

# EBAUCHES SA NEUCHÂTEL SWITZERLAND



Fontainemelon Watch Manufacturing Co.

**LE LANDERON** Branch, Le Landeron

**11 1/2 4750**

25.60 mm.

Enlarged view  
of movement

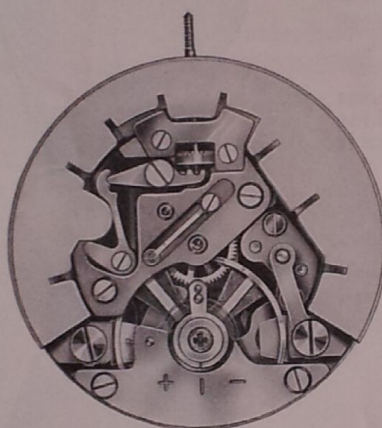


Fig. 1

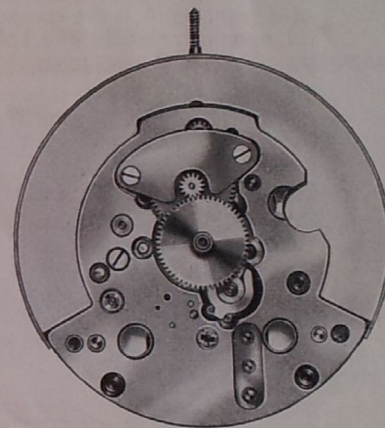


Fig. 2

## Electro-mechanical watch with sweep second

**Technical and practical communication for the use of the watch repairer**

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# 1. Introduction

This technical communication is intended mainly for watchmakers and jewelers, its purpose being to make them familiar with a new type of watch so that they may understand how it works and may thus be able to service and repair it.

It has an electro-mechanical movement with a balance that acts both as a regulating organ and as a motor. To a large extent, therefore, this device follows the traditional principles of watch design.

We are sure that the information given below will enable watch repairers to widen their knowledge, for the electric watch has become a reality, and the L-4750 electric caliber represents another addition in the production of calibers by Ebauches S.A.

The driving power for the L-4750 movement may be supplied either by a dry cell or by an accumulator that can be recharged.

## 2. Examples of feed by dry cell or accumulator

### 2. 1. Feed by dry cell

The dry cell is fitted into a waterproof compartment, which is independent of the movement.

#### Replacing the dry cell

The user himself can replace the dry cell as follows:

Unscrew the lid of the cell compartment by means of a coin, fig. 4. If the compartment has a snap-on lid, open it by means of a knife.

Throw away the used cell.

Fit a new cell. The + side of the cell should press against the mark + engraved on the back of the lid of the cell compartment. Complete cleanliness is essential.

Screw on the lid of the cell compartment.

Voltage of a new Leclanché 15 P 3.5 dry cell = 1.65 volt  $\pm$  0.05.

Voltage of a new Mallory WD-4 dry cell = 1.35 volt (an excess of 0.2 volt may be found if the cell is a very fresh one).

These two types of cells are interchangeable.



Fig. 3

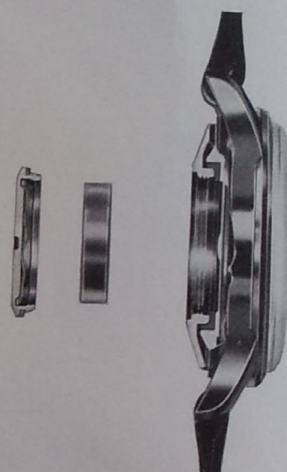


Fig. 4



Fig. 5



Fig. 6

### 2. 2. Feed by accumulator

The accumulator is independent of the movement. It is fitted into the back of the case and is hermetically sealed off from the movement.

#### Recharging the accumulator

Recharging is effected without opening the case, as follows:

Remove the recharging socket cover, fig. 7.

Insert the charger point into the recharging socket, fig. 7.

Place a new 1.5 volt cell of the flashlight-battery type (diameter 25 mm., height 50 mm.) in the charger, fig. 7.

Recharge for 10 to 12 hours.

#### Important:

It is advisable to recharge the accumulator every 6 months.

Voltage of a Leclanché 30 A 3 accumulator in working order on issue from stock = 1.30 volt  $\pm$  0.05.

Voltage of a freshly recharged 30 A 3 accumulator = 1.40 volt  $\pm$  0.05.



Fig. 7



## 3. Tools, material and instruments recommended for repair work

### 3. 1. Tools and material

Movement holder, fig. 8.  
 Plain feed ring, fig. 9 (for complete movement).  
 Feed ring with dry cell, fig. 10 (for complete movement).  
 Feed plate with 10 plain feed rings, for repairing batches of movements, fig. 11.  
 Plastic cover for movement.  
 Contact tweezers.  
 Non-magnetic tweezers.

The above material is supplied by EBAUCHES S. A., Repair Parts Service, NEUCHÂTEL, Switzerland, and can be obtained from your material distributor.

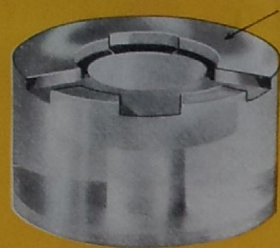


Fig. 8

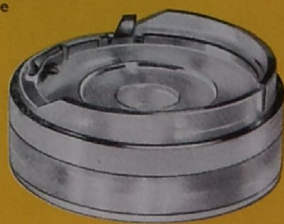


Fig. 9



Fig. 10



Fig. 11

### 3. 2. Instruments

#### Function

#### Instruments and manufacturers

#### Instruments

Checking voltage of cell or accumulator.

#### VOLT-OHMMETER

Volt-ohmmeter for D. C. with high internal resistance equal to or over 20,000  $\Omega$ /volt.

This instrument can be obtained from a qualified radio-electrician.



Fig. 12

Checking and observing the instantaneous rate.

The instruments now on the market are perfectly suitable (18,000 vibrations per hour).

The following are mentioned by way of example:

"VIBROGRAF"

Manufacturers:

RENO S.A., La Chaux-de-Fonds, Switzerland.

"CHRONOGRAPHIC"

Manufacturers:

GREINER ELECTRONIC, Langenthal, Switzerland.

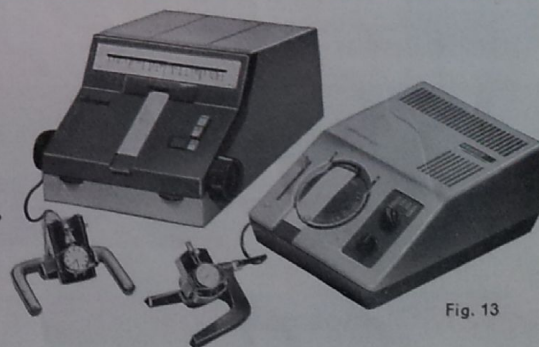


Fig. 13

Feed of movement on plain feed ring.

