EMMYWATCH

VINTAGE RESTORATIONS

Seiko 6138A Movement Parts (1)

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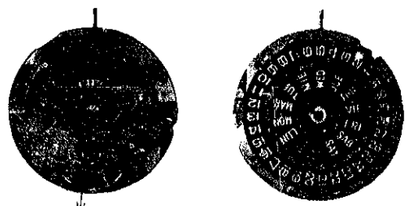
SEIKO

Caliber No. **6138A** | Jewels **21** | Style Name **Automatic Chronograph**

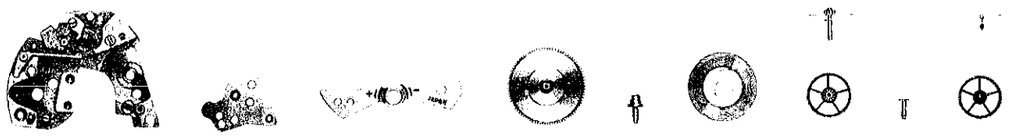


Cal. 6138A

Characteristics

Casing diameter: 27.00 mm
Maximum height: 8.00 mm
Vibrations per hour: 21,600
Automatic and auxiliary hand winding with sweep second
Chronograph (12 hours recorder & 30 minutes recorder)
Calendar (day & date)
Instant setting device for day & date calendar
Bilingual change-over system for day of week
"Diashock" Shock Resistant Device

Catalog No. 61-38-1



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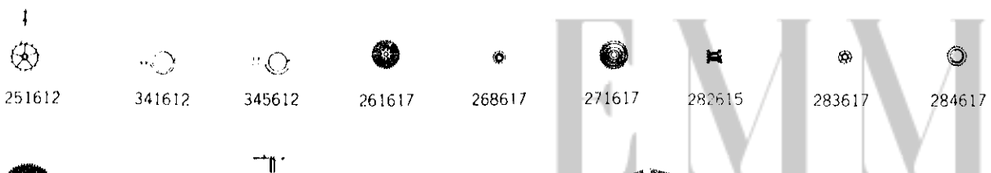

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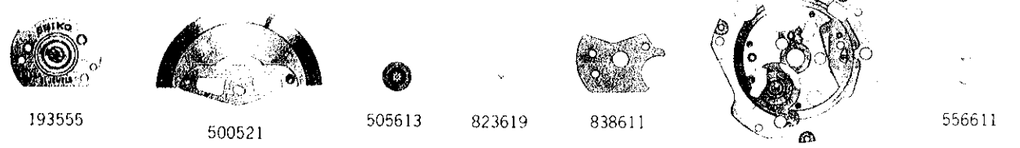
285614 287617 383617 384615 385615 388618 481617 354616



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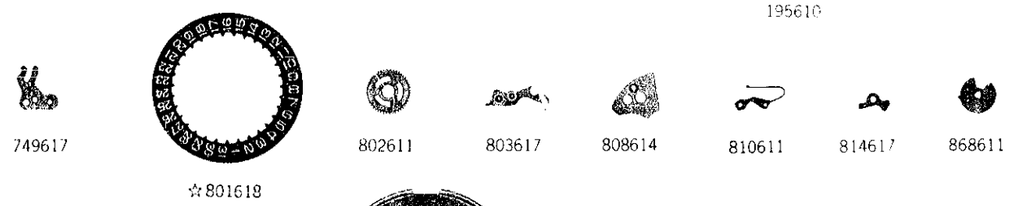


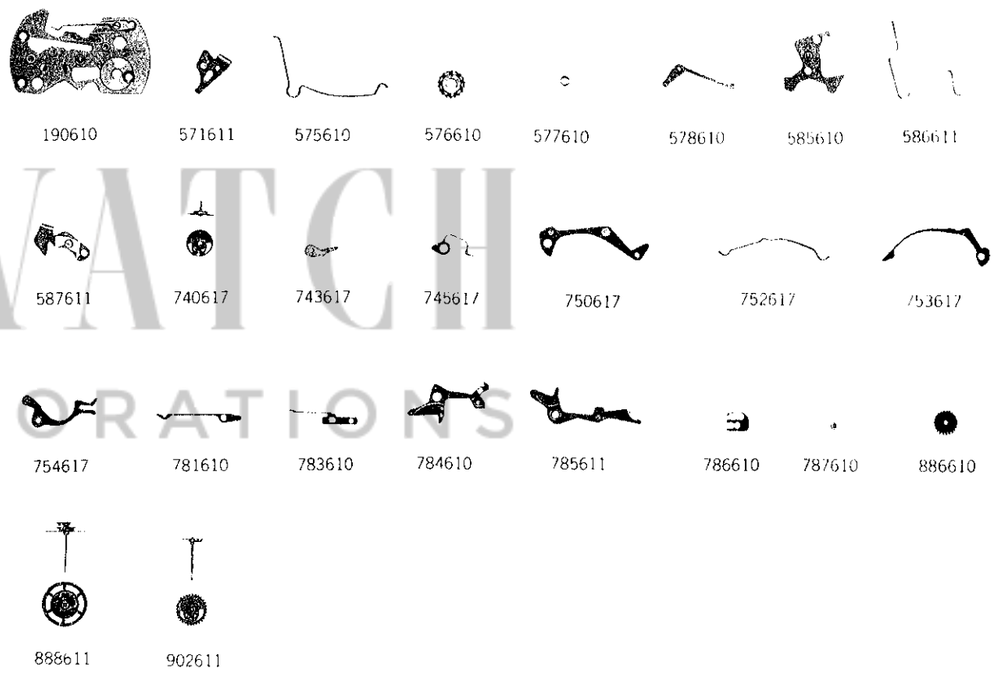
749617 ☆801618 802611 803617 808614 810611 814617 868611

☆870931 873610 ☆884632 986617 989617

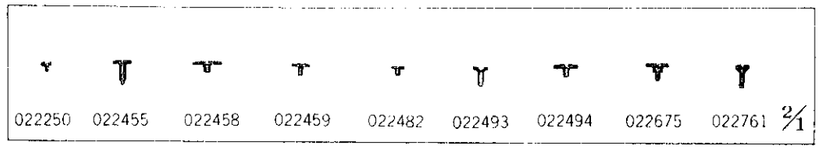
☆ : Please see remarks on the next reverse page.
As for all other parts not shown here, please refer to the basic calibre (Cal. No. **6106A** 25J Catalog No. 61-06-1 Green page).

Caliber No. **6138A** | Jewels **21** | Style Name **Automatic Chronograph**

continued



190610 571611 575610 576610 577610 578610 585610 586611
587611 740617 743617 745617 750617 752617 753617
754617 781610 783610 784610 785611 786610 787610 886610
888611 902611



022250 022455 022458 022459 022482 022493 022494 022675 022761 2/1

Calibre No.	6138A	Jewels	Style Name
⇨ Basic Calibre 6106A 25J Catalog No. 61-06-1		21j	(Automatic Chronograph)

