

Dial Switch 20 Type

1. This instruction details the dismantling, assembly, adjustment and lubrication of Dial Switch type 20. Views showing the names of the parts are given in Figs 1, 2, 3 and 4. The necessary adjustments are described in the following paragraphs.

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3. General Information

- .1 The dial produces the necessary impulse trains to step the exchange apparatus, and as different systems employ different ratios of make and break impulses the impulse wheel can be changed to suit.



FIG. 1

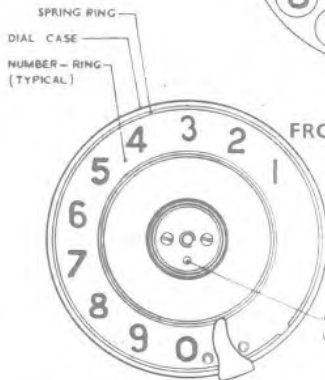


FIG. 2

FINGER-PLATE REMOVED

FRONT VIEWS

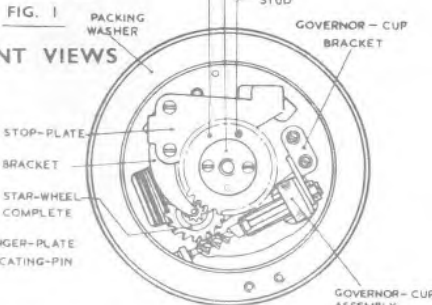


FIG. 3

NUMBER-RING REMOVED

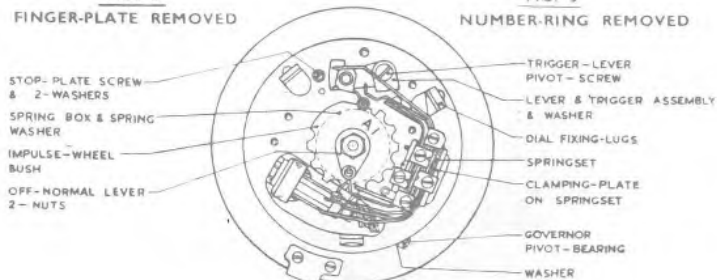


FIG. 4

REAR VIEW

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- 3.2 The dial is designed to provide a minimum pause between each train of digits of 240 milli-seconds, in order to ensure that when one train of impulses has been delivered, the selector thereby operated shall have time to switch to the next rank of selectors in the switching train and to prepare it to receive the succeeding train of impulses.
- .3 When a dial is dismantled, the parts should be thoroughly cleaned (see para 14) and inspected for wear. If any parts, especially the steel bearing in the governor-pivot bearing or cup, are found to be worn or rusty, they should be changed.
- .4 All screws and nuts should be securely tightened. They should not be damaged or mutilated in any manner.

4. Governor

- .1 The governor wings should be free from kinks or bows and, as an initial adjustment they should be set slightly inwards by means of Tool Switchboard 74. The governor cup fixing holes are elongated, to enable the cup to be positioned to give the best running position for the governor, i.e. the cup should be square with the governor when observed from the angles shown in Figs 5 and 6.

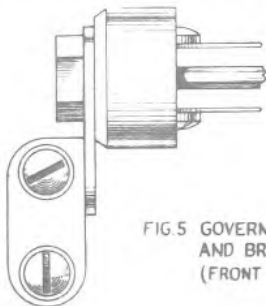


FIG 5 GOVERNOR CUP  
AND BRACKET  
(FRONT VIEW)

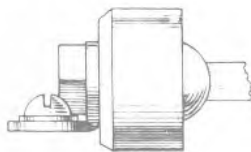


FIG 6 SIDE VIEW

- 4.2 The governor should run smoothly in both directions. It should be free, with a maximum end play of 13 mils as near as can be judged by feel. The governor may be tested to prove that it is running satisfactorily in both directions, by running a small screwdriver along the governor worm as shown in Fig 7. The governor should be adjusted to run smoothly before any further assembling or adjustments are carried out.