Checking and measuring current consumption.

Checking the contact image by means of the oscilloscope.

One or other of the following instruments may be recommended:

"ELECTROTEST"

Manufacturers:

RENO S.A., La Chaux-de-Fonds, Switzerland.

"MULTISCOPE"

Manufacturers:

GREINER ELECTRONIC, Langenthal, Switzerland.



Fig. 14



## 4. Removing the case

The method of fixing the movement inside the case varies according to the casing system used. Two commonly used types are described below.

### 4. 1. Case with dry cell, fig. 15

Remove the used cell (see 2. 1.).  
Unscrew the back of the case.  
Remove the feed bridle No. 4035.  
Remove the setting lever No. 443.  
Withdraw the hand-setting stem No. 405.  
Withdraw the hand-setting pinion No. 412.  
Remove the two special case screws No. 5102.  
Take the movement out of the case and place it on the flat side of the movement holder, with the dial upwards.  
Remove the hands and dial.  
Remove the casing bridle No. 960.  
Loosen the screw of the plate-enlargement ring, No. 5158.  
Withdraw the plate-enlargement ring.

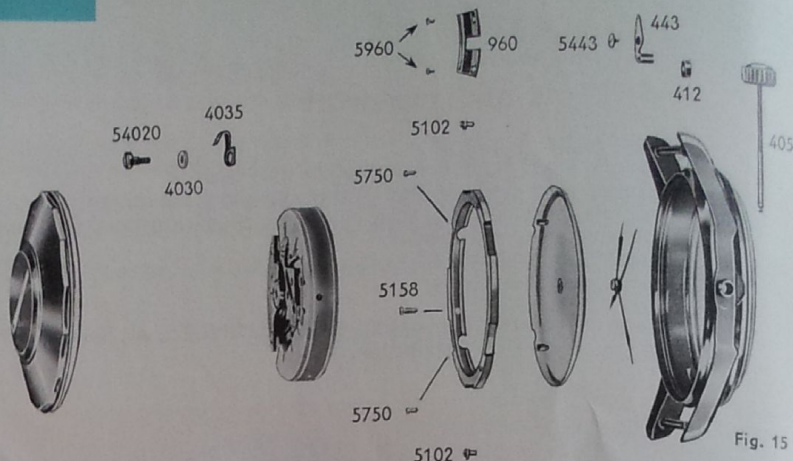


Fig. 15

### 4. 2. Case with accumulator, fig. 16

Unscrew the back of the case.  
Do not remove the accumulator.  
Remove the feed bridle for accumulator No. 4036.  
Remove the setting lever No. 443.  
Withdraw the hand-setting stem No. 405.  
Withdraw the hand-setting pinion No. 412.  
Remove the two special case screws No. 5102.  
Take the movement out of the case and place it on the flat side of the movement holder, with the dial upwards.  
Remove the hands and dial.  
Remove the casing bridle No. 960.  
Loosen the screw of the plate-enlargement ring, No. 5158.  
Withdraw the plate-enlargement ring.

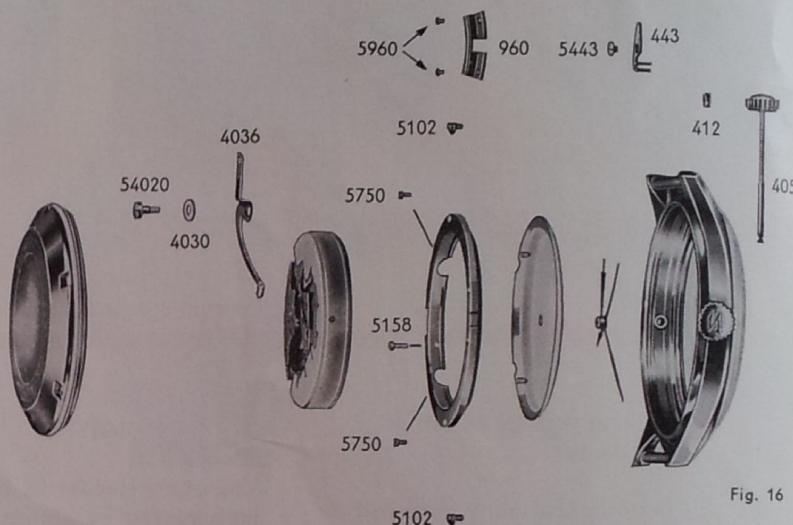


Fig. 16

### 4. 3. Replacing the accumulator

When an accumulator shows traces of oxidation, if it is swollen or if it will no longer take a fresh charge, it should be replaced as follows:  
Unscrew the clamping ring for accumulator No. 4953.  
Remove the accumulator No. 4969.  
Remove the waterproof joint of the accumulator compartment No. 4952.  
Remove the compensation spring No. 4954.

**Note:** To reassemble the accumulator, reverse the foregoing procedure, making sure that all parts are perfectly clean.

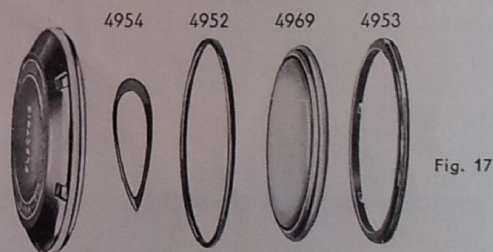


Fig. 17

## 5. Overhauling the movement

For a complete overhaul, the following order of operations is recommended:

5. 1. Disassembly.
5. 2. Cleaning.

### 5. 1. Disassembly

Place the movement on the flat surface of the movement holder.

- a) Disassemble the hand-setting mechanism.
- b) Disassemble the shock protectors (balance bearings).
- c) Remove the balance cock No. 121/1 and the balance No. 721.
- d) Remove the pallet cock No. 125 and the click lever No. 4330.
- e) Unscrew the lead No. 4160.
- f) Remove the stator fixing clamp No. 4025.