PART NO.	LIST OF MATERIALS
112526	**Barrel & train-wheel bridge** (with crown wheel, second intermediate ratchet wheel, operating lever, pillar wheel jumper and fly-back lever)
122629	**Center wheel bridge**
161805	Pallet cock
171523	**Balance cock**
190610	**Chronograph bridge** (with intermediate minute recording wheel and hammer click)
193555	**Framework for automatic device with ball-bearing**
195610	**Calendar plate**
205555	**Complete barrel with arbor** (with intermediate hour recording wheel, intermediate hour recording wheel ring, and friction spring for intermediate hour recording wheel)
213616	**Barrel arbor**
224612	**Center wheel & pinion with cannon pinion**
225617	**Cannon pinion**
231618	**Third wheel & pinion**
251612	**Escape wheel & pinion**
261617	**Minute wheel**
268617	**Second intermediate ratchet wheel**
271617	**Hour wheel**
282615	**Clutch wheel**
283617	**Winding pinion**
284617	**Crown wheel**
285614	**Ratchet wheel**
287617	**Intermediate ratchet wheel**
301611	Jewelled pallet fork & staff
310611	Balance complete with stud
315611	Balance staff
331610	Roller with jewel
341612	**Regulator**
345612	**Stud holder**
354616	**Winding stem**
381611	Click
383617	**Setting lever with axle**
384615	**Yoke (Clutch lever)**
385615	**Yoke spring (Clutch lever spring)**
388618	**Setting lever spring**
401616	**Mainspring with slipping attachment**
481617	**Crown wheel ring**
014363	Diashock upper frame
014364	Diashock lower frame
014365	Diashock hole jewel with frame
011210	Diashock cap jewel
014317	Diashock spring
500521	**Oscillating weight**
505613	**Transmission wheel**
823619	**Eccentric post**
831611	Pawl lever with jewel
838611	**Pawl lever seat**
556611	**Date finger**
749617	**Setting wheel lever guard**
☆**301618**	**Date dial**
802611	**Date driving wheel**
803617	**Setting wheel lever complete**
808614	**Date dial guard**
810611	**Date jumper**
814617	**Setting wheel lever plate**
817610	Intermediate date wheel
868611	**Day finger**

PART NO.	LIST OF MATERIALS
☆**870931**	**Day star with dial disk** (English ⟷ Spanish)
873610	**Day jumper**
☆**884632**	**Holding ring for dial**
963610	Snap for day star with dial disk
986617	**Day-date corrector wheel rocking lever**
989617	**Intermediate wheel for day correction**
571611	**Operating lever**
575610	**Operating lever spring**
576610	**Pillar wheel**
577610	**Pillar wheel ring**
578610	**Pillar wheel jumper**
585610	**Hammer**
586611	**Hammer spring**
587611	**Fly-back lever**
740617	**Hour recording wheel**
743617	**Hour recording wheel stop lever**
745617	**Spring for hour recording wheel stop lever**
750617	**Hour hammer**
752617	**Hour hammer spring**
753617	**Hour fly-back lever**
754617	**Intermediate hour recording wheel stop lever**
781610	**Hammer click**
783610	**Minute recording jumper**
784610	**First coupling lever**
785611	**Second coupling lever**
786610	**Chronograph finger**
787610	**Rest of chronograph finger**
886610	**Intermediate minute recording wheel**
888611	**Center chronograph wheel**
902611	**Minute recording wheel**
022150	Stud screw
022250	**Screw for minute recording jumper**
022351	Center wheel bridge screw
022455	**Calendar plate screw**
022458	**Screw for oscillating weight**
022459	**Framework screw for automatic device with ball-bearing**
022467	Ratchet wheel screw
022468	Pallet cock screw
022471	Click screw
022482	**Screw for intermediate wheel of day correction**
022493	**Bridge screw**
022493	**Chronograph bridge screw**
022494	**Pillar wheel screw**
022494	**First coupling lever screw**
022662	Setting lever spring screw
022662	Setting wheel lever guard screw
022675	**Holding screw for coupling levers**
022677	Date driving wheel screw
022760	Date dial guard screw
022760	Setting wheel lever plate screw
022760	Day jumper screw
022761	**Dial screw**

—continued on reverse page—

☆ ⇨ Please see remarks on the reverse page.

Items in light letters are not shown in photos; those parts are interchangeable with the basic calibre (Cal. No. **6106A** 25J Catalog No. 61-06-1 Green page).

Calibre No.	6138A	Jewels	Style Name
⇨ Basic Calibre 6106A 25J Catalog No. 61-06-1		21j	(Automatic Chronograph)

PART NO.	LIST OF MATERIALS
	—continued—
011145	Lower hole jewel for barrel
011167	Upper hole jewel for center wheel
011145	Lower hole jewel for center wheel
011306	Upper hole jewel for 3rd wheel
011405	Lower hole jewel for 3rd wheel
011406	Upper hole jewel for escape wheel
011406	Lower hole jewel for escape wheel
011503	Upper hole jewel for pallet
011503	Lower hole jewel for pallet
011147	Upper hole jewel for transmission wheel
011147	Lower hole jewel for transmission wheel
011424	Upper hole jewel for center chronograph wheel
011544	Lower hole jewel for minute recording wheel

PART NO.	LIST OF MATERIALS
023100	Tube for bridge screw (short)
023101	Tube for bridge screw (long)
023150	Tube for pallet cock
023150	Tube for balance cock screw
023181	Tube for screw of intermediate wheel of day correction
023189	Tube for framework screw of automatic device
023443	Fly-back lever pin
023444	Hammer click pin
023446	Intermediate minute recording wheel pin
023865	Second intermediate ratchet wheel pin
023868	Operating lever pin
023990	Pillar wheel jumper pin

Remarks :

Date dial

☆801618(White figures on black background)·····Used when both the crown and the date frame are located at **3** o'clock.

If the date dial is required in any other type, specify ① Cal. No. ② the crown position ③ the date frame position and ④ the dial No.

Day star with dial disk

☆870931(English ⟷ Spanish) ·····Used when both the crown and the day frame are located at **3** o'clock.

When ordering any other type of the day star with dial disks, clearly mention the number printed on the disk. If the number is unknown, specify ① Cal. No. ② the crown position ③ the day frame position ④ the dial No. and ⑤ the national language.

Holding ring for dial ———Measure the total thickness and the outside diameter.

☆884632·····1.36 mm total thickness and 31.1$^{\phi}$ mm outside diameter.

If the holding ring for dial is required in any other type, specify ① Cal. No. and ② the dial No.

6138A Automatic Chronograph

1) Specifications

Casing diameter	27.00mm
Height	7.90mm
Vibrations per hour	21,600
Automatic winding (with auxiliary hand winding)	

Calendar (Day & date, Bilingual change-over mechanism for day indication, Rotary type instant day & date setting device)

Chronograph (Second, hour hand – 12 hour totalizer; minute hand – 30 minute totalizer, accumulated)

2) Features

- **An-advanced automatic winding chronograph**
- Easy-to-use, regular chronograph mechanism
- SEIKO's special clutch mechanism without starting/stopping errors
- Simplified structure and automatic winding by the stabilized pawl lever system
- Day and date instant setting device operated simply by revolving the crown
- Bilingual change-over mechanism for day indication selectable by preference
- Auxiliary hand winding device instantly usable for measuring time
- External devices with many functions

3) Disassembly and assembly

Disassemble the watch according to Figs. ①→㉑

Assemble by reversing the above: Figs. ㉑→①

Installation of the automatic winding mechanism varies as compared with conventional watches.

The automatic winding mechanism should be installed after setting the movement with hands in the case for adjusting chronograph mechanism and setting hands works.

4) Lubrication

Colored symbols in the illustrated figures indicate the types of oil, its quantities to be applied, and lubricating points.

