The Telecommunication Journal of Australia

VOL. 6, NO. 5 — Registered at the General Post Office, Melbourne, for transmission by post as a periodical. — OCTOBER, 1947

CONTENTS

THE POSTAL ELECTRICAL SOCIETY OF VICTORIA

AUTOMATIC TELEPHONE DIALS

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GENERAL INFORMATION ON SIX PARTICULAR MAKES

Introduction: It is proposed to compare the general features of dials available from overseas. In particular, this article describes the various methods of giving the "inter-digital pause" or minimum time interval between successive trains of dialled impulses, and discusses the relative merit of introducing this pause at the beginning or at the end of each train, having regard to the various types of automatic switchgear with which the dial might be required to operate in Australia.

The dials included in this discussion are listed in Table I, and a general summary of the comparisons is given in Table II.

In all dials considered, the rate of impulsing is nominally 10 impulses per second.

Reliability of Electrical Contact: Experience indicates that the use of double contacts and the presence of a slight rubbing action when the contacts close, materially assist in ensuring reliability of contact.

The rubbing action exists in the Siemens No. 10 dial and, to a lesser extent, in the W.E. 5E dial, the impulse contacts having a slight "follow" after making. There is no rubbing action in the A.T.M. 24C and A.E.C. 24 dials except when the impulse contacts are lifted clear of the impulse cam at the end of each train. No rubbing action is provided in the S. & H. 180a and Ericsson S2836 dials. Of the dials examined, only the W.E. type has double point impulse contacts.

TABLE I.

Illustration	Type	Manufacturer	Country of Manufacture
Fig. 1	No. 10	Siemens Brothers & Co. Ltd.	Great Britain
Fig. 2	24C	Automatic Telephone & Electric Co. Ltd. (A.T.M.)	Great Britain
Fig. 3	24	Automatic Electric Co.	U.S.A.
Fig. 4	5E	Western Electric	U.S.A.
Fig. 5	Fg. Sch. 180a	Siemens and Halske	Germany
Fig. 6	S2836	Telefon AB. L. M. Ericsson	Sweden

The specimens compared are the latest types available in each case, but do not necessarily represent current practice of the manufacturers concerned. The 24C and 24 types are almost identical, differing only in the finger plate, ratchet wheel, and other respects indicated in Table II.

Impulse Contacts

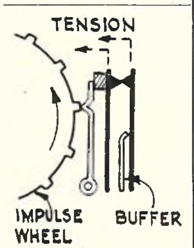
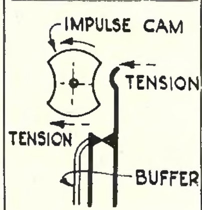
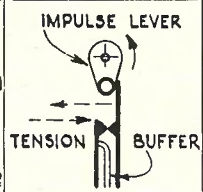
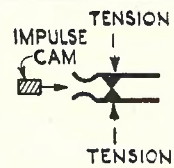
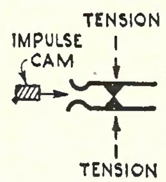
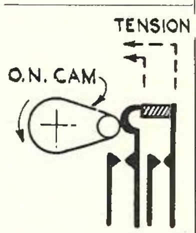
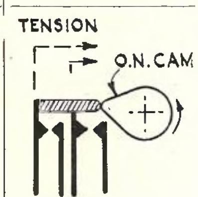
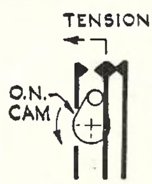
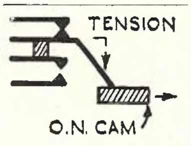
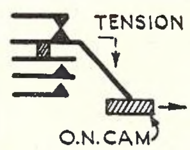
The make to break impulse ratio and the rate of impulsing are inherently bound up in the physical dimensions and adjustment of the dial parts and in the governor adjustment respectively, and are not considered here. Desirable features of these contacts, however, are:—

(a) reliability of electrical contact,
(b) uniformity of impulse ratio,
(c) freedom from contact "bounce"; and
(d) efficient suppression of impulses during forward motion of dial.

Uniformity of Impulse Ratio: The maximum of impulse ratio uniformity would be obtained if each impulse were formed by the same cam surface operating on the same impulse springs. This is not the case in any of the dials examined but, in the A.T.M. 24C and A.E.C. 24 dials, a rotating double cam is used, so that only two cam surfaces are involved and each surface produces every alternate impulse (Figs. 2 and 3).