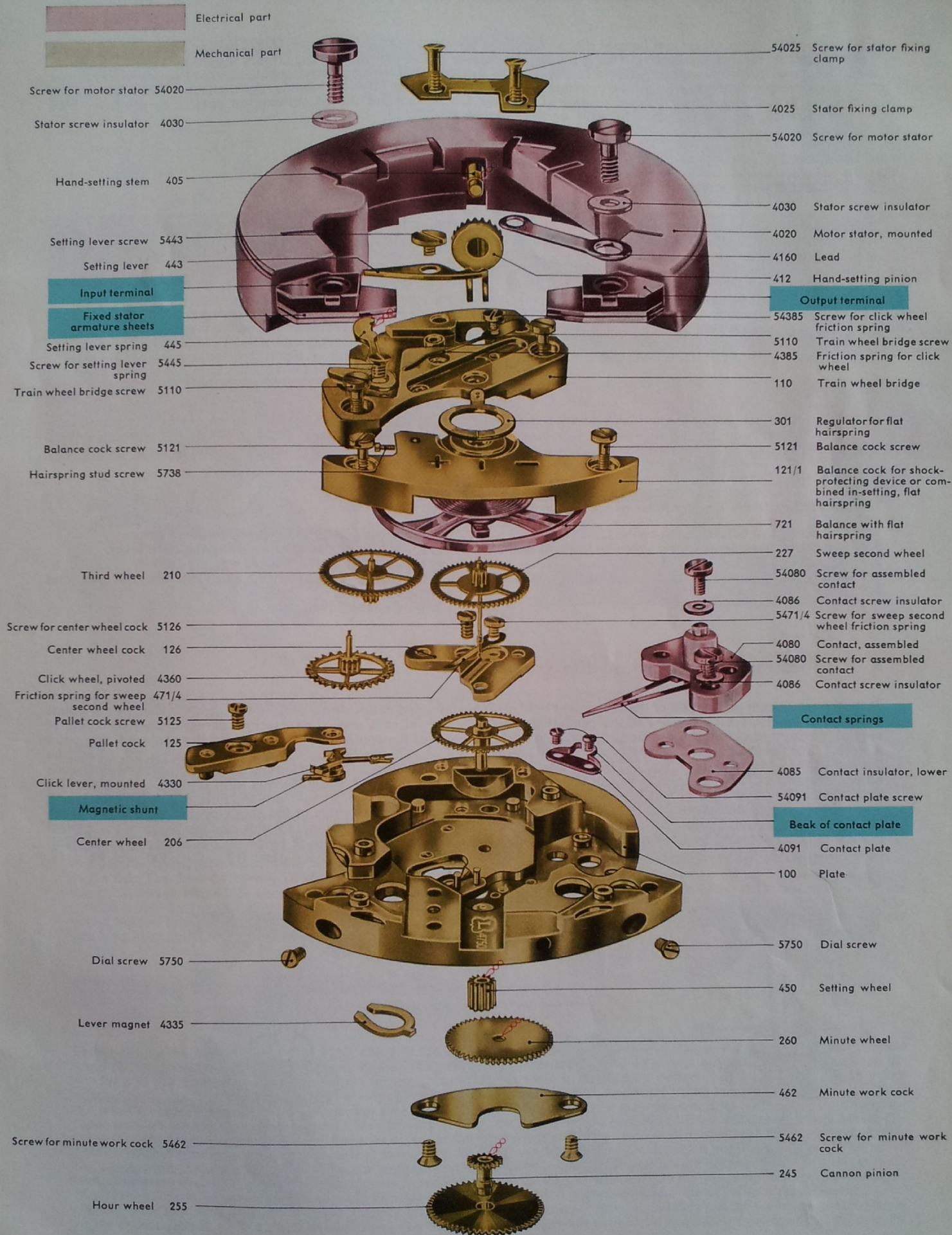
5. 3. Replacing any faulty parts.
5. 4. Assembling, with successive checking.
5. 5. Final checking of movement after overhaul.

- g) Carefully withdraw the motor stator No. 4020. If there are stator wedges No. 4040 between the laminations of the motor stator and the plate, **carefully separate** the one on the output terminal side of the stator from the one on the input terminal side, to avoid interchanging them when assembling the movement.
- h) Remove the friction spring of the click wheel, No. 4385, the train wheel bridge No. 110 and the train wheels.
- i) Remove the center wheel cock No. 126 and the center wheel No. 206.

**Notes:** The following parts may be left screwed to the plate: a) The assembled contact No. 4080. b) The contact plate No. 4091. c) The lever magnet No. 4335. In addition, the setting lever spring No. 445 may be left on the train wheel bridge and the friction spring of the sweep second wheel No. 471/4 may be left on the center wheel cock.



# The components of the watch



Thick oil

Fig. 18



## 5. 2. Cleaning

Clean all parts of the movement (except the motor stator N° 4020) in the cleaning machine, the last bath of which should consist only of isopropyl alcohol. The preceding baths may be of the usual type. Drying should be effected in warm air. The use of boxwood sawdust should in any case be avoided. Self-sticking paper should be used to remove any filings that may have been attracted by the lever magnet No. 4335. After any form of cleaning, the click lever No. 4330 and the click wheel No. 4360 must be given a coating of epilame. On no account should epilame be applied to the assembled contact N° 4080, the contact plate N° 4091 or the balance N° 721.

## 5. 3. Replacing any faulty parts

Before assembling the movement, check the condition of its parts and, if necessary, replace any faulty part or element. If any defect is found in the balance pivots, the contact finger or the roller, the complete balance should be replaced. The balance staff cannot be replaced by the watchmaker himself. Use only genuine repair parts supplied by the Spare Parts Service of EBAUCHES S. A., Neuchâtel, Switzerland, obtained through your materials distributor.

## 5. 4. Assembling, with successive checking

### Important:

In the electric watch, the balance drives all the moving parts of the movement. It goes without saying that stoppage may occur as a result of any dirt, burrs or excessive friction. Great cleanliness is essential while the movement is being assembled after overhaul, and when the movement is cased up the dial and hands must be fitted with the greatest care.

For assembling, the following order of operations is recommended:

- |  |   |
|--|---|
| 5. 5. Checking and adjusting the contact.                    | 5. 10. Assembling the hand-setting mechanism.         |
| 5. 6. Checking and adjusting the magnetic return action.     | 5. 11. Oiling the clickwork, fitting the click lever. |
| 5. 7. Assembling the train.                                  | 5. 12. Assembling the minute work.                    |
| 5. 8. Fitting the motor stator and lead, checking the conti- | 5. 13. Fitting the balance, checking the air gap and  |
| 5. 9. nuity of the circuit.                                  | endshake.   |
|  | 5. 14. General lubrication.                           |

## 5. 5. Checking and adjusting the contact

Place the movement on the side of the movement holder that is intended to take the plate. Check for clean contacts at points a, b and c, fig. 19. Check the tips of the contact springs with special care and, if necessary, correct them with a pair of special tweezers to obtain the position shown at (a), fig. 20. See that the contact springs are correctly centered. The point at which they touch and press against each other should be in line with the hole of the balance jewel, fig. 19. Check the tension of the contact springs, fig. 21; the tension is the pressure exerted by the springs as their tips press against each other. Proceed as follows: holding one of the contact springs by its free end, draw it away with a pair of tweezers. This will release the other spring, which should automatically shift 0.4 to 0.6 mm. away from the hole of the balance jewel. The amount of this shift should be between half and two thirds of the total radius of the shock-protecting device. Check the tension of the other contact spring in the same way. The space between the contact springs and the beaks of the contact plate should be adjusted by bending the beaks slightly. The space should be equal to twice the thickness of a spring (2e), fig. 19. For checking this space and the tips of the contact springs, a strong magnifying glass (12 to 20  $\times$ ) should be used.

