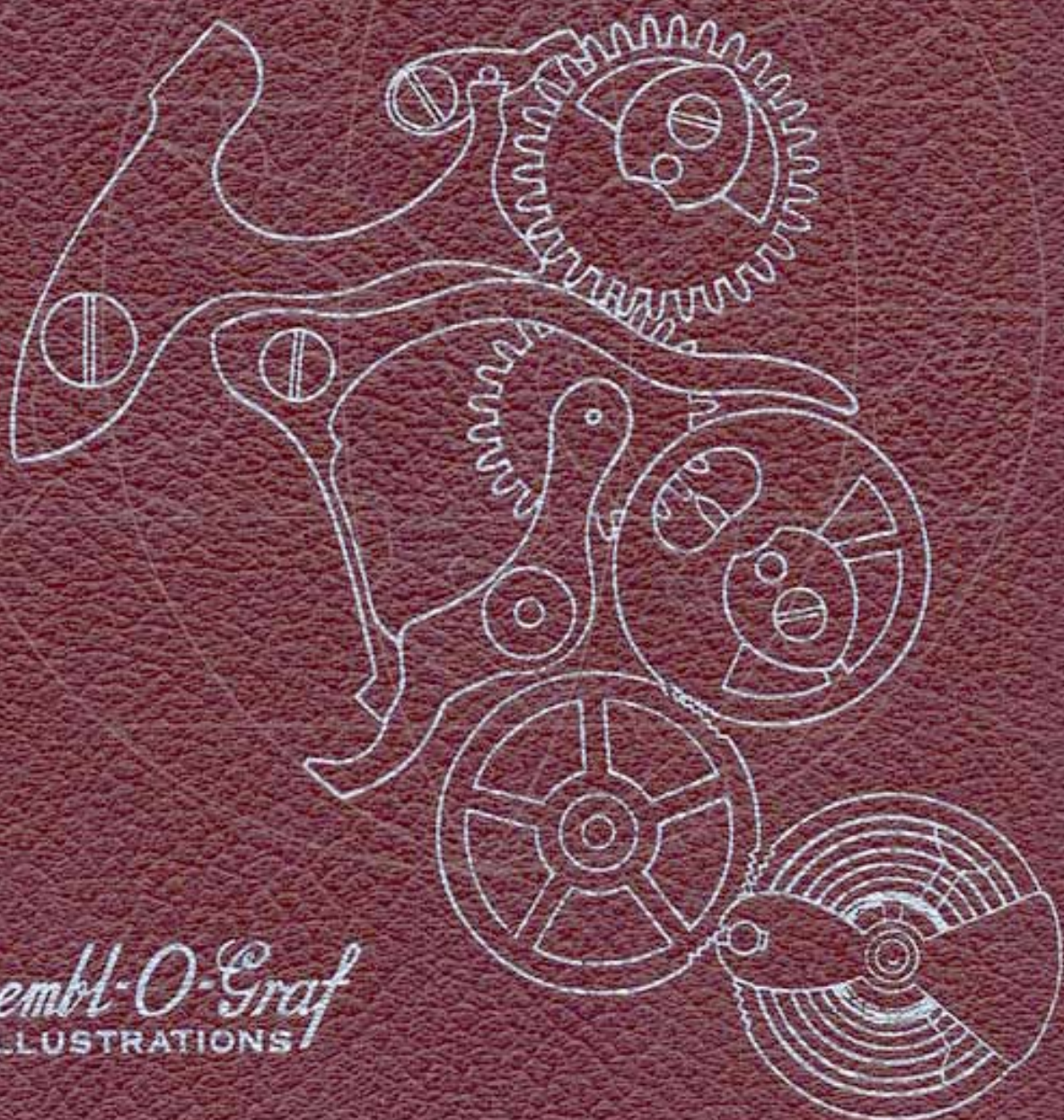
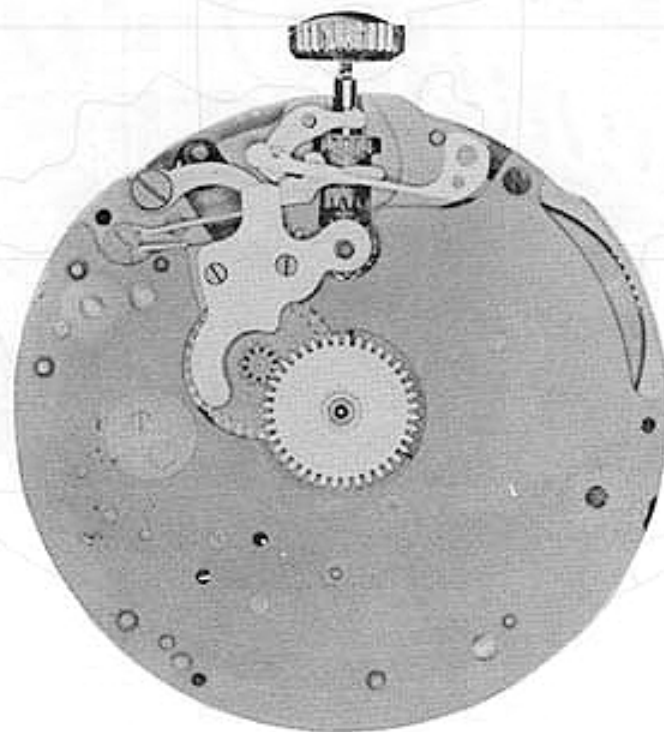


**WORLD'S ONLY
FULLY ILLUSTRATED
CHRONOGRAPH WATCH COURSE
VOLUME 8**



Ensembl-O-Graf
ILLUSTRATIONS

IDENTIFICATION OF CHRONOGRAPH



ALTERNATE SETTING PARTS



UNIVERSAL

Cal.285-14L Cal.287-15L
Cal.385-14L Cal.387-15L
Cal.386-14L Cal.292-15-5/6L

UNI-COMPAX
MINUTE REGISTER



ESEMBL-O-GRAF

THE WORLD'S FIRST FULLY
ILLUSTRATED TEXT BOOK

ON
CHRONOGRAPH REPAIRING
AND ADJUSTING



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BY

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PITTSBURGH, PENNSYLVANIA

INSTRUCTIONS

For use of book

DISASSEMBLY OF THE CHRONOGRAPH MECHANISM:

1. Study the isometric drawing at top of page 1-A. The isometric drawing was made for the following purposes:

- A. It helps to identify the part to be removed.
- B. This drawing aids in pointing out certain locations on the part that are mentioned in the oiling procedure.
- C. The text refers to certain points on the part. These points are shown in the isometric drawing. This should aid you in finding the exact location on the part that is described in the text.
- D. It helps you to determine the shape of the part in case a new part has to be made.
- E. When disassembling the chronograph, each part should be carefully examined as it is removed from the movement. Each part should be checked against the isometric drawings to see that the part is the correct shape and is not broken. Each part should also be checked for any pits of rust, roughness, or burrs and for worn parts which may cause the part not to work properly.

2. At the bottom of the page 1-A is a photograph of a chronograph. In this photograph is the same part painted in black. The part is in the exact location that this part occupies in the watch. Find this location in the watch.

3. Read the disassembly procedure and the hazards in disassembly on page 1 in this book.

4. Remove this part in the same procedure as described in the text.

5. A very important item in disassembling a chronograph is keeping the screws in order, much time will be lost in putting the chronograph together if screws are mixed up. This means you have to hunt for each screw, sometimes trying three or four screws before finding the correct one. It cannot be stressed too strongly that care should be taken so that screws are not mixed up. The system that we advise for beginners, is to replace each individual screw after each part is removed. This naturally eliminates the hazard of mixing up the screws and will save you much time in the end. Do this at least until you become so thoroughly familiar with the chronograph that you no longer feel it is necessary.

6. Continue to follow this procedure throughout the book, and disassemble each part until the last part of the chronograph is removed.

ASSEMBLY OF THE CHRONOGRAPH MECHANISM:

7. When you are ready to assemble the chronograph mechanism, study the isometric drawing on the last part in this book. This drawing should aid you in identifying the part to be assembled and detecting possible defects on the part.

8. At the bottom of this page is a photograph of a chronograph. In this photograph is the same part painted in black. The part is shown in the exact location it occupies in the watch. (Continued on next page)

INSTRUCTIONS (Continued)

9. After you find the correct location for this part in the watch, read the oiling procedure for this part. The oiling procedure for this part is located underneath the isometric drawing. It is best to read the oiling procedure before you put each part in place, as there are certain parts that must be oiled immediately, as it may prove difficult to oil them later.

10. Read the assembly procedure and the hazards in assembling for the last part in this book.

11. Replace the part in its exact location, as shown in photograph, using the procedure as described in the text.

12. Replace the screw that holds this part in place. Of course, the screws should be kept in order as we advised above, but if the screws are not in order or the watch was received with screws mixed up, you will find a screw drawn for each part that requires a screw, at the bottom of the text page.

13. After replacing this part, replace the next part, etc., until the last part is replaced, which will be part No. 1. For replacing each part, use the procedure as described in the text.

(Note: the assembly of the chronograph is exactly the reverse of the disassembly.)

14. After the chronograph mechanism is assembled, read the functions of the different parts in the mechanism. This should help you to understand more fully the purpose of each part and how it works in conjunction with the other parts. It is to your advantage also to read the function before assembling each part, as many mistakes can be prevented when the assembling is done with an understanding of the function.

15. Now put movement in its case, and replace dial and hands. If the movement is put in the case from the back side, the dial and the hands must be replaced first. (For information on setting the hands correctly on a chronograph, refer to the last page in this book.)

16. Read the text on adjustment of eccentric studs. This text should be read with reference to the eccentric stud picture. Now adjust each eccentric stud, one at a time, in the watch, as described in the text. Use the picture to find the position of these studs.

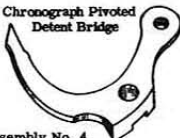
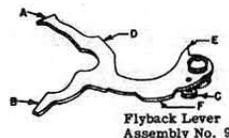
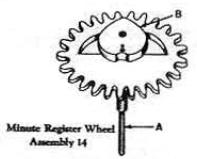
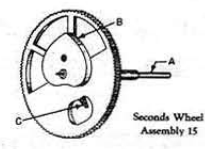
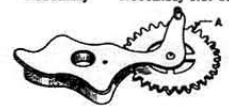
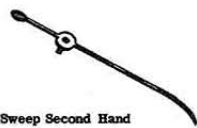
17. Study the text on functional results in this book, and check the chronograph mechanism as described in this text.

NOMENCLATURE OF PARTS FOR CHRONOGRAPH MECHANISM

18. After you have become thoroughly familiar with the chronograph mechanism you can disassemble and assemble the chronograph by using the nomenclature of parts as a guide. This makes it possible for you to use a procedure without going through each page in the book.

19. On each page in this book, the part number and the page number are the same. This makes it convenient for the reader and eliminates any confusion.

NOMENCLATURE OF PARTS FOR CHRONOGRAPH MECHANISM

 Wheel Over Fourth Wheel Assembly No. 1	 Minute Register Pawl Assembly No. 2	 Chronograph Pivoted Detent Spring Assembly No. 3
 Chronograph Pivoted Detent Bridge Assembly No. 4	 Intermediary Wheel Assembly No. 5	 Chronograph Pivoted Detent Assembly No. 6
 Actuating Detent Lever Spring Assembly No. 7	 Actuating Detent Lever And Joint Hook. Assembly No. 8	 Flyback Lever Assembly No. 9
 Flyback Lever Spring Assembly No. 10	 Brake Lever Spring Assembly No. 11	 Brake Lever Assembly No. 12
 Assembly No. 13 Seconds Wheel & Minute Register Wheel Bridge	 Minute Register Wheel Assembly 14	 Seconds Wheel Assembly 15
 Seconds Wheel Tension Spring Assembly No. 16	 Intermittent Lever Spring Assembly No. 17	 Intermittent Lever and Wheel Assembly Assembly No. 18
 Castle Wheel Pawl Assembly No. 19	 Castle Wheel Assembly No. 20	 Push Piece For Setting Back To Zero Assembly No. 21
 Sweep Second Hand	 Minute Register Hand	 Chronograph Button
 Chronograph Button		

ADJUSTING ECCENTRIC STUDS - THINGS TO CHECK

Listed below are a number of depthings and adjustments controlled by the eccentric studs.

1. Check depthing of wheel over fourth wheel teeth with the intermediary wheel teeth.

CORRECTION: If this depthing is incorrect you can correct it by adjusting eccentric stud ES-1.

Reference: Wheel over fourth wheel is assembly 1.
Intermediary wheel is assembly 5.

2. Check depthing of seconds wheel teeth with intermediary wheel teeth.

CORRECTION: If this depthing is incorrect you can correct it by adjusting eccentric stud ES-2.

Reference: Seconds wheel is assembly 15.
Intermediary wheel is assembly 5.

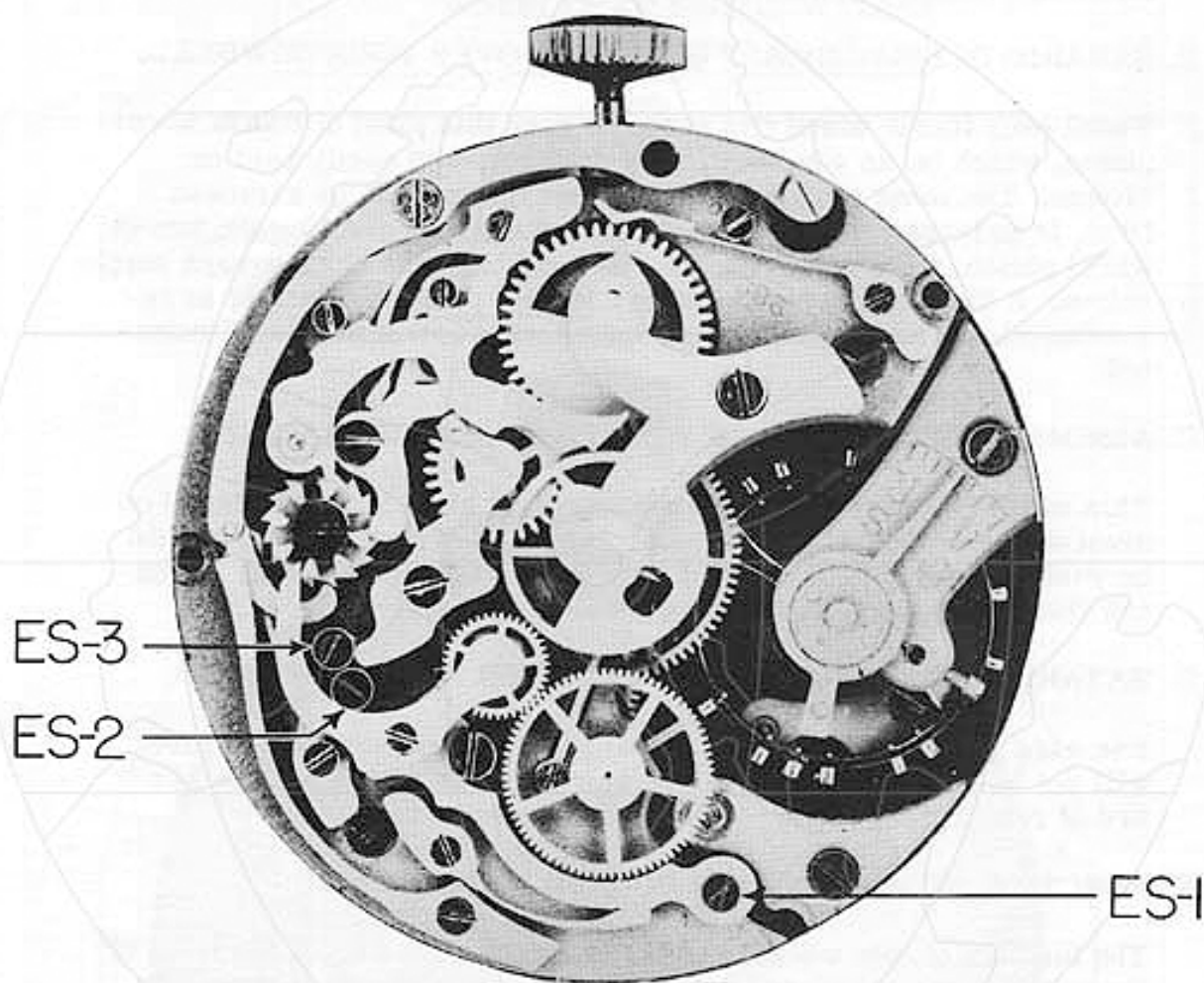
3. Check depthing of intermittent wheel teeth with seconds wheel dart tooth.

CORRECTION: If this depthing is incorrect you can correct it by adjusting eccentric stud ES-3.

Reference: Seconds wheel dart tooth is assembly 15-C.
Intermittent wheel is assembly 18-A.

ADJUSTING ECCENTRIC STUDS

DO NOT REMOVE THESE STUDS



CAUTION

In disassembling or assembling the chronograph, it is a good policy not to turn the eccentric studs. These eccentric studs are used to adjust one part to another. Naturally, in turning these studs, you will lose the desired adjustment of the chronograph mechanism. This will cause the chronograph to function incorrectly. Another reason for not turning these studs unless it is necessary is, that they soon become loose and will not hold the desired adjustment.

PART NO. 1

A. DISASSEMBLY PROCEDURE OF WHEEL OVER FOURTH WHEEL:

Wheel over fourth wheel fits friction tight on long pivot of fourth wheel pinion. This wheel should be removed with a sweep wheel remover, but can be removed with two small, thin edge screw-drivers. The screw-drivers are placed opposite each other under hub "A" of wheel. One screw-driver is turned clockwise, while the other screw-driver is turned counter-clockwise. This will loosen the wheel from the pivot, permitting it to be lifted out of place.

