



THE GENERAL ELECTRIC CO. LTD., OF ENGLAND

MAINTENANCE INSTRUCTION I.A.110

ADJUSTMENT AND MAINTENANCE OF G.E.C. TRIGGER DIALS

CAT. Nos. DL. 1100 Series (Standard),
DL. 1200 Series (Tropical).

Made under one or more of the following patents and applications :

<i>British.</i>	518721, 522807, 524262, 524263, 530598, 576615, 648663, 657002, 666828 and 676324.
<i>Australia.</i>	111251 and 113305.
<i>India.</i>	26777 and 27143.
<i>South Africa.</i>	1122/39.
<i>Palestine.</i>	173/1871 and 175/1905.
<i>Malay States.</i>	334R.

This dial differs from all others operated on the trigger principle in that a much longer pre-digit pause is obtained by the use of an articulated, that is, a doubly pivoted trigger.

The adjustment particulars and figures given in this Maintenance Instruction will give satisfactory operation of the dial. They are not, however, necessarily the only acceptable adjustments, and dials as despatched from the factory may have adjustments which, although differing somewhat from those given in these pages, are within the limits which long experience has shown to be acceptable.

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any detail of design.*

Manufactured by:

THE GENERAL ELECTRIC COMPANY LTD. OF ENGLAND
TELEPHONE, RADIO AND TELEVISION WORKS · COVENTRY · ENGLAND

Telephone: Coventry 4111 (10 lines).

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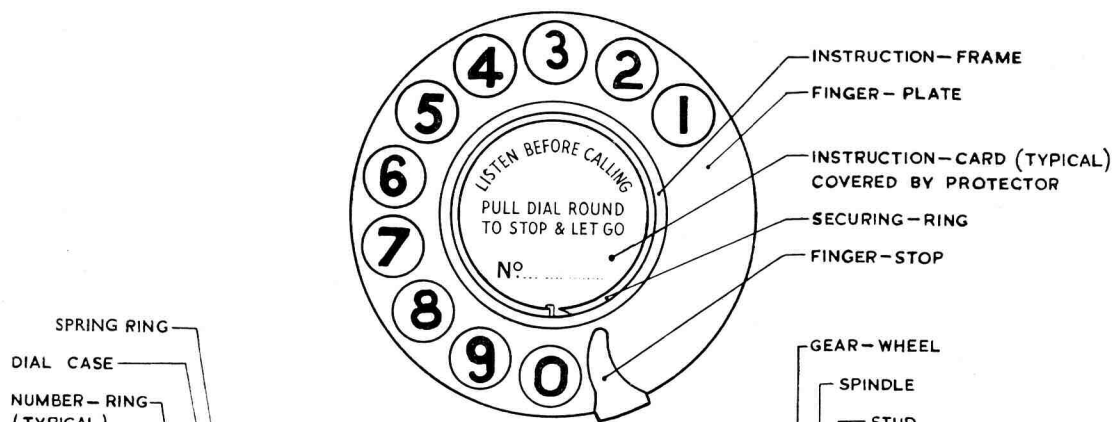


