DIALS, AUTOMATIC, Nos. 12.... to 19.... (TRIGGER TYPE)

[Maintenance Adjustment Instruction (M.A.I.) No. 25]

1. Introduction.—This Instruction describes the dismantling, assembly, adjustment and lubrication of P.O. trigger-type dials. A full description of the different types of trigger dial, their method of operation and their uses is given in B 1003.

2. The amount of maintenance adjustment that is permitted at particular locations is detailed in the E.I.s indicated below:—

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

3. Contents.—The information appears in the order given below:—

4. Names of parts.—The names of parts are indicated on the views of the typical trigger dial, Figs. 1, 2 and 3. The additional features of the coin-box dial (Dial, Auto., No. 13....) are shown in Fig. 20 and those of the tester dial (Dial, Auto., No. 16....) in Fig. 30.

5. Adjustment tolerances.—'Test' and 're-adjust' values are quoted wherever a sufficient margin of safety is available. These terms may be defined as follows:—

(*a*) *Test values.*—These values represent the safe limits within which reliable operation is guaranteed. When specified they should be used for checking adjustments. A dial requires re-adjustment if its adjustment proves to be outside the range of these values.

(*b*) *Re-adjust values.*—These values represent a closer limit of adjustment than those provided by the test values. A dial adjusted to these values will thus have a greater factor of safety and should not need attention so frequently as would be the case if the limits of test values were used for re-adjustment. Whenever a dial requires re-adjustment, the re-adjust values should be applied.

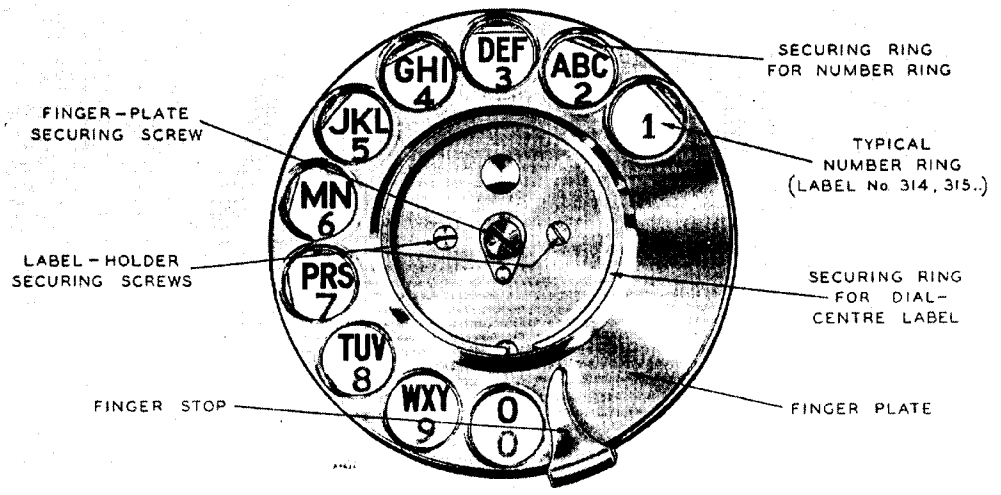

FIG. 1.—FRONT VIEW

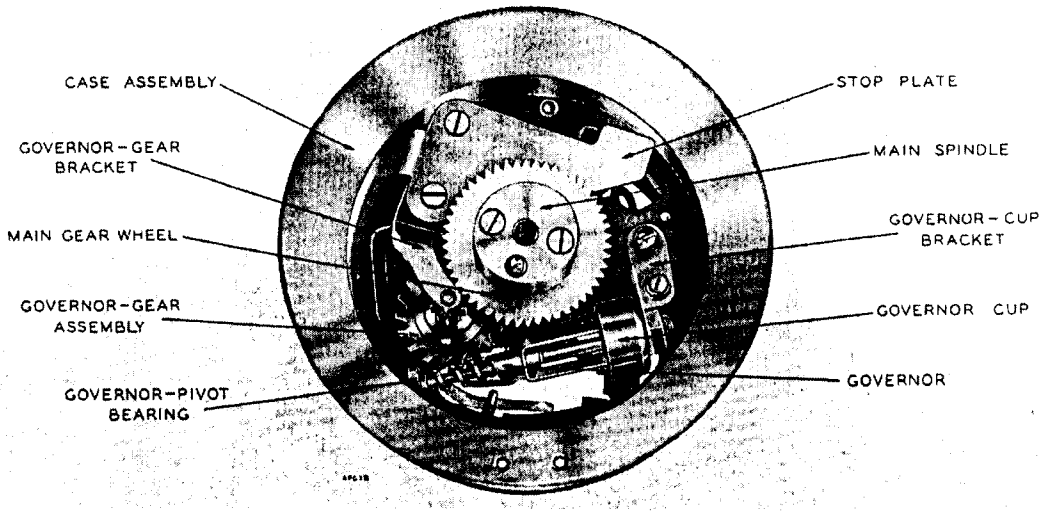

FIG. 2—FRONT VIEW (FINGER PLATE REMOVED)

