

[Maintenance Adjustment Instruction (M.A.I.) No. 56]

★[NOTE:—As this Instruction has been completely revised, individual paragraphs have not been “starred”]

(E) ROTARY ADJUSTMENTS

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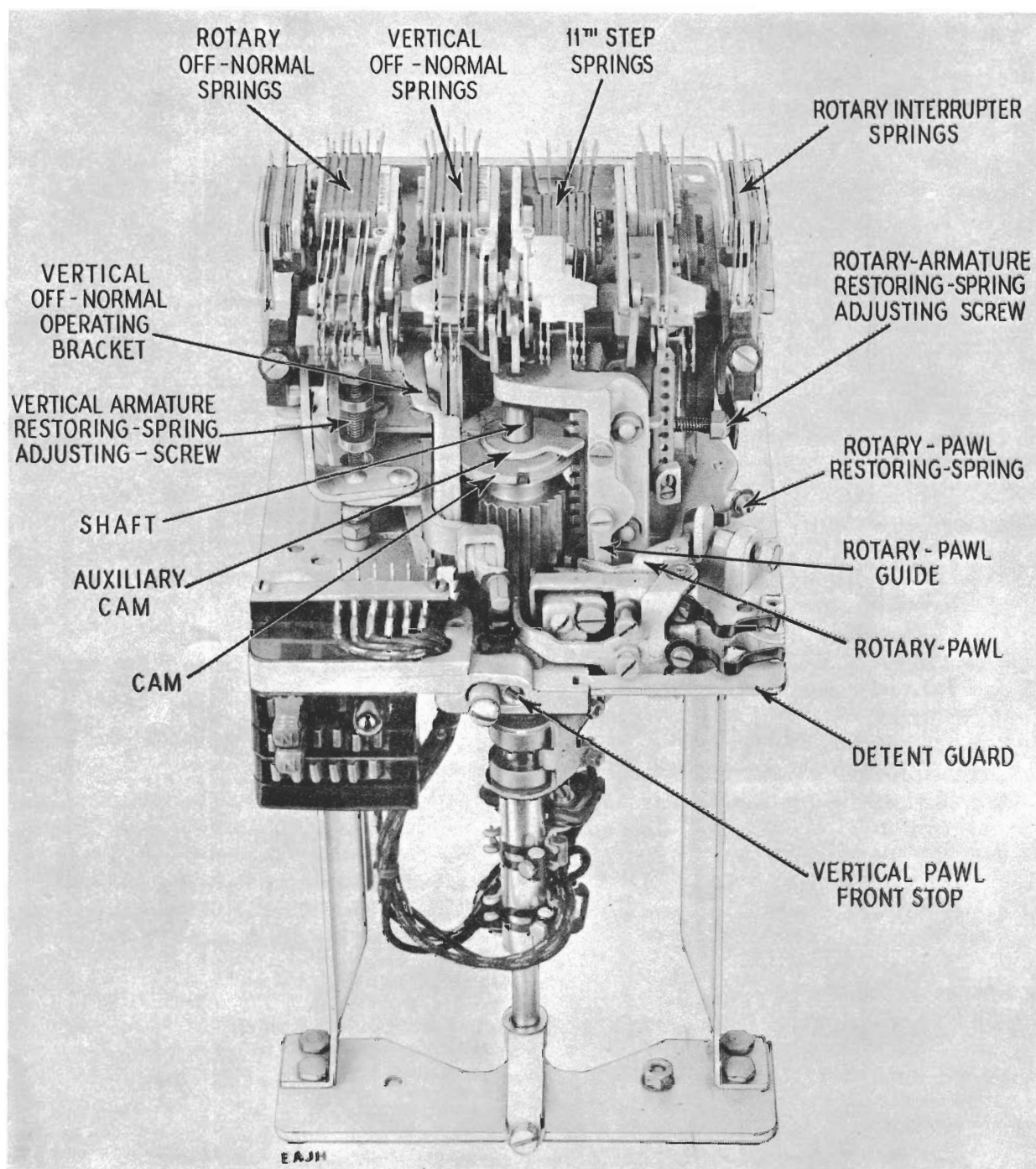


FIG. 1

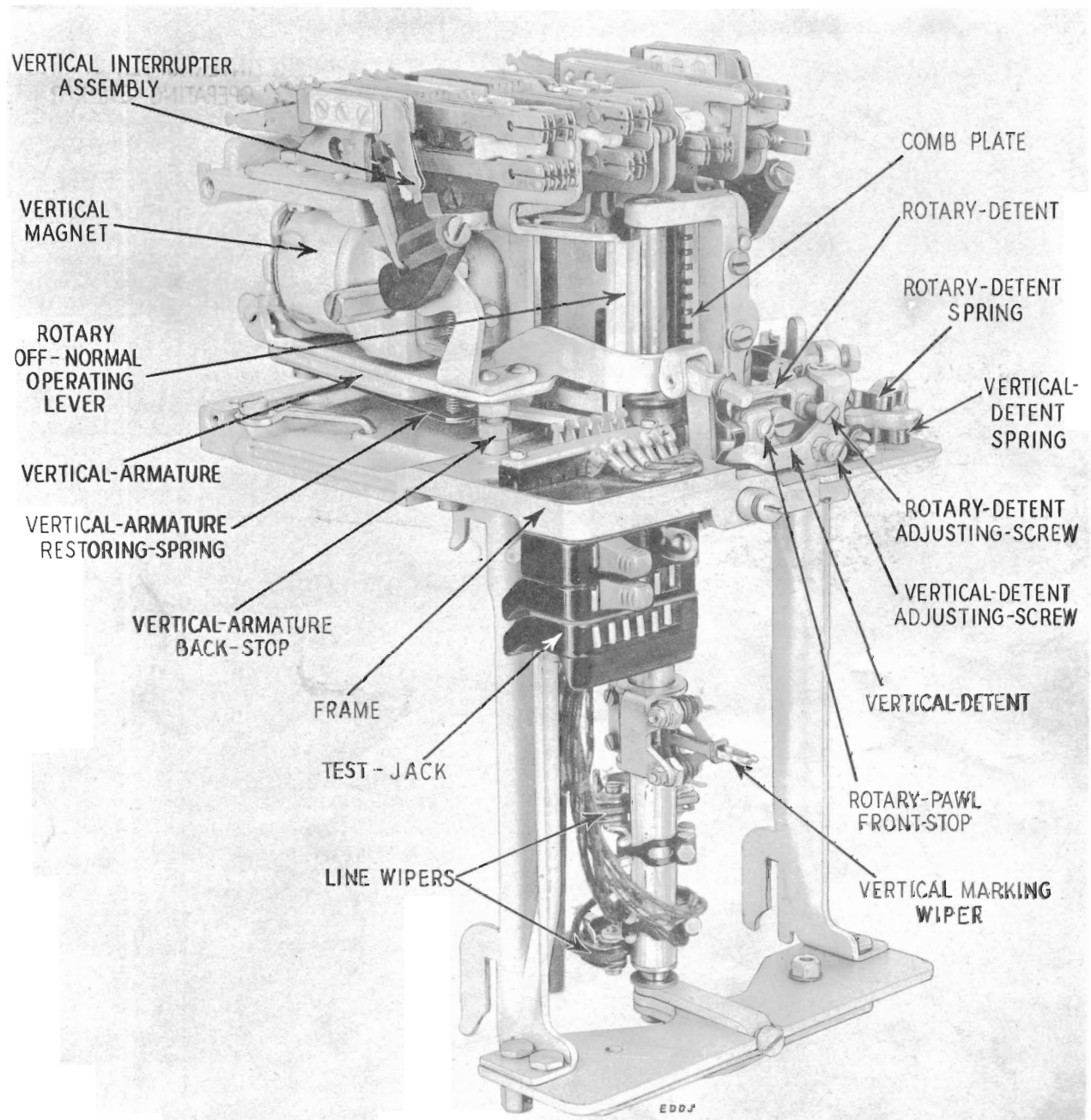


FIG. 2

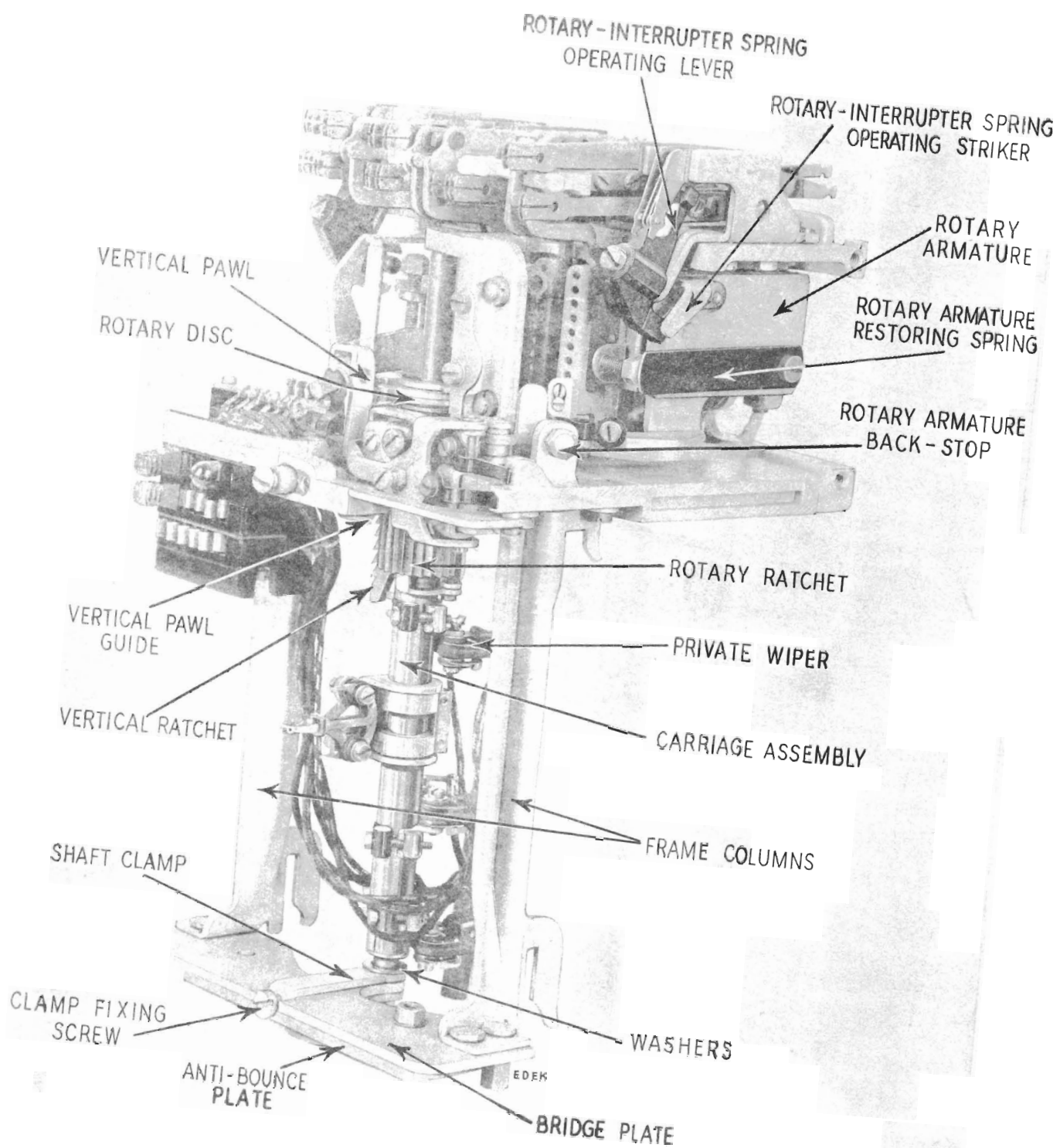


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2. Introduction.—This Instruction details the adjustments of the 2000-type two-motion selector mechanism.

3. This selector differs in principle of operation and constructional detail from all pre-2000-type mechanisms. The mechanism operates on the 'rectangular' principle, and a separate release magnet is not required. The shaft is fixed, and the carriage assembly — which carries the wipers — operates on it. The carriage assembly is stepped in the vertical and rotary directions against the tension of a coiled spring, located between the shaft and the carriage assembly. The release of the selector is effected by reconnecting the rotary magnet and thus rotating the carriage assembly in the forward direction until the 12th rotary position is reached. The carriage assembly thus leaves the bank at the right-hand side, drops vertically, and then restores horizontally (under the influence of the coiled spring) on what is known as the 'normal level' situated below level 1. It should be noted that if a selector steps in the vertical direction, it must rotate before release and subsequent use of the selector can take place.

4. The mechanism fits into a cradle and bank assembly consisting of a multiple of two or more bank-contact units of 220 points each: if necessary, the mechanism (complete with relay-set) may be jacked-out from this assembly and taken to a bench for adjustments. General views of the selector, showing the names of the parts, are given in Figs. 1, 2 and 3.

5. Test jacks.—The numbering of test jacks is shown in Fig. 4.

MECHANISM ADJUSTMENTS

(A) GENERAL

6. Major adjustments and replacements.—When it is necessary to make major adjustments or replacements, the selector should be removed from the shelf and placed on a bench or testing stand for adjustment. Vertical and rotary detents, and vertical and rotary armatures, are matched with their associated bearing-pins. When any part of these assemblies becomes faulty, the complete assembly should be changed.

7. Handling of selectors.—When handling the selectors, care should be taken not to place undue strain on the bridge plate; *selectors should never be lifted by the bridge plate or frame columns only.*

8. Removal of a selector from the shelf.—When a selector is to be removed from the shelf, it should first be busied by moving the red test-link from test jacks Nos. 13 and 14 to test jacks Nos. 7 and 8. The green test-link should then be withdrawn from test jacks Nos. 11 and 12, so as to disconnect the

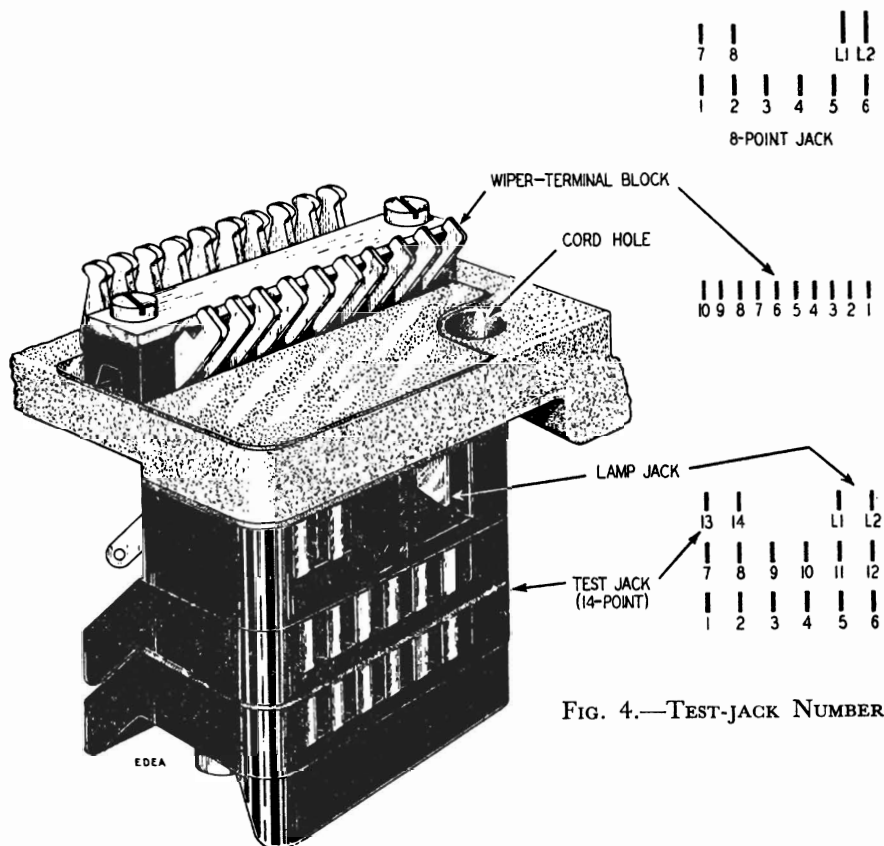


FIG. 4.—TEST-JACK NUMBERING

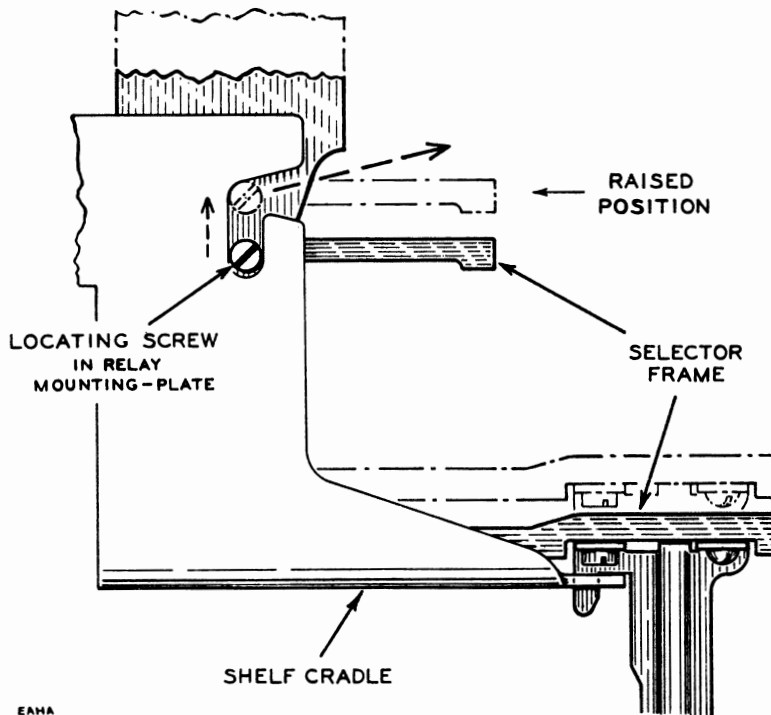


FIG. 5.—REMOVAL OF SELECTOR FROM CRADLE

rotary circuit and thus obviate the possibility of wipers rotating during the removal of the selector. If the selector is fitted with a vertical-marking wiper, the vertical-marking bank should next be swung clear of the wiper (see Fig. 138) and locked by the ball engaging the rear hole in the mounting bracket. The selector should then be gripped firmly alongside the shaft clamp at the bottom of the carriage and by the top cover-guide, and be pushed upwards with a steady pressure until the locating screws in the relay-mounting plate strike the tops of the slots in the shelf cradle (see Fig. 5): the selector should then be lifted forward until it is *just* clear of the slots, and then upwards until clear of the bank. Care should be taken not to swing the

selector too far forward, otherwise damage to the bank-engaging fork at the bottom of the frame columns will result.

9. Replacement of a selector on the shelf.—

When a selector is to be replaced on the shelf, it should first be checked that—

- (a) the red test-link is in test jacks Nos. 7 and 8 and the green test-link has *not* been replaced in test jacks Nos. 11 and 12, and
- (b) the wiper carriage is normal.

Before replacing the selector, the vertical-marking wiper (if one is fitted) should be swung to the front of the carriage so as to avoid the possibility of fouling the line- and P-banks.

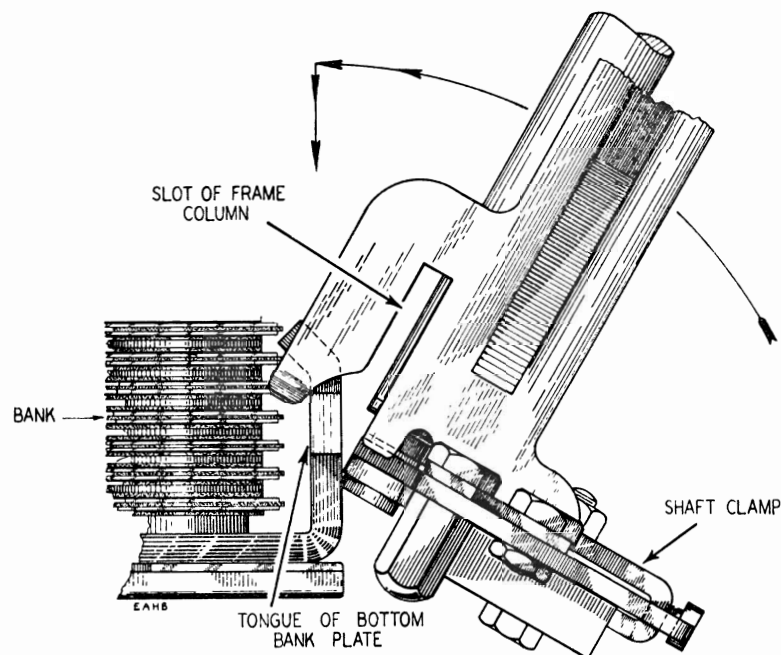


FIG. 6.—REPLACEMENT OF SELECTOR

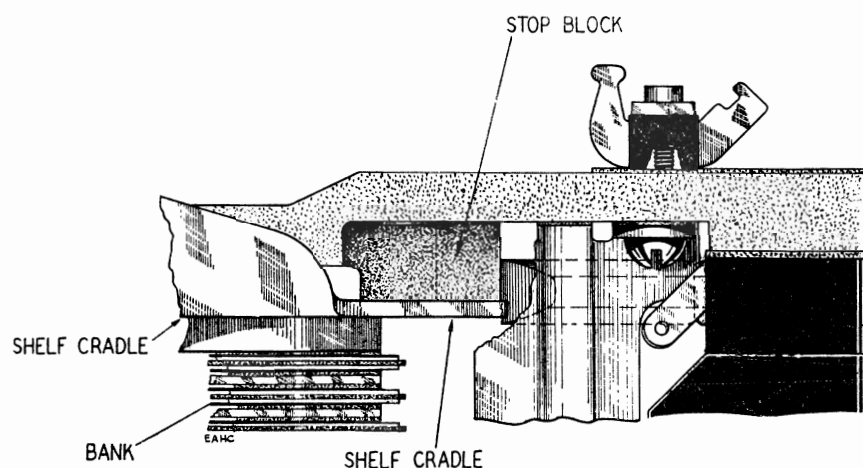


FIG. 7.—LOCATION OF SELECTOR ON CRADLE

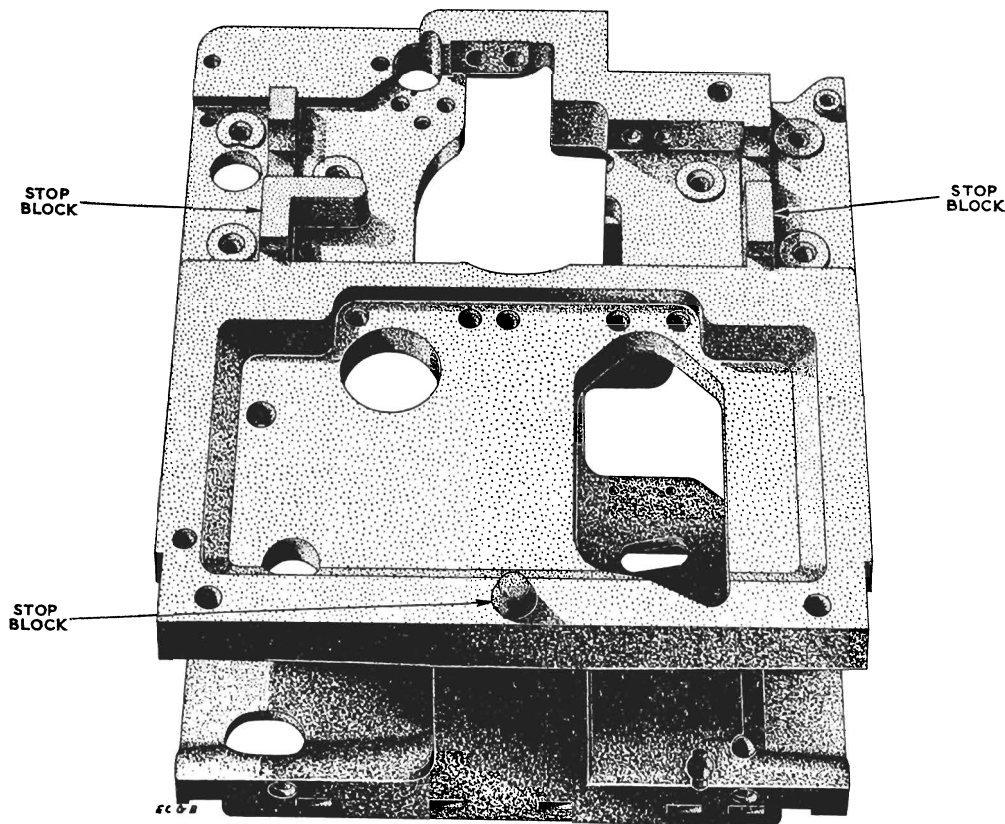


FIG. 8.—UNDERSIDE OF FRAME, SHOWING STOP BLOCKS

To replace the selector, the slots in the frame columns should be placed over the tongues on the bottom bank plate as shown in Fig. 6. The selector should then be hinged towards the shelf, so that the locating screws in the relay-mounting plate engage the slots in the shelf cradle, and then lowered into the shelf jack. The selector should slide down easily into position without straining the frame columns over the bottom bank-plate guides. The position of the selector should be such that it is located by the stop blocks on the underside of the frame resting fully on the cradle (see Figs. 7 and 8). To restore the selector into service, the test links should be returned to their normal positions.

10. Minor adjustments

(a) When it is necessary to make minor adjustments to a selector mounted in position on the rack, the selector should be busied in the manner described in par. 8 throughout the period that it is withdrawn from service. The green test-link should also be withdrawn if necessary.

(b) Care should be taken not to cause interference to subscribers engaged in conversation on outlets from the banks or to disengaged subscribers, due to the application of ringing currents to line via the bank

multiple. To prevent these conditions, an appropriate circuit contact should be insulated with a contact insulator, to prevent the wiper-switching relay operating.

(c) When the mechanism has been operated *by hand*, care should be taken to ensure that the armatures are resting on their back stops, and that the interrupters are resting at normal before the selector is restored to service.

11. Friction-locked adjusting screws.—The vertical- and rotary-pawl front stops, and the adjusting screws for the vertical- and rotary-armature restoring springs, are friction-locked and are only intended to be held, by friction, tight enough not to move in use.

(a) *Pawl front stops.*—The frictional locking of the vertical- and rotary-pawl front stops is obtained by a clamp plate and locking screw, as shown in Fig. 9.

(b) *Armature restoring-spring adjusting screws.*—To reset an armature restoring-spring adjusting screw, the screw should first be removed and the brackets be set outwards, so that the threads are thrown out of pitch. When the adjusting screw is reinserted, the brackets are sprung inwards until the threads are in

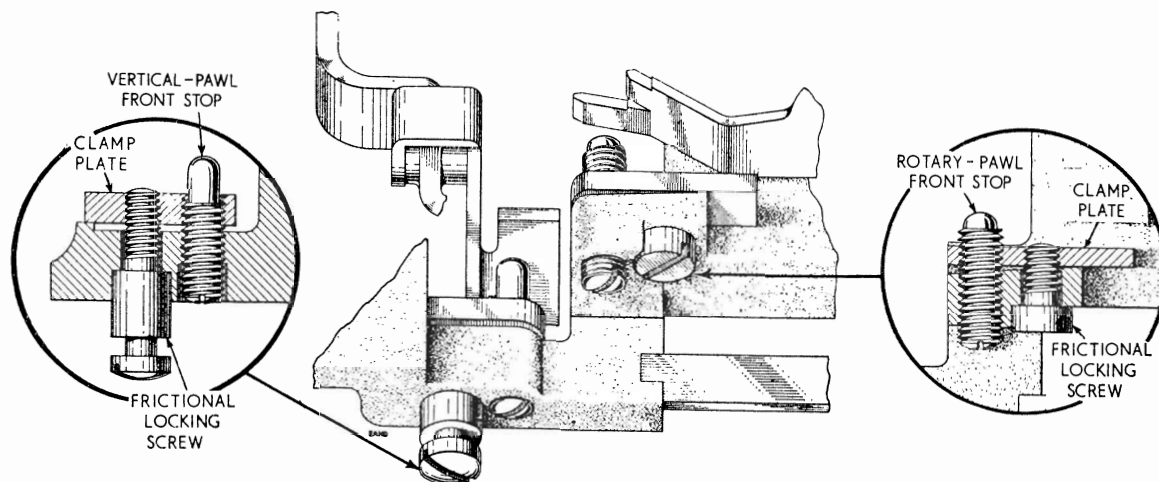


FIG. 9.—FRICTIONAL LOCKING OF VERTICAL- AND ROTARY-PAWL FRONT STOPS

pitch and the screw is held friction tight by the outward tension of the bracket.

(c) *Detent-adjusting screws.*—On early selectors, the vertical- and rotary-detent adjusting screws are also retained by friction, and it has been found in practice that there is some tendency for these screws to become loose. When such screws are discovered, lock nuts should be fitted. Lock nuts can be obtained from the Supplies Dept., using the designation "Nuts, Locking, Hex., Ord., M.S., Zn.P., No. 6BA." It may be found that, when fitting a lock nut to the vertical-detent adjusting screw, the screw is too short to enable the correct adjustment to be obtained; a "Screw, M.S., Zn.P., No. 6BA, $\frac{3}{8}$ -in., Ch. Hd." should then be fitted. These screws also may be obtained on requisition. On later selectors, lock nuts are fitted.

12. Fixing screws, nuts and residual plates.

(a) All fixing screws and nuts should be tight. *It is necessary, however, that care be exercised when turning screws which are tapped into the selector frame.* This is because the frame is produced by die-casting, which imposes certain limitations on the mechanical characteristics of the metal. Care is most necessary when re-inserting screws which have been withdrawn completely (e.g., replacing the fixing screws after changing a spring-set), to ensure that they are not cross-threaded, as this will cause the thread in the frame to be badly damaged.

(b) The residual plates on the vertical and rotary magnets should lie flat on the core faces.

13. Method of tensioning pawl and detent springs.—The tension of the pawl and detent springs can be varied as described in (a) and (b).

(a) *To increase the tension,* the fixing screw should be loosened just sufficiently to enable the spring to be turned away from its stop to a position where it can be levered free from obstruction. The spring can then be given a set at its root, by gently levering in the direction in which it normally exerts its tension.

The spring should then be restored to its stop and the fixing screws re-tightened.

(b) *Tension can be decreased,* by gently levering the spring away from its stop; the fixing screw need not be loosened for this. The spring should be levered away from the stop, using a small screwdriver inserted under the tip of the spring. If the spring has become distorted it should be changed. The tensions to which the springs should be adjusted are specified in the paragraphs relating to the vertical- and rotary-pawl and detent springs.

14. Adjustment tolerances.—'Test' and 're-adjust' values are quoted in this Instruction wherever a sufficient margin of safety is available.

(a) *Test values.*—These values represent the limits of adjustment within which reliable operation of the mechanism is ensured. A selector requires re-adjustment if any of its adjustments are proved to be outside the range of these values.

(b) *Re-adjust values.*—These values represent closer limits of adjustment than those provided by the test values. A selector adjusted to these values will have a greater factor of safety and should not need attention as frequently as a selector adjusted to the limits of the test values.

Whenever a selector requires re-adjustment, the re-adjust values should be used.

15. Sequence of adjustments.—The adjustments contained in this Instruction have been arranged in the correct sequence to apply both to normal re-adjustments and to re-adjustments following the complete dismantling and reassembly of a selector. Certain adjustments are interdependent, however, and if, in making a particular adjustment, it is impossible to avoid affecting another, an appropriate check is included in the paragraph concerned. When re-adjust values are not quoted, the mean figures should be aimed at.

16. Anti-bounce device.—The anti-bounce device should be secured to the bridge plate so that the projecting stud is approximately central in the hole in the plate (see Fig. 10). The anti-bounce plate should normally lie flat on the bridge plate. Deviations are permissible providing that the anti-bounce plate is in contact with the bridge plate at a point within $\frac{1}{8}$ in. of the shaft axis. Any gap between the anti-bounce plate and the bridge plate at the extreme free end should not exceed 20 mils.

(B) SHAFT AND WIPER-CARRIAGE ASSEMBLY

17. Shaft.—The shaft should be located in its conical seating so that there is no side play (see Fig. 11). If this condition is not complied with, reference should be made to par. 19.

18. Carriage assembly.—The carriage assembly should be free on the shaft when raised or lowered in the 12th rotary position. The side play, if any, should be only just perceptible.

19. Carriage-restoring spring.—The carriage-restoring spring should be tensioned so that, when the carriage is in the 11th rotary position on the normal level, it resists the following pressure applied to the tip of the wiper:—

- (a) Selectors fitted with Type I spring-sets: 50 - 60 gm.
- (b) Selectors fitted with Type II spring-sets: 45 - 60 gm.

As a guide to the number of turns of the carriage-restoring spring required to fulfil the above conditions the following approximate tension in grammes per turn will be useful:—

- 2-bank selectors: 20 gm.
- 3-4 „ „ 10 gm.

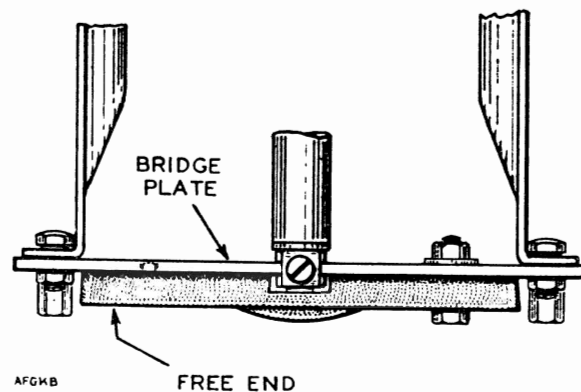


FIG. 10

The tension may be applied by lifting the carriage assembly to the ninth vertical position, loosening the clamp-fixing screw at the base of the carriage assembly, gripping the bottom of the shaft with the thumb and finger of the right hand, and rotating the shaft in an anti-clockwise direction (viewed from the top). The shaft should then be pushed firmly upwards from the bottom with the first finger of the left hand; at the same time, the shaft clamp should be pressed down with the thumb. The clamp-fixing screw should then be re-tightened (see Fig. 12). After adjustment, a check should be made to confirm that the hub assembly returns to normal with certainty when released from the 8th position in the normal level.

NOTE.—The drilling mark in the shaft will be seen immediately in front of the mechanism (see Fig. 11), when the carriage assembly is free and there is no tension in the restoring spring.

