863	.80
Glasgow	71,427	86,192	1.2
Manchester	100,018	102,407	1.0
Sheffield	32,357	31,976	.99
Birmingham	89,204	71,504	.80
Edinburgh	55,989	38,886	.69

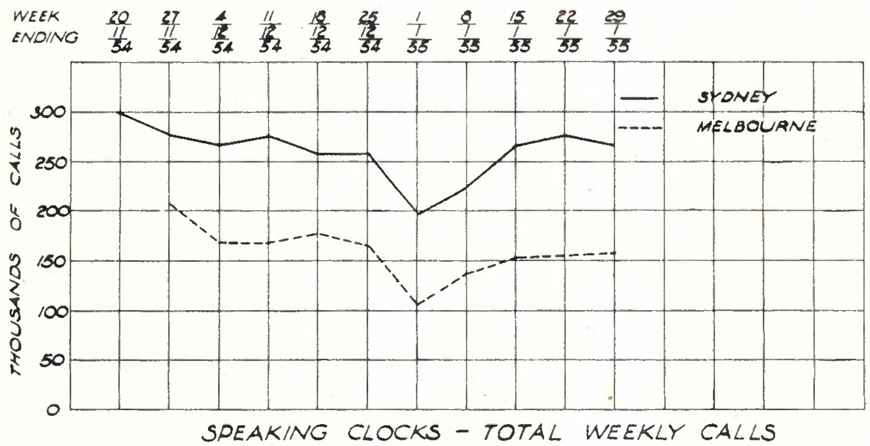


Fig. 4.—Weekly calls.

with the speaking clock, compared with the manual service. Such provision proved adequate except during the first four days of the new service in Melbourne when ten of the relay sets used with the former manual service were installed temporarily to help handle the curiosity traffic.

Fig. 3 shows the daily calling rate for the first month of operation in comparison with typical figures for the manual system taken just before the speaking clocks were introduced. Apart from the curiosity traffic during the first week of operation, there has been a permanent increase in the calling rate compared with the manual service. Fig. 4 shows the weekly calling rate for both Sydney and Melbourne clocks from cutover until the end of January 1955. The effect of the general holiday break over the Christmas-New Year period is clearly seen. In Table 1 the usage per subscriber of the speaking clock service in Australia is compared with that in various locations in Great Britain. The figures for the British clocks were taken in May 1954 and those for Australia in December, 1954. The table shows that the use of the speaking clock in Australia is quite comparable with that in Britain.

Equipment Performance: In regard to the timing accuracy of the clocks, Fig. 5 is a graph of the apparent daily errors as determined from the daily "corrections" to each clock. These are the combined effect of two main causes namely, errors in the clock equipment itself and adjustments to the correction signals required to follow astronomical predictions as explained earlier. Whilst in three cases in Fig. 5 the maximum correction required was excessive, two of these can be explained by errors in the correction signals and the third, at Sydney only, by probable unstandard operation of the clock correction system. It should be remembered that for the period shown in Fig. 5 both clock installations and correction signal generators had been in operation for a relatively short period only and some improvement in the above respects can be expected in addition to some further small improvement due to the settling down of the crystal oscillators.

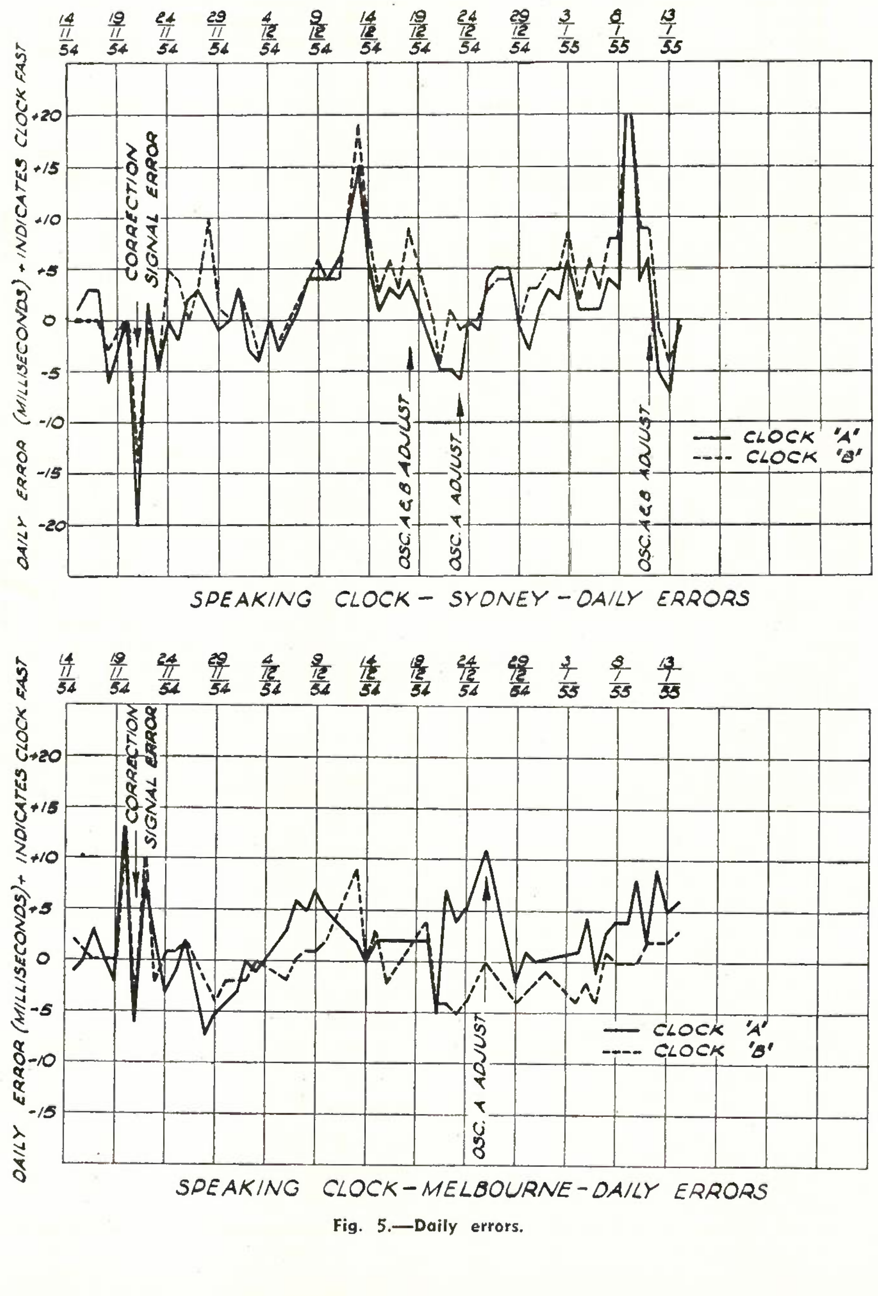


Fig. 5.—Daily errors.

An impression of the excellent stability possible with these oscillators may be obtained from the record in Fig. 5 of the one driving clock "B" in Melbourne. This oscillator was set up during the installation period and adjusted in frequency on 27/9/54. No further adjustment had been necessary in the period up to the end of February 1955. This record represents the best performance of all oscillators included in both Sydney and Melbourne equipments. Some others have required adjustment at intervals of two or three weeks.

Some modification of the pilot tone alarm circuit has been made to take account of battery voltage variations larger than expected. During conditions of mains failure, the 50 volt exchange battery, operated normally under floating conditions, drops in voltage with a consequent drop in exciter lamp brilliancy. This in turn has resulted in the operation of the pilot tone alarm due to the decreased photo-cell output. To overcome this condition, the sensitivity of the pilot tone alarm has now been reduced by circuit alteration so that this alarm does not operate until the voltage supplied to the equipment drops to 42 volts. This amended circuit has been operating satisfactorily since February 1955 and has maintained continuity of speaking clock service until the alternate clock is again operating from the standby A.C. supply.

Time Signal Generation and Distributing Equipment: With each installation of speaking clock equipment two time signal generators or XNG machines, so called, were furnished, one of which is illustrated in Fig. 6. One XNG machine is driven from the precise 50 c/s supply derived by frequency division from the crystal oscillator and which feeds announcing machine "A" whilst the other is driven by the supply to announcing machine "B". These XNG machines provide four different types of signal namely:—

(i) one pip/sec.
(ii) six pips/sec.
(iii) six pips/hour
(iv) XNG marine navigation signal once/hour

As the precision contacts supplied with the equipment for producing these signals were rated only at 10 volts 1 milliamp, some heavy duty contacts for the time signals were required. In addition provision for the multiple distribution of each type of signal was necessary. Consequently, a unit using 3000 type relays operated by the anode current of triode tubes was designed to give four outlets of signal type (i), 6 of type (ii), 12 of type (iii) and 3 of type (iv).

The unit also provides the following facilities:—

(a) Automatic selection of the XNG machine to follow the associated announcing machine in service, that is, normally XNG machine "A" in service simultaneously with Clock "A".
(b) Manual control to override the automatic selection of the XNG machine in service. This is provided to handle possible fault conditions where, for example, only the combination of announcing machine "A" and XNG machine "B" are available for service.
(c) Continuous comparison of the one pip/sec. outputs of the two machines. Should the time difference exceed six milliseconds, the outputs of both machines are disconnected from service and an alarm is operated to call the maintenance technician.
(d) Connection to both the aural and the visual (C.R.O.) general monitoring facilities provided, so as to assist in the phasing of the XNG machines when they are started up.

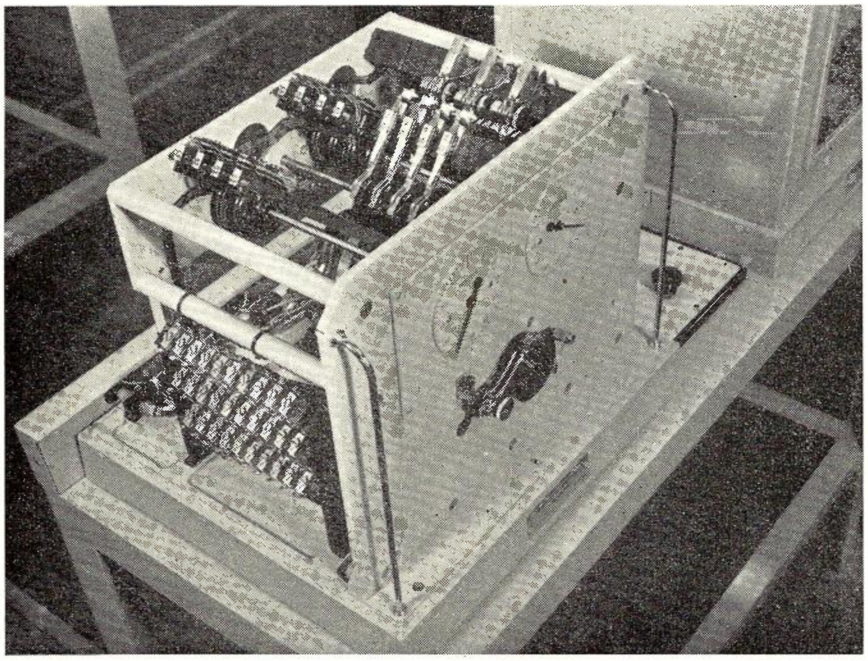


Fig. 6.—X.N.G. machine supplied with speaking clock.

The time signal distribution equipment described above forms one panel on Rack No. 6 of the speaking clock equipment, thus keeping each installation complete in itself.

The use of time signals and hence of this new equipment may be illustrated by reference to the scope of the service supplied by the Melbourne equipment, to which there are at present connected eleven permanent subscribers, including the Victorian national radio stations, the commercial radio stations and various Commonwealth and State Government Departments and Authorities. This service had, for some years past, been rendered on behalf of the Commonwealth Observatory by the P.M.G. Research Laboratories using pendulum clocks loaned by the Observatory.

Conclusion. Judging from the period of operation so far, the speaking clock does all that its designers intended, both in regard to accuracy and reliability. This achievement is particularly noteworthy when it is considered that the equipment, the installation of which is described herein, is the first production of a basically new design.

References:

1. "The British Post Office Speaking Clock, Mark II," A. J. Forty and F. A. Milne; Telecommunication Journal of Australia, Vol. 10, No. 1, Page 1, June, 1954.

2. "A Photographic Technique of Sound Recording on Glass Discs," A. J. Forty; Telecommunication Journal of Australia, Vol. 10, No. 1, Page 22, June, 1954.

3. "The British Post Office Speaking Clock, Mark II," R. L. Smith, Telecommunication Journal of Australia, Vol. 10, No. 2, Page 33, October, 1954.

PAYTEN'S BRIDGE R.A.X.

P. A. CLARK, A.M.I.E.Aust.

On November 2, 1954, an A.P.O. "C" type R.A.X. unit was placed in service at Payten's Bridge, near Eugowra, N.S.W. This R.A.X. is possibly unique amongst its fellows by reason of the method of feed of the subscribers' lines, the problems that it posed during its installation, involving the necessity to raise the building on piers well above flood level, and the intense interest that its provision aroused among residents of the district.

The equipment was installed in a standard 50/200 line prefabricated Armco R.A.X. building at the Villawood, Sydney, assembly depot and transported by Departmental low-loader to the site at Payten's Bridge. It was one of the 97 such exchanges placed in position in N.S.W. in the eighteen months ending 31/12/54. At cutover there were 38 subscribers connected and two trunks to Eugowra manual exchange. This installation is one of the first to provide all ring and tones by means of a relay set instead of a machine.

Commercial power supply is available at the site, so that charge-over-trunk facilities were not required. The unit is wired for multi-metering and the facilities can be provided by jacking-in the appropriate relay sets. Cabinet-housed motor car type batteries provide the exchange power and the test desk also operates as a routiner.

The numbering scheme is 200-244 inclusive, 245 being the alarm number which, when dialled, gives a tone to indicate an alarm. Urgent alarms, however, are also extended to the parent exchange over the second trunk. There were no party lines at Payten's Bridge although, before cutover, ten of the Eugowra subscribers were party services.

The site of the R.A.X. is near a bridge crossing the Lachlan River about seven miles from Eugowra, on the Eugowra-Forbes Road. It is situated in the grounds of a rural school which is the only building in the vicinity. The area is particularly susceptible to flooding, the river spreading over five miles of country and having a depth of four feet six inches during the floods of June, 1952. Because of the flood danger it was decided to place the R.A.X. on six feet high piers, thus raising it clear of even record flood waters. Subscribers' reticulation of the whole area, with the exception of two lines, run aerially on the trunk route and the privately erected portion of ten other subscribers' lines was entirely by means of underground cable.

The nature of the countryside lent itself to the use of mole plough and tractor, being situated in the middle of the Lachlan Valley, a place of deep, alluvially deposited soil. Since no Departmental lines were existant in the area, use of buried cable was obviously indicated. This decision was aided by the fact that cable was much less liable to damage by storm or flood. Ultimately a total length of 36,212 yards of cable, ranging in capacity from one hunderd pairs to two pairs, was laid in the area.

To utilise fully the advantage of speed offered by the mole plough method of cable laying, it is essential that all operations associated with it take as little time as possible. With this thought in mind the mole plough unit put into the field was fully mechanised. The personnel associated with the unit numbered eight and they were equipped with a caterpillar type D4 bulldozer, mole plough and cable trailer, a three ton capacity "Jumbo" type mobile crane, a four ton winch equipped truck and thirty cwt. double cabin truck. Cable drums were transported from Eugowra to a central dump at the site by semi-trailer, its loading and unloading being effected by means of the mobile crane. This resulted in considerable saving in labour charges, all these operations being carried out by three men only. In action the four ton truck was loaded with a day's supply of cable at the dump early each morning. The mobile crane was used for this operation. The crane and truck then moved ahead of the mole plough team and waited for it. When a cable drum was exhausted the cable trailer was replenished from the truck's load by means of the crane, with the minimum of idle waiting time. Using this method and equipment the mole plough unit and cable was delivered to the site and six and a half miles of cable laid in five days.