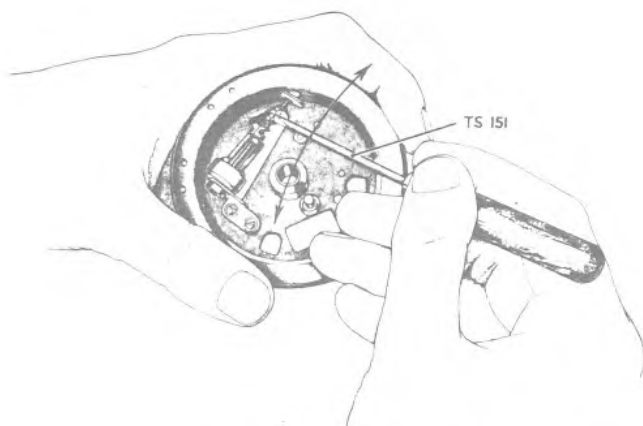


FIG.7 CHECKING ADJUSTMENT OF GOVERNOR

5. Governor Gear Adjustment

- .1 The governor gear should be adjusted as shown in Fig 8. To test the running of the governor gear and governor, replace the main gear wheel assembly temporarily, and revolve the finger plate a few times; if the governor gear engages the governor worm too deeply, vibration will occur.

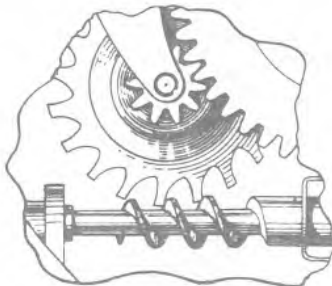


FIG.8 SETTING OF THE GOVERNOR GEAR

- 5.2 In the event of the governor or governor gear becoming damaged, the complete governor assembly or governor gear assembly, as the case may be, should be renewed. The dial should then be reassembled and adjusted.
6. Main Spring Adjustment
- .1 When fitting a main spring, it should be wound in the spring box starting from the outer edge, the arrow on the inside of the spring box indicating the direction of winding.
  - .2 To apply the correct tension to the main spring after the dial has been assembled, the finger plate should be rotated in a clockwise direction until the spring is felt to tighten; the finger plate should then be allowed to return through  $1\frac{1}{2}$  revolutions, and the stop screw then screwed down. The dial should then return to its normal position. To ensure that the stop plate engages the stud in the gear sufficiently, it should require a minimum of 3 turns of the stop plate screw from its normal position before the spring commences to unwind.

## 7. Switching Lever Adjustment

- .1 The switching lever should be adjusted so that in the normal position, it rests at the top of the set in the first lever spring (see Fig 9).
- .2 The adjustment of the switching springs and the switching lever which operates them should be such that on the return of the dial to its position of rest, the ebonite bush on the off normal lever does not touch the first lever spring until the impulsing springs have closed for the last time.

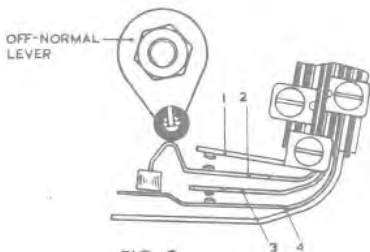


FIG. 9

NORMAL POSITION



FIG. 10

OFF NORMAL POSITION

## SWITCHING-SPRINGS

## 8. Switching Springs

- .1 The minimum contact opening should be 10 mils.
- .2 Springs 1 and 2 should be adjusted to break first, to ensure that clicks are not received in the subscriber's receiver when the dial is pulled off-normal. For this adjustment to be effective, there must be a gap of approximately 20 mils between the buffer of the first lever spring and the face of the second lever spring, when the dial is off-normal (see Fig 10).
- .3 Springs 2 and 4 should be tensioned to give a contact pressure of 18 gms min. 35 gms max. measured at a point adjacent to the contact.
- .4 Spring 5 is a protective spring only and should be adjusted to be parallel to Spring 4 when the dial is normal.

9. Impulse Springs

- .1 Check that the impulse springs are not affected by the movement of the mechanism until the return journey of the finger plate, and then not until after the "minimum pause" period has elapsed.
- .2 The inner (thick) impulse spring should be set so as to give a contact clearance of approximately 20 mils during the break period (see Fig 11).
- .3 The outer impulse spring should exert a contact pressure of 18-32 gms on the stiff inner impulse spring when the dial is at normal. The correct pressure shall be obtained by adjustment of the outer impulse spring, which shall be straight and free from kinks, and should be measured at a point as close as possible to the contact (see Fig 12). Adjustment should be made from the base of the spring using Tool Switchboard 74.