B. HAZARDS IN DISASSEMBLY OF WHEEL OVER FOURTH WHEEL:

Wheel over fourth wheel fits over the very thin pivot of fourth wheel pinion, which is, as you know, very delicate, and easily bent or broken. The main reason why we select this part to be removed first, is to lessen the hazards of bending the long pivot on the fourth wheel pinion, when removing the other parts of the chronograph mechanism. If the sweep wheel remover is held perfectly upright in removing wheel, hazard of bending fourth wheel pivot will be eliminated.

C. ASSEMBLY PROCEDURE OF WHEEL OVER FOURTH WHEEL:

This wheel fits over fourth wheel long pivot and should be placed on pivot with hub "A" of wheel down. Wheel over fourth wheel should be pushed down until it is level with the intermediary wheel. A hollow flat-faced punch should be used to push wheel down.

D. HAZARDS IN ASSEMBLY OF WHEEL OVER FOURTH WHEEL:

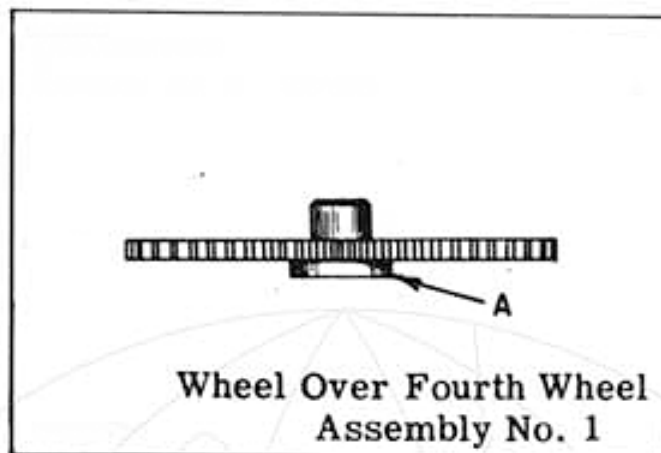
Use care in staking down this wheel, so that the fourth wheel pivot will not be bent or broken. If the movement is held level, the hazard of replacing this wheel will be eliminated.

E. FUNCTION OF WHEEL OVER FOURTH WHEEL:

The function of this wheel is to transmit the power from the train of the watch to the chronograph mechanism. This wheel continues to turn as long as the watch is running.

F. REMARKS:

Mechanically, we should regard this wheel as the intermediate chronograph wheel, as it is the main wheel which transfers the power from the movement train to the chronograph mechanism. The Swiss term for this part is wheel over fourth wheel and we will use this term to describe this wheel in this text.



OILING

The wheel over fourth wheel should not be oiled.



1-A

PART NO. 2

A. DISASSEMBLY PROCEDURE OF MINUTE REGISTER PAWL:

The minute register pawl is held in place by steady pins and fillister head screw FS-1. Remove screw, and loosen pawl from plate by sliding a thin blade screwdriver between pawl and plate. When steady pins are free in plate pawl may be lifted from movement.

(The shape of the screw for this part is shown at the bottom of the page.)

B. HAZARDS IN DISASSEMBLY OF MINUTE REGISTER PAWL:

The pawl should be carefully removed, as the tension spring is thin, and easily bent. A very slight bend in this tension spring may cause the pawl not to function properly.

C. ASSEMBLY PROCEDURE OF MINUTE REGISTER PAWL:

Place the pawl on the plate with steady pins in the pawl over proper holes in the plate. Press the pawl down to proper place with back of tweezers, and replace fillister head screw FS-1. The end "A" of the pawl should be centered between two teeth on the minute register wheel.

D. HAZARDS IN ASSEMBLY OF MINUTE REGISTER PAWL:

Before pressing pawl down to proper place on plate, be sure end "A" of pawl is not on top of a tooth on the minute register wheel.

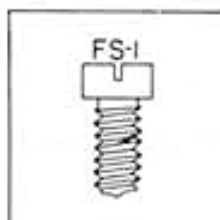
E. FUNCTIONS OF THE MINUTE REGISTER PAWL:

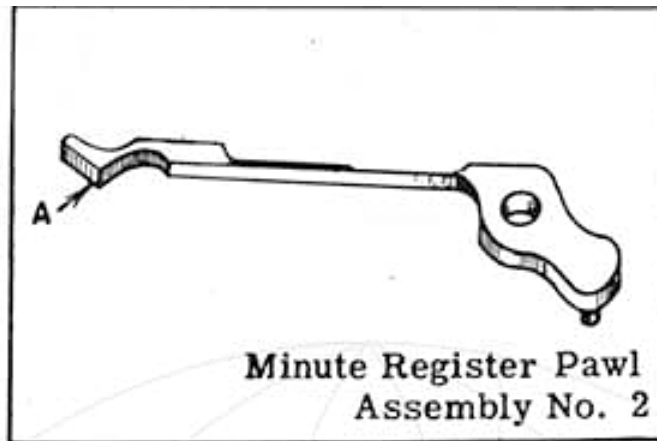
1. It holds a tension on the minute register wheel so it moves exactly one tooth each minute.
2. It holds the minute register wheel in a stationary position, so a bump cannot alter the position of this wheel.

F. REMARKS: After replacing the pawl, push flyback lever to center of watch until it returns the minute register wheel to a zero position. With the minute register wheel in this position, the end "A" of pawl should be centered between two teeth on this wheel.

The tension of the end "A" of pawl on the teeth of the minute register wheel must be very light, as any excess tension will cause the minute register wheel to be unnecessarily hard to turn. Still, the tension must be strong enough for the pawl to function properly, as stated above. The end "A" of the pawl must be highly polished, as any roughness here will hinder proper operation of the chronograph.

REFERENCE: Minute register wheel is Assembly 14.
Flyback lever is Assembly 9.





OILING

The minute register pawl should not be oiled.



2-A

PART NO. 3

A. DISASSEMBLY PROCEDURE OF CHRONOGRAPH PIVOTED DETENT SPRING:

This spring is held in place by a fillister head screw FS-2 and a steady pin. Remove screw, and loosen spring from plate with a thin blade screwdriver. When steady pin is free in plate, spring may be lifted from movement.

(The shape of screw for this part is shown at bottom of page.)

B. ASSEMBLY PROCEDURE OF CHRONOGRAPH PIVOTED DETENT SPRING:

Place the spring on the plate with the steady pin over proper hole in plate. Replace fillister head screw, but before tightening screw, check to see that the end "A" of spring is on top of the chronograph pivoted detent and the shoulder "B" is pressing against the side of detent. With spring in this position, tighten the screw to hold it in place.

C. FUNCTION OF CHRONOGRAPH PIVOTED DETENT SPRING:

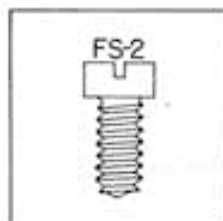
Functions of this spring are:

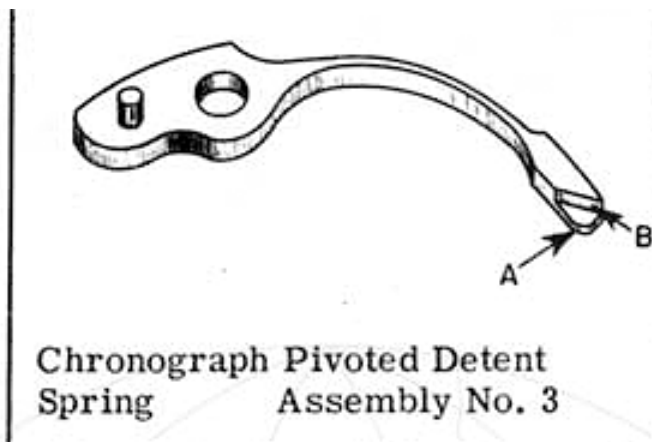
1. It holds a tension on the chronograph pivoted detent, so that it is forced toward the center of the watch.
2. It helps to hold the chronograph pivoted detent in the correct position, preventing it from working up on the eccentric stud.

D. REMARKS:

The tension, that the chronograph pivoted detent spring holds on the chronograph pivoted detent, must be strong enough to engage the intermediary wheel with the seconds wheel. Any excess tension tends to make the chronograph button harder to push.

REFERENCE: Chronograph pivoted detent is Assembly 6.





OILING

End "A" of chronograph pivoted detent spring should be slightly moistened with oil.



3-A

PART NO. 4

A. DISASSEMBLY PROCEDURE OF CHRONOGRAPH PIVOTED DETENT BRIDGE:

This bridge is held in place by a fillister head screw FS-3 and steady pins. Remove screw, and loosen bridge from detent with a thin blade screwdriver. When steady pins are free of detent, bridge may be lifted from movement.

(The shape of screw for this part is shown at the bottom of the page.)

B. HAZARDS IN DISASSEMBLY OF CHRONOGRAPH PIVOTED DETENT BRIDGE:

When using a screwdriver to loosen bridge from detent, care should be taken to keep bridge level, as any twisting may damage the pivots on intermediary wheel or burr the bushing in bridge or pivoted detent. The screwdriver should be carefully used, so as not to mar chronograph pivoted detent or bridge.

C. ASSEMBLY PROCEDURE OF CHRONOGRAPH PIVOTED DETENT BRIDGE:

Place bridge on pivoted detent with steady pins over proper holes in detent. Place the intermediary wheel so pivot on this wheel will enter pivot hole in bridge. The bridge may be pressed to proper position with back of tweezers and fillister head screw FS-3 replaced.

D. FUNCTION OF CHRONOGRAPH PIVOTED DETENT BRIDGE:

Functions of this bridge are:

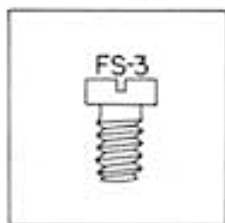
1. It holds the intermediary wheel in position.
2. The beak end "A" contacts the columns of the castle wheel to disengage the intermediary wheel from seconds wheel.

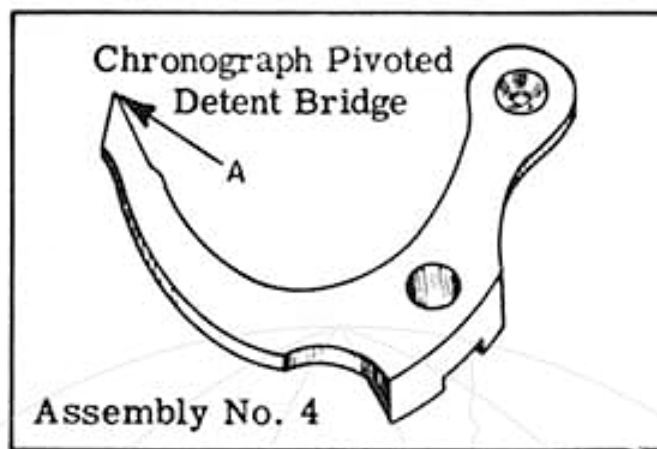
REFERENCE: Intermediary wheel is Assembly 5.
Seconds wheel is Assembly 15.

E. REMARKS:

The end shake of the intermediary wheel plus the freedom or end-shake the chronograph pivoted detent has under head of screw, should not permit the intermediary wheel to rise above the seconds wheel. This condition should be carefully checked, or the intermediary wheel may drop below the seconds wheel, when the chronograph is turned to a dial up position.

REFERENCE: Chronograph pivoted detent is Assembly 6.
Intermediary wheel is Assembly 5.
Seconds wheel is Assembly 15.





OILING

The pivot in bushing in chronograph pivoted detent bridge should be oiled as you would properly oil a train pivot in a watch.



4-A

A. DISASSEMBLY PROCEDURE OF INTERMEDIARY WHEEL:

To remove the intermediary wheel, simply lift it out of place.

B. ASSEMBLY PROCEDURE OF INTERMEDIARY WHEEL:

When replacing intermediary wheel the long end "A" of staff should be up. Place the bottom pivot of staff in hole in bushing of chronograph pivoted detent.

C. HAZARDS IN ASSEMBLY OF INTERMEDIARY WHEEL:

The pivot hole in bushing of chronograph pivoted detent should be carefully examined before replacing intermediary wheel. Any imperfection here will affect the timekeeping of the watch and hinder proper operation of chronograph.

D. FUNCTION OF INTERMEDIARY WHEEL:

Function of intermediary wheel is to transmit the power from wheel over fourth wheel, to the seconds wheel when these wheels are engaged. The intermediary wheel continues to turn, as long as the watch is running.

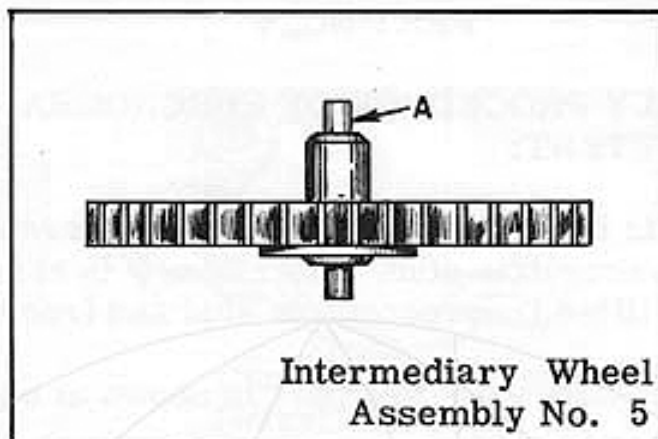
REMARKS:

A careful and detailed examination should be made of all wheels before replacing in the chronograph. Each wheel should be examined for burred pivots, bent or burred teeth, dirt or small pieces of grit wedged between the teeth.

When the VEE shaped teeth of one wheel meshes into the VEE shaped teeth of another wheel, there is very little clearance between the teeth, and because of this, even the smallest piece of grit or dirt wedged into one of these teeth may stop the chronograph.

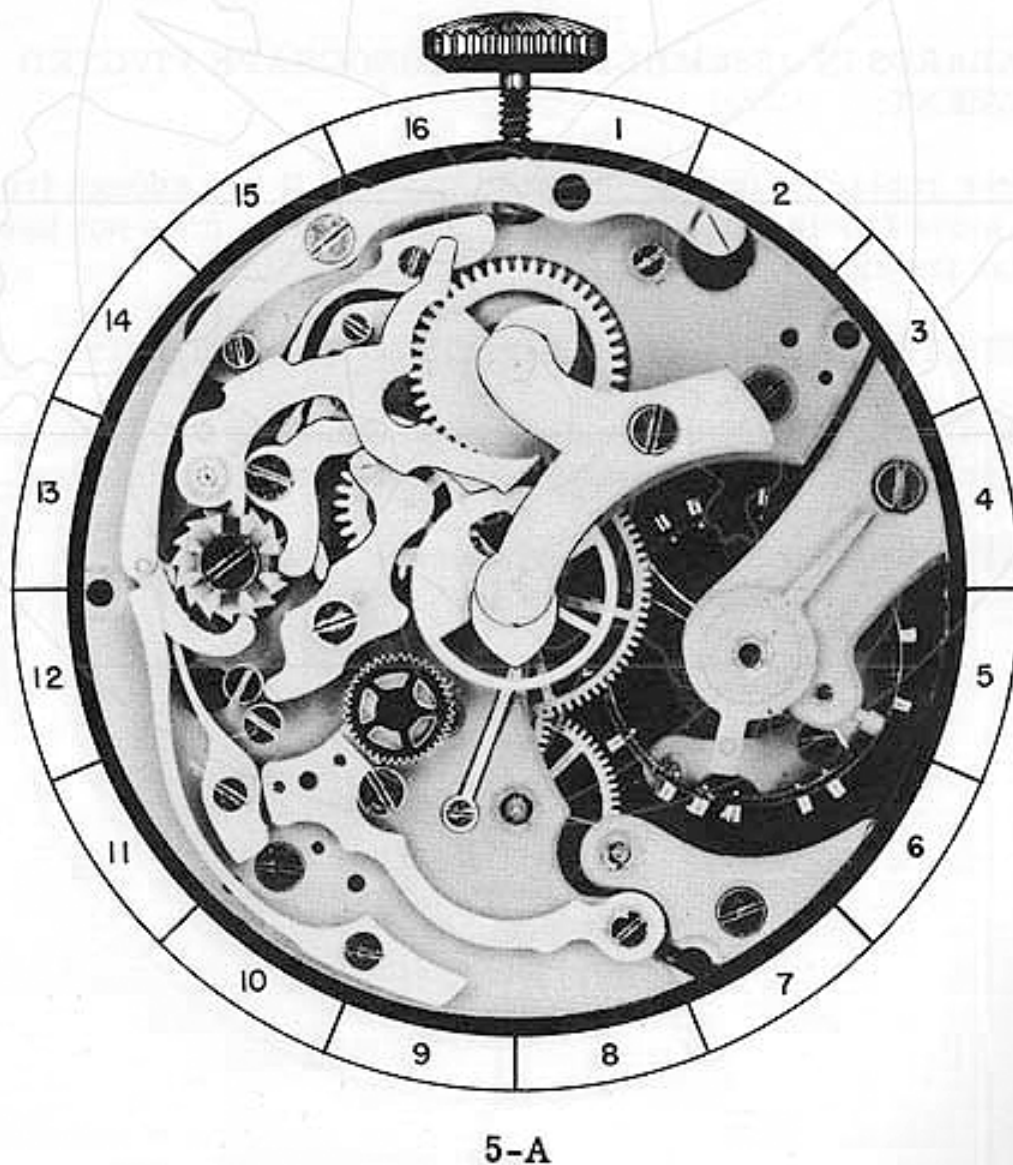
The intermediary wheel has VEE shaped teeth.