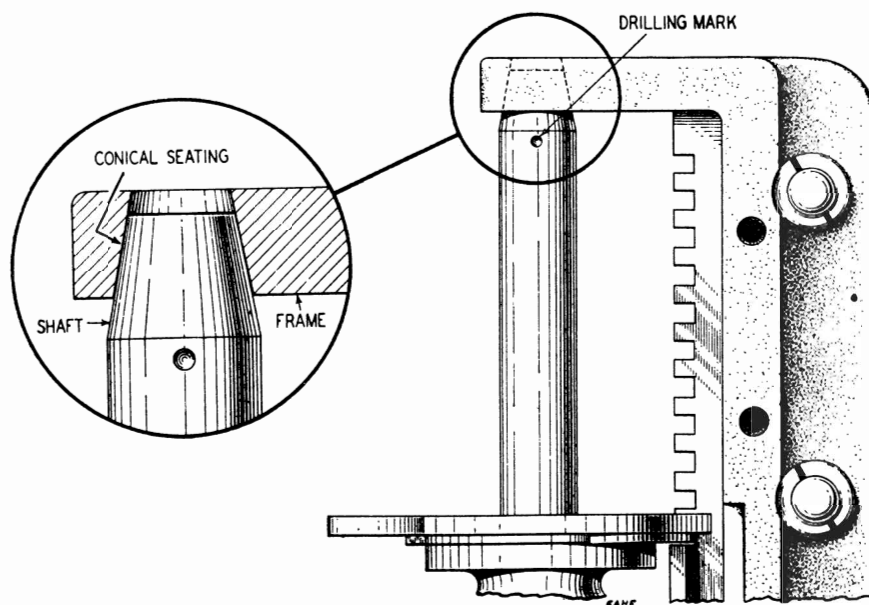


FIG. 11.—LOCATION OF SHAFT IN CONICAL SEATING

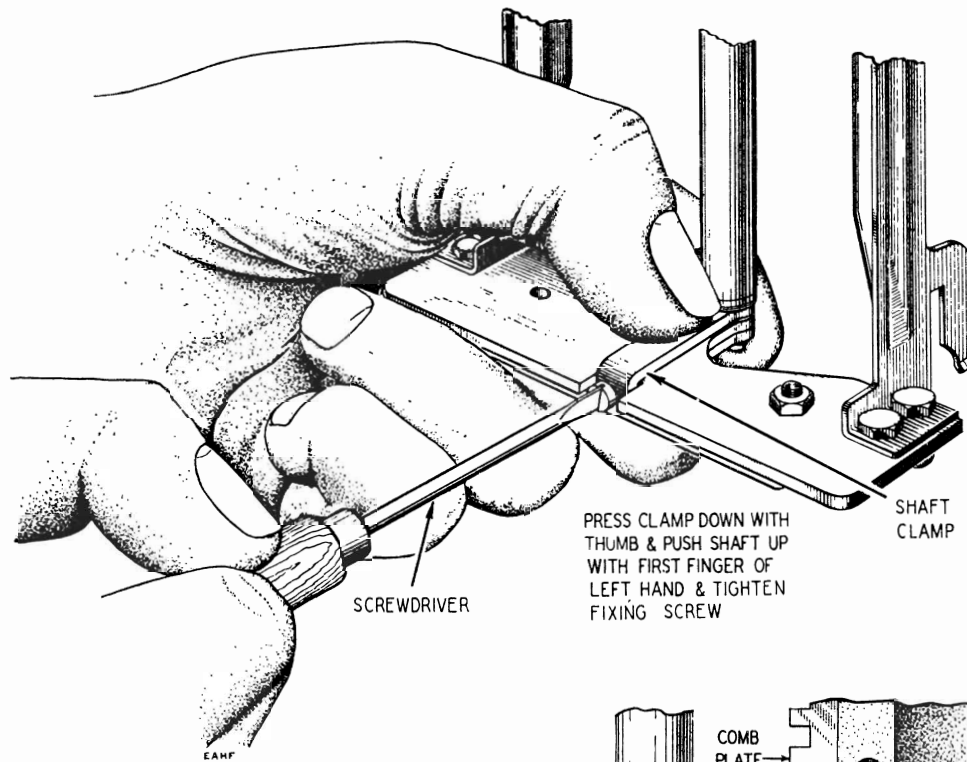


FIG. 12.—CLAMPING OF SHAFT

20. Shaft-clamp adjusting screw.—The shaft-clamp adjusting screw at the bottom of the shaft clamp should be adjusted so that the weight of the carriage when at normal and when returning in the normal level (see Fig. 13) is taken by the clamp, and not by the extended lug at the bottom of the comb plate. To obtain this adjustment, the clamp-fixing and clamp-adjusting screws should first be loosened and the clamp-adjusting screw withdrawn, and the clamp should then be pushed down to its lowest position, care being taken not to disturb the adjustment of the carriage-restoring spring. The clamp-fixing screw should then be tightened. The clamp-adjusting screw should next be screwed in, so that the carriage is raised until there is a clearance of 5–10 mils (3 mils min. 'test') between the extended lug on the comb plate and the rotary disk. The

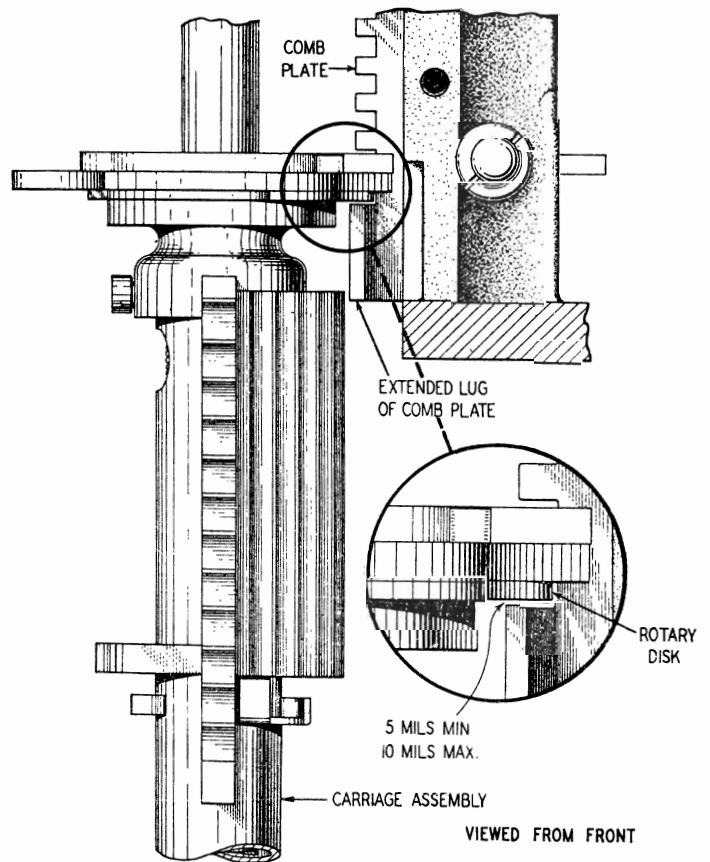


FIG. 13.—ADJUSTMENT OF SHAFT CLAMP

clamp-adjusting screw should then be locked by means of the lock nut and the clamp-fixing screw should be securely tightened. Re-check the extended lug on the comb plate and the rotary disk clearance. It should be checked that the rotary disk is clear of the top face of the bottom comb slot when the carriage is returning on the normal level (see Fig. 14).

(C) DETENT ADJUSTMENTS

21. Vertical- and rotary-detent bearings.—

The vertical and rotary detents should be free on their bearings without vertical play. The vertical play in the bearings can be taken up, by loosening the bracket-clamp screw, pushing the pin downwards, and tightening the screw (see Fig. 15). The side play, if any, should be only just perceptible: if the side play is excessive, the complete detent assembly should be changed.

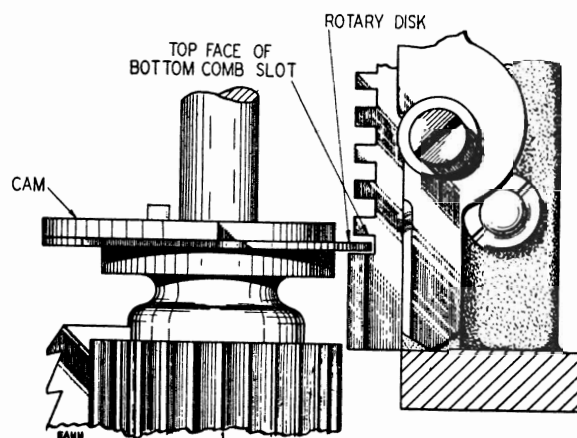


FIG. 14.—CHECK FOR CLEARANCE BETWEEN TOP FACE OF BOTTOM COMB SLOT AND ROTARY DISK, CARRIAGE RETURNING ON NORMAL LEVEL

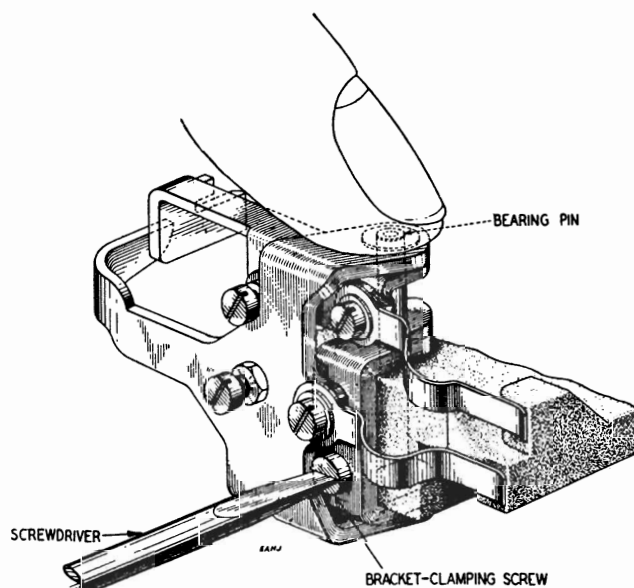


FIG. 15.—TAKING UP VERTICAL PLAY IN DETENTS

22. Vertical detent.—The vertical detent adjustments, consisting of two bending adjustments and one screw adjustment, should be made as detailed in either (a), (b) and (d), or (a), (c) and (d), according to the type of rotary disk fitted on the selector. The weight of the carriage is taken by the vertical detent during vertical motion only. When the carriage is rotated, the rotary disk enters the comb slot and the vertical ratchet leaves the vertical detent; the weight of the carriage is thus transferred from the vertical detent to the comb plate. On early-sample selectors, the entering edge of the rotary disk is cut square (see

Fig. 16) and, to prevent the comb plate obstructing the rotary disk on entry, the detent should be adjusted as outlined in (b). On later selectors the entering edge of the rotary disk has been chamfered (see Fig. 17), and presents a leading edge to the comb plate. The adjustment for this condition is outlined in (c).

(a) *Both types of rotary disk.*—The carriage assembly should be raised to the fifth level, and the tip of the detent bent sideways so that it is in full engagement with the left-hand side of the vertical ratchet (see Fig. 18).

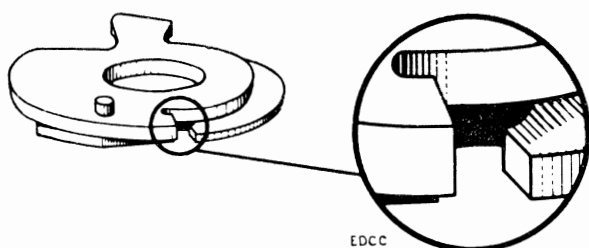


FIG. 16.—ROTARY DISK WITH SQUARE-CUT ENTERING EDGE

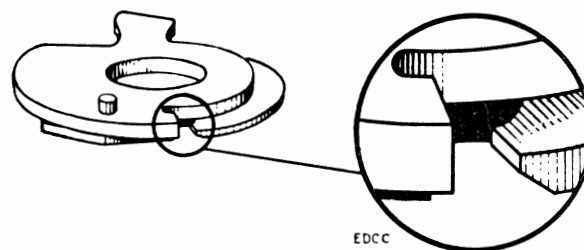


FIG. 17.—ROTARY DISK WITH CHAMFERED ENTERING EDGE

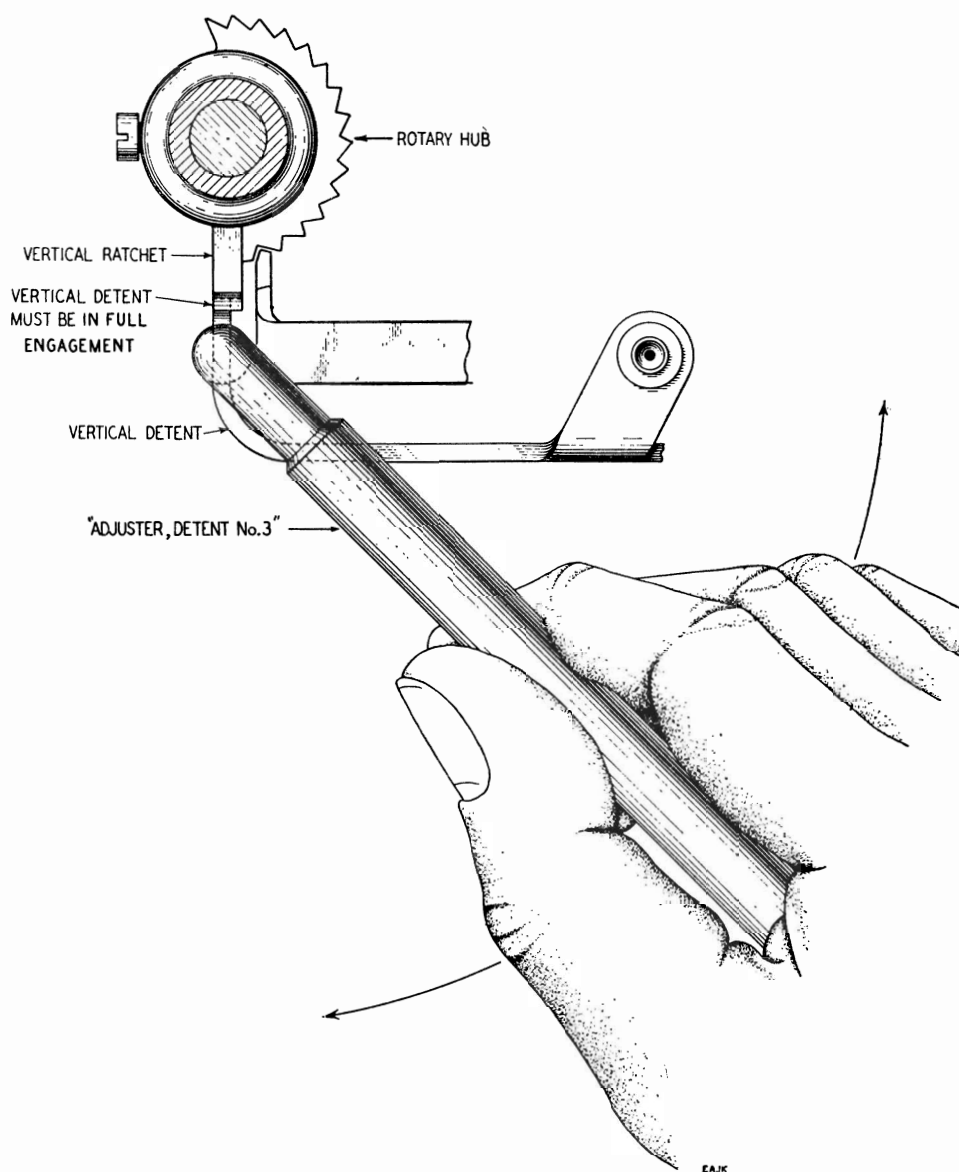


FIG. 18.—LATERAL ADJUSTMENT OF VERTICAL DETENT

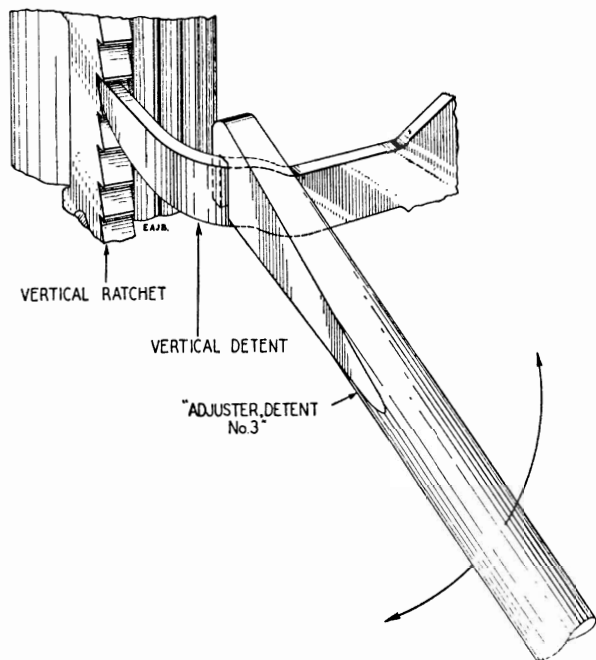


FIG. 19.—VERTICAL ADJUSTMENT OF VERTICAL DETENT

(b) *Square-cut rotary disk.*—The detent should be set, by raising the tip up or down [twist at the straight portion of the detent as near as possible to the point where it commences to curve in towards the vertical ratchet (see Fig. 19)], so that, when the carriage assembly is rotated, the rotary disk enters the slot in the comb with a drop of approximately 5 mils as shown in Fig. 20. Particular care should be taken with this adjustment. The amount of drop should be estimated by observing the rotary disk as it enters the comb slot, and should be checked on the first, fifth, and tenth levels.

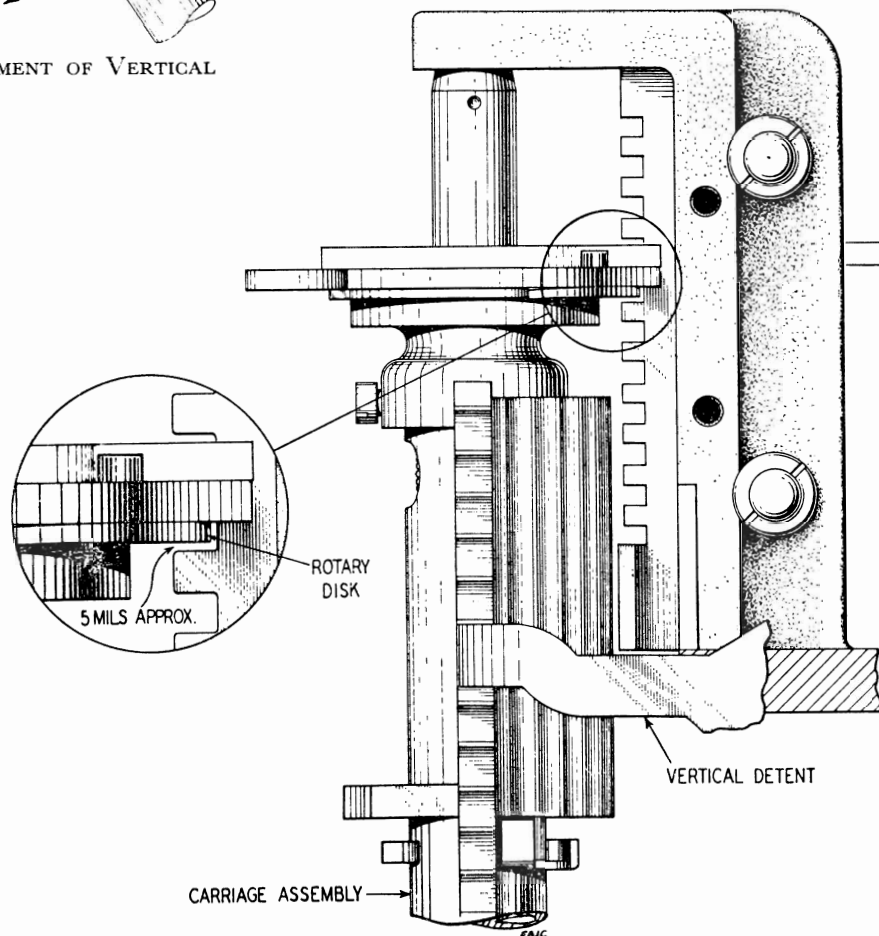


FIG. 20.—CHECKING VERTICAL ADJUSTMENT OF VERTICAL DETENT (Selectors with square-cut rotary disk)

(c) *Chamfered rotary disk.*—The detent should be set, by raising the tip up or down so that, when the carriage assembly is rotated, the rotary disk enters the comb slot without rise or fall (see Fig. 21). This adjustment should be checked on the first, fifth and tenth levels and, if variation exists, a mean adjustment should be obtained.

(d) *Screw adjustment.*—The locking nut on the vertical-detent adjusting screw should be loosened. With the carriage assembly raised to the fifth level, the detent-adjusting screw should be set, by turning it in or out, until the tip of the detent just touches the bottom of the vertical tooth (see Fig. 22). The locking nut should then be re-tightened.

The depth of engagement must be such that, when the carriage is normal, there is a clearance between the sloping face of the first vertical tooth and the underside of the detent. This is to ensure that the detent does not foul the vertical ratchet while the carriage is returning in the normal level (see Fig. 23).

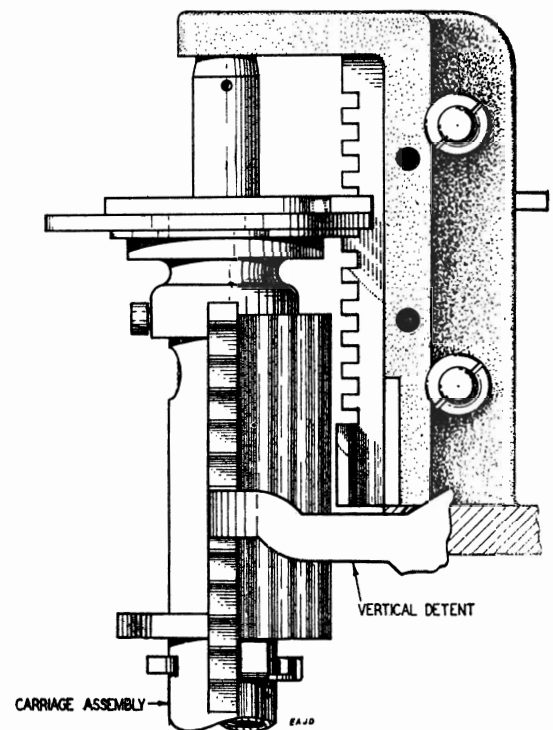


FIG. 21.—CHECKING VERTICAL ADJUSTMENT
OF VERTICAL DETENT
(Selectors with chamfered rotary disk)

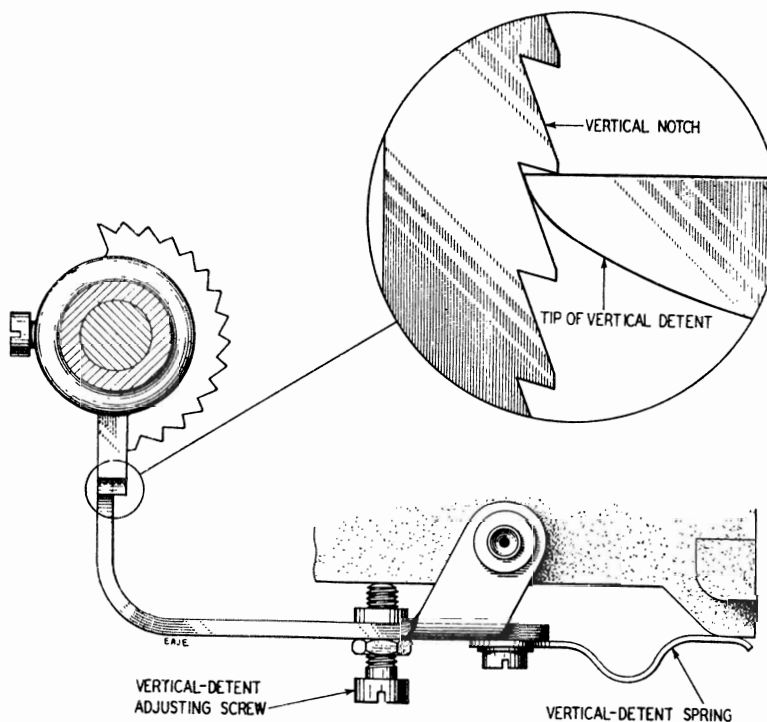


FIG. 22.—ADJUSTING DEPTH OF ENGAGEMENT OF
VERTICAL DETENT

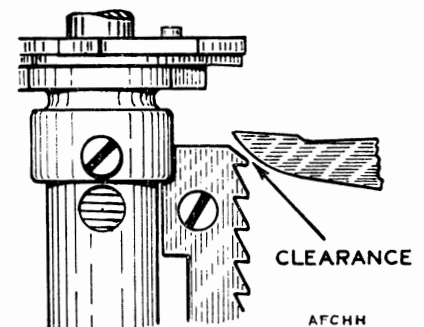


FIG. 23.—CLEARANCE
BETWEEN VERTICAL DETENT
AND FIRST VERTICAL TOOTH,
CARRIAGE NORMAL

23. Vertical-detent spring.—The vertical-detent spring should be tensioned to exert a pressure of 110 ± 30 gm. (70 to 150 gm. 'test') as measured at the tip of the detent, with the carriage assembly rotated on the tenth level (see Fig. 24).

24. Rotary detent.—Before adjustments are made to the rotary detent, it should be checked that the rotary-pawl front-stop locking screw is tight. The

clearance between the detent projection and the edge of the rotary disk should be such that there is slight rotary play in the carriage when in the normal position. The lower detent projection should clear the top face of the rotary ratchet and the carriage hub (see Fig. 28).

(b) When the carriage assembly is stepped vertically from the normal position, a small clearance is necessary between the tip of the rotary detent and

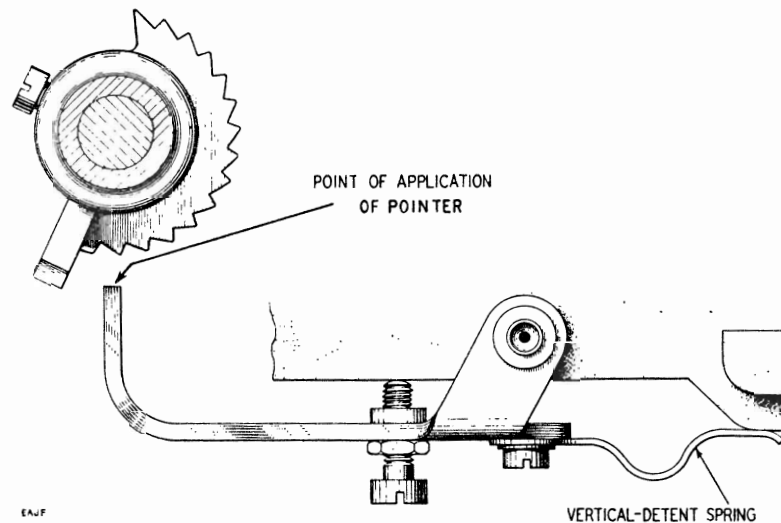


FIG. 24.—CHECKING TENSION OF VERTICAL-DETENT SPRING

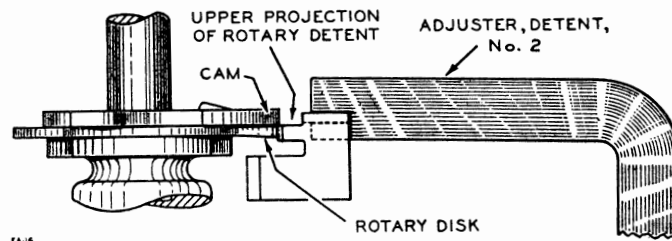


FIG. 25.—ALIGNMENT OF ROTARY-DETENT PROJECTION WITH ROTARY DISK

rotary-detent adjustments, consisting of two bending adjustments and one screw adjustment, should be made as detailed in (a), (b) and (c).

(a) With the carriage in the normal level the detent should be adjusted, by bending it up or down, so that the upper projection is flush with the upper surface of the rotary disk (see Fig. 25) and will just clear the underside of the cam when the carriage assembly is returning on the normal level. The upper projection should be adjusted laterally, by means of an "Adjuster, Detent, No. 2" (see Fig. 26), so that it will latch freely, and securely, behind the rotary disk with the carriage assembly at normal (see Fig. 27). The

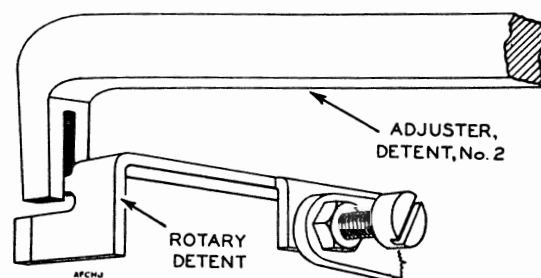


FIG. 26

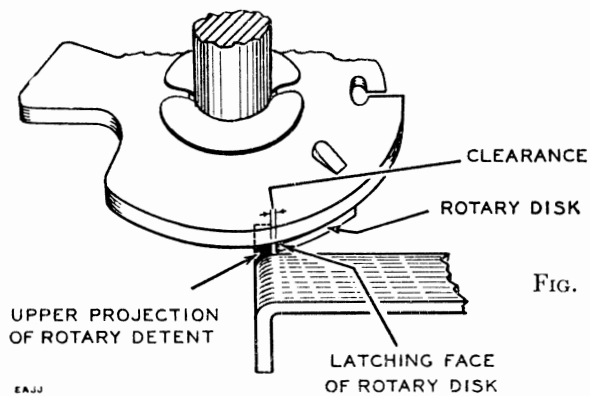


FIG. 27.—LATCHING OF ROTARY-DETENT PROJECTION WITH ROTARY DISK

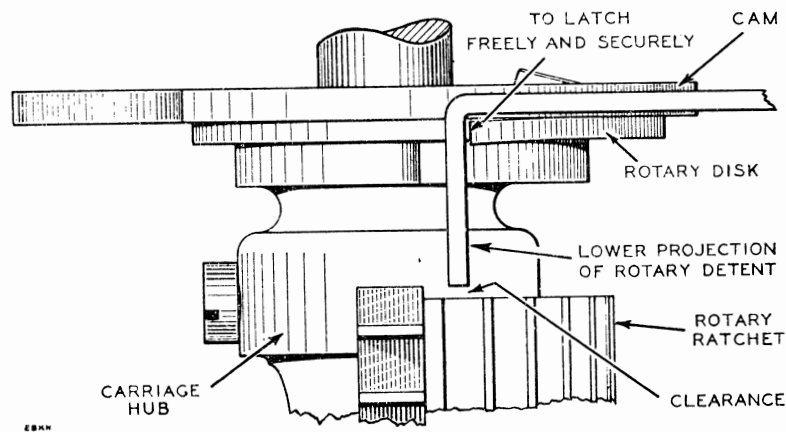


FIG. 28.—CLEARANCE BETWEEN ROTARY DETENT AND TOP FACE OF ROTARY RATCHET

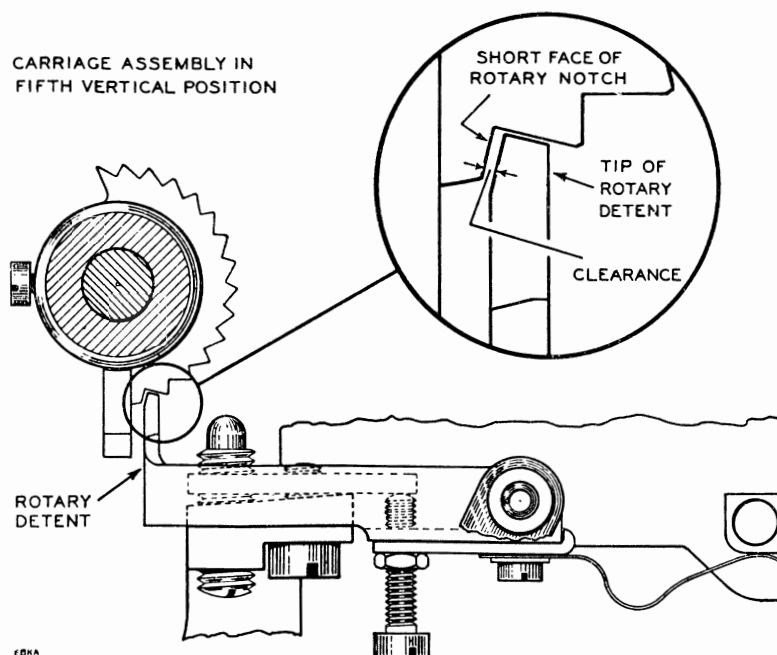


FIG. 29.—LATERAL ADJUSTMENT OF ROTARY-DETENT TIP

carriage is raised to the fifth vertical step. This adjustment should be done, by bending the tip of the rotary detent to the left or right, as required, using an "Adjuster, Detent, No. 2" as shown in Fig. 30.

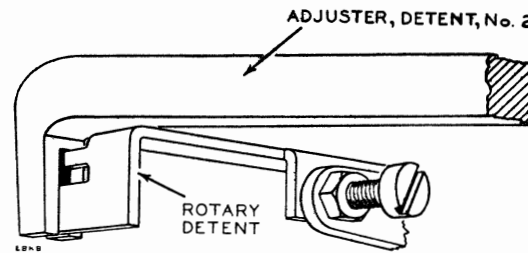


FIG. 30.—ADJUSTING LOWER PROJECTION OF ROTARY-DETENT TIP

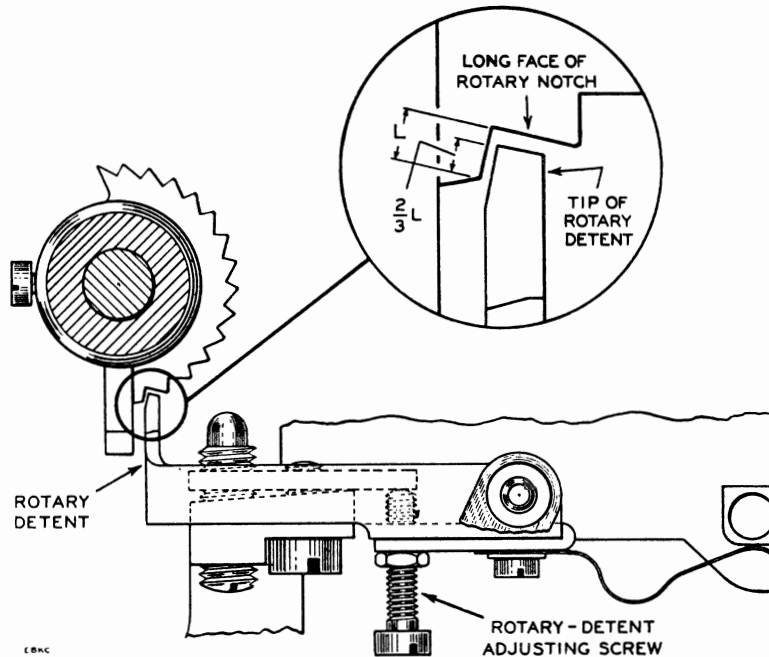


FIG. 31.—DEPTH OF ENGAGEMENT OF ROTARY DETENT

(c) The detent-locking nut should next be loosened. The detent-adjusting screw should then be set, by turning it in or out, so that the detent clears the long face of the rotary notch and it is possible to raise the carriage assembly from normal with the rotary detent riding clear in the first rotary notch on the ratchet (see Fig. 31). The detent-locking nut should then be tightened. A check should be made with the carriage in position 5 : 5 to ensure that the depth of engagement of the rotary detent in the rotary notch is at least two-thirds of the short face of the notch. A check should also be made to ensure that, when the carriage assembly is returning to normal from the 12th rotary position on the normal level, the upper detent projection latches freely and securely behind the rotary disk in the normal position.

The setting of the vertical and rotary detents should result in the vertical detent just clearing the vertical ratchet when the carriage is rotated one step (see Fig. 32). The setting should be checked on levels 1 and 0.

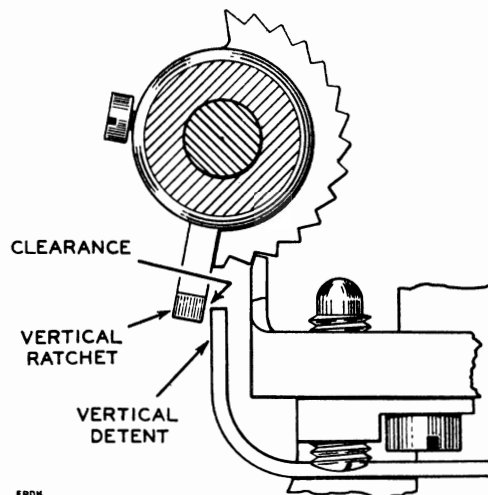


FIG. 32.—CLEARANCE BETWEEN VERTICAL DETENT AND VERTICAL RATCHET, WITH CARRIAGE ROTATED ONE STEP

25. Rotary-detent spring.—The rotary-detent spring should be tensioned to exert a pressure of 130 ± 30 gm. (90 to 170 gm. 'test') as measured at the tip of the upper projection of the rotary detent (see Fig. 33) with the carriage assembly raised.

(D) VERTICAL ADJUSTMENTS

26. Armature and pawl bearings.—The vertical armature and the pawl should be free on their bearings with a minimum amount of play.