Types of oil:

- Moebius Synt-A-Lube
- Seiko watch oil S-4

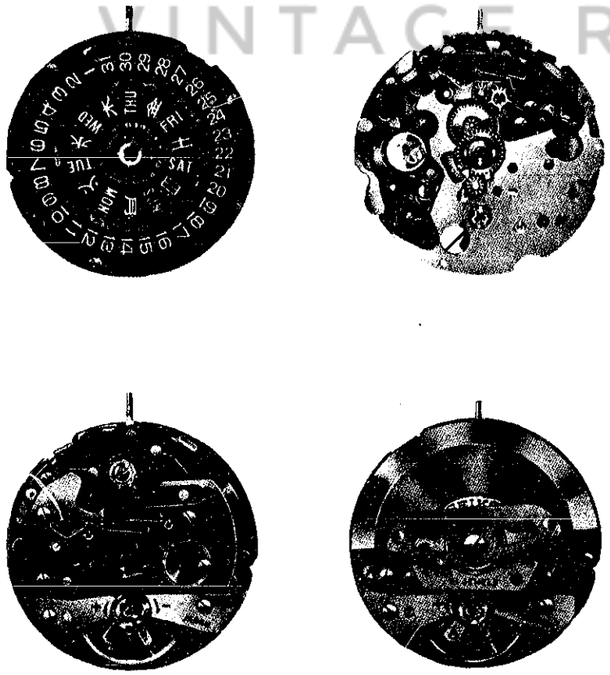
Oil quantity

- Extremely small quantity
- Normal quantity
- Sufficient quantity
- ⊗ Oil must not be applied.

Note: Unindicated portions do not require lubrication.

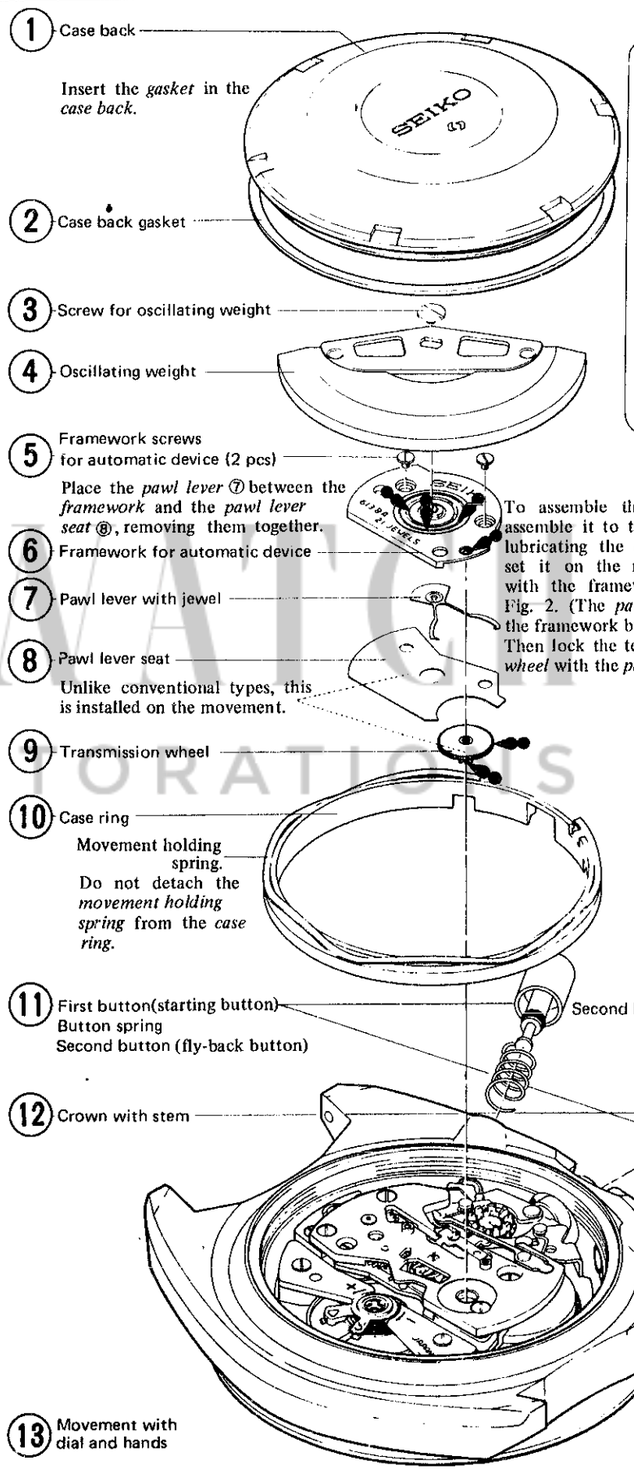
5) Checking and adjusting

Refer to 6139A Technical Guide for checking and adjusting items of second and minute chronograph mechanism.



Movement

6138A Automatic Winding Mechanism



Structure of Button Portion

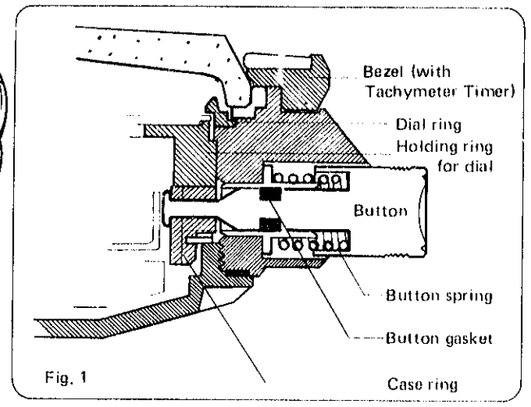


Fig. 1

To assemble the *pawl lever,* first assemble it to the framework after lubricating the *eccentric pin;* then set it on the movement together with the framework, as shown in Fig. 2. (The *pawl lever* coheres to the framework by oil adhesion.) Then lock the teeth of *transmission wheel* with the *pawl lever.*

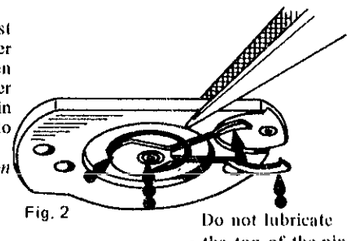


Fig. 2

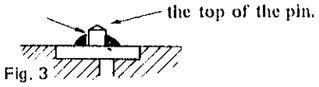
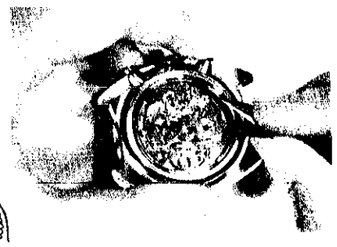


Fig. 3

The two buttons ⑪ must be depressed simultaneously to either remove or insert the *case ring.*



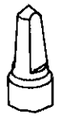
6138A Calendar Mechanism

(Installing the second hand and chronograph minute and hour hands)

1. At the fly-back position, tentatively set the hands on the "0" position.
2. Then repeat fly-back operation to ensure the "0" position. If the hands fail to resume correct position, adjust the hands while depressing the *fly-back button.*

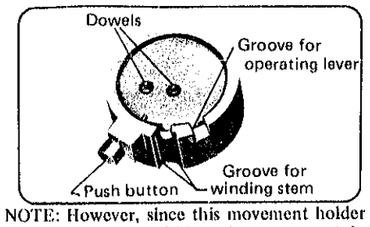
However, since the *fly-back lever* of the *chronograph hour hand* has a springing characteristic, it prevents the hand from rotating while the *hammer button* is depressed. Consequently, reinstall the *chronograph hour hand* so that it coincides with "0" position.