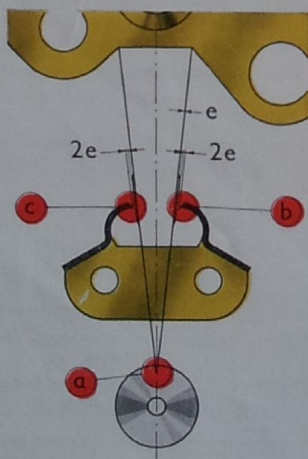


Fig. 19

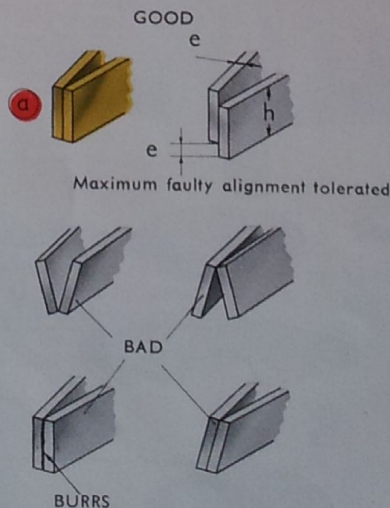


Fig. 20

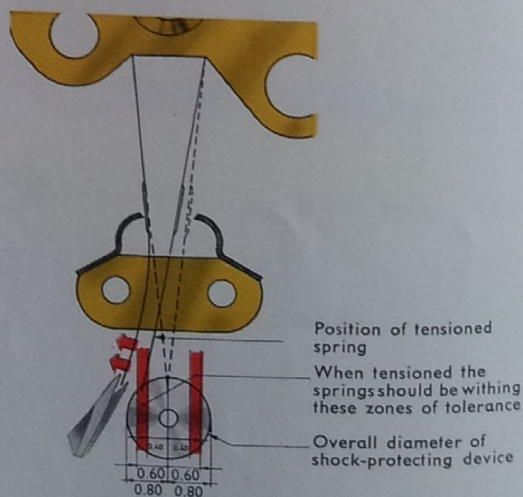


Fig. 21

Dimensions in mm.



When correctly tensioned and centered, the contact springs should be straight. Springs shaped as shown in fig. 22 and 23 will not work satisfactorily. Finally, make sure that the assembled contact is electrically insulated, from the plate, fig. 24.

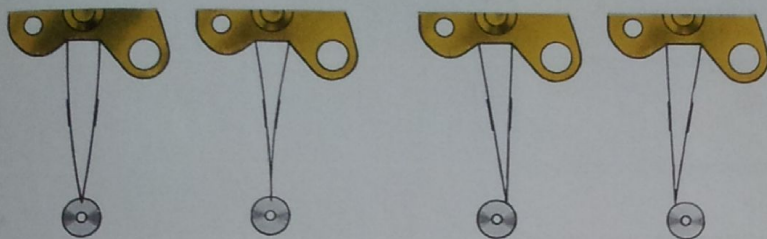
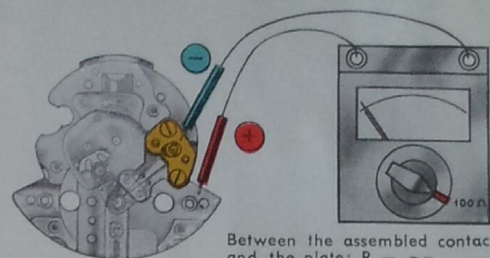


Fig. 22

Fig. 23



Between the assembled contact and the plate:  $R = \infty$   
Fig. 24

## 5. 6. Checking and adjusting the magnetic return action

Check the click lever pivots No. 4330 and the corresponding jewels to make sure that they are clean. Fit the click lever alone. Check the endshake. The banking pins must be vertical. Do not touch the banking pins or the pallets of the click lever. Move the lever by shifting the fork to make sure that the attraction of the click lever towards the banking pins is of equal intensity on either side. If this is not the case, divide the attraction equally by turning the magnetic shunt located underneath the lever, fig. 25. This operation can be effected when the click lever is in position. If the attraction is too weak after it has been equalized, it can be made stronger by slightly bending the magnetic shunt to bring it closer to the lever magnet. This can also be done with the click lever in position, fig. 26.

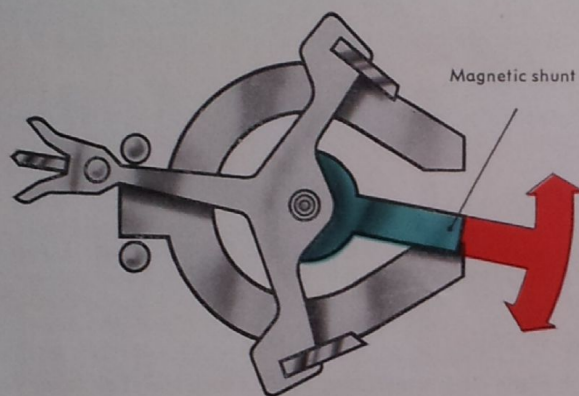


Fig. 25

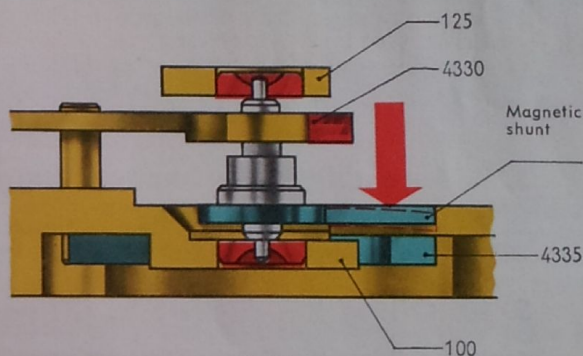


Fig. 26

## 5. 7. Assembling the train

Remove the click lever 4330. Fit the center wheel No. 206 and the center wheel cock No. 126. Check the center wheel for trueness in the flat. Lubricate the upper pivot of the center wheel and the pip of the lower pivot of the sweep second wheel No. 227. Then, in the following order, fit: the click wheel No. 4360, the sweep second wheel and the third wheel No. 210. Fit the train wheel bridge No. 110 in position and, before screwing it down, check the tension of the friction spring of the sweep second wheel, No. 471/4. This is done as follows: raise the train wheel bridge 0.05 mm. The sweep second wheel should then run free without endshake. If the shoulder of the pivot of the sweep second wheel presses against its jewel, the tension of the friction spring of the sweep second wheel is too great. On the other hand, if there is any clearance between the shoulder and the jewel, the tension of the friction spring of the sweep second wheel is not sufficient. When this operation has been finished, screw down the bridge and check the train for freedom of action and the sweep second wheel for trueness in the flat. The friction spring of the sweep second wheel should not be lubricated. Before fitting the friction spring of the click wheel, No. 4385, check its tension as follows: place the spring in position by turning it. Screw it down. If the tension is correct, the end which normally presses on the click wheel pivot slightly projects beyond the surface of the train wheel bridge (by 0.05 mm.). If this is not the case, the tension should be corrected. Then replace the spring in its normal working position so that it presses against the tip of the click wheel pivot.