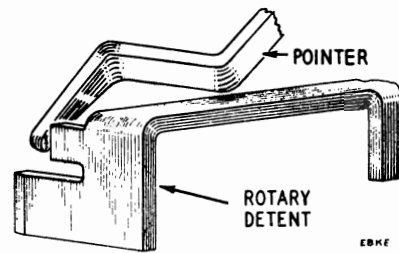


FIG. 33.—CHECKING TENSION OF ROTARY-DETENT SPRING

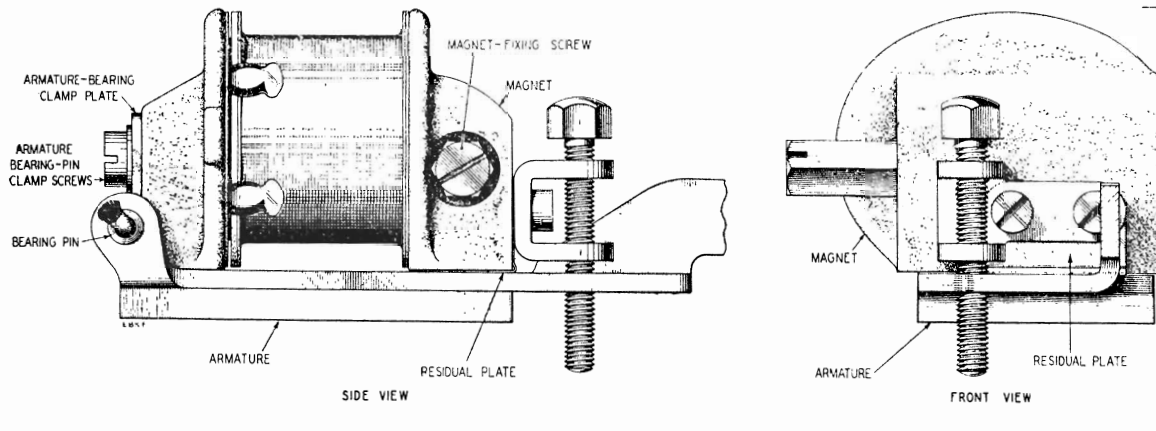


FIG. 34.—ADJUSTMENT OF VERTICAL-ARMATURE BEARING-PIN CLAMP

27. Armature-bearing clamp plate.—The correct setting of the armature-bearing clamp plate should ensure that, when the magnet is energized, the armature strikes squarely on both faces of the magnet core (see Fig. 34).

If it is necessary to reset the armature clamp plate, the armature bearing-pin clamp screws and the magnet-fixing screw should be loosened, and the armature operated electrically; the bearing pin should then be pushed into the casting as far as possible. The magnet-fixing screw and the armature bearing-pin clamp screws should then be re-tightened.

28. Pawl, pawl-guide, and armature stroke.—To facilitate the adjustment of the pawl, pawl-guide and armature stroke, the magnet-assembly fixing screw should be loosened (see Note) and the assembly pushed upwards, so that the armature travel is a maximum. The magnet-assembly fixing screw should then be re-tightened, and the vertical-pawl front stop withdrawn clear of the pawl in its operated position.

NOTE.—Care should be taken not to withdraw the magnet-fixing screw completely from its clamp plate, as difficulty may be experienced in replacing the screw.

29. Pawl.—The vertical pawl should engage the vertical teeth, so that it is in full engagement with the left-hand side of the vertical ratchet (see Fig. 35). If this condition is not met, the armature should be

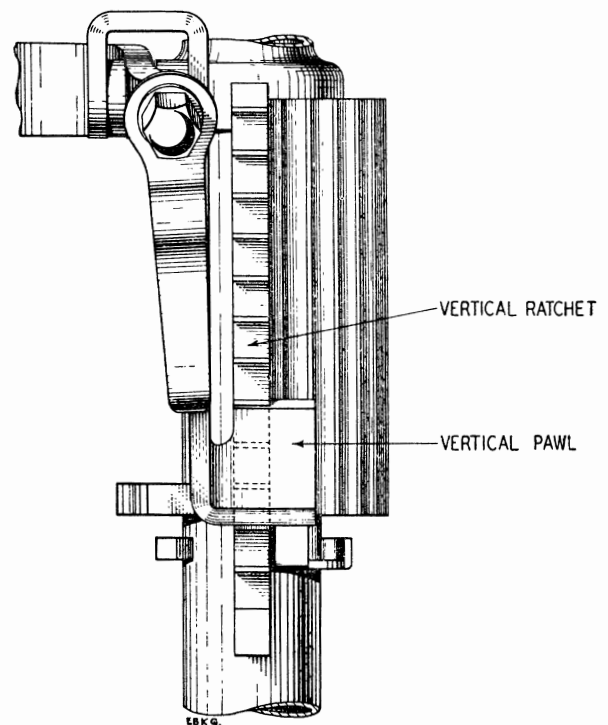


FIG. 35.—ALIGNMENT OF VERTICAL PAWL WITH VERTICAL RATCHET

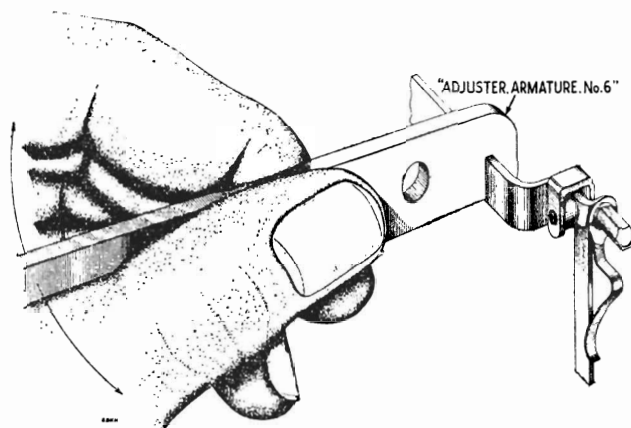


FIG. 36.—ADJUSTMENT OF VERTICAL ARMATURE FOR ALIGNMENT OF VERTICAL PAWL

adjusted, by bending as shown in Fig. 36, at the same time ensuring that the pawl strikes the teeth squarely. This adjustment, in conjunction with the setting of the rotary detent (see par. 24), should result in the vertical pawl just clearing the vertical-ratchet teeth when the carriage assembly is rotated one step and the vertical armature is operated by hand (see Fig. 37). This condition should be checked on levels 1 and 0, and if found to be incorrect, the rotary-detent adjustment detailed in par. 24 should be re-checked. The side portion of the vertical pawl should clear the pawl front stop, as shown in Fig. 38.

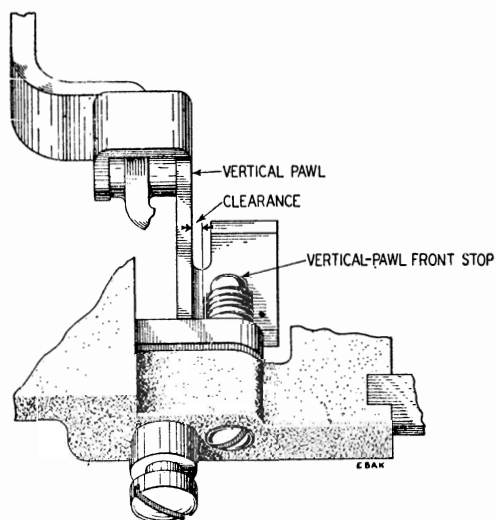


FIG. 38.—CLEARANCE BETWEEN SIDE OF VERTICAL PAWL AND PAWL FRONT STOP

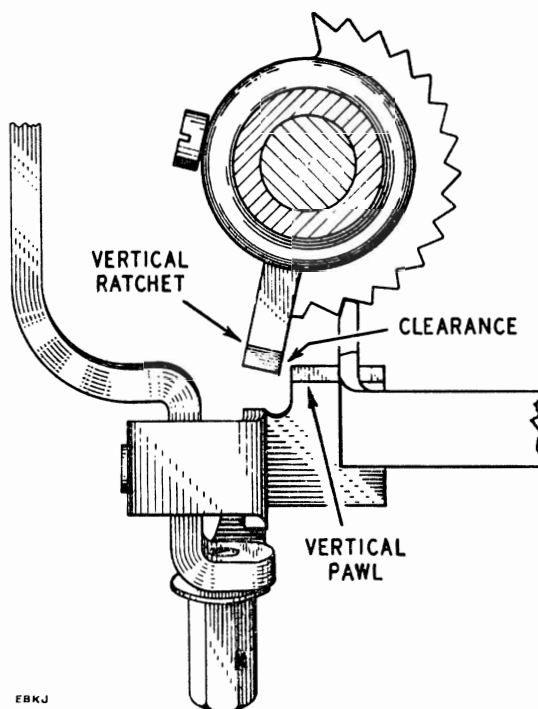


FIG. 37.—CLEARANCE BETWEEN VERTICAL PAWL AND VERTICAL-RATCHET TEETH, SHAFT ROTATED ONE STEP

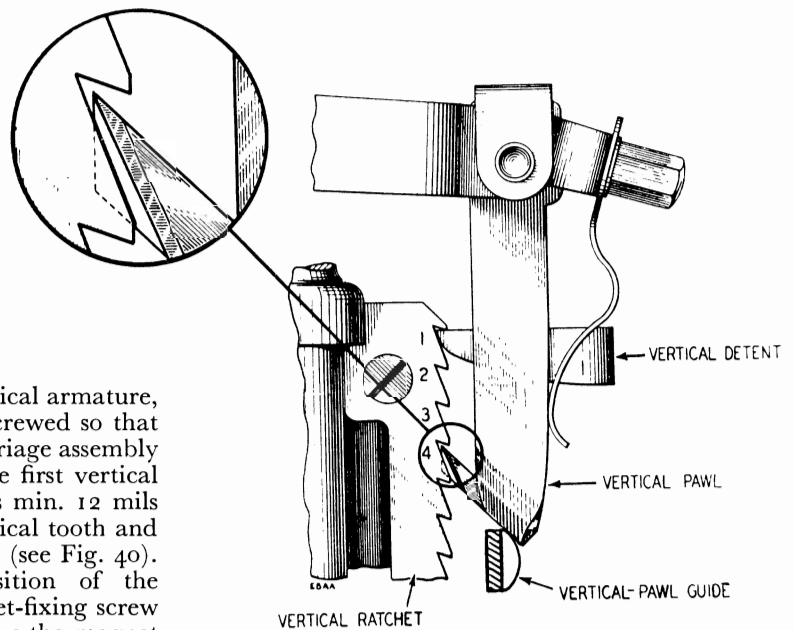
30. Pawl guide.—With the carriage assembly raised to the *first* level, the vertical-pawl guide should be adjusted, by bending it towards or away from the carriage, so that the tip of the pawl strikes into the root of the fourth vertical notch without sliding along either face when the armature is operated by hand (see Fig. 39). The tip of the pawl must on no account strike the short face of the tooth before entering the root. The carriage assembly should then be restored to normal.

★31. *Armature stroke.*

(a) To adjust the stroke of the vertical armature, the armature back stop should be unscrewed so that it lifts the vertical armature and the carriage assembly until the vertical detent drops over the first vertical tooth, and leaves a clearance of 7 mils min. 12 mils max. between the short face of the vertical tooth and the upper surface of the vertical detent (see Fig. 40).

(b) Without disturbing the position of the vertical-armature back stop, the magnet-fixing screw should be loosened just enough to allow the magnet to be moved and then, with the aid of a small screw-driver, the magnet assembly should be levered gently towards the armature until its pole face is just in contact with the armature (see Fig. 41). The magnet-fixing screw should then be tightened.

(c) The armature back stop should next be screwed in approximately 1 turn so that the armature is lowered; the armature should then be operated electrically and a check made to ensure that the clearance specified in (a) still exists.



★FIG. 39.—ADJUSTMENT OF VERTICAL-PAWL GUIDE

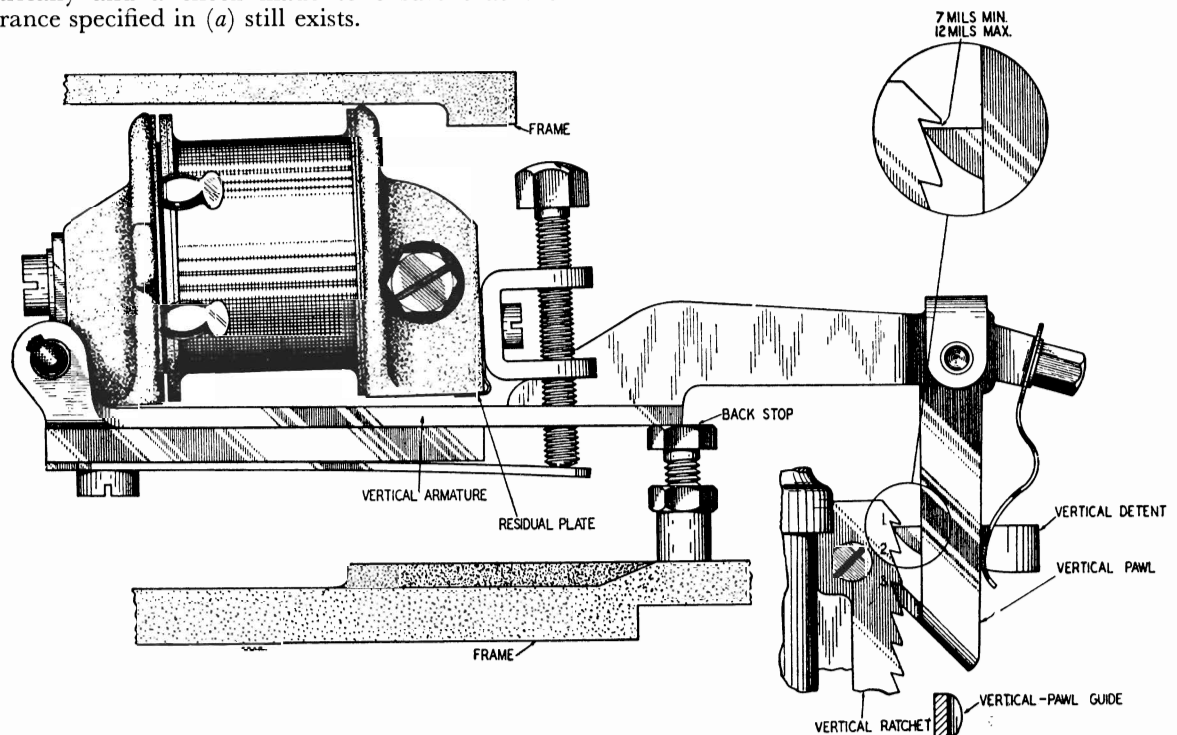


FIG. 40.—LOCATING VERTICAL ARMATURE IN OPERATED POSITION

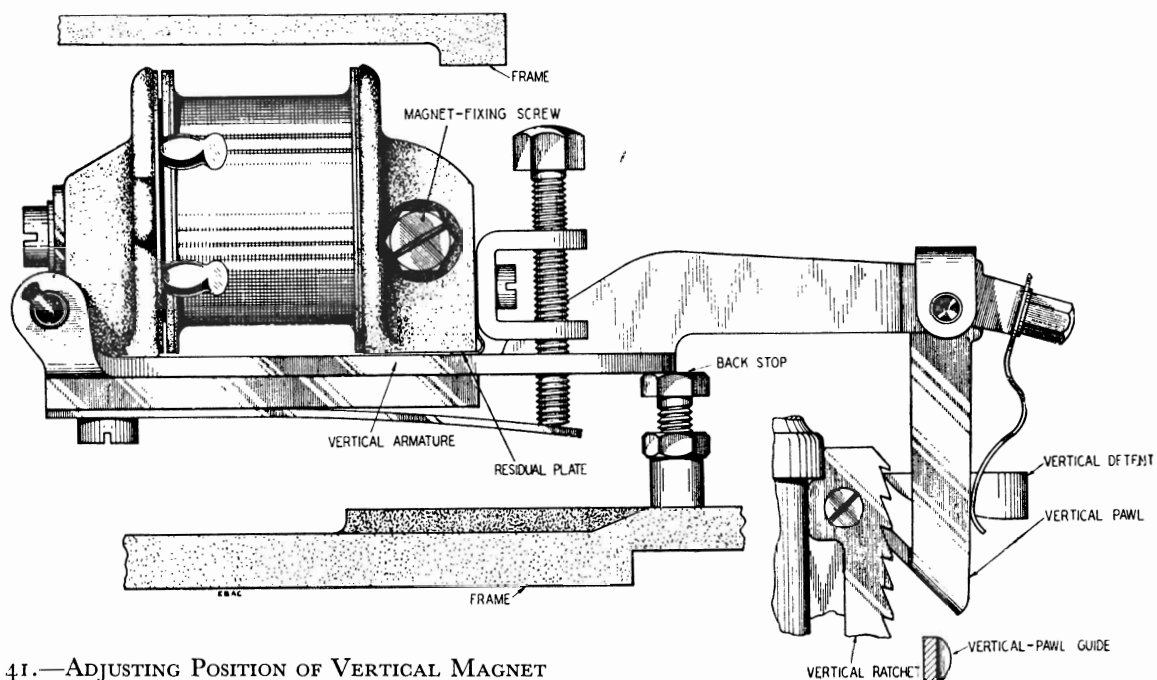
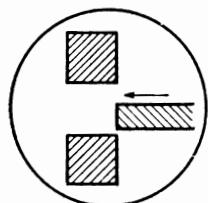
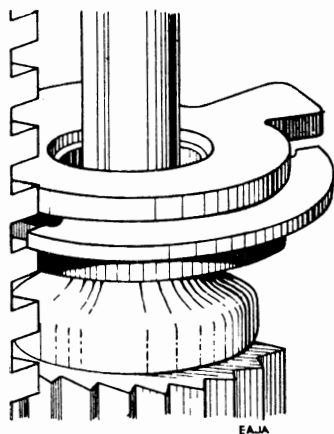
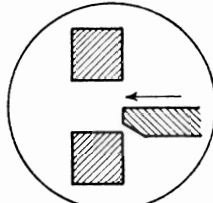
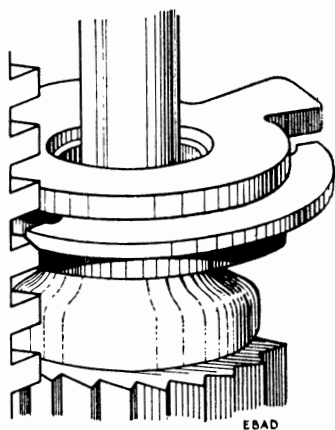


FIG. 41.—ADJUSTING POSITION OF VERTICAL MAGNET



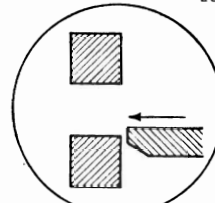
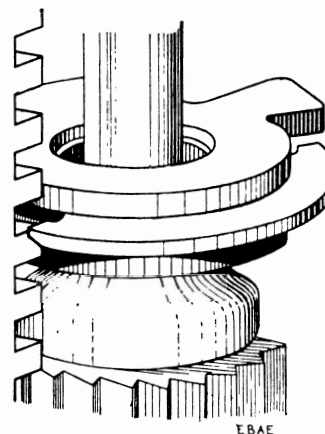
SECTION OF COMB TEETH
AND ROTARY DISK

FIG. 42.—CHECK OF CORRECT
ADJUSTMENT OF VERTICAL-
ARMATURE BACK STOP (ROTARY
DISK ENTERING COMB SLOT WITH-
OUT RISE)



SECTION OF COMB TEETH
AND ROTARY DISK

FIG. 43.—CHECK OF CORRECT
ADJUSTMENT OF VERTICAL-
ARMATURE BACK STOP (CORRECT,
ROTARY DISK ENTERING COMB
SLOT WITH SLIGHT RISE)



SECTION OF COMB TEETH
AND ROTARY DISK

FIG. 44.—CHECK OF CORRECT
ADJUSTMENT OF VERTICAL-
ARMATURE BACK STOP (INCORRECT,
VERTICAL PORTION OF ROTARY
DISK STRIKING COMB TEETH)

32. Armature back stop.—The position of the vertical-armature back stop should be adjusted so that, when the armature returns to normal against the back stop, the vertical pawl just trips over the vertical teeth without causing the carriage to rise. This adjustment should be checked on all vertical steps. The back-stop locking nut should then be tightened. To ensure that the carriage assembly can release if the vertical detent fails to drop in (the weight of the carriage then being taken by the vertical pawl), the vertical detent should be withdrawn and the carriage assembly held by the vertical pawl on level 2; the carriage should then be rotated, by hand, and the adjustments checked as detailed in (a) or (b). This check should be repeated on level 9.

(a) On selectors having rotary disks with a square-cut entering edge, check that the rotary disk enters the comb slot without rise when the carriage is rotated (see Fig. 42).

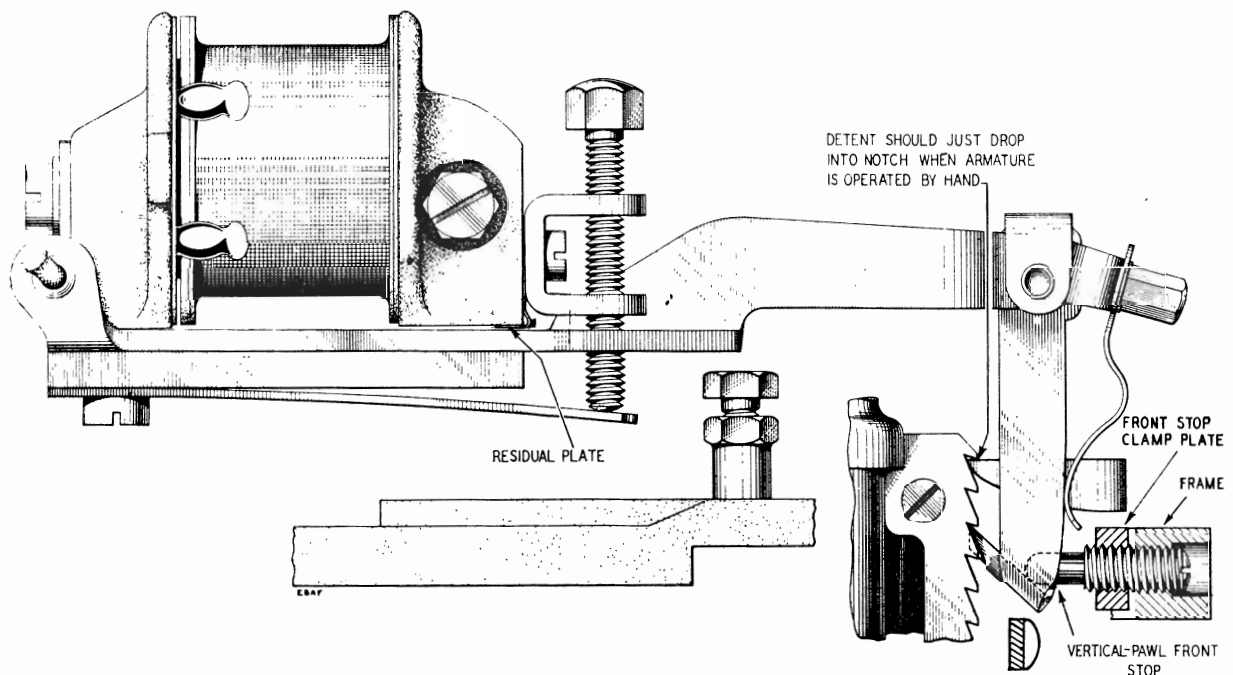
(b) On selectors having chamfered rotary disks, check that the disk enters the comb slot freely. The disk may rise slightly along its chamfered edge as it cuts-in (see Fig. 43) but the disk should never strike the comb plate on that portion of the disk above the chamfer (see Fig. 44). It should also be checked that the position of the vertical pawl is such that it

does not prevent the carriage assembly from returning to normal on the normal level.

★33. Pawl front stop.—The vertical-pawl front stop should be adjusted, by screwing the stop in until the vertical detent just drops in the root of the next tooth when the armature is operated by hand on any vertical step (see Fig. 45). This setting will ensure that, when the vertical armature is operated electrically, the vertical pawl strikes its front stop slightly in advance of the vertical armature striking the core face of the magnet. The vertical-pawl front stop should then be secured by means of the locking screw. With the vertical armature operated electrically, check that:—

(a) there is no vertical play in the carriage assembly, and

(b) the carriage does not rise or drop when the armature commences to restore. To allow for slight variation of the ratchet due to manufacture, however, it is permissible for the carriage to drop on some steps *but not on all*. The maximum permissible drop on any step is 5 mils. The amount of drop should be checked, by inserting a feeler gauge between the vertical detent and the short face of the vertical tooth, after operating the armature electrically.



★FIG. 45.—ADJUSTMENT OF VERTICAL-PAWL FRONT STOP

34. Pawl spring.—The vertical-pawl spring should be tensioned to exert a pressure of 100 ± 30 gm (60 to 140 gm 'test'), measured at the tip of the spring, when the vertical armature is operated (see Fig. 46). A check should be made to ensure that:—

(a) the curved tip of the spring clears the vertical-pawl front-stop clamp-plate, when the armature is normal and the carriage assembly is in the 10th vertical position.

(b) the side of the spring clears the vertical-pawl front stop, when the armature is normal.

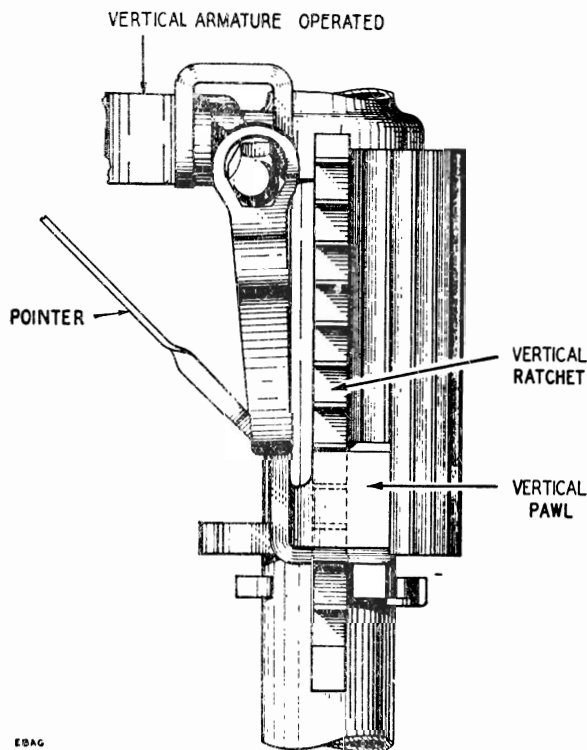


FIG. 46.—CHECKING THE TENSION OF THE VERTICAL-PAWL SPRING

35. Armature-restoring spring.—The vertical-armature-restoring spring should be adjusted by means of its adjusting screw, so that it exerts a pressure of 340 ± 40 gm (290 to 390 gm 'test'), as measured at the tip of the spring (see Fig. 47). A reasonable margin of adjustment in both directions should be left on the restoring-spring adjusting screw. A check should now be made to ensure that the combined adjustment of the pawl guide and the armature back stop are such that the carriage will restore to normal without the vertical pawl tip fouling the vertical ratchet.

36. Subsidiary vertical-pawl guide.—The subsidiary vertical-pawl guide is fitted to prevent the vertical pawl from touching the rotary teeth if the vertical armature is operated with the carriage in

any rotary position. With the carriage assembly at normal, it should be checked that the subsidiary pawl guide rests approximately central in the space between the bottom of the vertical teeth and the rotary ratchet (see Fig. 48). The subsidiary pawl guide should be clear of the vertical ratchet when the carriage assembly is at normal.

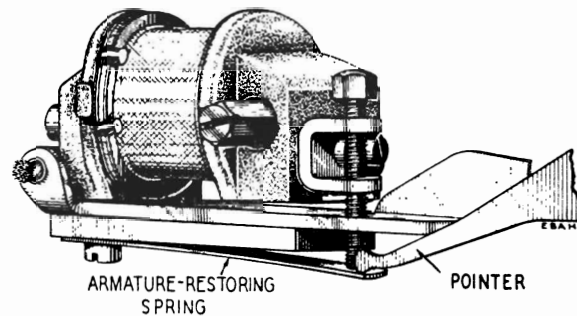


FIG. 47.—CHECKING VERTICAL ARMATURE-RESTORING SPRING TENSION

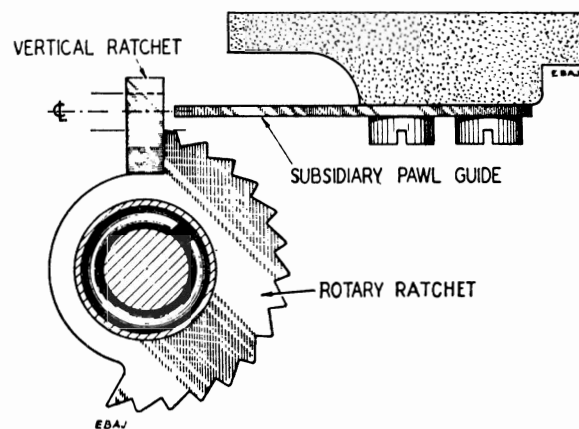


FIG. 48.—POSITION OF SUBSIDIARY VERTICAL-PAWL GUIDE (VIEWED FROM UNDERSIDE)

37. Armature and pawl bearings.—The rotary armature and pawl should be free on their bearings with a minimum of play.

38. Armature-bearing clamp plate.—The correct setting of the armature-bearing clamp plate should ensure that, when the magnet is energized, the armature strikes squarely on both faces of the magnet core (see Fig. 49). If this condition is not met, the armature bearing-pin clamp screws and the magnet-fixing screw should first be loosened; the armature should next be operated electrically, and the bearing-pin pushed into the casting as far as possible. The magnet-fixing screw and the armature bearing pin clamp screws should then be re-tightened.

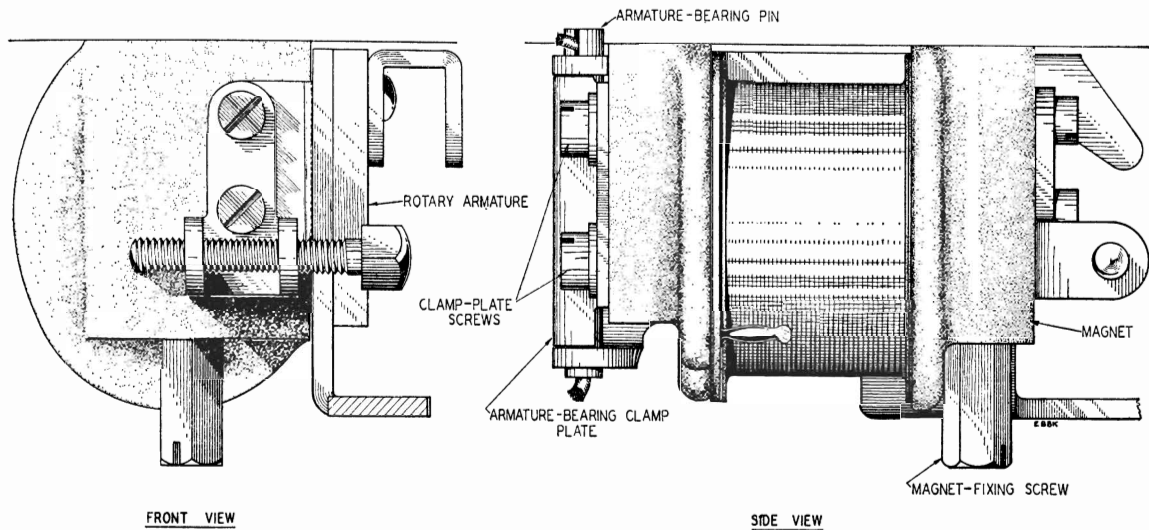


FIG. 49.—ADJUSTMENT OF ROTARY-ARMATURE BEARING-PIN CLAMPS

39. Pawl, pawl guide, and armature stroke.—To facilitate the adjustment of the pawl, pawl guide and armature stroke, the armature back stop should be replaced by an “Adjuster, Armature, No. 7”. The pawl front stop should be withdrawn clear of the pawl in its operated position, and the magnet-assembly fixing screw should be loosened (see Note) and the assembly positioned to the left-hand side, so that the armature travel is a maximum. The magnet-assembly fixing screw should then be re-tightened. The armature restoring-spring fixing screw should next be

loosened, so that tension is not exerted by the spring on its stop when the armature is operated.

NOTE:—The magnet-fixing screw should not be withdrawn completely, as difficulty may be experienced in replacing it.

40. Pawl.

(a) The pawl-locking projection should not project above the extended lug on the comb plate. This may be checked by holding the carriage in the 12th rotary position and operating the rotary armature (see Fig. 50).

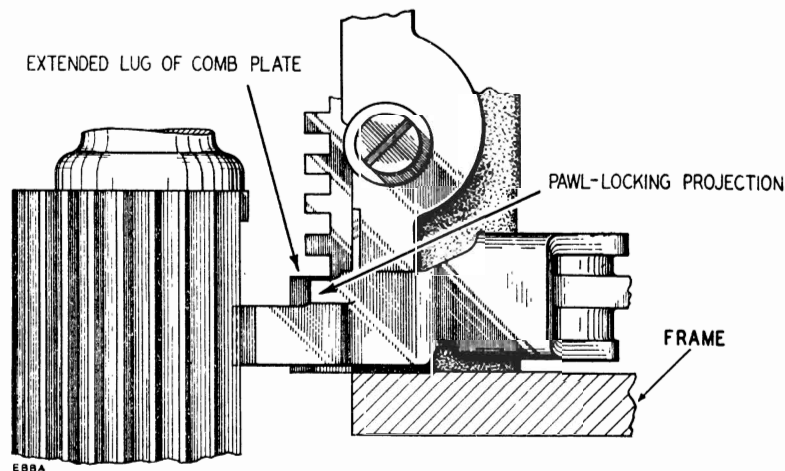


FIG. 50.—CHECKING ALIGNMENT OF ROTARY-PAWL LOCKING PROJECTION WITH COMB-PLATE LUG (CARRIAGE ASSEMBLY IN 12TH ROTARY POSITION WITH ARMATURE OPERATED)

(b) With the rotary armature operated, the pawl should clear the rotary ratchet, when the carriage is returning on the normal level (see Fig. 51).

(c) The tip of the rotary pawl should strike squarely into the rotary teeth, when the rotary armature operates.

(d) The rotary pawl or bearing must not bind on the frame (see Fig. 50).

along the long face of the tooth (see Fig. 53). The pawl-guide fixing screws should then be re-tightened. A check should next be made to ensure that:—

(a) With the carriage assembly held, *by hand*, against the rotary detent in the 12th rotary position and the armature operated, the locking projection of the rotary pawl locks securely behind the extended lug at the bottom of the comb plate, and that the

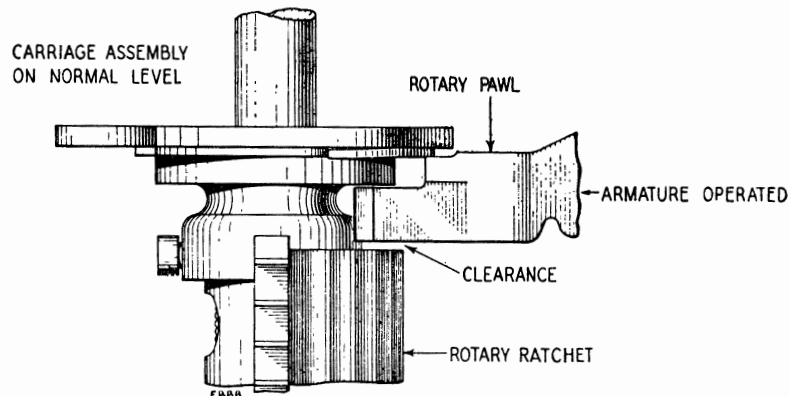


FIG. 51.—CLEARANCE BETWEEN ROTARY PAWL AND TOP OF ROTARY HUB

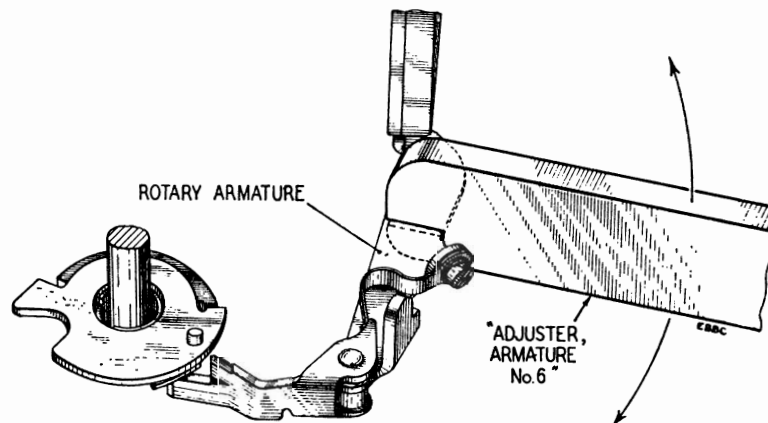


FIG. 52.—ADJUSTMENT OF ROTARY ARMATURE FOR ALIGNMENT OF ROTARY PAWL

If these conditions are not met, the armature should be adjusted by bending, as shown in Fig. 52.