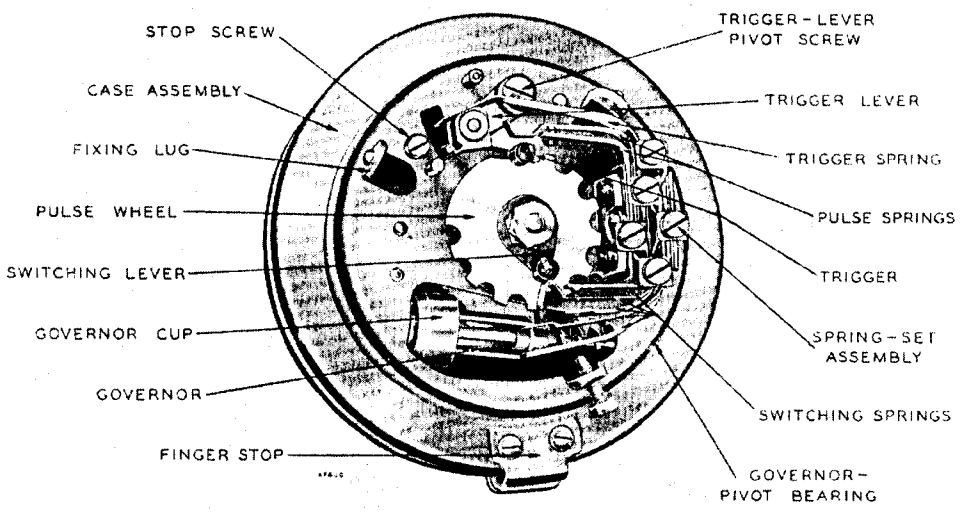

FIG. 3.—REAR VIEW

6. Sequence of adjustment.—The adjustments detailed in this Instruction have been arranged in the correct sequence to apply both to minor re-adjustments and re-adjustments following the complete dismantling and reassembly of a dial. If, during maintenance, a minor adjustment is required, care must be taken to ensure that other adjustments are not disturbed.

7. Cleaning.—Before making adjustments to a dial, it should be examined to see that it is clean. (A dirty dial may be sluggish in action although the main spring is fully tensioned.) The dial should be dismantled and the following parts washed in clean white spirit:—

(*a*) Governor
(*b*) Governor-pivot bearing

(*c*) Governor-cup and bracket
(*d*) Governor-gear assembly
(*e*) Main spindle
(*f*) Washers (if fit for re-use)
(*g*) Main spring (if fit for re-use).

The remaining parts should be cleaned with a soft cloth. Worn or defaced parts should be changed.

8. Lubrication.—After the mechanism has been cleaned, the parts which have been washed in white spirit should be wiped dry, particular attention being paid to bearing surfaces. The following parts should be lubricated with Oil, Bearing, No. 16 in the manner indicated:—

(*a*) Governor bearings	Apply one drop of oil to each end of the governor spindle
(*b*) Governor-gear spring clutch	Apply one drop of oil
(*c*) Governor-gear bearing	Apply one drop of oil to each bearing
(*d*) Governor worm	Apply one drop of oil
(*e*) Governor weights	Wiped lightly on a sparingly-oiled pad
(*f*) Main spindle	Apply one drop of oil to the bearing portion
(*g*) Trigger-lever bush and pivot screw	Apply one drop of oil under the screw head
(*h*) Trigger bearing pin	Apply one drop of oil at each end
(*j*) Trigger spring	Apply one drop of oil on bearing surfaces.

9. Care should be taken not to use the oil in excess, especially on the governor assembly. In particular, care should be taken to prevent oil getting on the braking surface of the governor cup. Each " drop " of oil specified should be the amount pendant on the end of a piece of No. 23 S.W.G. (9¼ lb.) bare wire after it has been dipped in a reservoir of oil, the level of which is maintained at a depth of ⅛ in.

10. A main spring which is fit for re-use should be dipped in Oil, Bearing, No. 16 and drained before assembly. Further lubricant should not be applied. Spare main springs should be stored in a bath of Oil, Bearing, No. 16.

ADJUSTMENTS

11. The checks detailed in pars. 12 and 13 should be made *when the dial has been dismantled.*

12. Governor.—The governor wings should be free from kinks and bows and, as an initial adjustment, they should be set slightly inwards and equidistant from the spindle by means of Pliers, Adjusting, No. 5. The governor-cup fixing holes are elongated, to enable the cup to be positioned to give the best running position for the governor, i.e. the cup should be square with the governor when observed from the angles shown in Figs. 4 and 5. *The adjustment is critical and should normally only be effected with the aid of a jig.*

GOVERNOR CUP AND BRACKET

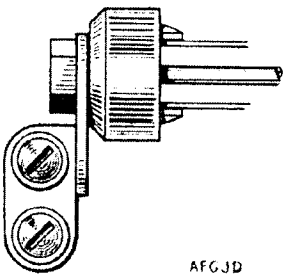

FIG. 4.—FRONT VIEW

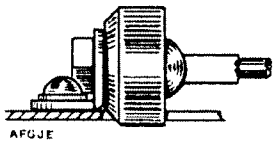

FIG. 5.—SIDE VIEW

The governor should run smoothly in both directions. It should be free, with a maximum end-play of 20 mils as near as can be judged by eye. The freedom of the governor may be tested by running a small screwdriver along the governor worm, as shown in Fig. 6. Further assembly or adjustment should not be made if the governor does not run smoothly.

13. Governor gear.—The governor gear should engage the governor worm and main gear-wheel correctly. To test the running of the governor gear replace the main gear-wheel, fit the finger-plate temporarily and revolve it a few times; if the governor gear engages the governor worm or main gear-wheel too deeply, the dial will not run smoothly. The governor gear should be set as shown in Fig. 7. If satisfactory the dial should then be reassembled (see par. 30) and then adjusted.

14. Fitting and adjusting the main spring.—The main spring should be wound in the spring box, starting from the outer edge (the arrow on the spring box indicates the direction of winding). The main spring should then be tensioned, by rotating the finger-plate in a clockwise direction, until the spring is felt to tighten; the finger-plate should then be allowed to return through one complete revolution and the stop screwed down. The dial should then return through not less than one half of a complete revolution to its normal position.