In the S. & H. 180a and Ericsson S2836 dials, rotating triple cams are used, so that three cam surfaces are involved and each surface produces every third impulse (Figs. 5 and 6). In these two dials the impulse springs are separated by the cam teeth entering between them. This calls for the impulse springs to be symmetrically disposed with respect to the cam teeth before separation, which necessitates equal tension on each spring. As impulse-ratio is normally adjusted by means of impulse spring tension, this means that impulse-ratio adjustment would be more complicated in the S. & H. and Ericsson dials than in the other dials examined. In the case of the S. & H. dial, a detent spring (Fig. 5), operated by a cam on the main shaft, engages a notch in any one of the impulse-cam teeth at the end of the return motion of the finger plate; this locks the cam at the correct orientation for commencement of the next

TABLE II.
Summary of Comparisons of Six Makes of Automatic Telephone Dials

TYPE OF DIAL.	Siemens No. 10.	A.T.M. Type 24C. A.E.C. Type 24.	W.E. Type 5E.	Siemens and Halske Fg. sch. 180a.	Ericsson (Sweden) Type S2836
Impulse Contacts					
Break length per cent.	66.6 (63 to 70).	A.T.M. 66.6 (63 to 70). A.E.C. 61.5.			
Mode of operation.	Toothed impulse wheel on main shaft.	Double cam on governor worm-gear shaft.	Toothed impulse wheel on main shaft, operating impulse lever.	Triple cam on governor worm-gear.	Triple cam on governor worm-gear shaft, driven by ratchet wheel secured to shaft.
Spring Assembly.					
Type of contacts.	Single point.	Single point.	Double point.	Single point.	Single point.
Method of suppressing impulses in forward direction.	Slipping-cam masks impulse wheel teeth.	Pawl on main shaft trails and does not transmit drive to double cam and worm-gear shaft.	Impulse lever trails over impulse teeth in a position clear of impulse springs.	Pawl on pinion trails and does not transmit drive to triple cam and worm gear.	Pawls on either side of triple cam. One pawl engages ratchet slots in frame-locking cam. Other pawl trails over ratchet secured to worm-gear shaft.
Off-Normal Contacts					
Mode of operation.	Cam on main shaft.	Cam on main shaft.	Cam on main shaft.	Cam on main shaft.	Cam on main shaft.
Spring Assembly (Dial normal).					
Type of contacts.	Single point.	Single point.	Double point.	Double point.	Single point.
Inter-Digital Pause					
Duration (pulse periods, approx.).	2¼.	A.T.M. 2¼. A.E.C. 1½.	1.	2.	1½.
Position with respect to impulses.	Before.	After.	Before.	After.	After.
Method of production.	Slipping-cam on impulse wheel, masking impulse teeth.	Cam on main shaft, lift-in impulse springs clear of impulse cam.	Reversal of trailing direction of impulse lever against impulse wheel.	Short circuiting of impulse contacts by cam operated off-normal contacts.	Short circuiting of impulse contacts by cam operated off-normal contacts.
Remarks.	Depends on friction between cam and disc on main shaft.	Positive operation by cam.	Positive operation by impulse wheel and lever.	Depends on off-normal contacts.	Depends on off-normal contacts.

Governor

Speed ratio to main shaft.	90:1.	A.T.M. 126:1. A.E.C. 117:1.	19.4:1.	112:1.	91:1.
Rotation.	Forward (with slight slipping) and return.	Return only.	Forward and return.	Return only.	Forward slightly (slipping and return).
Bearing thrust.	Both ways.	One way.	Nil.	One way.	Mostly one way.
Drive.	Spur gears and worm.	Spur gears and worm.	Spur gears only.	Spur gears and worm.	Spur gears and worm.
Remarks.	Spring clutch on worm-gear shaft permits some slipping in drive on forward rotation and allows governor to over-shoot after dial returns to normal position.	Ratchet wheel on spur gear, and pawl on main shaft, transmit only return drive to governor. Self-lubricating worm gear.		Ratchet wheel on worm gear and pawl on pinion transmit only return drive to governor. Self-lubricating worm gear.	Spring clutch on worm-gear shaft transmits only return drive positively to governor and allows governor to overshoot after dial returns to normal position.

General

Fitting and overall diameter.	3 point standard 3⅜″.	A.T.M. 3 point standard 3⅜″. A.E.C. Non-standard 3″.	Non-standard 3″.	Non - standard 3-7/32″.	3 point standard (adapter casing) 3″.
Type of terminals.	Screws.	Screws.	Screws.	Solder lugs.	Solder lugs.
Type of main spring.	Spiral.	Helical.	Helical.	Spiral.	Helical.
Remarks.	Moderately noisy in operation.	A.T.M. Noisy in operation. A.E.C. Quiet in operation.	Complex construction. Moderately quiet in operation.	Extreme simplicity of construction and mechanism. Quiet operation.	Quiet in operation.

forward rotation. A similar function is performed by the stepped spring-pawls on the impulse-cam of the Ericsson dial (Fig. 6), which fall into ratchet slots in the dial frame and retard the cam at the correct orientation.

