MASTER WATCHMAKING

# FITTING HAIRSPRINGS IN WATCHES
## LESSON 32 – PART I
### Sections 550 - 560

CHICAGO SCHOOL OF WATCHMAKING
Founded 1908 by Thomas B. Sweazey

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## SEC. 550 -- Oscillations and Vibrations

The number of oscillations or vibrations a balance makes in one day, one hour or one minute is controlled by the hairspring and the balance.

The greatest percentage of watches have balances which vibrate 18,000 times per hour or 300 times per minute, or five times per second. This amounts to 432,000 vibrations in 24 hours.

In order to impress upon the student the importance of accurate vibrating, let us say that instead of the balance vibrating exactly 300 times per minute, it vibrates 298 times in one minute. Now instead of vibrating 432,000 times in 24 hours, it would vibrate only 429,120 times. This is a difference of 2880 vibrations in 24 hours. As each vibration is equivalent to 1/5 of a second, this would amount to 9 minutes, 36 seconds per day.

Not all watches vibrate 18,000 times per hour. In some of the very old watches, the number of vibrations might be 14,400, 16,600, or 19,900; today we have watches that vibrate 21,600, 22,900, 19,500, etc. The following explanation will enable you to calculate the number of vibrations any balance will make in 24 hours, one hour, or one minute.

## SEC. 551 -- Calculating the Train of a Watch

Before vibrating a hairspring to a watch, it is necessary to calculate the number of vibrations the balance will make in one hour. We know the center wheel makes one revolution in one hour; therefore, we will use this as the starting point. Figure 32-1 illustrates the equation.

This method is also used to calculate the train of a clock.

The following example illustrates how the equation appears when we have an extra wheel and pinion and an escape wheel with 12 teeth:

$$\frac{42 \times 42 \times 35 \times 35 \times 12 \times 2}{7 \times 7 \times 7 \times 7} \text{ equals } 21{,}600 \text{ (vibrations per hour)}$$

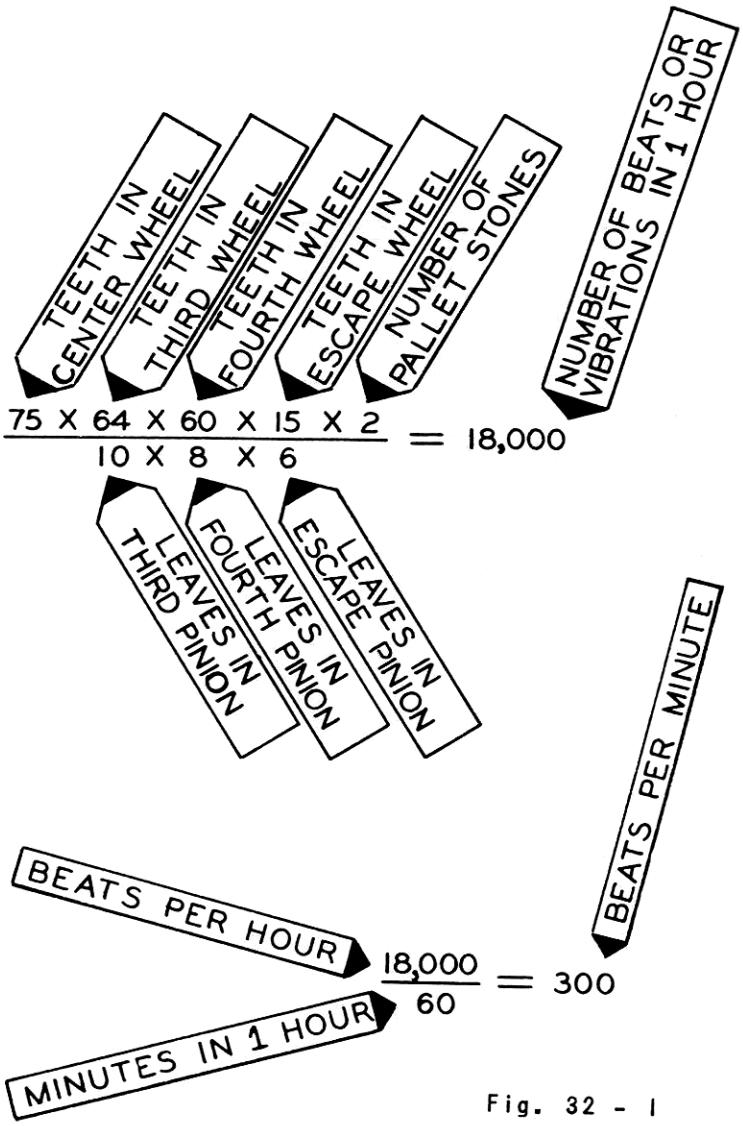



Fig. 32 - 1

## SEC. 552 -- Hairspring Vibrating Tools

A watchmaker should be able to calculate the train of a watch, select, collet, and replace a flat or breguet type hairspring for any watch. Many repairmen send the balance wheel, stud,

collet, and balance cock to a hairspring specialist, who, in turn, selects and vibrates a hairspring for the balance. At times this is recommended as it is impractical for the average repairman to carry a large selection of odd size hairsprings in stock. However, it remains for the watchmaker to fit and adjust the hairspring to the watch.