3. Completely push in the hands at the point where they correctly indicate the "0" position.

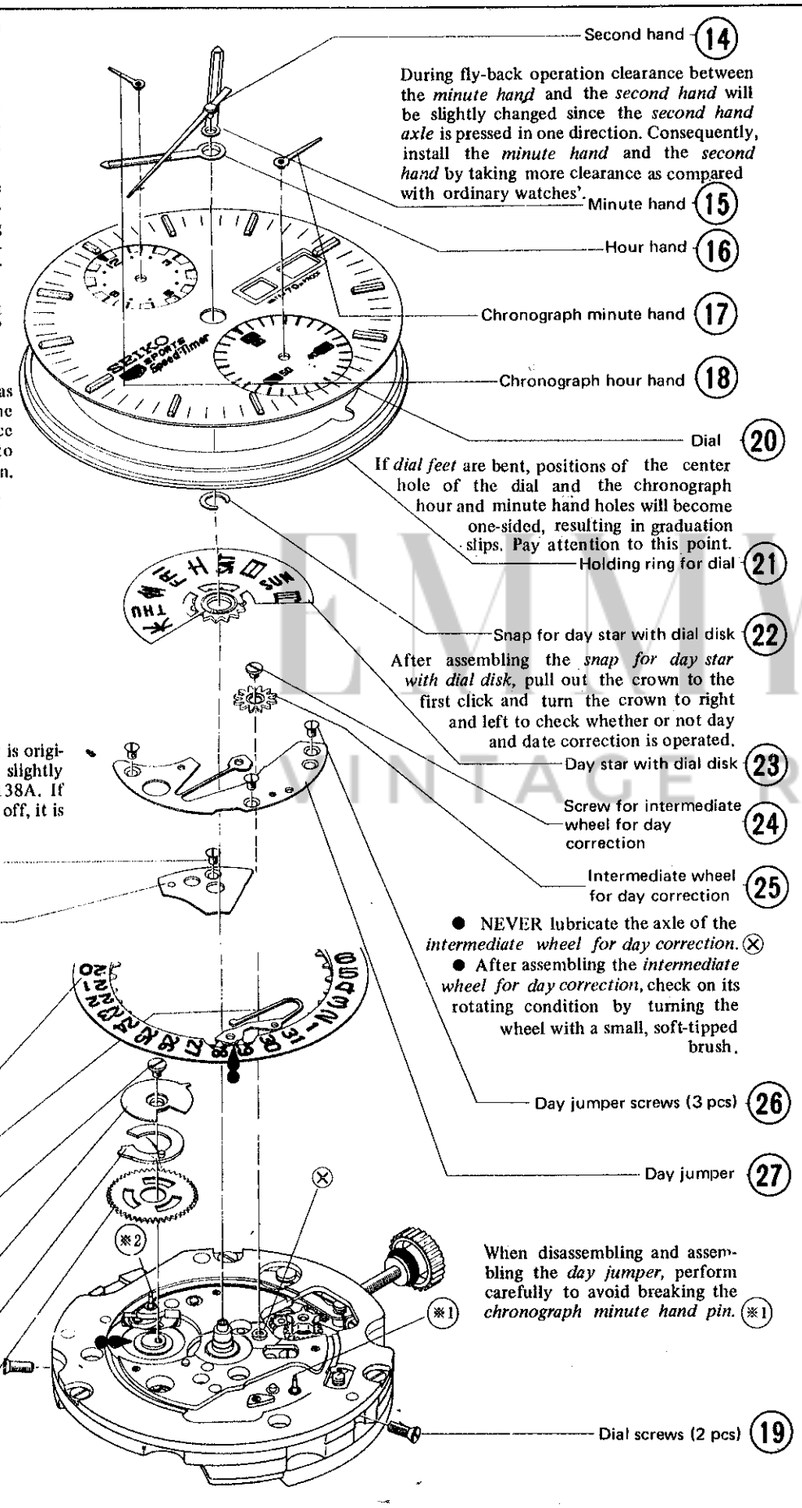


NOTE:
The *second hand axle* is cut as shown in the diagram. If the *second hand* is turned by force after completely depressing it to the bottom, the hand will loosen.

SEIKO provides a handy Movement Holder S-500 to facilitate hand-setting.



NOTE: However, since this movement holder is originally for 6139A, the movement is slightly raised when using this holder for 6138A. If the dowels on the holder are scraped off, it is impossible to use for 6139A.



(14) Second hand

During fly-back operation clearance between the *minute hand* and the *second hand* will be slightly changed since the *second hand axle* is pressed in one direction. Consequently, install the *minute hand* and the *second hand* by taking more clearance as compared with ordinary watches'.

(15) Minute hand

(16) Hour hand

(17) Chronograph minute hand

(18) Chronograph hour hand

(20) Dial

If *dial feet* are bent, positions of the center hole of the dial and the chronograph hour and minute hand holes will become one-sided, resulting in graduation slips. Pay attention to this point.

(21) Holding ring for dial

(22) Snap for day star with dial disk

After assembling the *snap for day star with dial disk,* pull out the crown to the first click and turn the crown to right and left to check whether or not day and date correction is operated.

(23) Day star with dial disk

(24) Screw for intermediate wheel for day correction

(25) Intermediate wheel for day correction

● NEVER lubricate the axle of the *intermediate wheel for day correction.* (⊗)
● After assembling the *intermediate wheel for day correction,* check on its rotating condition by turning the wheel with a small, soft-tipped brush.

(26) Day jumper screws (3 pcs)

(27) Day jumper

When disassembling and assembling the *day jumper,* perform carefully to avoid breaking the *chronograph minute hand pin.* (※1)

(28) Date dial guard screw

(29) Date dial guard

When disassembling and assembling the *date dial guard,* perform carefully to avoid breaking the *chronograph hour hand pin.* (※2)

(30) Date dial

(31) Date jumper

(32) Date driving wheel screw

(33) Day finger

(34) Date finger

(35) Date driving wheel

(※1)

(※2)

(19) Dial screws (2 pcs)

6138A Chronograph Mechanism

Explanations on this page are for the nucleus of 6138A. Sufficiently check and adjust the assembled movement.

1. Items to be checked before assembling the *jewelled pallet fork and staff,* after setting the *chronograph bridge.*
   1) Confirm that free running force is transmitted unaffectedly. Even though no roll back motion exists, as long as it functions smoothly there is no problem. And at the same time check the performance of starting and stopping actions of the *hour recording wheel* by turning over the movement.
   2) Check for meshing condition of the *first and second coupling levers* (Refer to 6139A-8).
   3) Check clearance between the *second coupling lever* and the *intermediate hour recording wheel stop lever pin* and their actions.
   When stopping, clearance must exist between the *second coupling lever* and the *intermediate hour recording wheel stop lever pin;* when starting, the *second coupling lever* must push and move the *intermediate hour recording wheel stop lever pin.*

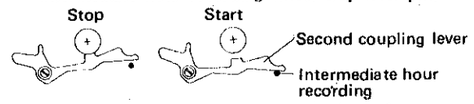


Fig. 4

Should they malfunction, adjust them by turning the second coupling lever axle eccentric pin. In this case, perform this adjustment while observing the delicate clearance between the second coupling lever and the clutch lever.

2. Items to be checked after assembling the *balance*
   1) Check for strength and height of the *minute recording jumper* (Refer to 6139A-8).
   2) Check for meshing position of the *chronograph finger* (Refer to 6139A-9).
   3) Check for contacting condition of the *hammer* and *hearts* (Refer to 6139A-10).