41. Pawl guide.—With the carriage raised, and rotated one step, the rotary pawl guide should be set by loosening the pawl-guide fixing screws and swinging the guide to the right or left, pivoting on the upper screw, so that the pawl strikes into the fourth rotary notch on the ratchet and slides one-third of the distance

pawl tip is quite clear of the ratchet on all levels (see Fig. 54).

(b) During the operation of the rotary armature on any step, the pawl-locking projection clears the extended lug on the comb plate.

If condition (a) is not met, the amount of slide of the pawl on the long face of the rotary tooth may be increased to a maximum of two-thirds.

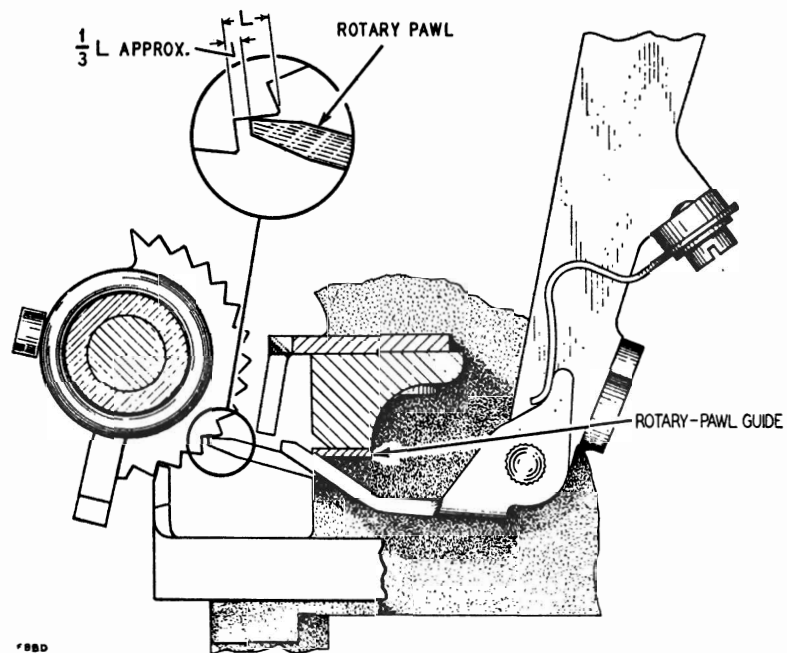


FIG. 53.—ADJUSTMENT OF ROTARY-PAWL GUIDE

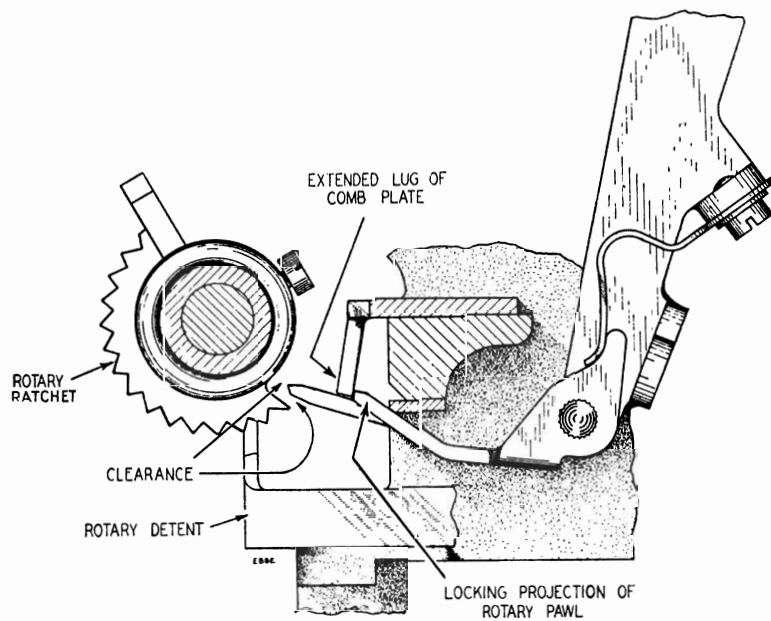


FIG. 54.—LOCKING OF ROTARY PAWL WITH COMB-PLATE LUG (CARRIAGE ON 12TH STEP)

42. Armature stroke.—The stroke of the rotary armature should be adjusted as detailed in (a), (b) and (c).

(a) With the carriage stepped to the fifth vertical step, the "Adjuster, Armature, No. 7" should be screwed-in (see Note) so that the rotary pawl rotates

the carriage until the rotary detent drops over the next rotary tooth, and leaves a clearance of 7 mils min. 12 mils max. between the detent and the short face of the rotary tooth (see Fig. 55).

NOTE:—Care should be taken to ensure that the operating strikers do not move the operating lever of the rotary-interrupter springs during this operation.

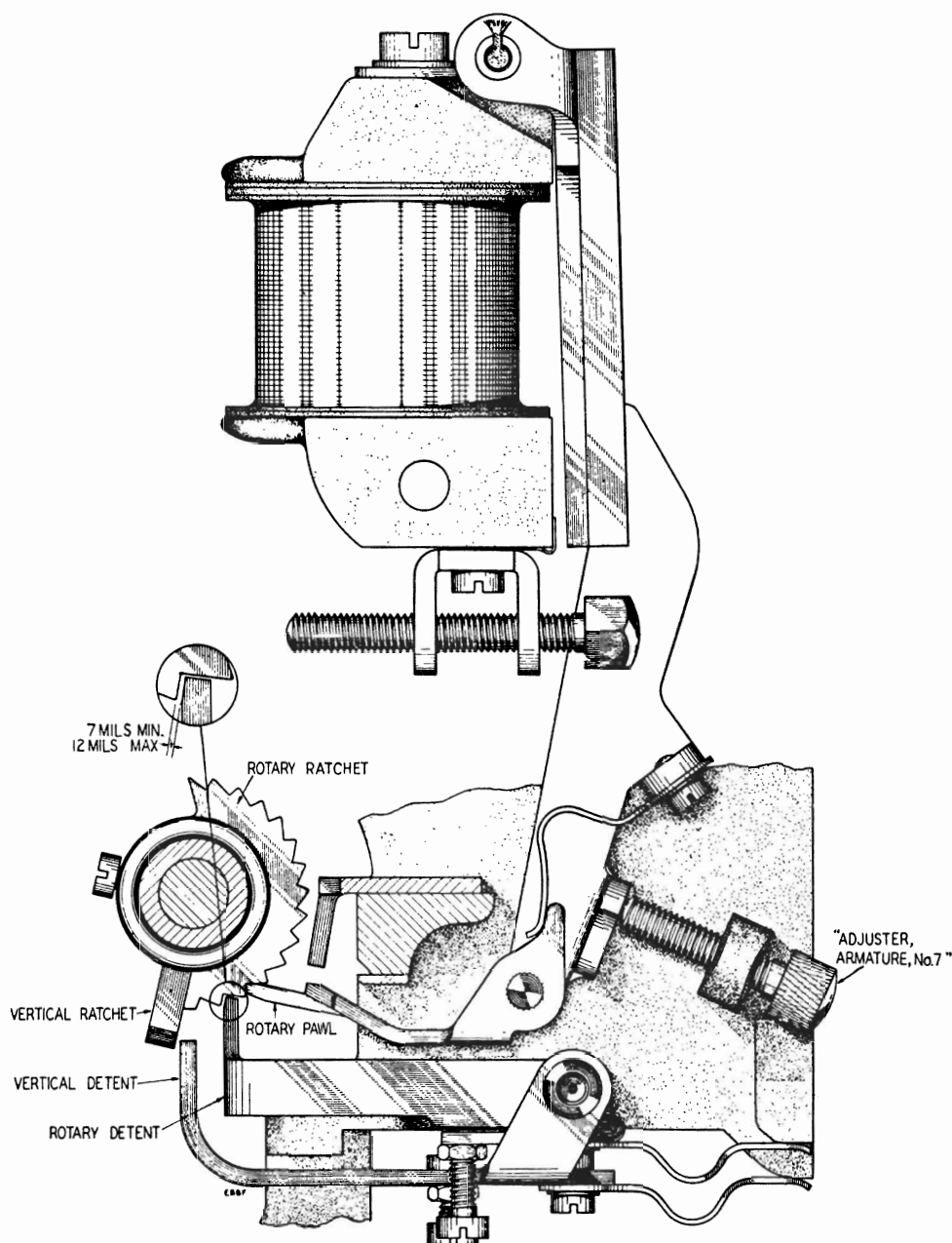


FIG. 55.—LOCATING ROTARY ARMATURE IN OPERATED POSITION

(b) Without disturbing the position of the Adjuster, Armature, No. 7, the magnet-fixing screw should next be loosened, and, with the aid of a small screwdriver, the magnet assembly should be levered gently over to the right-hand side until its pole face is just in contact with the armature (see Fig. 56). The magnet-fixing screw should then be re-tightened.

(c) The Adjuster, Armature, No. 7 should next be loosened. The rotary armature should then be operated electrically and a check made to ensure that the clearance of 7 mils min., 12 mils max. still exists between the detent and the short face of the rotary tooth. When the adjustment has been correctly obtained, the rotary-armature back stop and the armature-restoring spring should be replaced.

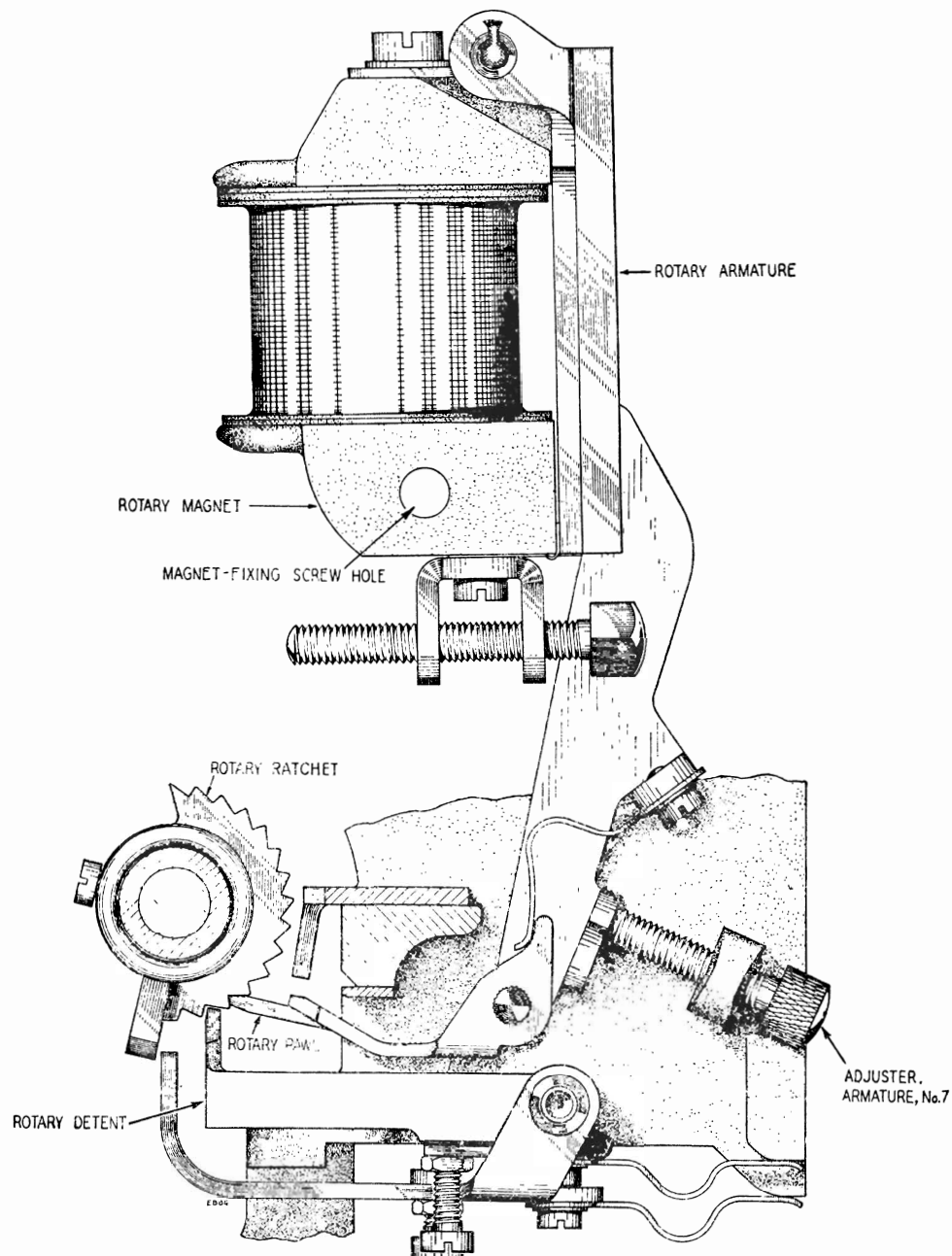


FIG. 56.—ADJUSTING POSITION OF ROTARY MAGNET

★43. **Armature back stop.**—The rotary-armature back stop should be adjusted so that, when the rotary armature is normal, the tip of the pawl clears the long face of the third rotary notch sufficiently to allow the carriage to be raised from normal to the first level (see Fig. 57). This clearance should be checked as follows:—

(b) there is no forward movement or back-lash in the carriage when the armature commences to restore. (To allow for slight non-uniformity of the ratchet due to manufacture, slight back-lash is permissible on some teeth *but not on all*. The maximum back-lash allowable is such that a 5-mil gauge binds when inserted between the rotary detent and the short

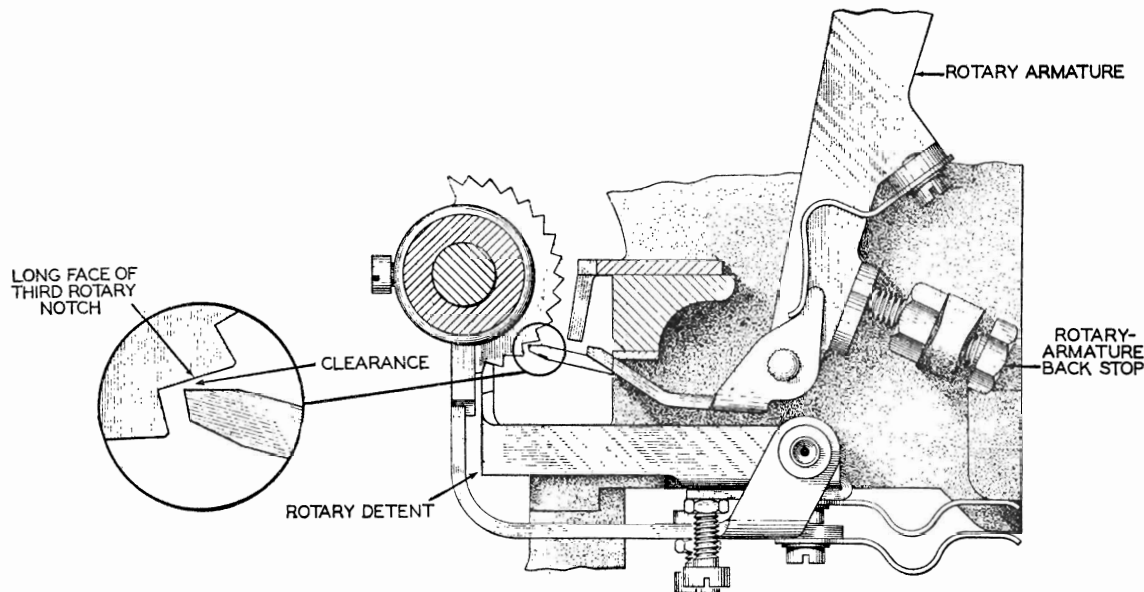


FIG. 57.—ADJUSTING NORMAL POSITION OF ROTARY ARMATURE

(a) With a 2-mil feeler gauge inserted between the lug on the rotary armature and its back stop, the rotary pawl tip should clear the rotary hub when the carriage is raised slowly by hand.

(b) With a 7-mil feeler gauge inserted between the lug on the rotary armature and its back stop, the rotary pawl tip should not clear the rotary hub when the carriage is raised slowly by hand.

When making these checks ensure that the feeler gauge is securely gripped between the lug on the armature and the armature back stop. The lock nut on the back stop screw should then be tightened.

★44. **Pawl front stop.**—To adjust the rotary-pawl front stop, the locking screw should first be slightly loosened; the carriage should then be raised to the fifth vertical step, and the pawl front stop screwed-in until the rotary detent *just* drops into the rotary notch when the rotary armature is operated by hand (see Fig. 58). This condition should be checked on each rotary step on levels 1 and 0. The purpose of the setting is to ensure that the rotary pawl strikes its front stop slightly in advance of the rotary armature striking the core face of the magnet. The pawl front-stop locking screw should be re-tightened when the correct adjustment has been obtained. With the armature operated electrically, a check should be made to ensure that:—

(a) there is no rotary play in the carriage assembly when an attempt is made to rotate the carriage by hand.

face of the rotary notch with the armature operated electrically.)

and (c) the adjustment of the pawl front stop has not disturbed the depth of the engagement of the rotary detent [see par. 24 (c)].

45. **Pawl spring.**—The rotary pawl spring should be tensioned to exert a pressure of 150 ± 30 gm (110 to 190 gm 'test'), as measured at the tip of the pawl with the armature normal and the carriage assembly raised to level 0 (see Fig. 59). When the rotary armature is normal or operated

(a) the leg of the rotary pawl spring should rest on the pawl tail only (see Fig. 57).

(b) the rotary pawl spring must not bind on the rotary armature, selector frame or level cam, when fitted.

46. **Armature restoring spring.**—The rotary-armature restoring spring should be adjusted by means of its adjusting screw so that it exerts a pressure of 340 ± 40 gm (290 to 390 gm 'test'), as measured at the tip of the spring. A reasonable margin of adjustment in both directions should be left on the restoring-spring adjusting screw. With the carriage in the 12th rotary position, it should be checked that the rotary armature restores fully on to its back stop when retarded by hand. When checking this condition, the interrupter-spring operating lever must be restored by hand.

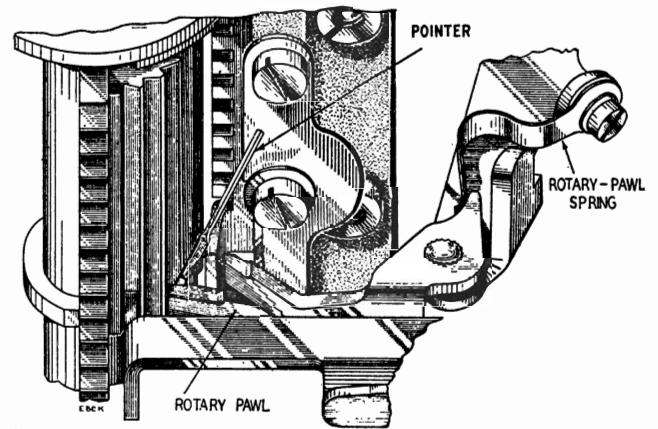


FIG. 59.—CHECKING TENSION OF
ROTARY-PAWL SPRING

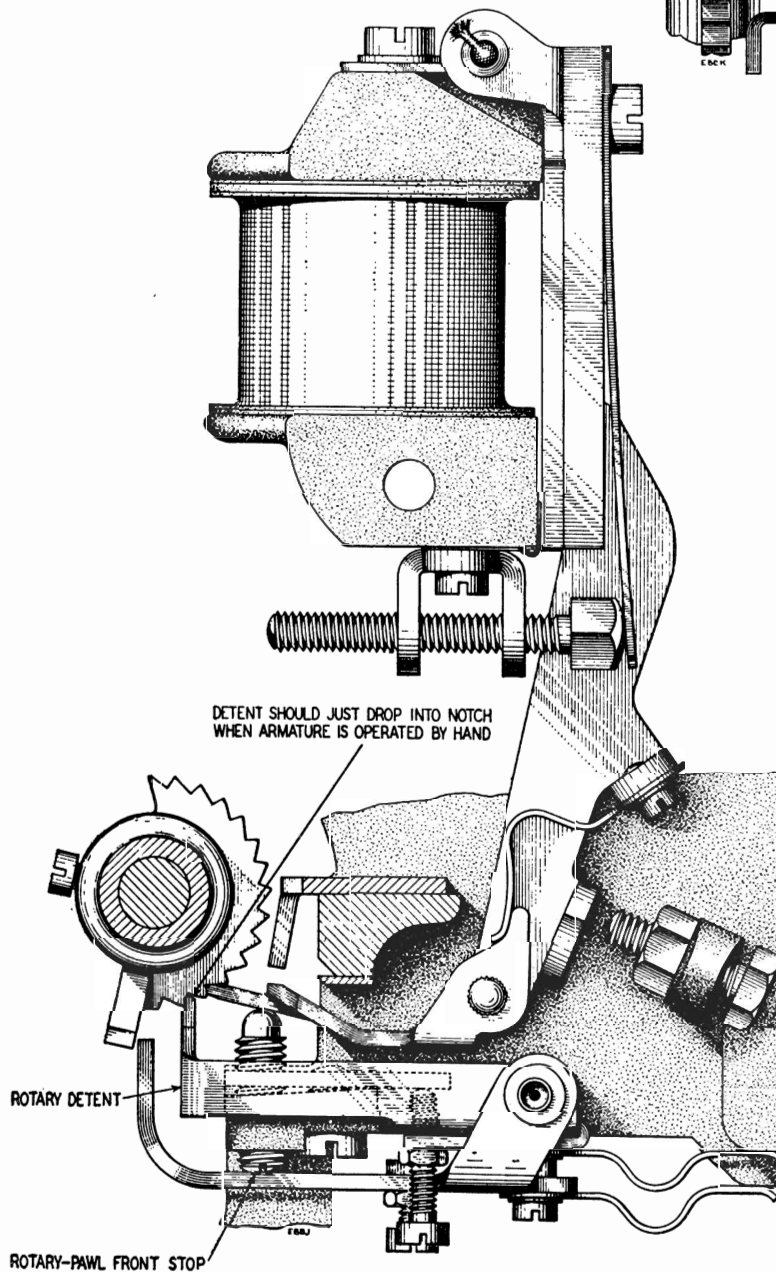


FIG. 58.—ADJUSTMENT OF
ROTARY-PAWL FRONT STOP

MECHANICALLY-OPERATED SPRING ASSEMBLIES, TYPE 1

(A) GENERAL

47. Operating levers and rollers.

(a) The operating levers should strike approximately in line with, and flat on, the buffers (see Fig. 60). The levers should be free on their bearings, with a minimum amount of vertical or side play. Vertical play can be taken-up by adjustment of the bottom-bearing screws.

(b) When rollers are fitted they should be free to revolve on their bearings, with a minimum amount of vertical or side play. Vertical play in the rollers can be adjusted by bending the roller brackets. If the roller bearings are worn, the complete lever assembly should be changed.

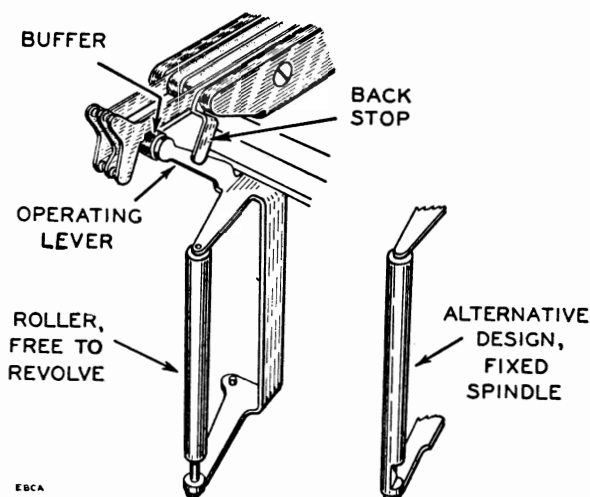


FIG. 60.—ALIGNMENT OF OPERATING LEVER WITH BUFFER

48. Straightness of springs.—All springs should be straight between the clamped portion and the contacts. The parallel condition of contact springs is controlled by the thickness of the insulators and the ebonite buffers between the springs. If the first spring in an assembly is a 'break' spring, the adjustment of this spring to lie straight throughout its length will ensure that the remaining contact springs, after being adjusted as indicated, will be reasonably parallel and straight throughout their length. If an assembly consists of 'make' contacts only, the first 'make' spring should be adjusted to lie straight throughout its length. A spring adjuster is provided for making spring adjustments, but duckbill pliers can be used if preferred on assemblies on which the springs are accessible. The principles involved in the method of tensioning springs are the same as those applying to relay springs and a description of these will be found in B 5144.

49. Alignment of contacts.

(a) Pairs of contacts which make electrical contact should not be out of alignment by more than one-third of the diameter of a contact (see Fig. 61).

(b) Twin contacts should open or close approximately simultaneously.

(c) The extended tip of the spring adjuster should be used for adjusting twin contacts.

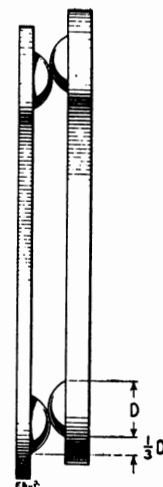


FIG. 61.—SHOWING MAXIMUM PERMISSIBLE MISALIGNMENT OF CONTACTS

50. Contact pressures and clearances.

(a) *Contact pressures.*—The contact pressure of all 'make' or 'break' contacts should be 30 ± 10 gm. When measuring contact pressures, the pointer of the tension-gauge should be applied to the bottom of the 'V' portion of the spring, as shown in Fig. 62. When measuring the contact pressure of 'break' contacts, the tension of the outer springs should be relieved (see Fig. 63). When the first combination of springs in an assembly is a 'change-over', the tension of the lever springs should be relieved while the contact pressure of the 'break' portion of the 'change-over' is being measured.

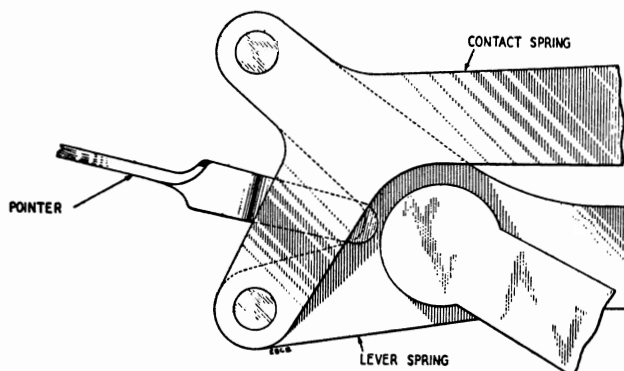


FIG. 62.—SHOWING POINT OF APPLICATION OF GAUGE

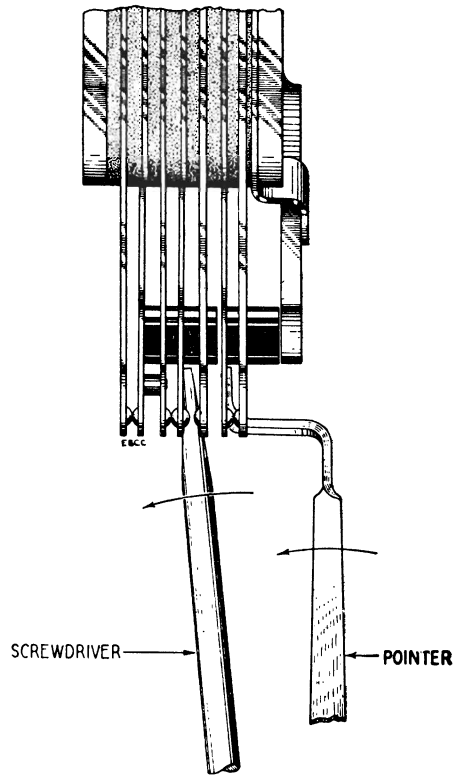


FIG. 63.—SHOWING TENSION OF
OUTER LEVER SPRING BEING
RELIEVED

(b) *Contact openings.*

(i) Contact openings are normally controlled by the thickness of the separating insulators and buffers and also by contact pressures, except for assemblies made up of one 'make' contact or one or more 'break' contacts. The contact opening should then be 20 ± 10 mils.

(ii) 'Change-over' contacts should have a minimum contact clearance of 5 mils between 'break' contacts before the 'make' contacts close.

51. Operating-lever back stops.—When the first set of springs in an assembly constitutes a 'break' or 'change-over' contact, the lever back stop should be adjusted to allow the lever to have perceptible play between the buffer of spring No. 2 and the back stop (see Fig. 64). This play should not exceed 10 mils (12 mils 'test'), measured between the lever and the buffer of spring No. 2. The extended tip of the spring adjuster should be used for adjusting the back stops.

(B) METHOD OF ADJUSTING SPRING-SETS

52. General.—For the purpose of this Instruction, and so that all aspects of spring adjustments may be considered, the adjustments of typical spring-sets only are described in pars. 53 to 57. The methods of adjusting the associated operating levers and arms are detailed separately in pars. 58 to 62.

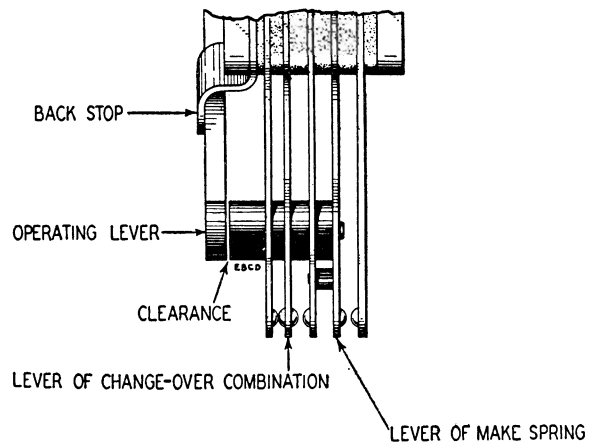


FIG. 64.—ADJUSTMENT OF BACK STOP

(a) To prevent spring vibration during the operation of the mechanism, intermediate 'make' springs are buffered against the succeeding 'break' or lever springs.

(b) When a 'make' spring is buffered against a 'break' spring, the 'make' spring should remain in contact with the buffer of the 'break' spring throughout its travel. When there is a sequence of 'break' contacts in an assembly, these 'break' contacts should open simultaneously, or in sequence, commencing from the first 'break' contact.

(c) When a 'make' spring is buffered against a lever spring, its tension should not be such that it lifts the buffer of the lever spring away from its preceding lever spring (see Fig. 65).

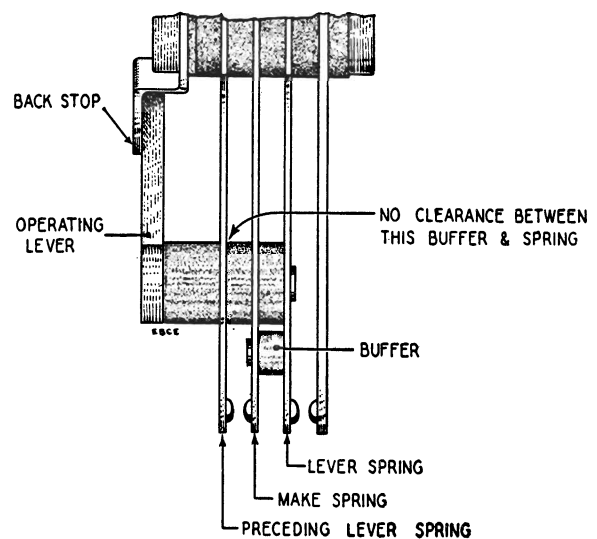


FIG. 65.—'MAKE' SPRING BUFFERED
AGAINST A LEVER SPRING

(d) In certain cases, buffer pressures are specified for lever springs. These buffer pressures should be measured with the gauge detail applied to the bottom of the 'V' portion of the spring. This pressure should be measured when the lever spring is free of its associated 'break' spring and/or outer lever spring.

53. Adjustment of typical spring-sets.—The following adjustments are detailed in, and the letters shown in the illustrations against the springs concerned also indicate, the order in which the adjustment should be made.

54. Single 'make' contact (see Fig. 66).

(a) Spring No. 2 should be adjusted so that it is straight throughout its length.

(b) The operating-lever back stop should be adjusted so that there is a contact clearance of 20 ± 10 mils. This clearance should be checked with the operating lever normal and the lever-spring buffer resting against the operating lever.

(c) Spring No. 1 should be tensioned so that its buffer rests against the operating lever with a pressure of 20 ± 10 gm.

(d) The operating lever should be adjusted by bending so that, when the springs are operated, the travel is such that the contact pressure of the 'make' contact is 30 ± 10 gm.

55. Two 'break' contacts (see Fig. 67).

(a) Spring No. 1 should be adjusted so that it is straight throughout its length.

(b) Spring No. 2 should be tensioned to exert a contact pressure of 30 ± 10 gm. on spring No. 1.

(c) Spring No. 4 should be tensioned to exert a contact pressure of 30 ± 10 gm. on spring No. 3; springs Nos. 3 and 4 should also be adjusted to open simultaneously, or in sequence, with springs Nos. 1 and 2.

(d) The operating lever should be adjusted by bending so that, when the springs are operated, the travel is such that the contact opening of the 'break' contacts is 20 ± 10 mils.

(e) The operating-lever back stop should be adjusted so that there is a clearance of not more than 10 mils between the operating lever and the buffer of spring No. 2.

56. Three 'change-over' contacts (see Fig. 68).

(a) Spring No. 1 should be adjusted so that it is straight throughout its length.

(b) Spring No. 2 should be tensioned to exert a contact pressure of 30 ± 10 gm. on spring No. 1.

(c) Spring No. 5 should be tensioned so that its buffer rests on spring No. 2 with a pressure of 40 ± 10 gm.

(d) Spring No. 8 should be tensioned so that its buffer rests on spring No. 5 with a pressure of 40 ± 10 gm.

(e) Springs Nos. 3 and 4 should be tensioned towards spring No. 5, so that the contact pressure between springs Nos. 4 and 5 is 30 ± 10 gm. (Check that the tension will not lift the buffer of spring No. 5 away from spring No. 2.)

(f) Springs Nos. 6 and 7 should be tensioned towards spring No. 8 so that the contact pressure between springs Nos. 7 and 8 is 30 ± 10 gm. (Check that the tension will not lift the buffer of spring No. 8 away from spring No. 5.)

(g) The operating lever should be adjusted by bending so that, when the springs are operated, the travel is such that the contact pressure of springs Nos. 3 and 6 is 30 ± 10 gm.

(h) Spring No. 9 should be adjusted so that, when operated, its contact pressure is 30 ± 10 gm.

(j) The operating-lever back stop should be adjusted so that there is a clearance of not more than 10 mils between the operating lever and the buffer of spring No. 2.

57. One 'break', one 'change-over' and two 'make' contacts (see Fig. 69).

(a) Spring No. 1 should be adjusted so that it is straight throughout its length.

(b) Spring No. 2 should be tensioned to exert a contact pressure of 30 ± 10 gm. on spring No. 1.

(c) Spring No. 4 should be tensioned to exert a contact pressure of 30 ± 10 gm. on spring No. 3; springs Nos. 3 and 4 should also be adjusted to open simultaneously, or in sequence, with springs Nos. 1 and 2.

(d) Spring No. 6 should be tensioned so that its buffer rests on spring No. 4 with a pressure of 20 ± 10 gm.

(e) Spring No. 8 should be tensioned so that its buffer rests on spring No. 6 with a pressure of 20 ± 10 gm.

(f) Spring No. 5 should be tensioned so that its buffer rests on spring No. 6.

(g) Spring No. 7 should be tensioned so that its buffer rests on spring No. 8. (Check that the tension of springs Nos. 5 and 7 will not lift the buffer of springs Nos. 6 and 8 away from springs Nos. 4 and 6.)