The D4 tractor, although seeming to be very low powered for the work it has to perform is, in the opinion of the writer, ideal for such operations. It is light in weight and does not require a low-loading vehicle for transport. The fact that vehicles readily available within a Country Division can transport it is valuable in the flexibility of operation that it offers. In effect, the mole plough unit can be transported to any part of the Country Division at a moment's notice. The small size and light weight of the 'dozer allows it to be easily unloaded at practically any site. Its low power is itself something of an advantage, as it prevents any tendency to plough deeply in bad country at too great a rate with consequent cable stretching and faults. At Payten's Bridge, cable was laid in soft, damp soil at a depth of eighteen inches or greater without ripping and at the same depth in hard, sunbaked soil after two ripping runs. The tractor is not overloaded, the present unit having laid well over one hundred miles of cable without any need for repairs. During waiting periods the crane was used to clear the ground of fallen timber and stumps along the route of the cable.

The risks arising from possible defects in the sheathing of the cable were minimised by gassing the cable on the drums, checking the length laid, before jointing, for loss of pressure after regassing it if necessary and finally gassing the whole length of jointed cable. Any faults found after laying were located by graphing the progressive pressure decrease at selected points along the faulty length. The cable was finally meggered in bell list lengths of about two thousand yards.

Trunks for the R.A.X. were provided by means of a new aerial route in conjunction with half a mile of 40 lb/mile trunk entrance cable. To expedite the provision of the trunk line a pole hole borer was used. A running sheet, showing all items of material required at each pole peg down to the last washer, was prepared. Material was loaded on a motor truck in the order of this schedule and the material dropped off at each pole position. This considerably expedited the fitting of poles. The wire was run off wire barrows fitted to the back of the thirty cwt. truck. In all, 160 poles were fitted and erected, thirty-five miles of wire provided and 5,500 yards of cable laid in thirty-five days. Two gangs were used in this phase of the work. At this stage all that remained to complete the provision of the external plant for the R.A.X. was the provision of a trunk and subscriber's cable crossing the Lachlan River.

Because of the steeply sloping banks of the river and the depth of the channel at the bridge, it was intended originally to cross the river by means of armoured cable in pipe. When the work was carried out the bed of the river was low and it seemed at first a comparatively easy task to make the crossing by means of cable buried in the bed of the river. The method of laying, as originally planned, was the use of a skid plough and water jets. This was abandoned because no suitable high pressure pump to feed the jets was available in such an isolated place, fire authorities being unwilling to allow their equipment to leave the large centres. Use of the skid plough alone was indicated.

There were many underwater obstructions in the river bed, most of them being large, water logged tree trunks. These proved very difficult to remove, a one inch steel hawser being broken several times while attempting to remove one in particular. This log, about thirty feet long and completely bedded in mud, resisted all efforts to remove it. It had caused the stream to cut a deep pool at one side of the obstruction. The river contour thus consisted of a shallow section of four feet six inch depth for half its width, suddenly deepening to twelve feet over the snag and ending in an equally steep bank on the other side of the pool. The skid plough could neither follow such a contour nor penetrate the timber of the snag.

The services of a marine diver, Mr. D. Hellings, who was engaged in desnagging western rivers for the Department of Main Roads, were then engaged.

He was able to dig a trench on the slowly flowing river's bed with a pick and shovel, clearing the bed of such obstructions as he could and burrowing under those that were immovable. He then guided the cables into the trench and backfilled it. This work was carried out during school holidays and proved to be an unfailing attraction for very many schoolboys and not a few adults.

Having achieved the river crossing the sole remaining problem was the erection of the six feet piers and the elevation of the four ton equipped R.A.X. building on top of them. After consideration it was finally decided to lift it by means of two hoists on a gantry built over it and then stand the piers underneath. Accordingly, footing poles were marked out, excavated, the concrete footings poured and carefully levelled. The R.A.X. unit was then delivered to the site and set down over the footings on wooden blocks.

While this work was going forward, piers of reinforced concrete 6′ x 9″ x 14″ were made at Bathurst. Since the height of the R.A.X. necessitated a flight of steps to a landing at the door these were also prefabricated at Bathurst. The piers were poured in wooden mould boxes and all attachment bolts, bolt holes and check-outs for attachment of the landing were cased in the concrete. A heavy wooden cradle to lift the R.A.X. was also constructed out of 6″ x 4″ hardwood. The timber used to make the latter was later used in fencing the R.A.X. site.

All this material was transported to the site by heavy truck, the piers alone weighing 4½ tons. One day was spent in assembling, erecting and staying the gantry, laying out the piers and attaching the cradle to the underside of the R.A.X. building. On the second day the building was lifted sufficiently to stand the piers underneath, the piers were fitted at the four corners and the building lowered on to them. The building was then steadied by means of temporary bracing timbers, the piers lined up and concreted and the remaining piers fitted and concreted. Each of the piers was braced by means of diagonal braces made of 60 lb. railway rail with attachment lugs welded at each end. The braces were pre-cut to the right length and angle at Bathurst. As the R.A.X. weight is concentrated at one end of the building, the braces, which amounted to a very considerable total weight, were used as ballast in the building to make it reasonably horizontal during the time it was hanging free.

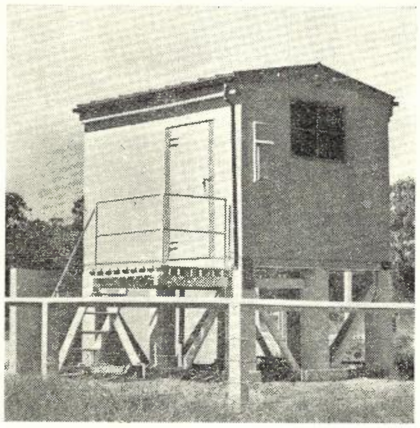


Fig. 1.—R.A.X. Building completed.

The whole of the lifting operation took about four hours and the R.A.X. building was safely and firmly on its foundations at the end of the day. The landing was then fitted to the building, the site fenced, and a high "V" shaped concrete wall placed in front. The purpose of the wall is to deflect any snags and debris which might otherwise be carried into the piers, to lodge there during a flood. This precaution was considered very necessary as such debris could very soon create such an obstruction to the flow of flood water as to cause serious shifting on the foundations (see Fig. 1).

The testing of the exchange unit was carried out with very little trouble and the cutover date fixed for November 2.

The opening ceremony was attended by representatives of local associations and the Department and all subscribers' lines were brought into service without incident before mid-day.

The local representatives spoke on the improvement of local telephone services, dwelling particularly on the fact that this area is isolated completely during times of flood.

RE-ROUTING OF SUBMARINE CROSSING — SYDNEY-ORANGE TRUNK CABLE

D. V. KELLY and J. P. McMAHON, B.A.

Introduction: On Sunday, 27/7/52, the cables on the Sydney-Orange trunk cable route were carried away by flood waters at the submarine crossing of the Nepean River, one mile west of Penrith Repeater Station. The cables consist of two 24 pair 40 lb. carrier type cables, and one 54 pair 20 lb. local type voice-frequency minor trunk cable. Communication between Sydney and towns west of Penrith on this route was completely disrupted. Eight 17-channel cable carrier systems and 3 programme channels were in operation on the carrier cables, while the voice-frequency cable was fully occupied with minor trunks. The cables were all heavy wire armoured, and it was found that they had been torn out at a joint in a manhole 100 yards from the river on the eastern bank, and the cables carried downstream. The location of the submarine cables was just downstream of the railway bridge, with the Victoria bridge carrying road traffic on the Western Highway adjacent to the Railway bridge. The length of the river crossing was 387 yards, for which emergency lengths of cable were available but due to the height and turbulence of the flood waters these could not be used.

Temporary Repairs: In order to give an emergency service, a single pair of wire O.D.T. was run on the railway bridge, and service restored on one 17-channel system. As replacement of cables in the river was out of the question, the obvious way to give quick restoration of service was by running temporary cables on the road bridge spanning the river. This required a length of 470 yards on each cable. Emergency cable of this length was not available and even subscribers' cable in 40 lb. or smaller conductor size, due to the general acute shortage at that time, was also not available immediately. 14 pair rubber insulated interruption cable was in stock, and in order to restore temporary communication as quickly as possible, two of these cables were run and jointed to the paper insulated carrier cables at each end of the break. This allowed for the restoration of all carrier and programme circuits. The joints were covered with rubber bandages. The 54/20 voice-frequency cable was restored similarly by running and jointing a 54 pair 10 lb. quad local type, steel tape armoured cable, a suitable length of which was fortunately on hand. These operations were hampered by heavy rain, darkness, and the presence of heavy weekend road traffic over the Victoria bridge, but by 1 a.m. on the Monday all circuits were restored to traffic.

Permanent Reconstruction: When the floodwaters had receded and the water cleared sufficiently, examination by a diver showed the river bed at the location of the submarine crossing to be almost all solid rock. When the cables were laid originally, the river had a mud bed, and a subsequent inspection had also shown that this was still the case. However, on the inspection after the cables had been torn away, it was found that this mud had been completely scoured away, leaving a bed which consisted mostly of bare rock shelf. Trenching of the river bed would have required the use of explosives, which was not considered desirable in such close proximity to the two bridges because of possible damage to piers.

Consideration was then given to the attachment of ducts to either the adjoining railway bridge, or the road bridge. The railway bridge was considered unsuitable because of the liability to fatigue, due to the heavy vibration from rail traffic. Examination of the road bridge showed that duct space could only be obtained under the footway, but that the Department of Main Roads had plans to extend the carriageway and occupy the present footway space with the carriageway. Consultation with Department of Main Roads engineers showed that placing the ducts in such a position as to allow for their ultimate incorporation into the deck slab was possible, provided they were so positioned that they did not interfere with the work of reconstruction, and that provision for expansion joints was made to coincide with those of the bridge. The duct requirements were estimated at six three inch pipes, but to exploit the space available to the utmost, as the maximum number of pipes that could be installed was eight, it was decided to instal this number.

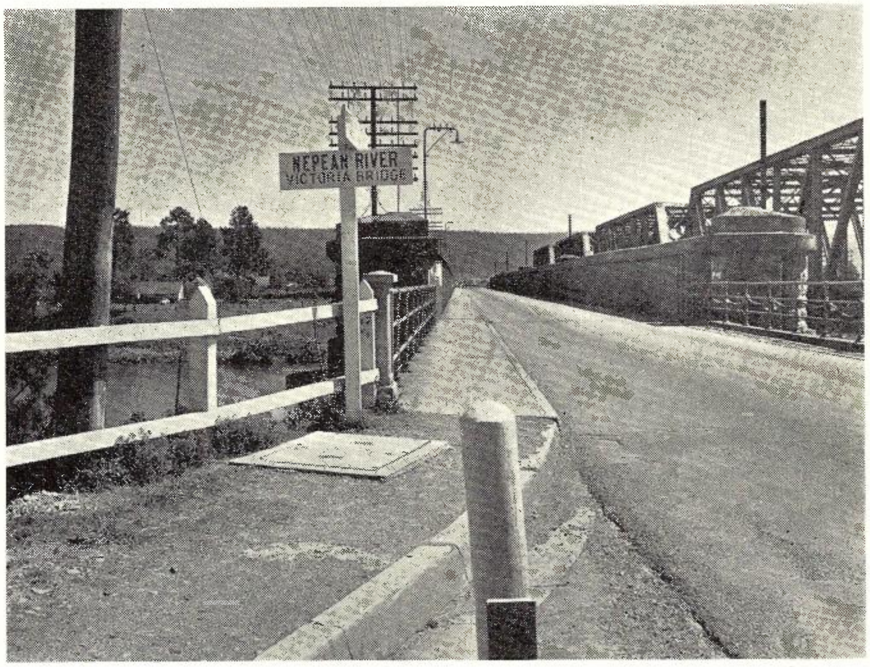


Fig. 2.—View of Victoria Bridge and adjacent railway bridge.

Design: The bridge consists of three spans each approximately 199 feet, and one span 138 feet long, crossing the actual river, with three approach spans on the banks on each side, each approximately 25 feet, giving a total length of 898 feet. The approach spans are of reinforced concrete carried on reinforced concrete piers. (See Figs. 1 and 2). The main spans (4, 5, 6 and 7, Fig. 1) are of box girder construction with fabricated steel crossmembers. The width of the bridge between box girders is 26 feet, the space being occupied by a carriageway of 21 feet and a footway of 5 feet. The main deck slab of the carriageway is a reinforced concrete slab 6 inches thick, overlaid with bitumen, the footway being of reinforced concrete cast in situ, with a space between the bottom of the footway and the top of the crossmembers 36 inches wide by 19 inches high. (See Fig. 3.) The three long spans are carried on four masonry piers, the shorter span being supported on the Western end by a steel pier. The approach spans (1, 2, 3, 8, 9 and 10, Fig. 1) have a similar section, the deck slab and footway being cast integrally, and carried on 18 x 6 inch rolled steel joists for the carriageway and a single 15 x 4 inch channel joist for the footway and being supported on reinforced concrete piers. No support existed for the pipes over this section. (See Fig. 4.)

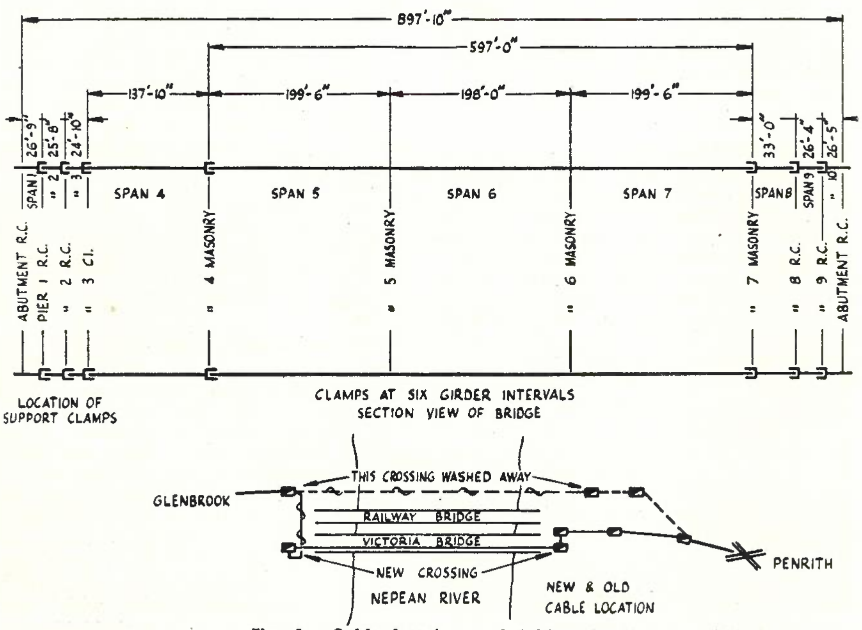


Fig. 1.—Cable location and bridge details.

The space beneath the footway offered a suitable location for the Department's ducts, the main problems being:—

(i) Design of expansion joints suitable for incorporation into the proposed deck slab extension.
(ii) Location of the pipes in their ultimate position for incorporation into this slab.
(iii) Installation of the pipes in the confined space.
(iv) Clamping of pipe in position pending the bridge reconstruction to reduce movement and vibration.
(v) Design of manholes which would allow for ease of drawing in the long lengths of cable involved and allow access clear of road traffic.
(vi) Provision for isolation of this section of the cable in the event of gas pressure failure on portion of the gassed section, of which this cable is part.

A 75 pair 10 lb. subscribers' cable in a 1½ inch galvanised iron pipe was already located in the footway aperture, the pipe not being continuous but leading only from pier to pier, access manholes being in situ on three of the four masonry piers. This pipe was without expansion joints and required to be removed before the bridge alterations were put in hand.

Expansion Joints. Spans 6 and 7 are anchored on pier 6, with spans 5 and 6 moving on roller systems on piers 4 and 5. The whole of the expansion of spans 5 and 6 is catered for by the expansion joint on pier 4, for which a maximum movement of 2.995 inches has been calculated. The smaller expansion joints on approach spans have a maximum movement of the order of 0.226 inches. The

Fig. 3.—View beneath footway on main spans before installation of pipes.

joints are constructed with a short length of 3½ inch pipe fitted as a collar on the fixed end of the joint, and welded to this end, with the moving section free to move within this collar. There are seven expansion joints required for each pipe (See Fig. 1).