In the Siemens No. 10 (Fig. 1) and W.E. 5E dials, each impulse is produced by a separate tooth on the impulse wheel, so that up to ten cam surfaces are involved. As the full number of teeth is employed only when "0" is dialled, wear will not be uniform on all teeth, and hence impulse ratio may not remain uniform. The toothed impulse wheel in the W.E. 5E dial is concealed within the body of the dial in Fig. 4.

Freedom from Contact "Bounce": The impulse contact springs, which must operate at the rate of 10 impulses per second, "remake" at a high speed after separation, and, being made of elastic material, tend to rebound on impact, or "bounce." When "bounce" actually occurs, it results, of course, in distorted signals.

In order to eliminate "bounce," it is necessary to arrange for the kinetic energy of the moving parts on impact to be absorbed. This may be effected by

(a) an elastic damping system,
(b) friction damping, or
(c) some combination of (a) and (b).

The fundamental principles of these methods are illustrated diagrammatically in Fig. 7.

In Fig. 7 (a) a spring, which is pre-loaded with the contacts unoperated, holds the stationary contact against a stop. When the contacts close, with proper design the energy of the moving contact is absorbed in extending the spring and in overcoming the inertia of the stationary contact, which is deflected away from the stop (References 4 and 5).

In Fig. 7 (b) a flexible buffer behind the stationary contact is deflected on impact of the moving contact, and the rubbing friction between the stationary contact and buffer absorbs some of the kinetic energy.

In Fig. 7 (c) the same device is used in the stationary contact, and, in addition, the moving contact is pre-loaded, i.e., the moving contact is borne on a leaf spring which is tensioned against the stationary contact when in the static "made" position. When the contacts close, the energy of the moving contact is absorbed in flexure of the leaf spring and in friction between the stationary contact and its buffer.

The impulse contact arrangements in the dials examined are shown diagrammatically in Table II, the contacts being shown in the closed position as when the dial is normal.

(i) In the Siemens No. 10 dial, when the impulse contacts are open, the stationary contact spring is pre-loaded by tension against a buffer (compare Fig. 7 (a)).

(ii) In the A.T.M. 24C and A.E.C. 24 dials, when the impulse contacts are closed, the moving contact spring is pre-loaded by tension against the stationary contact, which has a buffer behind it (compare Fig. 7 (c)).

(iii) In the W.E. 5E dial, when the impulse contacts are closed, the moving contact spring is pre-loaded by tension against the stationary contact which is pre-loaded by greater tension against a buffer.

(iv) In the S. & H. 180a and Ericsson S2836 dials, when the two moving impulse contact springs are closed, they are both pre-loaded by mutual tension.

In all these cases, conditions of "bounce" are governed by such factors as degree of contact spring pre-loading, impact force on closure, and the inertia, deflection characteristics and natural period of vibration of the contact springs and buffers, and it is obvious that the effect of such factors cannot be estimated from a visual examination.

Oscillograph measurements are often used to detect contact bounce, but no check was made of the adjustment of the contact springs of the sample dials under discussion, and, consequently, no cathode ray oscillograph measurements were made of these dials.

Suppression of Impulses during Forward Motion of Dial: As will be seen from Table II, each of the dials examined uses a different means to achieve this (except the A.T.M. 24C and A.E.C. 24 dials, which are equivalent in this respect), although the S. & H. 180a and Ericsson S2836 dials use somewhat similar means. In the Siemens No. 10 Dial (Fig. 1), maintenance of the correct frictional adjustment would be most necessary, as, if the slipping cam were badly worn or out of adjustment, it would be possible for this cam to slip too much. In such cases, the inertia of the slipping cam resisting the frictional pull during forward motion might result in failure of the cam to mask all teeth of the impulse wheel during

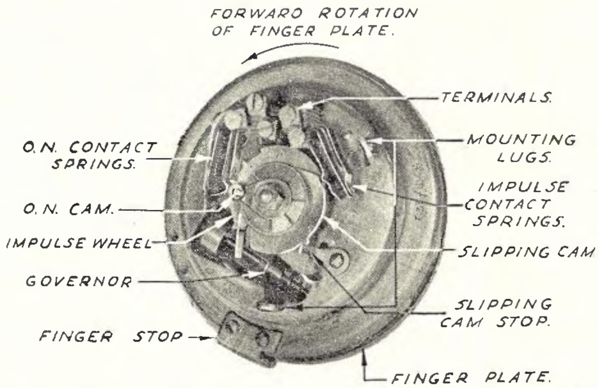


Fig. 1.—Siemens No. 10 Dial—rear view. (Normal position.)