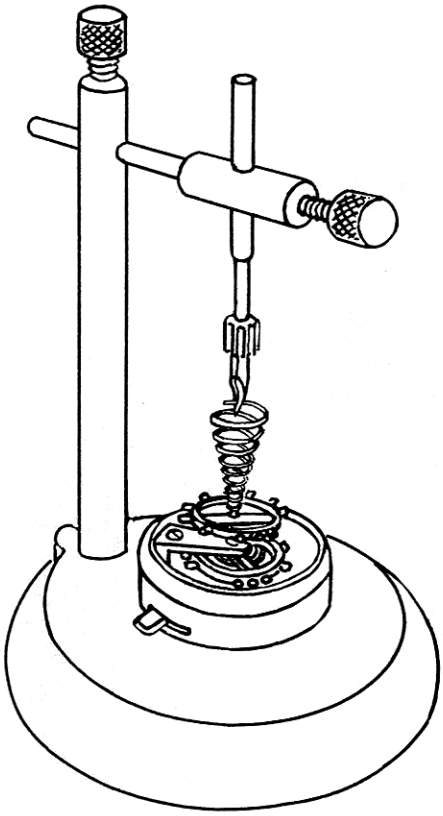
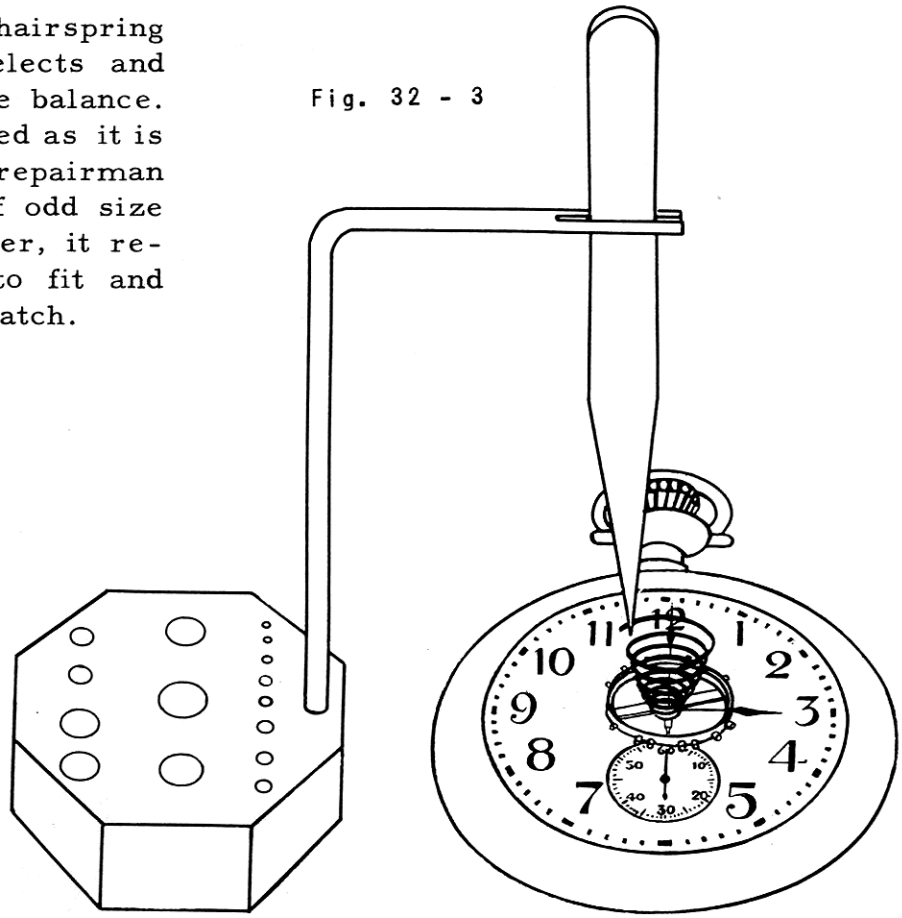


Fig. 32 - 2

Figure 32-2 illustrates a form of balance spring vibrating tool which uses a master balance vibrating 18,000 times per hour. This device would not work for balances which vibrate more or less than 18,000 times per hour.

For all practical purposes, a piece of 4 mm brass rod bent in the form shown in figure 32-3 will suffice. A slot has been cut in the upper section which will hold a fine pointed hairspring tweezer as illustrated. For a stand, the rod may be placed in a hole

Fig. 32 - 3




in a bench block. When vibrating a hairspring, the rod holding the tweezer which is holding the hairspring to be vibrated, should be adjusted so that the lower pivot just rests on the glass of the watch. The watch should be an accurate timekeeper and have a large second hand.

## SEC. 553 -- Counting the Vibrations

Figure 32-4 illustrates a balance wheel.