(h) The operating lever should be adjusted by bending, so that, when the springs are operated, the travel is such that the contact pressure of springs Nos. 5 and 7 is 30 ± 10 gm.

(j) Spring No. 9 should be adjusted so that, when operated, its contact pressure is 30 ± 10 gm.

(k) The operating-lever back stop should be adjusted so that there is a clearance of not more than 10 mils between the operating lever and the buffer of spring No. 2.

58. Vertical off-normal springs (abbreviation 'N').—When making the following adjustments, it will be found convenient to hold the rotary-detent latch away from its lock, so that the 'N' springs can be operated by rotating the carriage direct into the normal level. It may also be necessary to set the lever back stop away from the operating lever.

(a) The operating lever should be adjusted in conjunction with the spring assembly so that, on the return of the carriage to the normal position, the lever has sufficient movement to give the required travel to the lever springs. Adjustments to the operating lever should be made by bending the lever

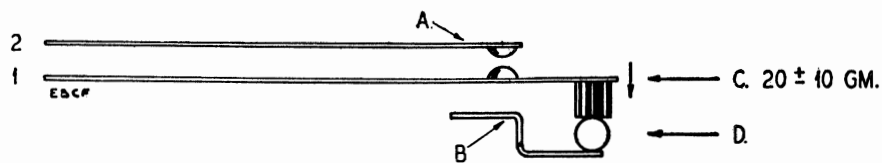


FIG. 66.—SINGLE 'MAKE' CONTACT

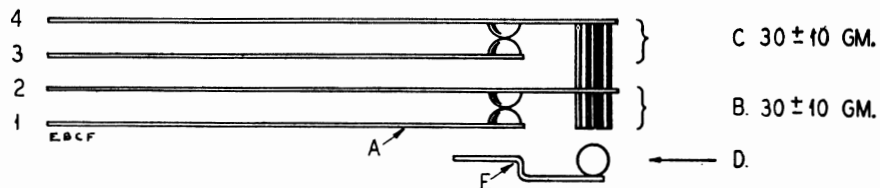


FIG. 67.—TWO 'BREAK' CONTACTS

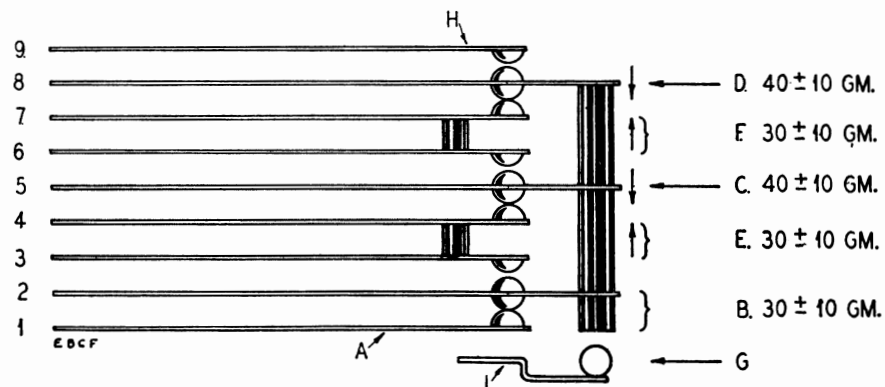


FIG. 68.—THREE 'CHANGE-OVER' CONTACTS

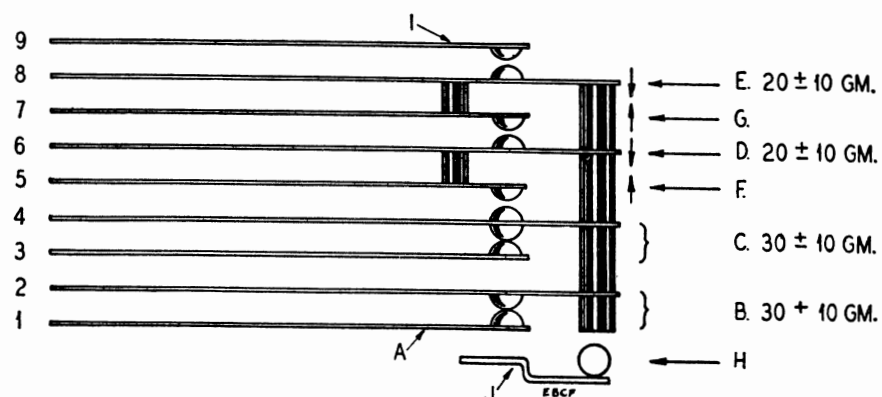


FIG. 69.—ONE 'BREAK', ONE 'CHANGE-OVER' AND TWO 'MAKE' CONTACTS

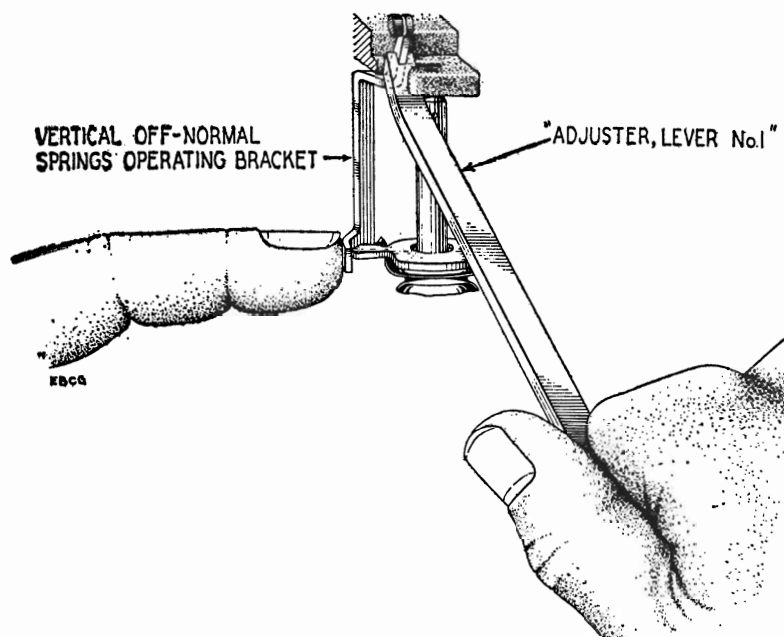


FIG. 70.—ADJUSTING THE VERTICAL OFF-NORMAL SPRING-OPERATING LEVER

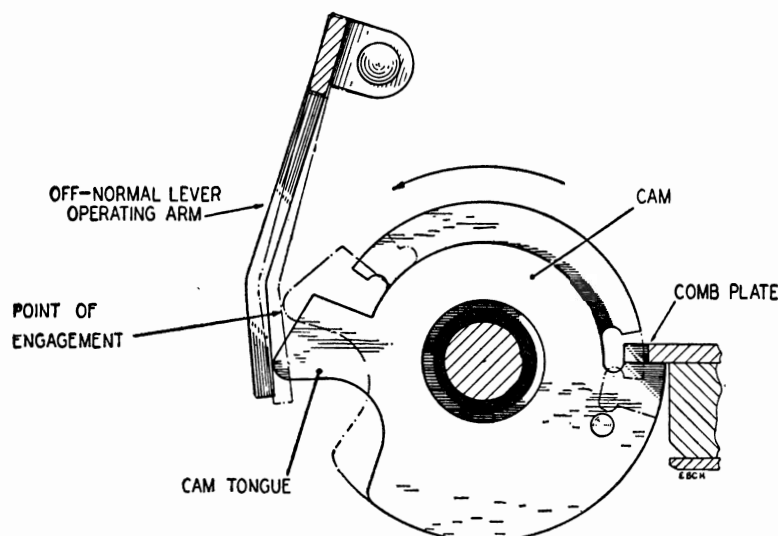


FIG. 71.—SHOWING POINT OF ENGAGEMENT OF CAM WITH VERTICAL OFF-NORMAL LEVER OPERATING ARM

just above its shoulder (see Fig. 70). It will be found that, when the correct travel of the operating lever has been obtained, the tongue on the cam commences its engagement with the lever-operating arm at a point just past the cranked portion of the arm (see Fig. 71). If the cam is striking the lever before it has passed the cranked portion, the lever should be removed from the selector and the operating arm bent to the shape shown in Fig. 72.

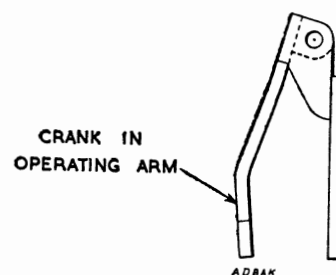


FIG. 72

(b) The lever-operating arm should be set, by bending upwards or downwards, so that there is a just-perceptible clearance between its top surface and the underside of the cam when the carriage assembly is raised to the first level (see Fig. 73). The arm should be bent by the use of "Pliers, Adjusting, No. 3". If considerable bending is required, it may be necessary to remove the assembly from the selector.

59. 11th-step springs (abbreviation 'S').—The operating lever should be adjusted in conjunction with the spring assembly so that, when the carriage is stepped to the 11th step on level 0, the lever has sufficient movement to give the required travel to the lever springs. Adjustments to the operating lever should be made as shown in Fig. 74. It should be checked that the vertical alignment of the operating

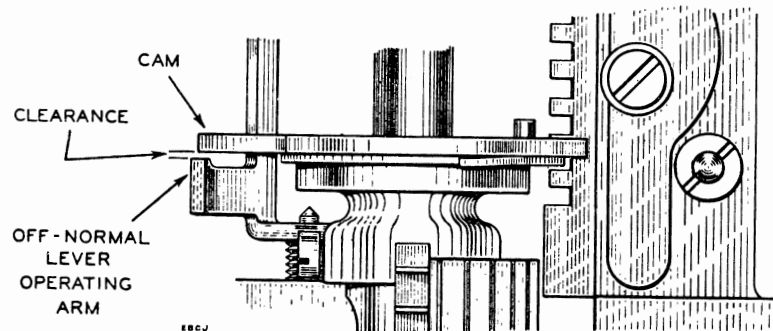


FIG. 73.—SHOWING CLEARANCE BETWEEN VERTICAL OFF-NORMAL LEVER OPERATING ARM AND CAM

When this adjustment is being made, care should be taken to ensure that the adjustments detailed in (a) are not disturbed. With the carriage assembly raised to level 1 and the vertical detent and pawl held out of engagement with the vertical ratchet, the adjustments detailed in (a) and (b) should ensure that, when the carriage assembly is held by the cam resting on the operating arm, the rotary disk enters the comb slot freely when the carriage is rotated by operating the rotary armature.

NOTE:—On selectors fitted with chamfered rotary disks, the carriage may rise slightly as it cuts-in, but on selectors fitted with disks having a square-cut entering edge, the carriage must enter the comb slot without rise.

lever is such that the movement of the lever springs is approximately the same on levels 1 and 0. This can be done by checking the contact pressure of a 'make' contact, when the carriage is standing on the 11th contact of level 1, and comparing the contact pressure of the same contact when the carriage is standing on the 11th contact of level 0 (see Note). If a 'make' contact is not fitted, the contact opening of a 'break' contact should be checked. If there is variation outside the permitted tolerances, the brackets should be re-set by positioning the carriage on the 11th contact of level 1 or 0, whichever is concerned, and gently levering inwards the bracket remote from the cam. It will be found, however, that the brackets will require only slight adjustment. The use of a

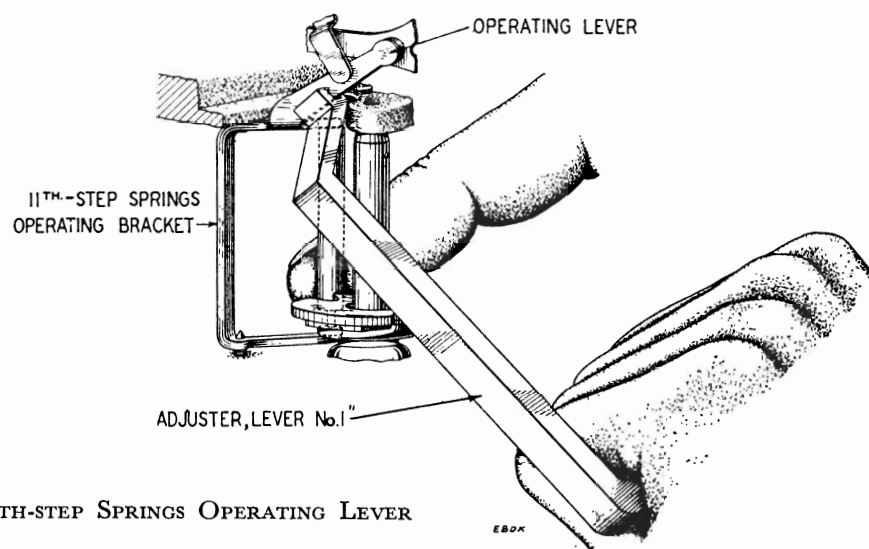


FIG. 74.—ADJUSTING 11TH-STEP SPRINGS OPERATING LEVER

small screwdriver will be found convenient for making this adjustment, its tip being applied to the bracket to press it gently inwards (see Fig. 75). A check

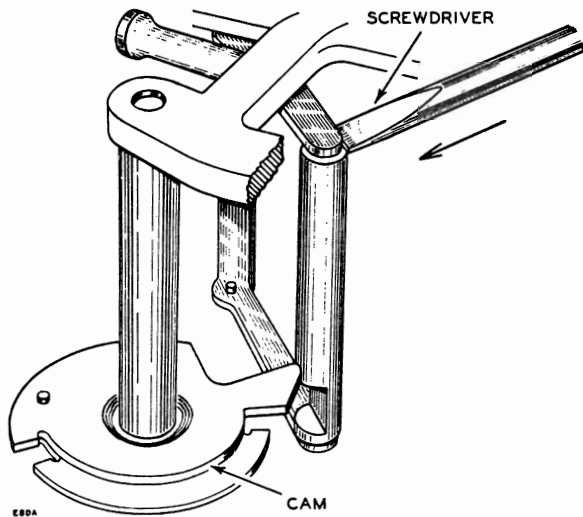


FIG. 75.—ADJUSTING 11TH-STEP OPERATING BRACKET TO CORRECT THE VERTICAL ALIGNMENT OF THE ROLLER

should also be made to ensure that the cam clears the lever on the steps preceding and succeeding the 11th step, and that the cam is clear of the full and reduced diameters of the lever during the release of the carriage from the 12th rotary step on level 0 (see Fig. 76).

NOTE:—When measuring contact pressures of 'make' contacts, care should be taken to ensure that the carriage is definitely on the 11th step, with the rotary detent resting against the short face of the rotary notch.

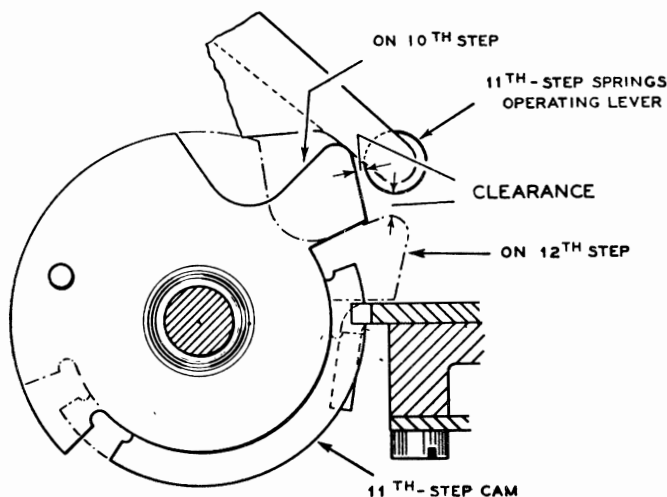


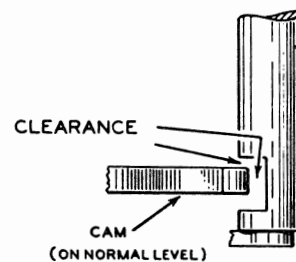
FIG. 76.—CHECKING POSITION OF OPERATING BRACKET OF 11TH-STEP SPRINGS

60. Rotary off-normal springs (abbreviation 'NR').—The operating lever should be adjusted in conjunction with the spring assembly so that, when the carriage is rotated one step on level 0, the lever has sufficient movement to give the required travel to the lever springs. Adjustments to the operating lever should be made as indicated for the lever of the 'S' springs. The adjustments should be checked as detailed in (a), (b) and (c).

(a) Check that the vertical alignment of the operating surface of the lever is such that the movement of the lever springs is approximately the same when the carriage is stepped to the first rotary position on levels 1 and 0. This can be done by checking the contact pressure of a 'make' contact when the carriage is standing on the first contact of level 1, and comparing the contact pressure of the same contact when the carriage is standing on the first contact of level 0. If a 'make' contact is not fitted, the contact opening of a 'break' contact should be checked. If there is variation outside the permitted tolerances, the brackets should be re-set by positioning the carriage on the first contact of levels 1 or 0, whichever is concerned, and gently levering inwards the bracket remote from the cam. It will be found, however, that the brackets will require only slight adjustment.

(b) When the carriage is rotating over any level, there should not be any appreciable variation in contact pressure or contact opening. This should be checked with the carriage in the first, second and tenth rotary positions. If such variation exists and the contact pressures or openings cannot be kept within their specified tolerances, the spring-set operating cam should be changed.

(c) Check that the cam clears the operating surface of the lever during vertical stepping, and also clears the full and reduced surface of the lever during the complete return of the carriage to normal from the 12th rotary position of level 0 (see Fig. 77). Clearance can be obtained by bending the two lever brackets upwards or downwards, as required.



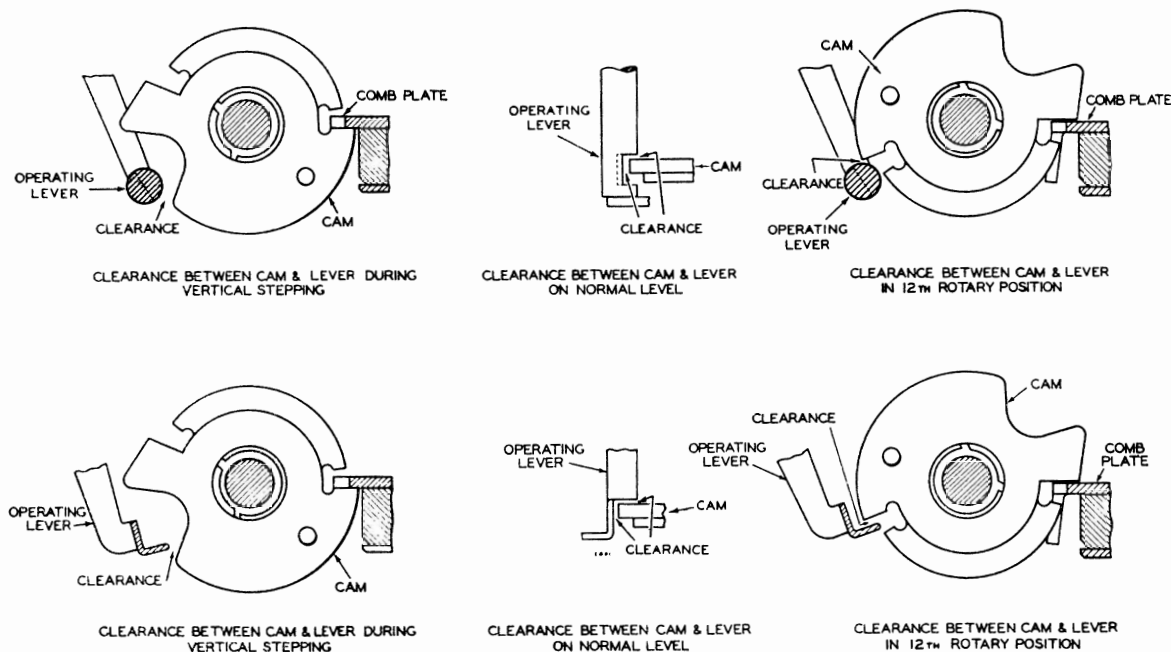


FIG. 77.—CHECKING POSITION OF OPERATING BRACKET OF ROTARY OFF-NORMAL SPRINGS

61. Level springs (abbreviation 'NP').—On circuit diagrams, level springs are designated as 'NP' when only one spring-set is fitted, and 'NPA' and 'NPB' when two spring-sets are fitted. For adjust-

ment purposes the level springs are considered as 'NPA' and 'NPB' only, the former occupying the inner position and the latter the outer position. The spring-sets are operated by two steps on a tongue of an auxiliary cam at the carriage head; the inner step operates the 'NPA' spring-set, and the outer step operates the 'NPB' spring-set (see Fig. 78). A tongue adjuster is provided for the adjustment of the tongue; the end of the tool marked 'A' should be used for adjustment to the 'NPA' operating step, and the end marked 'B' for the adjustment of the 'NPB' operating step (see Fig. 79). If the same level spring-set is required to operate on two or more adjacent levels, cam plates are fitted as shown in Fig. 80.

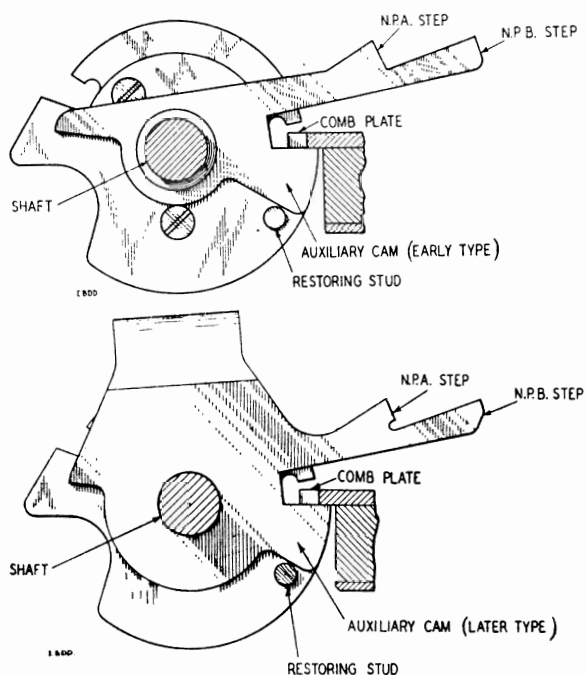


FIG. 78.—VIEW OF LEVEL-SPRING AUXILIARY CAM

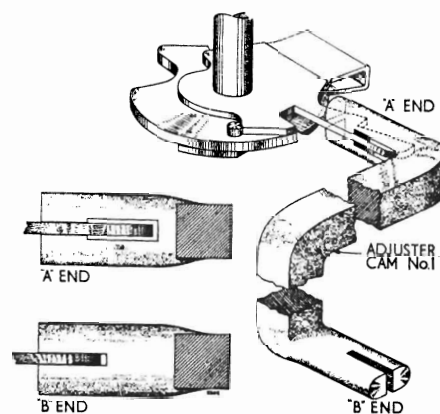


FIG. 79.—ADJUSTING THE N.P.A. AND N.P.B. OPERATING STEPS

62. The adjustments are detailed in (a) to (e).

(a) The auxiliary cam should be free on the carriage, with a minimum amount of vertical play, and should lie flat on the top of the carriage. The vertical play can be taken-up by adjustment of the upturned tongue at its lower bearing (see Fig. 81). Side play in the lower bearing should also be at a minimum. This can be adjusted by rotating the tongue bracket about its clamping screw.

Check that there is a clearance between the 11th step cam on the carriage and the inside face of the auxiliary cam, when the carriage is rotated from the 5th to the 10th rotary position on any level, when a cam is fitted (see Fig. 82).

NOTE 1.—On early selectors, the auxiliary cam is located by a bush on the carriage head (see Fig. 78). If vertical or side play develops in this type of cam, the cam should be changed for one of the later type, also shown in Fig. 78.

NOTE 2.—On some early supplies of selectors fitted with the later type of auxiliary cam, two thin washers were fitted between the underside of the cam and the top of the carriage. These washers have been found unnecessary and should be removed and scrapped if, or when, occasion arises to dismantle the carriage assembly. The excess vertical play resulting from the removal of the washers should be taken-up by adjustment as detailed in (a).

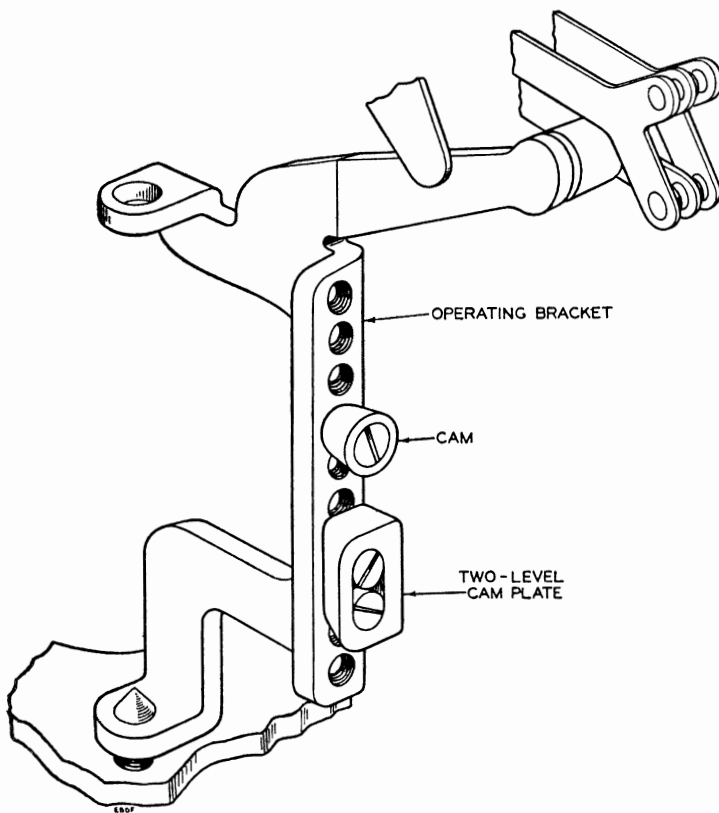


FIG. 80.—SHOWING TWO-LEVEL CAM PLATE FITTED TO OPERATING BRACKET

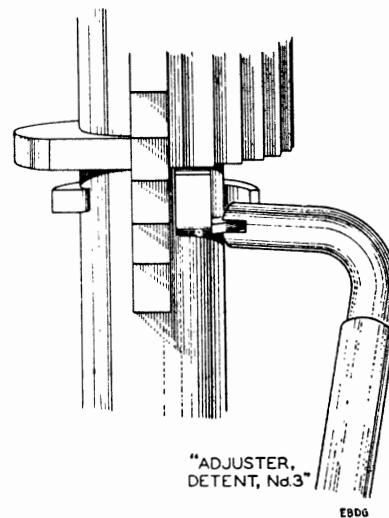


FIG. 81.—ADJUSTMENT OF AUXILIARY CAM

If bending occurs, the auxiliary cam should be changed.

There must also be a clearance between the curved arm of the lower bearing of the auxiliary cam and the vertical ratchet, when the carriage is stepped from the 6th to the 11th rotary position on any level, where a level cam is fitted (see Fig. 83). If binding occurs at

this point, the curved arm should be set downwards. It is permissible to remove the sharp corner of the arm if the necessary clearance cannot be obtained without distorting the arm.

Lack of clearance at either of the points shown in Figs. 82 and 83 is liable to cause premature return of the level springs during rotation.

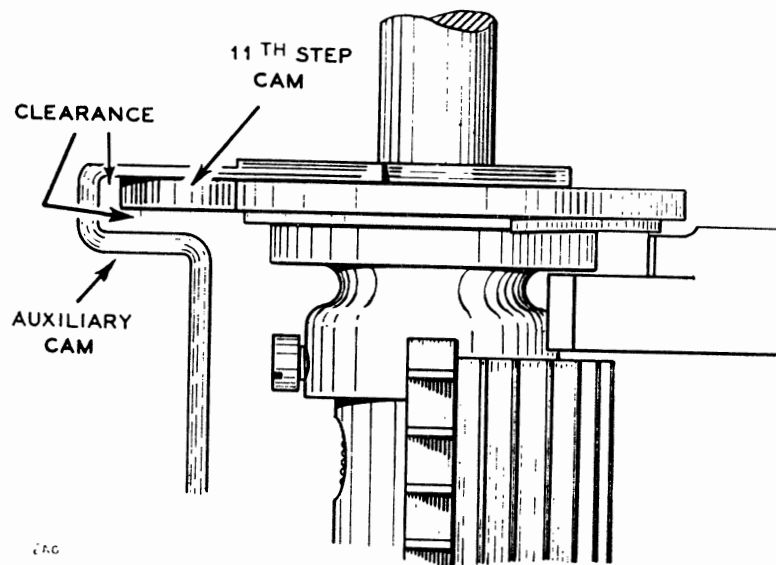


FIG. 82.

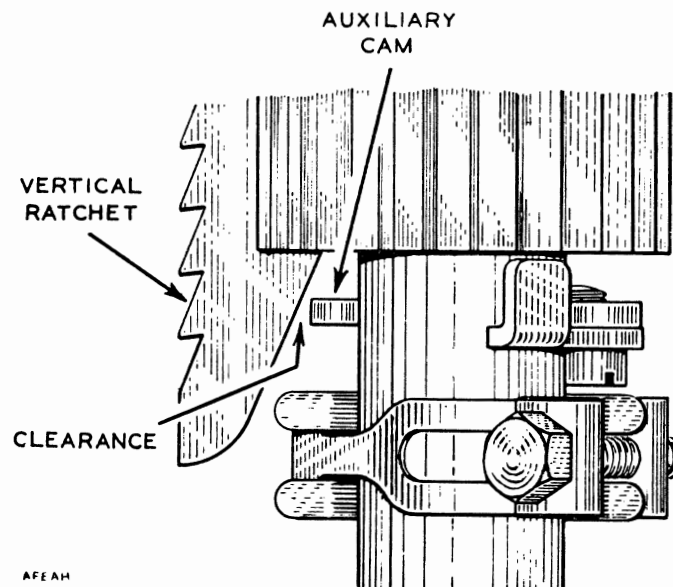


FIG. 83.

(b) *The operating tongue* should be adjusted, by bending up or down, so that its step engages centrally with the cam when the carriage is standing on the level on which the springs are to operate (see Fig. 84). When this adjustment is being made, the carriage should be held in the 12th rotary position, and the auxiliary cam supported by being clamped firmly against the rotary off-normal cam, using "Pliers, Wiring, No. 2" inserted from the front of the selector between the shaft and the comb plate; the upper jaw of the pliers should bear directly on the top of the auxiliary cam, and the lower jaw should bear against the flange at the top of the rotary hub. This method of supporting the auxiliary cam is necessary to prevent distortion, which would result in the cam not lying flat on the carriage. If cam plates are fitted, the operating steps should line-up with the centre of either of the cam-plate fixing screws. It should be noted that if the 'NPA' step is adjusted, the 'NPB' step will be affected. The 'NPB' step should be corrected by setting the tongue, up or down as required, from a point immediately in front of the 'NPA' step. The operating tongue should clear the cam or cam-plate when the carriage is standing on the vertical steps preceding and succeeding that on which the springs are intended to operate (see Fig. 85).

(c) The operating tongue should hold the level springs operated during rotation, until released by the restoring stud on the cam of the carriage assembly, when the latter is stepped from the 11th to the 12th rotary positions.

(d) *The operating lever* should be adjusted in conjunction with the spring assembly so that, when the level springs are operated by the carriage standing on the required level, the lever has sufficient movement to give the required travel to the level springs. Check that, when the carriage is lifted gently upwards, by hand, so that the step on the operating tongue is just over the inclined face of the operating cam, or cam plate, the carriage returns fully on to the vertical detent when the hand is removed. Adjustments to the operating lever should be made as indicated for the lever of the 'S' springs.

(e) *Clearance.*—There should be a minimum clearance of 10 mils between the steps of the operating tongue and the cams on the operating bracket, when the carriage is returning to normal from the 12th rotary position on level 0 (see Fig. 86).

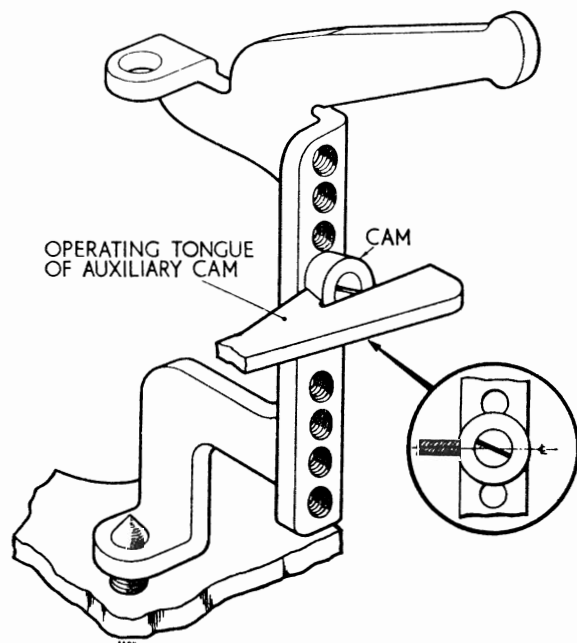


FIG. 84.—ALIGNMENT OF OPERATING TONGUE
WITH CAM

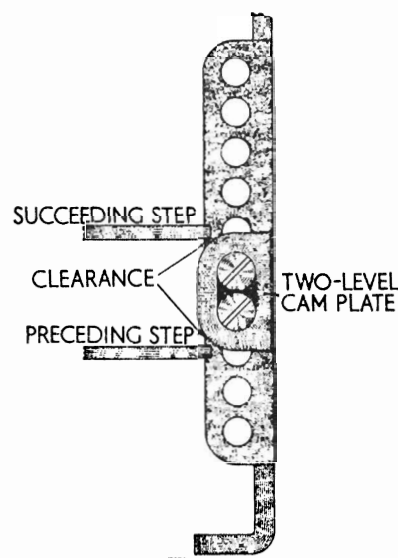


FIG. 85.—CLEARANCE ON
PRECEDING AND
SUCCEEDING STEPS

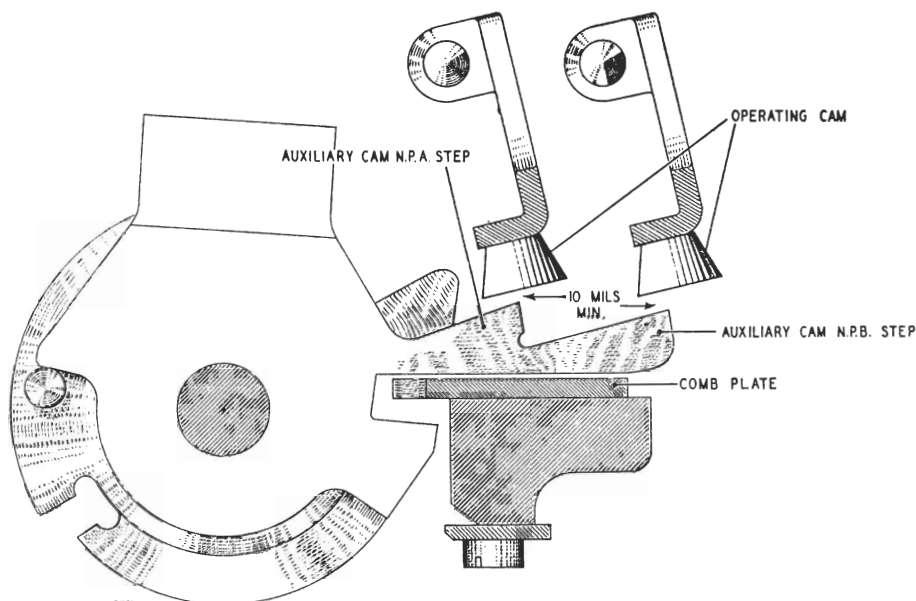


FIG. 86.—CLEARANCE BETWEEN OPERATING TONGUES AND CAMS
DURING RELEASE

MECHANICALLY OPERATED SPRING ASSEMBLIES, TYPE 2

(See Fig. 87)

(A) GENERAL

63. Operating levers ('N', 'NR' and 'S' only).

The operating levers should be free on their bearings with a minimum amount of vertical or side play. Vertical play can be taken-up by adjustment of the

bottom bearing screws. The dome on the operating arm on the lever should engage the auxiliary armature at a point approximately midway between the spring assemblies (see Fig. 88). When the operating arm of the lever is resting against its back stop, there should be a gap, not exceeding 6 mils, between the dome on the operating arm and the auxiliary armature (Fig. 89). Adjustment should be made by bending the back stop, using "Pliers, Adjusting, No. 5".