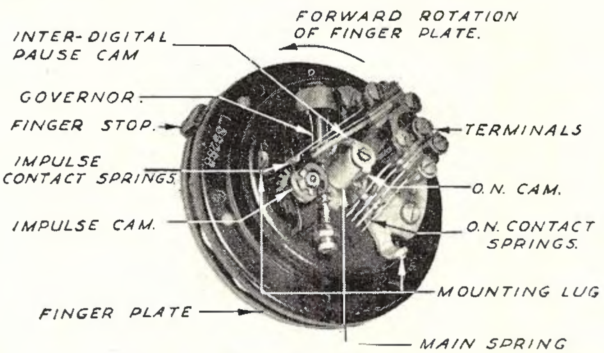


Fig. 2.—A.T.M. Type 24C Dial—rear view. (Normal position.)

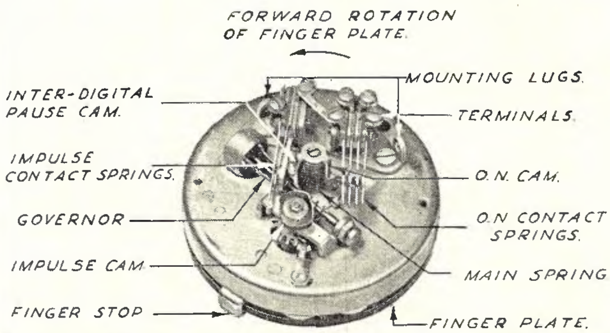


Fig. 3.—A.E.C. Type 24 Dial—rear view. (Normal position.)

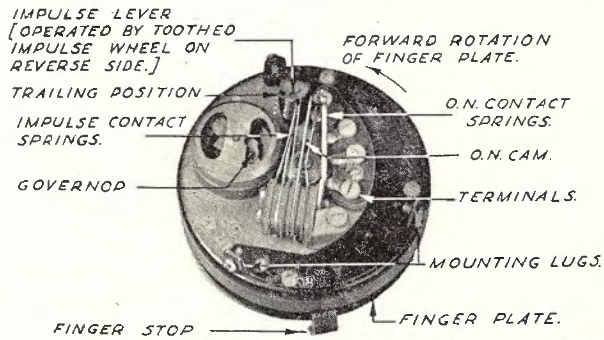


Fig. 4.—W.E. Type 5E Dial—rear view. (Normal position.)

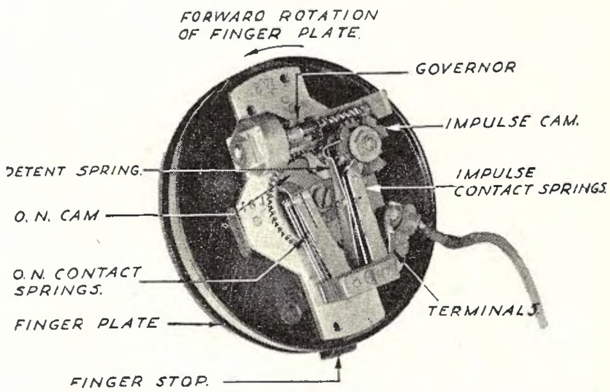


Fig. 5.—Siemens & Halske 180a Dial—rear view. (Normal position.)

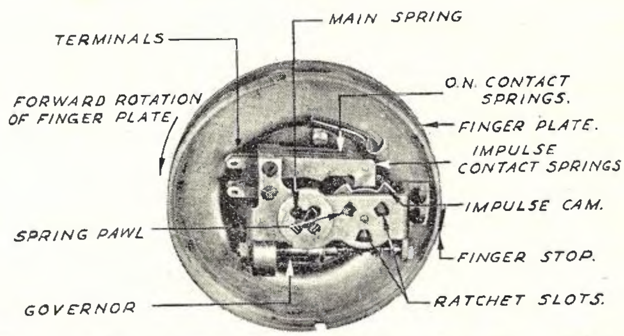


Fig. 6.—L.M. Ericsson Type S2836 Dial—rear view. (Three-point mounting adapter cap removed—normal position.)