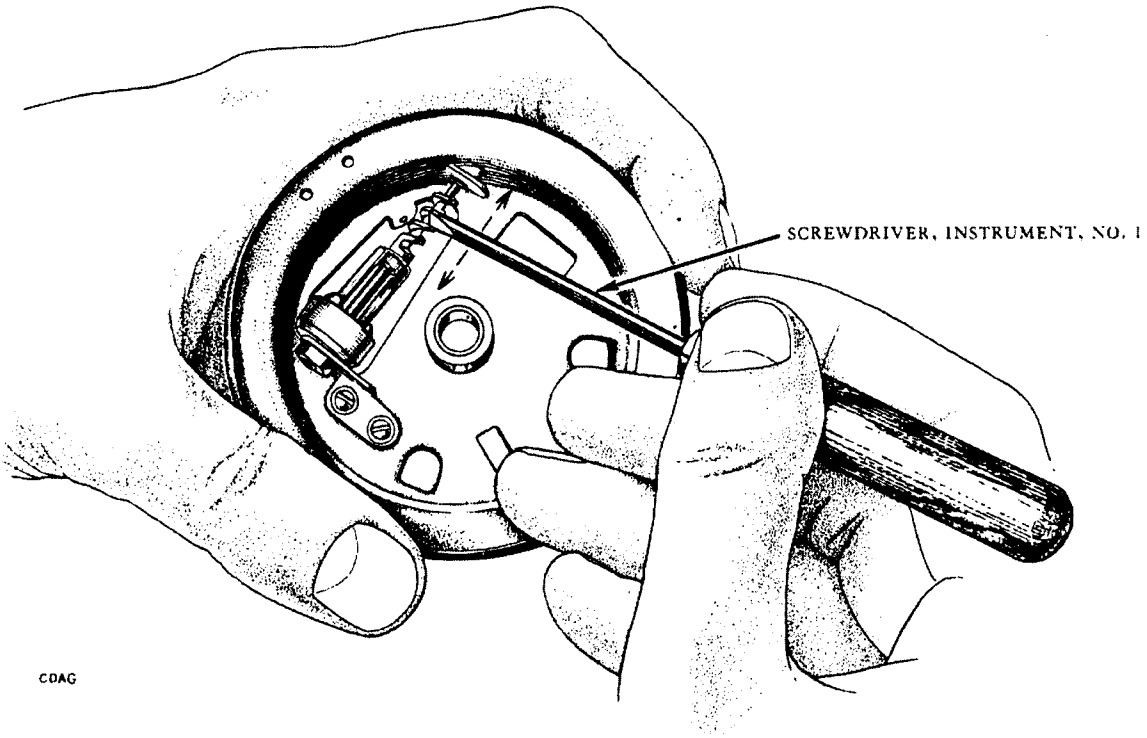

FIG. 6.—TESTING THE GOVERNOR FOR SMOOTH RUNNING

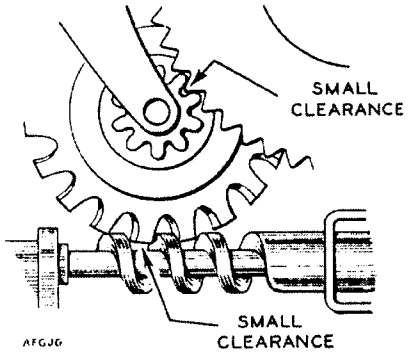

FIG. 7.—SETTING OF THE GOVERNOR GEAR

15. Trigger.

(*a*) The trigger should be free on its bearing with perceptible end-play and negligible side-shake. It should be square to the pulse wheel. The pulse spring should ride squarely on the trigger bush. (Figs. 8 and 9).

(*b*) With the finger-plate and trigger at normal, the pressure of the trigger spring on the trigger should be 29 ± 4 gm. (re-adjust), 29 ± 7 gm. (test), measured at the free end of the spring (see Fig. 8). When the dial is normal, the trigger should then rest on the pulse wheel.

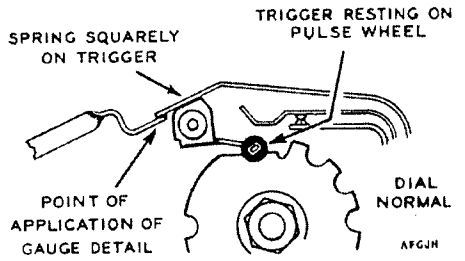

FIG. 8.—ADJUSTMENT OF TRIGGER SPRING

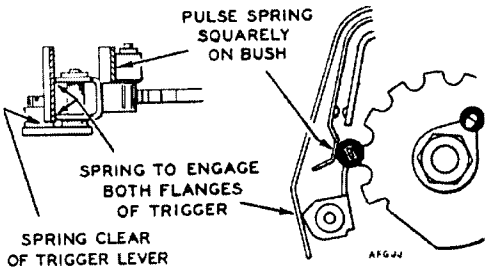

FIG. 9.

(*c*) When the finger-plate is slowly pulled from normal the trigger should engage the first tooth of the pulse wheel to a depth of 15 mils min., as judged by eye (Fig. 10).

There should be no tendency for the trigger to jump over the tooth when the finger-plate is pulled smartly from normal.

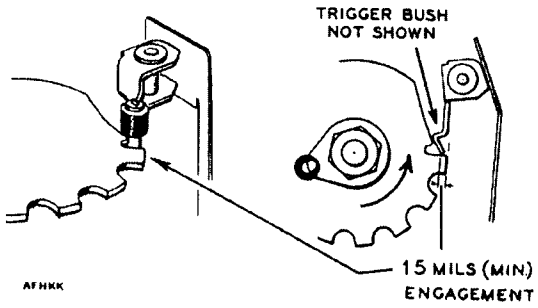

FIG. 10.—ENGAGEMENT OF TRIGGER IN 1ST STEP OF PULSE WHEEL

(*d*) When the finger-plate is pulled off normal and the trigger is in the outward position and in a recess of the pulse wheel, the trigger spring should again rest squarely along the forward flange of the trigger (Fig. 11). This will result in the trigger resting in the recesses in the pulse wheel to a depth of approximately half a tooth.