## 5. 8. Fitting the motor stator and lead, checking the continuity of the circuit

Before fitting the motor stator No. 4020, check it for proper insulation by connecting one of the ohmmeter plugs to the input terminal and the other to the laminations. The resistance measured should be practically unlimited. Then check the working of the contact protector elements (diode and resistance sunk in the plastic material of the stator). This check is effected as follows: connect the  $\oplus$  plug of the ohmmeter to the input terminal and the  $\ominus$  plug to the output terminal. Note the measurement shown by the instrument (value A). Reverse the plugs and take a second reading (value B). The difference between the two measurements (value A less value B) should be between 250 and 700  $\Omega$ . If no difference is registered, the protector elements are out of order; **they are no longer working and the motor stator must be replaced.** In this case, also check the condition of the contact finger and the beaks of the contact plate, which should show heavy traces of burning owing to the fact that the protector elements have not been working; the complete balance and the contact plate must then be replaced. When the motor stator is found to be in order, fit it in position. Do not forget to fit the stator wedges, if any (they should be carefully placed off to the side when the movement is disassembled). Before screwing down the motor stator, fit the lead No. 4160 to the output terminal, making sure that an insulator No. 4030 is placed under each screwhead of the motor stator. At this stage of assembly, the continuity of the circuit should be checked as follows: fig. 27 and 28.



Measurements to be taken	Results obtained	Conclusion
Fig. 27 	$R = \text{measurement A (5.8)}$	In order.
	$R = 0$	Short-circuit on input terminal of motor stator and on output terminal (or on the assembled contact).
	$R = \infty$	Motor stator useless, broken winding.
Fig. 28 	$R = \infty$	In order.
	$R = 0$	Short-circuit on input terminal.
	$R = \text{measurement A (5.8)}$	Short-circuit on output terminal or on assembled contact.

### The most common causes of short-circuits are the following:

- on the input terminal: omission of insulator No. 4030; feed bridge No. 4055 or 4036 touching shank of stator screw No. 54020; dirt between stator screw and input terminal (filings).
- on the output terminal: omission of insulator No. 4030; lead No. 4160 touching the shank of stator screw No. 54020; dirt between the motor stator screw and the output terminal (filings).
- on the contact unit: omission of upper insulators No. 4086 and lower insulator No. 4085; contact springs touching one or both of the beaks of contact plate No. 4091; dirt between the assembled contact screws No. 54080, assembled contact unit No. 4080 and plate No. 100; metal filings embedded in the insulators No. 4085 and 4086.

## 5. 9. Assembling the hand-setting mechanism

Fit the hand-setting pinion No. 412. Lubricate the hand-setting stem No. 405 and place it in position. Screw on the setting lever No. 443. Lubricate the functional portion of the setting lever spring No. 445.

## 5. 10. Oiling the clickwork, fitting the click lever

Apply a small drop of pallet oil on the tip of every 3rd or 4th tooth of the click wheel No. 4360. Place the click lever No. 4330 in position.

## 5. 11. Assembling the minute work

Lubricate the setting wheel and minute wheel studs. Assemble the minute work and screw on the minute work cock No. 462. Check the wheels for free running and endshake. Lubricate the center wheel No. 206; grease the inside of the cannon pinion No. 245 and push it into position (be careful of the teeth of the minute wheel No. 260). Check the pip of the cannon pinion to see that it is slightly less prominent than in a watch of the usual type.

## 5. 12. Fitting the balance

With Indian ink, trace a vertical stroke on the inside of the rim of the balance No. 721, opposite to the hairspring stud. This will make it easier to check the amplitude, fig. 29 a.

Assemble the shock-protecting devices without oiling them.

Place the balance in position and put it into proper running order after having made sure that the contact finger is perfectly clean. The contact finger should point in the direction of the center of the balance staff, fig. 29 b.

Check the endshake of the balance. It should be very slight (0.01 mm.), otherwise the watch will be noisy in slanting positions with the dial upwards. Check the interaction of the fork and roller and of the contact finger and contact springs. Check the air gap (i. e. the space between the mobile armature soldered to the balance and the laminations of the motor stator). The space between these parts should be 0.13 mm.  $\pm$  0.04 mm. This clearance is equivalent to half or three quarters the thickness of the mobile armature. It is corrected by adding stator wedges No. 4040, which are placed between the plate and the laminations of the stator (wedges 0.02 mm., 0.04 mm., 0.06 mm. and 0.08 mm. thick are available). Then place the complete movement in a demagnetizing machine.

Stroke in Indian ink.

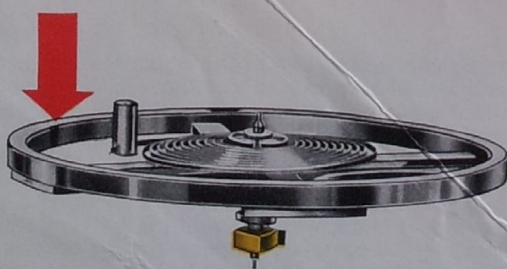


Fig. 29 a



Fig. 29 b

## 5. 13. General lubrication

Balance No. 721, third wheel No. 210, sweep second wheel No. 227, click wheel No. 4360 (in the case of the last-named wheel, raise the friction spring of the click wheel, No. 4385, to drop a little oil around the pivot, then, withdrawing the oiler, apply the rest of the oil drop to the lower surface of the friction spring where it is in contact with the click wheel pivot).



## 6. Checking the finished movement

First of all, check the damping (freeness) of the balance by turning it to the knocking position, then releasing it and counting the number of complete oscillations until the sweep second wheel stops moving. The number of oscillations should be between 30 and 40. If there are fewer than 30 oscillations, the balance is subject to excessive braking. Then place the finished movement on a plain feed ring, and the whole on the microphone of the testing instrument (Multiscope or Electrotest). Adjust the apparatus according to the manufacturer's directions. To make sure that the movement is in perfect working order, it is advisable to take the measurements corresponding to the coloured areas in the following table. If the watch refuses to go, refer to paragraph 5. 8. and again check the continuity of the circuit and the passage of current into the feed ring.