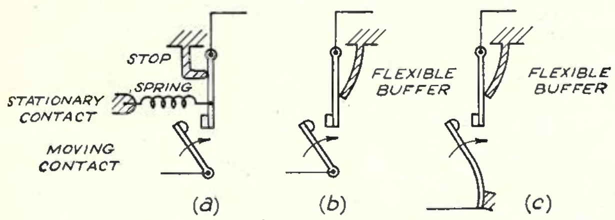


Fig. 7.—Methods of eliminating contact bounce.

this period, which would produce false impulse during the forward rotation.

Off-Normal Contacts

In all dials examined, the off-normal contact springs are operated by some form of cam attached to the main shaft, and there is appreciable "follow" in the pair of springs which "make" when the finger plate is rotated forward from its normal position. In the W.E. 5E and S. & H. 180a dials, contact of the off-normal springs is further improved by the use of double point contacts.

Inter-Digital Pause

The purpose of the inter-digital pause is to introduce sufficient delay between successive trains of impulses to permit exchange switchgear to operate and extend the calling subscriber's connection through to the circuit which is to receive the next train of impulses.

Duration of Pause: From Table II it will be seen that the W.E. 5E dial has the shortest pause, equivalent to approximately one dialling impulse only, while the Siemens No. 10 and A.T.M. 24C dials have the longest, equivalent to approximately $2\frac{1}{4}$ impulses (the length of impulses in all dials being approximately the same). To this pause is added the time taken to pull the finger-plate round to the stop and let go, but this obviously depends on the digit dialled and on the finger speed of the person operating the dial.

Position with respect to Impulses: The inter-digital pause may be introduced **before** or **after** each individual train of impulses. It is obvious, however, that this affects the first train of impulses only, as there will be such a pause between successive trains of impulses in either case, and a pause after the final train serves no useful purpose.

Normally, there will be a delay between the lifting of the telephone receiver and the commencement of the first train of impulses, due to the time which the operator or subscriber takes to lift the receiver, pull the dial round to stop, and let go. This, however, depends on the speed of the individual, and may be reduced to a very low duration if the receiver has previously been removed from the switch-hook and a call is initiated by releasing the switch-hook with one hand and commencing to dial immediately with the other.

In such a case, the pause between initiation of the call and commencement of the first impulse train will be negligible unless the inter-digital pause is located **before** the impulse train, as in the Siemens No. 10 and W.E. 5E dials. At Footscray Exchange, Melbourne, in which the subscriber is initially connected to a Discriminating Selector Repeater via a 2000 type Bi-motional Finder, the time from the lifting of the receiver to the connection to the first impulse accepting switch is appreciably longer than any pause practicable in any rotary type of dial design.

To meet such cases "dial-tone" is introduced in an automatic telephone system. Dial-tone is fed back to the calling subscriber only when the switching connection to the circuit which is to receive the first impulse train has been completed in the exchange, and it thus provides a signal which indicates that dialling may safely be commenced. Instructions provided for subscribers read, "Always listen before attempting to dial." This instruction is necessary even with dials having a pause as long as has Siemens No. 10, and, if the instruction is followed, the positioning of inter-digital pause **before** impulse-trains becomes unnecessary.

The positioning of the inter-digital pause **before** impulse trains may, to some extent, reduce the probability of false connections due to lost impulses in cases where subscribers do not listen for dial tone, but it will by no means eliminate all such false connections, and, in the case of some exchange equipment, it may eliminate very few. Dial-tone is therefore an essential requirement, and if this signal is used by subscribers, in accordance with instructions, a dial having an inter-digital pause **after** impulse trains is quite satisfactory.

Method of Production of Pause: In the Siemens No. 10 dial (Fig. 1) the inter-digital pause is produced by the slipping cam, which prevents operation of the impulse contacts until the finger plate, on its return rotation, has moved through an angle equivalent to approximately $2\frac{1}{4}$ impulses.

In the A.T.M. 24C and A.E.C. 24 dials the inter-digital pause is produced by a cam on the main shaft (Figs 2 and 3), which lifts the impulse contacts clear of the double impulse-cam at the end of the return rotation of the finger plate, for a period equivalent to approximately $2\frac{1}{4}$ impulses in the case of the A.T.M. dial and $1\frac{1}{3}$ impulses in the case of the A.E.C. dial. This method is quite positive.

In the W.E. 5E dial (Fig. 4) the inter-digital pause is created during the movement of the impulse lever from the trailing position (which it occupies during forward rotation of the finger plate) to the impulsing position, at the commencement of return rotation, and is equivalent in length to approximately one impulse. This method is quite positive.

In the S. & H. 180a and Ericsson S2836 dials, the inter-digital pause is produced by the off-normal cam (Figs. 5 and 6) on the main shaft, which operates a pair of "make" contacts forming part of the off-normal contact spring assembly.

