DIALS, AUTOMATIC

★**1. Scope of Instruction.**—This Instruction describes the dials in current use and gives general information relating to their operation, use and maintenance. Details of the dials are given in Table 1. Dials stocked by the Supplies Dept. and the installations at which they are used are shown in Table 2. B 5126 gives maintenance adjustment instructions for Dials, Automatic, Nos. 10... and 11... (slipping-cam type) while B 5125 contains corresponding instructions for Dials, Automatic, Nos. 12... to 19... (trigger type).

★**2. Contents.**

★**3. General.**—For a long time all the dials used by the P.O. were of the slipping-cam type, illustrated in Figs. 1, 2 and 3 and described in pars. 4 and 5. This type of dial was superseded by a trigger type which is shown in Figs. 7, 8 and 9 and described in par. 6 and 7. However, a large number of the slipping cam dials are still in use and will remain so for a number of years. The latest type of trigger dial is shown in Figs. 15 and 16 and described in par. 17. Dials of the trigger type are fully interchangeable with their counterparts of the slipping-cam type. The arrangement of the terminals is similar but there are slight differences in physical dimensions. The electrical characteristics are identical. Dgms. N 581 to N 584, N 588, N 610, N 612 and N 613 show the terminal numbering and spring-set connexions.

FIG. 1.—SLIPPING-CAM TYPE DIAL—FRONT VIEW

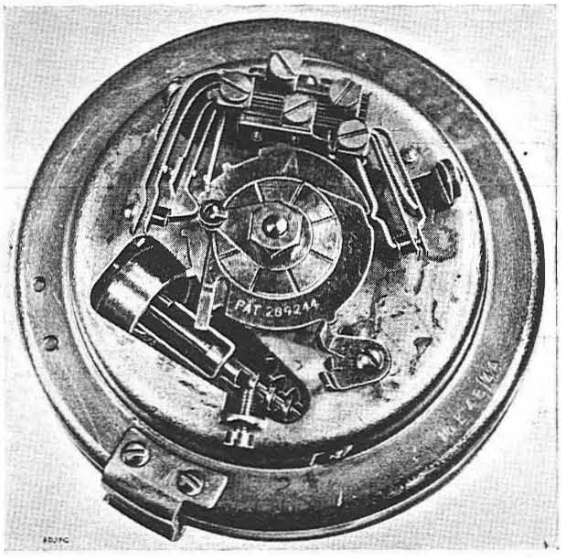

FIG. 2.—SLIPPING-CAM TYPE DIAL—REAR VIEW

TABLE 1

Dial, Automatic, No.	Type of mechanism	Finger plate	Speed (p.p.s.)	Ratio % break	Remarks
10LA	Slipping cam	Stainless-steel	10±1	63 – 70	Superseded by No. 12LA
12LA	Trigger	Stainless-steel	10±1	63 – 70	Superseded by No. 21LA
13FA	Trigger	Stainless-steel	10±1	63 – 70	Superseded by No. 22FA
15FT3	Trigger	Stainless-steel	11·75±0·5	76 – 80	Superseded by No. 25LT3
15FT4	Trigger	Stainless-steel	11·75±0·5	48 – 52	Superseded by No. 25LT4
16FA	Trigger	Stainless-steel	10±0·5	$64\frac{2}{3}$ – $68\frac{2}{3}$	Superseded by No. 25LA
16FT3	Trigger	Stainless-steel	11·75±0·5	76 – 80	Superseded by No. 25LT3
16FT4	Trigger	Stainless-steel	11·75±0·5	48 – 52	Superseded by No. 25LT4
17LA	Trigger	Aluminium alloy	10±1	63 – 70	—
19FA	Trigger	Stainless-steel	10±1	See Note	Superseded by No. 24FA
20LA	Trigger	Stainless-steel	10±1	63 – 70	Superseded by No. 23LA
21CA (Colour)	Trigger	P.V.C., (Colour)	10±1	63 – 70	—
21CA (Steel)	Trigger	Stainless-steel	10±1	63 – 70	—
21LA (Black)	Trigger	P.V.C., Black	10±1	63 – 70	—
22FA	Trigger	Stainless-steel	10±1	63 – 70	—
23LA	Trigger	Stainless-steel	10±1	63 – 70	—
24FA	Trigger	Stainless-steel	10±1	See Note	—
25CA	Trigger	P.V.C., Grey	10±1	63 – 70	—
25LA	Trigger	P.V.C., Black	10±0·5	$64\frac{2}{3}$ – $68\frac{2}{3}$	—
25LT3	Trigger	P.V.C., Black	11·75±0·5	76 – 80	—
25LT4	Trigger	P.V.C., Black	11·75±0·5	48 – 52	—
26LA	Slipping cam	Stainless-steel	10±1	63 – 70	Modified Dial, Automatic, No. 10 in flame-proof enclosure
28LA	Trigger	Stainless-steel	10±1	63 – 70	—

NOTE:—Change-over unit, nominal operate to normal ratio of 3:2 within the limits of 56–64% operate.