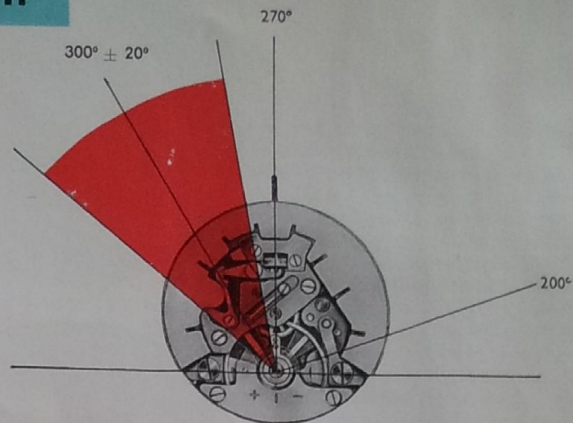
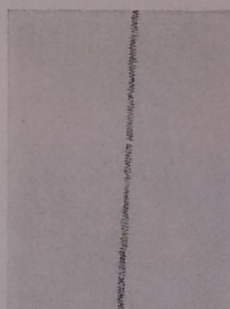


Fig. 30

Position	Voltage	Amplitude	Current consumption
D. D.	1.6 v.	$300^\circ \pm 20^\circ$	
P. D.	1.6 v.		less than 17 $\mu$ A.
P. D.	1.2 v.	over $200^\circ$	

If the performances correspond to those laid down in the table and the contact image is closely similar to that shown in fig. 32, the final timing correction may be effected. If the performances are inferior to those given in the table, it is necessary to look for any possible defects. The most common defects are the following:

- bad contact images.** Images similar to those given in fig. 33, 34, 35, 36 and 37 are due to defects that must be corrected according to the captions accompanying the figures.
- bad rate.** The amplitude is lower than that shown in the table, and therefore the current consumption is increased. Make sure that the air gap is normal (v. 5. 12.), that the stator wedges, if any, have been replaced, that the movement has been demagnetized and that the hand-setting stem is uncoupled (pushed-in position). Check the freedom of rotation and the damping of the balance, the endshake of the runner arbors, the lubrication of the movement and its general cleanliness.
- bad rate tracings.** Dots out of alignment in the instantaneous rate tracings show that the magnetic return action is out of adjustment, fig. 31.



Good

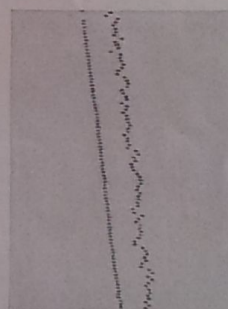


Fig. 31

Bad

### 6. 1. Contact images photographed by means of an oscilloscope

Fig. 32

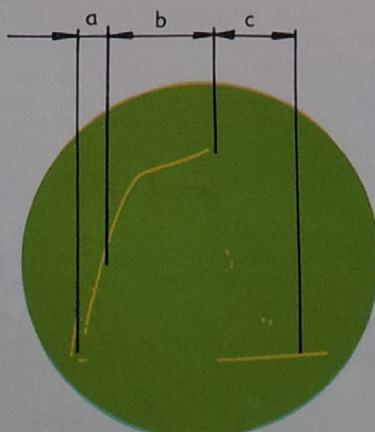


Fig. 32.  
Satisfactory contact.  
Succession of similar  
oscilloscope images  
superimposed.

#### a = Single contact area

Contact occurring only between the contact finger and the contact springs, v. fig. 38 and 39.

#### b = Double contact area

Apart from the contact described above, a second contact occurs between one of the contact springs and the corresponding beak of the contact plate, fig. 40.

#### c = Rebound area

The finger has come away from the springs which, by vibrating at the time of damping, cause a few very brief contacts between the springs and the beaks of the contact plate.



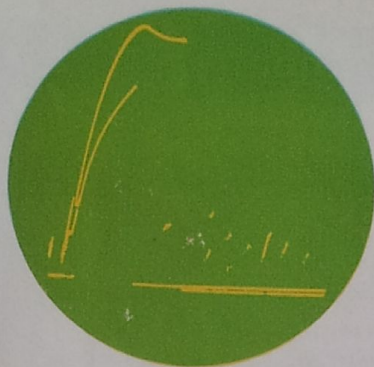


Fig. 33.  
Badly centered contact.

Series of non-superimposed images formed alternately of small and large images.

**Correction:** center the springs (v. 5. 5.).

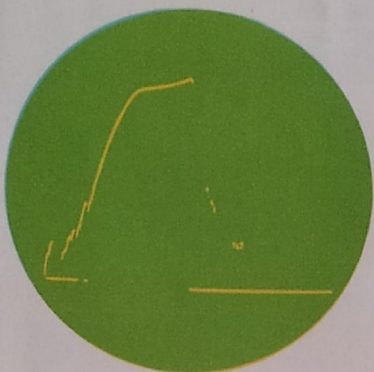


Fig. 34.  
Faulty contact between finger and springs.

The line corresponding to the single contact area is broken in several places.

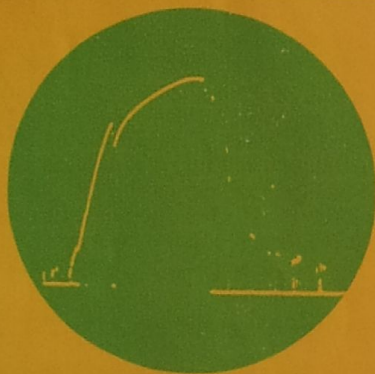
**Correction:** check the contact finger and the tips of the springs, as well as the tension (v. 5. 5), fig. 20 and 21.

**Note:** the contact between the finger and the springs is often faulty on one side only; images as above will then alternate with good ones.

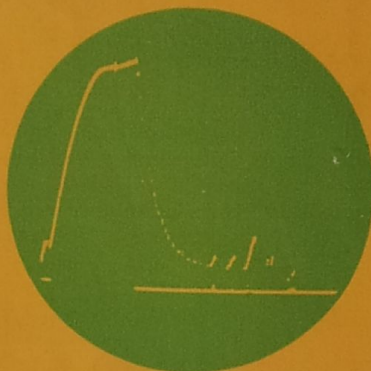
Fig. 35.  
Contact broken at the beginning of the double contact area.

Fig. 36.  
Excessive rebounds.

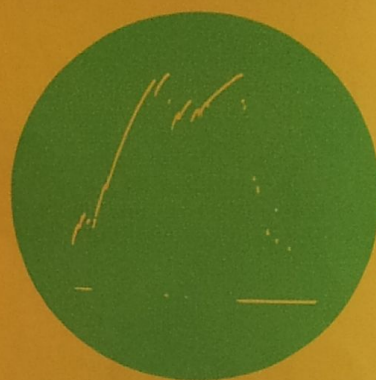
Fig. 37.  
Very bad contacts: several defects.



**Correction:** check the cleanliness of the springs and the beaks of the contact plate. Check the distance between the contact springs and the beaks of the contact plate (v. 5. 5., fig. 19).



**Correction:** check the cleanliness of the springs and the beaks of the contact plate. Check the tension of the contact springs and the distance between them and the beaks of the contact plate (v. 5. 5., fig. 19 and 21).



