The
Telecommunication Journal of Australia

VOL. 10, No. 4 JUNE, 1956

THE DEVELOPMENT OF THE S.E.50 SELECTOR

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Introduction

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

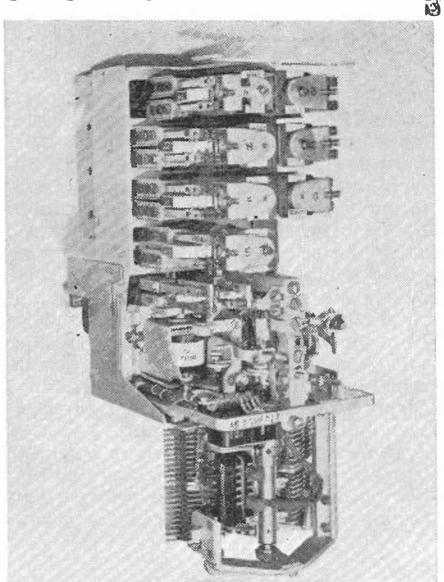

Fig. 1.—SE 50 Selector.

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.

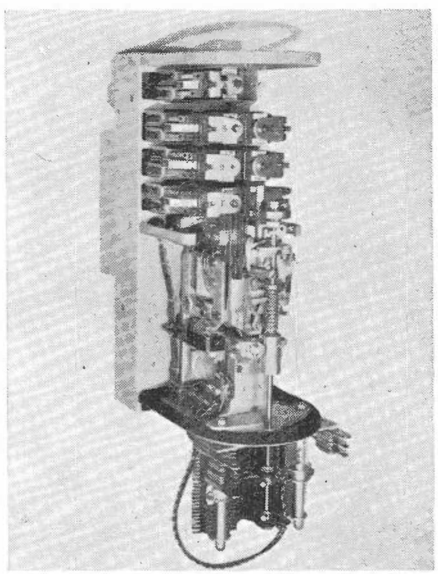

Fig. 2.—The Strowger Selector.

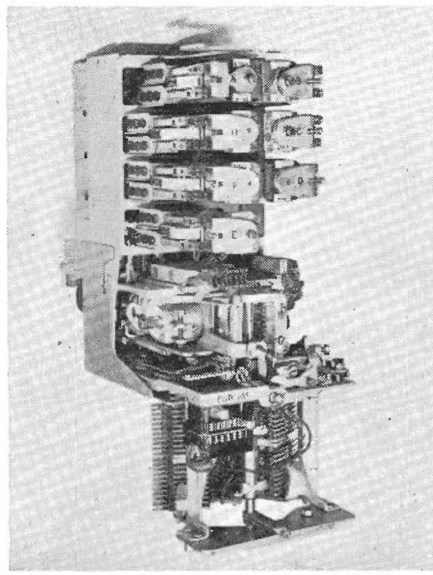

Fig. 2.—B.P.O. Type 2000 Selector.

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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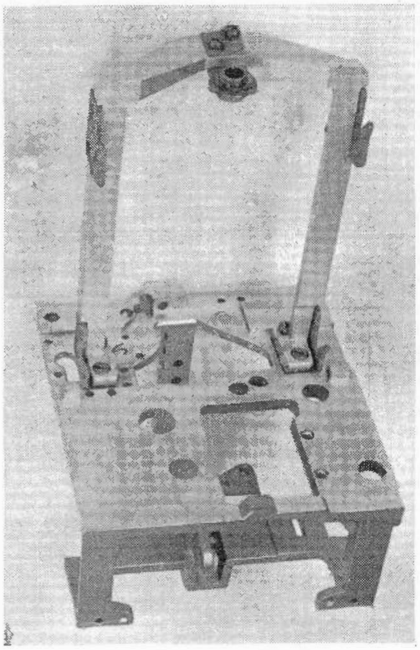

Fig. 4.—Frame and Frame Column Assembly.

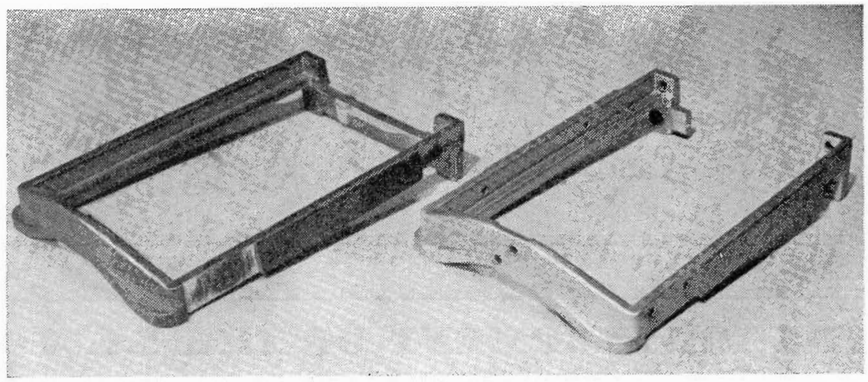

Fig. 6.—Frame Column. (a) Pressure Die Casting, (b) Machined and finished.