These contacts short-circuit the impulse contacts at the end of the return rotation of the finger plate, for a period equivalent to approximately 2 impulses in the case of the S. & H. dial and 1½ impulses in the case of the Ericsson dial.

Governor

Each of the dials is provided with a centrifugal governor of the spring controlled friction type, to regulate the return speed of finger-plate rotation.

Governor Speed: The governor speed of the W.E. 5E Dial is approximately 19.4 times the mainshaft speed. As centrifugal force is proportional to the mass of the rotating weights, to their radius about the governor centre, and to the square of the speed of angular rotation, this means that in order to obtain a similar speed control, this governor is necessarily larger in diameter and has heavier weights than the governors in the other dials examined, which are all driven at considerably higher speeds (i.e., from 90 to 126 times the mainshaft speed—see Table II).

The normal method of speed adjustment is by altering the set or tension of the governor springs. In the Siemens No. 10 and W.E. 5E dials, the springs are not particularly accessible, but in the other dials the springs are more exposed, and they may be more susceptible to accidental damage when the dial is removed from the telephone.

Direction of Rotation: In the A.T.M. 24C, A.E.C. 24 and S. & H. 180a dials, due to the use of a ratchet, the governor rotates during the return motion of the finger plate only. This reduces wear on the worm gearing teeth, the governor bearings and the friction surfaces, and also means that the axial thrust on the governor shaft, due to the worm gear drive employed, is in one direction only, so that only one bearing has to withstand thrust.

In the Siemens No. 10 and Ericsson S2836 dials, the drive is transmitted to the governor through a spring clutch on the shaft of the worm gear. During forward motion of the finger plate this clutch slips, so that the governor is driven positively only during the return motion, but the clutch also permits the governor to overshoot when the finger plate returns to its stop, so that the governor is not stopped too abruptly. In the Ericsson dial the slip of the clutch is almost 100% during forward motion, so that the governor has the same advantage as regards wear and thrust as the A.T.M. 24C, A.E.C. 24 and S. & H. 180a dials. In the Siemens No. 10 dial, however, the slip during forward motion is very slight and the governor rotates almost the same amount in both directions.

In the W.E. 5E dial the governor is driven during both forward and return motions. However, as the governor speed is relatively low and spur gearing only is employed, the wear would be correspondingly slight, and there is no axial thrust on the bearings.

Governor Drive: In the W.E. 5E dial the governor is driven from the main shaft through a train of two pairs of spur gears and pinions. In the other five dials examined the drive is through one spur gear and pinion pair, and a worm gear and worm. Of these dials, the A.T.M. 24C, A.E.C. 24 and S. & H. 180a dials employ a worm gear of laminated construction, having a layer of oil impregnated fibre between two outer layers of metal. This makes the worm gear self lubricating.

General Details

Fitting and Overall Diameter: The Siemens No. 10, A.T.M. 24C and Ericsson S2836 dials examined would fit the standard 3 point mounting provided on telephones of the P.M.G. Department in Australia. The three point fitting of the Ericsson dial, however, is provided by means of a rear adapter cap, having a hole for wiring leads; this adapter causes the dial, when mounted, to project approximately 7/16″ further from its mounting than the Siemens No. 10 or A.T.M. 24C dials, but it would serve to protect the dial mechanism from dust and possible damage when removed from the telephone, the latter two dials having no such protective rear cap.

The A.E.C. 24, W.E. 5E and S. & H. 180a dials examined had no provision for standard 3 point mounting. However, the A.E.C. dial could be provided with a body having a 3 point fitting similar to that of the A.T.M. 24C dial, and, by means of rear adapter caps similar to that fitted to the Ericsson S2836 dial, the W.E. and S. & H. dials also could be made to fit standard 3 point mountings. Adapter caps large enough to contain the mechanisms of these dials would cause the W.E. 5E dial to project about 13/16″, and the S. & H. 180a dial about 11/16″ further from the mounting than the Siemens No. 10 and A.T.M. 24C dials.

The overall diameter of a dial is of importance when it is required to mount flush in a telephone, e.g., in wall type Public Telephones used in Australia. The overall body diameter of the Siemens No. 10 and A.T.M. 24C dials is standard in this respect, i.e., 3⅓″. The A.E.C. 24, W.E. 5E and Ericsson S2836 dials, however, have an overall body diameter of 3″, and in the S. & H. 180a this dimension is 3-7/32″.

Terminals: The Siemens No. 10, A.T.M. 24C, A.E.C. 24 and W.E. 5E dials examined are provided with screw terminals. In the Siemens dial the terminals are close together. In the A.T.M., A.E.C. and W.E. dials the terminals are spaced further apart and are not likely to cause trouble.