Location of Pipes. On the four box girder sections the space beneath the footway provided a suitable location for the pipes, rivets on the fabricated crossmembers being set at 4 inch centres, and allowing for the pipes to be positioned as a neat fit, making due allowance for collars and expansion joints. In the drawing in process, these rivets also acted as guide lines for the pipes (See Fig. 3).

On the approach spans, no support for the pipes existed, and bearers to locate the pipes at their ultimate level were designed. These bearers were constructed of 3½ x 1½ inch channel beneath the footway, fastened on the kerb side to the reinforced concrete deck slab and on the outside to the 15 x 4 inch channel joist supporting the footway, accurately positioned so that the pipes were located in their final position in the proposed deck slab extension (See Fig. 4). These bearers will ultimately be removed in conjunction with the bridge reconstruction. The original bridge design provided for the carriageway extension to be carried by one 18 x 6 inch rolled steel joist, but to cater for the loss of strength caused by locating the ducts in the deck slab, the Department of Main Roads propose to install three 15 x 6 inch rolled steel joists in lieu of the one 18 x 6 inch originally proposed.

To allow for jointing of the pipes as they were drawn in to the main spans, and for the positioning of pipes and bearers on the approach spans, a staging was built under the approach spans at each end of the bridge.

Installation. The pipes were drawn in singly through the footway aperture on the main spans, a winch being located on the western bank, and pipes being jointed on the staging on the eastern bank, using a platform with rollers set to the level of the crossmembers of the main spans. The pipes were drawn in commencing at the first masonry pier on the east side to make for ease in installation of the expansion joint required there. A "bomb" type leading pipe was used with a swivel at the front end, to which a ½ inch steel hauling rope was attached, with a standard 3 inch collar at the rear into which the first pipe was screwed, succeeding lengths being jointed on as each pipe was drawn into the aperture. To eliminate collars catching on crossmembers, the collars were slightly tapered. Before reaching the staging all pipes were greased internally and draw wire was inserted as each pipe was jointed. The pipes were winched fully through the aperture to the steel pier on the western bank, past the main expansion joint on the western end of span 5. The pipes were then cut at the expansion joint and the leading end carefully moved the required distance to allow for the calculated expansion at the prevailing temperature.

The pipes on the approach spans were placed in position on the bearers, and expansion joints installed direct from the stagings. The clamps to hold the pipes in position were installed loosely before these joints were in position and later fully tightened. The pipes were then led through a hole driven in the bridge abutments to manholes at each end.

Clamps. Clamps to hold the pipes in position were required to prevent movement due to vibration. These consist of a shaped mild steel plate ⅜ inch thick, held in position on the crossmembers of the main spans by ⅜ inch diameter hook bolts and on the bearers on the approach spans by ⅜ inch diameter U-bolts (See Fig. 5).

Manholes. As the space now occupied by the footway will ultimately be portion of the carriageway, and because a straight pull into the ducts over such a long distance was desirable, a composite manhole 8 x 4 feet, having a type CL18 footway type cover on the ultimate footway location, and a type CL36 roadway type cover on the present footway at the ultimate roadway level, was designed and constructed at each end of the

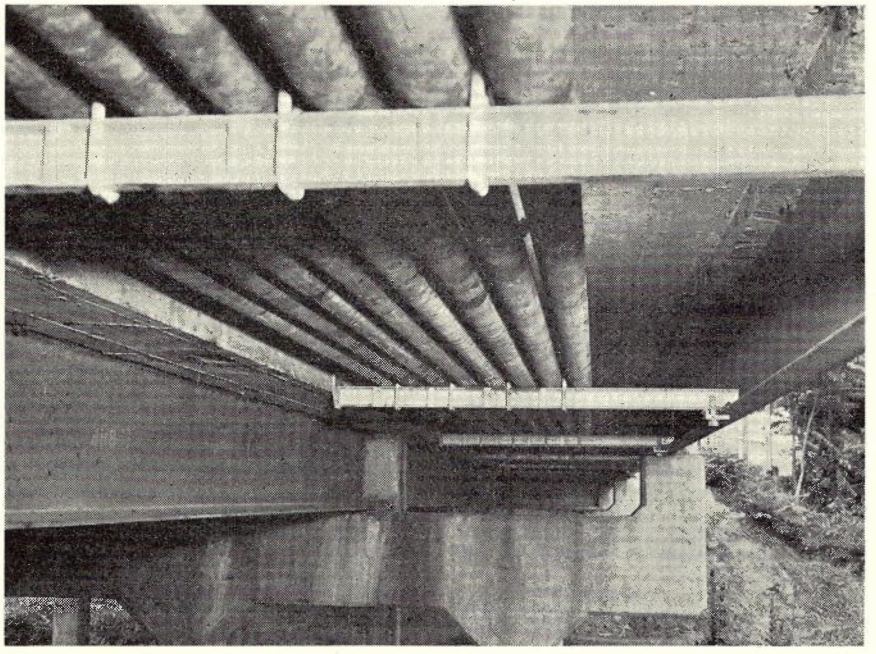


Fig. 4.—Showing pipes and bearers in position beneath footway on approach spans.

bridge. The roadway type cover is placed immediately in line with the centre of the pipe line on the bridge. On the eastern bank, standard 4 inch duct construction was provided to link up with the existing construction, and on the western bank armoured cables were led from the manhole to connect to the existing manhole at the end of the old submarine crossing.

Cable Protection. 312 yard lengths for each of the two 24 pair 40 lb. carrier type cables, and the 54 pair 20 lb. local type for the V.F. trunk cable were ordered specially. The cable is generally to Specification 6C, having one layer of 0.128 inch armouring wire, with the outside protective layer of jute and bitumen not being provided as the cables were being drawn into pipes. It was considered that the outside jute covering would introduce difficulties in drawing in the cables and also drawing out in the event of a possible fault. Vibration on the bridge is only slight and it is considered that the wire armouring and jute covering between the lead sheath and wire armouring will supply sufficient protection against faults due to fatigue. This length forms only a small portion of the existing gas pressure section between Penrith Repeater Station and Glenbrook, a length of 5½ miles. In order to allow easy checking of the bridge section in the event of gas pressure failure on the section, gas seals have been installed in each manhole on either side of the bridge, with by-pass valves inserted.

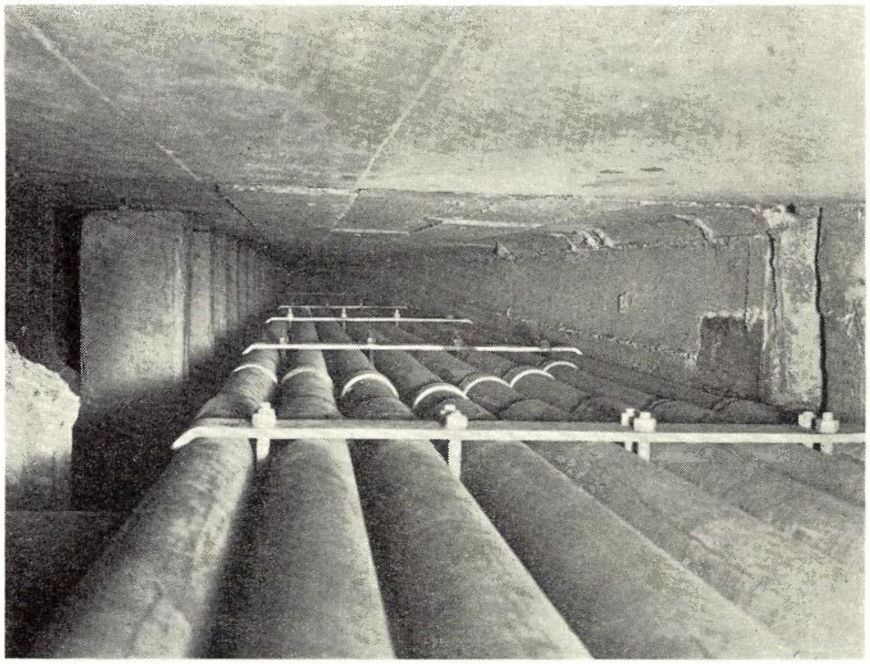


Fig. 5.—View beneath footway on main spans showing pipes installed.

An interesting sideline on this work was the behaviour of the rubber insulated temporary interruption cables laid to restore communication on the day of the failure. Due to delays occasioned by obtaining agreement with the Department of Main Roads, and later to material delays, over two years elapsed between the dates of failure and the completion of this work, and during this period the temporary cables remained, carrying all carrier and programme systems over the break although, as was to be expected, considerable degrading of transmission levels occurred. As required, additional circuits were provided by using O.D.T. wire. During this period a limited gas protection was maintained by connecting cylinders of dry air at opposite ends of the gas section and passing air through the cables, the air escaping at the temporary joints at each end of the interruption cables.

OBITUARY

MR. H. FULLER

Mr. Harold Alfred Fuller, a Sub-Editor of the Telecommunication Journal in New South Wales, passed away on 15th March, 1956, at the age of 48 years. He entered the P.M.G. in 1927 as a Cadet Engineer and qualified as Engineer in 1932. The depression was still affecting industry and his appointment as Engineer was delayed until 1934. In October, 1934, he set out for Wagga as an Engineer, arriving in the middle of a flood which marooned him in his hotel room in the main street. As always in his life, at Wagga he took much interest in the civic life of the town, being a foundation member of Wagga Apex Club, starting a Debating Society, and being Vice-President of the Eisteddfod Society.

He returned to Sydney from Wagga in 1937 and commenced acting as relief Divisional Engineer. Later he acted for about two years as Divisional Engineer, No. 4 District Works. He was appointed Divisional Engineer, Lismore, in 1945. At Lismore, Mr. Fuller carried a very heavy load, being responsible prior to the relief of the Division by the establishment of Divisions at Kempsey and then Grafton, for a staff of up to 700. He performed meritorious work during the calamitous floods which ravaged Lismore during his tenure of office there. He took an active part in the civic life of Lismore, being Secretary of the Lismore Rotary Club, Committee member of the Lismore Golf Club, President of Lismore Postal Institute and President of Lismore Musical Festival Society. He returned to Sydney in 1951 and acted for several months as Supervising Engineer, District Works.

The sympathy of his many friends is tendered to his wife, son and daughter who survive him.

REMOVAL OF 600 NUMBER PORTABLE EXCHANGE FROM SYDNEY TO LAUNCESTON

C. G. HAMMERSLEY, A.S.T.C.

On 10th of May, 1955, an automatic telephone exchange of 600 numbers capacity, in full working order and complete in its own portable exchange building, was transported from Sydney, New South Wales, to Launceston, Tasmania. A description of this transfer will be of interest to the readers of this journal, as this is the first time such an operation has been performed in this country, and possibly anywhere in the world.

The portable exchange was designed for areas where the telephone requirements do not yet justify a permanent exchange building, and to give interim relief in areas where the building programme is lagging behind the provision of external plant. From a number of prototypes a portable exchange building has emerged, designed primarily for use in the Metropolitan area. This exchange provides 600 numbers of 2000 or pre-2000 type equipment, and consists of final selectors and uniselectors, a single-sided rack of relay sets, a single-sided M.D.F., a test rack and a power recti-

Table 1.

No.	Capacity	Type	Present Location	Available for Transfer (Note 1) 1955/56	56/57	57/58	58/59	Old Location
1	300/500	Pre P.S. (Note 2) (Note 3)	Unanderra					
2	300/600	Pre P.S.	Ingleburn					
3	300/600	Pre P.S.	Glenbrook					
4	500	Pre P.S.	Rutherford					East Maitland
5	500/600	2000 P.S.	Albury North					
6	600	Pre P.S.	Blacktown	*				
7	600	2000 P.S.	Wollongong North					
8	—	—	—	—	—	—	—	
9	100	Pre.	Menai (Note 5)					
10	100	Pre.	Tomago (Note 5)					
11	100	Pre.	Kurnell					
12	100	Pre.	Terry Hills (Note 5)					
13	100/300	Pre.	Dudley (Note 5)					
14	—	—	—	—	—	—	—	
15	200	2000	Mt. Kuringai (Note 5)					
16	200/300	Pre	Sandgate (Note 5)					
17	200	Pre	Charlestown	Tarro				
18	—	—	—	—	—	—	—	
19	300	Pre.	Turella (Note 5)			*		
20	400/600	Pre.	Croydon Park					
21	400	Pre.	Canberra Civic No. 2	Wagga South No. 3				Lidcombe
22	400	Pre.	Kingsgrove No. 2	Mona Vale Extn.				
23	500	Pre.	Wallsend			*		Mayfield
24	500	Pre.	Manuka No. 2		*			Civic No. 1
25	.600	2000	Rydalmere				*	
26	600	2000	Silverwater No. 1		*			
27	600	2000	Mona Vale Extn.			*		Peakhurst
28	600	2000	Manuka No. 1					
29	600	2000	Harbord No. 1		*			
30	600	2000	Guildford		*			
31	600	Pre.	Botany			*		Willoughby
32	600	Pre.	Wagga South No. 1					
33	600	Pre.	Wagga South No. 2					
34	600	Pre.	La Perouse			*		
35	600	Pre.	Yarralumla					St. Leonards
36	600	Pre.	Silverwater No. 2		*			Ramsgate No. 2
37	600	Pre.	Revesby No. 2	Wollongong No. 2				
38	600	Pre.	Revesby No. 1	Harbord No. 2				
39	600	Pre.	Baulkham Hills		*			
40	600	Mixed	Kingsgrove No. 1	Sylvania				Caringbah
41	700	Keith	Matraville					Fivedock
42	800	Keith	Coogee					
43	800	Keith	Kings Cross					
	600	Pre.	Launceston, Tasmania					(4) Ramsgate No. 1

Notes:

(1) * An asterisk opposite one of the portable exchanges indicates that that exchange will be available for transfer to another location during the financial year listed at the head of the column in which the asterisk occurs. If the future location of the exchange has been determined already, the name of the locality is used instead of the asterisk.

(2) "Pre." indicates Pre-2000 type equipment.

(3) "P.S." indicates Penultimate Switching, i.e. the portable is operating as an exchange with one rank of switches before the final selectors.

(4) Since this portable exchange is no longer in N.S.W., it has not been allocated a number.

(5) R.A.X. type building.

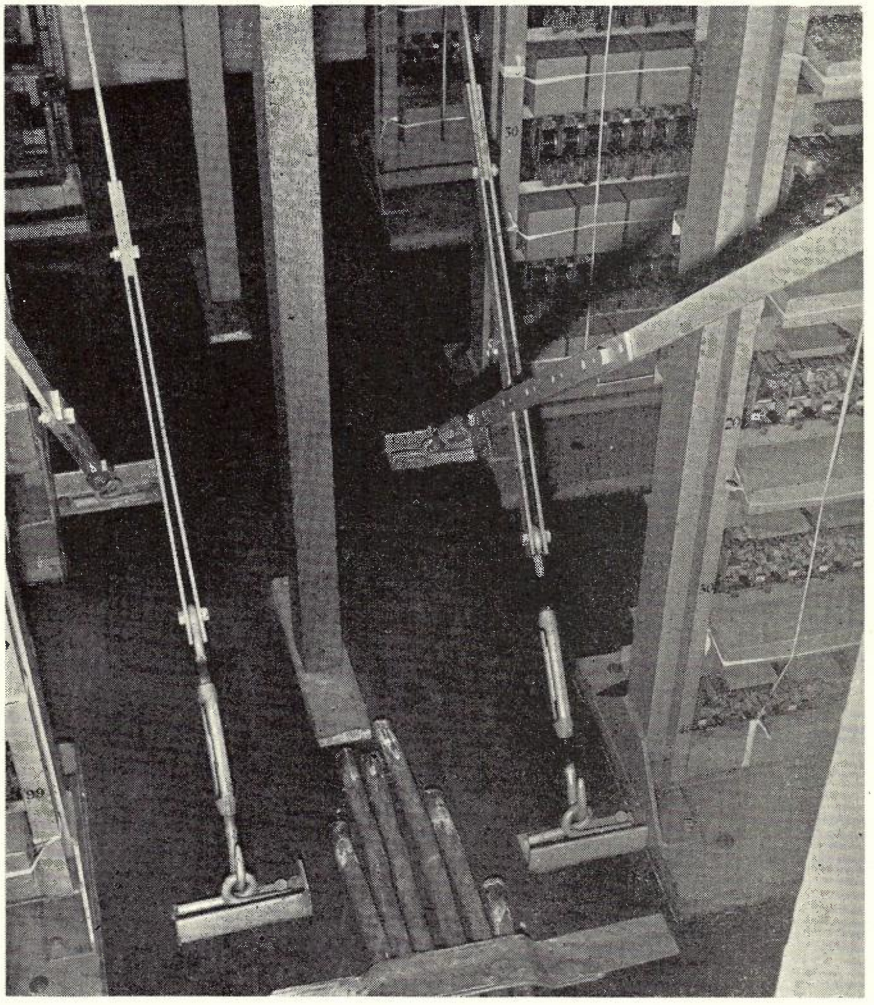


Fig. 1.—Internal bracing.

fier. Batteries are mounted in a compartment underneath the floor. This arrangement is suitable for trombone working in conjunction with a branch exchange, and when the permanent exchange building is cut into service, the street cables are cut away and the lead covered silk and cotton cables drawn back into the portable exchange. The latter cables are left permanently terminated on the M.D.F. and the exchange may now be transported to a new site.