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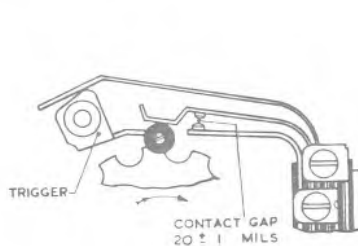


FIG. 11  
OPERATED POSITION

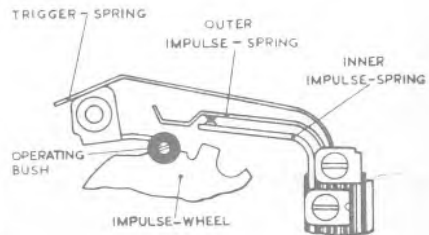


FIG. 12  
NORMAL POSITION

IMPULSE SPRINGS

10. Trigger Spring Adjustment

- .1 The trigger (restraining) spring should lie squarely on the flanges of the trigger and clear of the lever pivot screw.
- .2 When the finger-plate is pulled off-normal, the tip of the impulsing-vee of the trigger should engage the impulse wheel tooth by a minimum of 15 mils, as near as can be judged by eye (see Fig 13).

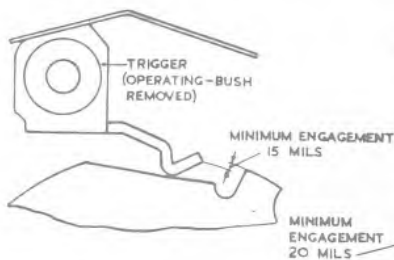


FIG. 13

NORMAL POSITION

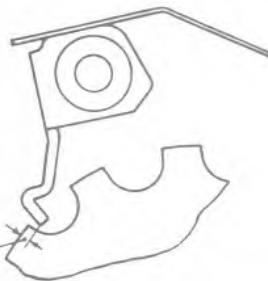


FIG. 14

FORWARD POSITION

**TRIGGER SPRING**

- .3 On the release of the finger plate, after the dialling of any digit the tip of the trigger should engage the impulse wheel by a minimum of 20 mils, as near as can be judged by eye (see Fig 14).
- .4 The above adjustments should be obtained by setting the angle in the trigger spring.
- .5 With the finger plate and trigger at normal the tension of the trigger spring should be 20-35 gms. measured at the free end of the spring.
- .6 Consistent with the above adjustments the trigger spring should be so set that during the operation of the dial the trigger should be clear of the bottom of the impulse wheel.



11. Dial Speed

- .1 The speed of the dial can be varied by adjusting the wings of the governor. The wings should be bent from the root only, by means of Tool Switchboard 74 (see Fig 15).
- .2 To increase the speed of the dial, the wings should be bent inwards.
- .3 To decrease the speed of the dial, the wings should be bent outwards.
- .4 The governor wings and weights are so proportioned that the speed of the dial will be approximately 10 impulses per second when the wings are set parallel to each other and the governor spindle.