(36) Balance cock screws (2 pcs)

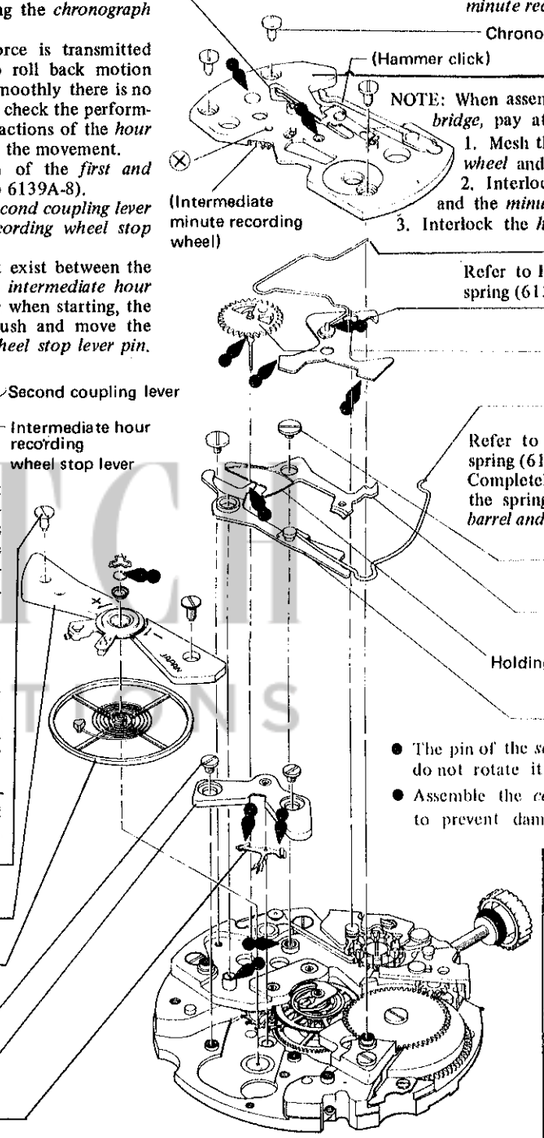
(37) Balance cock

(38) Balance complete with stud

(39) Pallet cock screws (2 pcs)

(40) Pallet cock

(41) Jewelled pallet fork and staff



It is not necessary to remove the *minute recording jumper* and *screws.* Move them only when adjusting the *minute recording jumper.*

(42) Chronograph bridge screws (3 pcs)

(43) Chronograph bridge

NOTE: When assembling the *chronograph bridge,* pay attention to the following.
1. Mesh the *intermediate minute recording wheel* and the *minute recording wheel.*
2. Interlock the *minute recording wheel* and the *minute recording jumper.*
3. Interlock the *hammer click* and the *fly-back lever pin.*

(44) Hammer spring

Refer to Fig. 10 for assembling this spring (6138A-7)

(45) Hammer

(46) Minute recording wheel

(47) Operating lever spring

Refer to Fig. 7 for assembling this spring (6139A-5)
Completely set the center portion of the spring around the tube of the *barrel and train wheel bridge.*

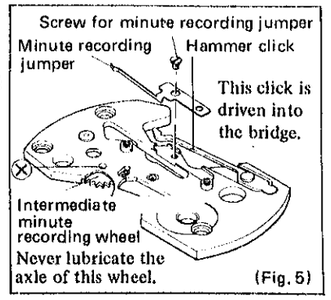
(49) First coupling lever screw

(50) First coupling lever

(48) Holding screw for coupling levers

(51) Second coupling lever

● The pin of the *second coupling lever* is eccentric; do not rotate it except during adjustment.
● Assemble the *coupling levers* in a starting condition to prevent damaging the *fourth wheel.*

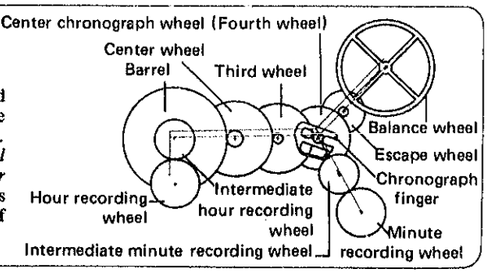


(Fig. 5)

Train wheel (process of force transmission)

Transmission of force when chronograph mechanism is started.
Transmission of force when chronograph mechanism is stopped.

When the minute and second chronographs are started, the force is transmitted to both chronograph and train wheel by the action of the clutch, and when the chronographs are stopped, the force is transmitted only to the train wheel. When the hour chronograph is started, the force is transmitted from the *barrel → friction spring for intermediate hour recording wheel → intermediate hour recording wheel → hour recording wheel.* When the hour chronograph is stopped, force transmission to the *hour recording wheel* is stopped by a slip of the *friction spring for intermediate hour recording wheel.*

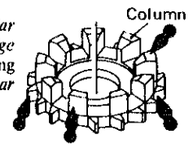


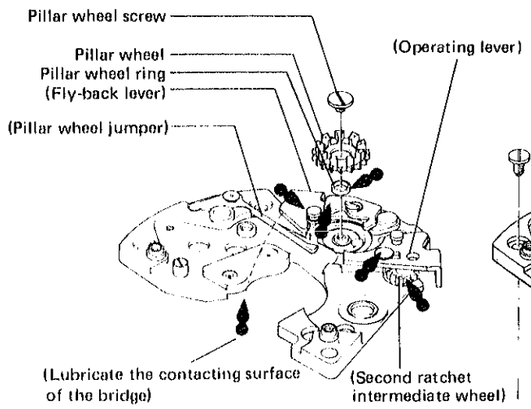
6138A Train Wheel

To prevent chipping, install the pillar wheel on the *barrel and train wheel bridge* before assembling the latter.

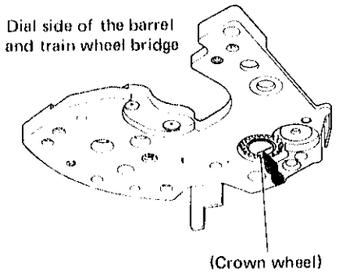
Lubricating the pillar wheel

Assemble the *pillar wheel* to the *bridge* while interlocking with the *pillar wheel jumper*.