Table I shows the number, type and distribution of portable exchanges in New South Wales. It will be noted that about 25% have already been in service in more than one location. The suitability of the building may be judged by the variety of switching equipment installed. When penultimate switches are included, local switching is available for a three digit system. Not all portable buildings however, are of this type. Some are R.A.X. buildings, which are of smaller dimensions.

The particular exchange under discussion was installed at Ramsgate, a Botany Bay suburb of Sydney, where it had been in service for some years. When the Ramsgate Permanent Exchange was cutover in December, 1954, the portable exchange became available for transfer. It was assigned to South Launceston, Tasmania, to advance the conversion of Launceston telephone facilities from manual operation to automatic. The preparation of the building for interstate transport involved a number of precautions against problems that do not arise in normal transport from one site to another within the city. In the first place, the portable exchange building is based on a welded frame of 8 x 3 inch rolled steel joists and is designed for transport by low loader. It is not designed to resist the crushing forces engendered when the building is lifted in a wire rope sling. Again, since the building was to be carried as deck cargo, there was a possibility in heavy seas, of the building being deluged by spray, and precautions were necessary against the penetration of moisture. Finally, the floor of the building during normal transport does not tilt nearly as much as it could on a deck of a ship, and it was necessary to brace all racks and secure all items which might become loose, such as switches, relay covers, etc The operations involved in the preparation of the equipment and the building and in the transport of the building tc the wharves are detailed in the following paragraphs.

Preparation of Equipment

Switch Covers

(a) L. & K. Relay Sets. Covers tied on with tape (Fig. 1).

(b) Duplex Relay Sets. Cradle fabricated and bolted to Relay Set shelf (Fig. 2).

(c) Auto-Auto Relay Sets. 2 x ¼ inch steel strap bolted to shelf such that the strap overlapped the cover tops firmly clamping them in place (Fig. 3).

Bracing of Boards

(a) Base of primary boards bolted through floor, a 3 x ¼ inch steel strap

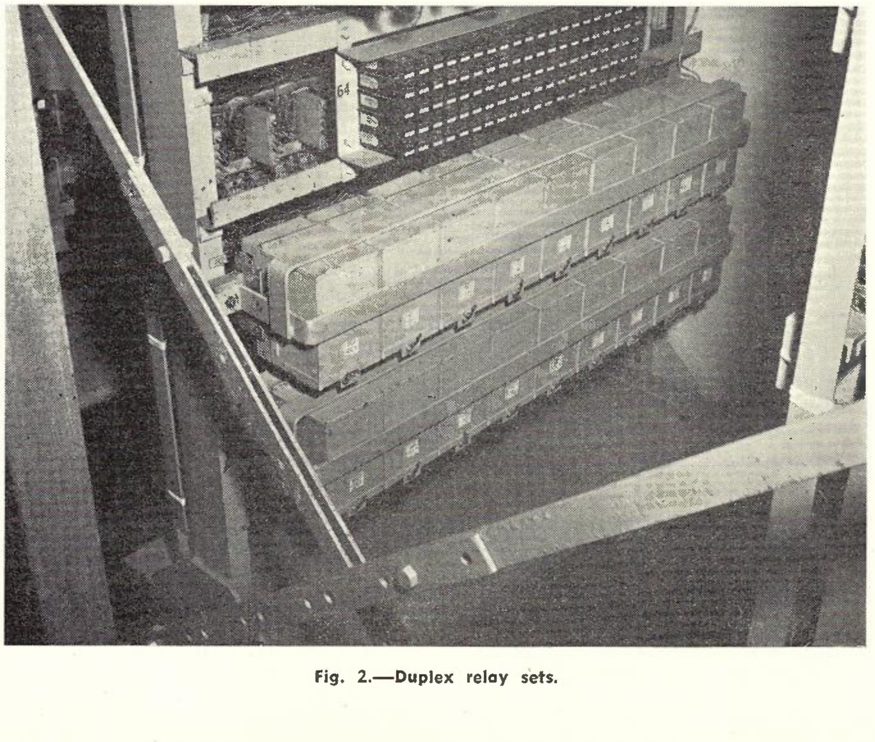


Fig. 2.—Duplex relay sets.

being used to washer the bolts on the underside of the floor.

(b) Angle braces from top of rack to eyebolts on floor fitted, correct tension being obtained by means of turnbuckles incorporated in the bracing straps (Fig. 1).

(c) Boards tied together at the top by a horizontal 2 x 1 inch channel.

3. Silk and cotton lead cables clamped to floor by means of lead strap (Fig. 1).

4. Batteries removed.

Preparation of Building

1. Downpipe and guttering removed, awning and steps detached from doorway.

2. Internal bracing was accomplished by supporting horizontal 3 x 3 inch beams on 3 x 3 inch studs at 4 feet centres down main aisle, the object being to guard against crushing forces while building was being slung during loading operations (Figs. 1 and 4).

3. External protection against abrasion due to shipboard hazards was provided by 12 x 1 inch boards mounted on 2 x 1 inch battens to a height of about 5 feet 6 inches. Bottom of frame and roof eaves were protected against damage from wire rope slings by 4 x 3 inch timbers.

4. Protection against ingress of moisture. The four skylights were covered with masonite and sealed with sisalkraft wrapping. The door was similarly treated, the key being screwed to the woodwork underneath the wrapping.

Transport of Building to Wharves

Transport of the building to the wharves was undertaken by the Department of Supply, whose officers are normally responsible for the transport of portable exchange buildings. A special low loader was used, the tray of which had been cut and lengthened from the normal 16 feet to 19 feet 6 inches by an extension welded into the middle section.

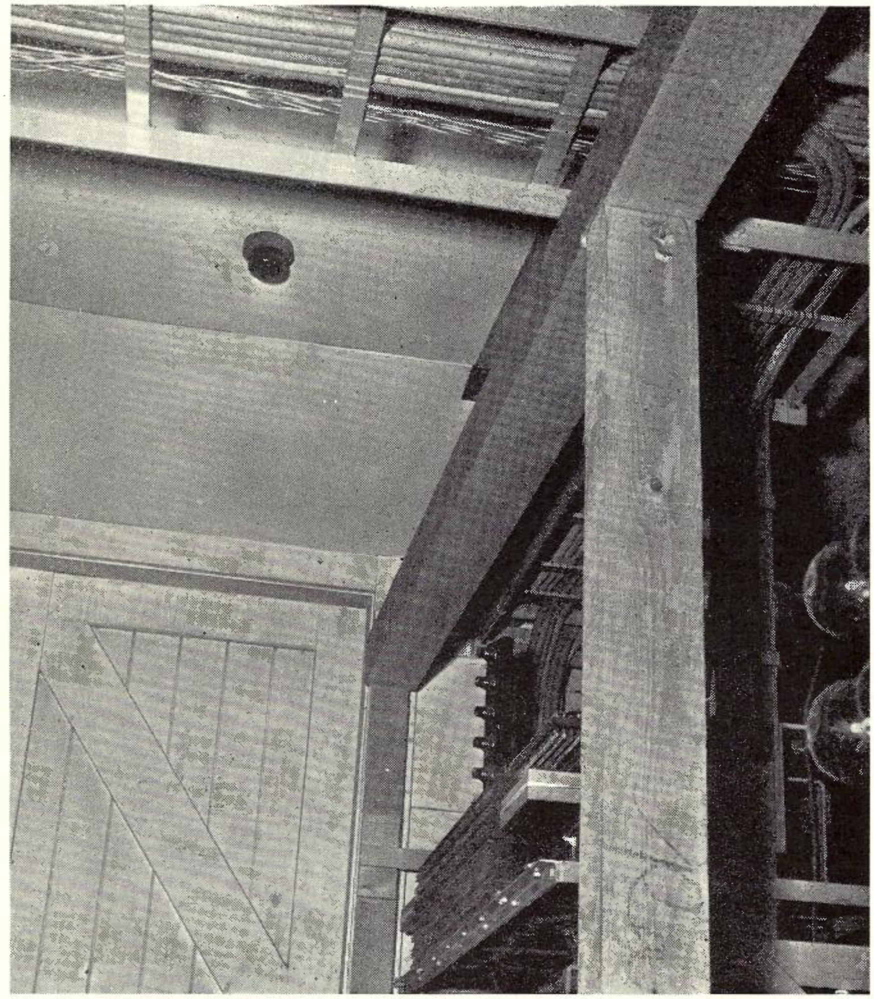


Fig. 4.—Internal bracing.

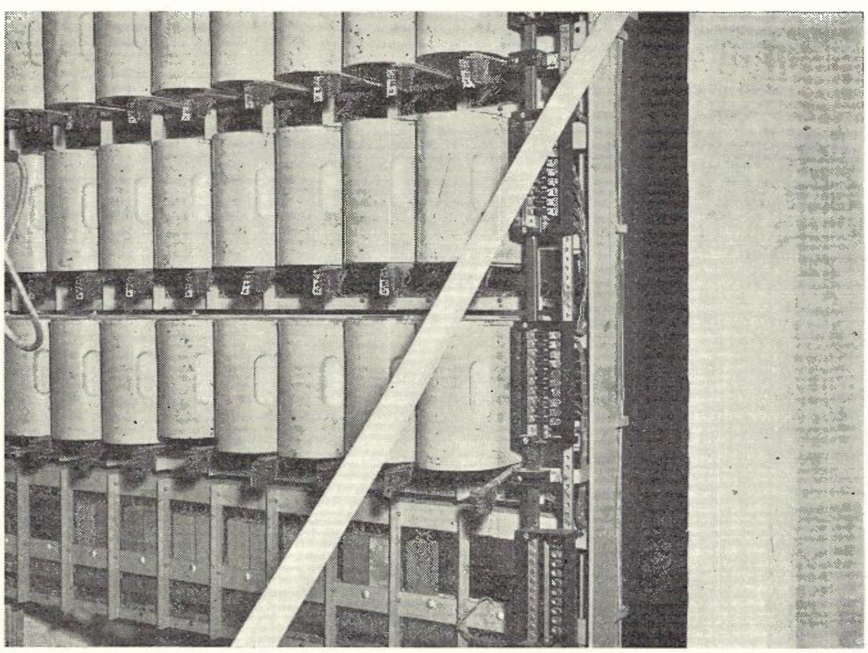


Fig. 3.—Auto-auto relay sets.

The loader was backed up to the narrow side of the building and skids laid from the back of the tray under the full length of the building. The rear wheels were removed from the tray which was then lowered on to 2 inch diameter rollers laid on the skids (Fig. 5). The loader was then backed up so that the tray slid under the building between the piers, until it protruded at the rear. The building was jacked up clear of the piers and packing inserted between the base and the piers (Fig. 6). The rear wheels were replaced on the tray, the packing under the building removed, and the building lowered on to the tray. The loader could then be driven away.

The route to the wharves was planned in advance and surveyed to ensure that there was adequate clearance for the 16 foot high load under all overhead obstacles such as wires and bridges. Permission was obtained to drive the low-loader through the city on condition that the load reached its destination before 8 a.m. This is a standard requirement, since the low-loader with its 12 foot wide load and slow rate of progress would cause continuous traffic jams during busy hours. As it was, under pre-

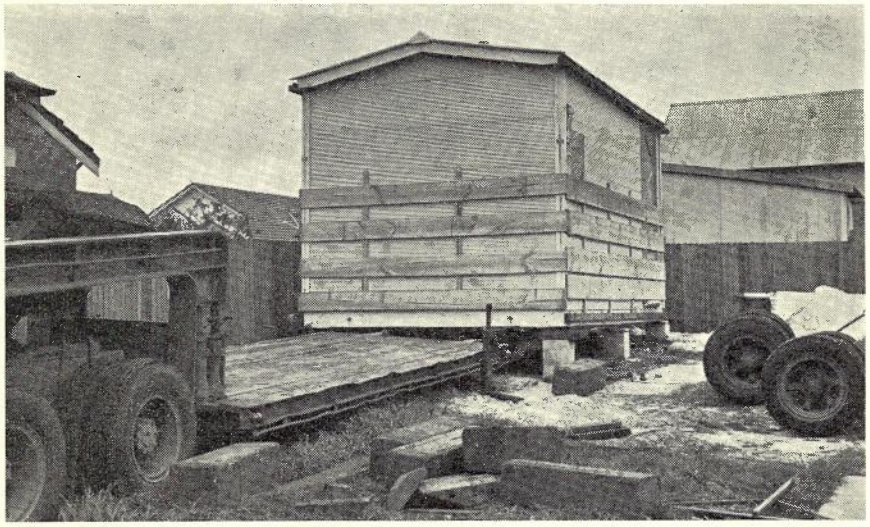


Fig. 5.—Loading prior to backing.

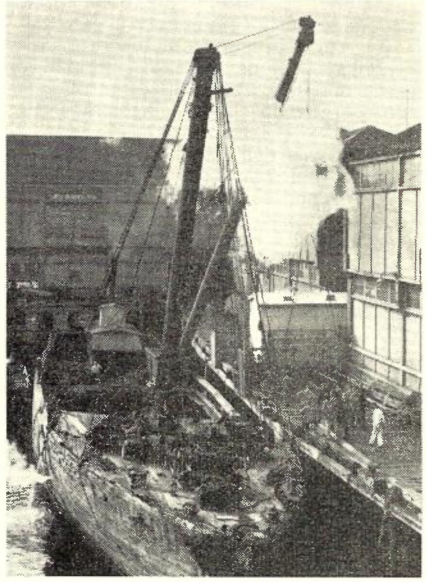


Fig. 8.—Loading Exchange on "Penguin".

vailing traffic conditions, the 15 mile journey took nearly 1½ hours. En route, the load was assessed at a public weighbridge, and found to be 9 tons 6 cwt.

Owing to lack of headroom and manoeuvring space, it was impossible to deliver the exchange direct to the wharf at which the M.V. "Kootara" was berthed. The building (Fig. 7) was therefore backed into an alley at No. 5 Darling Harbour which gave direct access to the water. Arrangements were made for it to be picked up by the lighter "Penguin" and transferred to No. 12 Darling Harbour where the M.V. "Kootara" was berthed.

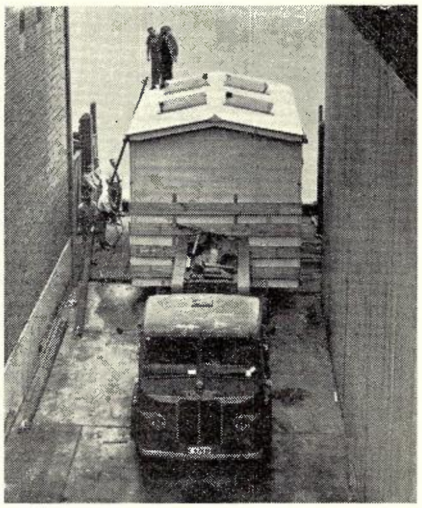


Fig. 7.—Exchange at wharf.

Loading of Exchange

A double sling was used to lift the exchange, spreaders being fitted to take the crushing forces (Fig. 8). The "Penguin" carried the exchange suspended from the jib and on arrival at No. 12 Darling Harbour transferred it directly to the cradle which had been prepared for it on top of the Midships hatch on the "Kootara". The building was wedged in position by shipwrights, and then lashed down with wire ropes to ringbolts on the hatch structure. It was then covered by tarpaulins, and a hatch tent was roped in position over these. Finally the jibs were lowered, on each side of the exchange, and made tight in their standards (Fig. 9). The exchange, which is valued at £24,050, was then considered ready for sea transport.