FIG. 1

FRONT VIEWS

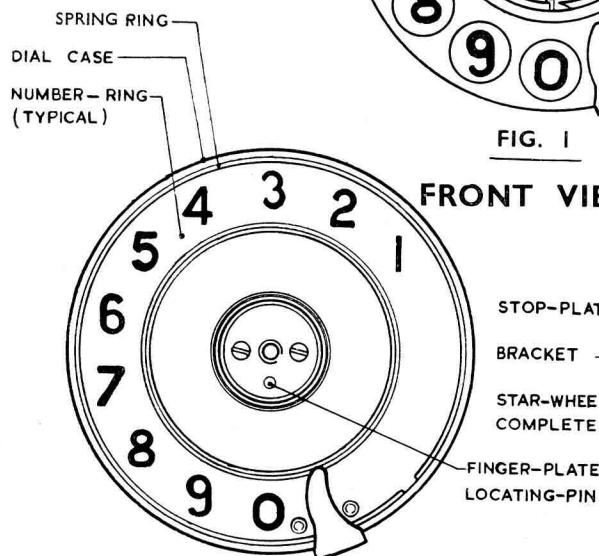


FIG. 2

FINGER-PLATE REMOVED

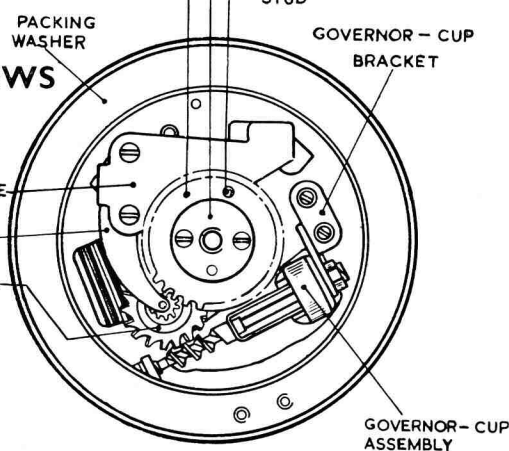


FIG. 3

NUMBER-RING REMOVED

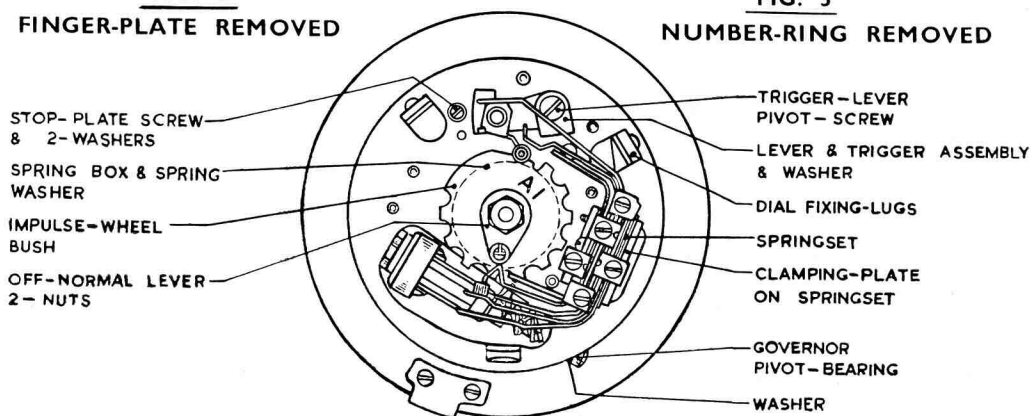


FIG. 4

REAR VIEW

Figures 1, 2 and 3 illustrate front views of the dial, whilst rear view is shown in Fig. 4.

IDENTIFICATION

The impulse-springs, switching-springs and the trigger-spring are shown in greater detail in Figs. 5-10. *The spring numbers given in Fig. 7 are used in the following pages for identification.*

GENERAL

Before despatch from the Works all dials are very carefully tested and adjusted. Gross maladjustments are not likely to develop during normal service, and, unless there is evidence of faulty operation, the adjustments should not be touched.

Note:—1 mil=one thousandth of an inch=.0254mm.

SPECIFICATION

SPEED

The dial is adjusted at the works to send not less than 9, nor more than 11, impulses per second.

The dial mechanism runs smoothly at a uniform speed, and the impulses are produced without any chattering of the impulse-contacts when tested with an oscillograph.

IMPULSING

The break-period of each impulse, expressed as a percentage of the total impulse-period, is within the range 63 to 70, which is standard. Where dials are supplied with a special "break and make" ratio, these will be as specified on the particular order.

MINIMUM PRE-DIGITAL PAUSE

The minimum pre-digital pause, i.e. the minimum time that elapses after release of the finger-plate and before the commencement of the first break-period, is 240 milli-seconds.

TOOLS REQUIRED

Below are listed the tools that are necessary for dismantling, re-assembling, adjusting and testing. The tools specified should be used only for the purpose for which they are intended. No tool should be used which is in such a condition that screws, nuts or springs would be marred by its use. All screws and nuts must be tight.

- 1—tension gauge 4-24 grms., G.E.C. Cat. No. GT 1101—for measuring spring tensions.
- 1—tension gauge 10-80 grms., G.E.C. Cat. No. GT 1102—for measuring spring tensions.
- 1—set of feeler gauges—for general use.
- 1—box spanner $\frac{9}{32}$ " A/F ($\frac{7}{16}$ " outside dia. max.)—for nuts on main-spring.
- 1—flat spanner $\frac{1}{4}$ " A/F—for special nut on governor cup.
- 1—flat spanner $\frac{5}{32}$ " A/F—for stud in gear.
- 1—each $\frac{1}{8}$ " and $\frac{3}{16}$ " screwdrivers—for general use.
- 1—pair bent duckbill pliers and
- 1—pair taper-nosed pliers
(for general spring adjustment and governor-wing adjustment).