TABLE 2

Apparatus or equipment		Dial, Automatic, No.
Subscribers' apparatus	700-type telephones	21CA, (Colour) 25CA‡, 28LA†
	Pre-700-type telephones	10LA, 12LA, 28LA†, 21LA, Black
	P.B.X. switchboards	21LA, Black
Coin-box installations	Pay-on-answer	21CA, Steel
	Pre-payment, director	23LA
	,, ,, non-director	22FA
Exchange manual switchboards	—	21LA, Black
Testers	50% break	25LT4
	$66\frac{2}{3}$% break	25LA
	80% break	25LT3
Telegraphs	Telex installations	24FA
	T.A.S. installations	21LA, Black
Telephone No. 280	—	17LA
Telephone No. 149	—	26LA

† See par. 28

‡ See par. 26

The Rate Book number of each dial is followed by characters which indicate the type of number ring and pulse wheel fitted. The first letter indicates the number ring, namely, F has figures only, L letters and figures, C has neither letters nor figures. Standardization of lettered number rings is detailed in Stations, A 3115. The second letter and any following number refer to the type of pulse wheel. Dials stocked by the Supplies Dept. and their use at various installations are shown in Table 2.

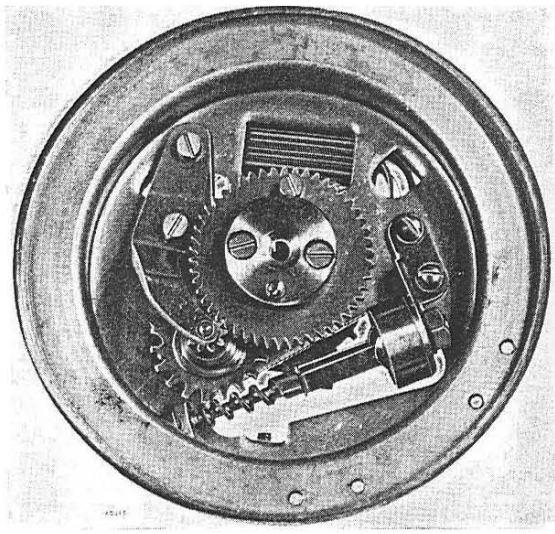

FIG. 3.—SLIPPING-CAM TYPE DIAL—GEAR TRAIN

4. Description of Dial, Automatic, No. 10LA (slipping-cam type).—A Dial, Automatic, No. 10LA is illustrated in Figs. 1, 2 and 3. It consists of a circular case in the centre of which is a brass bush in which the main spindle and gear-wheel turn. On the main spindle, at the rear of the dial, are mounted a main spring in a spring box, a pulse wheel, a slipping cam between washers, a spring washer and an off-normal lever. The outer end of the main spring is anchored in the spring box, which is keyed to the spindle, and the inner end of the spring engages in a slot in the brass bush. When the spindle is rotated clockwise, as viewed from the dial front, the spring is wound up. The dial mechanism is held in its rest position against the tension of the main spring by a screw in the main gear-wheel engaging with a post in the case. Removal of the screw allows the main spring to unwind.

Within the case are mounted a centrifugal governor and worm on a common spindle, and a gear-wheel which drives the worm. A pinion on the gear-wheel shaft meshes with the main gear-wheel on the main spindle so that the governor spins rapidly when the mechanism runs. The governor weights move outwards under centrifugal force and, at the required speed, bear on the inner surface of the governor cup to exert a braking influence on the spindle. This keeps the speed of the mechanism within the required limits.

The governor gear-wheel assembly includes a simple 'free-wheel' device consisting of a coiled spring coupling which slips when the dial is wound up, so that the governor does not resist this motion.

The front of the case is enclosed by the number ring, which is held in the case by a spring ring.

The finger-plate assembly is attached to the main spindle boss which just protrudes through the number ring. This assembly comprises the finger plate, label-holder, and a backing plate to give rigidity to the finger plate.

The pulsing mechanism consists of the pulse wheel and slipping cam on the main spindle and the pulse lever and spring-set mounted on the rear of the case.

The spring-set assembly also contains two auxiliary contacts which are normally held open by an insulating bush on the off-normal lever. When the finger plate is moved from its normal position, these contacts make in sequence and re-open in the reverse order on its return.

5. *Operation of the slipping-cam mechanism.* The pulse wheel is keyed to the main spindle and the slipping cam is frictionally coupled to the wheel by steel washers under the pressure of the phosphor-bronze spring washer. Movement of the cam is restricted by its two lugs engaging a forked stop mounted on the dial case. The mechanism in its normal position is shown in Fig. 4.

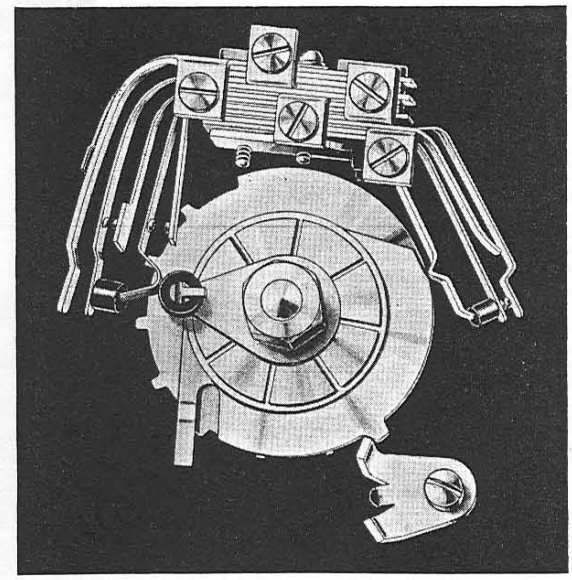

FIG. 4.—SLIPPING-CAM TYPE DIAL—MECHANISM NORMAL

When a digit is selected, the pulse wheel and slipping cam rotate together at first and the raised sector of the cam moves under the set of the pulse lever. The pulse contacts are thus kept closed. Then, the longer lug of the slipping cam strikes the forked stop to prevent any further rotation of the cam. The pulse wheel continues to rotate and the cut-away sectors are exposed from under the cam. The number of sectors that appear is determined by the digit selected; a dial wound up to digit '5' is shown in Fig. 5.