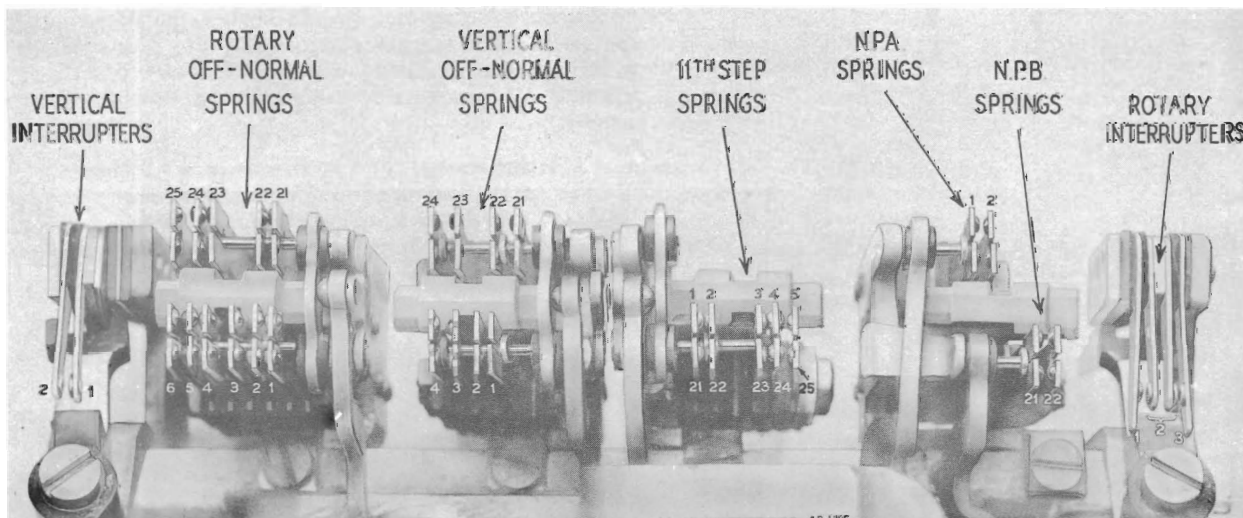


FIG. 87

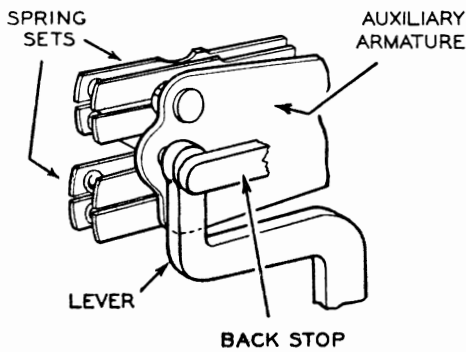


FIG. 88

64. Auxiliary armatures ('N', 'NR' and 'S' only).—The armatures should be free on their bearings with a minimum amount of side play. Both studs of the armature should rest on their back stops, when the armature is normal. When only one spring assembly is fitted, the stud on the free side of the armature may clear the arm of the bracket by 5 mils maximum (see Fig. 90).

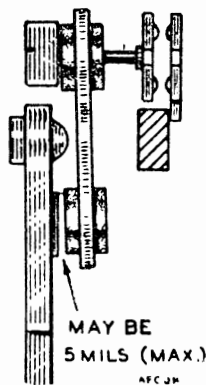


FIG. 90

65. Spring-sets ('NR' and 'S' only).—The position of the spring-sets should be such that there is a clearance of 20 mils minimum between the adjacent back stops (see Fig. 91).

66. Straightness of springs.—All springs should be firmly clamped in their assemblies. All spring-sets should be capable of operation without causing the lever-spring pins to bind on adjacent springs. There must also be a clearance between the sides of the springs and the buffer block. When the spring-sets are operated or non-operated, the clearance between adjacent springs of adjacent contact units should be 10 mils minimum.

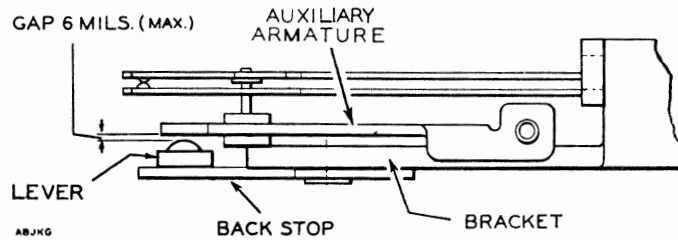


Fig. 89

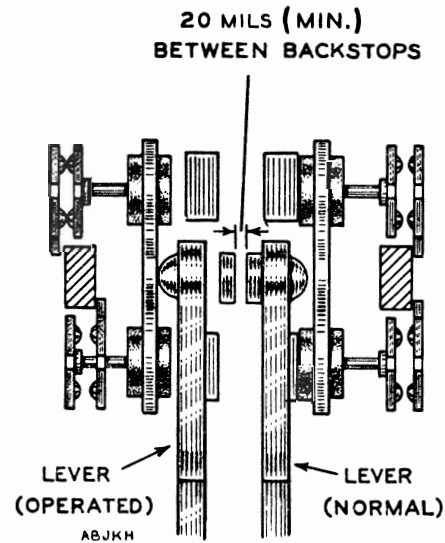


FIG. 91

The operating pins of all spring-sets should rest approximately centrally on the operating studs of the auxiliary armatures.

All buffered springs should be reasonably straight between the clamped portion and the point which rests on the buffer-block step. All lever springs should be reasonably straight throughout their length.

67. Alignment of twin-contact tongues.—Twin-contact points should open, and close, simultaneously as far as can be judged by eye.

An "Adjuster, Spring, No. 2" should be used for adjusting the tongues, as shown in Fig. 92.

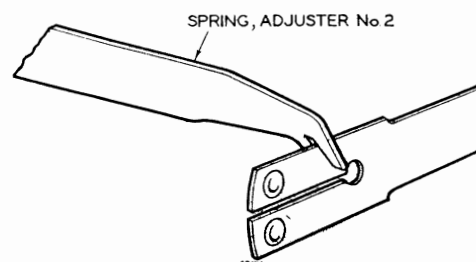


FIG. 92

68. Alignment of contacts.—Pairs of contact points which make electrical contact one with the other (one in one spring and the other in the adjacent spring) should not be out of alignment by more than one-third of the diameter of a contact (see Fig. 93). This can be judged by eye. If faulty, the spring-set should be changed.

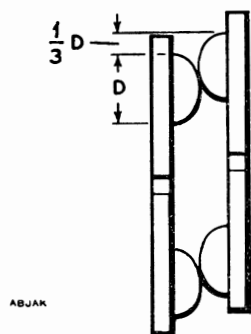


FIG. 93

69. Contact clearances.—The contact clearance on any contact unit should not be less than 10 mils. 'Break' contact units and the break portion of the 'change-over' contact units should be measured with the spring assembly operated. 'Make' contact units and the make portion of the 'change-over' units should be measured with the spring assembly normal. 'Change-over' contacts should have a minimum clearance of 8 mils between the 'break' contacts just before the 'make' contacts close during the change-over (see Fig. 94).

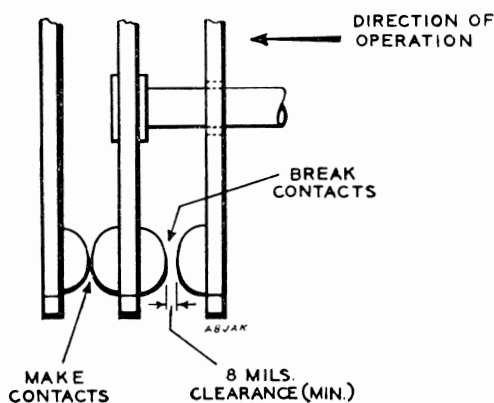


FIG. 94

70. Sequence of contact operation.—All 'break' contacts should open before any 'make' contacts close. If the clearances are found to be incorrect, the straightness of the springs, particularly the twin contacts, should be checked and corrected when necessary.

71. Buffer-block clearance.—With the spring-set unoperated, the 'break' springs of all 'break' or 'change-over' contact units should be at least 2 mils clear of the buffer-block step. Similarly, with the spring-set operated, the 'make' springs of all 'make' or 'change-over' contact units should be at least 2 mils clear of the buffer-block step. The spring lift should be judged by eye. If the lift is insufficient, the straightness of the springs should be checked. A contributory cause may be wear of the contacts, if so, the block clearance should be corrected by setting the springs immediately in front of the lifting pin or buffer stop. If the contact is pitted, it should be renovated and cleaned before re-adjustment. If the wear is found to be excessive, the spring-set should be changed.

72. Contact pressures and spring tensions (block pressures).—Contact pressure is not measured directly. It is determined by the pressure required to lift the contact springs away from the buffer-block steps. The pressure of the contact spring against the buffer-block step and the tension of the lever spring should be measured by applying the tension gauge so that the gauge pointer bridges the two tongues of the spring at the spring tip (see Fig. 95).

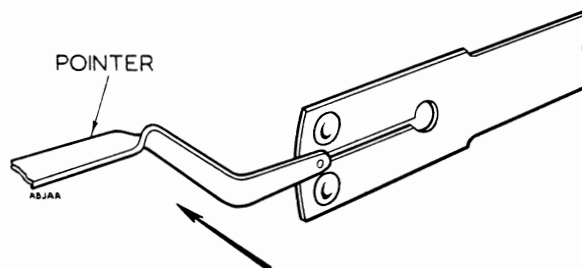


FIG. 95

(a) *Block pressures:*—

- (i) The 'make' springs of 'make' or 'change-over' contact units should rest on the buffer-block steps with a tension of 20 to 35 gm. (test) 25–30 gm. (re-adjust), when the spring-set is unoperated.
- (ii) The 'break' springs of 'break' or 'change-over' contact units should rest on the buffer-block steps with a tension of 20 to 35 gm. (test) 25 to 30 gm. (re-adjust), when the spring-set is operated.

(b) *Lever-spring tensions:—*

(i) Each lever spring should be tensioned towards the auxiliary armature so that its lifting pin or stud rests against its adjacent lever spring on the auxiliary armature.

On the outer lever spring, the tension should not be less than 5 gm. (test) 7 gm. (re-adjust). The total tension of all lever springs against the stud of the auxiliary armature, measured on the innermost lever spring, should be 5 to 30 gm. (test) 7 to 25 gm. (re-adjust) (see Fig. 96).

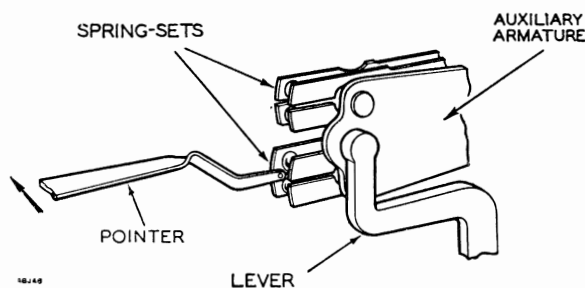


FIG. 96

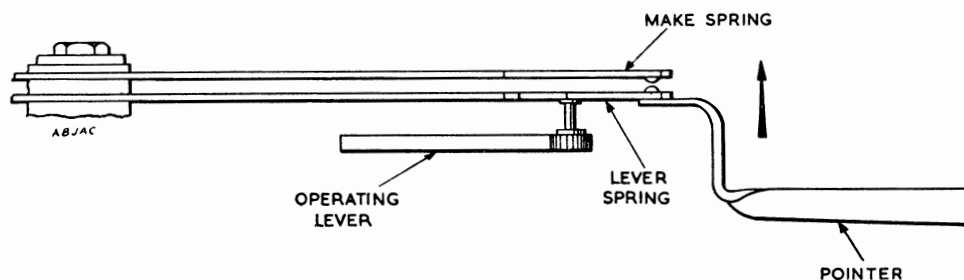


FIG. 97

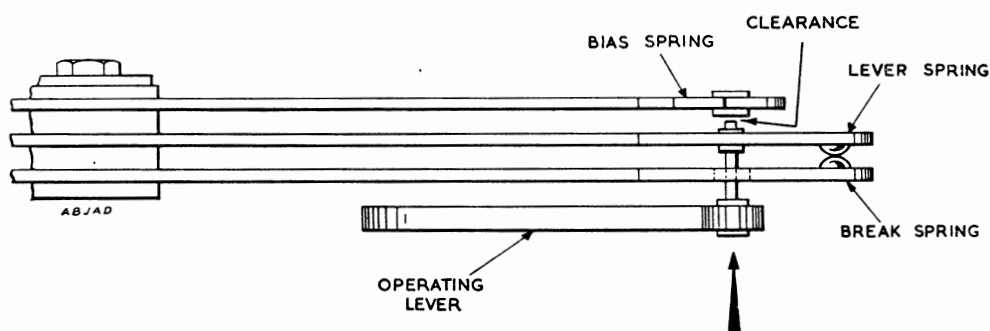


FIG. 98

(c) *Spring tensions of 'NPA' and 'NPB' spring-sets:—*

(i) When a single 'make' contact unit only is fitted, the lever spring should exert a pressure on the operating lever of 20 to 35 gm. (test) 25 to 30 gm. (re-adjust). See (a) above.

The tension should be measured at the point indicated in Fig. 97. Adjustments of other 'make' contact units should be made in accordance with sub-par. (b) above.

(ii) When a single 'break' contact unit only is fitted, the unit is provided with a bias spring (see Fig. 98). The bias spring should be adjusted as a 'make' spring of a 'change-over' unit and should exert a pressure of 20 to 35 gm. (test) 25 to 30 gm. (re-adjust) on the buffer-block step. The pressure should be measured with the spring-set unoperated and the gauge pointer applied adjacent to the lifting stud (see Fig. 99).

With the contact unit normal, there should be a clearance between the insulating stud on the bias

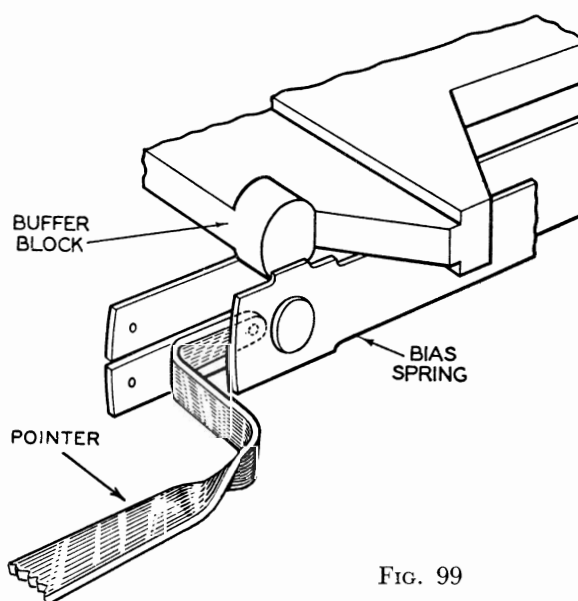


FIG. 99

spring and the lifting pin on the lever spring. See also (a) and (b) above.

(B) METHOD OF ADJUSTING SPRING-SETS

73. General.—The main principles of adjustment of the spring-sets are as follows:—

(a) Adjustment of each buffered spring against the block steps, and

(b) Adjustment of each lever spring, in turn.

74. Alternative tools.—Springs may be tensioned either with an "Adjuster, Spring, No. 12" or "Pliers, Adjusting, No. 2". When using pliers, it is important that the spring should be gripped lightly, otherwise the required tension will not be obtained.

75. Method of tensioning springs.—Do not increase, or decrease, the tension of a spring by merely giving it a bend or set. If the spring is set at the root, or bent at some point along the spring, the pressure at its lifting pin or stud will be increased but the spring

will not be straight and appreciable setting at the spring tip will be necessary to obtain the required contact opening. The correct method is to apply a uniform bow in the spring by stroking from its root to its lifting pin or lug so that, when it is finally set at its root to increase its pressure, the bow is removed and the spring becomes straight.

To increase the tension of a 'make' spring on the buffer-block step, by means of an "Adjuster, Spring, No. 12", proceed as follows:—

(a) Place the prongs of the tool over the root of the spring, as shown in Fig. 100.

(b) Using the tool as a lever, exert a light inward pressure on the spring, at the same time pressing the tip of the tool outwards (see Fig. 101).

(c) Keep the spring under pressure and gently draw the tool along the spring towards the buffer-block step (see Fig. 102) so that an outward bow is formed along the length of the spring.

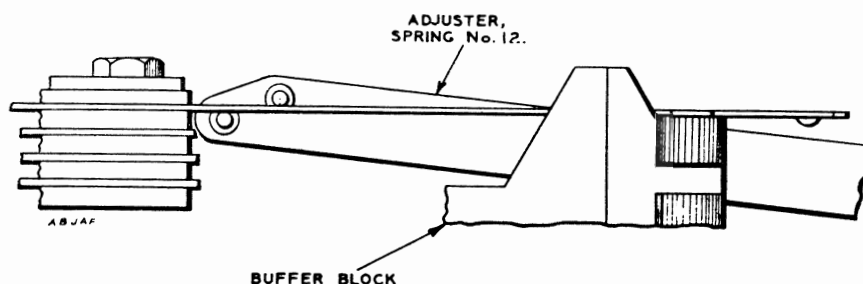


FIG. 100

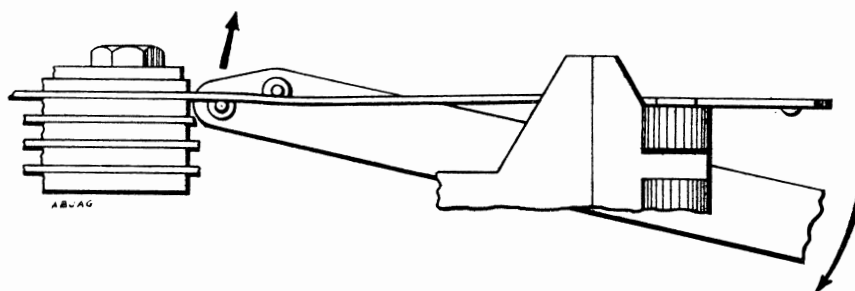


FIG. 101

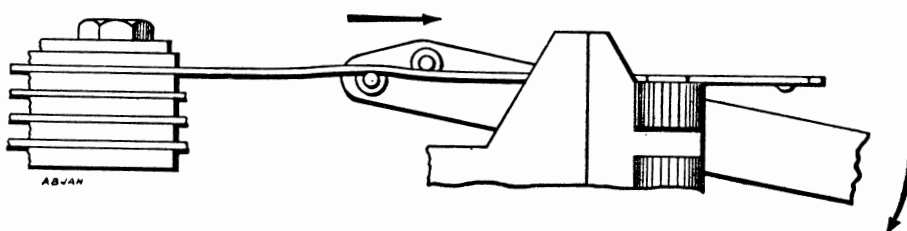


FIG. 102

(d) Replace the tool at the root of the spring and give the spring an inward set until the spring becomes straight (see Fig. 103).

By using the appropriate end of the tool (see Fig. 104), the tension in any spring can be increased or decreased. To decrease the tension, a procedure similar to that for increasing the tension should be followed, except that the spring should be stroked so as to decrease the bow in the spring.

If "Pliers, Adjusting, No. 2" are used, employ a similar forward-stroking action, i.e. starting at the fixed end of the spring and stroking uniformly and firmly towards the buffer block until a bow is formed; then give the spring a set at the root to increase the tension and straighten the spring.

76. Vertical off-normal springs ('N' springs).

When making adjustments, it will be found convenient to hold the rotary-detent latch away from its lock so that the 'N' springs can be operated by rotating the carriage direct into the normal level.

(a) The operating lever should be located to meet the requirements specified in par. 63.

(b) The movement of the operating lever, which is provided by the cam striking the lever tongue when the carriage returns in the normal level, should be sufficient to give the required travel to the lever springs. This may be checked by withdrawing the rotary latch, moving the carriage into the normal level and observing that the springs operate fully, when the carriage returns to normal.

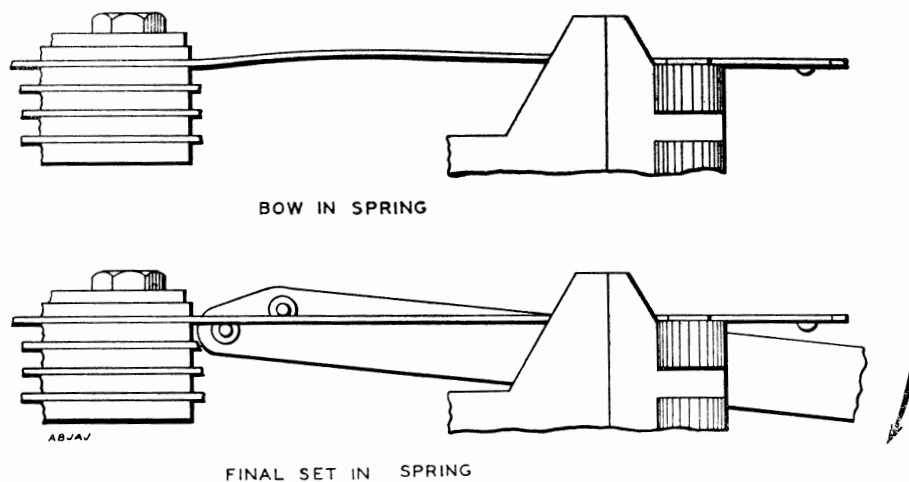


FIG. 103

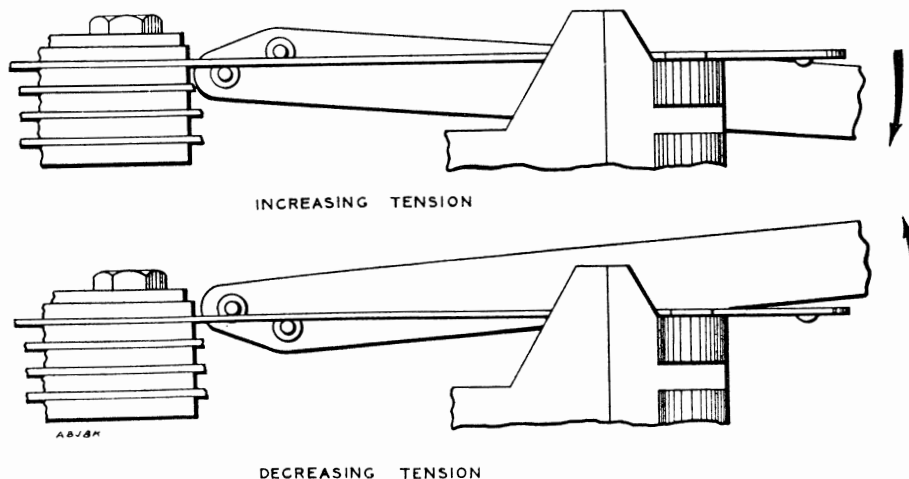


FIG. 104

(c) When the carriage is returning in the normal level, the cam should engage the tongue of the operating lever at a point just beyond the cranked portion in the lever (Fig. 105). If the cam is striking the lever before it has passed the cranked portion, the lever should be adjusted to the shape shown in Fig. 72.

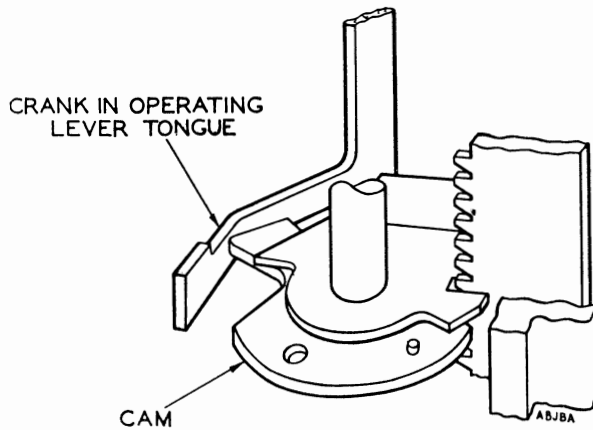


FIG. 105

(d) When the hub assembly is raised to the first level, there should be just-perceptible clearance between its top surface and the underside of the cam (see Fig. 106). The lower operating arm should be bent upwards, or downwards, to provide the required clearance.

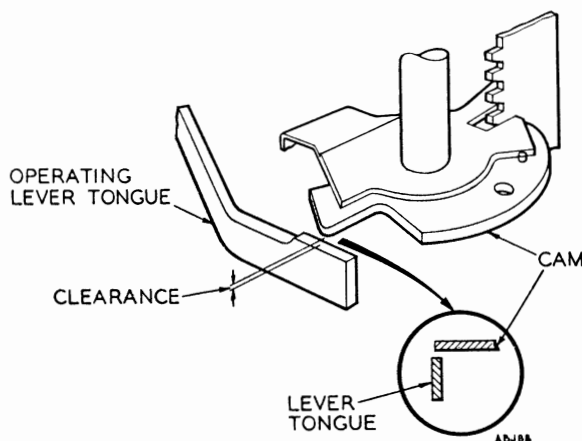


FIG. 106

When this adjustment is being made, care should be taken to ensure that the adjustments detailed in (a) to (c) are not disturbed.

(e) With the hub assembly raised to level 1 and the vertical detent and pawl held out of engagement with the vertical ratchet, the adjustments detailed in (a) to (d) should ensure that the rotary disk enters the comb slot freely, when the hub assembly is rotated by operating the rotary armature.

NOTE:—On no account must the rotary disk strike the comb plate on that portion of the disk above the chamfer.

77. 11th-step springs ('S' springs).

(a) The operating lever should be located to meet the requirements specified in par. 63.

(b) The movement of the operating lever, which is provided by the projection on the rotary cam when stepping into the 11th position, should be sufficient to fully operate the springs. This should be checked on level 5.

If insufficient movement of the springs is obtained, the operating lever should be bent towards the springs, as shown in Fig. 107. An "Adjuster, Lever, No. 2" should be used for this purpose.

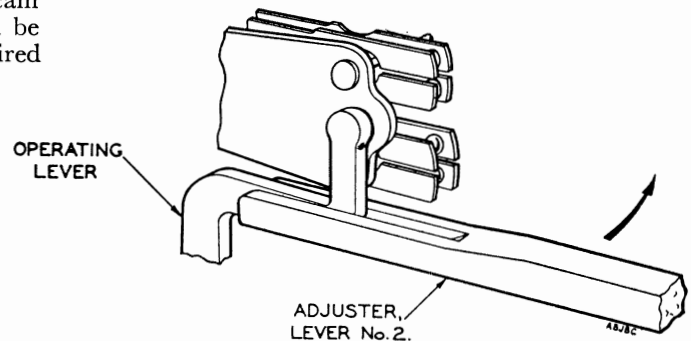


FIG. 107

(c) Check that the vertical alignment of the operating surface of the lever is such that the movement of the lever springs is approximately the same on levels 1 and 0. This can be done by checking the contact pressure of a 'make' contact, when the carriage is standing on the 11th contact of level 1, and comparing the contact pressure of the same contact when the carriage is standing on the 11th contact of level 0. If a 'make' contact is not fitted, the contact opening of a 'break' contact should be checked.

NOTE:—When measuring contact pressures, care should be taken to ensure that the carriage is definitely on the 11th step, with the rotary detent resting against the short face of the rotary notch.

If adjustment of the operating surface of the lever is necessary, an "Adjuster, Lever, No. 2" should be used. The jaws of the tool should be placed over the horizontal web of the lever (see Fig. 108) and the web gently turned until the desired position is obtained.

(d) A check should be made to ensure that the cam on the hub assembly clears the operating lever on the steps preceding and succeeding the 11th step; also during release on the normal level. The selector should also restore reliably from the 11th rotary position on any level.

78. Rotary off-normal springs ('NR' springs).

(a) The operating lever should be located to meet the requirements specified in par. 63.

(b) The movement of the operating lever, which is provided by the cam when the carriage enters the first rotary position, should be sufficient to fully operate the springs. This may be checked by observing that the spring-set operates correctly when the carriage is rotated one step on level 0. If insufficient movement of the springs is obtained, the operating lever should be bent towards the springs, as shown in Fig. 107. An "Adjuster, Lever, No. 2" should be used for this purpose.

(c) Check that the vertical alignment of the operating surface of the lever is such that the movement of the lever springs is approximately the same when the carriage is stepped to the first rotary position on levels 1 and 0. This can be done by checking the contact pressure of a 'make' contact when the carriage is standing on the first contact of level 1 and comparing the contact pressure of the same contact when the carriage is standing on the first contact of level 0. If a 'make' contact is not fitted, the contact opening of a 'break' contact should be checked. Any varia-

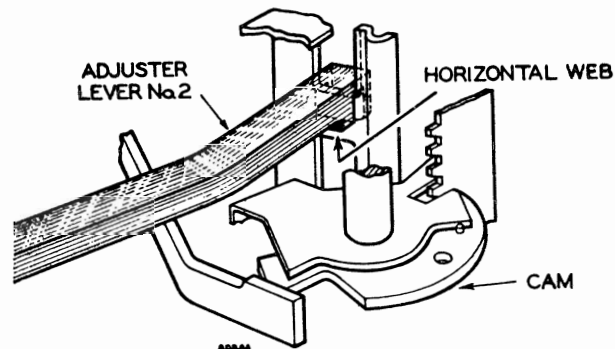


FIG. 108

tions should be corrected by locating the carriage on the first contact of levels 1 or 0, whichever is concerned, and gently levering inwards the arm remote from the cam.

(d) With the lever resting against its back stop, check that the cam clears the lever when the vertical armature is operated electrically on any vertical step or during release of the carriage (see Fig. 109).

(e) When the hub assembly is rotated over any level, there should not be any appreciable variation in the contact pressure or contact opening. This should be checked with the carriage in the first, second and tenth rotary positions.

(f) The vertical ratchet teeth should not foul the 'NR' lever when the carriage is in the 4th and 5th rotary positions on any level.

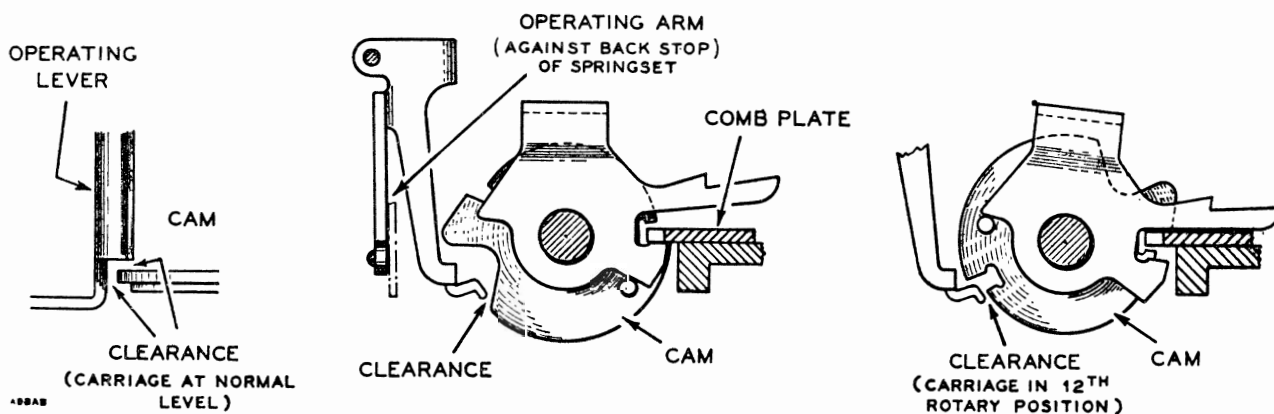


FIG. 109

79. Level springs ('NP').—The auxiliary-cam adjustments are detailed in pars. 51 and 62 (a), (b) and (c).

The operating lever should be adjusted so that the following conditions are met:—

(a) They are free on their bearings with a minimum amount of side play.

(b) After the springs have been adjusted, the levers should rest against their respective back stops.

(c) The travel of the lever, provided by the auxiliary cam passing on to the level cam, should be sufficient to fully operate the springs. This should be checked by stepping the carriage to a level on which a level cam is provided and noting the movement of the springs. If the travel is insufficient, the lever should be bent towards the springs, as shown in Fig. 107. An "Adjuster, Lever, No. 2" should be used for this purpose.

(d) When operated, the 'NPA' lever should not foul the buffer block or the 'NPB' back stop.

(e) The 'NPB' lever should not foul the buffer block in any position.

When the carriage is lifted gently upwards, by hand, so that the step in the operating tongue is just over the inclined face of the operating cam, or cam plate, the carriage should return fully into the vertical detent when the hand is removed. Adjustments to the operating lever should be made by an "Adjuster, Lever, No. 1". Check that the level-spring operating tongue holds the springs operated until released by the restoring stud on the cam, when the carriage is stepped from the 11th to the 12th rotary position.

There must be a clearance between the steps of the operating tongue and the cam (or cams) on the operating bracket, when the carriage is returned to normal from the 12th rotary step on level 0 (see Fig. 110).

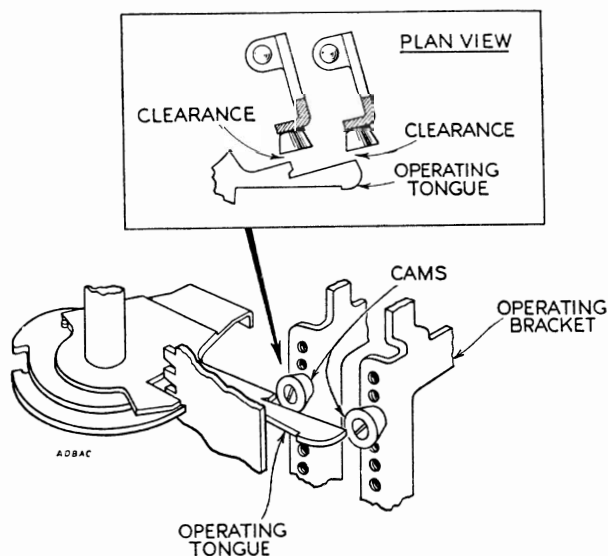


FIG. 110

When two contact units are fitted in the 'NPA' position, there must be a minimum clearance of 10 mils between the 'make' and 'break' springs of the adjacent contact units, when the level cam is on the point of releasing.

VERTICAL- AND ROTARY-INTERRUPTER SPRINGS

80. General.—The operating lever of the interrupter springs is so designed that, after being carried beyond its centre line by the operating striker, it continues its movement under the control of the loop spring until it reaches the stop. During this movement the lever operates contacts, the type of which is determined by the circuit requirements. The spring-set assembly employed for 'change-over' contacts is identical to that used for 'make-before-break' contacts, the function being determined by adjustment.

81. Before adjustments are made to an interrupter-spring assembly, the adjustments of the vertical or rotary movements (whichever are concerned) should be in accordance with the adjustments specified in this Instruction. It will be found to be of assistance if, before making the adjustments, the armature is wedged midway on its travel, so that the operating lever can be moved in either direction without being obstructed by the striker; to obtain this condition, a suitable wedge (made up locally) should be inserted between the armature and its back stop.

INTERRUPTERS Nos. 1 AND 2

82. Interrupter-spring operating lever.—The operating lever should be free on its bearings, with a minimum amount of play. The travel of the operating lever is determined by the location of the lever stops (which are set during manufacture and should not be disturbed). This travel ensures that if the 'break' contact performs the magnet-interrupter function, this contact does not open until the lever has passed its centre of balance.

[Par. 83 follows]

83. Contact pressures and clearances.

(a) *Contact pressures.*—The contact pressure of both 'break' and 'make' springs should be 40 ± 10 gm. (25 to 55 gm. test), measured at a point immediately in front of the contact (see Fig. 111). The contact pressure of the 'make' spring should be measured with the operating lever in the operated position.