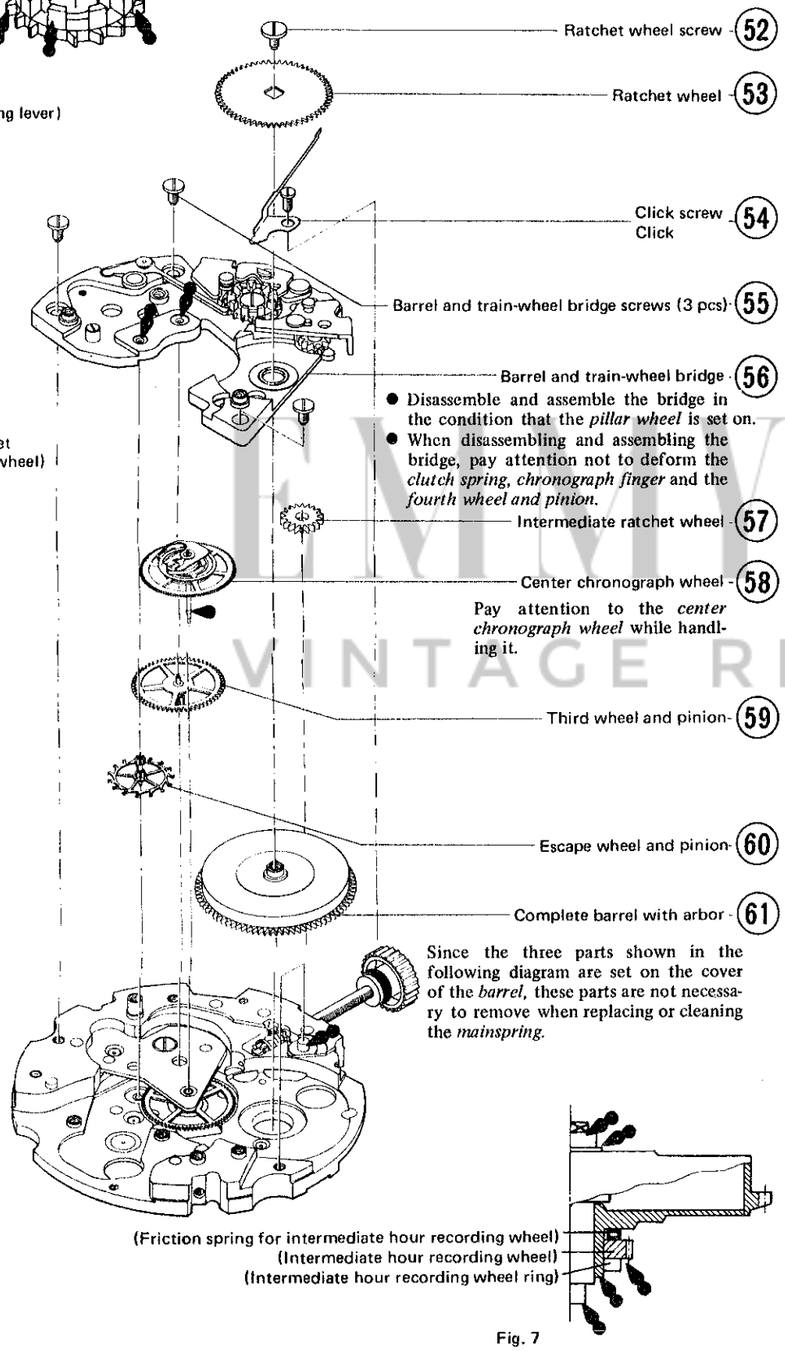


Operating lever, fly-back lever, pillar wheel jumper, second intermediate ratchet wheel, and *crown wheel* are driven into the *barrel and train wheel bridge.*



Lubricating the fourth wheel

Apply oil between the clearance of the *fourth wheel pinion* and the *axle.*



- Disassemble and assemble the bridge in the condition that the *pillar wheel* is set on.
- When disassembling and assembling the bridge, pay attention not to deform the *clutch spring, chronograph finger* and the *fourth wheel and pinion.*

Pay attention to the *center chronograph wheel* while handling it.

Since the three parts shown in the following diagram are set on the cover of the *barrel,* these parts are not necessary to remove when replacing or cleaning the *mainspring.*

Fig. 7

6138A Hour Chronograph Mechanism

62 Calendar plate screws (3 pcs)

After tightening the *calendar plate* screws, check whether or not each lever operates smoothly by pressing the portion marked with *① on the *hour fly-back lever.* Causes of malfunctions are considered to come from defective assembly and/or lever warp when replaced with a new one.

63 Calendar plate

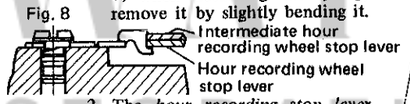
Pay attention not to break or bend the *hour hand axle* ② when attaching or detaching the *calendar plate.*

When assembling the *calendar plate,* check on pivoting of the *hour hand axle,* and the interlocking condition between the *hour wheel* and the *intermediate date wheel.* If the *hour fly-back lever* protrudes to the outer circumferential side, the *calendar plate* cannot be assembled. Thus, assemble the *calendar plate* while pushing the *hour fly-back lever* toward the center.

67 Spring for hour recording wheel stop lever

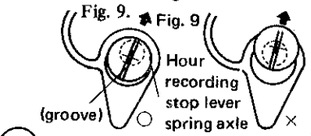
1. The *hour recording stop lever axle* is designed as shown in Fig. 8; when detaching the *spring,* remove it by slightly bending it.

Fig. 8



2. The *hour recording stop lever spring axle* is an eccentric pin. Do not turn it as it is not screw. If it is turned inadvertently, always correct it so that the groove of the *eccentric pin* (arrow mark) faces the center of the *hour recording wheel.* Correct it in a direction that spring force becomes strong as illustrated left in Fig. 9.

Fig. 9



68 Intermediate hour recording wheel stop lever

69 Hour recording wheel stop lever

70 Hour recording wheel

Pay attention not to scratch the teeth of the *hour recording wheel* when handling it.

71 Intermediate date wheel

Assemble the *intermediate date wheel* with the pinion positioned upward.

72 Hour wheel

The *hour recording stop lever spring axle* is an eccentric pin; do not turn it. If it is turned inadvertently, adjust it by referring to Fig. 9.

64 Hour hammer spring

Refer to Fig. 15 in 6138A-7 for the set position of the *hour hammer spring.*

A cross section diagram of the portion around the *eccentric pin* of the plate is shown in the following diagram. Correctly set the *eccentric pin* in the grooved portion.

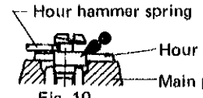


Fig. 10

65 Hour fly-back lever

1. Refer to Fig. 15 in 6138A-7 for the set position of the *hour fly-back lever.* The cross section diagram is shown in Fig. 10. Correctly set it to the eccentric portion.
2. Do not turn the *eccentric pin* of the *hour fly-back lever.* If it is turned inadvertently, correct it as shown in Fig. 11.

Fig. 11

Correct the *eccentric pin* so that the larger surface of it faces the *second button.*

66 Hour hammer

Refer to Fig. 17 in 6138A-8 and the following diagram for the set position of the *hour hammer.*

1. Set position of the *hour hammer axle*

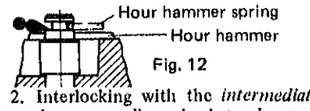


Fig. 12

2. Interlocking with the *intermediate hour recording wheel stop lever*

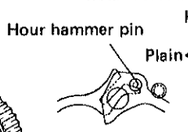


Fig. 13

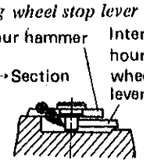
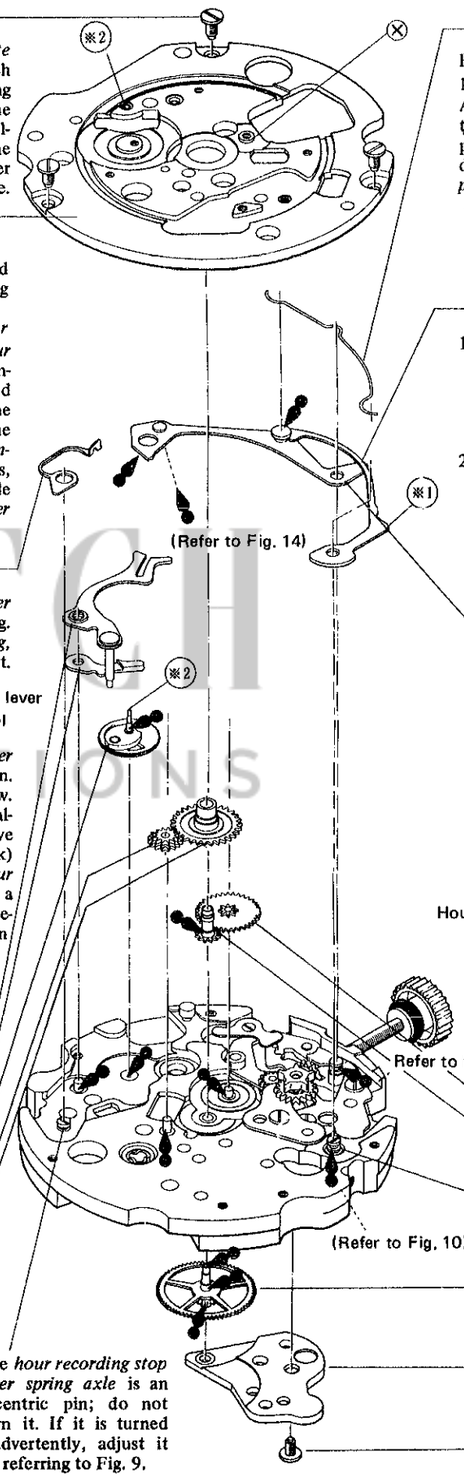