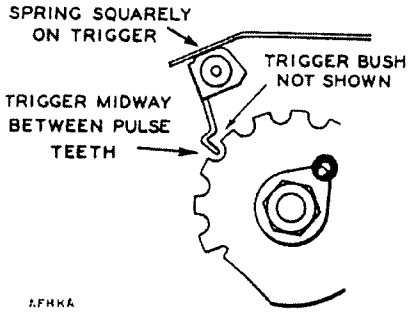

FIG. 11.—ADJUSTMENT OF TRIGGER SPRING

(*e*) When the finger-plate starts to return to normal slowly, the trigger tip must engage the approaching tooth by 20 mils minimum, as judged by eye, with no tendency to jump over the tooth (see Fig. 12).

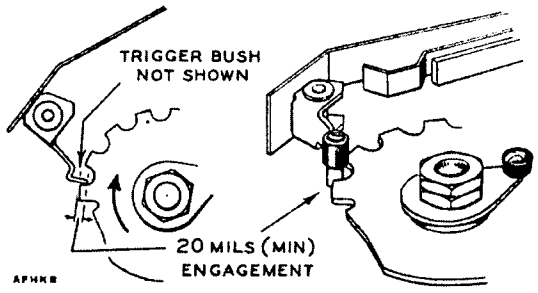

FIG. 12.—CHECKING DEPTH OF ENGAGEMENT OF TRIGGER

(*f*) If the adjustments detailed in (*a*) and (*e*) cannot be met, the trigger should be changed.

16. Pulse springs.—The adjustment of the pulse springs must not be undertaken unless a pulse ratio tester is available to check the results of the adjustment. Where a tester is available, the springs should be adjusted as follows:—

(*a*) The springs should be straight and free from kinks

(*b*) Spring 1 should be set initially so that the contact opening during the break period of a pulse is 20 mils approx. (see Fig. 13).

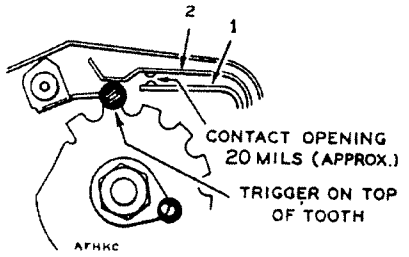

FIG. 13.—ADJUSTMENT OF PULSE SPRINGS

(*c*) Spring 2 should be tensioned to exert a pressure of 29 ± 4 gm. (re-adjust), 29 ± 7 gm. (test), on spring 1, measured at the contacts, when the dial is normal (see Fig. 14).

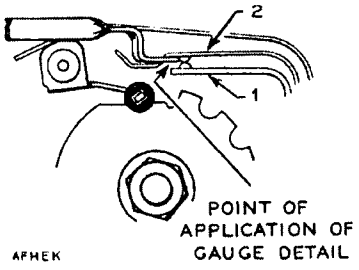

FIG. 14.

(*d*) Using Pliers, Adjusting, No. 1, spring 1 should be finally set so that the pulse contacts give a pulse ratio of 65–68% break (re-adjust), 63-70% (test). Reducing the contact opening will reduce the break period and vice versa. If the contact opening is less than 10 mils after adjustment for ratio has been made, the pulse wheel and trigger should be examined for wear.

(*e*) The adjustment of spring 2 should be re-checked after the spring 1 adjustment has been completed.

17. Switching lever and springs.

(*a*) As an initial adjustment, with the dial normal, the switching lever should be adjusted to rest at the top of the 'V' bend in the first switching-lever spring (see Fig. 15).

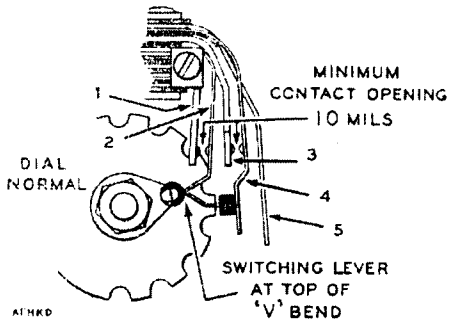

FIG. 15. INITIAL ADJUSTMENT OF SWITCHING LEVER

(*b*) When the dial is normal, the minimum contact separation should be 10 mils. When the dial is off-normal, there must be a space of approximately 20 mils between the buffer of the first lever spring and the face of the second lever spring (see Fig. 16).

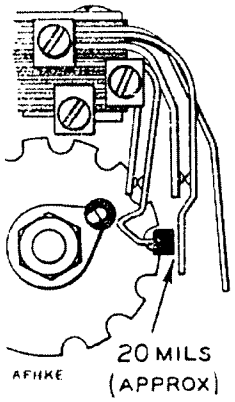

FIG. 16.—ADJUSTMENT OF SWITCHING SPRINGS

(*c*) The two lever springs (springs 2 and 4) should exert a pressure of 29 ± 4 gm. (re-adjust), 29 ± 7 gm. (test), on the contact springs (springs 1 and 3), measured with the gauge detail opposite the contacts (see Fig. 17).

(*d*) Spring 5 is a protective spring only and should be adjusted to lie approximately parallel to spring 4 when the dial is normal.

(*e*) With the switching springs and pulse springs correctly adjusted, the switching lever should be finally adjusted so that, on the return of the dial to its normal position, the insulating bush on the switching lever does not touch the first switching-lever spring until after the pulse springs have closed at the end of the last pulse (see Fig. 18).