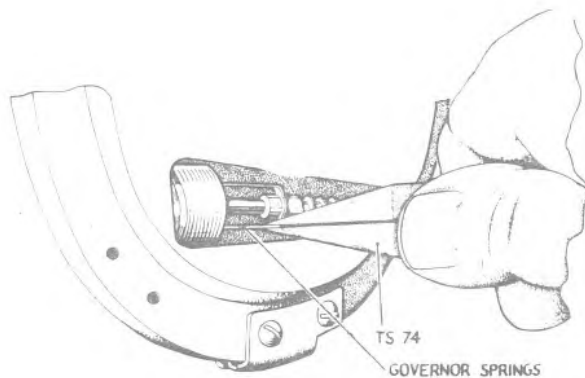


FIG.15 ADJUSTMENT OF DIAL SPEED

■ 12. Lubrication

- .1 Before making any adjustments to a dial, it should be examined to see that it is clean, as a dirty dial is sluggish in action although the main spring may be at full tension.
- .2 A dirty dial should be dismantled and the following parts washed in clean white spirit :-
  - .21 Governor
  - .22 Governor pivot bearing
  - .23 Governor cup and bracket
  - .24 Governor gear assembly
  - .25 Main spindle
  - .26 Main spring
- .3 The remaining parts should be cleaned with a soft cloth. After the mechanism has been cleaned, the parts which have been washed in white spirit should be wiped dry and the following parts lubricated with Oil to SB Code RMS.94 in the manner indicated :-
  - .31 Governor bearings Apply one drop of oil to each end of the governor spindle
  - .32 Governor-gear spring clutch Apply one drop of oil
  - .33 Governor-gear bearing Apply one drop of oil to each bearing
  - .34 Governor worm Apply one drop of oil
  - .35 Main spindle Apply one drop of oil to the bearing portion
  - .36 Trigger-lever, bush and pivot screw Apply one drop of oil under the screw head.
  - .37 Trigger bearing pin Apply one drop of oil at each end
  - .38 Trigger spring Apply one drop of oil on bearing surfaces
- .4 Care should be taken not to use the oil in excess, especially on the governor assembly. In particular, care should be taken to exclude oil from the braking surface of the governor cup. Each drop of oil specified should be that pendant on the end of a piece of No.23 SWG .024" dia. bare copper wire after it has been dipped into a reservoir of oil, the level of which is maintained at a depth of 5/8th of an inch.
- .5 A main spring which is fit for re-use, should, after being washed in white spirit, be replaced in the spring box. After replacement, the spring should be lubricated by the application of three drops of oil, distributing them over the spring.

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- 12.6 Spare coiled main-springs should be stored in a bath of Oil to SB Code RMS.94. The springs should be drained before assembly, and further lubricant should not be applied.
13. Dismantling
- .1 Remove the springset by removing the two screws facing outwards. Care should be taken to avoid bending or distorting the springs.
  - .2 Remove the trigger-lever pivot-screw, trigger and lever assembly and washer.
  - .3 Remove the finger stop.
  - .4 With the dial resting face downwards, loosen the stop-plate screw until the dial case revolves. When the spring has fully unwound, remove the screw and two washers.
  - .5 With the securing ring, protector and instruction card from the instruction frame, the securing-ring is best removed by inserting a narrow sharp-edged screwdriver between the securing ring and the inner edge of the instruction frame, and levering the ring firstly towards the frame centre and then outwards.
  - .6 Remove both nuts from the spindle.
  - .7 Remove off-normal lever and bush.
  - .8 Remove the impulse wheel and washer.
  - .9 Remove the spring-box and spring from the dial case. The removal of the spring-box with the spring intact is facilitated by the use of a knife blade to lever the inned end of the spring from its bed in the slot of the dial-case.
  - .10 Remove the finger plate by means of the central screw.

- 13.11 Remove the securing ring, number ring, packing washer, gear wheel and spindle. The securing ring is easily removed by inserting the edge of a screwdriver between the ring and the dial-case, about  $\frac{1}{2}$ " from the break in the ring, and gently levering outwards. The number-ring, packing washer, gear-wheel and spindle are then free to be removed.
- .12 Remove the stop-plate, bracket and governor-gear complete.
- .13 Remove the governor-cup bracket and governor.
- .14 Remove the governor pivot bearing and washer.
- .15 Remove the instruction-frame and plate from the finger-plate.
- .16 Remove the gear wheel from the spindle.
- .17 Remove the stud from the gear-wheel.

14. Assembly

The following list details the order in which the parts should be assembled:- (Exploded view Fig 16 refers)

- .1 Assemble the gear, wheel, fitted with the stud, to the spindle so that the stud is on the side away from the finger plate locating-pin. It is most important that the stud be thoroughly tight in the gear wheel.
- .2 Assemble the governor pivot-bearing and washer to the dial case and lubricate.
- .3 Replace the governor with the governor cup and bracket, and lubricate.
- .4 Adjust to Para 4.
- .5 Replace the governor gear complete, and the bracket together with the stop plate, to the dial case and lubricate the bearings.
- .6 Adjust to Para 5.
- .7 Assemble the spring box complete with spring, to the dial case (see Para 6). Lubricate the spring.
- .8 Assemble the spindle and wheel to the dial case, so that the key-way in the spindle engages the key of the spring. Lubricate the spindle.