Fig. 14



73 Minute wheel

74 Cannon pinion

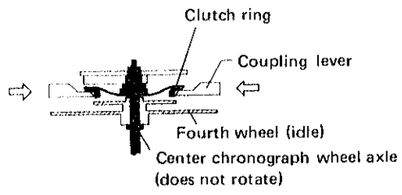
The *hour fly-back lever axle* is an eccentric pin; do not turn it. If it is turned inadvertently, adjust it by referring to Fig. 10.

77 Center wheel

76 Center wheel bridge

75 Center wheel bridge screw

Stopping of chronograph minute and second hands



Stopping of chronograph hour hand

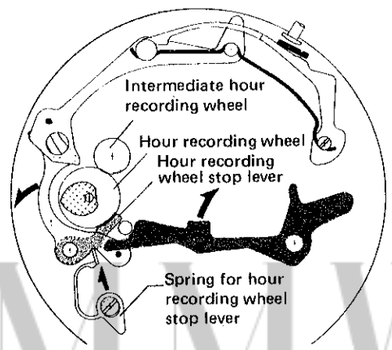
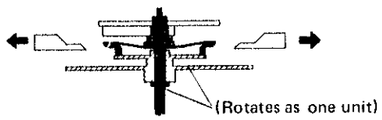


Fig. 15

Stopping

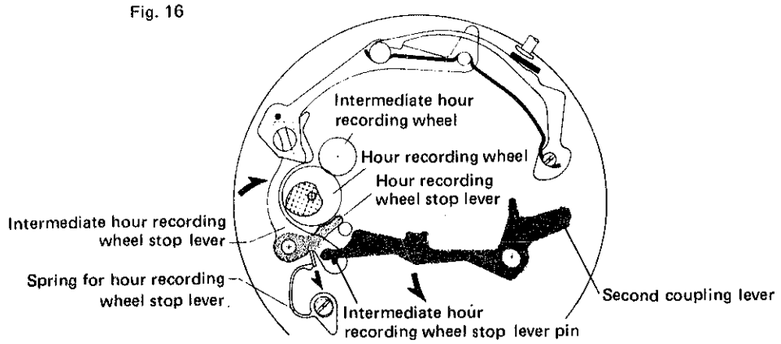
The *minute and second recording wheels* are stopped when the *clutch ring* is raised through action of the *coupling levers*. The *hour recording wheel* comes to a halt by a slip of the *hour recording friction spring* of the barrel. The slip comes from the fact that the *hour recording wheel stop lever* brakes the *hour recording wheel* by the *spring for hour recording wheel stop lever*.

Starting of chronograph minute and second hands



Starting of chronograph hour hand

Fig. 16



Starting

The *minute and second recording wheels* are started when the *coupling levers* are separated from the *clutch ring*. Simultaneously, the *second coupling lever* pushes the *intermediate hour recording wheel stop lever pin*, revolving the *intermediate hour recording wheel stop lever* in the → direction. And then, the force of the *spring for hour recording wheel stop lever* is not transmitted to the *hour recording wheel stop lever* to release the brake of the *hour recording wheel* and let it start.

Resetting

1. **Resetting of the chronograph minute hand and second hand**
   When pressing the *second button*, the force is transmitted to *fly-back lever* → *intermediate fly-back lever* → *hammer*, and the *hammer* strikes the *minute heart* and the *second heart* to reset the hands to "0" position.
2. **Resetting of the chronograph hour hand**
   Simultaneously with the above, the *fly-back lever* presses the *hour fly-back lever* and the force is transmitted to the *hour hammer* to reset the *chronograph hour hand* to "0" position. At this moment, the *intermediate hour recording wheel stop lever* revolves in the → direction by action of the *hour hammer pin*, and the *hour recording wheel* is released. When the *second button* is released, the *chronograph hour hand* returns to a stopped condition.

Resetting of chronograph minute hand and second hand

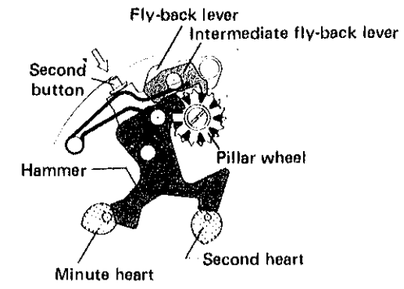
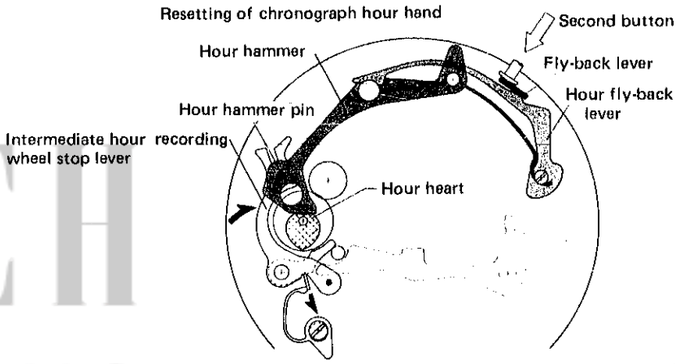


Fig. 17

Resetting of chronograph hour hand



Fly-back safety mechanism

This mechanism protects the movement from the shock generated by the *second button*. End portions of the *hammer* and the *intermediate fly-back lever* are located outside the column during starting condition. When the *second button* is depressed, the end portion of the *intermediate fly-back lever* slips among the columns of the *pillar wheel* (as shown in Fig. 18), and the force is not transmitted beyond the *hammer*. On the other hand, the *hour hammer* does not move because the pin located on its tip strikes the *intermediate hour recording wheel stop lever*. At this moment, momentum of the *second button* is absorbed by a springing characteristic of the *hour fly-back lever*. Safety action is exhibited by integration of the above-mentioned operations.