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-

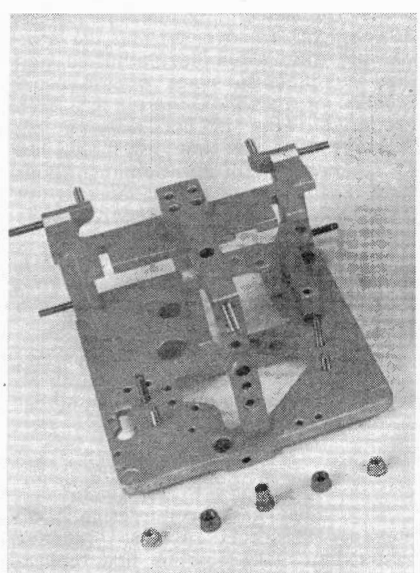

Fig. 5.—Frame, showing position of the 11 tapped holes.

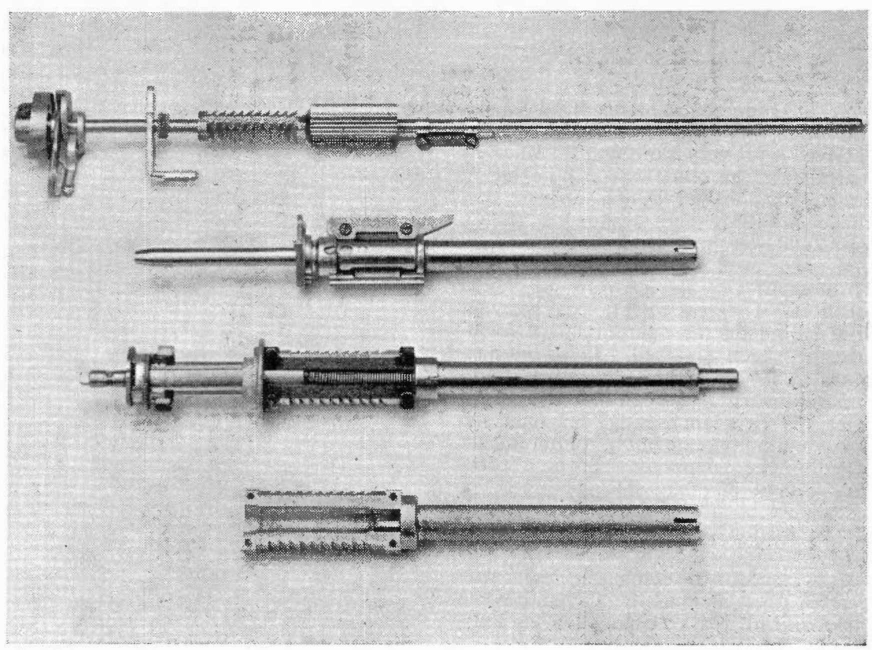

Fig. 7.—Vertical and Rotary Ratchet Assembly. (a) Strowger Selector, (b) P.P.O. 2000 type Selector, (c) SE 50 Selector.

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).