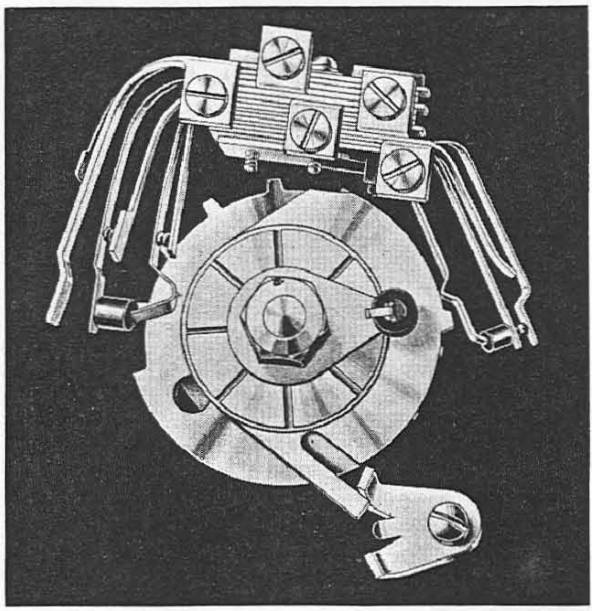

FIG. 5.—SLIPPING-CAM MECHANISM—DIAL WOUND-UP FOR DIGIT '5'

When the finger plate is released, the mechanism rotates back to its normal position with the governor controlling the speed. During the first part of the return motion, the slipping cam and pulse wheel move together, so that the pulse lever slides over the cam. Thus, the pulse contacts remain closed for 220 milliseconds (at 10 p.p.s.) to give the minimum inter-digital pause (see par. 8). This period ends when the slipping cam has rotated sufficiently for its raised sector to clear the set of the pulse lever, which then drops on to the lower sector to open the pulse contacts. Further movement of the slipping cam is prevented by its shorter lug striking the forked stop. As the pulse wheel continues to rotate, each 'tooth' raises the pulse lever and closes the contacts until the contacts are finally closed at the normal position of the dial.

Fig. 6 shows the mechanism sending the first break period of digit '5'.

6. Description of Dial, Automatic, No. 12LA (trigger type).—The general construction of this trigger type dial is similar to that of the slipping-cam type (as described in par. 4) and is shown in Figs. 7, 8 and 9.

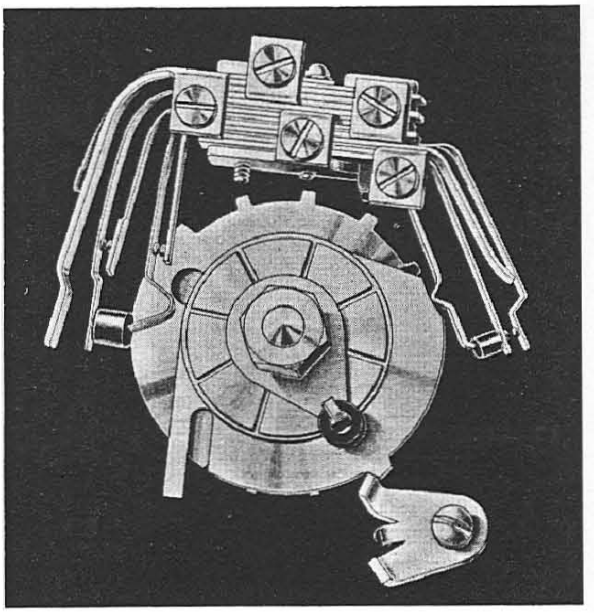

FIG. 6.—SLIPPING-CAM MECHANISM SENDING 1ST BREAK PERIOD OF DIGIT '5'