**Correction:** refer to 5. 5.

## 7. Fitting the dial and hands - Casing up - Final checking

Place in position and screw down the plate-enlargement ring No. 158. On it, fit the casing bridle No. 960 and the two special case screws No. 5102. Place in position the hour wheel No. 255 with its friction spring, which should be slightly tensioned. (If the friction spring has been lost, it is important to replace it by a sufficiently weak tension spring, to avoid any additional braking action.) Then fit the dial and hands. Remove the setting lever No. 443, the hand-setting stem No. 405 and the hand-setting pinion No. 412. Place the movement in the case, which should have been carefully cleaned beforehand. Fit the hand-setting stem, the hand-setting pinion and the setting lever. Drive home the special case screws. Screw on the feed bridle, i. e. No. 4035 for a dry cell case or No. 4036 for an accumulator case. Check the voltage of the source of current (dry cell or accumulator) by means of a voltmeter. Replacement is necessary if the voltage is below the values indicated in 2. 1. and 2. 2. Screw on and tighten the back of the case.\* Place the watch in a demagnetizer. Then check a) a defect in the feed system, or b) a stoppage in the train.

In the event of (a), see that the dry cell or accumulator is properly and cleanly fitted in its compartment. Make sure that the voltmeter shows a voltage corresponding to the values indicated in sections 2. 1. and 2. 2., between the actual back of the case and the part on which the feed bridle rests. Also make sure that the feed bridle is sufficiently tensioned. If the watch will not work in spite of these checks, check the continuity of the circuit, leaving the movement in the case, but removing the balance, (v. 5. 8.).

In the event of (b), the ticking of the watch will be audible, but the hands will not turn. This is caused by a mechanical stoppage due to the click wheel, which is not being impelled by the click lever. Make sure that the hand-setting stem is pushed in, so that the hand-setting pinion is not in mesh with the setting wheel. If the watch still fails to work in spite of this check, examine the hands and see that the train is perfectly clean, (v. 5. 4.).

\* In the case of accumulator-driven watches, it is necessary to check the voltage of the accumulator between the body of the case and metal center of the recharging socket.



## 8. Description and functioning

### 8. 1. Motor and contacts

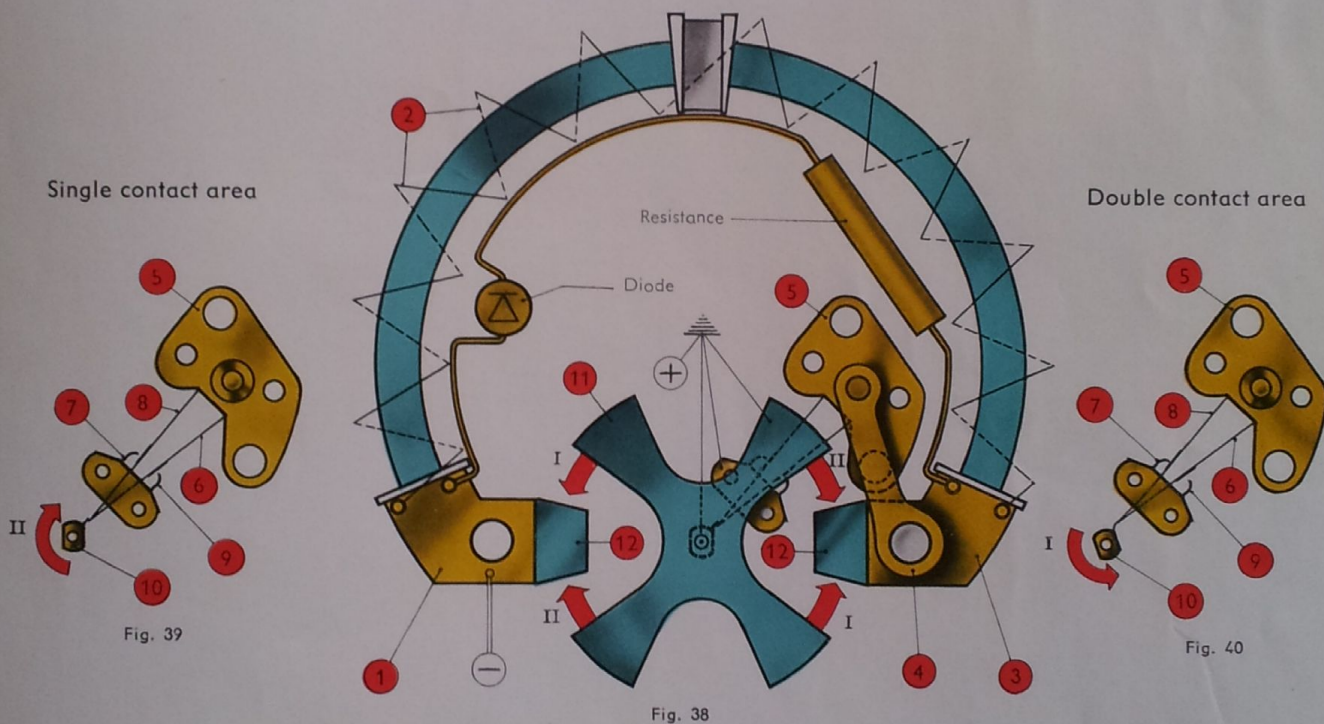
The functioning of the L-4750 watch is explained by fig. 38, 39 and 40. In addition to the balance and roller found in watches of the usual type, the balance staff carries a "mobile armature" with four arms soldered underneath the balance (11) and a collet fitted with a contact finger (10). Suppose the balance, after having been moved away from its position of equilibrium, returns under the action of the hairspring, moving in the direction of arrow (I), fig. 40. At the point of rest, the contact finger (10) will touch the contact spring (6). The electric circuit is thus closed, and the current will flow as follows: From the input terminal (1), it flows through the winding (2) and reaches the output terminal (3) of the motor stator. Then, circuit by passing from the contact springs (6) and (8) to the contact springs (6) and (8). The current then completes its path through the hairspring stud and the whole of the movement, reaches the  $\oplus$  pole of the source of current. The flow of current through the winding magnetizes the fixed laminations (12) of the motor stator. The mobile armature (11) is then turning, causes the spring (8) to press against the beak (7) of the contact plate, which is also connected to the  $\oplus$  pole, fig. 40. This closes the second contact, the purpose of which is to make for more reliable functioning. When the impulse has been given, the balance turns through its supplementary arc and swings back in the direction of arrow (II), fig. 38 and 39, until it reaches its position of rest. The finger (10) touches the contact spring (8), fig. 39, and the current again flows through spring (6) and the beak of the contact plate (9). An impulse is thus given on each vibration.

The following parts are grounded:

The  $\oplus$  pole of the source of current.  
The contact plate.  
The contact finger, by way of the balance staff,  
the collet, the hairspring and the hairspring stud.  
The whole movement.