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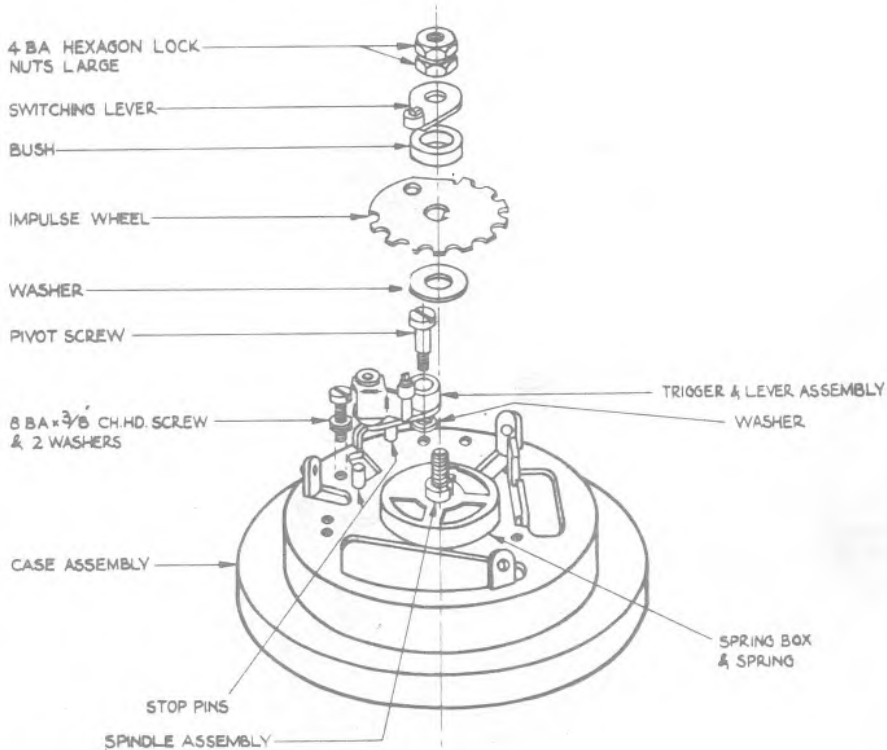


FIG 16. EXPLODED VIEW OF DIAL SWITCH 20

- 14.9 Assemble to the spindle:-
- .91 Washer.
  - .92 Impulse wheel, to engage the key-way in the spindle, checking that it is positioned with the stamped side uppermost.
  - .93 Bush
  - .94 Off normal lever.
  - .95 One nut, finger tight.
  - .10 Replace the stop-plate screw and two washers leaving about  $\frac{1}{8}$ " to be screwed down.
  - .11 Assemble the packing washer, number ring and spring ring to the dial case. Check that the two small holes in the packing washer and those in the number-ring are opposite the finger stop holes, otherwise the number-ring may be damaged when the finger stop fixing screws are assembled.
  - .12 Assemble the instruction-frame and plate to the finger plate and fix to the spindle. When assembling the instruction frame to the finger plate, check that the hole in the instruction frame for the securing ring is opposite the "O" finger-hole.
  - .13 Assemble the instruction card (if supplied) with the lines of lettering horizontal when the finger plate is in its normal position, then the protector and the securing ring.
  - .14 Adjust to Para 6.
  - .15 Assemble the finger-stop to the dial-case.
  - .16 Assemble the trigger and lever assembly to the dial case with the trigger-level pivot screw and washer. The trigger-lever should be free on the pivot screw with perceptible end-play, but with a minimum of side shake.
  - .17 Assemble the springset to the dial case. If any portion of a springset is damaged, the complete springset should be replaced in preference to changing individual parts.
  - .18 Adjust to Paras 7-9.

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- 14.19 Assemble the second nut to the spindle.  
.20 Adjust to Para 10.  
.21 Adjust speed to Para 11 in accordance with Instruction F 6006.