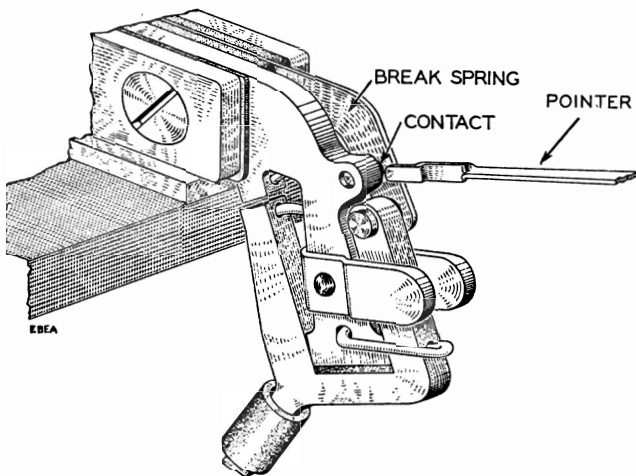


FIG. 111.—POINT OF APPLICATION OF GAUGE WHEN MEASURING CONTACT PRESSURE

(b) *Contact clearances.*—The tip of the 'break' contact on all types of interrupter spring-set should be adjusted by bending with "Pliers, Adjusting, No. 5" so that, when the operating lever is operated and resting fully against its stop, there is a contact clearance of 15 ± 3 mils between the 'break' contacts (see Fig. 112).

84. Adjustment of 'change-over' contacts.

To ensure that the 'break' contact opens before the 'make' contact closes, there should be a clearance of not more than 10 mils between the tip of the 'make' spring and the stud of the operating lever when the operating lever is fully operated (see Fig. 113). Adjustment may be effected by bending the tip of the 'make' spring with "Pliers, Adjusting, No. 5".

85. Adjustment of 'make-before-break' contacts.—The clearance between the tip of the 'make' spring and the stud of the operating lever when the lever is operated should be such that, during operation of the lever, the 'make' contact closes before the 'break' contact opens. Also, when the operating lever is normal, there should be a clearance of not less than 10 mils between the 'make' contacts (see

Fig. 114). Adjustment may be effected by bending the tip of the 'make' spring with "Pliers, Adjusting, No. 5".

86. Loop springs.—The loop spring should have sufficient tension to carry and hold the operating lever reliably over to its back stop, against the tension of the 'make' and 'break' springs. The tension of a loop spring can be increased by placing one of the tips of "Pliers, Wiring, No. 2" through the loop as shown in Fig. 115 and applying light pressure with the pliers, thus tending to straighten out the loop. The tension can be decreased by placing the tips of the pliers over the loop as shown in Fig. 116 and applying light pressure.

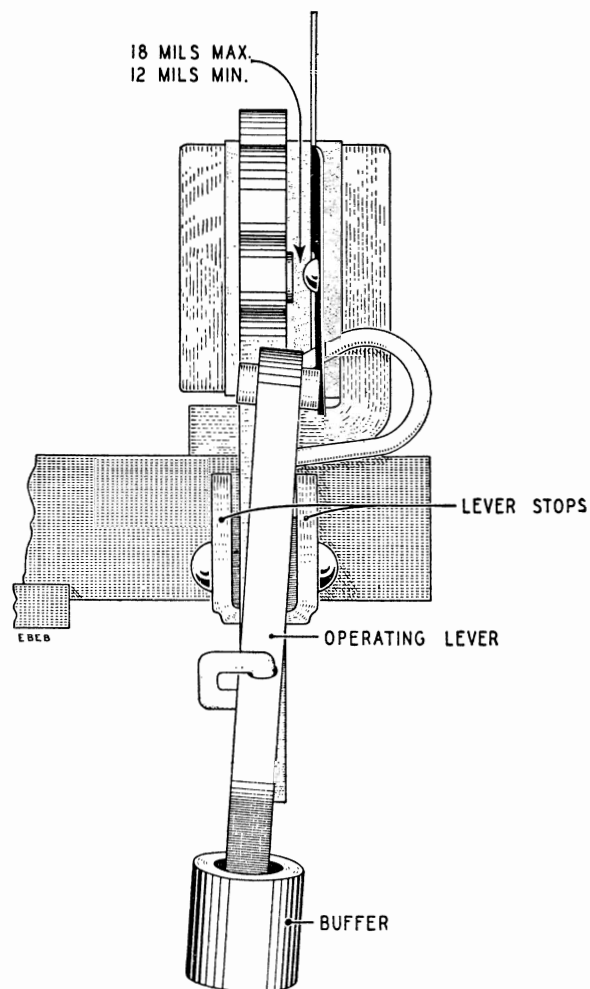


FIG. 112.—BREAK-CONTACT
ADJUSTMENT, LEVER
OPERATED

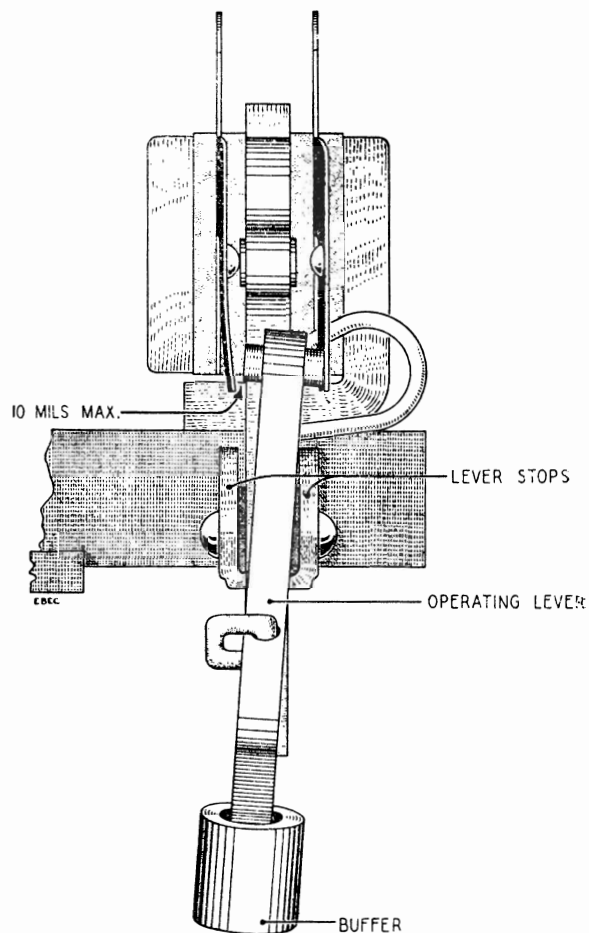


FIG. 113.—'CHANGE-OVER' CONTACT ADJUSTMENT, LEVER OPERATED

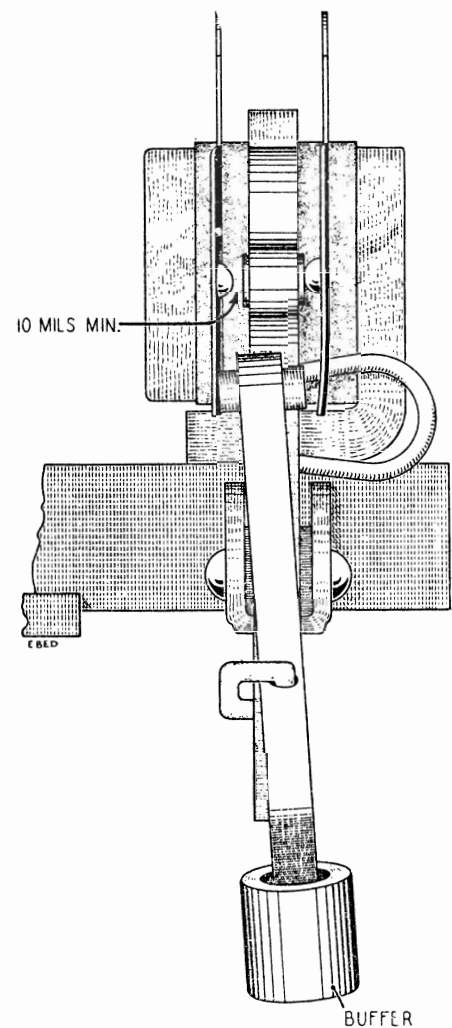


FIG. 114.—'MAKE-BEFORE-BREAK' CONTACT ADJUSTMENT, LEVER NORMAL

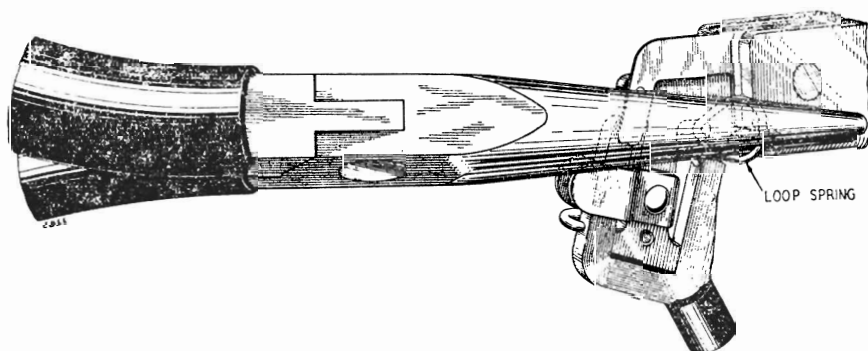


FIG. 115.—INCREASING TENSION OF LOOP SPRING

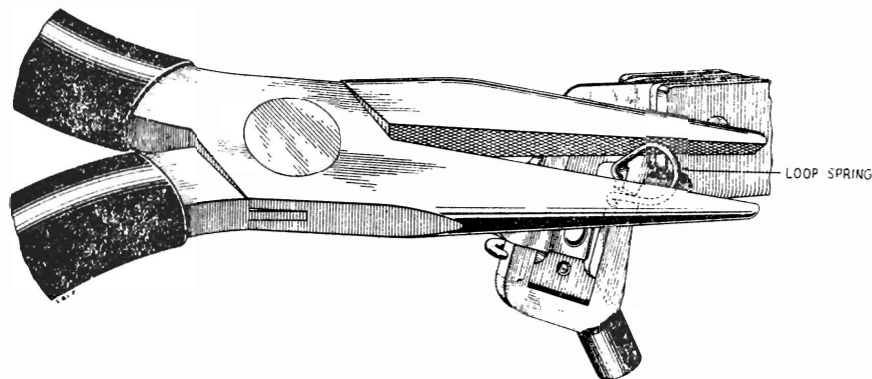


FIG. 116.—REDUCING TENSION OF LOOP SPRING

87. It is essential that the resultant tension of the loop and contact springs be such that the operating lever will not move from its stop with a pressure of 150 gm. applied immediately in front of the spring-operating stud on the lever (see Fig. 117). The lever should, however, trip over to the other stop with a pressure of 220 gm. This should be tested with the operating lever in both the operated and non-operated positions and, if it is found that the tension is unbalanced to the extent that it is outside the limits in one direction only, it may be corrected by:—

- (a) varying the contact pressure within the specified limits, or
- (b) varying the tension of the loop spring.

88. If adjustment within the limits of 150 to 220 gm. cannot be obtained by these methods, it indicates that the rear arm of the operating lever requires re-setting. For example, if it is found that by raising the tension on one side to just above the minimum of 150 gm. the tension of the other side is raised above the maximum of 220 gm., then the rear arm of the lever should be bent towards the side having the lowest tension. This can be done by holding the operating lever by placing the forked end of an "Adjuster, Interrupter, No. 5" over the horizontal limb of the lever, and, using an "Adjuster, Interrupter, No. 4", bending the rear arm of the lever in the desired direction. This method is illustrated in Fig. 118 for rotary-interrupter springs, and in Fig. 119 for vertical-interrupter springs.

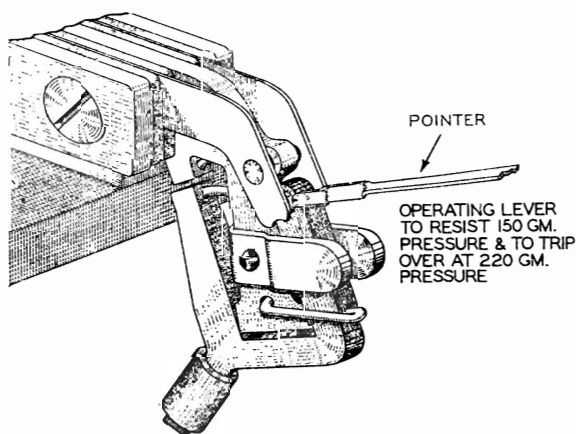


FIG. 117.—CHECKING TENSION OF LOOP AND CONTACT SPRINGS

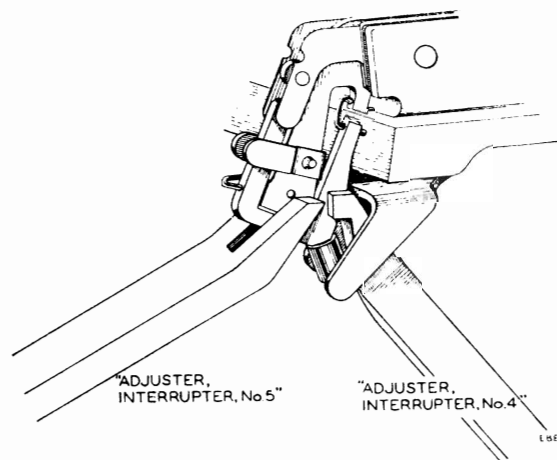


FIG. 118.—ADJUSTMENT OF OPERATING LEVER FOR ROTARY-INTERRUPTER SPRINGS

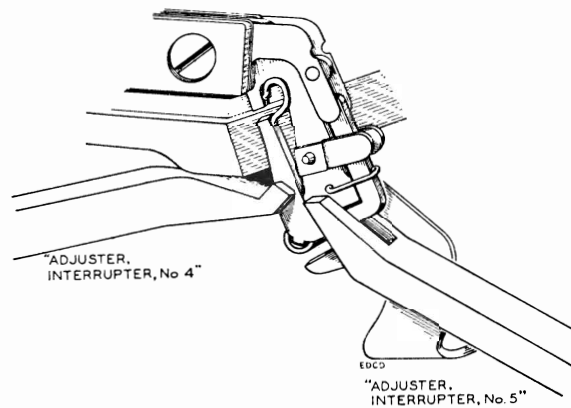


FIG. 119.—ADJUSTMENT OF OPERATING LEVER
FOR VERTICAL-INTERRUPTER SPRINGS

89. Operating and restoring strikers.—If a wedge has been previously inserted between the armature and the back stop for the purpose of facilitating adjustment of the interrupter springs, it should be withdrawn before adjustment of the operating and restoring strikers is proceeded with. The adjustment of the strikers should be as detailed in (a), (b) and (c).

(a) With the armature operated electrically, and the spring-operating lever fully operated, there should be a clearance of not more than 5 mils between the operating striker and the buffer (see Fig. 120).

(b) With the armature fully restored and resting against its back stop, and the spring-operating lever in the normal position, there should be a clearance of not more than 5 mils between the restoring striker and the buffer (see Fig. 121).

(c) *Rotary-interrupter springs only.*—With the spring-operating lever normal, and the rotary armature operated electrically with the carriage held in the 12th rotary position (i.e. the upper projection of the rotary pawl is locked against the extended lug at the bottom of the comb plate), there should be a clearance between the operating striker and the lever buffer, so that the 'break' contacts do not open.

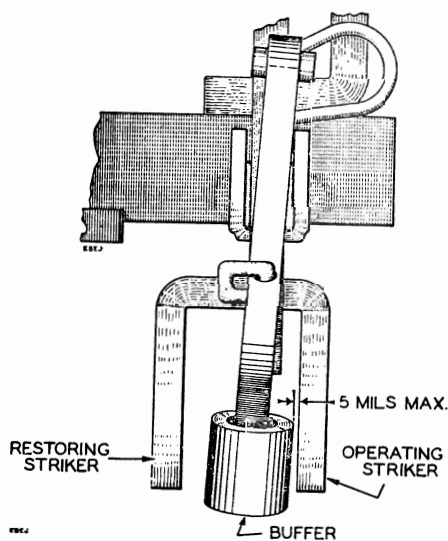


FIG. 120.—SHOWING 5 MILS MAX. CLEARANCE
BETWEEN OPERATING STRIKER AND BUFFER,
ARMATURE OPERATED

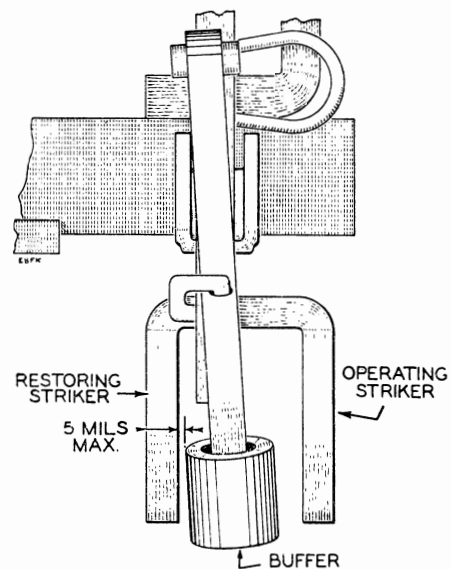


FIG. 121.—SHOWING 5 MILS MAX. CLEARANCE
BETWEEN RESTORING STRIKER AND BUFFER,
ARMATURE NORMAL

90. If re-adjustment of the strikers is necessary, they should be bent by means of an "Adjuster, Interrupter, No. 5 or 6", as shown in either Fig. 122 or Fig. 123 (vertical- or rotary-interrupter springs, respectively), until the correct conditions are obtained.

92. Interrupter-operating lever.—This should be free on its bearing with a minimum amount of play. The travel of the lever is determined by the distance between the two projections on its fork and the thickness of the stop (see Fig. 124). This travel is deter-

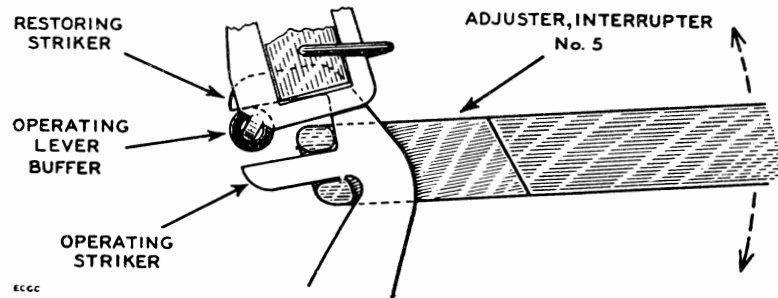


FIG. 122.—ADJUSTMENT OF VERTICAL STRIKERS

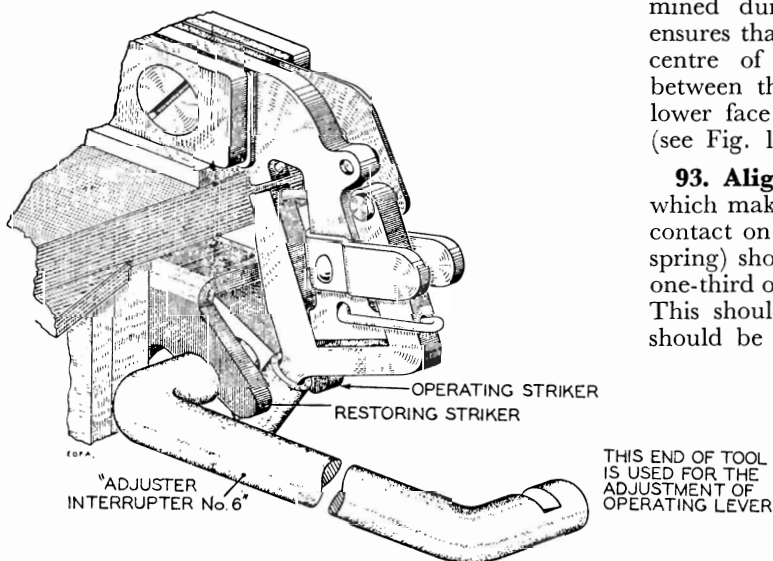


FIG. 123.—ADJUSTMENT OF ROTARY STRIKERS

INTERRUPTERS Nos. 4 AND 5

91. General.—Interrupters Nos. 4 and 5 are of a new design and are interchangeable with Interrupters Nos. 1 and 2. When existing stocks of the older type of interrupters are used up, the new type will be supplied for new work and for replacement purposes. The main principles of the toggle type of interrupter have not been changed, but the construction and adjustment have been simplified. The operating lever, bearing pin, bearing-pin washer and loop spring, if faulty, can be changed, but if other parts require replacement, the complete interrupter should be changed. The operating lever and its bearing pin are a matched pair and must be changed together.

mined during manufacture and the lever design ensures that the centre of the lever coincides with its centre of balance. There must be a clearance between the horizontal surface of the fork and the lower face of the stop in any position of the lever (see Fig. 125).

93. Alignment of contacts.—Pairs of contacts which make electrical contact with one another (one contact on one spring and the other on the adjacent spring) should not be out of alignment by more than one-third of the diameter of the contact (see Fig. 126). This should be judged by eye. A faulty assembly should be changed.

94. Contact springs must be straight throughout their length when the contacts are closed. Contact clearance should be obtained by setting the inner contact spring from its root and not by bending the tips of the outer contact springs.

95. Contact clearances.—The contact clearance of a 'make' contact, when the operating lever is normal, and that of the 'break' contact, when the lever is operated, should be 12 mils minimum (10 mils test) (see Fig. 127).

96. Operating-lever shoulder clearance.—There must be a clearance of 7 mils minimum, 5 mils minimum (test) between the shoulder of the operating

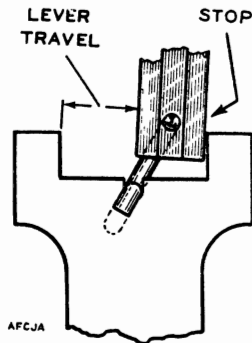


FIG. 124

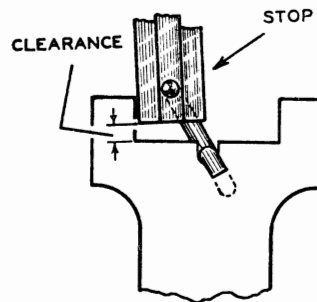


FIG. 125

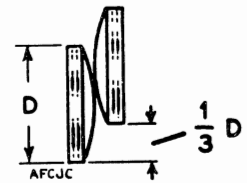


FIG. 126

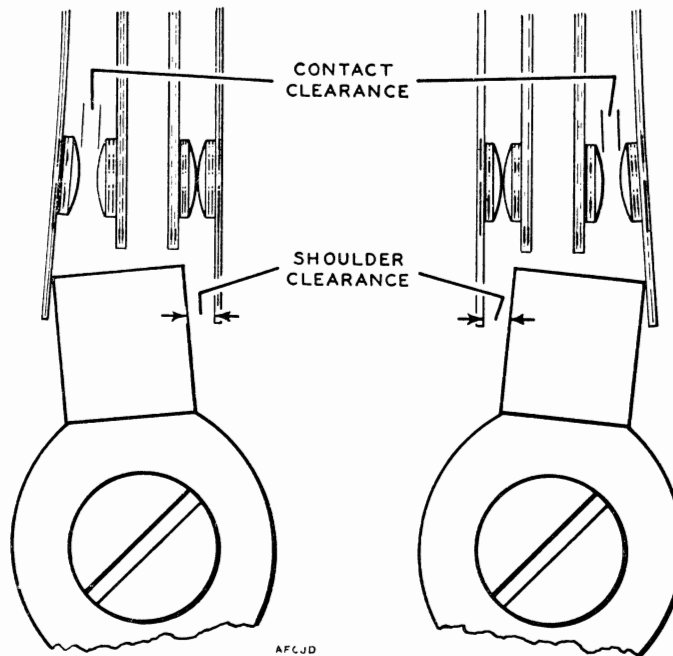


FIG. 127

lever and the tip of the 'break' spring, with the operating lever normal, and with the tip of the 'make' spring with the operating lever operated (see Fig. 127). The clearance should be obtained by adjustment of the inner contact springs.

97. Contact pressures.—The pressures of both the 'make' and the 'break' contacts should be between 40 and 55 gm. (35 gm. minimum test), measured on the outer contact spring, immediately in front of the contacts (see Fig. 128). The pressure of the 'make' contacts should be measured with the operating lever fully operated and the pressure of the 'break' contacts should be measured with the operating lever fully restored.

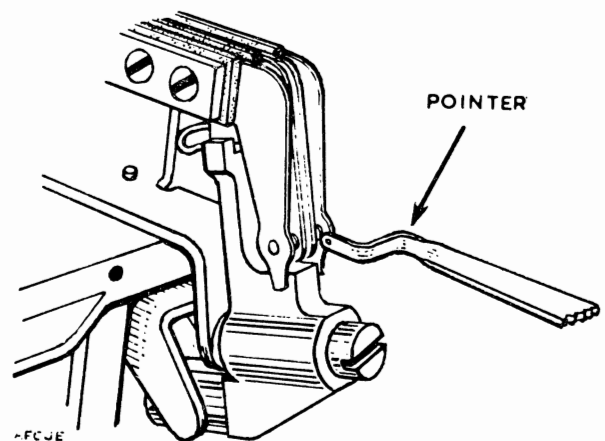


FIG. 128

98. Loop spring.—After the lever has passed its centre line of balance, the loop spring should have sufficient tension to carry, and hold, the operating lever reliably against each of its stop positions against the tension of the 'break' and 'make' contact springs. The tension of the loop spring should be such that the operating lever will not move from either of its stop positions with a pressure of 50 gm. (45 gm. test), applied to the side of the lever and in line with the loop spring (see Fig. 129). The lever should trip over positively with a pressure of 115 gm. (125 gm. test). This test should be made in both directions and made without relieving the tension of the contact springs. If it is found that the loop spring tension is

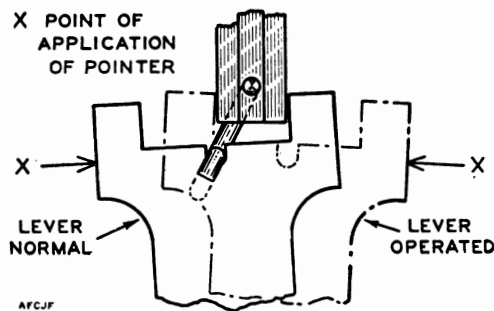


FIG. 129

outside the specified test limits, it may be corrected as follows:—

- (a) By varying the contact pressure within the specified limits, or
 - (b) By varying the tension of the loop spring.
- If it is desired to increase the tension, the loop spring can easily be removed with a pair of "Pliers, Wiring, No. 2" and the two limbs of the spring opened outwards. The tension can be decreased without removing the spring, by lifting the lower limb of the spring upwards with the tips of the pliers.

99. Sequence of contact operation (change-over contacts).—The 'make' contacts of a change-over contact unit should not close before the 'break' contacts open. This condition must be obtained by adjusting the inner contact springs.

100. Operating and restoring strikers.—With the armature operated electrically and with the operating lever fully operated, there should be a clearance of between 7 mils and 12 mils (5 to 13 mils test) between the operating striker and the operating lever (see Fig. 130). With the armature fully restored and resting against its back stop, and with the operating lever fully restored, there should be a clearance of between 7 mils and 12 mils (5 mils minimum test) between the restoring striker and the operating lever (see Fig. 131). In addition, a check should be made to ensure that the interrupter lever fully restores when the armature is slowly returned, by hand, to its back stop.

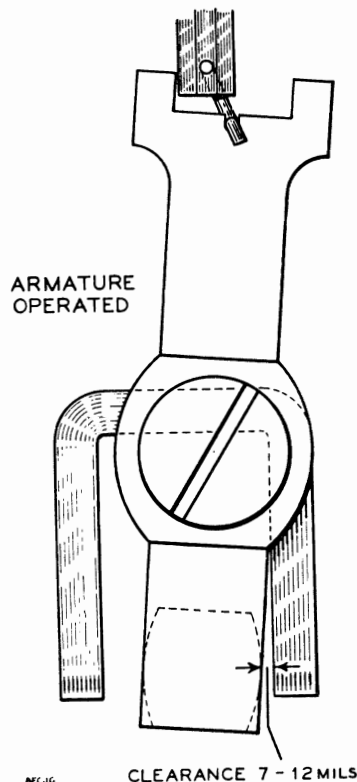


FIG. 130

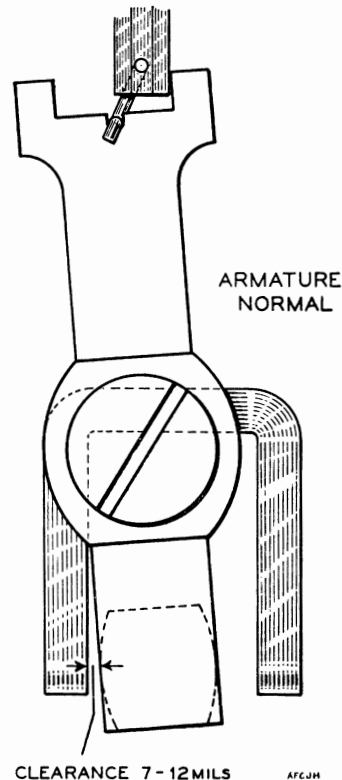


FIG. 131

101. Rotary interrupter springs only.—With the operating lever fully restored, the rotary armature operated electrically, and with the carriage held in the 12th rotary position (i.e. with the upper projection of the rotary pawl locked against the extended lug at the bottom of the comb plate), there must be a clearance between the operating striker and the operating lever. This is to ensure that the 'break' contacts do not open when the carriage is releasing in the 12th rotary position and the normal level.

102. Re-adjustment of the strikers.—If re-adjustment is necessary, the strikers should be bent, by means of the "Adjuster, Interrupter, No. 5 or No. 6" (see Figs. 132 and 133), until the required conditions are obtained (see pars. 100 and 101).

NOTE:—Care must be taken, when adjusting the strikers, to ensure that the limbs of the operating-lever fork are not damaged. This will be avoided if the armature is first wedged in its mid-way position.

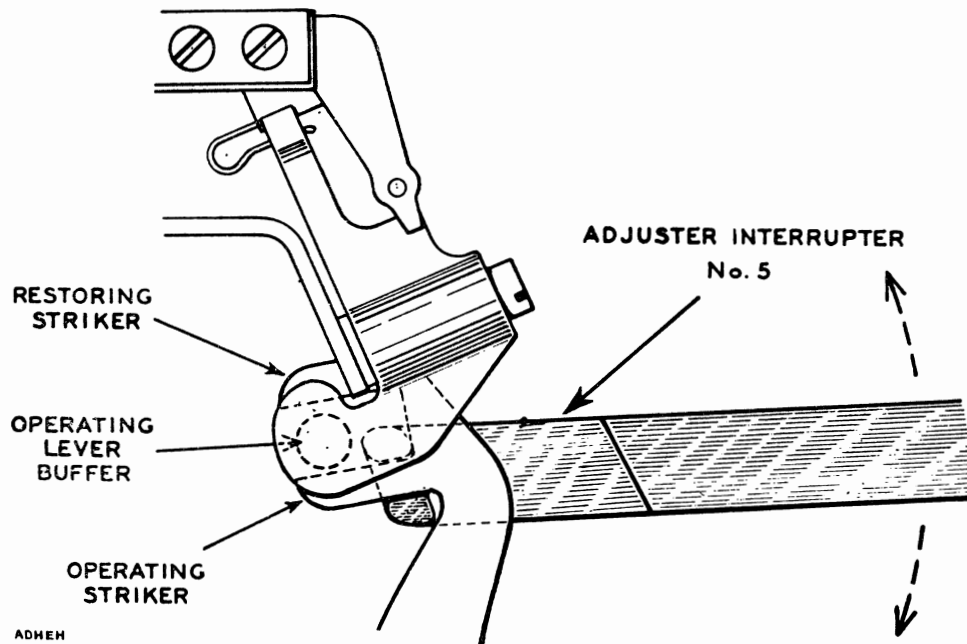


FIG. 132

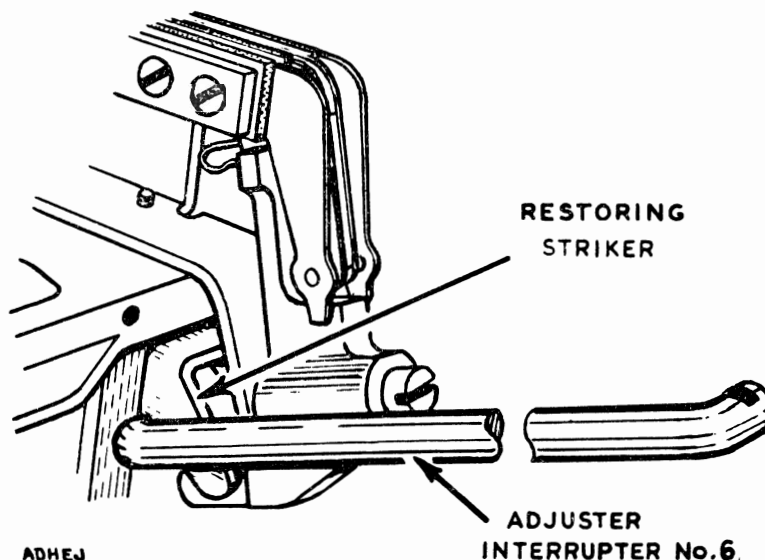


FIG. 133.—ADJUSTMENT OF ROTARY STRIKERS

LINE AND P-WIPERS

103. Adjustment of wiper springs.—During manufacture, each wiper spring is set outwards from the base, the distance between the tips being $\frac{1}{4}$ in. minimum so that, when the collar is fitted, the springs are tensioned outwards against the collar. The adjustment of the wipers should be checked as follows:—

(a) The tip domes must be opposite each other, as judged by eye; wipers faulty in this respect should be changed.

(b) Each blade from the collar to the tip should be parallel to the separator, when viewed from the front, i.e. the blades must not be twisted.

(c) The gaps between the inner surfaces of each blade and the faces of the separators must be equal,

the extreme tips. Check that the splay is the same on each blade.

Place a new collar (Part No. 1/SCO/382) just over the wiper tips and check that there is equal clearance between the blades and the separator. Any inequality should be rectified by re-adjustment.

The collar should then be slid down the blades, as far as the collar lugs, and then worked into position, one side at a time, the blades being held gently against the separator by means of "Pliers, Adjusting, No. 5", applied at the tip side of the collar. The point of application of the pliers should not be beyond the separator. Under no circumstances should pressure be applied at the rear of a collar because this will destroy the outward tension of the blades.

Re-check the assembly in accordance with (a) to (e) above.

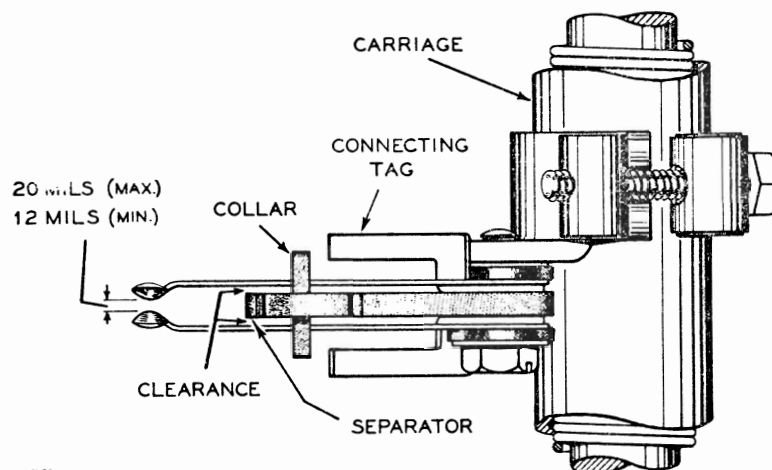


FIG. 134.—CLEARANCE BETWEEN WIPER TIPS WHEN OFF THE BANK

as judged by eye, when viewed from the side (see Fig. 134).

(d) Each blade must rest in the recess of the collar, without binding.

(e) Depress the collar until the blade is resting against the separator; check that the other blade moves away from the separator and still rests against the collar. With the collar still held, check that sufficient outward tension is present by depressing the other blade with a screwdriver or other suitable tool; remove the tool and note that the blade returns quickly to the collar. Check the other blade of the assembly in a similar manner.

If the wiper blades fail to satisfy the requirements specified in (b) to (e), the collar should be cut off by means of "Pliers, Wiring, No. 1".