REFERENCE: Chronograph pivoted detent is Assembly 6
Seconds wheel is Assembly 15



OILING

The bottom pivot should be oiled, before it is replaced in the chronograph pivoted detent. The top pivot should be oiled after the bridge for this wheel is replaced.



PART NO. 6

A. DISASSEMBLY PROCEDURE OF CHRONOGRAPH PIVOTED DETENT:

This detent is held in place by shouldered screw SS-1 and pivots on an eccentric stud. After screw is removed, the detent may be lifted from eccentric stud and free of movement.

(The shape of screw for this part is shown at bottom of page.)

B. ASSEMBLY PROCEDURE OF CHRONOGRAPH PIVOTED DETENT:

Place detent on plate, in position shown in photograph, with the hole in end of detent over eccentric stud, as detent pivots on this stud. Replace shouldered screw SS-1. The detent should move freely under the head of this screw.

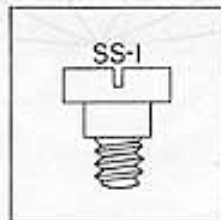
C. HAZARDS IN ASSEMBLY OF CHRONOGRAPH PIVOTED DETENT:

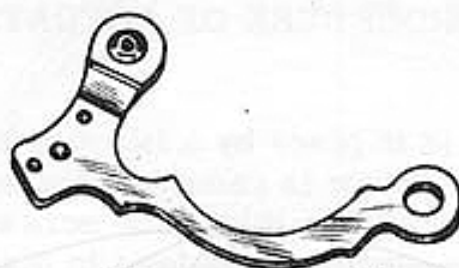
After replacing detent, check to see that it has enough freedom to move freely under head of screw, and yet, does not have excess freedom.

D. FUNCTION OF CHRONOGRAPH PIVOTED DETENT:

The function of chronograph pivoted detent is to engage and disengage the intermediary wheel with the seconds wheel.

REFERENCE: Intermediary wheel is Assembly 5.
Seconds wheel is Assembly 15.

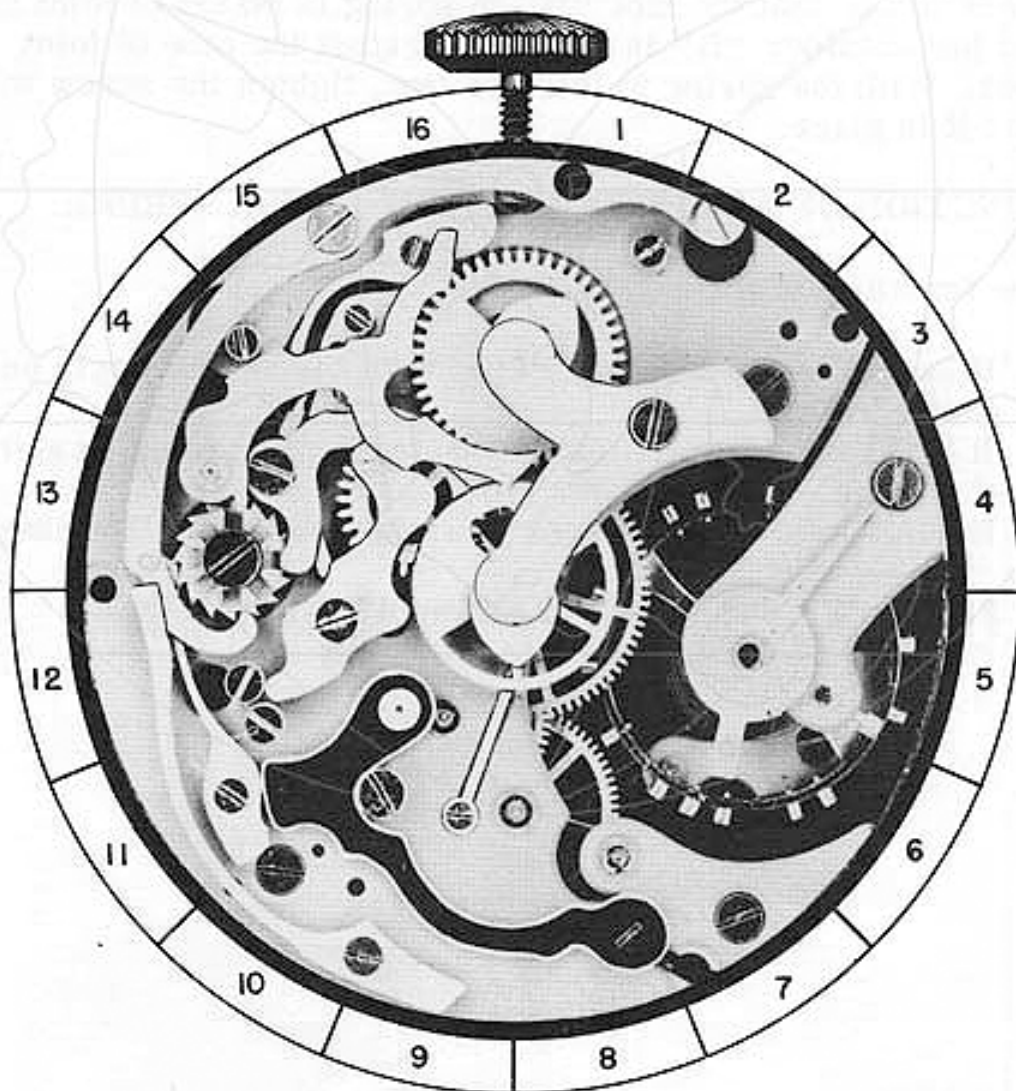




Chronograph Pivoted
Detent Assembly No. 6

OILING

The eccentric stud that chronograph pivoted detent pivots on should be slightly moistened with oil.



6-A

PART NO. 7

A. DISASSEMBLY PROCEDURE OF ACTUATING DETENT LEVER SPRING:

This spring is held in place by a fillister screw FS-4 and a steady pin. After screw is removed, the spring may be loosened from plate by sliding a thin blade screwdriver between plate and spring. When steady pin is free in plate, the spring may be lifted from movement.

(The shape of screw for this part is shown at bottom of page.)

B. ASSEMBLY PROCEDURE OF ACTUATING DETENT LEVER SPRING:

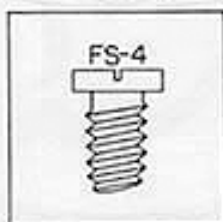
Place spring on plate with steady pin over proper hole. Replace fillister head screw FS-4, but before tightening screw, check to see that the slot "B" in spring is on top of joint hook and the shoulder "B" is pressing against the side of joint hook. With the spring in this position, tighten the screw to hold it in place.

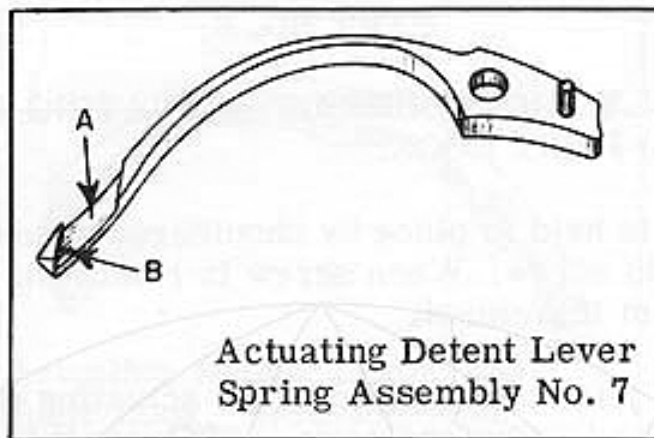
C. FUNCTION OF ACTUATING DETENT LEVER SPRING:

The functions of this spring are:

1. It keeps the joint hook engaged with the ratchet teeth on castle wheel.
2. It holds a tension on joint hook, forcing it toward center of watch.
3. It helps hold the joint hook down in position on the plate.

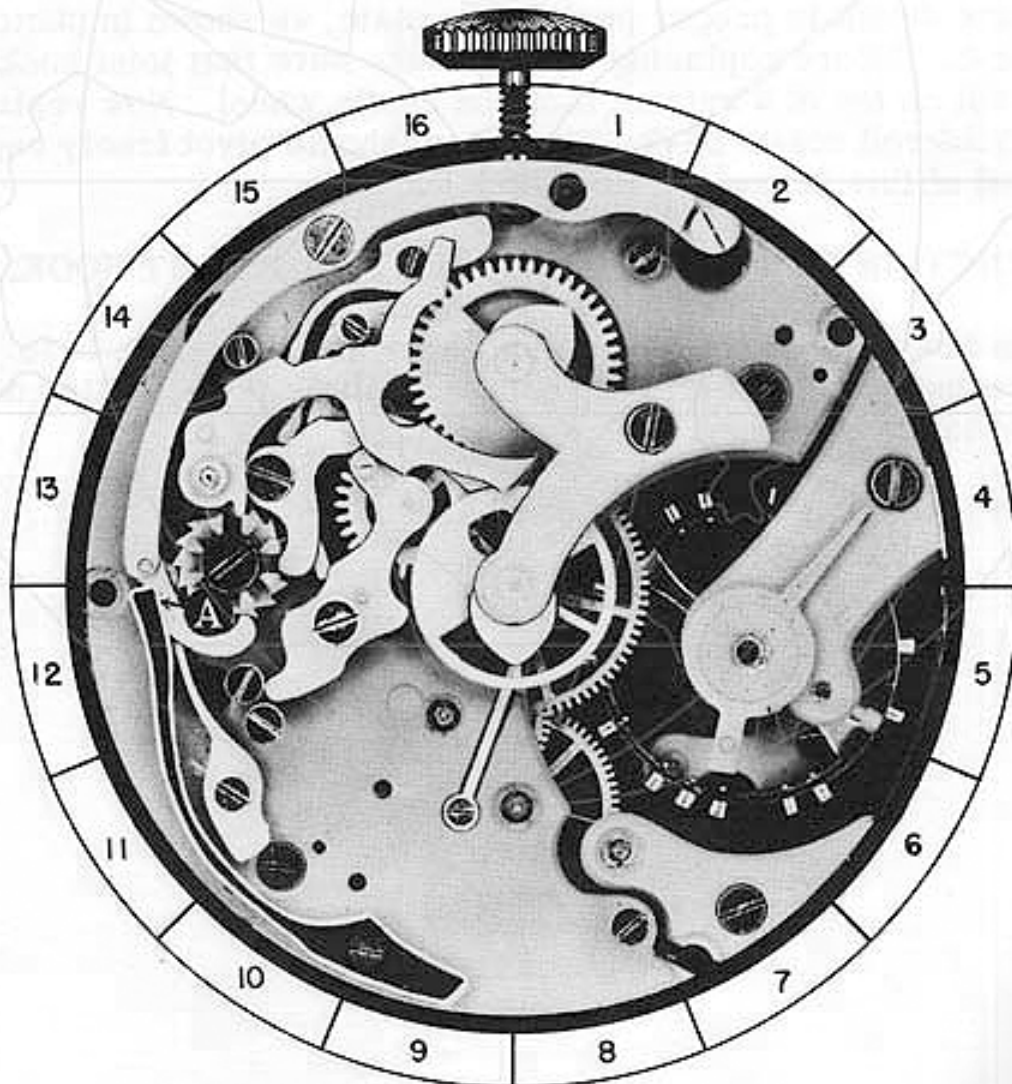
REFERENCE: Joint Hook is Assembly 8-A.
Castle wheel is Assembly 20.





OILING

End "A" of actuating detent lever spring should be slightly moistened with oil, at the point it contacts joint hook.



7-A

PART NO. 8

A. DISASSEMBLY PROCEDURE OF ACTUATING DETENT LEVER AND JOINT HOOK:

This detent is held in place by shouldered screw SS-2 and pivots on this screw. When screw is removed, detent may be lifted from movement.

NOTE: The joint hook is held to the actuating detent by a pin and under ordinary conditions, it is not necessary to remove joint hook.

(The shape of screw for this part is shown at bottom of page.)

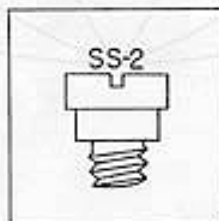
B. ASSEMBLY PROCEDURE OF ACTUATING DETENT LEVER AND JOINT HOOK:

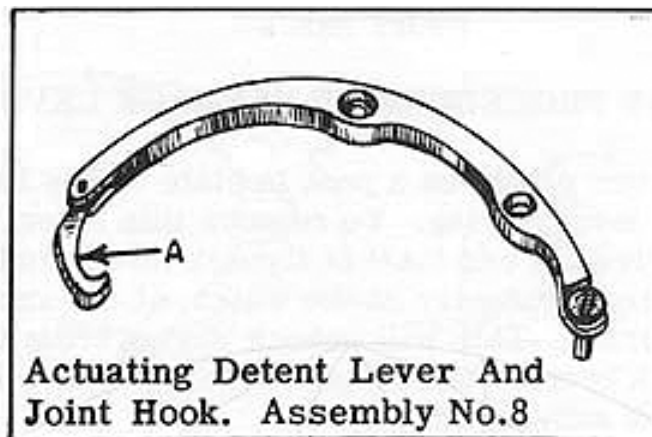
Place detent in proper position on plate, as shown in photograph. Before replacing screw, make sure that joint hook is not on top of a ratchet tooth on castle wheel. Now replace shouldered screw SS-2. The detent should pivot freely under head of this screw.

C. FUNCTION OF ACTUATING DETENT AND JOINT HOOK:

The function of actuating detent lever and joint hook is to turn the castle wheel, one tooth, each time the actuating detent lever is pushed.

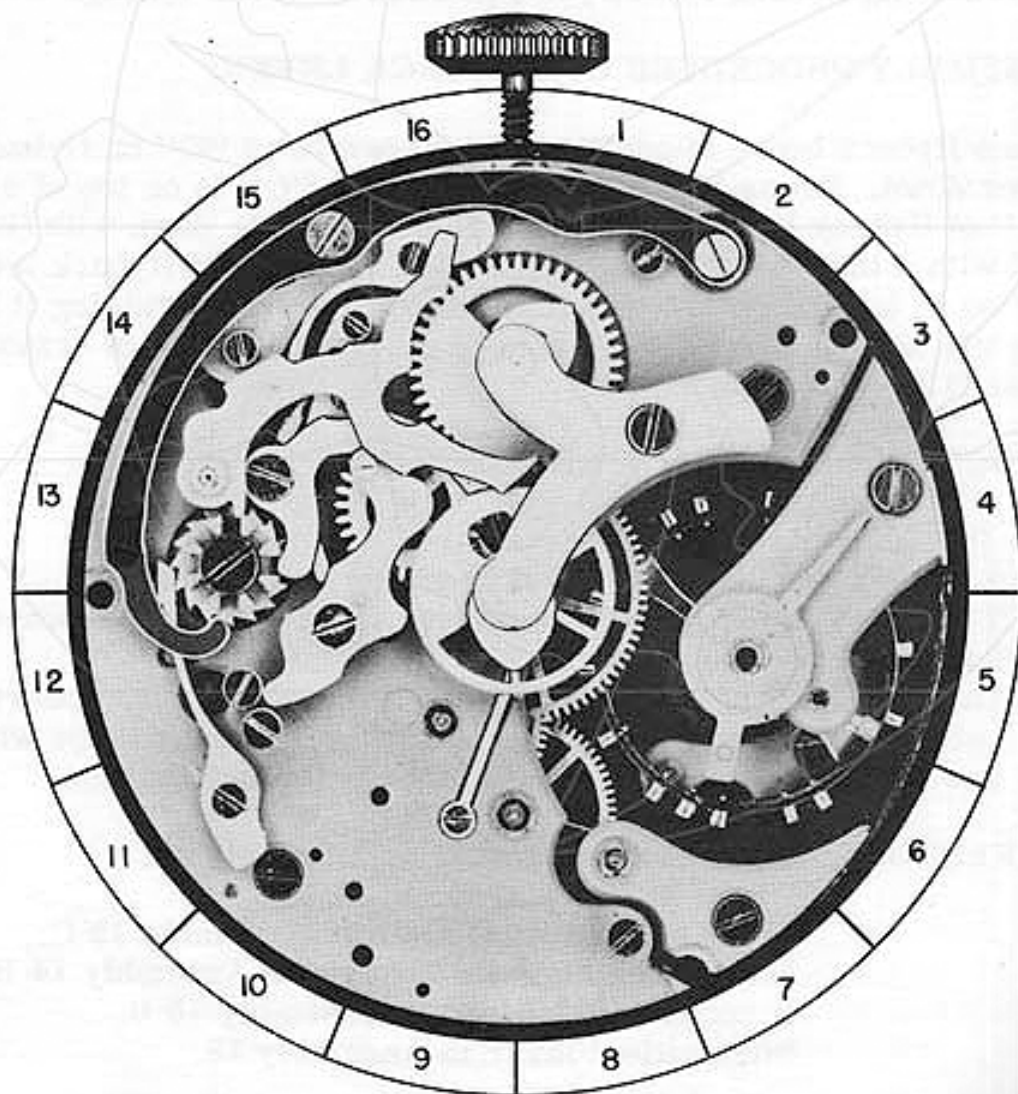
REFERENCE: Castle wheel is Assembly 20.