The S. & H. 180a and Ericsson S2836 dials are fitted with solder lug terminals and, in order to avoid a soldering operation when replacing dials, it would generally be necessary to provide the dial with a short flexible five-conductor cord having spade lug terminations at the free end for connection to terminal screws in the telephone instrument. The S. & H. dial examined had such a cord connected and anchored to it, and the

Ericsson dial was provided with an anchor clip for a similar cord. Such a method of connection, however, would be inconvenient compared with the method of connecting leads already in the telephone to screw terminals on the dial.

Main Spring: The Siemens No. 10 and S. & H. 180a dials were fitted with flat clock type spiral springs. These are housed in cylindrical casings which serve also to retain lubricant. The A.T.M. 24C, A.E.C. 24, W.E. 5E and Ericsson S2836 dials, on the other hand, were fitted with wire type springs wound in a helix, and without lubricant.

Number Plate and External Finish: In all dials the number plates are of metal and detachable, obviously with the intention of providing numerals with or without letters or symbols to suit the telephone administration concerned. In all but the Ericsson S2836 dial, these plates are in the form of a flat ring secured by some form of clip to the body of the dial behind the finger plate. In the Ericsson S2836 dial the number plate is in the form of a disc secured at the centre of the finger plate, with numbers at its periphery, there being no provision for mounting a plate similar to those in the other dials. All number plates are of enamel or similar hard finish, the Siemens No. 10, A.T.M. 24C, A.E.C. 24 and W.E. 5E dials having black letters on a white background, while the S. & H. 180a and Ericsson S2836 dials have white letters on a black background. The Siemens, A.T.M., A.E.C. and W.E. dials only are provided with a clipped holder for a disc instruction card at the centre of the finger plate. The external finish of dials could obviously be varied to suit the telephone administration concerned. It is interesting to note that the Siemens and Halske dial has a moulded plastic body and finger plate.

General Construction and Operation: From the subscriber's point of view, it is desirable for a dial to be quiet in operation. In the A.E.C. 24 dial, noise is largely eliminated by the use of a rubber mask adjacent to the brass ratchet wheel. This mask has teeth which project beyond the teeth of the brass ratchet, and cushion the blows of the pawl during forward rotation. The rubber is possibly a synthetic material to obviate the deterioration produced by oil in natural rubber.

References

1. The Siemens Brothers Dial—Pamphlet 596A. Siemens Brothers & Co. Ltd., Woolwich, London.
2. The Type 24C Dial—Engineering Bulletin No. 405. Automatic Telephone and Electric Co. Ltd., Liverpool and London.
3. Subscribers' Station Equipment—Engineering Bulletin 302. Automatic Electric Inc., Chicago, U.S.A.
4. "Contact Bounce," G. Windred, The Electrical Engineer, 26.4.40.
5. "The Vibration of Electric Contacts," M. N. Russell and S. Kleilien, Electrical Engineering, Transactions, April, 1944.

MR. A. R. GOURLEY

With deep regret we record the death of Mr. A. R. Gourley, who took suddenly ill after returning home from the office on Friday, 21st November, and passed away on the following Tuesday, 25th November, 1947. The news came as a great shock to his many friends throughout the Service, and his loss has caused much concern amongst those who were closely associated with him.

This Society owes much of its progress to Mr. Gourley. From 1932 to 1942 he was Secretary and from 1935 to 1944 one of the Board of Editors of the Journal. A tribute was paid to him in our issue of February, 1943, when recording his election as a Life Member of the Society, a distinction conferred on him in recognition of his outstanding service. The success of this Journal is largely due to the enthusiasm, energy and leadership which he displayed as a foundation member of the Board of Editors.

He has given splendid service to the Department, mainly in the Telephone Equipment Section, Central Office, where he held the position of Assistant Supervising Engineer, Service. He will be long remembered for his cheerful manner and ready laughter, in addition to his outstanding ability and wise counsel to all those who sought his advice.

All those who knew him will earnestly regret the loss of a valued officer, and will mourn the absence of a good friend. We extend to Mrs. Gourley and her family our deep sympathy in their bereavement, and wish to express the high esteem in which her husband was held by all members of this Society.