The following parts are insulated from the movement:

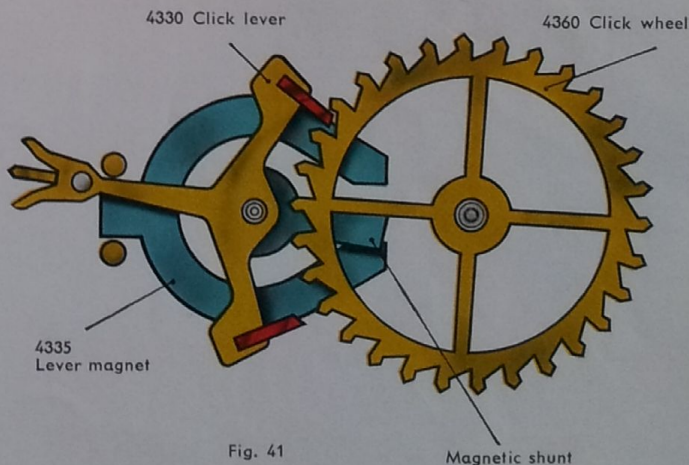
The  $\ominus$  pole of the source of current.  
The feed bridge.  
The input terminal of the motor stator.  
The output terminal of the motor stator.  
The lead.  
The assembled contact.



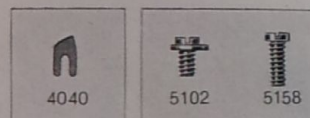
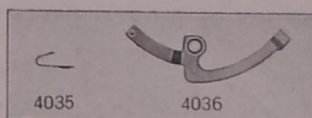
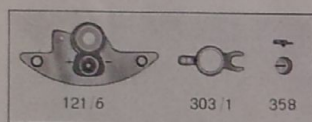
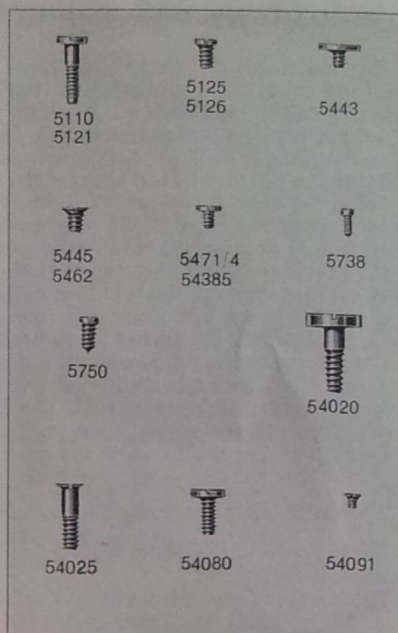
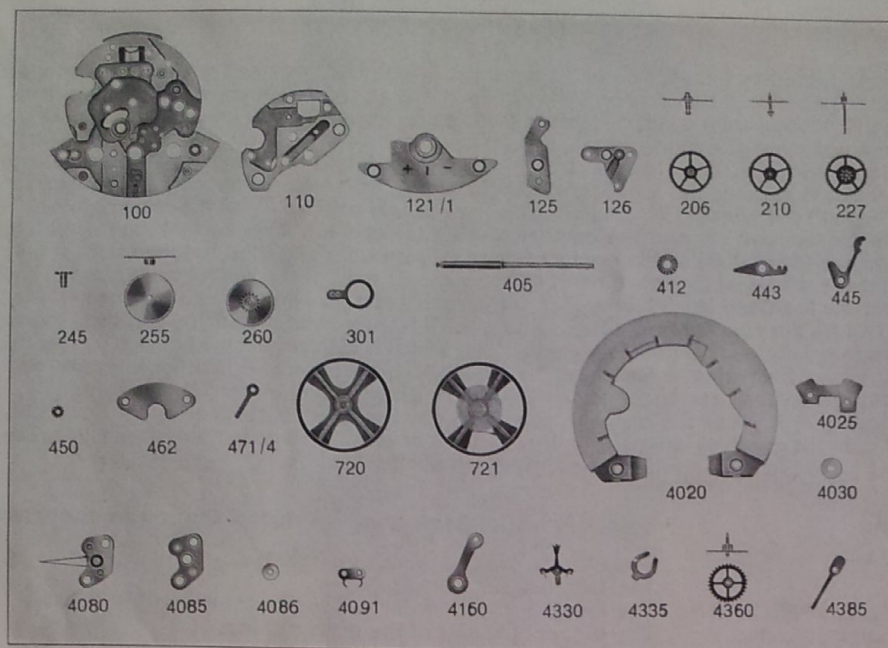
### 8. 2. Clickwork and train

The movement of the balance is transmitted to the train by way of the click mechanism, as follows:

- Each time the balance passes its point of rest, the impulse pin shifts the click lever from one banking pin to the other. During the supplementary arc, the click lever is held against the banking pins by the attraction of the lever magnet (fixed under the plate) on the magnetic shunt (fixed on the arbor of the click lever).
- Each time it swings, the click lever drives the click wheel half a step. The click wheel is stopped by the friction spring of the click wheel after each angular shift.
- From the click wheel, the motion is transmitted to the hands by a train of the usual type.







# Nr. LIST OF MATERIALS

100	Plate
110	Train wheel bridge
121/1	Balance cock for shock-protecting device or combined in-setting, flat hairspring
121/6	Balance cock for regulating and shock-protecting devices, flat hairspring
125	Pallet cock
126	Center wheel cock
206	Center wheel
210	Third wheel
227	Sweep second wheel
245	Cannon pinion
255	Hour wheel
260	Minute wheel
301	Regulator for flat hairspring
303/1	Two-piece regulator for regulating device, flat hairspring
358	Adjuster for regulator
405	Hand-setting stem
412	Hand-setting pinion
443	Setting lever
445	Setting lever spring
450	Setting wheel
462	Minute work cock
471/4	Friction spring for sweep second wheel
720	Pivoted balance with roller and contact finger
721	Balance with flat hairspring
4020	Motor stator, mounted
4025	Stator fixing clamp
4030	Stator screw insulator

# Nr. LIST OF MATERIALS

4035	Power connection for battery watch
4036	Power connection for accumulator watch
4040	Stator wedge
4080	Contact, assembled
4085	Contact insulator, lower
4086	Contact screw insulator
4091	Contact plate
4160	Lead
4330	Click lever, mounted
4335	Lever magnet
4360	Click wheel, pivoted
4385	Friction spring for click wheel
5102	Case screw
5110	Train wheel bridge screw
5121	Balance cock screw
5125	Pallet cock screw
5126	Screw for center wheel cock
5158	Plate-enlargement ring screw
5443	Setting lever screw
5445	Screw for setting lever spring
5462	Screw for minute work cock
5471/4	Screw for sweep second wheel friction spring
5738	Hairspring stud screw
5750	Dial screw
54020	Screw for motor stator
54025	Screw for stator fixing clamp
54080	Screw for assembled contact
54091	Contact plate screw
54385	Screw for click wheel friction spring