OILING

The following points should be slightly moistened with oil.
The shouldered screw that actuating detent lever pivots on.
The point that joint hook is pinned to actuating detent lever.



8-A

PART NO. 9

A. DISASSEMBLY PROCEDURE OF FLYBACK LEVER:

The flyback lever pivots on a post in plate and is held in position by the flyback lever spring. To remove this lever, place a thin blade screwdriver at end "A" of flyback lever spring, and force it slightly toward the center of the watch, at the same time pressing down on spring. This will unhook spring from the screw head "C" on flyback lever. The flyback lever may now be lifted from post and free of movement.

REFERENCE: Flyback lever spring is Assembly 10.

B. HAZARDS IN DISASSEMBLY OF FLYBACK LEVER:

Before removing flyback lever, unhook flyback lever spring from screw "C" on under side of flyback lever. This must be done or in removing flyback lever, you will bend or break spring.

C. ASSEMBLY PROCEDURE OF FLYBACK LEVER:

Place flyback lever in position with screw head "C" on flyback lever down. Press lever down until screw "C" is on top of end "A" of flyback lever spring. Hold flyback lever down with finger, and with a thin blade screwdriver push end "A" of flyback lever spring in toward center of watch, at the same time raising it up slightly so that end "A" of spring can hook on inside of screw head "C" on flyback lever.

D. FUNCTION OF FLYBACK LEVER:

The functions of the flyback lever are:

1. It disengages the brake lever from the seconds wheel.
2. It disengages the intermittent lever from the seconds wheel dart tooth.
3. The ends "A" and "B" of flyback lever contacts the hearts on seconds wheel and minute register wheel forcing these wheels and the hands attached to them back to a zero position.

REFERENCE: Flyback lever spring is Assembly 10.

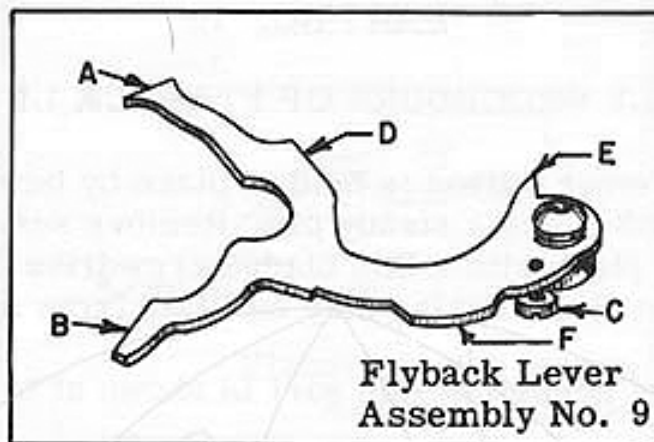
Brake lever is Assembly 12.

Seconds wheel dart tooth is Assembly 15 C.

Minute register wheel heart is Assembly 14 B.

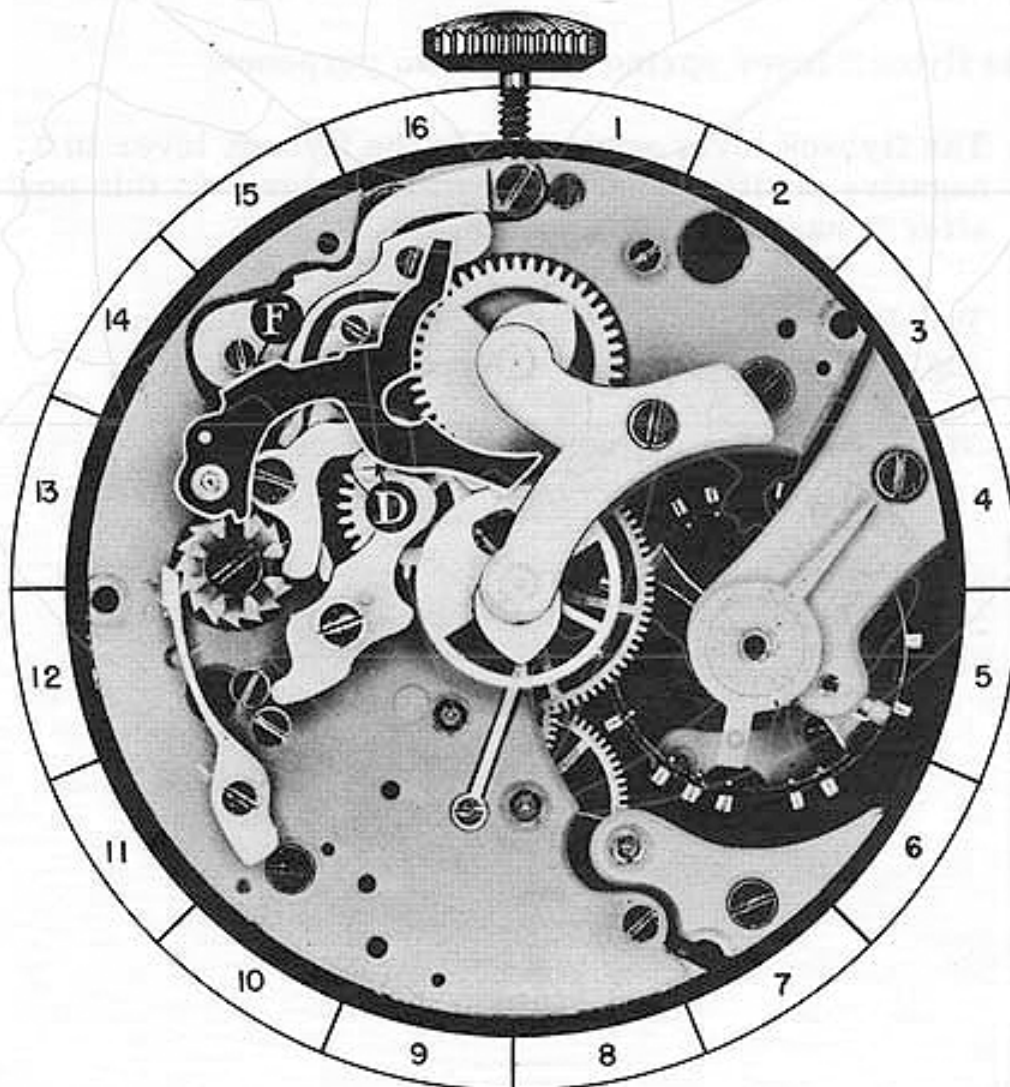
Seconds wheel heart is Assembly 15 B.

Intermittent lever is Assembly 18.



The following points on flyback lever should be slightly moistened with oil:

1. The stud on which flyback lever pivots.
2. Screw "C" at point of contact with flyback lever spring.
3. Surface "D" at point of contact with intermittent lever.
4. Point "F" at point of contact with push piece for setting back to zero.



9-A

A. DISASSEMBLY PROCEDURE OF FLYBACK LEVER SPRING:

The flyback lever spring is held in place by beveled counter-sink screw BS-1 and a steady pin. Remove screw, and loosen spring from plate with a thin blade screwdriver. After steady pin is free in plate, spring may be lifted from movement.

(The shape of screw for this part is shown at bottom of page)

B. ASSEMBLY PROCEDURE OF FLYBACK LEVER SPRING:

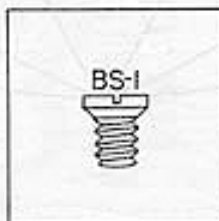
Place spring on movement with steady pin in proper hole in plate. Now press spring down flush on plate with back of tweezers, and replace beveled countersink screw BS-1.

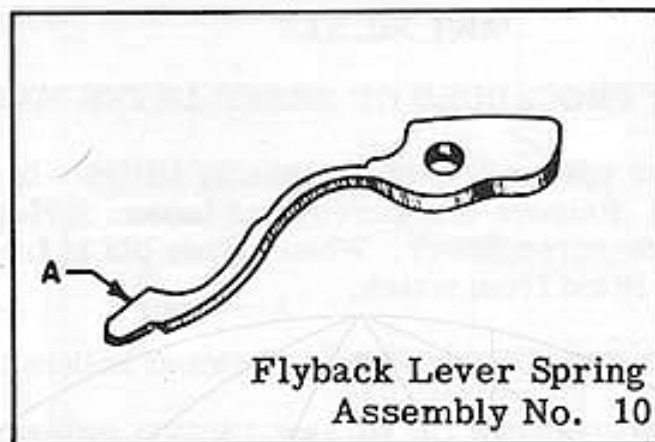
C. FUNCTION OF FLYBACK LEVER SPRING:

The flyback lever spring serves two purposes:

1. The flyback lever spring holds the flyback lever in a negative position and will return the lever to this position after it has been moved manually.
2. It holds the flyback lever down on post, preventing it from working up, and coming out of place.

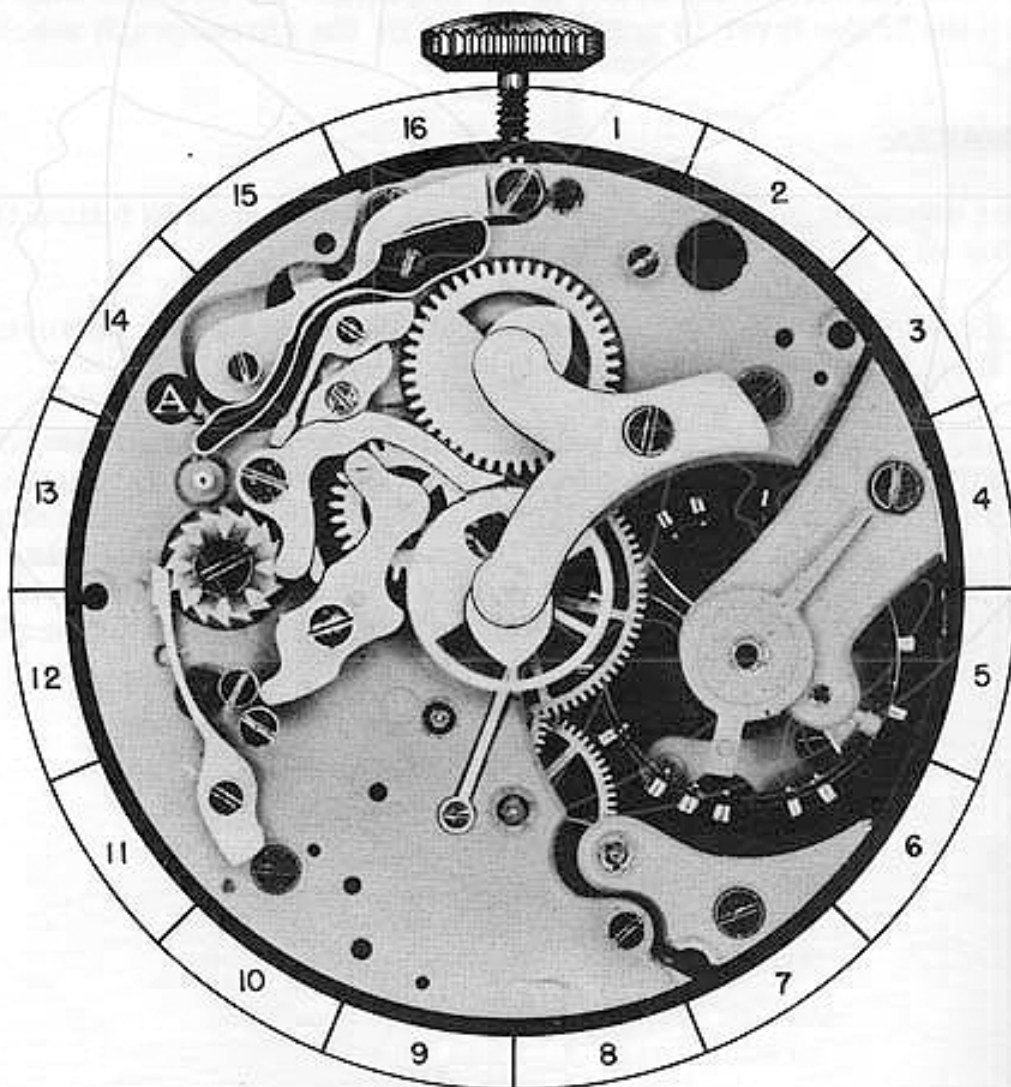
REFERENCE: Flyback lever is Assembly 9.





OILING

End "A" of flyback lever spring should be slightly moistened with oil after flyback lever is put in place.



10-A

PART NO. 11

A. DISASSEMBLY PROCEDURE OF BRAKE LEVER SPRING:

The brake lever spring is held in place by fillister head screw FS-5 and steady pin. Remove this screw, and loosen spring from plate with a thin blade screwdriver. When steady pin is free in plate, the spring may be lifted from watch.

(The shape of screw for this part is shown at bottom of page.)

B. ASSEMBLY PROCEDURE OF BRAKE LEVER SPRING:

Place brake lever spring on plate, with steady pin in proper hole. Press down in position, and replace fillister head screw FS-5.

C. FUNCTION OF BRAKE LEVER SPRING:

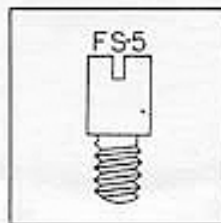
The function of this spring is to hold a tension on the brake lever. This tension forces the brake lever to contact the seconds wheel, when the brake lever is not disengaged by the chronograph mechanism.

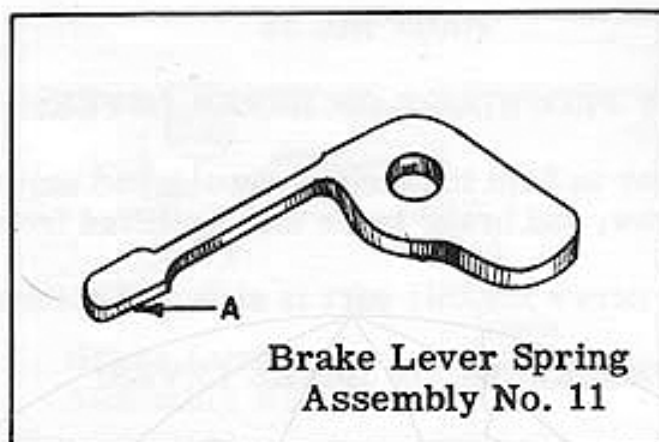
REMARKS:

When adjusting springs for proper tension, it is good to follow this policy as a general rule:

1. A spring should just hold enough tension on a part to perform its function properly.
2. Any excess tension on a part in a chronograph mechanism will cause the chronograph to be harder to work, also causing more wear, etc. Of course, the amount of pressure the spring should hold on a part is determined in the factory; because of this, it is seldom that you should have to adjust a spring. However, you may have to make one of these springs, and the above rules should aid you in setting the proper tension.

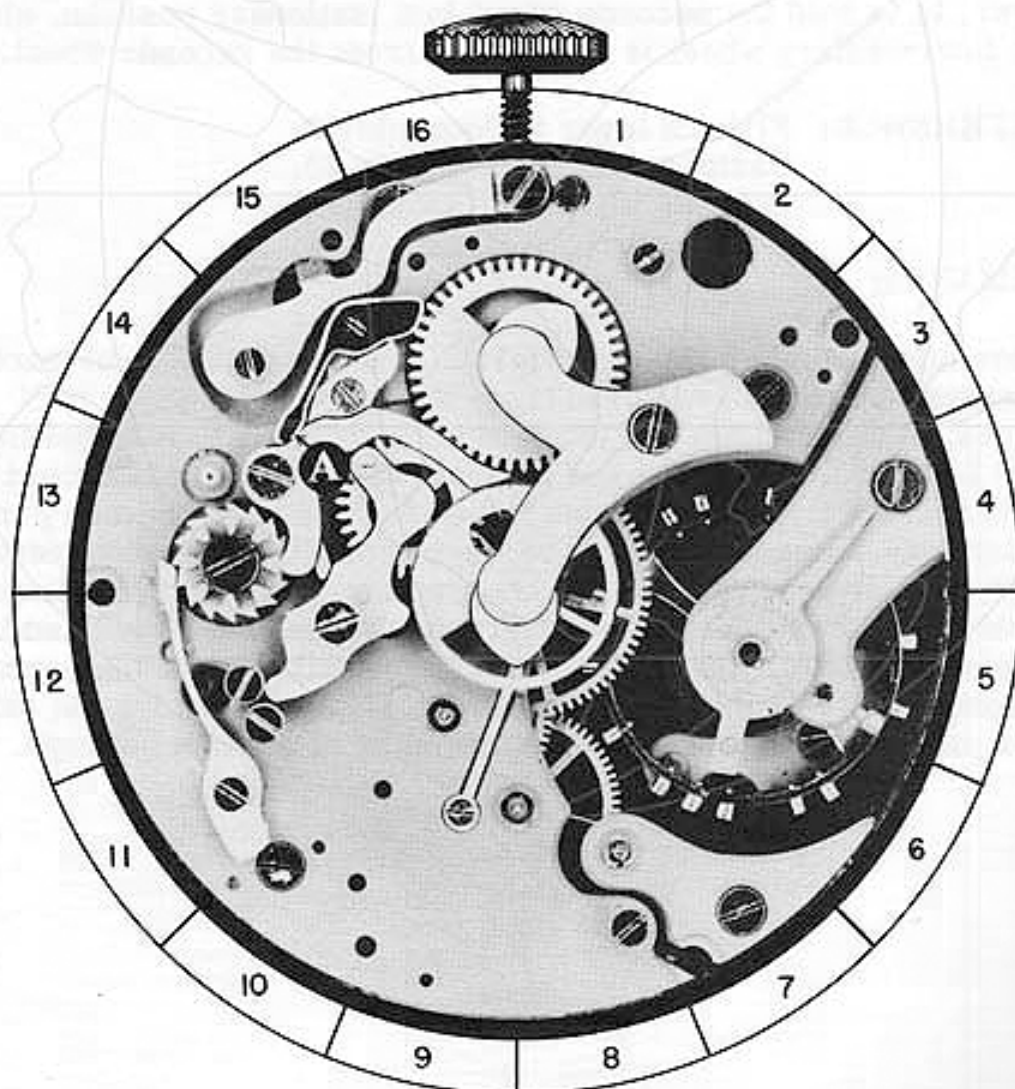
REFERENCE: Brake lever is Assembly 12.
Seconds wheel is Assembly 15.