Correct the alignment of the blades, if necessary, by means of "Pliers, Adjusting, No. 5".

Adjust the blades for outward splay, if necessary, by setting or stroking in an outward direction from points as near the fixing screws as possible, until a clearance of $\frac{3}{8}$ in. approximately is obtained between

104. Wiper tips.—All line and P-wipers should have a clearance of 12 mils min., 20 mils max. between the contact tips of the wiper springs when off the bank (see Fig. 134). Any adjustment necessary to obtain this clearance should be made by setting the spring, using "Pliers, Adjusting, No. 5" at a point immediately in front of the collar.

105. Position of wiper assembly on carriage.

(a) With the wiper-clamp fixing screws lightly tightened, wipers should be set to rest as accurately as possible on a point one-third of the way on the sixth contact of levels 1 or 0 (see Fig. 135). If there is any difference in the positions taken up by the wipers on contacts 1 and 11, a mean adjustment should be obtained.

(b) The vertical position of the wipers on the carriage should be such that the wiper tips enter the bank levels without appreciable rise or fall. If there is any difference in entry on levels 1 and 0, a mean adjustment should be made on level 5. When the wipers are standing on any bank contact on any level,

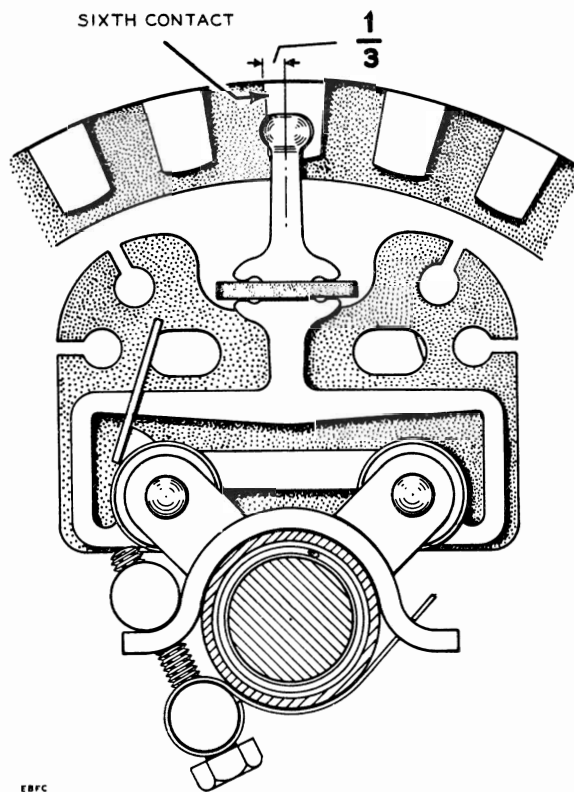


FIG. 135.—POSITION OF WIPER ON CONTACT

each wiper spring must rise clear of the separating insulation (see Fig. 136).

(c) Wiper tips should be clear of the bank insulation when the carriage assembly is raised from the normal position to level 0 and lowered from the 12th rotary position; the wiper tips should also be clear of the bank contacts when returning on the normal level.

When these adjustments have been made, the wiper-fixing screws should be tightened until it is not possible to rotate the wiper assembly on the carriage when reasonable pressure is applied by hand. Care must be taken not to over-tighten the wiper-fixing screws, otherwise distortion of the carriage tube may occur. Finally, check that the wiper cords are free of the wiper springs.

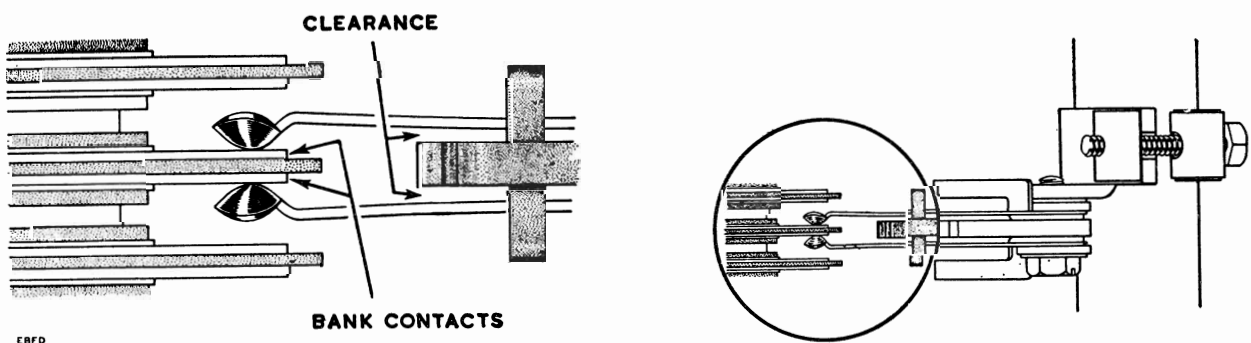


FIG. 136.—SHOWING WIPER RESTING ON BANK CONTACTS

VERTICAL-MARKING BANK AND WIPERS

106. Bank.

(a) The vertical-marking bank should be located so that it is approximately parallel to the selector-frame column.

(b) The position of the bank should also be such that the wiper tips rest on the bank contacts at a point which is not less than one-quarter of the way along the length of the contacts (see Fig. 137). Slight

107. Wiper-assembly bracket.—The wiper-assembly bracket should rotate freely on the carriage with no more than just-perceptible vertical play. If vertical play exists, it should not allow the wiper tips to move more than one-third of the width of a bank contact. If the vertical movement of the wipers at the tips is found to be excessive, the play between the bearing collar and the bearing bracket (see Fig. 140) should be examined and the assembly changed, if necessary.

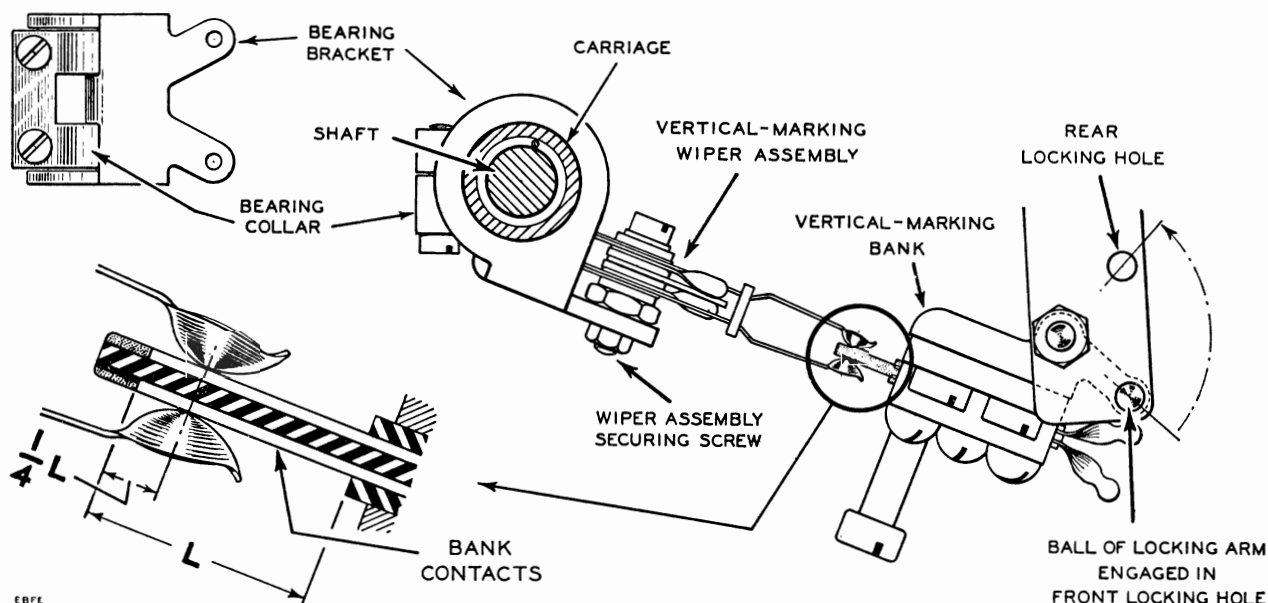


FIG. 137.—POSITION OF WIPERS ON CONTACTS

adjustments to the bank may be obtained by loosening the two vertical-marking bank-fixing screws and moving the bank about the play in the screw-fixing holes.

(c) The bank should be held firmly in position by the ball of the locking arm engaging correctly in the front hole in the mounting bracket. The tension of the spiral spring on the bank-supporting pillar should be sufficient to ensure this and, if there is any play between the ball and the hole, the ball arm should be bent upwards.

As stated in par. 8, before the selector is removed from its position on the shelf, the vertical-marking bank should be swung clear of the wiper and locked by the ball engaging the rear hole in the mounting bracket (see Fig. 138). When restoring the bank to its correct position, care should be taken to ensure that the wiper tips are not damaged or distorted by the front edge of the bank insulation (see Fig. 139).

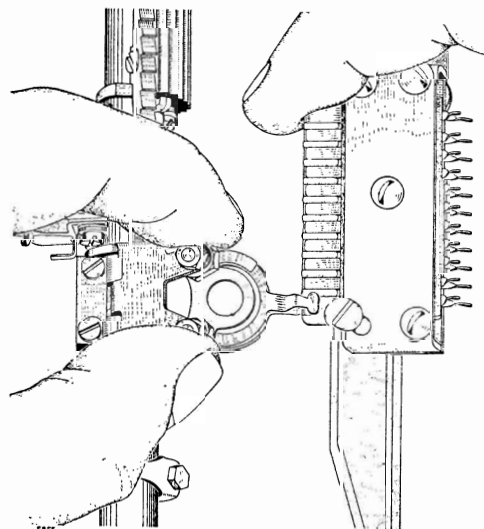


FIG. 138.—DISENGAGING VERTICAL-MARKING BANK FROM WIPER

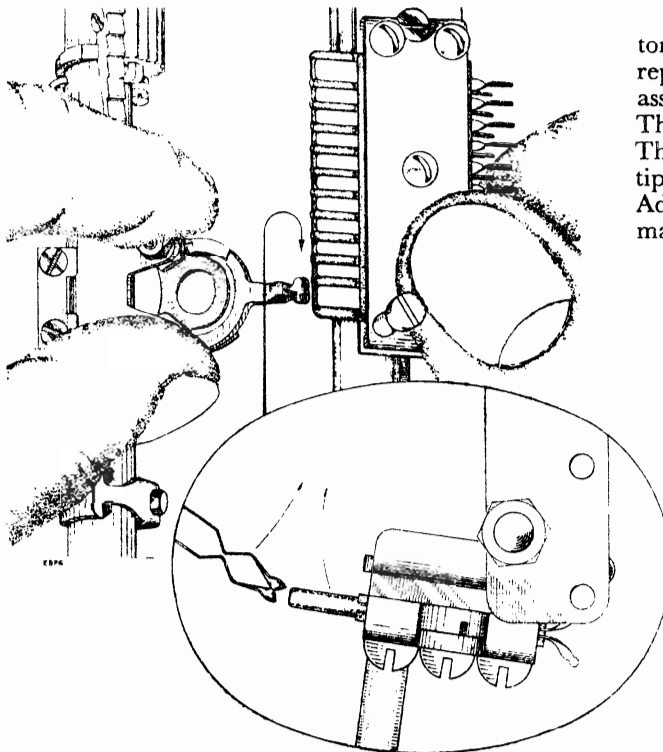


FIG. 139.—RE-ENGAGING BANK WITH WIPER

109. Wiper No. 13.—The wiper springs and insulators are assembled as a complete unit which, for replacement purposes, is detachable from the wiper-assembly bracket by removing the two securing nuts. The tips of the wipers should be opposite each other. The position of the wipers should be such that the tips rest slightly below the centre of the bank contact. Adjustment to the position of the wipers should be made with the carriage standing on the fifth vertical

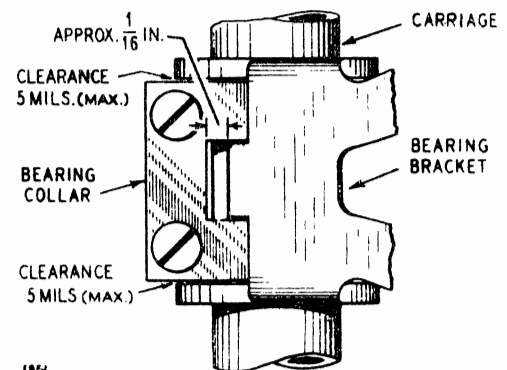


FIG. 140.—SETTING OF WIPER-ASSEMBLY LOCATING COLLAR

108. Wiper-assembly locating collar.—With the carriage in the normal position, the wiper-assembly locating collar should be set with the screw heads towards the front, so as to leave a clearance of not less than $\frac{1}{16}$ in. between the end of the slot in the collar and the tongue of the bearing bracket (see Fig. 140). This clearance should prevent the collar touching the wiper-assembly when the carriage is in the 12th rotary position.

step and the wiper resting on the sixth bank contact; on this contact the wipers should be adjusted by means of the locating collar (see also par. 108), so that the tips take up a position between the limits of one-third to half-way on the contact (see Fig. 141). Care should be taken to ensure that, when the carriage is rotated to any position on any level, the tip of the wiper is quite clear of the raised portion of the bank insulation.

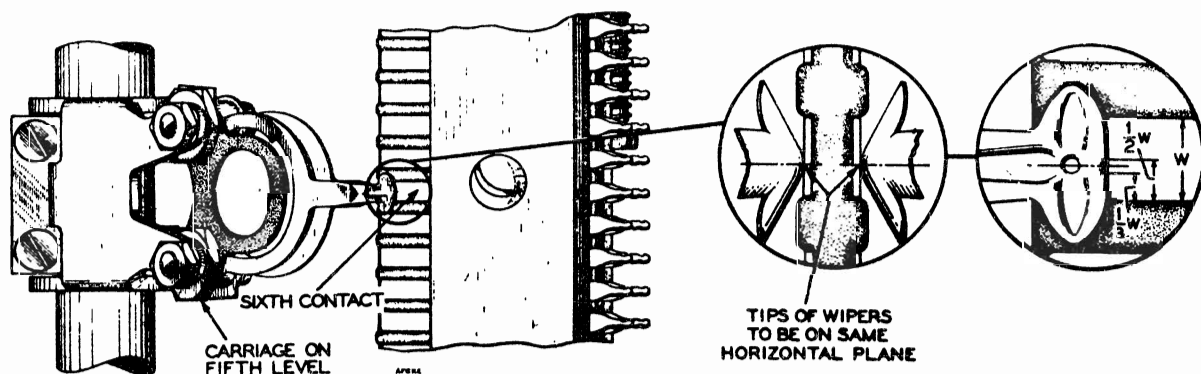


FIG. 141.—POSITION OF VERTICAL WIPER ON VERTICAL-MARKING BANK (WIPERS No. 13)

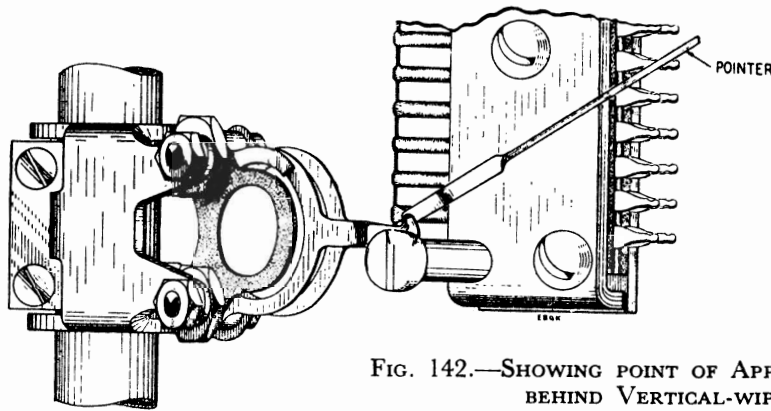


FIG. 142.—SHOWING POINT OF APPLICATION OF POINTER BEHIND VERTICAL-WIPER TIP

110. The wiper springs should be tensioned at the base so that the wiper-contact pressure is between 25 and 40 gm., measured immediately behind the tip of the wiper (see Fig. 142). The tension need only be measured on one wiper spring.

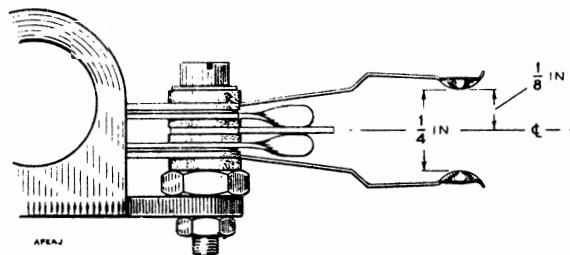
111. Wipers No. 23.—The following adjustments should be made with the wipers removed from the vertical-marking bank.

(a) With the collar removed, each wiper spring should be set outwards (approximately equally from a point near the fixing screws) so that there is a clearance of approximately $\frac{1}{4}$ in. between the contact points at the wiper tips (see Fig. 143).

(b) With the collar replaced, the contact points must be approximately opposite each other. This can be checked by lightly pressing the wiper springs together at a point just behind the collar and noting the alignment at the tips. Correct alignment of the two wiper tips is important and slight corrections can be made by adjustment of the wiper blades. If the wiper springs are so twisted that this adjustment cannot be obtained, the wipers should be changed.

(c) When viewed from the side (see Fig. 144) each wiper spring should be approximately straight from the fixing screw to the collar and equidistant from the centre separator.

(d) To check that the wiper springs are not binding on the collar, depress until one spring rests against the separator and note that the other spring

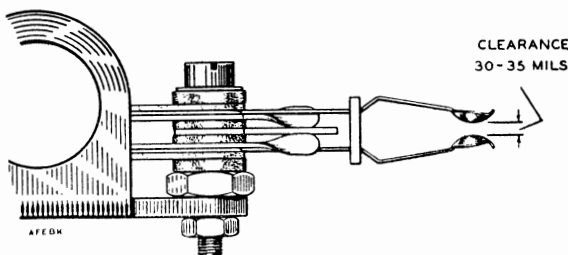


★FIG. 143

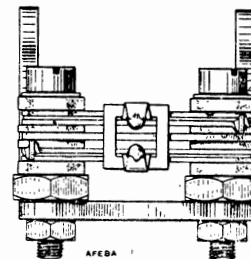
moves outwards and still rests against the collar. With the collar still held, depress the other spring with a small screwdriver or other suitable tool, and check that it returns freely to the collar when the tool is removed. Check the other spring in a similar manner.

(e) Check that the collar rests against the shoulders of the wiper springs and that it is held squarely between the two springs (see Fig. 145).

(f) The gap between the wiper contact points should be between 30 and 35 mils (25 and 40 mils 'test') (see Fig. 144). Adjustment for this condition should be obtained by setting the spring immediately in front of the collar, using "Pliers, Adjusting, No. 5"



★FIG. 144



★FIG. 145

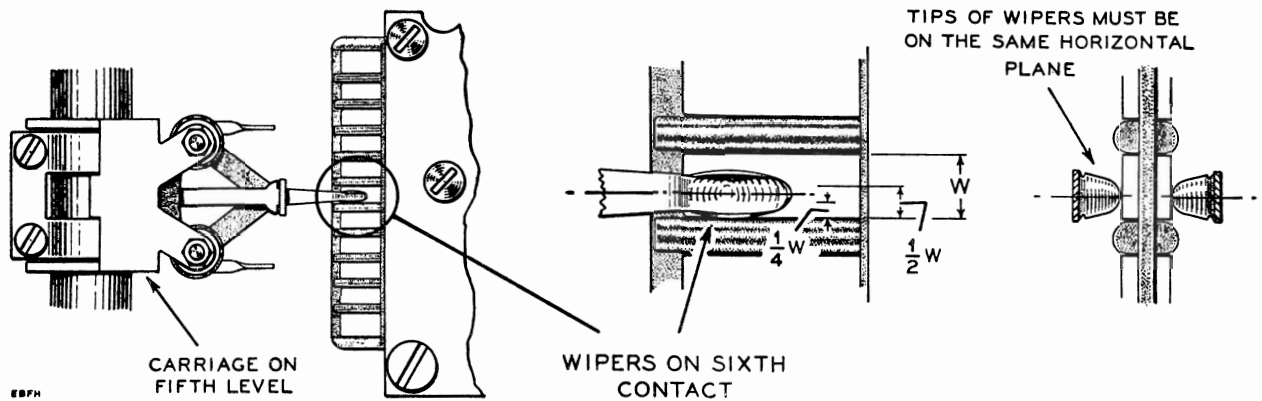


FIG. 146

112. When on the bank, the wipers should be positioned to rest slightly below the centre of the sixth contact when the shaft is standing on the fifth level (see Fig. 146). The position of the wipers should, however, be such that they rest on the contact between a quarter and half the width of the contact. No portion of the wiper other than the tip should touch the bank.

Care should be taken to ensure that, when the carriage is rotated to any position on any level, the tip of the wiper is quite clear of the raised portion of the bank insulation (see Fig. 146).

SHELF JACKS

113. Adjustment of springs.—Shelf-jack springs should be adjusted so that there is a space of approximately 18 mils between either jack spring and the other of a pair, except when the P-wire and earth circuits are connected to a pair; these latter springs should be adjusted to make a good contact when the selector plug is removed. All shelf-jack springs should be curled outwards at the tips, but care should be taken to ensure that, when the selector is replaced, the selector plug enters the shelf jack freely without causing adjacent springs to be forced into contact (see Fig. 147).

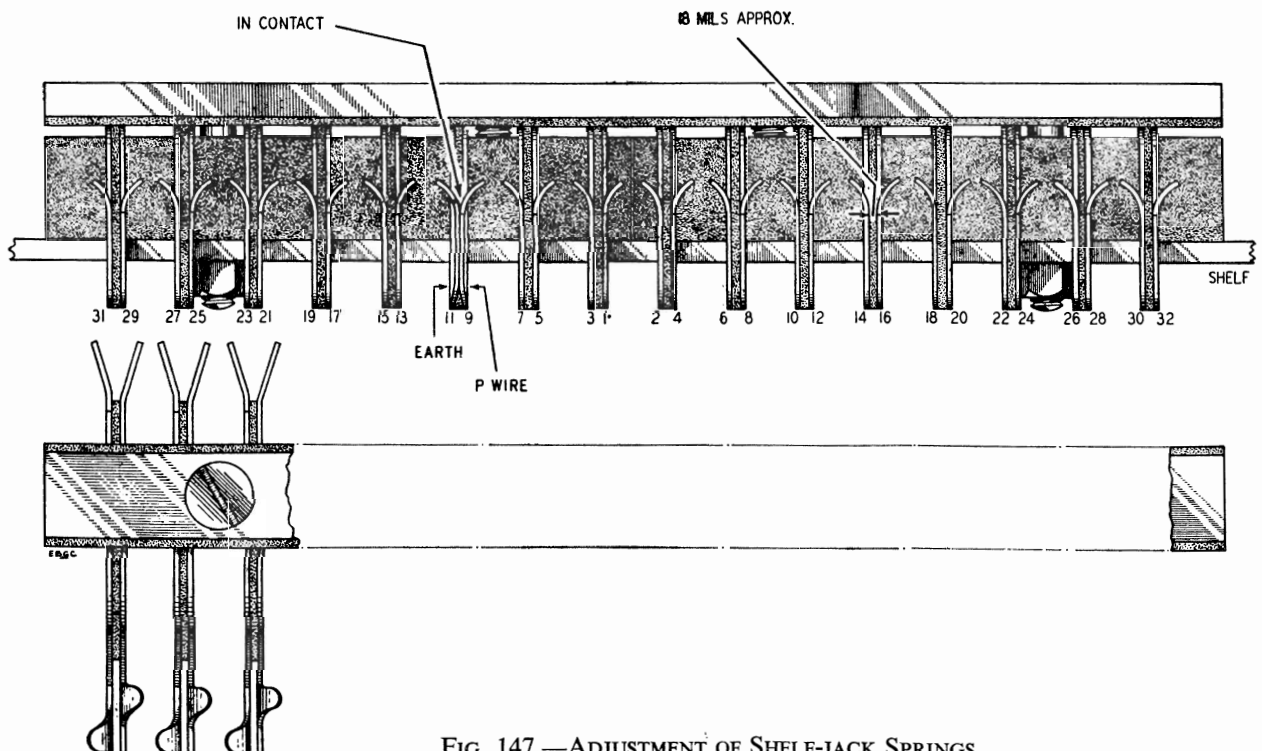


FIG. 147.—ADJUSTMENT OF SHELF-JACK SPRINGS

MISCELLANEOUS

114. Lubrication.—Details of the lubrication of the selector are indicated in B 5137.

115. Wiper-cord termination.—Wiper cords should be terminated as described in B 3101.

★116. Fitting an anti-bounce plate to a selector which has previously been adjusted.

The individual operations for fitting an anti-bounce plate should be performed in the following sequence:—

(a) Relieve the tension on the bridge plate, by loosening the clamp-adjusting screw and clamp-fixing screw.

(b) Check that the bridge plate is not 'bowed'. Change any bridge plate that is not straight.

(c) Fit the anti-bounce plate (see par. 16).

(d) Check that the anti-bounce plate is correctly located and conforms to the conditions specified in par. 16.

(e) Re-tighten the clamp-fixing and clamp-adjusting screws, and re-adjust as detailed in pars. 17 to 20.

★117. Dismantling.—The following list details the order in which the parts of the mechanism should be dismantled:—

(a) Remove the relay mounting plate.

(b) Remove the spring-sets.

(c) Remove the wipers.

(d) Remove the spring-set operating brackets. (To facilitate this operation, the carriage assembly should be raised to level 0.)

(e) Remove the detent guard.

(f) Remove the vertical- and rotary-detent springs.

(g) Remove the vertical and rotary detents.

(h) Remove the subsidiary pawl guide.

(j) Remove the vertical pawl guide.

(k) Remove the vertical pawl spring.

(l) Remove the vertical pawl front stop (this is longer than the rotary pawl front stop).

(m) Remove the vertical magnet assembly.

(n) Remove the vertical armature, vertical-armature restoring spring, restoring-spring adjusting screw and bracket, and residual plate, from the magnet (the brass fixing screw for this magnet is longer than that of the rotary magnet).

(o) Remove the vertical armature back stop.

(p) Remove the rotary armature back stop.

(q) Remove the rotary pawl front stop (this is shorter than the vertical pawl front stop).

(r) Remove the rotary pawl spring.

(s) Remove the rotary magnet assembly.

(t) Remove the rotary-magnet locating plate.

(u) Remove the vertical-magnet locating plate.

(v) Remove the rotary armature, rotary-armature restoring spring, restoring-spring adjusting screw and bracket, and residual plate, from the magnet (the fixing screw for this magnet is shorter than that of the vertical magnet).

(w) Remove the rotary pawl guide.

Loosen the clamp screw and release the tension of the carriage restoring spring.

(x) Remove the comb plate.

(y) Remove the anti-bounce plate then the bridge plate.

(z) Remove the complete shaft and carriage assembly.

(aa) Remove the shaft clamp, clamp-adjusting and fixing screws.

(ab) Remove the shaft washers, the level-springs auxiliary cam, the vertical ratchet, the V.M.B. wiper-locating collar and bearing bracket from the carriage.

★118. Assembling.—The following list details the order in which the parts of the mechanism should be assembled and adjusted:—

(a) Replace the shaft clamp and the clamp-adjusting and fixing screws to the bridge plate.

(b) Replace the bridge plate then the anti-bounce plate.

(c) Replace the vertical ratchet, the level-springs auxiliary cam, the V.M.B. wiper-locating collar and bearing bracket to the carriage and fit the two (or more) shaft washers.

(d) Replace the shaft and carriage assembly.

(e) Replace the comb plate.

Adjust from par. 17 to the end of par. 20.

(f) Replace the rotary pawl front stop (set the front stop well back in the frame) [see sub-par. 117 (q)].

(g) Replace the vertical and rotary detents (see Note 1).

(h) Replace the vertical- and rotary-detent springs.

As a preliminary adjustment, the rotary detent should be adjusted by means of its adjusting screw so that the detent tip is just clear of the long face of the first rotary tooth.

(j) Adjust to end of par. 25.

Replace the detent guard.

(k) Replace the vertical armature, vertical-armature restoring spring, restoring-spring adjusting screw and bracket, and residual plate to magnet [see sub-par. 117 (n)] (see Note 1).

(l) Replace the vertical-armature back stop (set the stop well down in the frame).

(m) Replace the vertical-magnet locating plate.

(n) Replace the vertical magnet assembly.

(o) Replace the vertical pawl guide.

(p) Replace the vertical pawl spring.

(q) Replace the vertical-pawl front stop [see sub-par. 117 (l)].

(r) Replace the subsidiary pawl guide. As a preliminary adjustment, position the guide well away from the vertical ratchet so that its front face is below the roots of the vertical teeth.

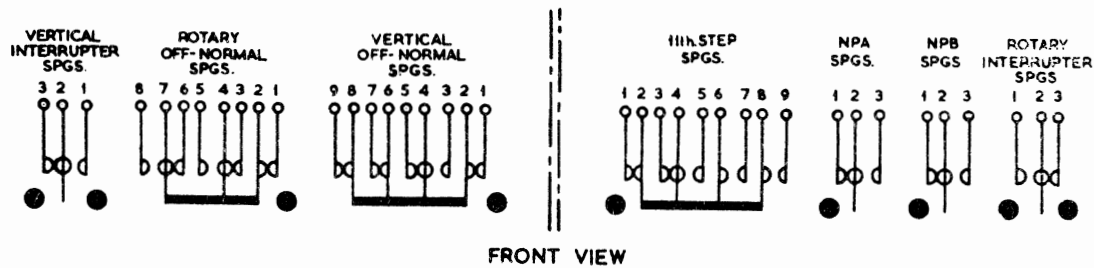
Adjust to end of par. 36.

(s) Replace the rotary armature, rotary-armature restoring spring, restoring-spring adjusting screw and bracket, and residual plate to magnet [see sub-par. 117 (v)] (see Note 1).

(t) Replace the rotary-magnet locating plate.

(u) Replace the rotary magnet assembly.

TYPE 1 SPRING ASSEMBLIES



TYPE 2 SPRING ASSEMBLIES

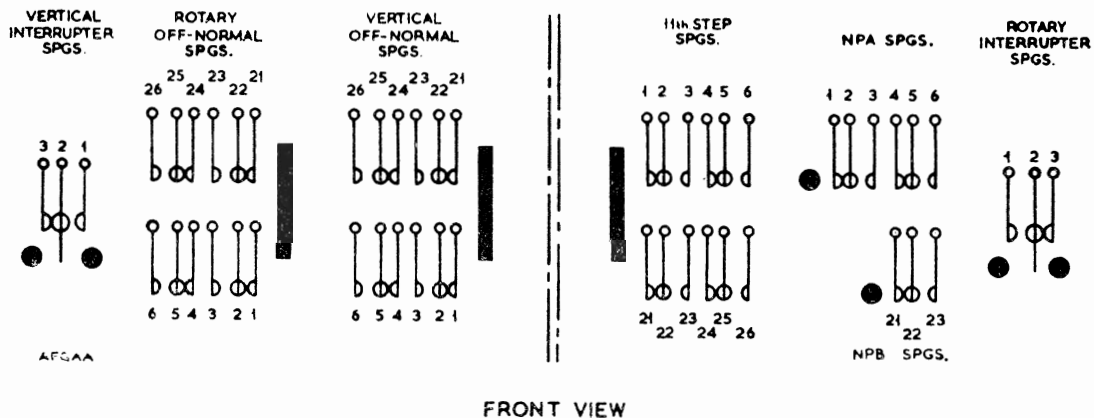


FIG. 148

- (v) Replace the rotary-pawl guide
- (w) Replace the rotary-pawl spring
Adjust to the end of par. 46
- (x) Replace the spring-set operating brackets (it will be found convenient if the operating bracket for the 11th-step springs is replaced first)
- (y) Replace the spring-sets
Adjust to the end of par. 62 (Type 1) or par. 79 (Type 2)
- (z) Replace the vertical- and rotary-interrupter springs
Adjust to end of par. 102
- (aa) Replace the wipers
Adjust to the end of par. 105 or, if vertical-marking wipers are fitted, to the end of par. 112 (see Note 2)
- (ab) Replace the relay-mounting plate.

NOTES:—

- (1) If a vertical or rotary detent or vertical or rotary armature pawl requires replacing, the com-

plete assembly should be changed; *NOT* individual detents and pawls.

- (2) Before replacing any wiper, check that the wiper-securing screws are tight.

119. Replacement of parts.—A list of parts of mechanism for replacement purposes is contained in B 5508.

120. Numbering of springs.—For maintenance purposes, the numbering of individual springs of the mechanically-operated spring assemblies, and of the vertical- and the rotary-interrupter springs, is as shown in Fig. 148.

121. Tools for 2000-type selectors.—The tools necessary for the adjustment of these selectors are detailed in Table 1. The basis for provision of tools for maintenance in automatic exchanges is given in **TOOLS & TRANSPORT, Hand Tools, A 0040.**

The tools should be used only for the purposes for a condition that screws or nuts would be damaged which they are intended. Any tool that is in such by its use should be changed.

TABLE 1.—TOOLS

Quantity	Rate Book description	Use
1	Pliers, Wiring, No. 2	For general use
1	„ Adjusting, No. 1	„ spring adjustment
1	„ „ No. 2	„ adjustment of mechanically-operated springs (Type 2)
1	„ „ No. 3	„ general use
1	„ „ No. 5	„ adjustment of back stops of mechanically-operated spring assemblies (Type 2), wipers and interrupter springs
1	Screwdriver, Instrument, No. 1	„ general use
1	„ „ No. 2	„ „
1	„ „ No. 3	„ „
1	„ „ No. 5	„ „
1	Pliers, Wiring, No. 1	„ „
1	Mirror, Inspection, No. 1	„ „
1	Cleaner, Contact, No. 1	„ „
1	Insulator, Contact, No. 1	„ „
2	Spanner, Cranked, No. 3	„ „
1	„ Box Cranked, No. 5	„ mechanically-operated spring-sets (Type 2)
★ 1	„ Flat, BA 4-6	„ lock-nuts on vertical- and rotary-detent adjusting screws
1	„ Box, No. 1	„ fully tightening vertical and rotary magnet adjusting screw
1	„ Box, No. 8	„ wiper and pawl screws
1	„ Box, No. 14	„ positioning vertical- and rotary-magnet adjusting screws
1	Adjuster, Spring, No. 2	„ adjustment of twin tongues of mechanically-operated springs (Type 2)
1	„ „ No. 12	„ mechanically-operated springs (Type 2)
1	„ „ No. 21	„ mechanically-operated springs (Type 1)
1	„ Lever, No. 1	„ operating levers of mechanically-operated springs (Type 1)
1	„ „ No. 2	„ adjusting operating lever of mechanically-operated springs (Type 2)
1	„ Detent, No. 2	„ rotary detent and subsidiary pawl guide
1	„ „ No. 3	„ vertical detent, pawl guide, and level-springs bracket
1	„ Cam, No. 1	„ auxiliary cams which operate level springs
1	„ Armature, No. 6	„ vertical and rotary armatures
1	„ „ No. 7	„ rotary-armature stroke
1	„ Interrupter, No. 4	„ vertical- and rotary-interrupter rear arms
1	„ „ No. 5	„ vertical-interrupter strikers and vertical- and rotary-interrupter levers
1	„ „ No. 6	„ rotary-interrupter strikers
1	Ringdriver No. 4	„ comb-plate nuts and mechanically-operated spring-set bearings
1	Gauges, Feeler, No. 2	„ general use
★	„ „ No. 10 Parts 3 and 18 mils	„ „
	„ „ No. 1 Part No. 2B	„ adjustment of rotary-pawl front stop
	„ „ „ Part No. 22C	„ line wipers
	„ „ „ Parts Nos. 25C, 35C, 40C	„ adjustment of Wipers No. 23
1	„ Tension, No. 1	„ general use
1	„ „ No. 2	„ „
1	„ „ No. 3	„ „
1	„ „ No. 4	„ „

References:—B 3101, B 5137, B 5144, B 5508
(TPM 2/3) TOOLS & TRANSPORT, Hand Tools, A C040
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