15. Replacement of Parts

When it is necessary to replace any component, reference should be made to the Spare Part Folder, which is supplied to each Administration.

■ 16. Adjusting Tools

TS 74	Pliers Adjusting	- for adjustment of springs and governor wings
TS 148B	Spanner	- for tightening spindle nuts
TS 149A	Duckbill Pliers	- for general spring adjustment
TS 151 )	Screwdrivers	- for general use
TS 152 )		
TS 201	Feeler gauges	- for general use
TS 252	Contact cleaner	
TS 94	Spanner	- for stud in gear wheel
Pressure Gauge 4 )		- for measuring spring tensions
Pressure Gauge 5 )		

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

END OF INSTRUCTION

References: F.6006

TO REMOVE DIAL FROM INSTRUMENT

(1) Remove screw which engages the lowest of the three fixing lugs, withdraw dial from its mounting until the terminals are exposed, disconnect the cord from the dial noting the order of the coloured connections for guidance in replacing.

TO REFIX DIAL TO INSTRUMENT

(2) Reconnect the dial wiring cord, taking care to replace the connections in the same order as before. Insert the dial into its mounting and replace the fixing screw.



### DIRTY DIALS

(3) Before making any adjustments to a dial, it should be examined to see that it is not dirty. Dials in this condition will be sluggish in action even though the main spring has full tension.

To clean the dial, remove the locking ring, withdraw the instruction (number) card from the finger plate, and wash out the dial with clean petrol or benzine or similar solution. Allow the dial to dry, then relubricate all running bearings with a touch of Baudot or clock oil. Take care not to use oil in excess. Replace the instruction card and locking ring and check the speed of the dial in accordance with para. 5.

ADJUSTMENTS

(4) In order to ensure the satisfactory operation of a dial the adjustments specified in the following paragraphs must be maintained. These have been arranged in the order in which they should be observed.

## SPEED OF DIAL

(5) The speed of a dial is controlled by a governor which is automatic in its action. The springs and weights are so proportioned that when the former are set parallel to each other and the centre spindle, the speed of the dial is approximately correct.

The normal speed of a dial is such that the impulses are given at a rate of 10 per second, the permissible limits for dial speeds being said 11 impulses per second.

The best method of testing the speed of a dial is by means of the Dial Speed Testing Circuit - see report on "Circuit for Testing the Speed of Sub's Dials". The average time for one complete spin should be approximately 1.2 to 1.3 seconds.

If the speed is not within the limits as specified the dial should be removed from its mounting and adjusted as follows:-

### To Increase Speed

Use fine nosed pliers, Tool No. 74, and press firmly but not heavily on the root of the governor spring, so causing the balls to bear on the governor frame less heavily.

### To Decrease Speed

Use the same tool inserting the point under the governor springs, and lift springs lightly away from the governor spindle.

In both cases care should be taken to keep the springs the same distance from the governor spindle.

### IMPULSING CONTACTS

(6) The impulse period of a dial is the time during which the impulse contacts are open. It is important that the ratio of make to break be maintained within certain limits.

This is attained by accuracy in the manufacture of two details - the impulse cam and its associated lever. These are made to the exact dimensions necessary for the correct impulse period. They should therefore, never be bent, filed or altered in any manner whatever. Very slight alteration of the ratio can be effected by bending the buffer on which the outer impulse spring rests.

The adjustment of the contact springs should be as follows:-

Contact pressure at NORMAL ..... 20 - 30 grams

Tension to lift lower impulse spring  
only from aboatite pig on lever ..... 5 - 10 grams

Contact opening ..... 14 mils.

Follow of upper impulse spring when  
contacts close, i.e. the distance between  
the end of the buffer and the impulse  
spring ..... 6 mils.

### OFF NORMAL CONTACTS

(7) The off normal contacts are arranged to provide two makes whenever the dial finger plate is rotated from its normal position of rest. It is important that these springs shall not be actuated until the last break is complete and the impulse contacts have closed.

The contact opening of these off normal contacts must not be less than 10 mils. and the spring adjustment must be sufficient to ensure a distinct follow.