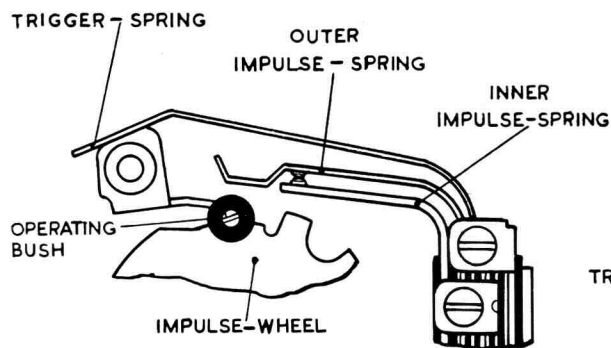


FIG. 5

NORMAL POSITION

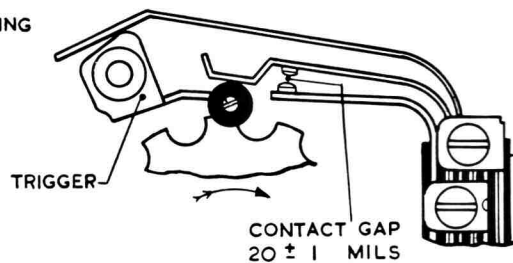


FIG. 6

OPERATED POSITION

IMPULSE-SPRINGS

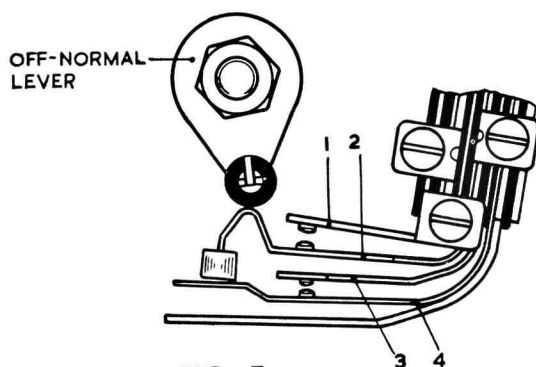


FIG. 7

NORMAL POSITION

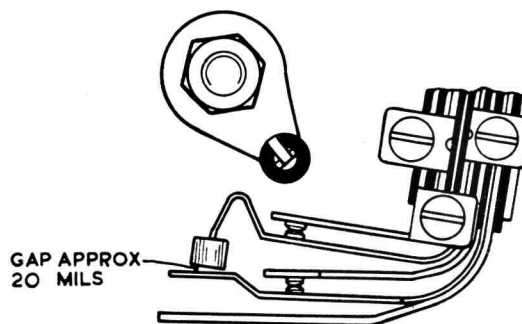


FIG. 8

OFF NORMAL POSITION

SWITCHING-SPRINGS

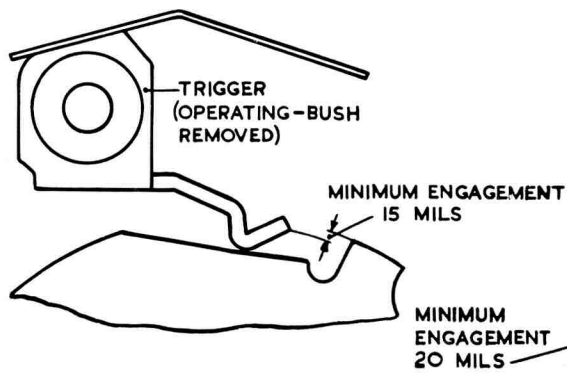


FIG. 9

NORMAL POSITION

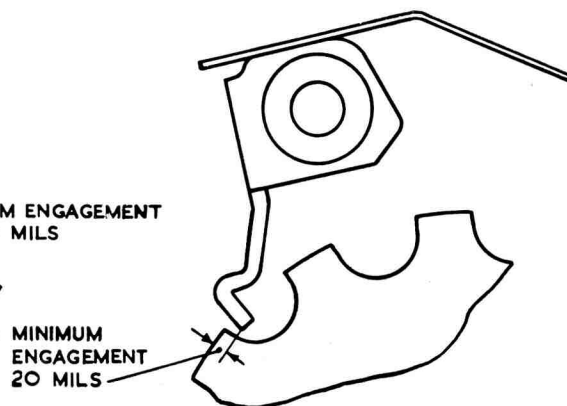


FIG. 10

FORWARD POSITION

TRIGGER SPRING

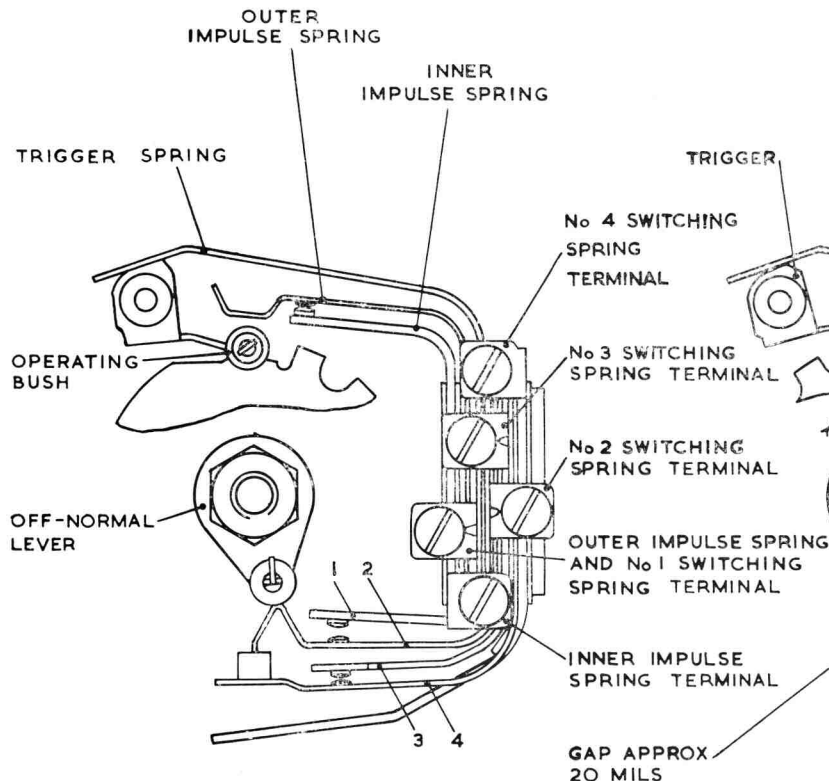
FIG. 5

FIG. 6

IMPULSE-SPRINGS

NORMAL POSITION

OPERATED POSITION



NORMAL POSITION

OFF NORMAL POSITION

SWITCHING-SPRINGS

FIG. 7

FIG. 8

NOTE :- For wiring purposes please refer to relevant wiring diagram.

QUICK TESTS

1 SPEED TEST

The following practical speed test will prove of use as a rapid means of verifying the speed of impulse transmission.

Check Dial "O" ten times in rapid succession, being careful NOT to assist nor hasten the finger-plate during its return to its normal position. The correct time for the completion of this cycle of operations is 20 secs., plus or minus 2 secs.

Action Should the dial prove to be fast or slow, the governor wings need adjusting in the manner described later.

2 IMPULSE-RATIO TEST

Check The impulse ratio is automatically obtained when the inner (thick) impulse-spring is set so as to give a contact gap of 20 ± 1 mils during the break-period.

Action If necessary, adjust the inner impulse-spring.

3 OFF-NORMAL LEVER TEST

Check The insulating-bush of the off-normal lever must not touch *spring 2* until after the impulse-springs have completed the last break-period of any train of impulses.

Action Should this condition not be met, the off-normal lever should be adjusted.

MAINTENANCE LUBRICATION

The following parts of the dial mechanism must be lubricated with a very light lubricating oil, slightly thicker than clock-oil.

(a) *Star-wheel complete.* One drop of oil between the pinion and the boss of the star-wheel. One drop of oil on the clutch-spring and one on each journal.

(b) *Governor.* One drop of oil on the worm, and one on each journal.

(c) *Spindle.* One drop of oil.

(d) *Spring.* When dismantled, the spring should be stored in a bath of very light lubricating oil; it must be drained before assembly in box, and no further lubricant applied.

(e) *Trigger bearing-pin and shank of trigger-lever pivot-screw.* One drop of oil on each end.

(f) *Trigger-spring where it rests on the trigger.* One drop of oil to each place.