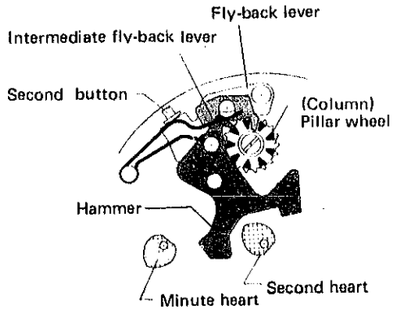
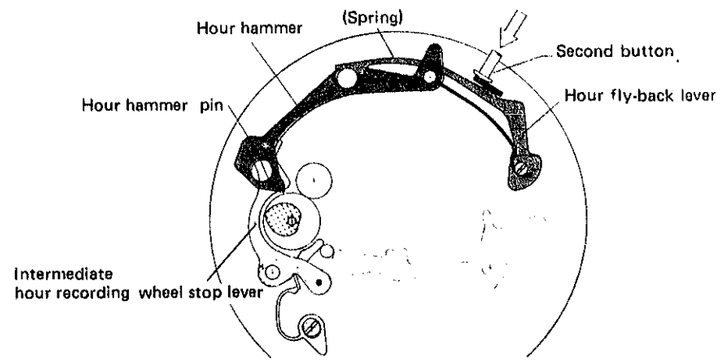
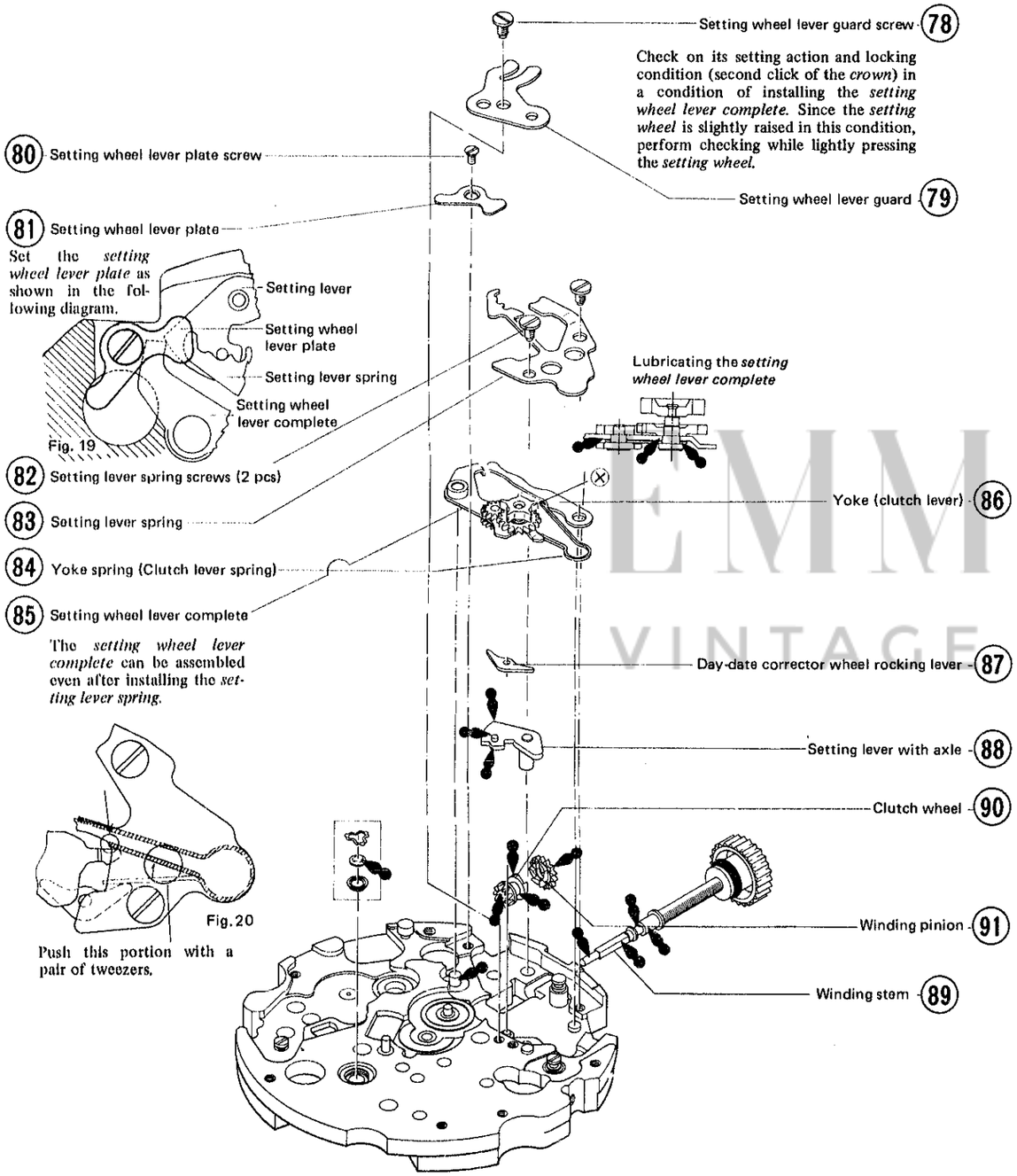


Fig. 18





Ordinary position of crown (mainspring winding)

The *crown wheel* and the *second intermediate ratchet wheel* are caulked on the *barrel and train wheel bridge*. The *intermediate ratchet wheel* is supported by a pin mounted on the plate.

Second position of crown (day and date correction)

1. **Clockwise – Date correction**
   When turning the *crown* to the right (clockwise), the *correcting gear* moves to the *date dial* side and interlocks with it, thus date is corrected. Force transmission is through *crown* → *clutch wheel* → *setting wheel* → *correcting gear* → *date dial*.
2. **Counterclockwise – Day correction**
   When turning the *crown* to the left (counterclockwise), the *correcting gear* moves to the *day star with dial disk* side and interlocks with the *intermediate wheel for day correction*, and day is corrected. Force is transmitted through *crown* → *clutch wheel* → *setting wheel* → *correcting gear* → *intermediate wheel for day correction* → *day star with dial disk*.

Third position of crown (setting time)

The *setting wheel lever complete* moves to the *minute wheel* side by action of the *setting lever with axle*, and the *intermediate setting wheel* interlocks with the *minute wheel*, hand is set correctly. Simultaneously, motion of the *setting wheel lever complete* is transmitted to the *day-date correction wheel rocking lever*, and the *correcting gear* attains a position where it interlocks neither the *date dial* nor *intermediate wheel for day correction* by action of the *setting wheel lever complete* and the *day-date correction wheel rocking lever*.

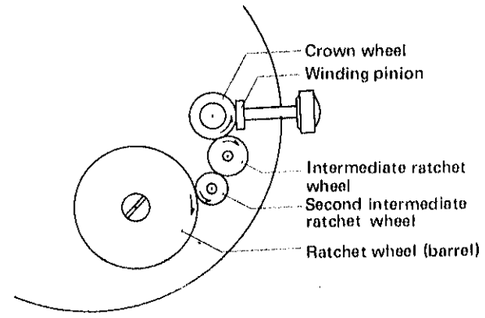


Fig. 21

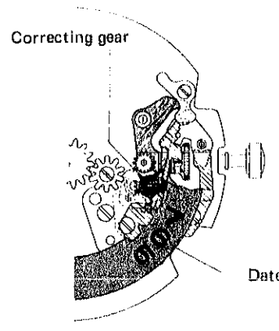


Fig. 22

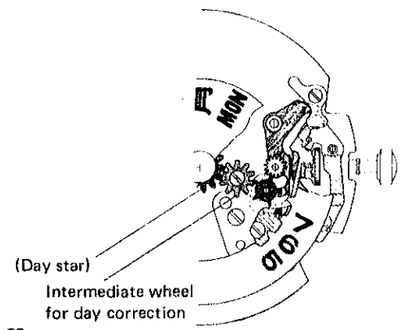


Fig. 23

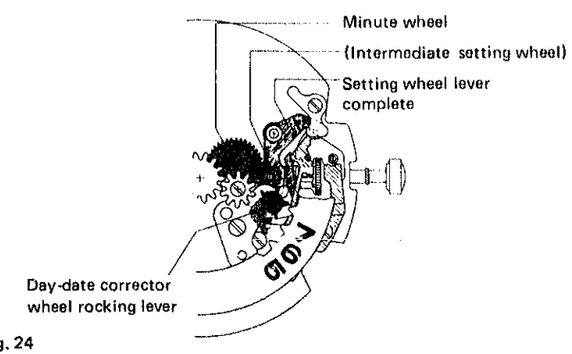


Fig. 24