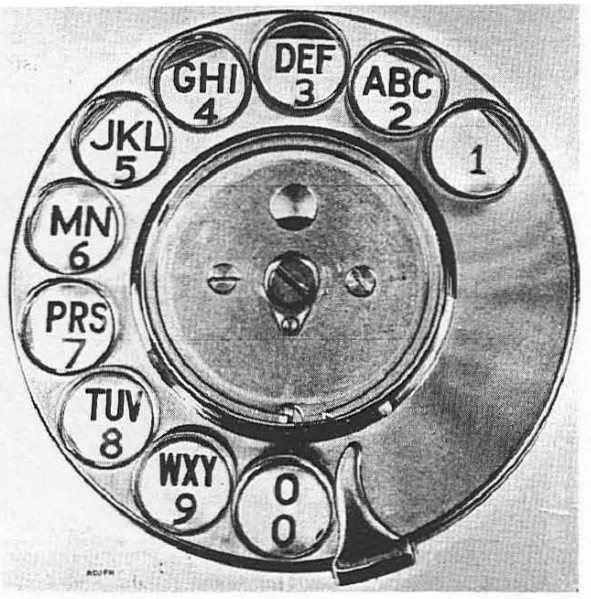

FIG. 7.—TRIGGER TYPE DIAL—FRONT VIEW

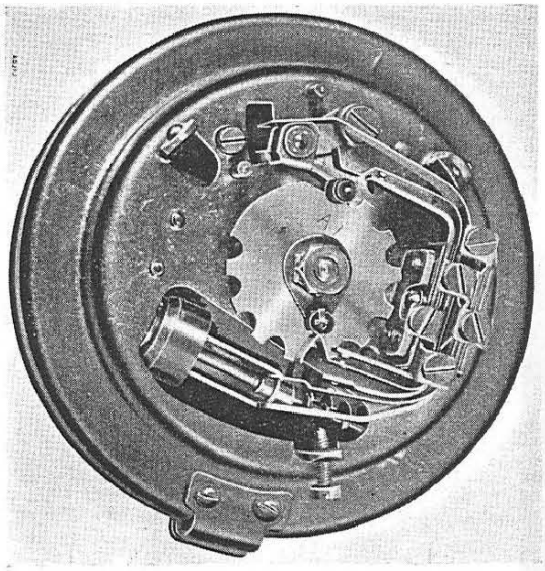

FIG. 8.—TRIGGER TYPE DIAL—REAR VIEW

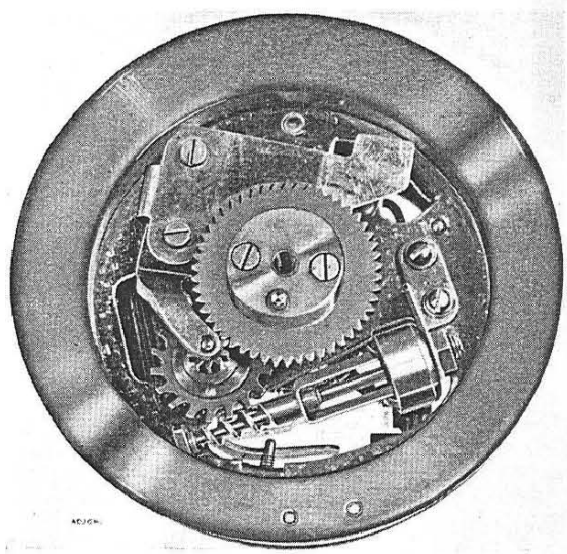

FIG. 9.—TRIGGER TYPE DIAL—GEAR TRAIN

The trigger dial differs from the slipping-cam dial on the following major points:—

(*a*) An articulated trigger assembly is used for the pulsing mechanism. This assembly has two main parts: a swinging lever which pivots about a screw in the main case, and a trigger which pivots on a pin at the free end of the swinging lever. A flat spring, which is part of the spring-set assembly, bears on the trigger to ensure its set follows the contour of the pulse wheel.

(*b*) The pulse contacts comprise a lever spring tensioned against a stiff buffer spring and they are moved apart by an insulating bush on the trigger striking an extension of the lever spring.

(*c*) The dial mechanism is held in its rest position by a spring stop plate which is fastened by the screws that hold the bearing bracket for the governor gear wheel. A lug on the stop plate engages with a pin on the underside of the main gear-wheel when the plate is sprung upwards by a screw inserted through the back of the case. Slackening the screw allows the stop plate to spring away from the gear-wheel and let the main spring unwind.

(*d*) The number ring has a smaller hole in the centre so that it is more difficult for dust to get into the dial mechanism.

7. *Operation of the trigger mechanism.* The normal position of the mechanism is illustrated in Fig. 10, where the trigger is shown to be in the pulsing position and the insulating bush is clear of the pulse lever spring.

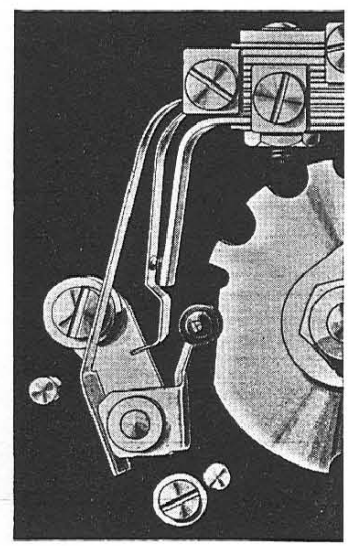

FIG. 10.—TRIGGER MECHANISM NORMAL

When a digit is selected, the end of the trigger engages with the first tooth of the pulse wheel and is moved to the position shown in Fig. 11. Further rotation of the pulse wheel causes the end of the trigger to ride over the 'teeth' and the number of teeth that pass equals the number selected.

When the finger plate is released, the mechanism rotates in the opposite direction and the trigger is moved back to the pulsing position. This movement occurs in approximately 240 milliseconds, giving the minimum inter-digital pause. Having reached the

pulsing position, the trigger rides over the teeth of the pulse wheel and the insulating bush breaks the pulsing contacts at each tooth (Fig. 12).

The number of pulses sent equals the number of teeth over which the trigger passed when the dial was wound up.