The following communication was subsequently received from Hobart:—

SUPENG
SYDNEY
REFERENCE TESY OF 23.5.55 PORTABLE EXCHANGE TRANSFERRED TO LAUNCESTON ARRIVED EXCELLENT CONDITION STOP NO SIGN CORROSION SEA ATMOSPHERE NO INDICATION INTERNAL MOISTURE CONDENSATION OR LOW I.R. AND NO MECHANICAL DAMAGE.
SUPENG HOBART.

Fig. 6.—Jacking up Exchange.

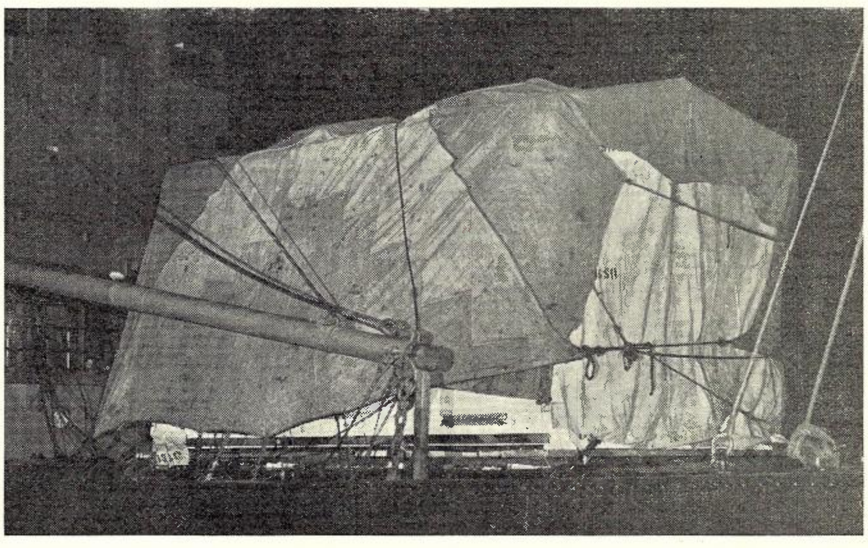


Fig. 9.—Exchange on "Kootara".

EXTERNAL PLANT STORAGE FACILITIES AT COUNTRY LINE DEPOTS

H. W. F. EDWARDS, A.F.C., A.M.I.E.Aust.

Introduction: The post-war era has resulted in an expansion in all aspects of the telecommunications field; one which has been given considerable thought in Australia is the development of standard type P.M.G. line depot buildings and the layout of their sites. It has been a slow but steady development, and there are still many depots where the buildings are out-of-date and inadequate. In Australia, the satisfaction of the demand for new telephone services is a major problem, and the improvement of facilities at line depots is one method of increasing efficiency, and thereby increasing output to meet the excessive demand.

Standard Layout: In country towns where a new line depot is planned, a site is procured large enough to accommodate a standard type depot building. These buildings vary in size according to the permanent staff employed, and are L-shaped in construction. Fig. 1 shows a typical building. Using a rectangular block wherever possible, the minimum width required to give sufficient space for storage ramps is two chains. In this frontage, 50 feet is allowed for the width of the building, and 30 feet for the entry and exit driveways. The depth of the block is 165 feet minimum, and the driveways form a "U" surrounding the depot building. The entry driveway is wider than the exit, thereby allowing sufficient space for vehicles to be stationary alongside the delivery platform without impeding through-traffic into the depot. Fig. 2 shows a typical layout, and gives the overall dimensions of the pole ramps, crossarm ramps, and other storage facilities required at a country line depot.

In the Southern Country Division in Western Australia, five of the twenty-one line depot sites are designed along the lines outlined in Fig. 2, and one such depot is located at the seaside resort of Bunbury, 116 miles south of Perth. Because this depot is situated in a residential part of the town, special measures were taken to beautify the site, and where possible hide the ramps, etc., from the public eye. This was achieved by the cultivation of Victorian ti-tree hedges as shown in Fig. 3. It will be noticed also that box trees have been planted in the foreground, and when funds become available, the permanent brick-built depot building will be constructed on the area which is at present a couch grass lawn. The storage facilities at this depot are typical of the most recent developments and are described in the following paragraphs.

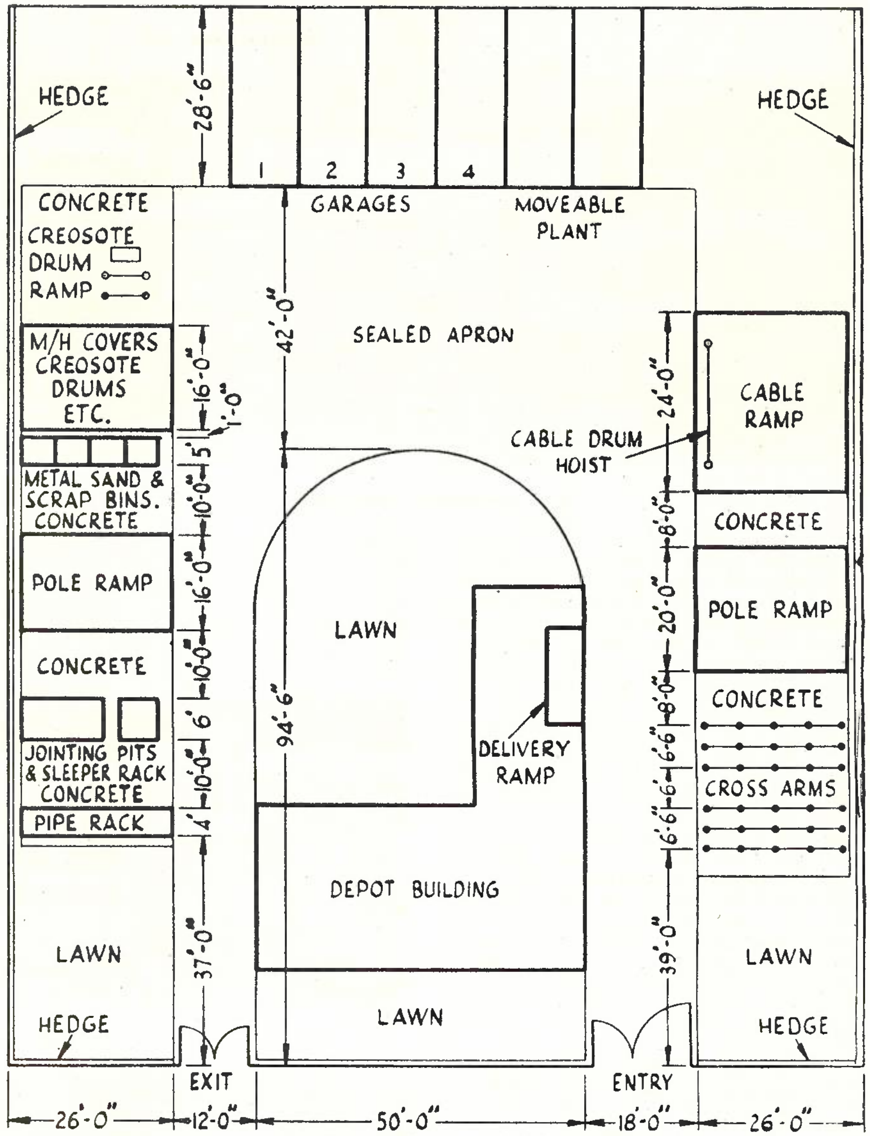


Fig. 2.—Line Depot typical layout.

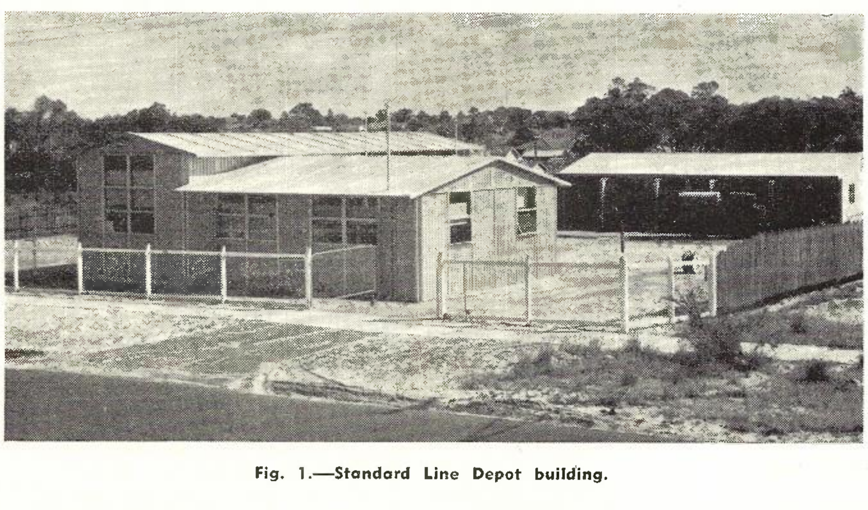


Fig. 1.—Standard Line Depot building.

Construction of Pole Ramp: Fig. 4 shows the construction of the pole ramp. In its construction, use was made of redundant No. 10 sections of sectional steel poles for the uprights, and steel rails for the cross-members. Where the rails are welded together (Fig. 5), the stumps were sunk into the ground to a depth to give 3 feet 4 inches showing

Fig. 3.—Bunbury Line Depot.

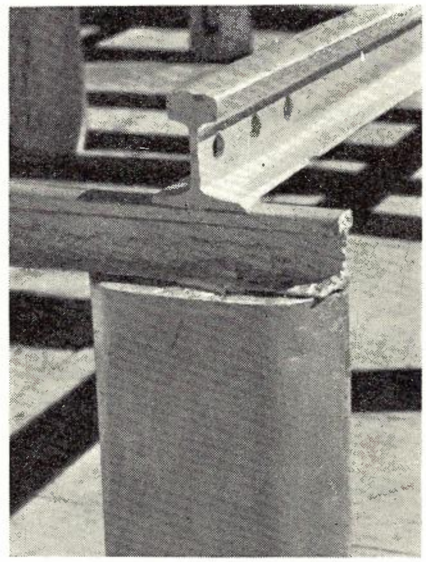


Fig. 6.—Pole ramp detail.

above the 2 inch concrete base; where only the one rail rested on the stump, the height of this stump was raised according to the size of rail used. The mean height of the top of the ramp above ground level is 4 feet, and 30 lb. and 60 lb. steel rails were used for the cross-members. To consolidate the ramp into a clean-looking, solid structure, the No. 10 pole section was set into the ground at the required depth, and was filled with concrete, re-inforced where possible with scrap iron. An obsolete transposition band was bent into the form of a "U" and inserted into the concrete so that the base of the rail would be gripped by the band (Fig. 6). The rail was then welded to the bands, and likewise where a rail rested on another rail these were also welded together, to make an integral structure. To cover unsightly rust, the entire ramp was painted with "Orminoid," a bituminous-based aluminium paint. Short sections of steel rail were shaped to fit onto the ramp so that poles could be rolled off the delivery truck; the principle used is shown in Fig. 5 where the skid is supported by two pieces of angle-iron in lieu of the truck. To prevent poles from rolling off the ramp, back-stops were provided by sinking steel rails into the concreted steel pole sections as shown in Fig. 4. In addition to these permanent stops, a chock was designed which would slide along the rail, and which was capable of locking a pole or poles in any desired position on the ramp. The chock is simply constructed, and has proved to be most successful. It works on the principle that the pole resting against the top of the chock produces a non-slipping reaction on the top and sides of the rail (Fig. 7). As an added safety precaution, and to ensure that poles could not roll off the front end of the ramp, holes were drilled in the steel rails so that the chock

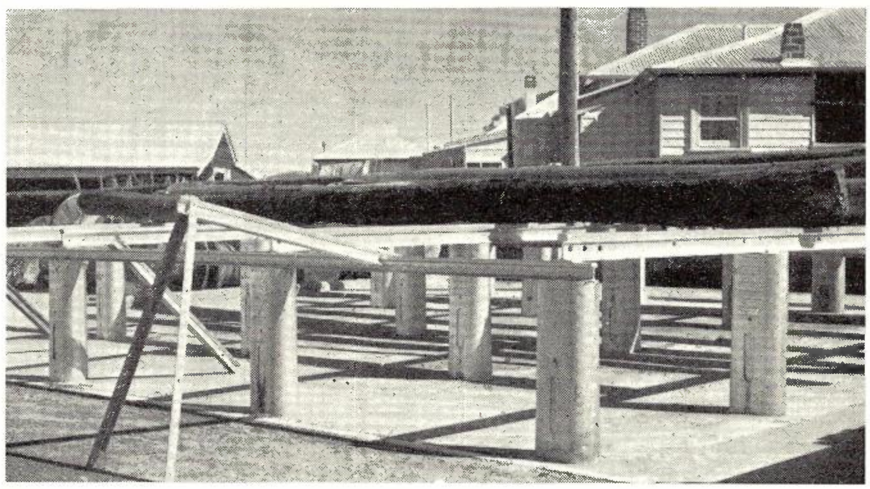
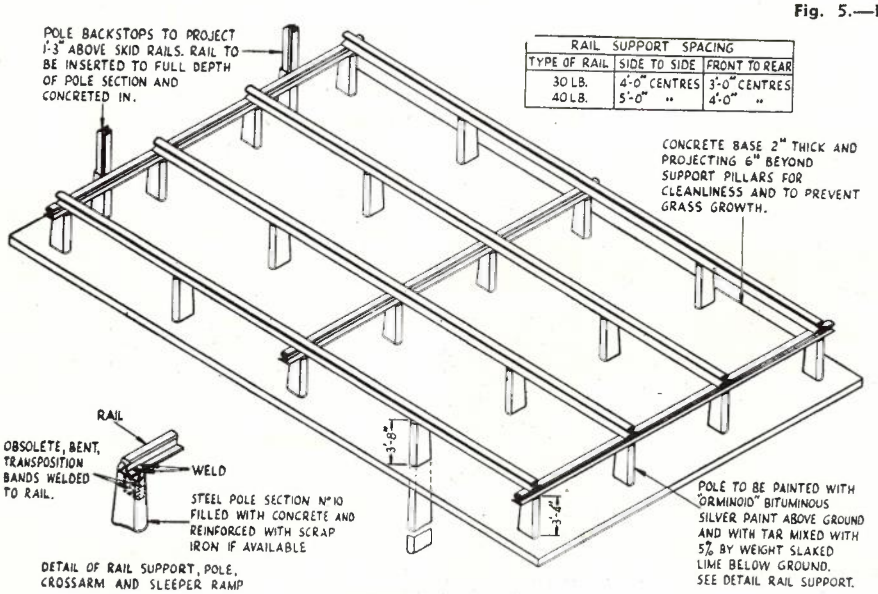


Fig. 5.—Pole ramp.



RAIL SUPPORT SPACING		
TYPE OF RAIL	SIDE TO SIDE	FRONT TO REAR
30 LB.	4'-0" CENTRES	3'-0" CENTRES
40 LB.	5'-0" "	4'-0" "

Fig. 4.—Pole ramp.

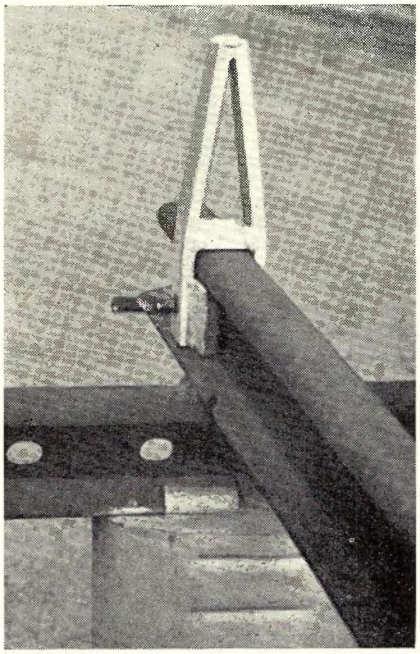


Fig. 7.—Pole chock.