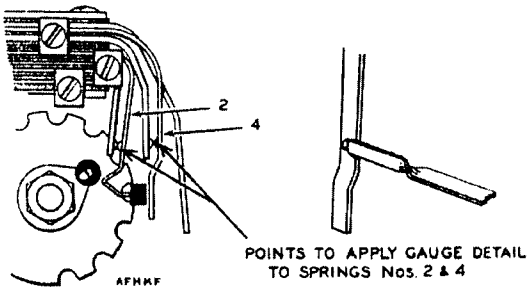

FIG. 17.—CHECKING TENSION OF SWITCHING SPRINGS

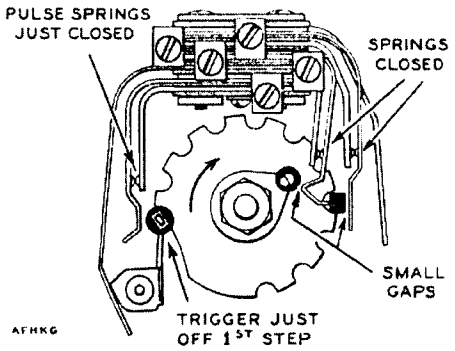

FIG. 18.—FINAL ADJUSTMENT OF SWITCHING LEVER

18. Dial speed.—The wings of the governor should be straight and free from kinks. The weights should be equidistant from the governor spindle, as near as can be judged by eye. The wings of the governor should be adjusted with Adjuster, Dial Governor, so that the speed of the dial is 10 ± 0·5 p.p.s. (re-adjust), 10 ± 1 p.p.s. (test). To increase the speed of the dial the wings should be bent inwards (see Fig. 19), and vice-versa to reduce the speed of the dial. A dial speed tester is necessary to check the results of the adjustment.

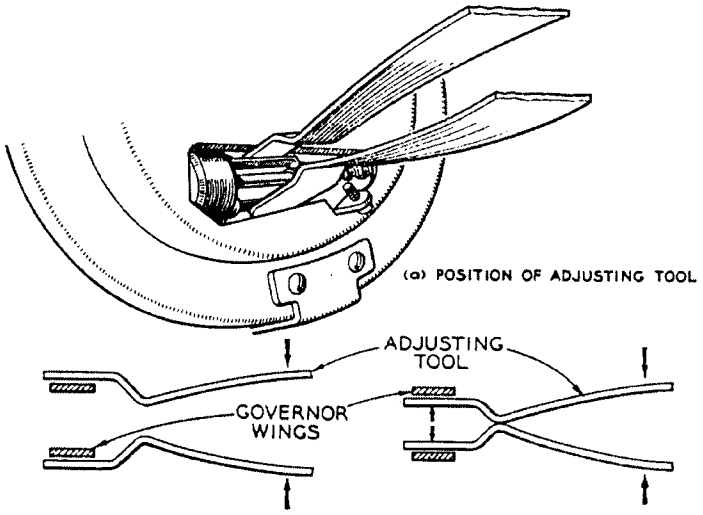

FIG. 19.—ADJUSTMENT OF DIAL SPEED

ADJUSTMENTS OF AUXILIARY CONTROL CAM AND SPRING-SET ASSEMBLY OF DIAL, AUTO., No. 13

19. A rear view of a Dial, Automatic, No. 13 showing the names of the auxiliary parts is given in Fig. 20.

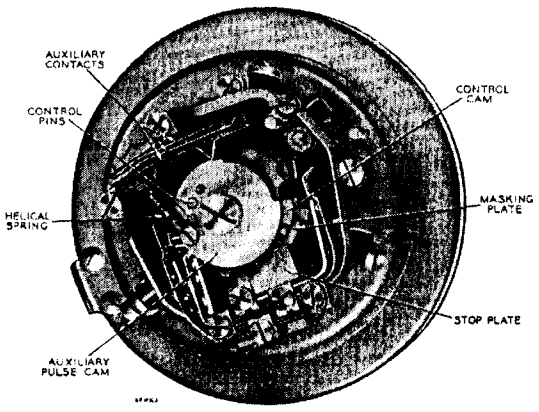

FIG. 20.—TRIGGER-TYPE DIAL FOR USE ON COIN-BOX CIRCUITS (REAR VIEW)

20. Control cam.—Check should be made for the following:—

(*a*) When the dial is normal, there should be a clearance of approx. 10 mils between the trigger bush and the control cam (see Fig. 21).

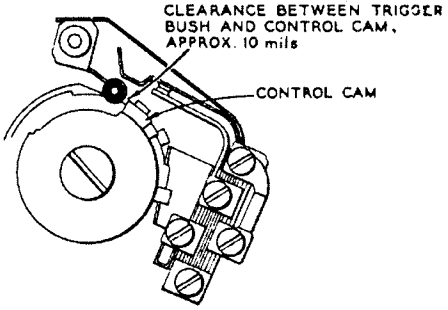

FIG. 21.—CLEARANCE BETWEEN CONTROL CAM AND TRIGGER BUSH

(*b*) The friction of the control-cam spring on the main-spindle extension should be such that, when the finger-plate is moved in either direction, the control cam follows the movement positively. If the control cam tends to stick, and the difficulty cannot be cleared by cleaning, the cam should be changed.

(*c*) The operation of the control cam should be checked by rotating the finger-plate to '9' or '0', releasing the finger-plate, and allowing the dial to pulse. During pulsing, the finger-plate should be stopped before it returns to normal and the dial re-wound. A check should be made to verify that the control cam moves under the insulating bush of the trigger to hold the pulse contacts open (see Fig. 22).