INSULATION RESISTANCE

The insulation resistance between any two points not required to be electrically connected should be not less than 100 megohms when tested with 250 volts D.C.

ADJUSTMENTS

The adjustments given below are included also in their logical sequence in the ASSEMBLING Section.

1 GOVERNOR

- (i) The fixing-holes in the governor-cup bracket are elongated to enable the cup to be adjusted to give the best running position for the governor. This position is obtained when the cup is square with the governor.
- (ii) The governor should run smoothly in both directions with a maximum end-play of 13 mils, as near as can be judged by feel.

2 STAR-WHEEL COMPLETE

- (i) See that the star-wheel is engaging the worm correctly, otherwise the governor will not run smoothly. If the pinion engages the gear-wheel too deeply, vibration will be set up.
- (ii) The clearance between the star-wheel and the root of the worm-thread should be approximately 10 mils.
- (iii) A good method of testing the gearing is to fit the spindle and gear temporarily, and to revolve the spindle a few times.

3 MAIN-SPRING

- (i) Rotate the finger-plate in a clockwise direction until the spring is felt to tighten. (Do not overwind).
- (ii) Allow the finger-plate to return through $1\frac{1}{2}$ revolutions, then screw down the stop-plate screw.
- (iii) Release the finger-plate, which should then return to its normal position.
- (iv) To ensure that the stop-plate engages the stud in the gear sufficiently, it should require a minimum of three turns of the stop-plate screw from its normal position before the spring commences to unwind.

4 TRIGGER-LEVER

- (i) The trigger-lever should be free on the pivot-arm with perceptible end-play, but with a minimum of side-shake.

5 IMPULSE-SPRINGS

- (i) CHECK that the impulse-springs are not affected by the movement of the mechanism until the return journey of the finger-plate, and then not until after the "minimum-pause" period has elapsed.
- (ii) The inner (thick) impulse-spring should be set so as to give a contact gap of 20 ± 1 mils during the break-period. This adjustment gives the correct impulse-ratio automatically.
- (iii) The operating-bush on the trigger should make good engagement with the outer impulse-spring during the break-period of each impulse.
- (iv) The contact-pressure should be 20-30 grammes when the springs are at normal. This tension is to be obtained by adjusting the outer spring, which must be

straight and free from kinks. Adjustments should be made from the base of the spring.

6 SWITCHING-SPRINGS

- (i) The adjustment of the switching-springs, and the off-normal lever operating them, should be such that the actuation of the springs coincides with the movement of the finger-plate from its position of rest. Springs 1 and 2 should be adjusted to break first. To obtain this sequence there should be approximately a 20-mil gap between spring 4 and the insulating-bush on spring 2, when the finger-plate is off-normal. Springs 2 and 4 should be tensioned to give a contact-pressure of 20-35 grammes.
- (ii) Contact openings must be not less than 10 mils.
- (iii) CHECK that the off-normal lever is so adjusted that its insulating-bush does not touch spring 2 until after the impulse-springs have completed the last break-period of any train of impulses.

7 TRIGGER-SPRING (or Restraining Spring)

- (i) See that the trigger-spring lies squarely on both flanges of the trigger, and is clear of the lever pivot-screw.
- (ii) When the finger-plate is pulled off-normal, the tip of the impulsing-vee of the trigger should engage the impulse-wheel tooth by a minimum of 15 mils, as near as can be judged by eye.
- (iii) On the release of the finger-plate, after the dialling of any digit, the tip of the impulsing-vee of the trigger should engage the impulse-wheel by a minimum of 20 mils, as near as can be judged by eye.
- (iv) With the finger-plate and trigger at normal the tension of the trigger-spring should be 30-45 grammes, measured at that point of engagement with the trigger which is farthest from the free end of the spring.
Consistent with the above adjustments, the trigger-spring should be so set that, during operation of the dial, trigger clicks are reduced to a minimum. In this connexion note that:—
- (v) After the trigger has moved into the forward position, the tip of the trigger should be clear of the bottom of the impulse-wheel teeth during the subsequent winding-up of the dial.
- (vi) During impulsing, on the make-period of the impulse, the impulsing-vee should be just clear of the bottom of the impulse-wheel teeth.

Dismantling should very seldom be necessary.