OILING

End "A" of brake lever spring should be slightly moistened with oil at point it contacts brake lever.



11-A

A. DISASSEMBLY PROCEDURE OF BRAKE LEVER:

The brake lever is held in place by shouldered screw SS-3. Remove this screw, and brake lever may be lifted from movement.

(The shape of screw for this part is shown at bottom of page.)

B. ASSEMBLY PROCEDURE OF BRAKE LEVER:

Place brake lever in position on plate, with end "B" of brake lever contacting castle wheel. With brake lever in this position, replace shouldered screw SS-3. Check to see that lever pivots freely under head of this screw.

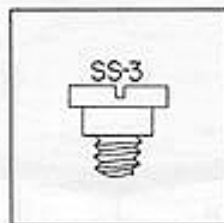
C. FUNCTION OF BRAKE LEVER:

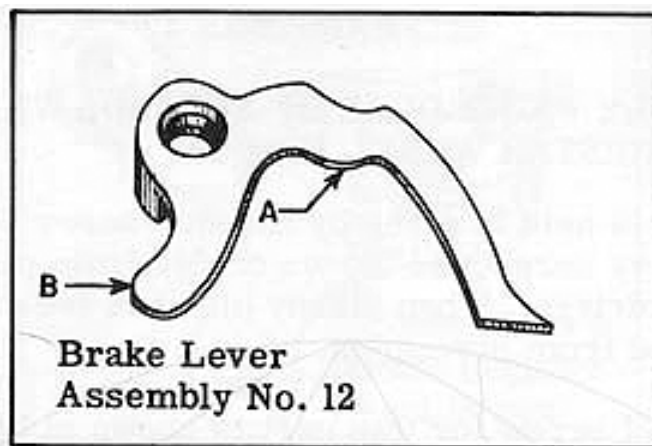
The function of the brake lever, when not disengaged by the flyback lever, is to hold the seconds wheel in a stationary position, when the intermediary wheel is disengaged from the seconds wheel.

REFERENCE: Flyback lever is Assembly 9.
Castle wheel is Assembly 20.
Seconds wheel is Assembly 15.

REMARKS:

When disassembling the chronograph, each part should be carefully examined as it is removed from the movement. Each part should be checked against the isometric drawing to see that the part is the correct shape and is not broken. Each part should also be checked for any pits of rust, roughness, burrs, or worn parts which may cause the part not to work properly. The replacement of the defective part in the chronograph may necessitate the complete disassembly of the chronograph. Through a close examination of each part, you will soon become familiar with the parts in a chronograph. This will enable you to quickly recognize the defective part and repair it before replacing it in the chronograph.

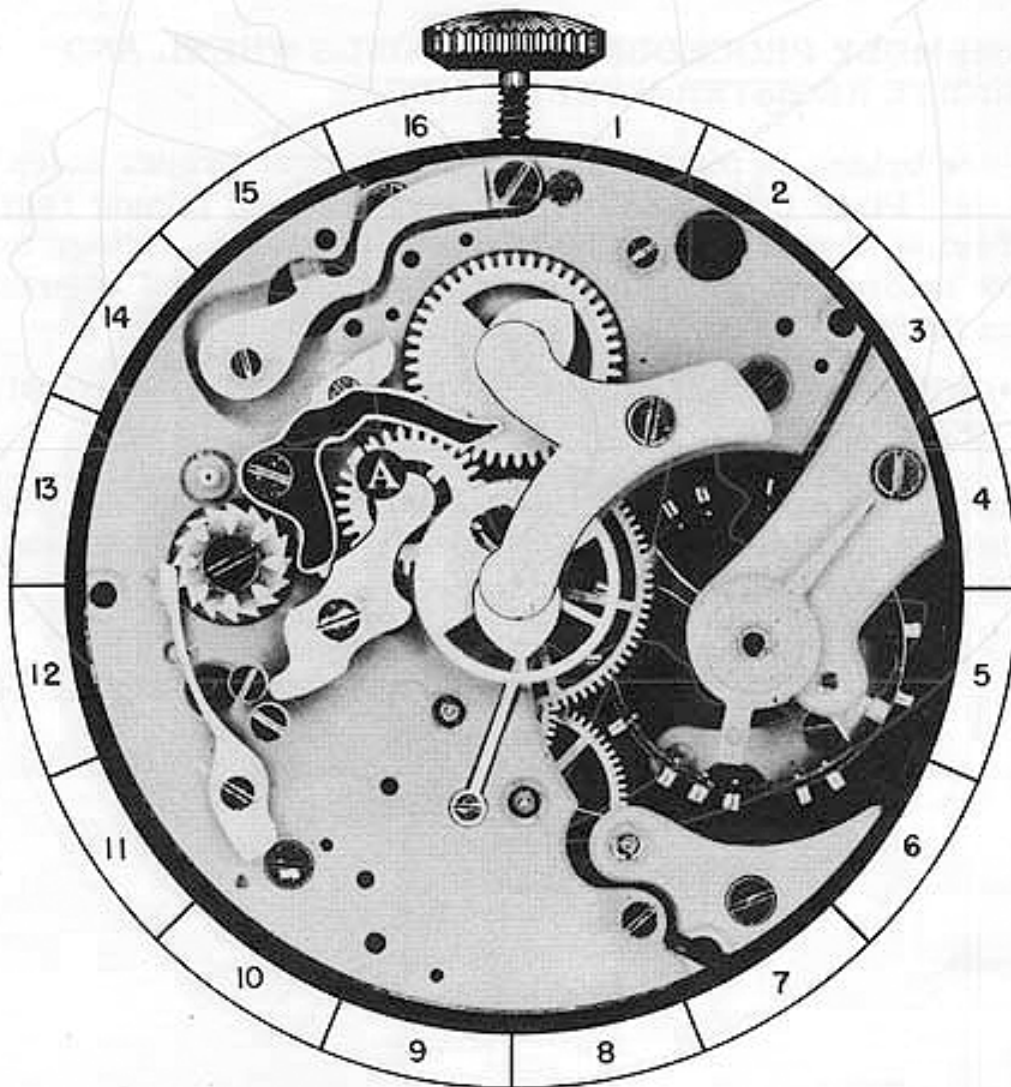




OILING

The following points on brake lever should be slightly moistened with oil.

1. The shouldered screw that brake lever pivots on.
2. Point A on brake lever that contacts intermittent lever.



12-A

A. DISASSEMBLY PROCEDURE OF SECONDS WHEEL AND MINUTE REGISTER WHEEL BRIDGE:

This bridge is held in place by fillister screw FS-6 and steady pins. Remove screw, and loosen bridge from plate with a thin blade screwdriver. When steady pins are free in plate, bridge may be lifted from movement.

(The shape of screw for this part is shown at bottom of page)

B. HAZARDS IN DISASSEMBLY OF SECONDS WHEEL AND MINUTE REGISTER WHEEL BRIDGE:

When removing bridge from plate, avoid twisting of bridge, as this may damage pivots or wheels, or may chip jewels in bridge. The screwdriver should be carefully used, to prevent marring of bridge and plate.

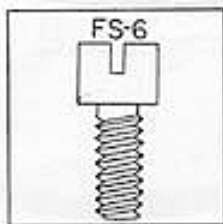
C. ASSEMBLY PROCEDURE OF SECONDS WHEEL AND MINUTE REGISTER WHEEL BRIDGE:

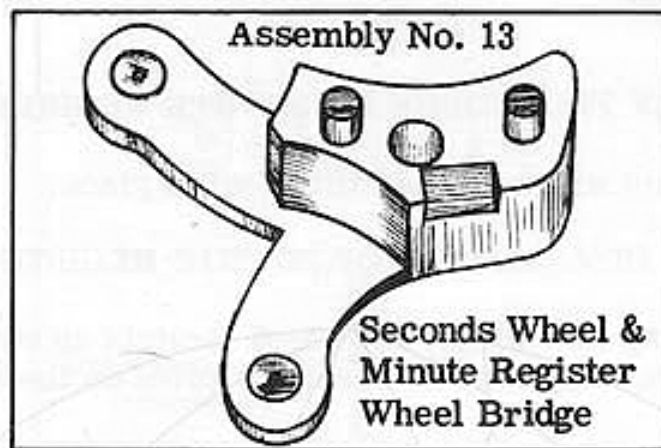
Place bridge on plate, with steady pins over proper holes in plate. Place top pivots of seconds wheel and minute register wheel, so they will enter jewel holes in bridge. Bridge may now be pressed down to proper place with back of tweezers, and fillister screw FS-6 replaced.

D. FUNCTION OF SECONDS WHEEL AND MINUTE REGISTER WHEEL BRIDGE:

The function of this bridge is to hold the top pivots of seconds wheel and minute register wheel in position, so these wheels can function properly.

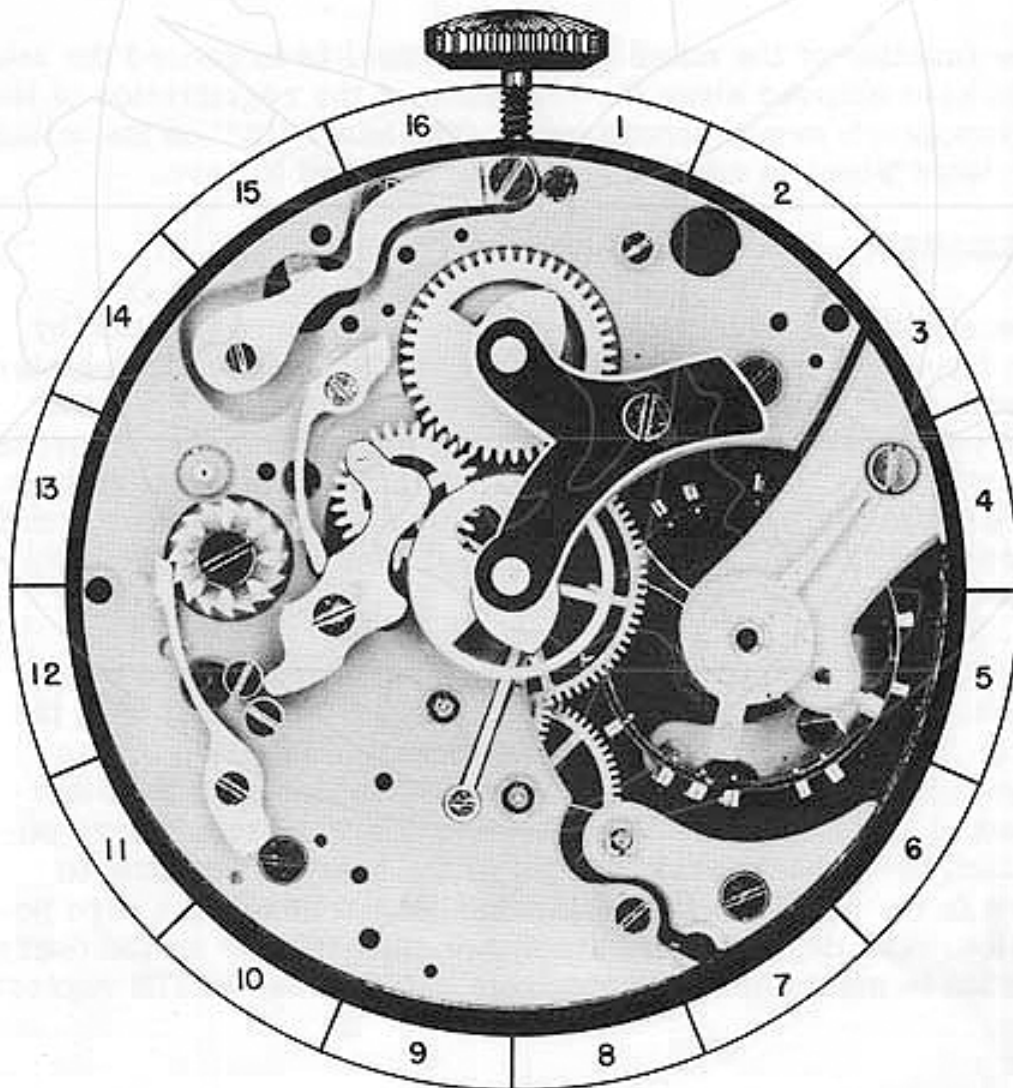
REFERENCE: Seconds wheel is Assembly 15
Minute register wheel is Assembly 14





OILING

The pivots in the jewels in this bridge should be oiled as you would properly oil a train pivot in a watch.



13-A

PART NO. 14

A. DISASSEMBLY PROCEDURE OF MINUTE REGISTER WHEEL:

To remove this wheel, simply lift it out of place.

B. HAZARDS IN DISASSEMBLY OF MINUTE REGISTER WHEEL:

When removing this wheel, lift wheel straight up out of watch, as any twisting may bend or break the pivot on the minute register wheel.

C. ASSEMBLY PROCEDURE OF MINUTE REGISTER WHEEL:

Place the minute register wheel in its proper position in the watch, as shown in the photograph. The long pivot "A" on this wheel must be placed down.

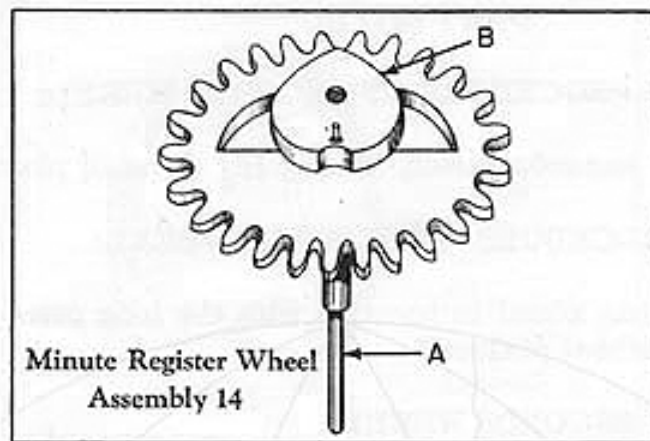
D. FUNCTION OF MINUTE REGISTER WHEEL:

The function of the minute register wheel is to record the minutes that have elapsed since the beginning of the registration of the chronograph sweep second hand. The heart "B" on the minute register wheel is used in returning the hand to zero.

REMARKS:

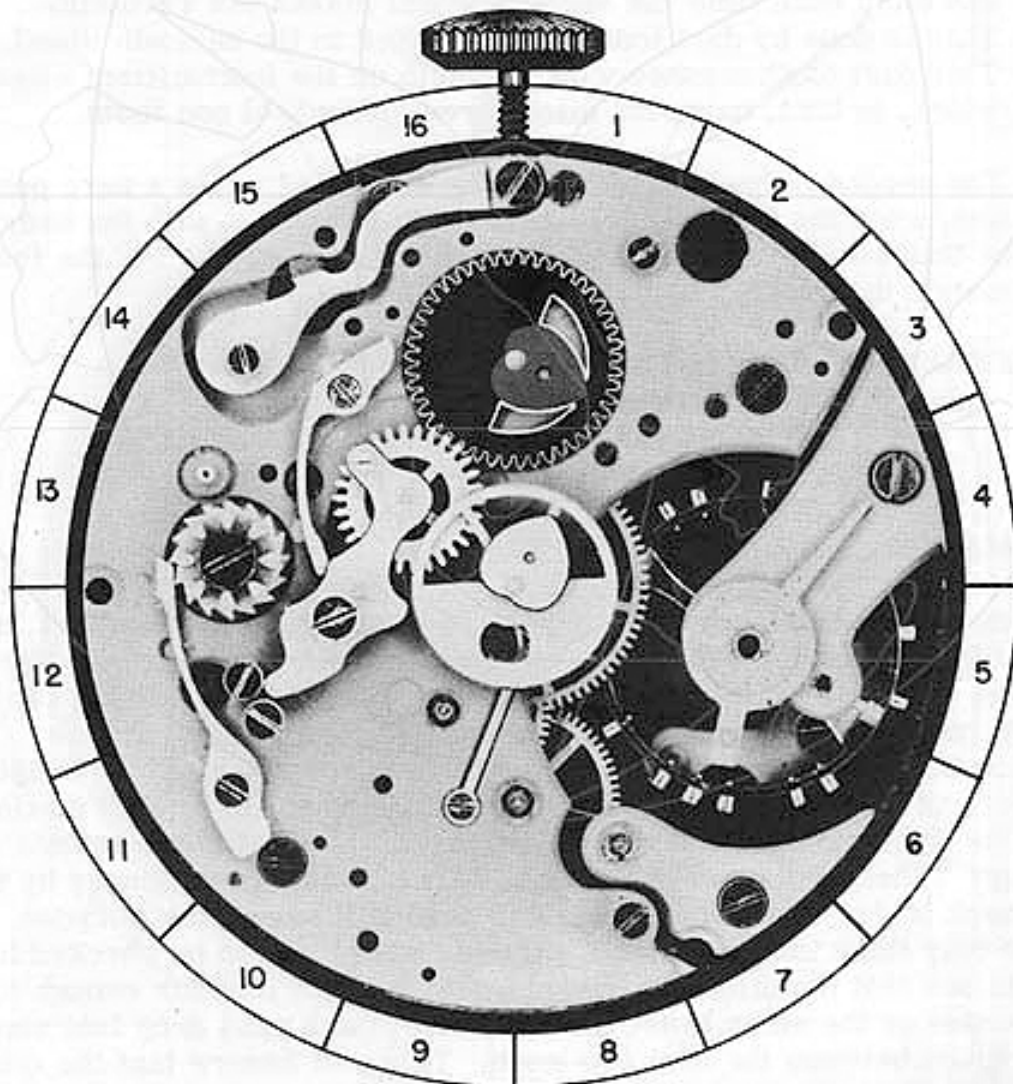
The minute register wheel is returned to a zero position by the flyback lever contacting the heart "B" on minute register wheel. The heart on this wheel is set eccentric. When the flat end of flyback lever contacts the eccentric heart, it forces the heart to turn. The heart will turn until the flat end of flyback lever sets across the two lobes at top of heart. With the pressure equalized at these two points, it would turn no further, and this would be a zero position.