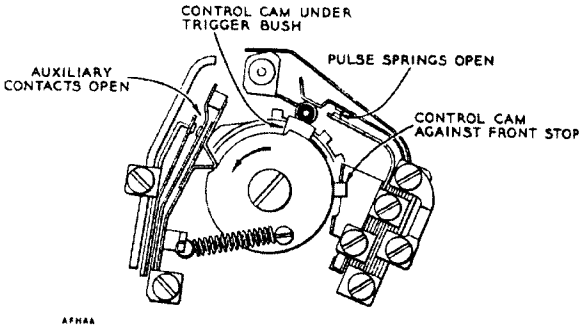

FIG. 22.—CONTROL CAM HOLDING PULSE SPRINGS OPEN

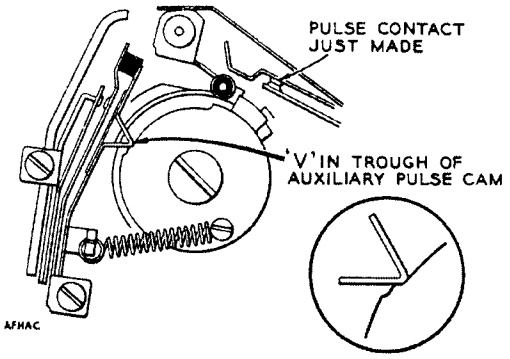

FIG. 24.—SETTING OF AUXILIARY PULSE CAM

21. Auxiliary pulse cam.

(*a*) The cam should swing freely on its bearings with a minimum amount of side-play.

(*b*) The ' V '-shaped cam follower should ride on top of the auxiliary cam when the dial is normal (see Fig. 23) at a distance of approximately 30 mils from the end of the trough in the cam.

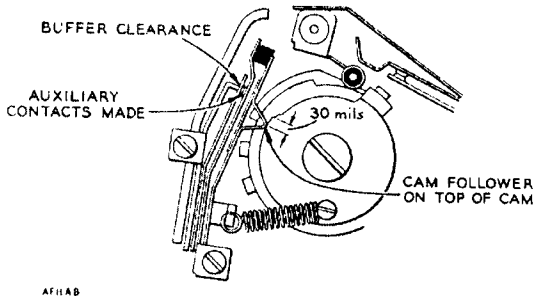

FIG. 23.—CAM-FOLLOWER ON TOP OF AUXILIARY CAM (DIAL NORMAL)

(*c*) When ' 9 ' or ' 0 ' is dialled, the switching lever should trip the auxiliary cam off-normal by contact with the control pin, immediately before the finger-plate is stopped by the finger striking the finger stop. Also, the switching lever should trip the auxiliary pulse cam back to its normal position, by contact with the control screw as the finger-plate stops on the return of the dial to normal. The auxiliary pulse cam should not allow the auxiliary-spring contacts to close until after the pulse contacts have finally closed (see Fig. 24).

(*d*) If the above conditions cannot be obtained, the position of the switching lever (par. 17) should be checked and corrected, if necessary. If difficulty is still experienced, the alignment of the auxiliary springs in the assembly may be at fault and the assembly should be changed.

22. Auxiliary springs.—The springs should be straight and free from kinks. The springs have an intentional set at the root, which should not be removed. They should be adjusted in the following manner:—

(*a*) When the dial is normal, there should be a clearance between spring 3 and its buffer.

(*b*) When the auxiliary cam is tripped off-normal, the combined inward tension of springs 1 and 2 should be such that the ' V '-shaped cam follower exerts a pressure of 4–8 gm. on the auxiliary cam, measured at the top of the 'V' bend, and spring 2 should rest on spring 1 (see Fig. 25).

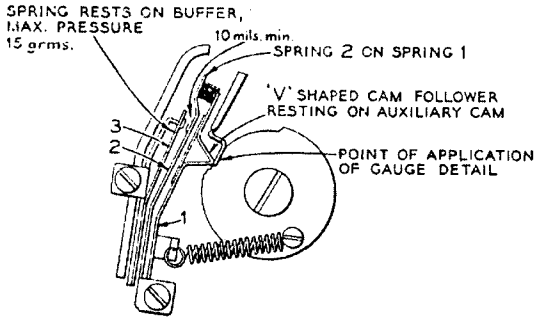

FIG. 25.—ADJUSTMENT OF AUXILIARY SPRINGS

(*c*) The contact opening between springs 2 and 3 should then be 10 mils minimum. This is adjusted by varying the position of the buffer spring (see Fig. 25).

(*d*) When the contacts are open spring 3 should exert a pressure of 9–14 gm. (re-adjust), 8–15 gm. (test), on the buffer, when measured at the end of the spring.

(*e*) When the ' V '-shaped cam follower rests on the small step of the auxiliary cam, spring 3 should be clear of the buffer (see Fig. 26).

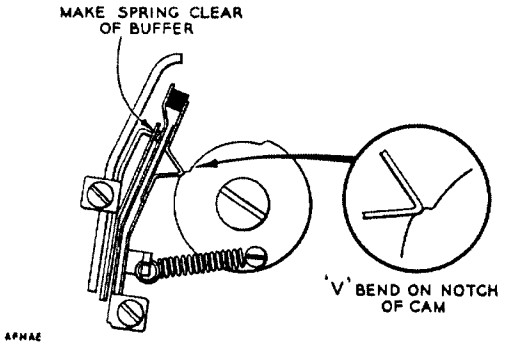

FIG. 26.—ADJUSTMENT OF AUXILIARY SPRING-SET

(*f*) The tension of the helical spring should be such that, when the dial is prepared for pulsing "9", the control cam exerts a minimum pressure of 12 gm. on the switching-lever bush, when measured at the helical spring-retaining screw (see Fig. 27). As the finger-plate starts to return

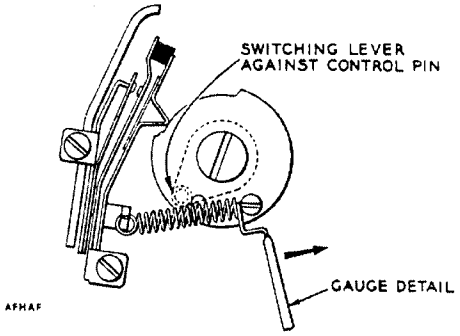

FIG. 27.

to normal, the auxiliary cam should also return until stopped by the sloping face of the cam-step resting against the 'V'-shaped cam follower (see Fig. 28).