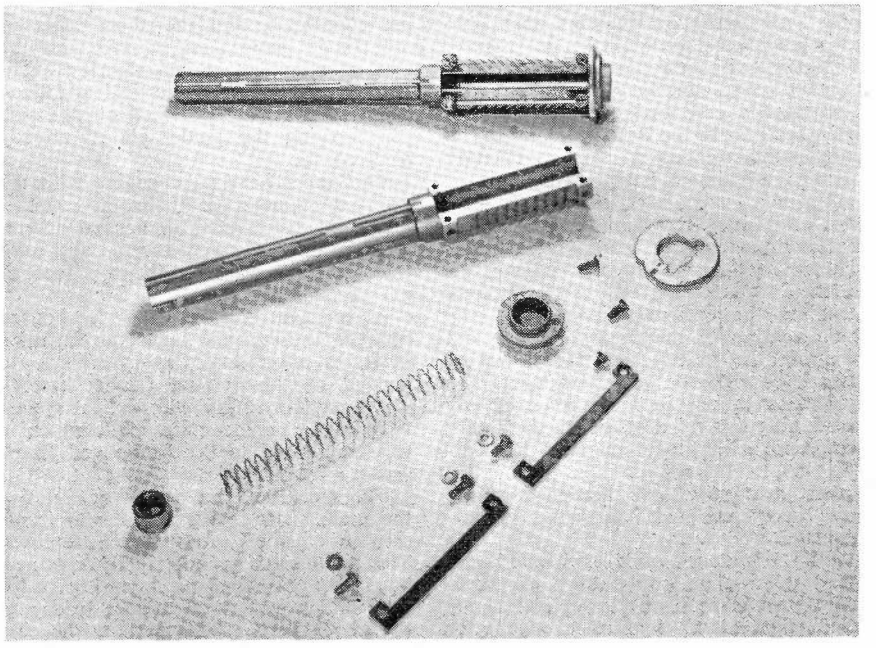

Fig. 9.—Vertical Ratchet Assembly and Details.

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-

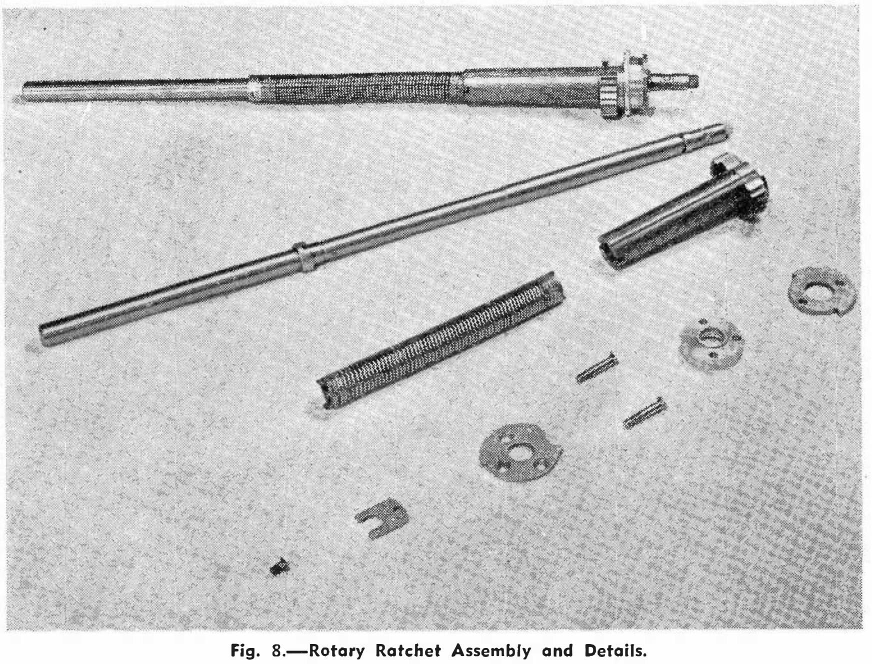

Fig. 8.—Rotary Ratchet Assembly and Details.

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

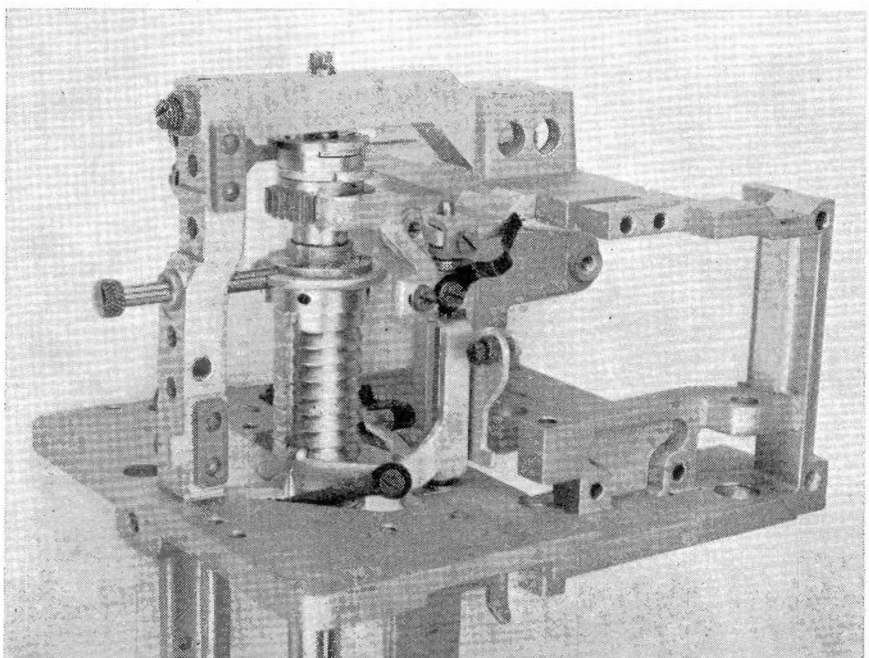

Fig. 10.—Detent Assembly.