If this wheel has turned less than 160 degrees from a zero position when the flyback lever is brought in contact with the heart, it will turn in the opposite direction to which it was turning, to bring this wheel to a zero position. On the other hand, if the wheel is turned past 160 degrees from a zero position, the flyback lever will force the heart to continue to turn in the direction it was turning until it reaches a zero position. The degrees used above are approximate as the degree varies in most chronographs from 150 degrees to 170 degrees.



OILING

The top and bottom pivots of minute register wheel should be oiled after bridge for this wheel is placed in watch. Oil these pivots as you would normally oil a train pivot.



14-A

PART NO. 15

A. DISASSEMBLY PROCEDURE OF SECONDS WHEEL:

To remove the seconds wheel, simply lift it out of place.

B. ASSEMBLY PROCEDURE OF SECONDS WHEEL:

Place the seconds wheel in position, with the long pivot "A" down in hole in center wheel pinion.

C. FUNCTION OF SECONDS WHEEL:

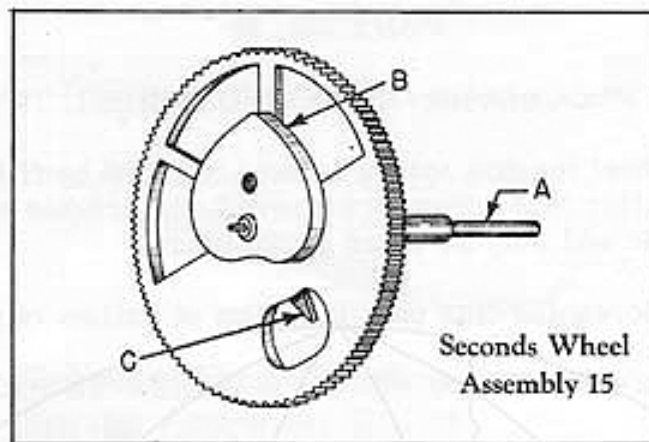
The functions of the seconds wheel are:

1. The seconds wheel registers the seconds, that have elapsed since the beginning of the registration. This is done by a hand being attached to the long pivot "A" on seconds wheel.
2. The seconds wheel must move the minute register wheel forward one tooth each time the seconds wheel makes one revolution. This is done by dart tooth "C" attached to the seconds wheel. This dart tooth meshes with the teeth on the intermittent wheel which, in turn, move the minute register wheel one tooth.
3. The seconds wheel must return the seconds hand to a zero position, when the flyback lever is brought in contact with the heart on this wheel. Seconds wheel heart is shown as "B" in the isometric drawing.

REFERENCE: Flyback lever is Assembly 9.
Seconds wheel dart tooth is Assembly 15 C.
Intermittent lever and wheel assembly is
Assembly 18.

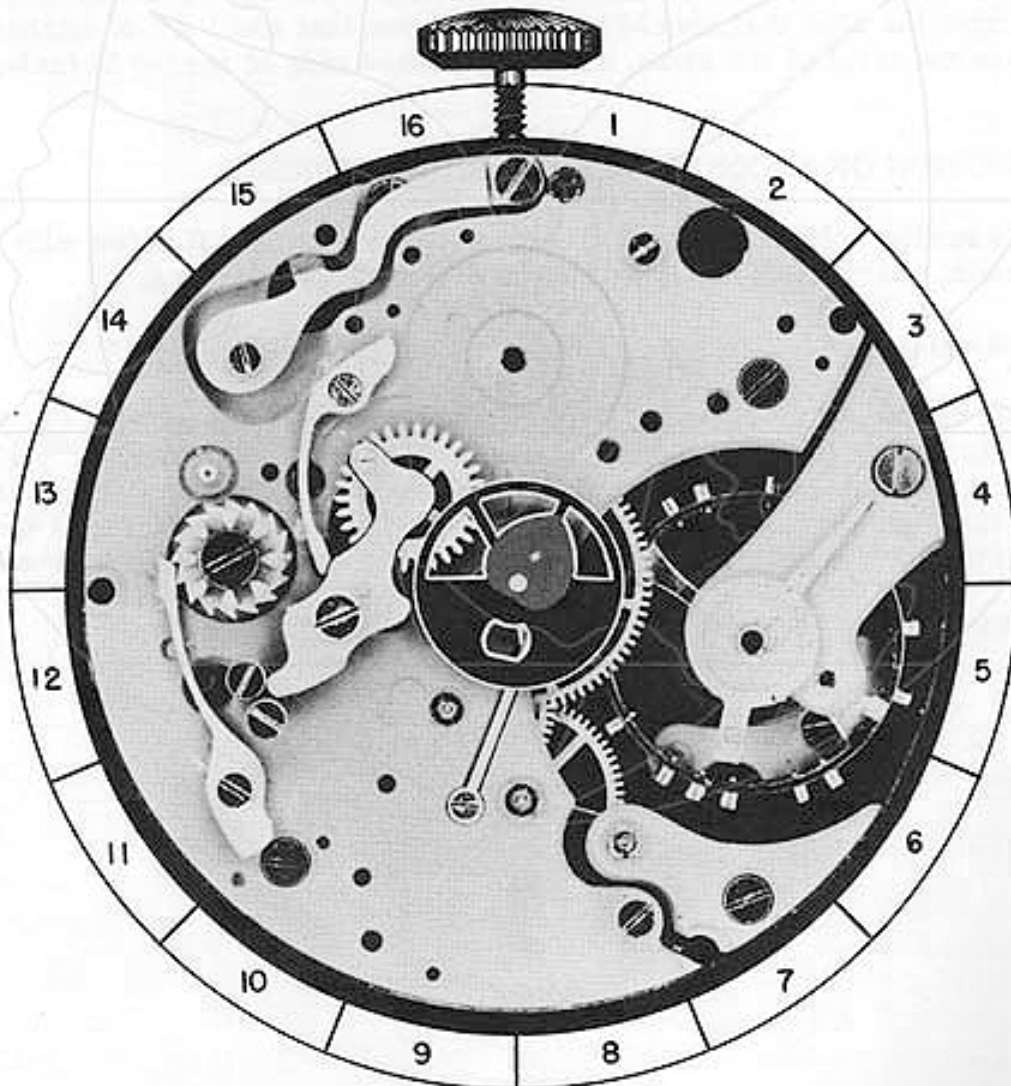
REMARKS:

When the flyback lever is forced toward the center of the watch, and held in this position, check the seconds wheel and minute register wheel with a very fine broach to see if either of these wheels can be turned. The minute register wheel will turn slightly at this point, but the seconds wheel should be held very tightly by the flyback lever. It is most essential for the seconds wheel to be held stationary by the flyback lever at a zero position. In the case of the minute register wheel, it does not have to be held absolutely stationary by the flyback lever. The minute register pawl will serve this purpose. The only thing that the minute register wheel should be checked for, is to see that the minute register wheel will not turn far enough to one side or the other to let the minute register pawl drop into another space between the next two teeth. This will assure that the minute register wheel will always be brought back to a zero position.



OILING

The top pivot of seconds wheel should be oiled after bridge for this wheel is placed in watch.



A. DISASSEMBLY PROCEDURE OF SECONDS WHEEL TENSION SPRING:

The seconds wheel tension spring is held in place by fillister head screw FS-7. After this screw is removed, the tension spring will be free on the plate and may be lifted out of place.

(The shape of screw for this part is shown at bottom of page.)

B. ASSEMBLY PROCEDURE OF SECONDS WHEEL TENSION SPRING:

Place seconds wheel tension spring in its proper position, with hole in spring over proper hole in plate. Replace fillister screw FS-7, but before tightening screw, make sure that end "A" of spring is not over the hole in center wheel pinion. End "A" of this spring should fit right along side of the center wheel pivot hole. It should not fit over it. The proper position of this spring is shown in the photograph. After spring is replaced and screw is tight, check to make sure that tension spring is still in its proper position, as shown in the photograph. This spring should also be checked to see that it is right side up. The way to determine the side that should be up, is to see that end "A" of spring is above the level of the plate, and the polished side of spring is facing up.

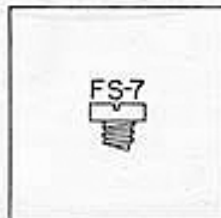
C. FUNCTION OF SECONDS WHEEL TENSION SPRING:

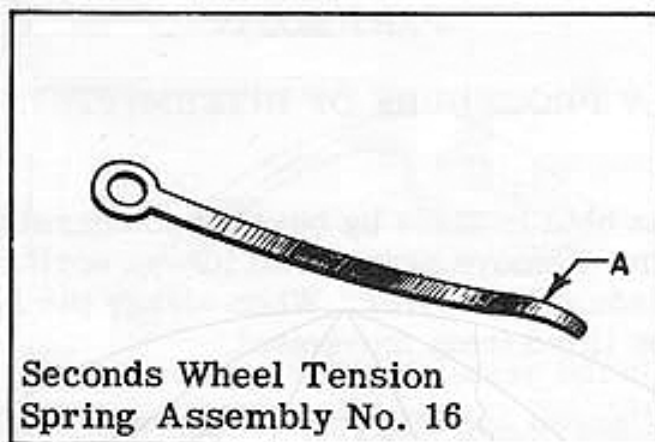
This spring holds a tension on seconds wheel, so that it turns with a smooth, even action, with no irregular jumping or jerking.

REMARKS:

When replacing this spring, it is important to see that the end "A" of this spring is in its proper position. If it is not, the end "A" of spring may hold a tension on the seconds wheel staff, causing excess friction, which may cause the watch to stop. The seconds wheel tension spring should hold only an upward tension on the seconds wheel.

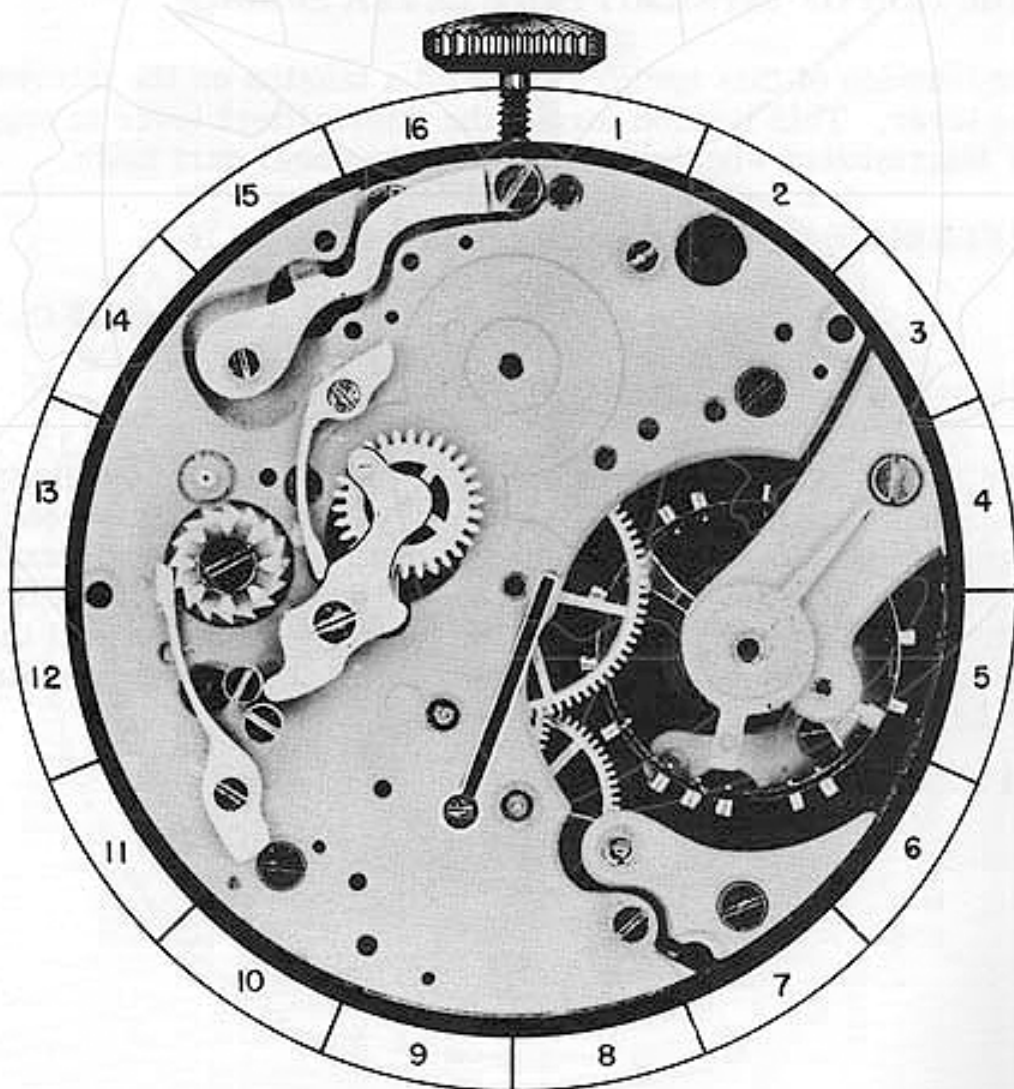
REFERENCE: Seconds wheel is Assembly 15.





OILING

The seconds wheel tension spring should not be oiled.



16-A

PART NO. 17

A. DISASSEMBLY PROCEDURE OF INTERMITTENT LEVER SPRING:

This spring is held in place by beveled countersink screw BS-2 and steady pin. Remove screw, and loosen spring from plate with a thin blade screwdriver. When steady pin is free in plate, spring may be lifted from movement.

(The shape of screw for this part is shown at bottom of page.)

B. ASSEMBLY PROCEDURE OF INTERMITTENT LEVER SPRING:

Place spring in position on plate, with steady pin over proper hole in plate. Now press spring down flush on plate, and replace beveled countersink screw BS-2.

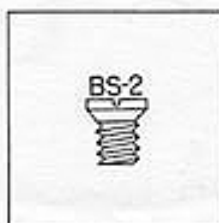
C. FUNCTION OF INTERMITTENT LEVER SPRING:

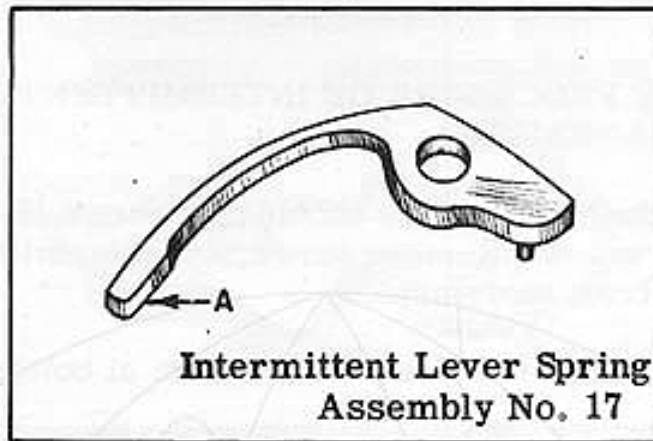
The function of this spring is to hold a tension on the intermittent lever. This tension forces the intermittent lever to engage the intermittent wheel with the seconds wheel dart tooth.

REFERENCE: Intermittent lever is Assembly 18.
Intermittent wheel is Assembly 18 A.
Seconds wheel dart tooth is Assembly 15 C.