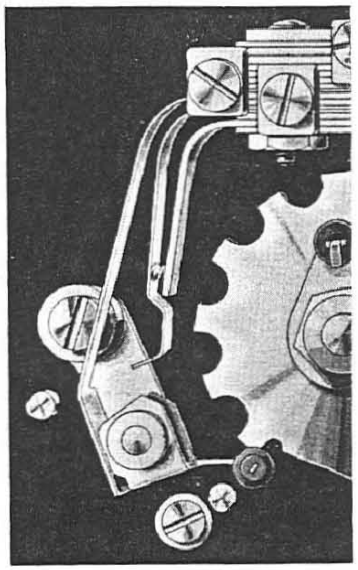

FIG. 11.—TRIGGER MECHANISM—TRIGGER MOVED AWAY FROM PULSE LEVER SPRING

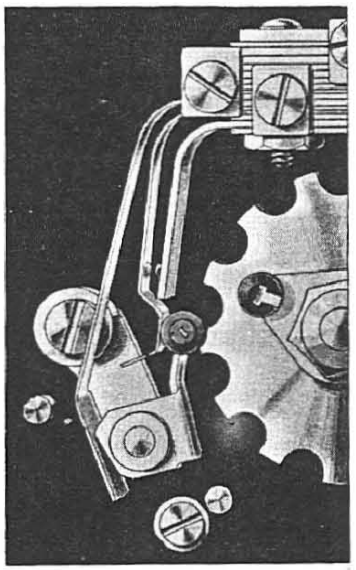

FIG. 12.—TRIGGER MECHANISM—TRIGGER RIDING OVER TOOTH OF PULSE WHEEL AFTER RELEASE OF FINGER PLATE

8. Purpose of the slipping-cam and trigger mechanisms.—Both mechanisms provide the minimum inter-digital pause before pulses are sent out so that:—

(*a*) If a subscriber commences to dial without waiting for the receipt of dialling tone the delay in sending the first pulse provides additional time to allow a free outlet to be seized.

(*b*) the dial mechanism is able to attain its governed speed before it sends out pulses.

Neither of these advantages could be achieved with P.O. dials if the pause occurred after the pulse train, instead of before it.

9. Advantages of the trigger mechanism.

(*a*) Its operation does not rely on frictional contact between surfaces, as in the slipping-cam design. Frictional contact can vary considerably during the years of service without attention that are expected of a dial, and departure from the correct value can cause false pulsing or stalling.

(*b*) The position to which the finger plate must be rotated to select the digit required is less critical than with the slipping-cam design, in which a small variation can cause a shortened first pulse or a false one. With the trigger design the correct number of pulses will be obtained if the finger plate is moved short of, or past, the finger stop by half the diameter of the finger hole.

(*c*) Wear of the pulse contacts and wear of the trigger set or pulse wheel affect the pulse ratio in opposite ways, so that any changes tend to neutralize one another.

With the slipping cam wear tends to increase the break to make ratio of the pulses.

★10. Description of Dial, Automatic, No. 13FA (trigger type).—Dials for some types of coin-collecting box circuits require auxiliary contacts which break when certain digits are selected and remain open until the pulsing stops.

The general construction of the No. 13... dial is similar to the trigger dial (described in par. 6) but an auxiliary spring-set and associated parts are mounted on the back of the dial, as shown in Fig. 13.

The contacts of the auxiliary spring-set are normally held in the 'made' position by a cam mounted on an extension of the main spindle. A small control cam, loosely coupled to the main spindle by a spring clip, is mounted between the contact cam and the off-normal lever, and its movement is limited in both directions by a stop plate which is fixed to the supporting bracket of the main spring-set assembly. A masking disk is fitted over the pulse wheel to reduce the effective height of every tooth except the first one, and the insulating bush on the trigger is longer than that on the normal trigger dial.

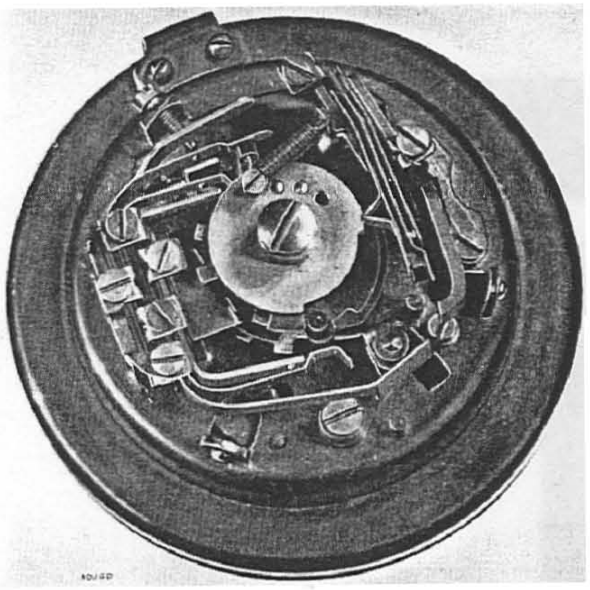

FIG. 13.—TRIGGER TYPE DIAL FOR USE ON COIN-BOX CIRCUITS—REAR VIEW

11. *Operation of the coin-box auxiliary contacts.* The auxiliary cam is free to turn on the main spindle and has a light helical spring attached to it from a bracket on the auxiliary spring-set assembly. Two control pins are riveted into the cam and project on the underside so that the off-normal bush can strike them.