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 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 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 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.

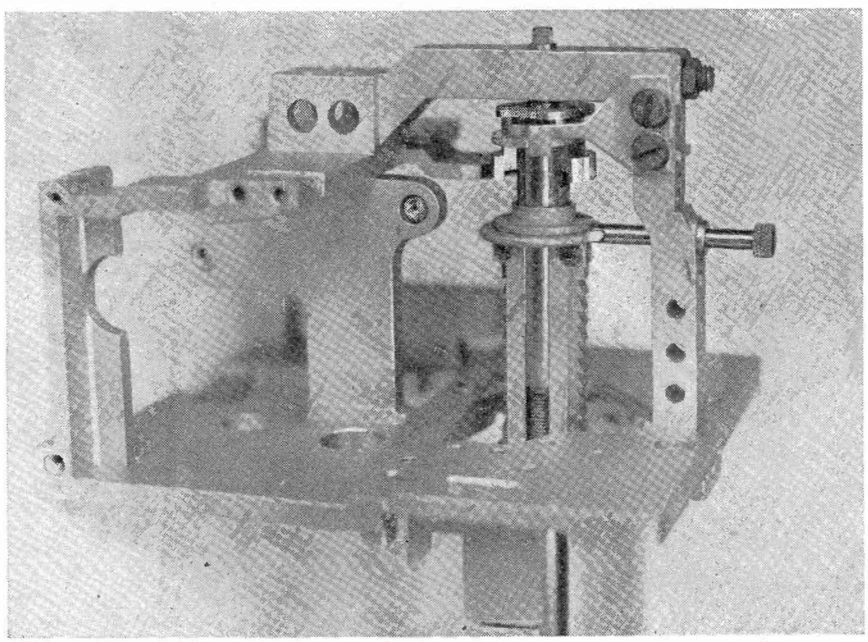

Fig. 11.—Datum Pin in position preparatory to making the four primary adjustments.

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.

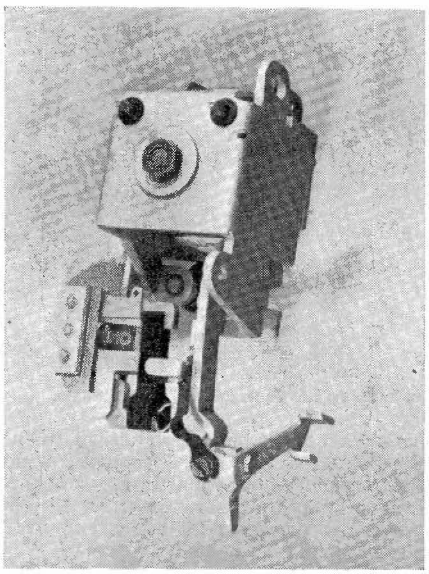

Fig. 12.—Vertical Magnet Assembly. Side view.

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.

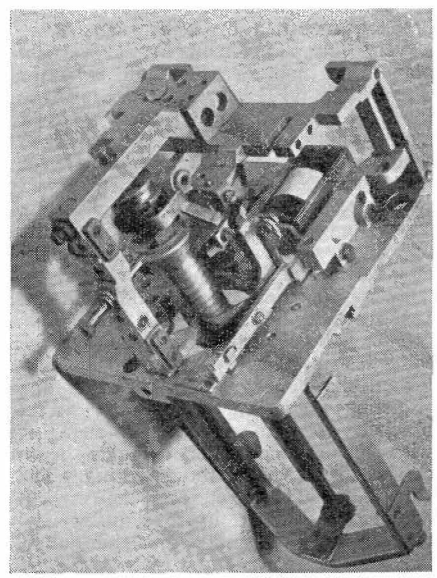

Fig. 13.—Release Coil and Associated Units.

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.

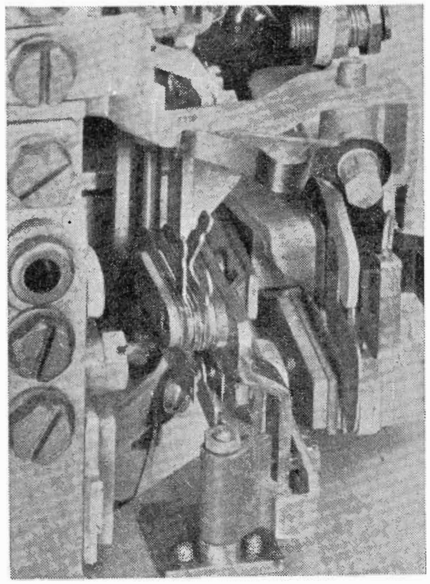

Fig. 14.—Release Armature Spring Set "Z".