After removing plastic cover (if fitted):

- 1 Remove the springset by removing the two screws facing outwards. Care should be taken to avoid bending or distorting the springs.
- 2 Remove the trigger-lever pivot-screw, trigger and lever assembly and washer.
- 3 Remove the finger-stop.
- 4 With the dial resting face-downwards, loosen the stop-plate screw until the dial-case revolves. When the spring has fully unwound, remove the screw and two washers.
- 5 Remove the securing-ring, protector and instruction card from the instruction-frame. The securing-ring is best removed by inserting a narrow sharp-edged screwdriver between the securing-ring and the inner edge of the instruction-frame, and levering the ring firstly towards the frame centre, and then outwards.
- 6 Remove both nuts from the spindle.
- 7 Remove the off-normal lever and bush.
- 8 Remove the impulse-wheel and washer.
- 9 Remove the spring-box and spring from the dial case. The removal of the spring-box with the spring intact is facilitated by the use of a knife-blade to lever the inner end of the spring from its bed in the slot of the dial-case.
- 10 Remove the finger-plate by means of the central screw.
- 11 Remove the spring-ring, number-ring, packing-washer, gear-wheel and spindle. The spring-ring is easily removed by inserting the edge of a screwdriver between the ring and the dial-case, about $\frac{1}{2}$ " from the break in the ring, and gently levering outwards. The number-ring, packing-washer, gear-wheel and spindle are then free to be removed.
- 12 Remove the stop-plate, bracket, and star-wheel complete.
- 13 Remove the governor-cup bracket and governor.
- 14 Remove the governor pivot-bearing and washer.
- 15 Remove the instruction-frame and plate from the finger-plate.
- 16 Remove the gear-wheel from the spindle.
- 17 Remove the stud from the gear-wheel.

DISMANTLING

RE-ASSEMBLING

(a) Certain parts need lubricating during assembly; refer to the Section on Maintenance Lubrication.

(b) For general assembly see Figures 1-4.

1 Assemble the gear-wheel, fitted with the stud, to the spindle so that the stud is on the side away from the finger-plate locating-pin. It is most important that the stud be thoroughly tight in the gear-wheel.

2 Assemble the governor pivot-bearing and washer to the dial-case.

3 Assemble the governor with the governor-cup and governor-cup bracket to the dial-case.

- (i) The fixing-holes in the governor-cup bracket are elongated to enable the cup to be adjusted to give the best running position for the governor. This position is obtained when the cup is square with the governor.
- (ii) The governor should run smoothly in both directions with a maximum end-play of 13 mils as near as can be judged by feel.
- (iii) No attempt should be made to proceed with further assembling until the governor has been adjusted to run smoothly.

4 Assemble the star-wheel complete, and the bracket together with the stop-plate, to the dial case.

- (i) CHECK that the star-wheel is engaging the worm correctly, otherwise the governor will not run smoothly; if the pinion engages the gear-wheel too deeply, vibration will be set up.
- (ii) The clearance between the star-wheel and the root of the worm-thread should be approximately 10 mils.
- (iii) A good method of testing the gearing is to fit the spindle and gear temporarily, and revolve the spindle a few times.

5 Assemble the spring-box complete with spring, to the dial-case.

- (i) Should it be necessary to fit the spring in the box, the spring should be wound in the spring-box starting from the outer edge; the arrow on the inside of the spring-box indicates the direction of winding. If a lip is present in the spring-box, the first turn should fit behind the lip.

6 Assemble the spindle and wheel to the dial-case, so that the key-way in the spindle engages the key of the spring-box.

7 Assemble to the spindle:—

- (i) Washer,
- (ii) Impulse-wheel, to engage the key-way in the spindle, checking by Fig. 4 that it is positioned correct side up,
- (iii) Bush,
- (iv) Off-normal lever,
- (v) One nut, finger-tight,
- (vi) Stop-plate screw and two washers, leaving about $\frac{1}{8}$ " to be screwed down.

8 Assemble the packing-washer, number-ring and spring-ring to the dial-case.

- (i) CHECK that the two small holes in the packing-washer, and those in the number-ring, are opposite the finger-stop fixing-holes, otherwise the number-ring may be damaged when the finger-stop fixing screws are assembled.

9 Assemble the instruction-frame and plate to the finger-plate, and fix to the spindle.

- (i) When assembling the instruction-frame to the finger-plate, CHECK that the hole in the instruction-frame for the securing-ring is opposite the "O" finger-hole.

10 Assemble the instruction-card (if supplied) with the lines of lettering horizontal when the finger-plate is in its normal position, then the protector and the securing-ring.