## SLIPPING CAM

(8) The function of the slipping cam is to screen two of the gaps in the impulse cam so that when the dial is actuated and released, a pause equivalent to two complete impulses is made before an impulse is sent, thus definitely providing the time required by the exchange apparatus to fulfill the searching function.

The action of the slipping cam is dependant upon the phosphor bronze spring washer which provides sufficient friction to ensure satisfactory action without causing the cam to wear.

When the dial is returning to normal, the small projection on the slipping cam must rest against the adjustable stop secured to the base, so that the lever associated with the impulse segment is permitted to just fall into engagement with the teeth of the impulse wheel. To obtain this adjustment, the adjustable stop (ITEM 10) should be carefully bent.

On moving the dial from normal by inserting finger in (1, i.e. Number One) and pulling dial round until finger is touching finger stop, the adjustable limb of the slipping cam should stop against the adjustable stop (ITEM 10), the slipping cam being in such a position as to expose corner of the first tooth of the impulse wheel. Should the amount of tooth so exposed be more or less than the corner, the adjustable limb of the slipping cam (ITEM 4), should be carefully bent until the required adjustment is effected.

Note:- On no account should the adjustable stop (ITEM 10) be used to effect this latter adjustment. The correct tension to be applied by the spring washer is determined by the friction of the slipping cam. This friction, measured in grams by a tension gauge applied tangentially to the projection on the slipping cam should be such that the slipping cam will not move when a pressure of 60 grams is applied, but will do so throughout its whole travel when a pressure of 80 grams is applied.

DAMAGED FINGER STOP

(9) If bent through accident, the finger stop must be removed and bent back to its correct position before replacing on dial.

DAMAGED FINGER PLATE

(10) The finger plate is also sometimes damaged by accident and may become bent. This may be remedied in the following manner :-

Remove the locking ring which retains the instruction card, withdraw the latter, and then remove the screw at the centre. The finger plate may now be lifted off, flattened, and replaced in a similar manner.



REPLACING A NUMBER RING

(11) Remove finger plate as per paragraph 10, remove ring, retaining number ring plate and replace with new number ring plate, the remaining parts are then reassembled in a similar manner.

REPAIRS TO GOVERNOR AND GOVERNOR CLUTCH

(12) When a dial is disassembled as described in paragraphs 9 and 10, the governor and governor gears are exposed to view. In the case of a breakdown of these parts, we recommend the replacement of the complete governor spindle or star wheel and clutch assembly, as the case may be. The dial should then be reassembled and adjusted as described in paragraphs 4 to 6.

DAMAGED GEARS

(13) Whenever a dial is undergoing adjustment or repair, the gear wheels should be examined for damaged teeth. Dials in this condition should be discarded as it will not be found economical to fit new gear wheels in dials which have worn or strained gears.

#### OTHER REPLACEMENTS

(14) The construction of the dial is such that whilst the controlling gear is situated in a position to which access can be gained by the removal of the finger stop and finger plate, as described in paragraphs 9 and 10, the main spring, impulse and slipping cams, and all parts concerned in the electrical functions of the dial, are situated at the back. Access to these parts is gained by removing the dial from its mounting as described in paragraph 1.

(15) To replace a faulty main spring, care should be taken to first release any tension that may exist. This is done by loosening the screw in the main gear wheel (for which purpose a hole is provided near the centre of the finger plate) and allowing the spring to run down.

The two hexagonal nuts on the centre spindle are now removed and the parts will then lift off in the following order:-

- 1st - Arm assembly
- 2nd - Spring washer
- 3rd - Slipping cam
- 4th - Bush
- 5th - Impulse Wheel
- 6th - Spring box with spring

Any of these parts may be replaced if necessary and re-assembled in reverse order.

When the new main spring is assembled, the correct tension is applied, by winding the spring up fully: this is done by rotating the finger plate in a clockwise direction until the spring is felt to tighten. Now allow the finger plate to return through one complete revolution and screw down the stop screw in the main gear wheel: the dial will now stop when it arrives at its normal position.

Before assembling a new main spring, it should be well lubricated with vaseline, as this assists the smooth running of the dial.

In the case of a springset being damaged, we recommend that the complete springset be replaced, in preference to changing individual parts.