When any digit up to and including '8' is selected, the spindle moves independently of the cam, which is held in its normal position by the pressure of the auxiliary spring-set.

If '9' or '0' is selected, the insulating bush on the off-normal lever strikes the operating pin (that furthest from the anchor screw for the helical spring) and rotates the cam to allow the auxiliary contacts to break. During the return motion the contacts remain open because the helical spring is not strong enough to turn the cam and lift the lever spring up the cam step. After the last pulse has been sent, the off-normal bush strikes the resetting pin (nearest to the anchor screw) and resets the cam and contacts to their normal position.

When free dialling of digit '8' is required, another control pin can be screwed into the tapped hole in the cam.

12. *Prevention of fraudulent calls.* The control cam, the masking disk, the longer trigger bush and the light helical spring in No. 13FA dials function to prevent certain forms of fraudulent calls being made.

★13. Dials, Automatic, Nos. 15... and 16... These dials are for testers and are of the trigger type. Details of their speeds and ratios are included in Table 1. The standard governor mechanism is used, specially adjusted to give the required speeds, and the special pulse ratios are obtained by the use of different pulse wheels.

The No. 16... dials are fitted with an extra spring-set and off-normal lever (Fig. 14). The spring-set is similar to the auxiliary one on the No. 13FA dial and is operated directly by the additional off-normal lever which is mounted on an extension of the main spindle. The angular position of this lever can be varied so that the spring-set is operated and the contacts made at different positions of the finger plate.

It is thus possible to utilize the contacts as make contacts for any particular instant in the travel of the dial, or as break contacts for the duration of the operation of the dial.

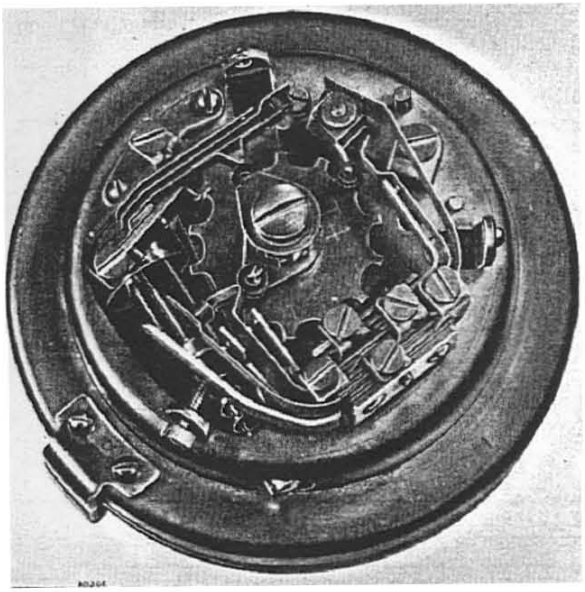

FIG. 14.—TRIGGER TYPE DIAL FOR USE WITH TESTERS

★14. Dial, Automatic, No. 17LA.—This dial is used for the Telephone No. 280. It has the same pulsing mechanism as the Dial, Automatic, No. 12 described in par. 6 and 7 but its mechanism is mounted on a smaller case than that of the No. 12 dial. The number ring fits closely over the case and is printed with figures only. The finger plate is also smaller than that used on the No. 12 dial and is printed with letters in positions corresponding to the figures on the number ring.

★15. Dial, Automatic, No. 19FA.—This is a trigger type dial having a similar form of construction to the No. 12 dial. It is fitted with one pair of off-normal contacts and the pulsing action is effected with a change-over unit. This dial is used for signalling on

automatic telegraph switching systems and the double pulse of the change-over contacts is adjusted to a nominal 3: 2 (operate to normal) ratio.

★**16. Dial, Automatic, No. 20LA.**—This is a trigger type dial having a similar form of construction to the Dial, Automatic, No. 12. It permits free dialling of digits '1', '9' and '0' and is used on prepayment coin-collecting boxes in director areas. The operation of the auxiliary spring-set for the dialling of '9' and '0' is the same as that of the No. 13 dial. To give the free dialling of digit '1' the masking disk is also used as a cam which, in conjunction with an operating lever, controls the auxiliary spring-set assembly. It is arranged that the auxiliary contacts are opened, or remain open for the duration of the last pulse of each pulse train.

In the normal position of the finger plate, the auxiliary contacts are opened by the operating lever which is resting on its cam. As the finger plate is rotated clockwise, the cam releases the lever, and the contacts close. The operation of the auxiliary spring-set is as previously described for the No. 13FA dial until the make period of the pulsing springs immediately before the last pulse is transmitted. During this make period the lever will again come under the control of the cam. If the contacts have already been opened by the switching cam when dialling '9' or '0', the lever will only increase the contact gap. If a digit other than '9' or '0' is dialled, the auxiliary contacts will be closed, until they are opened by the lever during the make period immediately before the last pulse, and will remain open until the dial is reoperated.