PORTABLE TRAFFIC RECORDER (RESISTOR TYPE) FOR USE IN AUTOMATIC EXCHANGES AND P.A.B.X'S

W. M. D. Squair

Introduction: The need for a method of recording traffic flow in automatic exchanges not equipped with B.P.O. type traffic recorders, other than by tedious visual observation of switch groups, has led to the development and use of a simple portable recorder on which the actual number of simultaneous connections in each switch group under observation, may be read directly from an ammeter in terms of direct current values. As is well known, traffic flow is measured in "traffic units" (T.U.) and the traffic flow through a switch group at a particular instant in T.U. is equivalent to the number of simultaneous connections in that group. Accordingly, the Portable Traffic Recorder has been designed to enable instantaneous counts of simultaneous connections to be made at regular short intervals (say three-minute intervals) throughout a given period (usually the "Busy Hour") and the average traffic flow in T.U. is then obtained by averaging these readings.

General Description: The Recorder consists of a control unit with which may be associated up to 48 portable resistor units. The control unit is housed in a cabinet which may be placed on an associated stand (Fig. 1) and comprises essentially a uniselector, ammeter, 50 volt dry cell battery, keys, relays and lamps (Fig. 2). A suitable ammeter is a 10 inch "Elliot" with a 1-75 scale. The uniselector is a three level 50 point switch and is controlled by a non-locking key. On the first level of the switch, two bank contacts are used for testing purposes and the remaining 48 contacts are wired to spring type terminals mounted on the back of the control cabinet. These terminals are connected to the private wires of the group of switches under test through resistances which are mounted in portable units. When installed, jumper wires are run from the terminals on the control unit to the resistor units. The uniselector is stepped to associate the ammeter circuit with each test wire in turn.

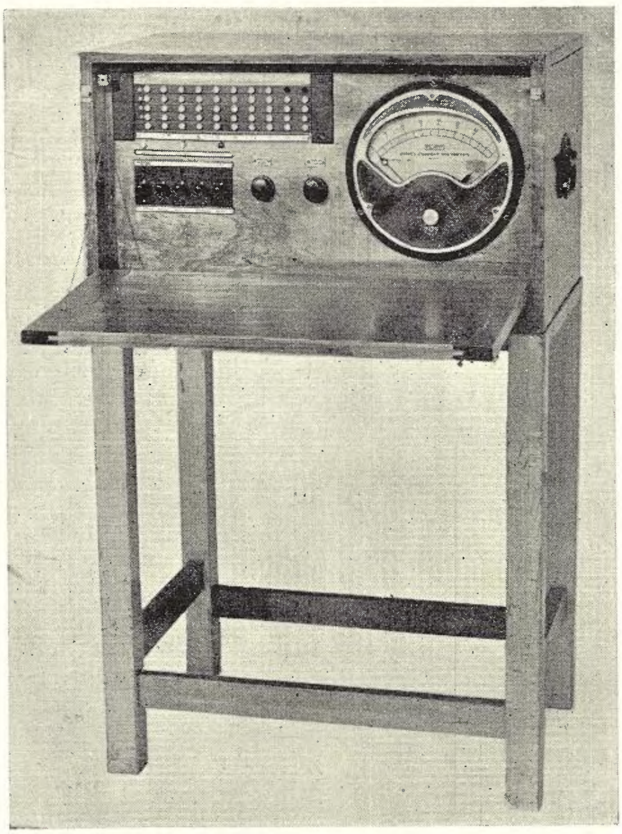


Fig. 1.—Traffic Recorder Control Unit.

The portable resistor unit (Fig. 3) is of pothead type construction and consists of 52 1W 0.5 MΩ (1 per cent. accuracy) vitreous resistors in 4 groups of 13. One side of each group of 13 is commoned and brought out to a spring type terminal (which is jumpered to the control unit) and the other side of each resistor is connected to one wire in a 52 wire flexible cable about seven yards in length.When in use the resistor unit is usually hung from an exchange cable runway in a convenient position as close as possible to the terminal points of the switch group under observation (Fig. 4) and the free ends of the flexible cable are terminated with non-soldered wrapped connections on the private wire terminal of each switch in the group concerned.

As the private wire of an engaged switch is earthed, there will be a current flow of 0.1 m.a. (50 volts through 500,000 ohms) for each engaged switch when the ammeter circuit is momentarily connected to a particular resistor unit. The ammeter on the control unit which has a moving coil system of approximately 600 ohms resistance, is suitably shunted and calibrated to give a full scale deflection of 75 points with a current flow of 7.5 m.a.; so that each point represents one circuit connected to earth and the number of switches in use at the moment of test may be read directly by the number of points deflection on the ammeter.

Four groups of not more than 13 switches each can be connected through the one resistor unit provided all the private terminals concerned are close enough to be reached by the free ends of the flexible cable. When there are more than 13 switches in a group, the sets of 13 resistors may be placed in parallel up to a maximum of 75 resistors (limit of ammeter range). This involves the use of a second resistor unit when the switches