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 correlation 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

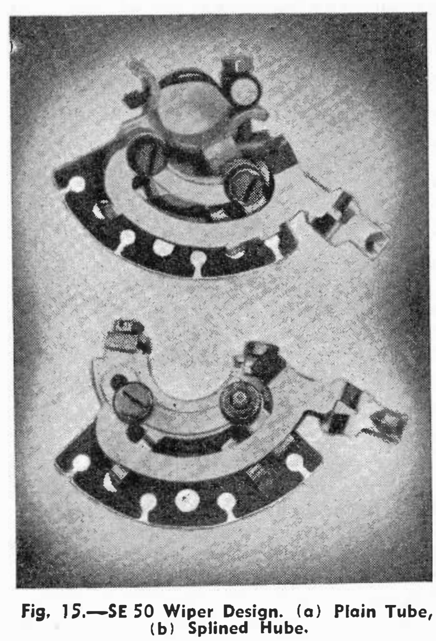

Fig. 15.—SE 50 Wiper Design. (a) Plain Tube, (b) Splined Hube.

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

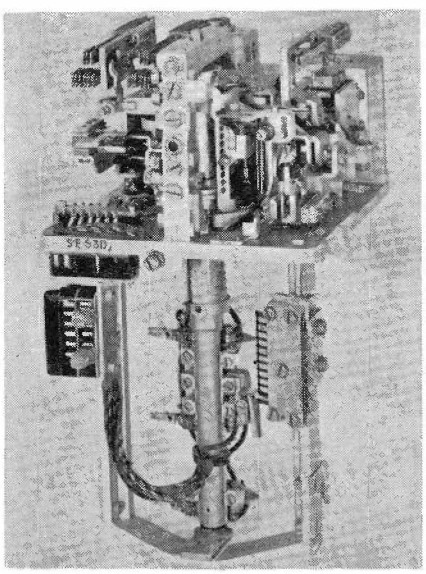

Fig. 16.—Vertical Bank and Wipers for Line Finders.

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.

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

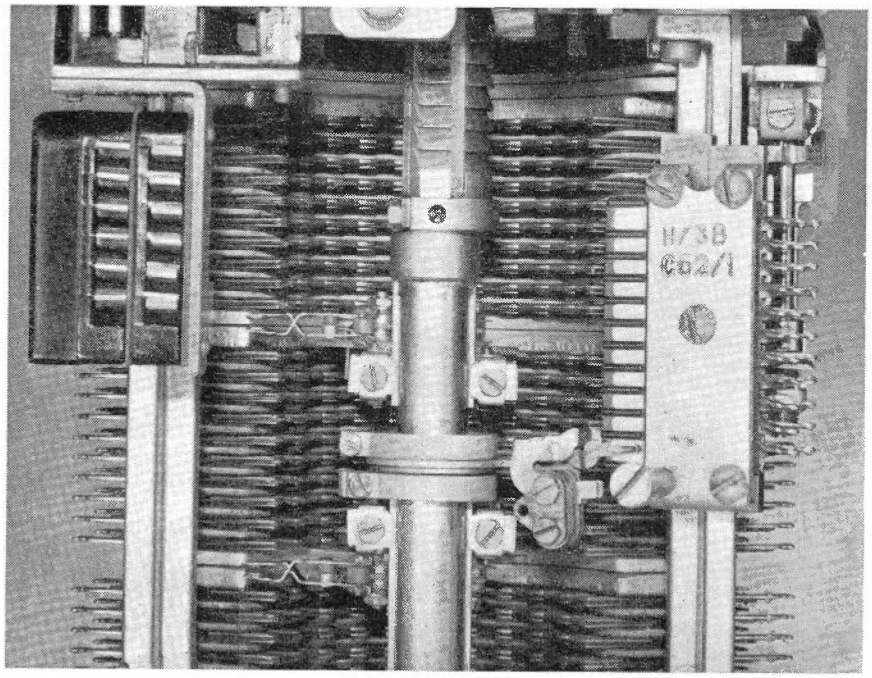

Fig. 17.—Standard Vertical Wiper.

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.

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 Engineering of the University of Adelaide and Mr. J. S. Lacey, General Secretary of the Professional Officers' Association.