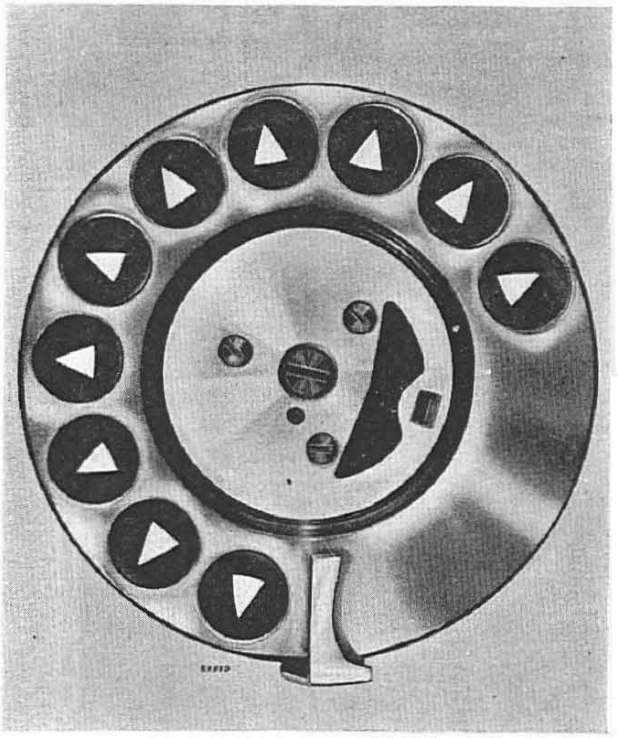

FIG. 15.—MOULDED BODY DIAL—FRONT VIEW

★**17. Description of moulded body dial.**—A typical dial using this form of construction is shown in Figs. 15, 16 and 17. The mechanism is essentially the same as that of the trigger dials previously described, except that it is mounted on a steel baseplate attached to a black moulding which forms the body. The material of the pulsing contacts has been changed to palladium to avoid high resistance contacts which have occurred on earlier dials. The number ring is located on two pillars between which its retaining spring is clipped. The finger plate is formed from rigid P.V.C. sheet in the colour range to match 700-type telephones. The label protector is moulded in clear polymethyl methacrylate. It snaps into position in the finger plate, and is held by three pips which are equally spaced around its periphery. A stainless-steel finger plate has been retained for some dials, e.g. those fitted at public call offices. The dial mechanism is held in the rest position by a screw passing through a lug on the steel baseplate and engaging with a pin screwed into the main gear-wheel.

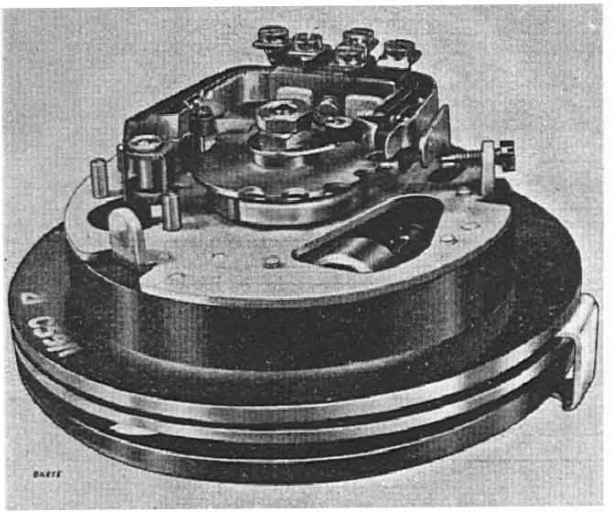

FIG. 16.—MOULDED BODY DIAL—REAR VIEW

★**18.** *Removal of the label protector.*—The label protector should be removed by one of the following methods.

(*a*) *Extractor No. 29.* This is a rubber suction disk with a finger grip (Fig. 18). The extractor should be firmly pressed on to the label protector and then sharply pulled away. It can be released from the protector by sliding or by lifting one edge of the rubber with the finger nail.

(*b*) An alternative method is to use a Screwdriver, Instrument, No. 1. This should be inserted radially between the finger plate and the number ring at the

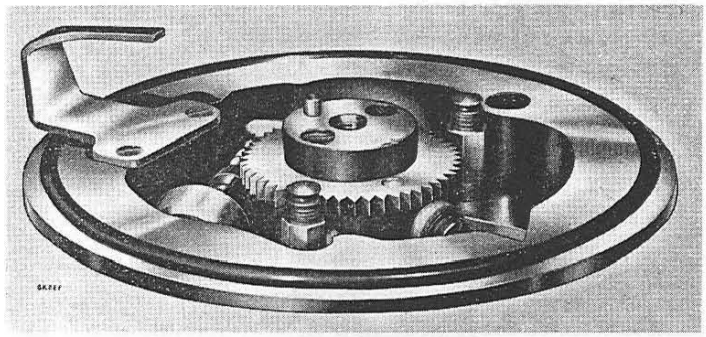

FIG. 17.—MOULDED BODY DIAL—WITH FINGER PLATE AND NUMBER RING REMOVED

FIG. 18.—MOULDED BODY DIAL—REMOVAL OF LABEL PROTECTOR WITH EXTRACTOR NO. 29

'3 o'clock' position on the dial (Fig. 19). The screwdriver will then enter a slot in the finger plate, and by turning the screwdriver beneath the pip in a thin metal plate which is under the label protector the protector will be ejected. Care must be taken to ensure that the end of the screwdriver is under the metal plate and not between the plate and the label protector. It is advisable to hold two fingers over the protector to restrain it during ejection.