REMARKS:

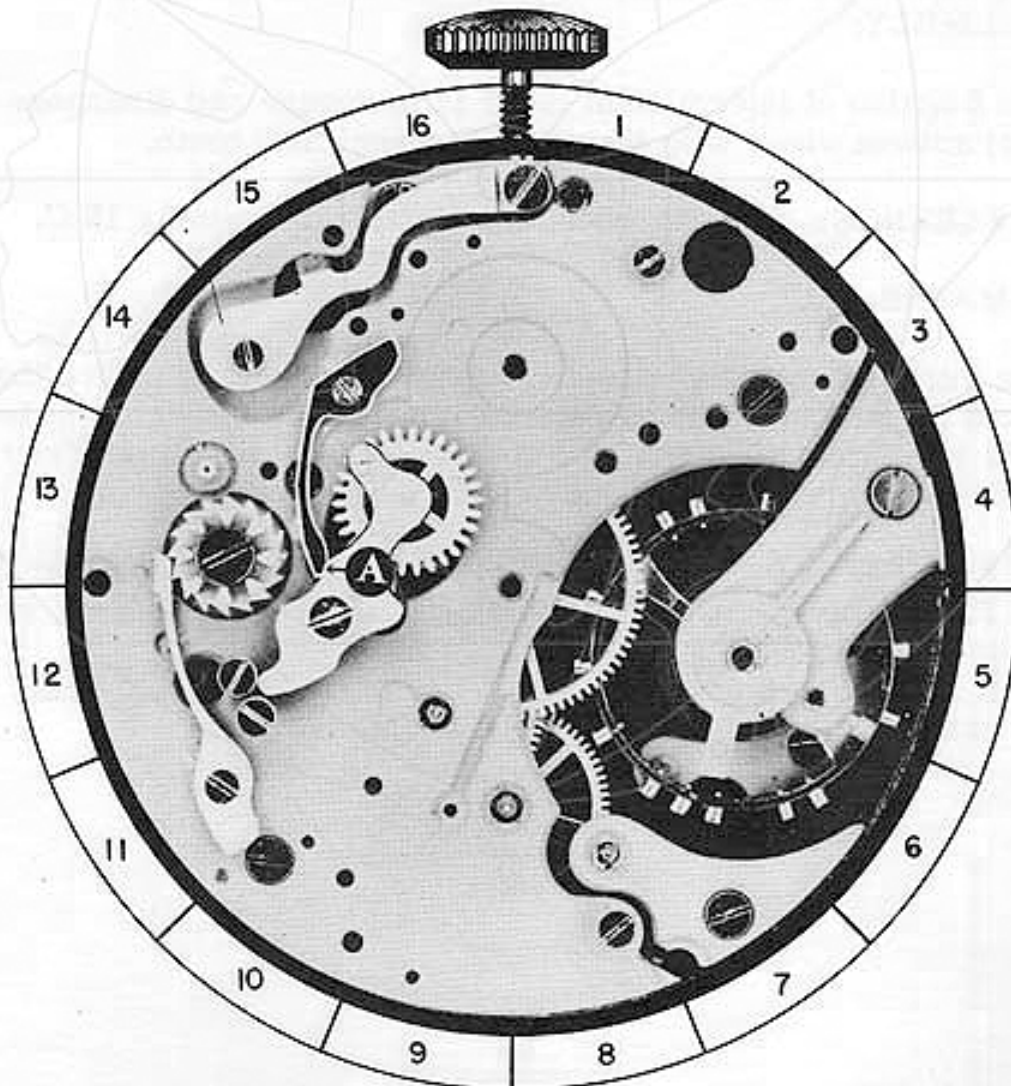
This type of chronograph is called the semi-instantaneous type. The minute register hand is stationary until the 58th second of registration. Between the 58th and 60th second of registration, the minute register hand moves forward very slowly. At the 60th second of registration, the minute register hand will move forward very quickly to complete the registration of one minute on the dial.





OILING

End "A" of intermittent lever spring should be slightly moistened with oil at point it contacts intermittent lever.



17-A

PART NO. 18

A. DISASSEMBLY PROCEDURE OF INTERMITTENT LEVER AND WHEEL ASSEMBLY:

This lever is held in place by shouldered screw SS-4, and pivots on this screw. Remove screw, and intermittent lever may be lifted from movement.

(The shape of screw for this part is shown at bottom of page.)

B. ASSEMBLY PROCEDURE OF INTERMITTENT LEVER AND WHEEL ASSEMBLY:

Place intermittent lever in position on plate, and replace shouldered screw SS-4. Check to see that lever pivots freely under head of this screw.

C. FUNCTION OF INTERMITTENT LEVER AND WHEEL ASSEMBLY:

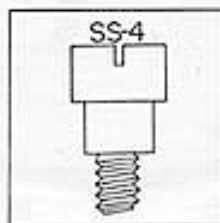
The function of intermittent lever is to engage and disengage intermittent wheel with the seconds wheel dart tooth.

REFERENCE: Seconds wheel dart tooth is Assembly 15 C.

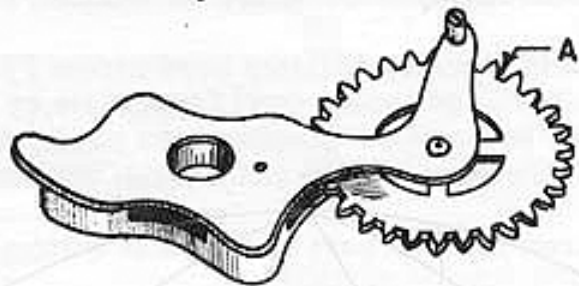
REMARKS:

The intermittent wheel should be carefully checked to see that it has proper endshake and spins freely in the intermittent lever. This wheel must of necessity spin freely, as any excess friction on the intermittent wheel may cause the following errors:

1. Result in an error in the register of minutes on the dial.
2. The minute register pawl setting at an incorrect position on minute register wheel.
3. It may cause the watch to stop due to the dart tooth being unable to turn the intermittent wheel.

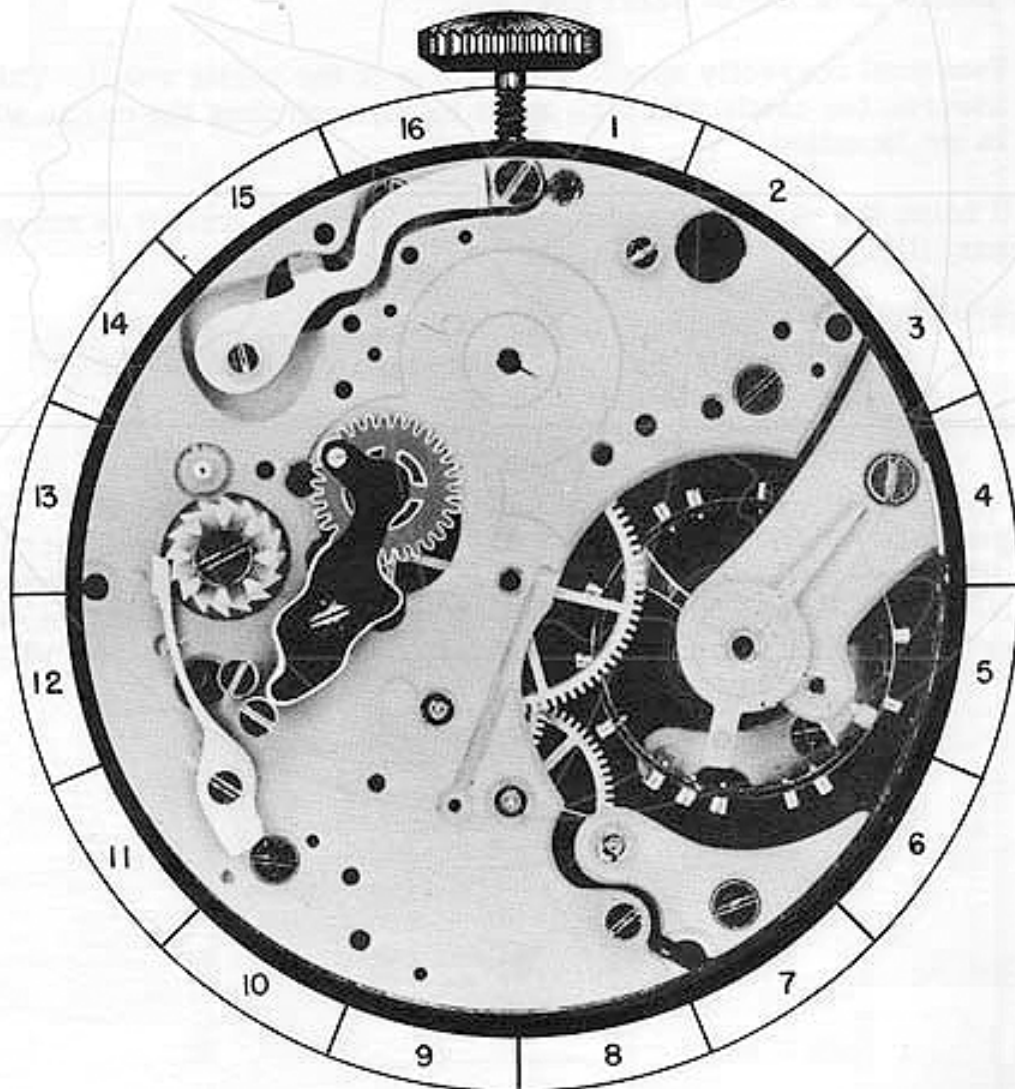


Intermittent Lever and Wheel
Assembly Assembly No. 18



OILING

The shouldered screw that intermittent lever and wheel assembly pivots on should be slightly moistened with oil.



18-A

PART NO. 19

A. DISASSEMBLY PROCEDURE OF CASTLE WHEEL PAWL:

This pawl is held in place by fillister head screw FS-8 and steady pins. Remove screw, and loosen pawl from plate, by sliding a thin blade screwdriver between the plate and the pawl. After steady pins are free in plate, the pawl may be lifted from the movement.

(The shape of screw for this part is shown at bottom of the page.)

B. ASSEMBLY PROCEDURE OF CASTLE WHEEL PAWL:

Place the pawl on the plate with steady pins in proper holes. Before pressing down in place, check to see that end "A" of pawl is between two ratchet teeth on the castle wheel. Press down into place and re-place fillister head screw FS-8, that holds this part in position.

C. FUNCTION OF CASTLE WHEEL PAWL:

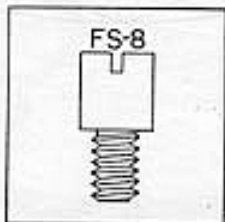
The functions of castle wheel pawl are:

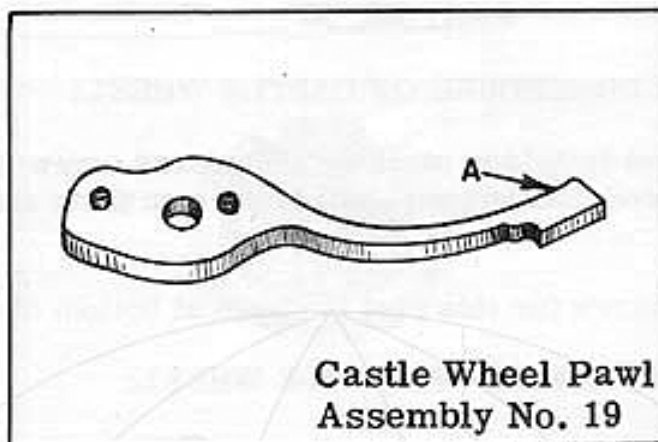
1. This pawl correctly spaces the turning of the castle wheel. This assures the castle will turn a full tooth, each time the castle wheel is set in action.
2. It holds the castle wheel in its correct position, until it is moved manually.

REFERENCE: Castle wheel is Assembly 20.
Ratchet teeth on castle wheel is Assembly 20-B.

REMARKS:

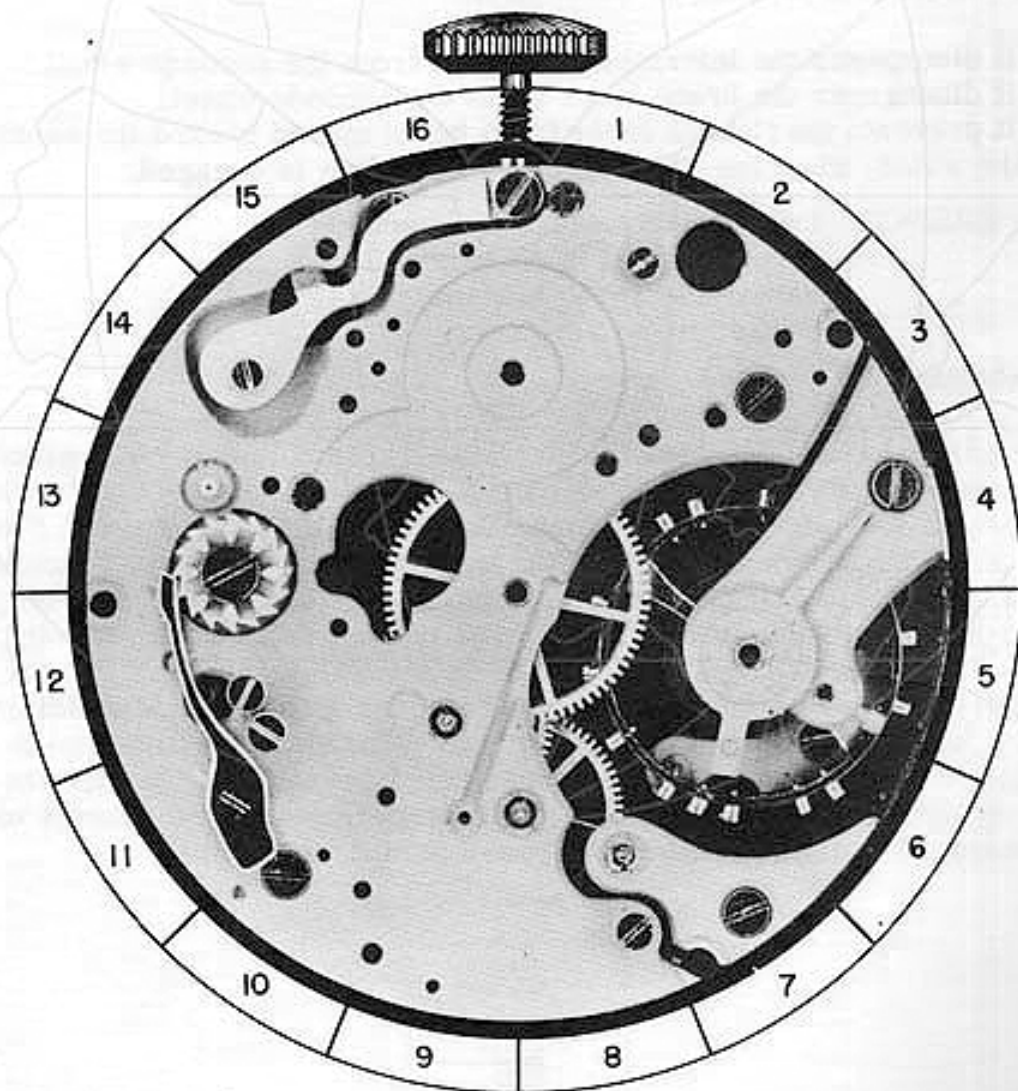
The end "A" of the castle wheel pawl should be highly polished. Any roughness or pits of rust at this location may cause the pawl not to function properly. If it is necessary to polish this part, care should be taken not to change the shape of end "A" of the pawl. It must be of the correct shape to properly space the turning of the castle wheel.





OILING

The castle wheel pawl should not be oiled.



19-A

A. DISASSEMBLY PROCEDURE OF CASTLE WHEEL:

The castle wheel is held in place by shouldered screw SS-5. After this screw is removed, castle wheel will be free on plate and can be lifted out of place.

(The shape of screw for this part is shown at bottom of page.)

B. ASSEMBLY PROCEDURE OF CASTLE WHEEL:

Place the castle wheel in its proper position, on the plate, as shown in the photograph. Replace shouldered screw SS-5 that holds this wheel in place. Check to see that wheel turns freely under the head of this screw. Of course, this wheel should not have excess freedom, as such a condition could cause improper functioning of the chronograph.

C. FUNCTION OF CASTLE WHEEL:

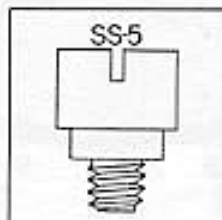
The functions of the castle wheel are:

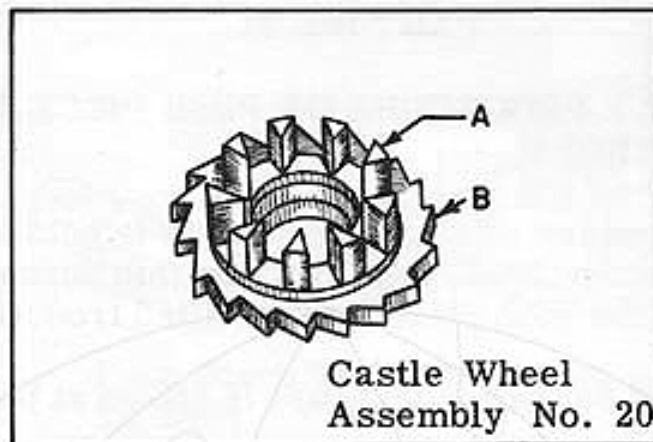
1. It disengages the intermediary wheel from the seconds wheel.
2. It disengages the brake lever from the seconds wheel.
3. It prevents the flyback lever from being moved toward the center of the watch, when the chronograph mechanism is engaged.

REFERENCE: Intermediary wheel is Assembly 5.
Seconds wheel is Assembly 15.
Flyback lever is Assembly 9.
Brake lever is Assembly 12.

REMARKS:

The castle wheel performs its functions by the columns "A", which are evenly spaced around the center of the wheel. As the castle wheel is turned, the columns either force the part to move out from the center of the castle wheel or permit it to move in to the empty space between two columns. For example, the intermediary wheel is disengaged from the seconds wheel by a column of the castle wheel, forcing the end of chronograph pivoted detent from between two columns, until the point of this lever rests on the column. To engage the intermediary wheel with the seconds wheel, the castle wheel is turned one space. This permits the end of the chronograph pivoted detent to enter the empty space between two columns, which permits the two wheels to be engaged by the chronograph pivoted detent.