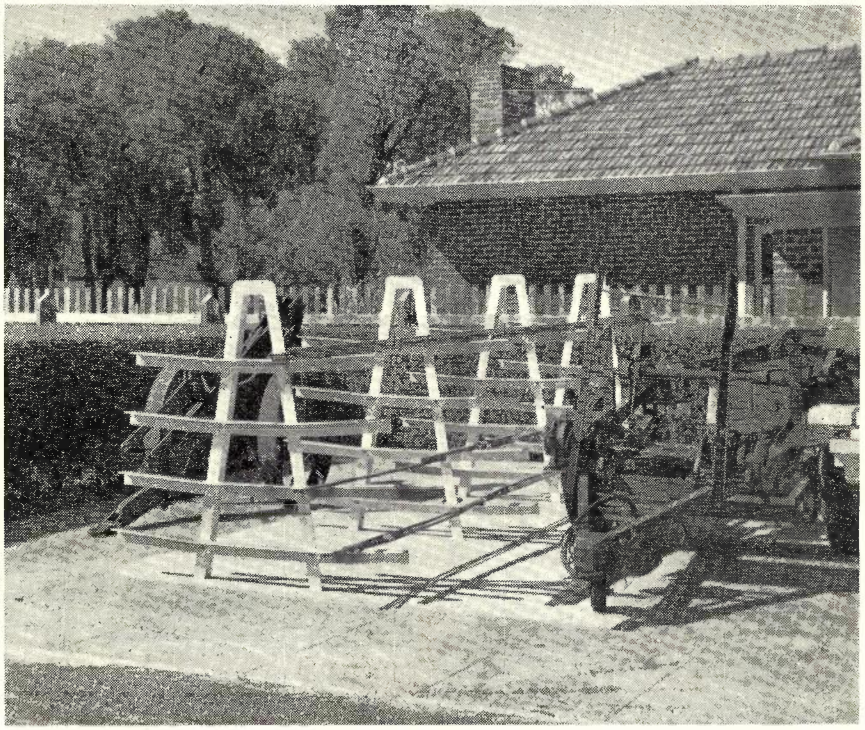


Fig. 9.—Pipe rack.

could be locked in position by means of a bolt.

Construction of Crossarm Ramp. Material similar to that of the pole ramp was used, except that it was only necessary to use 30 lb. rail for the crossmembers, and the mean height above ground level was reduced to 2 feet. Three rows of uprights were provided, each row 3 feet 3 inches between centres, and the uprights in the row spaced 6 feet apart. Fig. 8 shows two ramps constructed in this manner. All sizes of crossarms can be stored on these ramps without fear of distortion to the arms.

Construction of Pipe Rack: The pipe rack consists of four separate sections, constructed entirely of 2 x 2 x $\frac{1}{4}$ inch angle iron. These are in the shape of an inverted "V" with four crossmembers welded to the "V" spaced 14 inches apart (Fig. 9). The "V" sections were sunk into a concrete base at 6 feet intervals. In the light of experience it would appear desirable to reduce the interval between two of these uprights to take the very short lengths of pipe, and add another "V" to make it the 20 feet length.

Sleeper Ramp: Using similar construction to that of the crossarm ramp, the sleeper ramp has six uprights, in two rows of three, spaced 5 feet 6 inches apart. Two 7 feet lengths of rail were welded to the uprights in the usual manner. The mean height of the ramp above ground level is 2 ft.

Creosote Drum Ramp: As the construction of the ramps already mentioned depended on the supply of redundant sections of steel poles, it was neces-

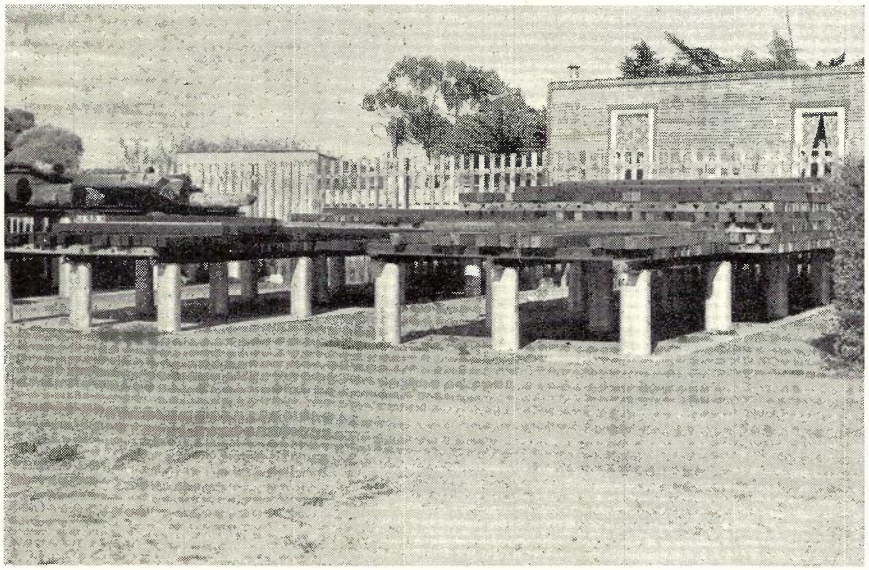


Fig. 8.—Crossarm ramps.

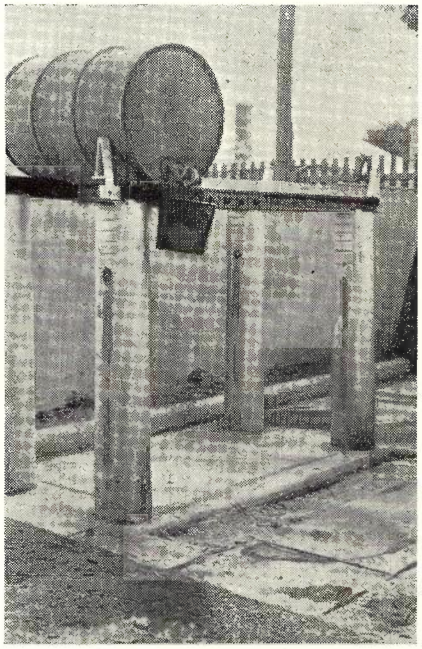


Fig. 10.—Creosote drum ramp.

sary to utilise some of the smaller sections where the weight factor was not of great importance. As will be seen from Fig. 10, the four uprights of smaller section were placed to give a rectangular base 6 by 2 feet and height of 3 feet 9 inches above the concrete ground level. A sand-filled trough was provided in the concrete base to catch the creosote drips. It will be noticed in Fig. 10 that the pole chock has been used to hold the drum in position.

Cable Drum Supports: To facilitate running-off and accurate measurement of short lengths of cable, two supports were made in the usual manner, the steel sections being sunk into the ground 4 feet 9 inches apart, to give a clearance above the ground of 4 feet 3 inches. At different levels to accommodate varying sizes of cable drums, heavy-type swan-necked spindles were inserted in the uprights as in Fig. 11. At five yard intervals, small concrete markers were inserted into the ground. As measurements of cable up to 50 yards in one direction are made by this method, it was necessary to place these markers accurately from the datum mark. The above supports were situated near the cable drum ramp, and also nearby a small axle rack was provided; this rack holds the various sized axles for the cable drums used between the supports.

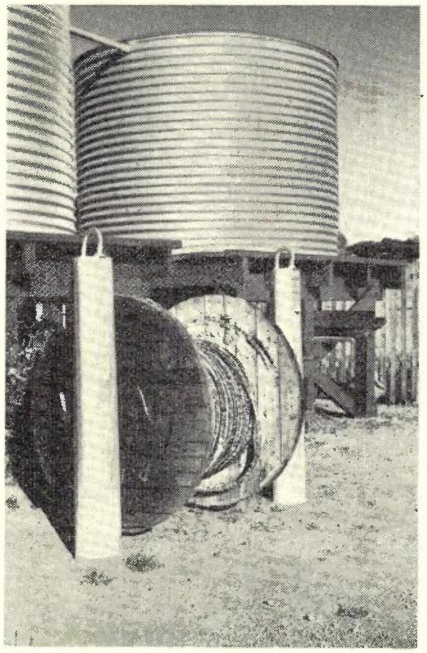


Fig. 11.—Cable drum supports.

Manhandling of Cable Drums: As most of the drums reach a country line depot by rail and/or truck, the damage to the drums is sometimes quite considerable. Probably the greatest amount of damage occurs when the drum is deposited at the depot. Without any ready means of lowering the cable drum gently to the ground, it is frequently dumped from a height of 4 feet on to an old car tyre. Added to this the scarcity of cable jinkers makes further movement of the drum not only a problem but a danger. To facilitate rapid and easy movement of cable drums at the larger line depots, a 3 ton endless-chain hoist has been erected (Fig. 12). The hoist is carried on a 'creeper' trolley, which runs on a 12 x 5 inch "H" section steel beam. Its span of 16 feet is supported on two solid jarrah poles sunk in concrete, and the height of the beam above the concrete cable platform is 20 feet. The hoist is located at the front of the cable drum ramp. Thought was given to providing a gantry arrangement, but the added initial cost is not justified at the average-sized country line depot. It will be noticed that the span is much longer than that necessary to back a truck under the hoist; this was arranged so that a drum could be loaded onto the side of the truck. Most Departmental trucks are fitted with a ladder rack across the back of the tray, and to load a drum directly from the rear would involve negotiating this rack. Because of the value of lead and copper, provision is being made to safeguard the cable by constructing a cyclone fence around the ramp, and at the same time to provide a roof to protect the cable from the weather elements.

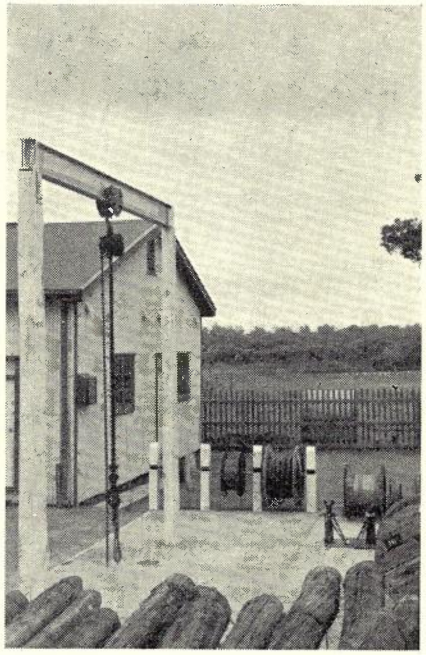


Fig. 12.—Cable drum hoist.

Bins for Scrap Wire, etc.: A concrete structure, 3 inches thick and built in accordance with Fig. 13, provides a neat arrangement for the storage of scrap iron, scrap wire, screenings and sand. Wooden frames were made and erected, into which the concrete was poured. These frames are used at several depots, and have proved to be effective and efficient. It will be seen from Fig. 13 that each bin has a sloping front, and one has a lockable wooden lid fitted to the sloping front. This bin houses the scrap copper wire and lead. The cross-section of each bin is 5 by 4 feet, with a 1 foot 6 inch front and 5 foot back. Any number of bins can be provided in the one structure depending on the space available.

Conclusion: The provision of a satisfactory country line depot is a problem and it is apparent that improvements can still be made on the storage facilities outlined. Nevertheless, it has been found that neat and solidly constructed storage facilities can be provided, mainly by the use of obsolescent and redundant material.

In view of the need for accurate stores accounting, neat and well-stored material adds to the ease of checking this material in and out of the depot. It cannot be denied that an efficiently run line depot must lead to efficient workmanship in the field, and the action of providing suitable external storage facilities is but one phase of this organisation.

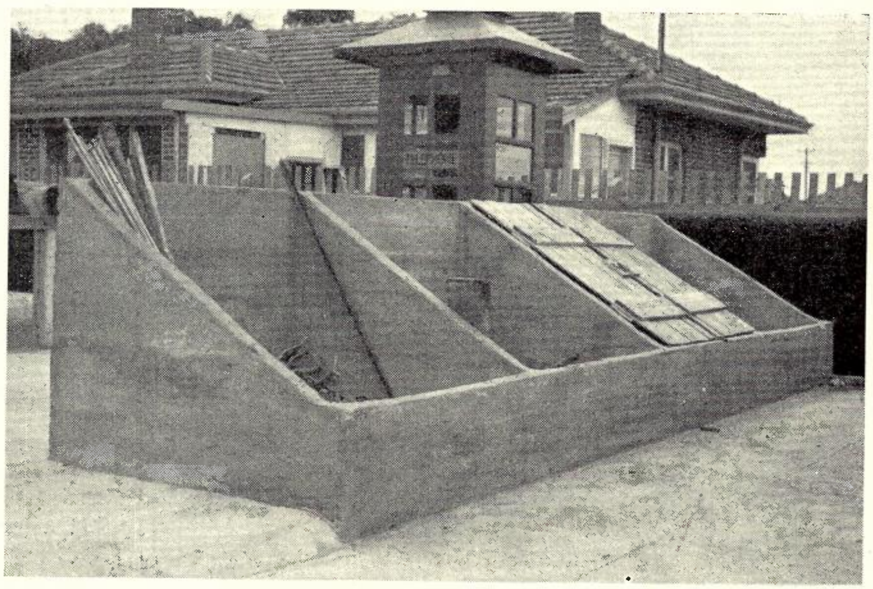


Fig. 13.—Storage bins.

RETIREMENT – MR. W. SANDBACH

On 6th March, Mr. Walter Sandbach, Assistant Director, Engineering, Victoria, retired from the Department at the end of 45 years of service. The esteem and friendship of the Engineering and other staff towards Mr. Sandbach was evidenced by the large attendance at the farewell dinner that marked the occasion. On the way up to the position from which he retired, Mr. Sandbach gained wide experience in all aspects of Engineering in both the Central Office and Victorian Administrations. After serving with the Royal Corps of Signals in France during World War I, Mr. Sandbach was placed on the Reserve of Officers list and was, at the beginning of World War II commissioned as Lieutenant Colonel, Lines of Communication, in the 3rd Military District, which consisted of Victoria and the Southern part of N.S.W. This appointment required the recruiting and training of a thousand Post Office Personnel on a military basis to control, in the event of enemy attack on the Continent, the communications in the district.

As a man and an Engineer, Mr. Sandbach's friendly approach in official and personal relationships gained for him, throughout his career, the respect and loyal co-operation from others that is so necessary for successful leadership of what he fondly refers to as "the team". Mr. Sandbach's interest in, and appreciation of the qualities demanded for successful control, resulted in the organisation of staff instruction means to ensure diffusion of supervisory and managerial knowledge throughout the Victorian Engineering Division. The success of this scheme was typical of the results that rewarded the attitude of interest and purpose that Mr. Sandbach applied at every stage of his career. The members of the Society, in saying farewell to Mr. Sandbach, extend to him their best wishes for full enjoyment of a well earned retirement after a notably active and effective career.

MR. C. J. GRIFFITHS, M.E.E., A.M.I.E.E., A.M.I.E. AUST.

After many years of sterling service, Mr. C. J. Griffiths has resigned from the Board of Editors. His close association with the affairs of the Postal Electrical Society and the Telecommunication Journal dates from 1934 when he was elected a member of the Committee on which he served till 1947. Mr. Griffiths joined the Board of Editors in 1944 in succession to the late Mr. A. Gourley. The following years brought many problems in the production of the Journal, but, in spite of increasing pressure of Departmental work and greater responsibilities, he spared no effort in endeavours to ensure that the Journal appeared regularly and that the highest possible standard was maintained.

Mr. Griffiths has been a staunch believer in the Telecommunication Journal from the days of its first publication. He has contributed several articles of special technical interest, and has afforded much advice and assistance to other writers.

The Society owes a large debt to Mr. Griffiths for his valuable efforts on behalf of the Journal, a debt which cannot be adequately repaid, although as a small token of appreciation of his services he was elected a life member of the Society in 1953. I am sure all our readers will join with us in saying a heartfelt "Thank you, Mr. Griffiths".

ANSWERS TO EXAMINATION PAPERS

EXAMINATION No. 3747—Engineer Transmission.

13th March, 1951 and subsequent dates FOR PROMOTION OR TRANSFER AS ENGINEER, THIRD DIVISION, ENGINEERING BRANCH, POST-MASTER-GENERAL'S DEPARTMENT, ALL STATES

Section 1—Long-Line Equipment.