11 Adjust the main-spring. The correct tension is obtained as follows:—

- (i) Rotate the finger-plate in a clockwise direction until the spring is felt to tighten; (do not over-wind).
- (ii) Allow the finger-plate to return through $1\frac{1}{2}$ revolutions, and screw down the stop-plate screw.
- (iii) Release the finger-plate, which should then return to its normal position.
- (iv) CHECK that the stop-plate engages the stud in the gear sufficiently. A minimum of three turns of the stop-plate screw from its normal position should be required before the spring commences to unwind.

12 Assemble the finger-stop to the dial-case.

RE-ASSEMBLING (continued)

13 Assemble the trigger and lever assembly to the dial-case with the trigger-lever pivot-screw and washer. The trigger-lever should be free on the pivot-screw with perceptible end-play, but with a minimum of side-shake.

14 Assemble the spring-set to the dial-case.

- (i) Ensure that the centre-screw of the spring-set does not come loose by applying resin varnish to the thread where the screw comes through the clamping-plate.
- (ii) See that the trigger-spring bears against both outside flanges of the trigger.

15 CHECK the adjustment of the impulse-springs by verifying that:—

- (i) The impulse-springs are not affected by the movement of the mechanism until the return journey of the finger-plate, and then not until after the minimum-pause period has elapsed.
- (ii) The inner (thick) impulse-spring is set so as to give a contact gap of 20 ± 1 mils during the break-period. This adjustment gives the correct impulse-ratio automatically.
- (iii) The operating-bush on the trigger makes good engagement with the outer impulse-spring during the break-period of each impulse.
- (iv) The contact pressure is 20-30 grammes when the springs are at normal. This tension is to be obtained by adjusting the outer spring, which must be straight and free from kinks. Adjustment should be made from the base of the spring.

16 CHECK the adjustment of the switching-springs by verifying that:—

- (i) The adjustment of the switching-springs, and the off-normal lever operating them, is such that the actuation of the springs coincides with the movement of the finger-plate from its position of rest. Springs 1 and 2 should be adjusted to break first, and to obtain this sequence there should be approximately a 20-mil gap between spring 4 and the insulating-bush on spring 2, when the finger-plate is off-normal. Springs 2 and 4 should be tensioned to give a contact-pressure of 20-35 grammes.
- (ii) Contact openings are not less than 10 mils.

- (iii) The switching-springs are so adjusted, that the insulating-bush on the off-normal lever does not touch spring 2 until after the impulse-springs have completed the last break-period of any train of impulses.

17 Assemble the second nut to the spindle.

18 CHECK the adjustment of the trigger-spring by verifying that:—

- (i) The trigger-spring lies squarely on both flanges of the trigger, and is clear of the lever pivot-screw.
- (ii) When the finger-plate is pulled off-normal, the tip of the impulsing-vee of the trigger engages the impulse-wheel tooth by a minimum of 15 mils, as near as can be judged by eye.
- (iii) On the release of the finger-plate, after the dialling of any digit, the tip of the impulsing-vee of the trigger engages the impulse-wheel by a minimum of 20 mils, as near as can be judged by eye.
- (iv) With the finger-plate and trigger at normal the tension of the trigger-spring is 30-45 grammes, measured at that point of engagement with the trigger which is farthest from the free end of the spring.

Consistent with the above adjustments, the trigger-spring should be so set that, during operation of the dial, trigger clicks are reduced to a minimum.

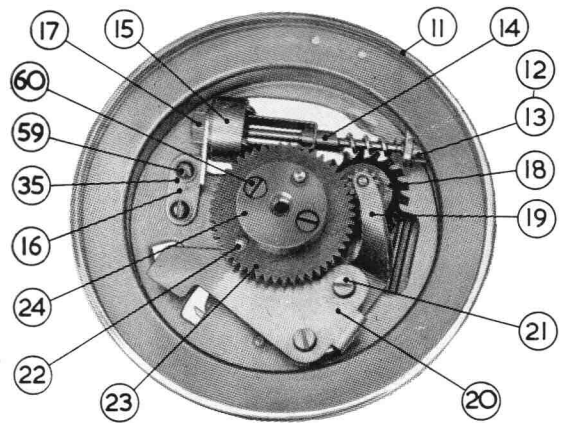
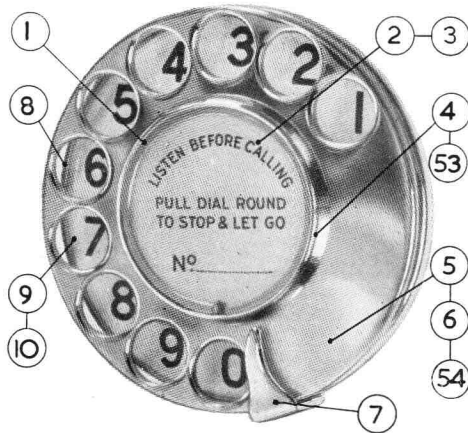
In this connexion note that:—