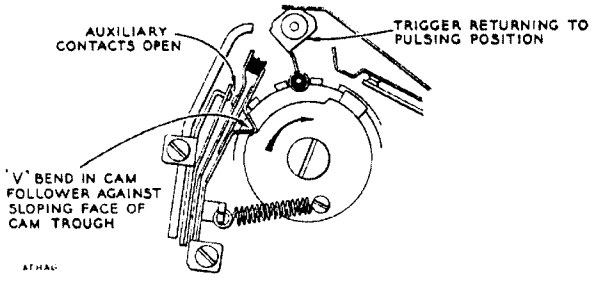

FIG. 28.

When the finger-plate has returned so far that the trigger has dropped into the first recess on the pulse wheel and the finger-plate is reoperated to prepare for pulsing of another digit, the tension of the helical spring should move the notch in the cam under the 'V'-shaped cam follower (see Fig. 29).

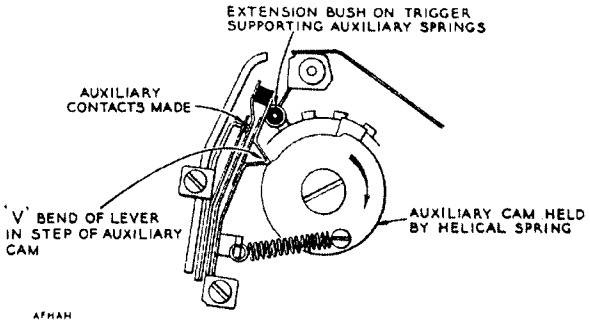

FIG. 29.

ADJUSTMENTS OF AUXILIARY SPRING-SET ASSEMBLY AND CAM OF DIAL, AUTO., No. 16

23. A rear view of a Dial, Automatic, No. 16, showing the names of the auxiliary parts, is given in Fig. 30.

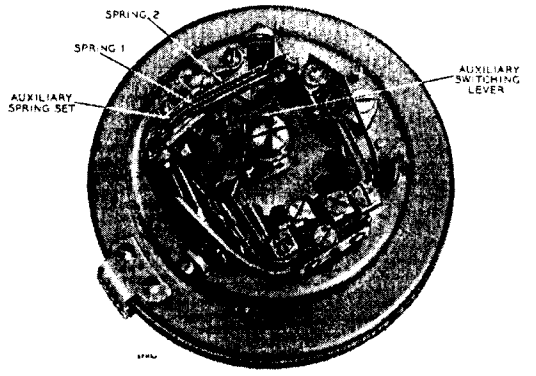

FIG. 30.—REAR VIEW OF DIAL FOR USE WITH TESTERS

24. Auxiliary switching lever.—The auxiliary switching lever should be adjusted so that, on the return of the dial to its position of rest, the insulating bush on the switching lever does not touch the lever spring of the auxiliary spring-set until after the pulsing springs have closed at the end of the last pulse.

25. Auxiliary springs.—When the dial is normal, the auxiliary contacts should be closed, and there should be a gap between the contact spring (spring 2) and its buffer of at least 2 mils. When the dial is off-normal, the minimum contact separation should be 10 mils. Spring 2 should then exert a pressure of 29 ± 4 gm. (re-adjust), 29 ± 7 (test), on its buffer, when measured at the tip of the spring.

ADJUSTMENT OF PULSE SPRINGS ON DIAL, AUTO., No. 19

26. When a dial is being adjusted on a bench:—

(*a*) The springs should be straight and free from kinks.

(*b*) Spring 1 should be set intially so that the contact gap between springs 1 and 2 is about 17 mils when the contacts are fully operated.

(*c*) Spring 2 should be tensioned to exert a pressure of 29 ± 4 gm. (re-adjust), 29 ± 7 gm. (test) on spring 1, measured at the contact when the dial is normal.

(*d*) Using Pliers, Adjusting, No. 1, spring 1 should be finally set so that the contacts on springs 1 and 2 give a pulse ratio of 63–67% break (re-adjust), 61–69% (test). Reducing the contact opening will reduce the break period, and vice versa.

(*e*) The adjustment of spring 2 should be re-checked after the spring 1 adjustment has been completed.

(*f*) Spring 3 should be tensioned so that it exerts a pressure of 29 ± 4 gm. (re-adjust), 29 ± 7 gm. (test) against the buffer measured at the contact when the dial is normal.

(*g*) Spring 3 should be finally set so that the contacts on springs 2 and 3 give a pulse ratio of 41–45% break (re-adjust), 39–47% (test).

(*h*) The movement of spring 3 should be checked to see that it lifts from the buffer block when the contacts are operated.

(*j*) If the gap between the contacts on springs 2 and 3 is less than 8 mils with the dial normal, examine the the pulse wheel and trigger for wear.

27. When a dial is being adjusted *in situ*:—

(*a*) The springs should be straight and free from kinks.

(*b*) Spring 2 should be tensioned to exert a pressure of 29 ± 4 gm. (re-adjust), 29 ± 7 gm. (test) on spring 1, measured at the contacts when they are normal.

(*c*) Spring 1 should be set so that there is a gap of 16–18 mils between the contacts on springs 1 and 2 when the springs are fully operated.

(*d*) Spring 3 should be tensioned so that it exerts a pressure of 29 ± 4 gm. (re-adjust), 29 ± 7 gm. (test) against the buffer, measured at the contact with the dial normal.

(*e*) Spring 3 should be set so that there is a gap of 8–10 mils between the contacts on springs 2 and 3 when the dial is normal.

(*f*) The movement of spring 3 should be checked to see that it lifts from the buffer block when the contacts are operated.

After adjustment as above, a test of the dial must be made with the tesk desk at the switching centre to confirm that the speed and ratio of the dial are within acceptable limits. Any dial which fails to meet the limits after adjustment in accordance with this Instruction should be maintenance-exchanged.