Q.5.—Discuss the causes of noise in multi-channel carrier telephone systems.

How is noise measured on a telephone channel?

Briefly discuss the characteristics of any channel noise measuring instrument.

A.—The causes of noise in multi-channel carrier telephone systems may be broadly classified into equipment noise and circuit noise. Equipment noise can be produced by

(i) Random noise due to the resistance at the grid of the first tube of amplifiers. The mean square voltage of this noise is given by the expression $e^2 = 4\ k\ T\ R\ (f_2 - f_1)$ where k = Boltzman's constant, T = degrees K, R = resistance in ohms and $(f_2 - f_1)$ is the frequency band considered. This noise approximates −133 dbm for a 3 Kc/s bandwidth.

(ii) Tube noise due to shot effect, flicker effect and microphonic effects. The first two are normally negligible, and the last effect is a function of the mechanical stability of the tube elements.

(iii) Power supply noise. This can be due to direct injection of commutator or rectifier ripple or to a high impedance source of power which facilitates intersystem couplings.

(iv) Intermodulation produced in amplifiers, modulators and filters which carry the groups of channels.

(v) Interference due to lack of suppression filters as for example that caused at the extremes of channel frequencies by bandpass filters with sloping cutoffs.

(vi) Undesired couplings caused by electromagnetic or electrostatic coupling between equipment elements, or by common impedances such as common power supplies, earth wires, bias circuits or carrier frequency generators.

Circuit (or line) noise can result from the following factors.

(i) Atmospheric noise which includes all interference induced in a circuit by natural conditions. This noise level varies with the weather, the season, and the geographical location.

(ii) Induction from man made sources such as power lines, power line carrier systems, radio transmitters and large industrial electrical plant.

(iii) Crosstalk from other carrier systems operating on adjacent pairs. This is a major source of interference and requires transposition schemes, balancing equipment, and system techniques (such as frequency frogging) to keep it within acceptable limits.

Control of impedance variations and close attention to office cabling and earthing practices is also important.

Assuming that well designed systems are used and that normal precautions are taken with office equipment and power supplies, the noise originating in open wire lines is the controlling factor. In cable carrier systems using carrier cables the equipment noise is the controlling factor. Australian design is based on a noise performance of not worse than −51 dbm (wtd.) at a receiving point of zero relative level for 99% of the time on a 1000 mile route.

The noise on a telephone channel is normally measured with a psophometer at "hybrid line" or "demod out" with the corresponding "hyb line" or "mod in" terminated in 600 ohms. The psophometer weighting should correspond to the C.C.I.F. 1949 recommendations.

A typical instrument is the W.E. 2B noise set with FIA weighting which corresponds closely to the 1949 curve. The meter characteristics also closely simulate the C.C.I.F. specifications. This set is a portable self-contained instrument, and indicates the noise magnitude visually by a meter deflection. It has convenient inbuilt calibration facilities and a comprehensive choice of frequency weightings, and input impedances. It may be used for both weighted and flat measurements.

With regular arrangements the sensitivity of the set is such that readings can be taken directly above a reference of −90 dbm. For sets modified to FIA weighting this sensitivity is slightly reduced. A monitoring receiver is provided and should be used when taking measurements, as it aids in identifying the noise.

For noise which is not steady the meter should be read similarly to a volume indicator, that is the deflection reached by the majority of the maximum swings, occasional overswings past the point being neglected.

Section 2—Radio and Broadcasting

Q.6—(i) Give a full explanation of the meaning of the following terms as applied to an R.F. transmission line and show how the appropriate expressions are derived:—

(a) reflected wave;

(b) standing-wave ratio.

(ii) An R.F. transmission line of negligible attenuation, whose characteristic impedance is 70 ohms is terminated in an impedance of 50 + j20 ohms. Calculate the amplitude and phase of the reflected wave relative to the incident wave at the termination and the standing-wave ratio.

A. (i) (a) **Reflected wave.**

Fig. A shows a transmission line of characteristic impedance Z_O fed by a signal source of internal impedance Z_O and terminated at the distant end by an impedance Z_T

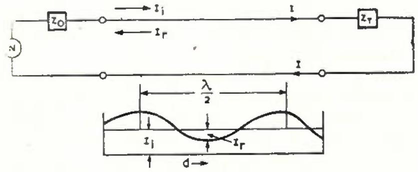


Fig. A

The current I at any point on the line is the vector sum of the current I_i incident upon the load Z_T and the current I_i reflected from the load. The amplitude and the current I_i reflected wave is given by

$$I_r = I_i \left(\frac{Z_T - Z_O}{Z_T + Z_O}\right) \text{ where}$$

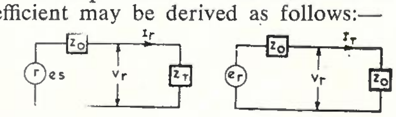
$$\frac{Z_T - Z_O}{Z_T + Z_O} = \text{Reflection coefficient}$$

The reflection coefficient is defined as the ratio of the current in the terminating impedance to the current which would exist if the line was terminated by an impedance of value equal to its characteristic impedance.

Considering the expression for reflection coefficient $\frac{Z_T - Z_O}{Z_T + Z_O}$, Z_O is usually a pure resistance and when the line is terminated by a pure resistance of value equal to Z_O it will be seen that the amplitude of the reflected wave is zero. Under these conditions the line is correctly terminated or "matched".

For other value of Z_T a reflected wave exists, conditions of complete reflection ($I_r = I_i$) occur when $Z_T = O$ (short circuited line) and when $Z_T = \infty$ (open circuited line).

The expression for the reflection coefficient may be derived as follows:—



(a) (b)

Fig. B

Considering Fig. B sketches (a) and (b) if the line attenuation is neglected (as it may be in the case of R.F. lines) $e_r = e_s$

$$\text{then from (a) } I_r = \frac{e_s}{Z_O + Z_T} = \frac{e_r}{Z_O + Z_T}$$

Had the line been terminated by Z_O (sketch (b))

$$I_T = \frac{e_r}{2\ Z_O}$$

reflected current $= I_T - I_r$

$$= \frac{e_r}{2\ Z_O} - \frac{e_R}{Z_O + Z_T}$$

$$= \frac{e_r\ (Z_O + Z_T) - 2\ e_r\ Z_O}{2\ Z_O\ (Z_O + Z_T)}$$

$$= \frac{e_r}{2\,Z_0} \times \frac{Z_T - Z_0}{Z_T + Z_0}$$

$$= I_T \left(\frac{Z_T - Z_0}{Z_T + Z_0}\right)$$

reflected coefficient

$$= \frac{I_T - I_R}{I_T}$$

$$= \frac{I_T \dfrac{(Z_T - Z_0)}{Z_T + Z_0}}{I_T}$$

$$= \frac{Z_T - Z_0}{Z_T + Z_0}$$

(b) **Standing Wave Ratio.** The phase difference between the incident and reflected waves is different at various points along the transmission line, the phase varying through 2π radians or 180° in a distance equal to one half wavelength for a line in which the phase velocity is equal to that of light (see Fig. A). Thus the resultant current which is the vector sum of the incident current I_i and the reflected current I_r, varies from a maximum to a minimum and back to a minimum again in a distance equal to one half wavelength as shown in the lower sketch. When the value of I_r is much less than I_i, the variation of amplitude of the resultant with distance is approximately sinusoidal. When $I_i = I_r$ the maximum value of I is $2I_i = 2I_r$ and the minimum value is zero.

The standing wave ratio is defined as

$$\frac{I\ max}{I\ min.} = \frac{I_i + I_r}{I_i - I_r} = \frac{I + \dfrac{I_r}{I_i}}{I - \dfrac{I_r}{I_i}}$$

The standing wave ratio is also expressed in terms of the voltage appearing across the line

$$\frac{E\ max.}{E\ min.} = \frac{E_i + E_r}{E_i - E_r}$$

The reciprocal of both current and voltage standing wave ratios are also used.

$$\frac{\text{reflected wave}}{\text{incident wave}} = \frac{Z_0 - Z_T}{Z_0 + Z_T}$$

$$= \frac{70 - 50 - j\,20}{70 + 50 + j\,20}$$

$$= \frac{1 - j1}{6 + j1}$$

$$= \frac{1.414\ \angle -45^\circ}{6.08\ \angle +9.4^\circ}$$

$$= 0.23\ \angle -54.4^\circ$$

Thus the amplitude of the reflected is 0.23 times that of the incident wave at the termination and the phase displacement of the reflected wave is 54.4° lagging.

The value of the standing wave ratio which results is

$$SWR = \frac{1 + .23}{1 - .23} = 1.6$$

$$\text{or } SWR = \frac{1 - .23}{1 + .23} = .625$$

Q.7.—(i) Give the equivalent circuit of a piezo-electric quartz crystal used for controlling the frequency of an R.F. valve oscillator (but omitting the valve circuit), and relate each electrical component shown in the diagram to its physical counterpart in the crystal and its mounting:

(ii) Assuming equivalent inductance and capacitance of 2.5 henries and 0.04 $\mu\mu$F respectively and negligible resistance with 20 $\mu\mu$F due to the mounted crystal, associated wiring, etc., calculate the frequency of resonance.

A. (i)

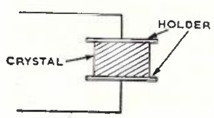


Fig. A

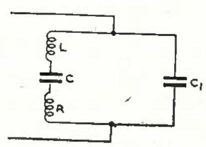


Fig. B

In the equivalent electrical circuit the designations L, C, R and C_1 represent the following:

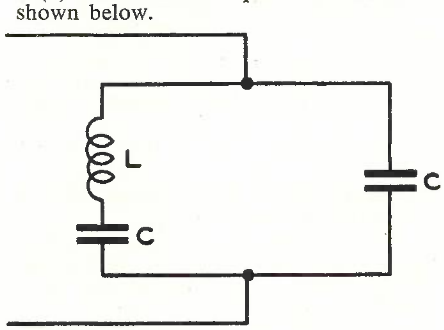
"L" represents the equivalent mass of the crystal.

"C" represents the equivalent compliance of the crystal.

"R" represents the frictional losses of the crystal when vibrating.

"C_1" represents the resulting shunt capacity of the crystal electrodes and holder when crystal is in position but not vibrating.

(ii) The resultant equivalent circuit is shown below.



where $L = 2.5$ henries
$C = 0.04 \times 10^{-12}$ farads
$C_1 = 20 \times 10^{-12}$ farads

At parallel resonance

$$f = \frac{1}{2\pi} \sqrt{\frac{C + C_1}{L\,C\,C_1}}$$

$$\text{hence } f = \frac{1}{2\pi} \sqrt{\frac{(0.04 + 20)10^{-12}}{2.5 \times 0.04 \times 20 \times 10^{-24}}}$$

$$= 505\ \text{Kc/s}$$

The derivation of this formula is as follows.

At parallel resonance the impedance of the left hand arm equals the impedance of the right hand arm, that is

$$2\pi fL - \frac{1}{2\pi fC} = \frac{1}{2\pi fC_1}$$

$$\text{hence} \quad 2\pi fL = \frac{1}{2\pi fC_1} + \frac{1}{2\pi fC}$$

$$\therefore \quad 2\pi fL = \frac{C + C_1}{2\pi fCC_1}$$

$$\therefore \quad f^2 = \frac{C + C_1}{4\pi^2 LCC_1}$$

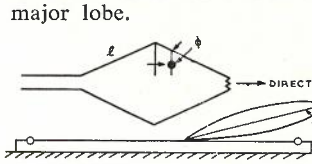
$$\therefore \quad f = \frac{1}{2\pi} \sqrt{\frac{C + C1}{L\,CC_1}}$$

Q.8.—(i) Outline the main characteristics of a rhombic aerial for use with an H.F. transmitter and explain the effect the length of side and height above ground has on the radiation.

(ii) Mention one method of improving the performance of a simple rhombic and state the effect on the characteristic impedance.

(iii) Sketch the shape of the vertical plane polar diagrams at 6 Mc/s. and 18 Mc/s. of a rhombic aerial designed to operate on these frequencies and give any appropriate comment.

A.—(i) The rhombic aerial is capable of providing a high gain at its imptmum frequency with a high degree of discrimination against unwanted signals from directions other than that of the major lobe.



A substantial gain and directivity is obtainable over approximately a 3 to 1 frequency range with reasonably constant input impedance which is of the order of 600 ohms for a multiwire rhombic (see 8 (ii)). A terminating resistor is required of about 800 ohms for receiving or low power transmitting aerials. For high power transmitters it is necessary to use a dissipative transmission line preferably of stainless steel construction.

The major lobe lies along the major axis in the direction of the arrow shown above. The plane of the aerial is, of course, horizontal for HF use and the angle made by the major lobe with the horizontal will depend on the frequency and the rhombic parameters.

Rhombic aerials are not usually considered useful for frequencies where the leg length (l in sketch) is less than 2 wavelengths. For $l = 2\lambda$ the angle (α) made by the major lobe with the horizontal cannot exceed just over 30° irrespective of the so-called "tilt angle". Where l is greater than 2λ and for a given angle ϕ, the angle made by the major lobe with the horizontal decreases. One reason for the usefulness of this aerial is the fact that not only is the input impedance reasonably constant over a range of frequency but for given values of ϕ and l the angle $\propto$ falls with increasing frequency, i.e. as the length of the sides increases in terms of wave length. This corresponds to the requirements of ionospheric propagation.

An "optimum" rhombic may be described as one in which the principal side lobes have been suppressed by correct choice of ϕ and the height above ground. The effect of reflection from the ground plane is to introduce a "height factor" with successive zeros and maxima as the angle made by the incident or transmitted ray with the horizontal is increased from 0°. If ϕ is chosen so that the angle of the main side lobes with the horizontal is about twice that of the major lobe the next largest side lobes will fall at about 0°. If the height of the aerial is now made such that the first maximum in the height factor is at the angle of the major lobe, the next zero in the height factor will be at such an angle as to suppress the main side lobes. The next largest side lobes are, of course, suppressed by the zero in the height factor at 0°. By correct choice of the length l, the angle of the major lobe may be varied over a range and still comply with the above requirements. The "optimum" design is then to be preferred and its properties will hold good over a narrow band of frequencies.

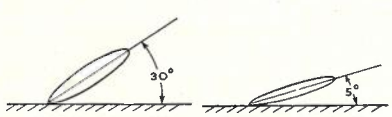
As the rhombic is generally used over a 2 or 3 to 1 range of frequency the above ideal conditions can only be met at one of the operating frequencies.

(ii)

Multiwave rhombics.

The variation of the input impedance can be reduced by constructing the rhombic of two or three wires in parallel which are joined at the ends of the rhombic and separated by 3 or 4 feet at the middle. The input impedance will then be about 600 ohms.

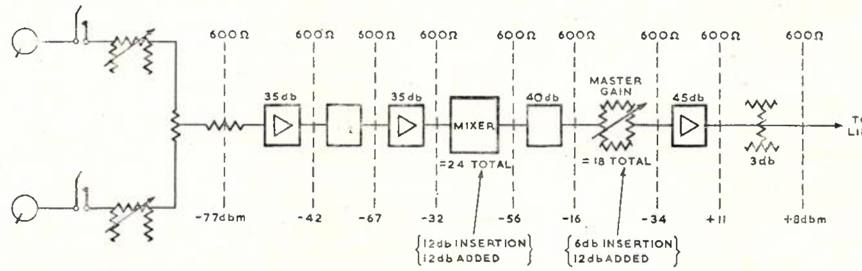
(iii) let $l = 2\lambda$ at 6 Mc/s
$= 6\lambda$ at 18 Mc/s
and $\phi = 70°$



At 6 Mc/s . **At 18 Mc/s**

As previously stated the angle made by the major lobe with the horizontal falls as the frequency is increased.

Q.9.—A pair of high fidelity gramophone pickups, the average output level of which is minus 65 dbm, is to be installed in a broadcasting studio. With the aid of a block diagram describe the apparatus which would be necessary to ensure that an average level of plus 8 dbm. would be transmitted to line from the studio and show the positions of the faders, gain control and low frequency equalizer (s) with respect to the amplifying equipment, stating the levels at each point along the circuit.



Block diagram of a typical studio circuit.

Each pick-up is fed through an announcer's key and fader to a combining network. The 6db insertion loss of the fader and the 6db loss of the combining network bring the level at this point to -77 dbm.