- (v) After the trigger has moved into the forward position, the tip of the trigger should be clear of the bottom of the impulse-wheel teeth during the subsequent winding-up of the dial.
- (vi) During the impulsing, on the make-period of the impulse, the impulsing-vee should be just clear of the bottom of the impulse-wheel teeth.

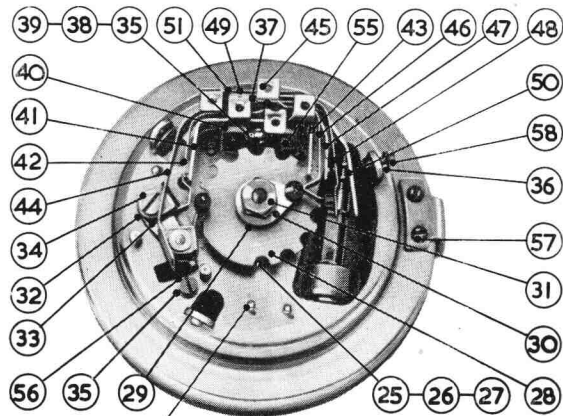
19 As mentioned in the Specification Section, the speed of the dial should be not less than 9, and not more than 11, impulses per second. The speed can be varied by adjusting the wings of the governor, which should be bent from the root.

- (i) To increase the speed bend the wings inwards.
- (ii) To decrease the speed bend the wings outwards.

LOCATION OF PARTS



FRONT VIEW—NUMBER RING REMOVED



THIS PARTICULAR SCREW BECOMES ITEM (38) WHEN COVER FITTED

REAR VIEW—COVER REMOVED

PLASTIC COVER
FITTED ONLY AT
CUSTOMER'S
REQUEST

(52)
BECOMES
(62)

WHEN COVER
IS FITTED

(61)

SPECIAL NUT
FOR COVER

LIST OF PARTS

ITEM	DESCRIPTION	ITEM	DESCRIPTION	ITEM	DESCRIPTION
1	Securing ring	22	Stud	44	Restraining Spring
2	Protector	23	Gear Wheel	45	Terminal Plate
3	Instruction Card	24	Spindle	46	Contact Spring
4	Instruction Card Frame	25	Spring Box		
5	Finger Plate	26	Spring	47	Contact Spring
6	Plate	27	Washer		
7	Finger Stop	28	Impulse Wheel	48	Contact Spring
8	Spring Ring	29	Bush	49	Insulator
9	Number Ring	30	Off Normal Lever	50	Terminal Plate
10	Packing Washer	31	Nut	51	Clamping Plate
11	Case & Bush	32	Washer	52	Special Terminal Screw
12	Washer	33	Trigger & Lever	53	Screw 8BA x $\frac{5}{32}$ " CSK. HD.
13	Pivot Bearing	34	Pivot Screw	54	Screw 4BA x $\frac{5}{32}$ " CSK. HD.
		35	Washer	55	Screw 8BA x $\frac{7}{16}$ " INST. HD.
14	Governor	36	Washer	56	Screw 8BA x $\frac{3}{16}$ " CH. HD.
15	Governor Cup	37	Spring Set	57	Screw 8BA x $\frac{3}{16}$ " RD. HD.
		38	Screw	58	Screw 7BA x $\frac{1}{4}$ " CH. HD.
16	Bracket	39	Bush	59	Screw 8BA x $\frac{5}{32}$ " RD. HD.
17	Special Nut	40	Insulating Plate	60	Screw 8BA x $\frac{5}{32}$ " CH. HD.
18	Star Wheel Complete	41	Contact Spring	61	Special Nut
19	Bracket			62	Special Terminal Screw
20	Stop Plate	42	Contact Spring		
21	Screw	43	Contact Spring		