SPECIAL DIALS

28. Dials with special speed and pulse ratio. Special dials are used for certain testers. The special speeds are obtained with the standard governor mechanism specially adjusted. The required pulse ratios are obtained by special pulse wheels. These special dials have the percentage break period engraved on the finger-plate (see Fig. 31).

The 'test' and 're-adjust' limits for these dials are shown in the following table:—

Dial, Auto., No.	Speed p.p.s.		Ratio % break	
	Test	Re-adjust	Test	Re-adjust
15FT3	11·75±0·5	11·75±0·5	76—80	77—79
15FT4	11·75±0·5	11·75±0·5	48—52	49—51
16FT3	11·75±0·5	11·75±0·5	76—80	77—79
16FT4	11·75±0·5	11·75±0·5	48—52	49—51

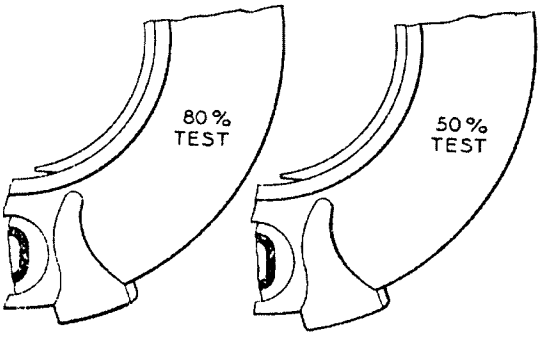

FIG. 31.—MARKING OF DIALS, AUTO., No. 15FT.... AND No. 16FT.

DISMANTLING AND ASSEMBLY

29. Dismantling.—The order in which the parts should be dismantled is as indicated below:—

(*a*) Remove the spring-set assembly
(*b*) Remove the forked stop-plate
(*c*) Remove the auxiliary spring-set assembly and helical spring
(*d*) Remove the securing screw of the auxiliary pulse-control cam
(*e*) Remove the auxiliary pulse-control cam
(*f*) Remove the control cam

} Dials, Auto., No. 13 .... only

(*g*) Remove the securing ring and celluloid protector
(*h*) Remove the label
(*j*) Remove the finger plate
(*k*) Remove the finger stop
(*l*) Remove the number ring
(*m*) Withdraw the stop screw and allow the dial to revolve until the main spring is unwound
(*n*) Remove the hexagon lock-nut and clamping nut or, on Dials, Auto., No. 13, the spindle for the auxiliary-pulse cam
(*o*) Remove the switching lever
(*p*) Remove the spacing washer (and masking washer on " Dials, Auto., No. 13 ")
(*q*) Remove the pulse wheel
(*r*) Remove the spacing washer and spring box with the spring enclosed
(*s*) Remove the governor-gear bracket, stop plate and governor-gear assembly
(*t*) Remove the governor cup and bracket and governor-pivot bearing.

30. Assembly.—The order in which the parts should be reassembled is detailed below. The parts referred to in par. 8 should be lubricated during assembly.
(*a*) Replace the finger plate and label holder to the main spindle
(*b*) Replace the governor cup, the bracket, and the pivot bearing, and adjust the governor for free running
(*c*) Replace the governor-gear assembly, complete with bracket and stop plate, and adjust for smooth running
(*d*) Replace the spring box and main spring
(*e*) Replace the main-spindle assembly, so that the keyway in the spindle engages the keyway of the spring box
(*f*) Replace the washer and pulse wheel to engage the keyway, checking that the pulse wheel has the code marking uppermost
(*g*) Replace the masking washer. Take care to ensure that the gap in the masking plate exposes the first pulse tooth
(*h*) Replace the spacing washer
(*j*) Replace the switching lever
(*k*) Replace the lock-nuts, or extension spindle on Dials, Auto., No. 13
(*l*) Replace the control cam
(*m*) Replace the auxiliary pulse cam
(*n*) Replace the retaining screw for the pulse cam
} For Dials, Auto., No. 13 only
(*o*) Replace the number ring and its securing spring. See that the holes in the number ring are opposite the finger-stop fixing holes. If this is not done, damage may be caused to the number ring when the finger-stop screws are replaced. Adjust the tension of the main spring
(*p*) Replace the finger stop
(*q*) Replace the trigger assembly, making sure that it swings freely with perceptible end-play, but negligible side-shake
(*r*) Replace the forked stop so that the narrow projection on the control cam moves between the arms of the forked stop
(*s*) Replace the auxiliary spring-sets. If any portion of a spring-set is damaged, the complete spring-set should be replaced, in preference to changing individual parts
(*t*) Replace the helical spring
(*u*) Replace the main spring-set assembly
(*v*) Replace the label with the lettering horizontal when the dial is in its normal position
(*w*) Replace the celluloid protector and the securing ring.
All screws and nuts should be tight. They should not be damaged or mutilated in any manner.

TOOLS

31. Tools and their uses are described in Table 1. The tools should only be used for the purpose for which they are intended. A tool which is in such a condition that screws, nuts, or springs would be damaged by its use should not be used. The tool, if damaged or faulty, should be changed.

TABLE 1

Rate Book description	General description and use
Adjuster, Dial Governor	Tweezers for adjusting dial speed
Screwdriver, Instrument, No. 1	Screwdriver for general use
Screwdriver, Instrument, No. 2	Screwdriver for auxiliary-pulse-cam retaining screw
Pliers, Adjusting, No. 1	Bent duckbill pliers for general adjustment of springs
Pliers, Adjusting, No. 5	Taper-nosed pliers for general adjustment of springs
Spanner, Flat, No. 2	Spanner, for switching-lever securing nuts
Gauges, Feeler, No. 1	Feeler gauges, for general use
Gauges, Tension, No. 1	Pressure gauges, for measuring spring pressures
Gauges, Tension, No. 2	Pressure gauges, for measuring spring pressures

References:—B 1003, B 5002, B 5003, B 5004
(Tp2/8)

END