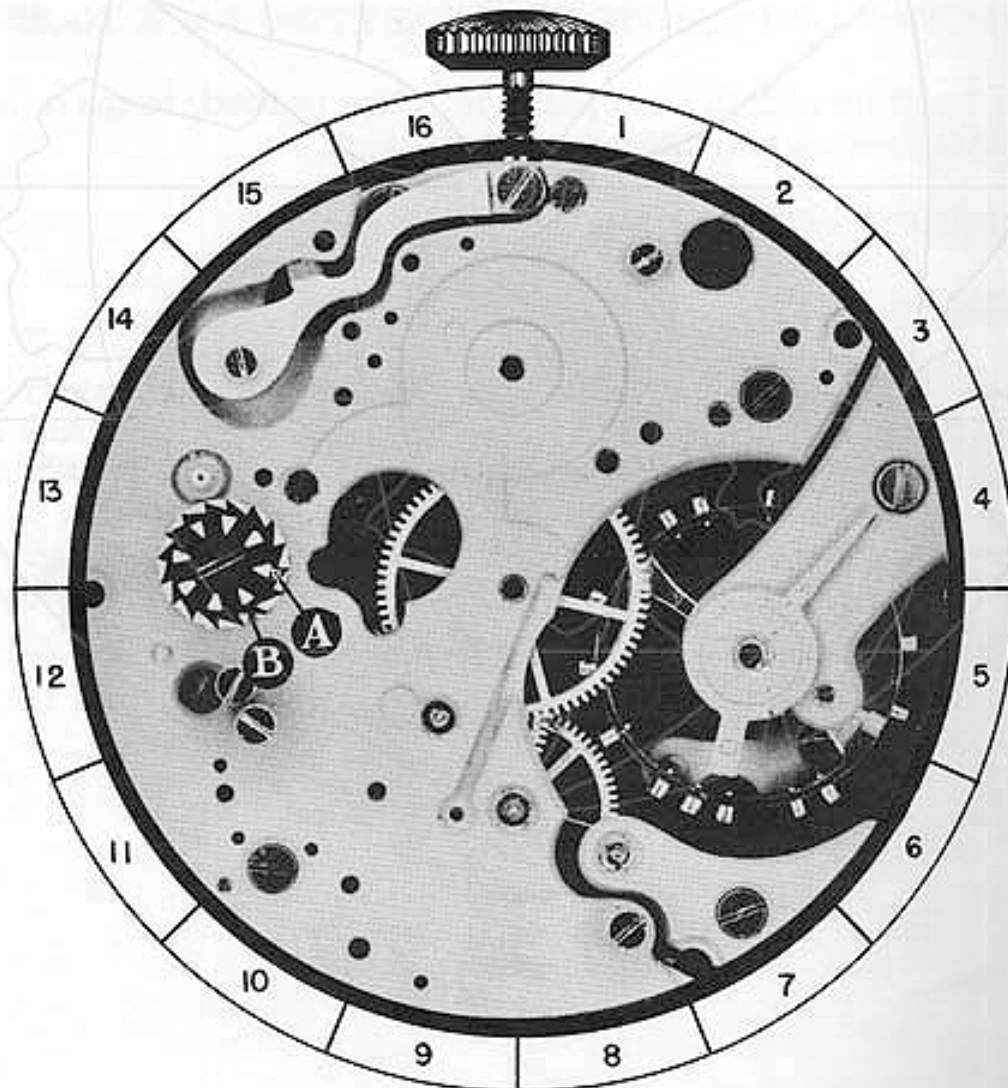




OILING

These points on the castle wheel should be slightly moistened with oil:

1. The shoulder of screw on which the castle wheel pivots.
2. The columns 'A' at point of contact with parts of this mechanism.
3. The ratchet teeth 'B' on the castle wheel.



20-A

PART NO. 21

A. DISASSEMBLY PROCEDURE OF PUSH PIECE FOR SETTING BACK TO ZERO:

The push piece for setting back to zero is held in place by shouldered screw SS-6, and pivots on this screw. When screw is removed, the push piece may be lifted from movement.

(The shape of screw for this part is shown at bottom of page.)

B. ASSEMBLY PROCEDURE OF PUSH PIECE FOR SETTING BACK TO ZERO:

Place push piece in position on plate, as shown in the photograph, and replace shouldered screw SS-6. Check to see that push piece turns freely under head of this screw.

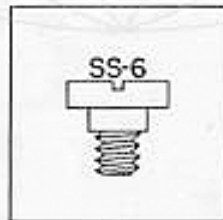
C. FUNCTION OF PUSH PIECE FOR SETTING BACK TO ZERO:

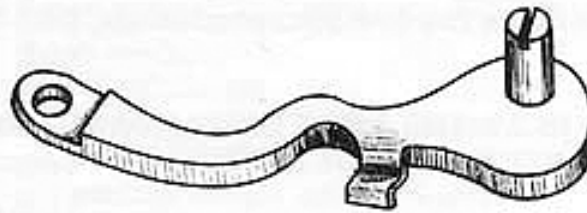
The function of this push piece is, when pushed, to move the flyback lever toward the center of watch.

REFERENCE: Flyback lever is Assembly 9.

REMARKS:

Each part, that should move under the head of a shouldered screw, should be checked for the required freedom. Any excess freedom is not desired. In the case where a part has too much vertical movement or endshake under the head of a shouldered screw, the shoulder on the screw is too long. To correct this, cut back the shoulder on the screw, reducing the length of it.

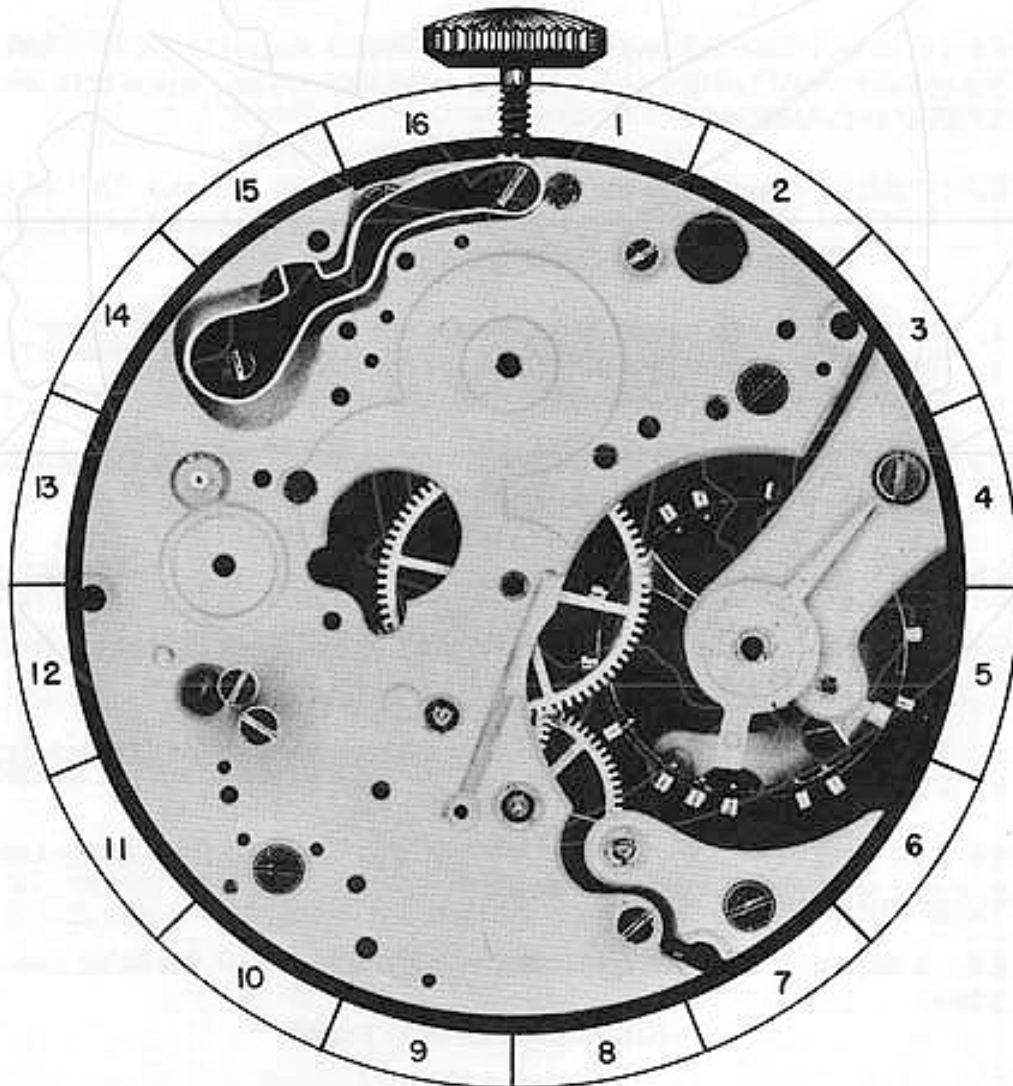




Push Piece For Setting Back
To Zero Assembly No. 21

OILING

The post that push piece for setting back to zero pivots on should be slightly moistened with oil.



21-A

FUNCTIONAL RESULTS

After completely assembling chronograph with the exception of back of case, place chronograph in front of you, pendant up, with back of chronograph facing you.

1. PUSH THE BUTTON AT THE LEFT OF PENDANT, HOLD IN THIS POSITION, AND CHECK THE FOLLOWING:

(Make sure that the castle wheel is in the proper position so button can be pushed.)

- A. Check to see that seconds wheel and minute register wheel return the hands connected to these wheels to a zero position.

CORRECTION: The following errors could prevent these hands from returning to a zero position:

- a. Hands being loose and not set correctly.
- b. The minute register wheel or the seconds wheel binding and not turning freely.

- B. Check to see that the end "A" of the minute register pawl is centered between two teeth on the minute register wheel, when this wheel is at a zero position.

CORRECTION: The following errors may prevent the end "A" of the minute register pawl from being centered between two teeth on the minute register wheel:

- a. Minute register wheel binding and not turning freely.
- b. Intermittent wheel binding and not turning freely.
- c. The pawl not holding sufficient tension on the minute register wheel.

2. RELEASE THE BUTTON AND CHECK THE FOLLOWING:

- A. Check to see that flyback lever returns to its original position.

CORRECTION: The following errors may prevent the flyback lever from returning to the original position:

- a. Flyback lever spring not holding enough tension on flyback lever.
- b. Flyback lever not turning freely on post in plate.

3. PUSH THE BUTTON AT THE RIGHT OF THE PENDANT, RELEASE IT, AND CHECK THE FOLLOWING:

- A. Check depth of teeth on intermediary wheel with teeth on seconds wheel.

(Continued on next page)

FUNCTIONAL RESULTS
(Continued)

CORRECTION: The following errors may prevent correct depthing of these teeth:

- a. Chronograph pivoted detent spring not holding enough tension on chronograph pivoted detent.
- b. Chronograph pivoted detent not turning freely.
- c. Improper adjustment of eccentric stud, ES-2.
(See adjustment of eccentric studs.)

B. Check depthing of seconds wheel dart tooth with intermittent wheel teeth.

CORRECTION: The following errors may prevent proper depthing of the dart tooth with intermittent wheel teeth:

- a. Intermittent lever not turning freely on post in plate.
- b. Improper adjustment of eccentric stud, ES-3.
(See adjustment of eccentric studs.)

REMARKS: If the depthing of the intermittent wheel teeth with the seconds wheel dart tooth is deep, the minute register wheel may move two teeth each time the seconds wheel makes one revolution.

If the depthing is shallow, the minute register wheel may not turn far enough, to register a minute on the dial.

C. Check to see that the minute register hand moves forward in a steady manner, with no irregular jumping or jerking.

CORRECTION: This irregular movement of the seconds hand is usually caused by the seconds wheel tension spring not holding enough tension on seconds wheel.

4. PUSH THE BUTTON AT THE RIGHT OF PENDANT A SECOND TIME, RELEASE IT, AND CHECK THE FOLLOWING:

A. Check to see that brake lever is in contact with seconds wheel.

CORRECTION: The following errors may prevent the brake lever from contacting the seconds wheel:

- a. Brake lever not turning freely under head of screw.
- b. Brake lever spring not holding enough tension on brake lever.

DIRECTIONS FOR READING CHRONOGRAPH DIAL

THE TACHOMETER

- A** The tachometer is used to indicate the speed of an object in miles per hour. A tachometer can only indicate the average speed of an object traveling over a course of a measured mile.

METHOD OF USING TACHOMETER

1. Start the chronograph sweep second hand at the exact moment the object starts to travel the measured distance of one mile.
2. When the object has traveled the course of one mile, stop the chronograph at the point on the tachometer scale where the sweep second hand stopped. It will indicate the average speed in miles per hour.

SPLIT SECOND SCALE

- B** This scale is divided into 300 divisions. Each indicating $1/5$ of a second every fifth division is marked with extra long lines denoting one second.

The main purpose of this scale is to measure a fraction of a second accurately.

SECOND HAND

- C** The second hand indicates the passing of seconds and should move one space each second. One complete revolution of hand denotes passage of one minute. This hand is independent of chronograph mechanism and continues to register the seconds as long as watch is running.

TELEMETER

- D** The telemeter is used to denote the number of miles between two points. This is done by comparing the speed of light to the speed of sound.

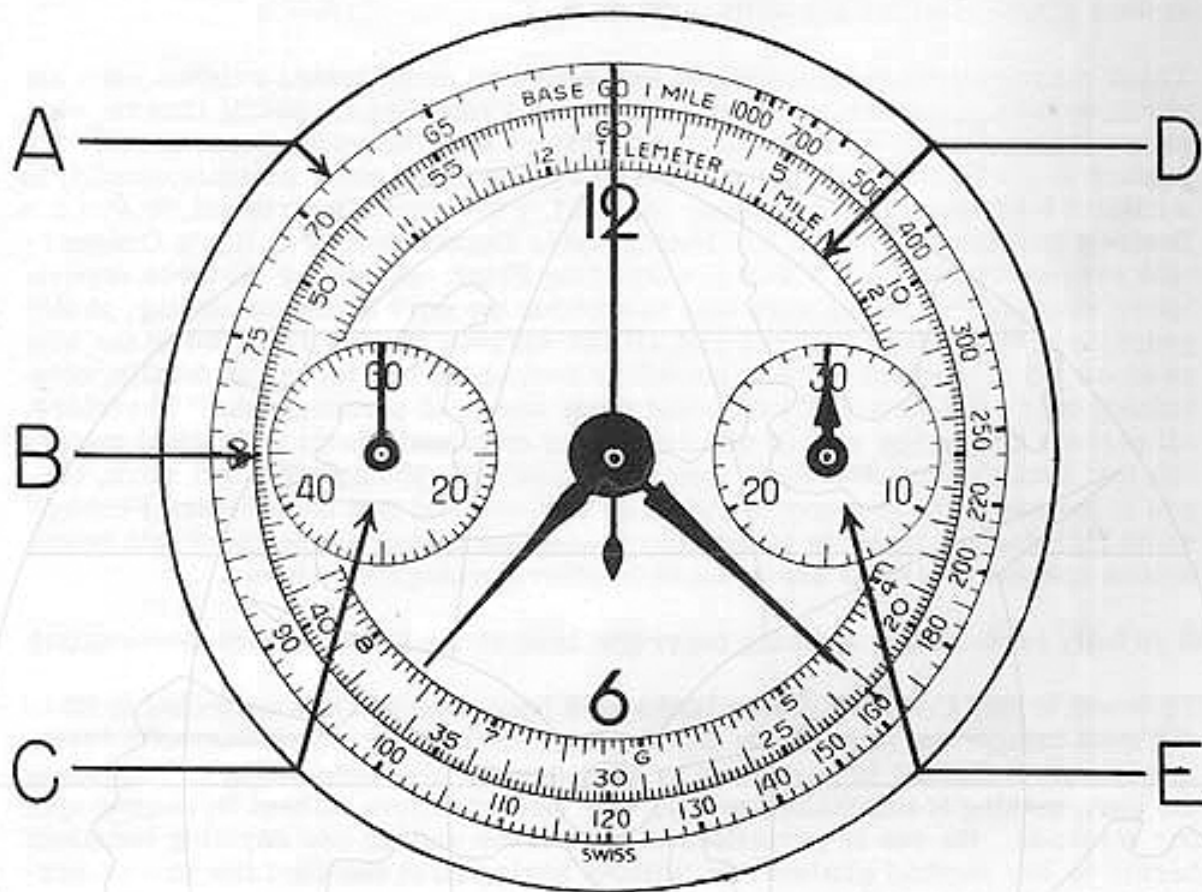
METHOD OF USING TELEMETER

1. Start chronograph sweep second hand when you see lightning.
2. Stop the chronograph sweep second hand when you hear the thunder. The point on the telemeter scale where the sweep second hand stopped will indicate the distance in miles the lightning is away from you.

MINUTE REGISTER

- E** The minute register hand indicates the passing of minutes. This hand should move forward one space each minute. One complete revolution of minute register hand indicates passage of 30 minutes. Two revolutions one hour.

THE CHRONOGRAPH DIAL



SETTING THE HANDS CORRECTLY ON A CHRONOGRAPH:

After the chronograph is completely assembled and in working condition, place chronograph in its case. Now replace the hands, replace the hour hand, minute hand and second hand as you would on a regular watch. At this point, do not replace the sweep second or the minute register hand. Now push the button and bring the flyback lever in toward the center of the watch. When the flyback lever is held in toward the center of the watch, place the sweep second hand at 60 on split second scale 'B'. Place the minute register hand at 30 on minute register scale 'E'. After these hands are replaced, start chronograph mechanism with sweep second hand turning. Leave chronograph mechanism run for at least one minute, now push the button to bring the flyback lever in toward the center of the watch again, and check to see that the minute register hand and the sweep second hand goes back to their original position.