It will be necessary to equalise for the recording characteristic, and 25db insertion loss may be expected in the equalisers. The signal must be amplified before equalisation in this example as otherwise the signal to noise ratio would deteriorate considerably. A level of -30 to -40 dbm is desirable for feeding to the mixer network, so that 60 to 70 db of preamplification is required. This could be achieved with a single amplifier but a more common arrangement would be two amplifiers as shown. In the circuit shown, the equaliser is placed between two preamplifiers of 35 db gain each.

The mixer and master gain controls are not operated at minimum loss.

The loss of the mixer is varied for each channel so as roughly to match the levels; and the dynamic control is maintained in the master gain control. 12db reserve loss in each is shown in this instance.

The remainder of the Block diagram is self explanatary.

Note:—With the wide use of microgroove recordings, the current practice is to mount two pick-ups on each turntable (one for L.P. and one for Standard). Radio Report No. 24 describes a continuing network for such a scheme and also gives details of this RIAA equaliser which is now Departmental Standard.

Q.10.—Discuss the relative merits of superheterodyne and tuned radio-frequency radio receivers for the reception of overseas high frequency transmissions required for rebroadcasting purposes.

A.—The performance of superheterodyne and tuned radio frequency radio receivers differs considerably in respect to sensitivity and selectivity. As these characteristics largely influence the choice of a receiver for the reception of high frequency broadcasting transmissions, they may be used to compare the merits of the two receivers.

Sensitivity. The sensitivity of a receiver is dependent upon the amplification provided between the aerial and the detector. In a TRF receiver the gain is limited by difficulties in avoiding oscillation in variable tuned radio frequency amplifier stages. This difficulty is overcome in a superheterodyne receiver by providing most of the radio frequency amplification at a fixed, relatively low, intermediate frequency. The tuned circuits of the I.F. amplifiers, being fixed, are compact (no ganged variable condenser) and unwanted feedback through stray capacitances is less. More amplification can therefore be provided and the superheterodyne receiver has a much higher sensitivity than the T.R.F. receiver.

Selectivity. The selectivity of a receiver depends upon the number of resonant circuits used in the tuned stages between the aerial and the detector. In a T.R.F. receiver to operate throughout the H.F. broadcasting bands the number of resonant circuits is limited by the difficulties in keeping them all in tune as the variable tuning capacitor is adjusted. In a superheterodyne receiver most of the tuned circuits operate at the fixed intermediate frequency and can be readily adjusted or aligned for optimum selectivity. As the intermediate frequency is lower than the signal frequency or given frequency, difference between wanted and unwanted signals corresponds to a proportionately larger frequency difference of the intermediate frequency, resulting in easier rejection of unwanted signals. The use of fixed tuned circuits in the intermediate frequency amplifier sections of the superheterodyne receiver also permits the introduction of coupled tuned circuits designed to provide a uniform response to sideband components while still rejecting unwanted signals on adjacent frequencies.

The performance of the superheterodyne receiver as regards sensitivity and selectivity is far superior to that of the tuned radio frequency receiver and it would be preferred for the reception of overseas H.F. broadcasts.

EXAMINATION No. 3942 SENIOR TECHNICIAN. ELECTRICAL THEORY AND PRACTICE

K. A. Neilson.

Q.1 (a) Explain why the armature of a telephone relay does not release immediately the coil is disconnected.

A.—(a) When the circuit to a normal telephone relay is opened, the coil current ceases and the coil flux decays to zero. The flux in decaying cuts the coil, core, armature, and yoke, inducing circulatory eddy currents, which by Lenz's Law, prolong the flux in the operate direction and increase the holding time of the relay.

The value of eddy currents and their flux is dependent largely on the inductance of the relay, and the point at which the relay will release is affected by the adjustment of spring tension, and residual air gap.

Q.1. (b) Describe five methods which may be used for increasing the time that elapses before release occurs.

Electrical means only should be described and mechanical methods should not be included in your answer.

A.—(b) Five methods of increasing the release time of a relay are

(i) Provision of an armature end or heel end slug, or copper core sleeve.
(ii) A short circuited coil.
(iii) Shunting the coil with a rectifier.
(iv) Shunting the coil with a resistance.
(v) Shunting the coil with a condenser.

(i) When the relay circuit is opened, the slug or copper core sleeve behaves as a short circuited turn of very low resistance. The eddy currents and their flux, resulting from the collapse of the coil flux, prolong the relay's operate condition until the flux falls to the release value.

(ii) A permanently short circuited winding or one short circuited by relay contacts, has the same effect as a core slug, because a ready path is provided for induced currents, and the operate condition of the relay is maintained.

(iii) A rectifier shunting the relay winding and connected in the high resistance direction to the normal operate current, will provide a path for induced current flow when the relay circuit is opened. The decaying coil flux induces an e.m.f. across the coil which is applied across the rectifier in its conducting direction, allowing a transient current flow in the local circuit, consisting of the coil and the rectifier in its conducting direction.

(iv) Similarly, a resistance connected across the relay winding provides a path for induced current flow when the coil's operate circuit is opened.

(v) If a condenser is placed in shunt with the relay winding, it is normally charged to the P.D. existing across the relay. When the relay circuit is opened the condenser discharges through the relay winding, maintaining the current in its original direction, for the discharge time of the condenser.

In examples ii, iii, iv and v, the continuance of current through the relay winding in the same direction, after the circuit has been broken, delays the relay's release until the flux falls to the release value.

Q.1. (c) Describe the effects on the release lag of a relay by increasing
(i) The armature air gap, i.e., stroke;
(ii) The residual air gap;
(iii) The spring tension.

A.—(c)

(i) An increase in armature air gap would theoretically have no effect on release time of a relay, but in practice the increase of spring tension on operation, resulting from an increase in the armature stroke, would cause the relay to release earlier.

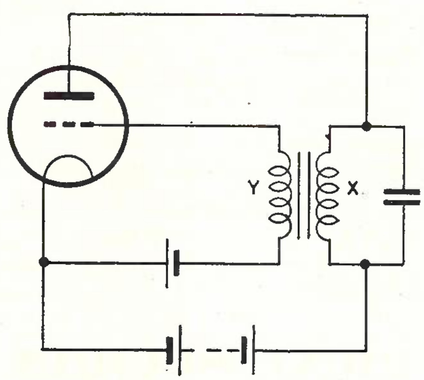
(ii) An increase in residual air gap, results in an earlier release of the relay, because the larger gap increases the reluctance of the magnetic circuit, and a higher value of flux is required to hold the armature operated.

(iii) An increase of spring tension would cause the relay to release earlier, a higher value of holding flux would be required to counteract increased spring tension on the armature.

Q.2. (a) Draw the circuit of a simple thermionic valve oscillator.

(b) Describe its operation and state the means of controlling the frequency.

A.—(a)



TUNED ANODE OSCILLATOR

(b) The operation of a thermionic valve oscillator depends on

(a) A connection or coupling between the output and input circuits, whereby some of the output energy will be fed back from the output to the input, in phase with the existing signal in the input circuit.

(b) Either the input or output circuit must have specified capacitance and inductance to establish resonance at the frequency required to be generated. The frequency is controlled by varying either the capacitance or the inductance.

With reference to Fig. 1 the condenser and inductance in the anode circuit are of such prescribed values as to form a tuned circuit which will resonate at the desired frequency.

$f = 1/(2\pi\sqrt{LC})$

where f = frequency in c/s.
L = inductance in Henries.
C = capacitance in Farads.

The tuning inductance "x" forms the primary of a transformer, the secondary of which, "y", is connected across the grid and cathode.

The connections are such that the irregularities of anode current, of frequency suitable to the tuned circuit, are amplified and applied in a 180° phase shift, through the transformer, to the grid.

This together with 180° phase shift through the valve, means that the signal is impressed on the grid in phase with the original signal and amplified.

The process is repeated, each successive cycle being amplified, until a signal of constant amplitude, determined by the characteristics of the tube and circuit components, is reached.

Q.2. (c) What approximate values of the components would cause the circuit to oscillate at a frequency of 1000 C.P.S.

A.—(c)

If $f = 1/(2\pi\sqrt{LC})$
where f = frequency in c/s
L = inductance in henries
C = capacitance in farads
$\omega = 2\pi f$
then $\omega = 1/\sqrt{LC}$ and $\omega^2 = 1/LC$
and $L = 1/(\omega^2 C)$
f = 1000 and if the capacitance is assumed to be $1\mu F$
then $L = 10^6/(4 \times 484 \times 10^6 \div 49)$
$\therefore L = 0.0253$ henries
Answer: Capacitance of condenser 1 μF
Inductance of choke .0253 henries

Q.3. A 50 volt exchange battery has a capacity of 400 ampere hours and an ampere hour efficiency of 88%. The voltages at the battery terminals required to maintain a constant charging current are 52 volts at the commencement of the charge and 70 volts at the end of the charge. It is desired to recharge the battery at a constant current from 120 volt D.C. supply mains in 6½ hours using a series resistance of which part is variable. Calculate the current carrying capacity required for fixed and variable resistance units, and the values in ohms of the fixed and variable resistances respectively.

A.—(3)

Efficiency = (Ah output/Ah input) 100%
Given Ah capacity of battery = 400 Ah
& Efficiency = 88%
Then total charge required = 400/0.88 Ah
Constant current required to charge 400/0.88 Ah in 6½ hrs.
= 400/(0.88 × 6.5) = 70 amps

Battery e.m.f. at commencement of charge = 52V
Charging e.m.f. = 120V
∴ Effective charging e.m.f. = 120V-52V
= 68V
Total R required at commencement of charge = 68/70
= .971 ohm
Battery e.m.f. at end of charge = 70V
Charging e.m.f. = 120V
∴ Effective charging e.m.f. = 120V-70V
= 50V
Total R required at end of charge = 50/70
= .714 ohm
Maximum R required = .971
Minimum required = .714
∴ Variable R = .971–.714 = .257 ohm

ANSWERS: Fixed R = 0.714 ohm
Variable R = 0.257 ohm
Current rating of both resistances = 70 AMPS

Q.4. (a) Why are the types of Voltmeter commonly used at power frequencies unsuitable for speech frequencies.

A.—(4a) Voltmeters used for A.C. at power frequencies are usually Moving Iron, or Dynamometer types.

The moving iron instrument depends for its action on the principle of a pivoted soft iron vane, carrying a pointer, being drawn into a solenoid, which is energised by the current to be measured.

The deflection of the instrument, therefore varies approximately as the square of the current.

The moving iron meter requires more power to operate it than is available in speech frequency circuits, as the relation between the current through the meter, and the deflection shown, results in little movement of the pointer for small currents.

Owing to hysteresis effects, these meters are not suitable for the range of audio frequencies, and accurate readings are difficult as the scales are non-linear.

The Dynamometer Voltmeter principle is identical with that of the moving coil type, except that an electromagnetic field, is used in place of the permanent magnetic field.

Speech frequency measurements are not practicable as the inductive coils vary in reactance with changes of frequency.

Q.4. (b) Describe a type of Voltmeter in general use for speech frequencies and indicate its disadvantages, if any.

A.—(b) Three types of meter are suitable for the measurement of speech frequencies.

(i) Rectifier voltmeter
(ii) Vacuum tube voltmeter
(iii) Thermocouple type voltmeter.

The rectifier type will be described. See Fig. 1.

Moving coil meter, with bridge type rectifier. This meter indicates the unidirectional impulses resulting from the rectification of the current flow by the bridge type copper oxide rectifier.

The rectifier units although fundamentally the same as those used for heavier current work, are specially developed to have a small capacitance between the plates, to improve the frequency response, and to provide for the operation of the rectifier under optimum current conditions.

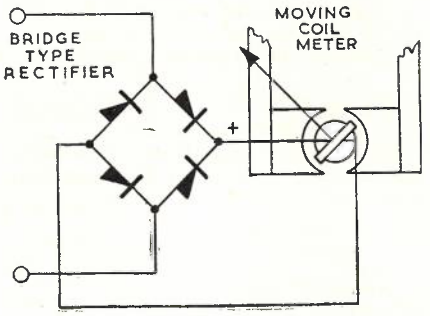


Fig. 1.

Briefly, the construction of the moving coil meter is as follows:—

A radial and even magnetic field is provided by means of a horse-shoe magnet, with soft iron pole pieces, and a soft iron core. These have such dimensions that the former on which the moving coil is wound, pivots readily in the narrow gap between the pole pieces and the core.

Attached to the former is a pointer which moves across a calibrated, largely linear, scale. The lead in of current, and the control of the moving coil is by means of two springs, mounted in opposite directions to compensate for temperature changes affecting the zero position of the needle.

Disadvantages:—

(i) The scale of the rectifier voltmeter is linear with the exception that the first few divisions are sometimes cramped, owing to the non linear operation of the rectifier at low current values.

(ii) If the meter is used on an A.C. in which harmonics have altered the wave form from that at which the meter was calibrated, the readings will be inaccurate.

(iii) The inherent capacity between the rectifier elements can affect the meter reading, because of the reactance offered to A.C. current flow.

(iv) Temperature changes can affect the sensitivity of the instrument, as the temperature coefficient of resistance characteristic of the rectifier, causes a change in the forward and reverse resistance of the rectifier, with changes in temperature.

Also, a low range voltmeter has a large temperature coefficient of resistance as compared with a high range voltmeter. This is because the multiplier, as distinct from the moving coil, is usually wound with manganin, eureka or similar wire and the low range meter has a greater ratio of its resistance subject to temperature coefficient of resistance changes.

(v) Ageing of the rectifier components can alter the characteristic of the bridge rectifier and produce errors in the scale readings.

POSTAL ELECTRICAL SOCIETY OF VICTORIA

Annual Report 1954/55

During the 1954/55 year the customary lecture programme was arranged, members being able to hear talks by Messrs. A. A. Smith, J. L. Harwood, F. Milne, L. Wadsworth and P. Bethell. Through the courtesy of the Department, visits of inspection to the new Speaking Clock Installation at City West, and the new North Essendon Automatic Exchange (Siemens No. 17 Type) were arranged for interested members.

The Society has once more been able to hold its meetings in the Theatre of the Radio School of the Melbourne Technical College. The Committee of the Society wishes to express its thanks to the Principal and Officers of the College for this facility.

The Society must extend its thanks once more to the Director-General, Sir Giles Chippindall, for his assistance during the past year and must indicate the pleasure of its members with his recent honour. With Sir Giles' assistance, the Society has received a Departmental subsidy of £1,300 during the past year to enable it to continue the publication of the Telecommunication Journal.

The Committee desires to express its thanks to the authors of articles, members of the drafting staff who have prepared illustrations, members who have assisted in the collection of subscriptions, and to Miss Wright, for their work during the past year.

R. D. KERR,
Hon. Secretary.

SPECIAL NOTICE

ALTERATION TO JOURNAL DATE SEQUENCE

Although the last issue of the Journal, Volume 10, No. 3, was dated February 1955, the present issue, Volume 10, No. 4, is dated June 1956.

For some years past, issues have been distributed approximately twelve months after the dates shown on the covers, the delays being due mainly to difficulties in obtaining articles for publication. The Committee of the Postal Electrical Society of Victoria and the Editors of the Journal had hoped that the shortage of articles would be a temporary difficulty only, and that following the reduction in the size of the Journal from 48 to 32 pages, it would be possible to reduce future delays gradually until the dates on the issues corresponded approximately with the dates of publication.

However, it is now apparent that the supply of articles is deteriorating still further, rather than improving. Moreover, some confusion to subscribers has been caused by the differences in dates, and this has resulted in some instances in the failure to renew subscriptions, aggravating the financial position of the Society. For these reasons it has been decided, reluctantly, to omit the dates June, 1955, to February, 1956, and to bring the present issue into line with the date of distribution.

The alteration to the dates will not affect subscriptions in any way as each 10/- payment is related directly to the issue numbers of the Journal. For example, the last Renewal Notice to Subscribers covered issues Volume 10, Nos. 4 to 6 inclusive, and the next subscription will be due when Volume 10, No. 6 is distributed. Subscribers who have previously paid subscriptions for the 1955-56 year will receive issues Volume 10, Nos. 4 to 6 of the Journal in satisfaction of their subscriptions.

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