★**19. Dial, Automatic, No. 21CA, (Colour).** This moulded body dial is for use with 700-type telephones. The number ring fitted is in matching colour and has printed arrow heads which appear beneath the finger holes. Some earlier Dials, Automatic, No. 21CA, (Colour) will have number rings without arrow heads.

★**20. Dial, Automatic, No. 21CA, Steel** is for use on Telephone No. 705. It is similar to the Dial, Automatic, No. 21CA, (Colour) but is fitted with a stainless-steel finger plate. The number ring is as fitted on Dial, Automatic, No. 21CA, Green.

★**21. Dial, Automatic, No. 21LA, Black** is similar to Dial, Automatic, No. 21CA, Black with the exception that it is fitted with a number ring printed with figures and letters. It supersedes Dial, Automatic, No. 12LA.

★**22. Dial, Automatic, No. 22FA** has a stainless-steel finger plate and a mechanism similar to that of Dial, Automatic, No. 13, mounted on a moulded body. It is fitted with a number ring bearing figures only. It supersedes Dial, Automatic, No. 13FA.

★**23. Dial, Automatic, No. 23LA** has a mechanism similar to that of Dial, Automatic, No. 20, mounted on a moulded body. It is fitted with a stainless-steel finger plate and a number ring bearing figures and letters. It supersedes Dial, Automatic, No. 20LA.

★**24. Dial, Automatic, No. 24FA** has a similar mechanism to Dial, Automatic, No. 19, mounted on a moulded body. It is fitted with a number ring bearing figures only and a black P.V.C. finger plate. It supersedes Dial, Automatic, No. 19FA.

★**25. Dial, Automatic, Nos. 25LA, 25LT3 and 25LT4** have mechanisms similar to Dials, Automatic, Nos. 16LA, 16LT3 and 16LT4 respectively, mounted on a moulded body. The dials are fitted with a number ring bearing figures and letters, and a black P.V.C. finger plate. These dials are used in testers and supersede Dials, Automatic, No. 16...

★**26. Dial, Automatic, No. 25CA.**—This dial is similar to Dial, Automatic, No. 25LA except that it has a grey P.V.C. finger plate and a number ring bearing arrowheads. It is for use on the operator's telephone of Switchboard, P.M.B.X., No. 2/... where inter-switchboard circuits are provided for dialling into P.A.B.X.s.

★**27. Dial, Automatic, No. 26LA.**—This is a modified Dial, Automatic, No. 10 fitted in a flameproof enclosure and is used with the Telephone No. 149. The flameproof construction requires it to have an additional spindle and to prevent this impeding the return of the pulsing mechanism the steel finger plate is coupled to the pulsing mechanism by means of a clutch. At the moment of release of the finger plate it is declutched from the pulsing mechanism and returns to normal very quickly under the action of an additional coiled spring. The return of the pulsing mechanism is therefore unimpeded. When the finger plate returns to normal it is locked until the completion of pulsing. Then when the mechanism returns to normal the finger plate is unlocked and the next digit can be dialled. The finger plate should be locked by repositioning the screw in the flyback mechanism when the Telephone No. 149 is used on C.B. systems.

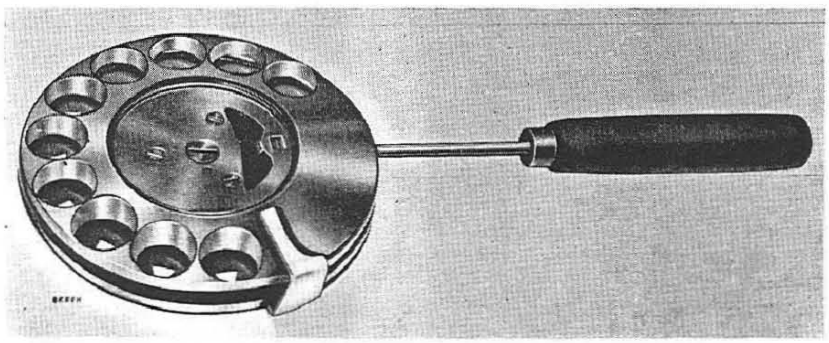

FIG. 19.—MOULDED BODY DIAL—REMOVAL OF LABEL PROTECTOR WITH SCREWDRIVER

★**28. Dial, Automatic, No. 28LA.**—This dial has a mechanism similar to that of a Dial, Automatic, No. 22 but modified by the addition of a cam so that the contacts of the auxiliary spring-set are closed during the pulsing of any contact other than '9'. It is used on installations where outgoing access is required to be limited to the '999' emergency service only.

★**29. Dials for blind subscribers and subscribers with defective sight.**—The modification of dials for use by blind subscribers is described in WORKS, Execution, C 0026. For subscribers having difficulty in operating the dial due to defective sight, the procedure outlined in Stations, A 3114 should be followed.

★**30. Maintenance of dials.**—The following Instructions detail the amount of maintenance that should be done on dials:—

(*a*) At subscribers' premises . . . . . B 5002
(*b*) At manual and auto-manual exchanges . . B 5004
(*c*) At local dial adjustment centres . . B 5003

Complete adjustment instructions for trigger-type dials are given in B 5125 and details for slipping-cam type dials are given in B 5126.

References:—B 5002, B 5003, B 5004, B 5125, B 5126
(S1) Stations, A 3114, A 3115
WORKS, Execution, C 0026

END