A. The balance arm at rest.

B. The balance arm at the 1st vibration.

C. The balance arm at the 2nd vibration.

Start the balance vibrating with a camel hair brush. The vibrations in the average watch are 300 per minute. However, the student will find it impractical to count this rapidly. For example: The

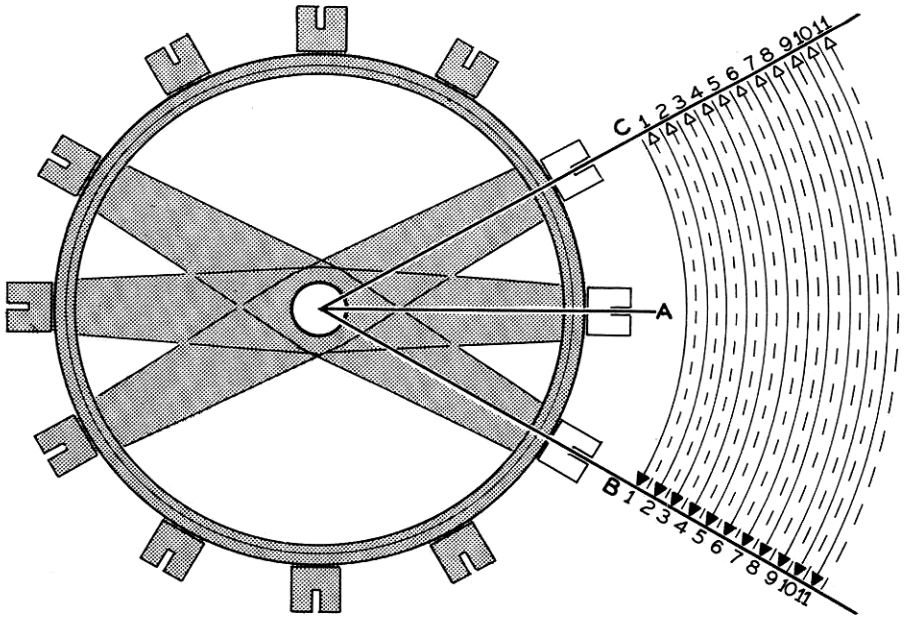
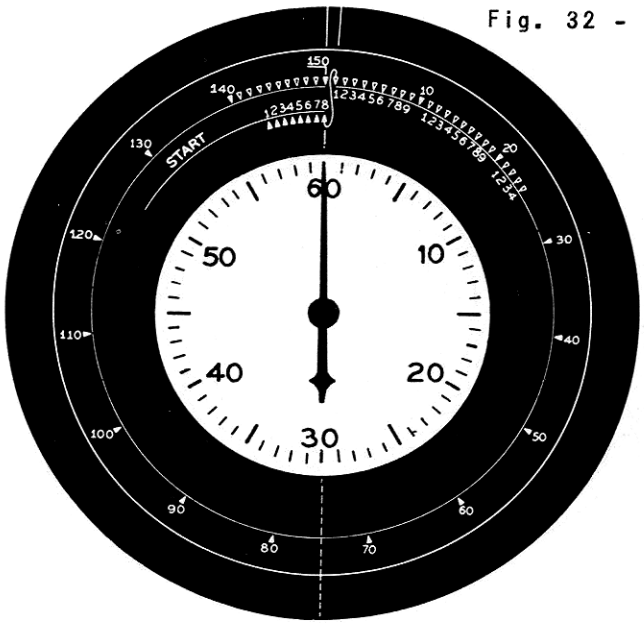



Fig. 32 - 4

balance is vibrating from C to B and B to C. However, if you will count only the times the arm stops at line B or C and multiply by 2, you will have the actual number of vibrations the balance makes. Now by timing these vibrations with an accurate indicator (the second hand of a master timepiece) you can tell exactly how many vibrations the balance makes in one minute.

The white center in figure 32-5 illustrates a second bit as seen on an average railroad grade of watch. Now placing the balance with hairspring in the vibrating stand with the pivot resting lightly on the glass of the master watch, start the balance oscillating with a dial brush or pegwood and practice counting the vibrations. Count as follows: 1 - 2 - 3 - 4 - 5 - 6 - 7 - 8 - 9 - 10 - 1 - 2 - 3 - 4 - 5 - 6 - 7 - 8 - 9 - 20 etc. The important part of counting is to start and end correctly. Refer to figure 32-5 and start counting as the balance vibrates: 1 - 2 - 3 - 4 etc. and on any count that reaches 60 simultaneously with the second hand of the master watch, the first count after that will be number 1, and the final count of 150 ends

Fig. 32 - 5




exactly at 60. This is illustrated in the black section surrounding the second bit in figure 32-5.

If the hairspring vibrates less than the desired count, loosen tweezers in stand and slide the points of the tweezers along the coil toward the collet. This will increase the number of vibrations. Moving the points of the tweezers along the coil of the hairspring away from the collet will decrease the number of vi-

brations. When the exact point of vibrations has been located, break off the hairspring exactly one coil larger. This will enable you to locate the point of vibration readily until secured to the stud.

## SEC. 554 -- Fitting a Flat Hairspring to a Watch

1. Calculate number of vibrations balance should make in one minute (Sec. 551).

2. Select hairspring and place in position over inverted balance cock as in figure 32-6, with the theoretical center of the hairspring over the center of the balance hole jewel.

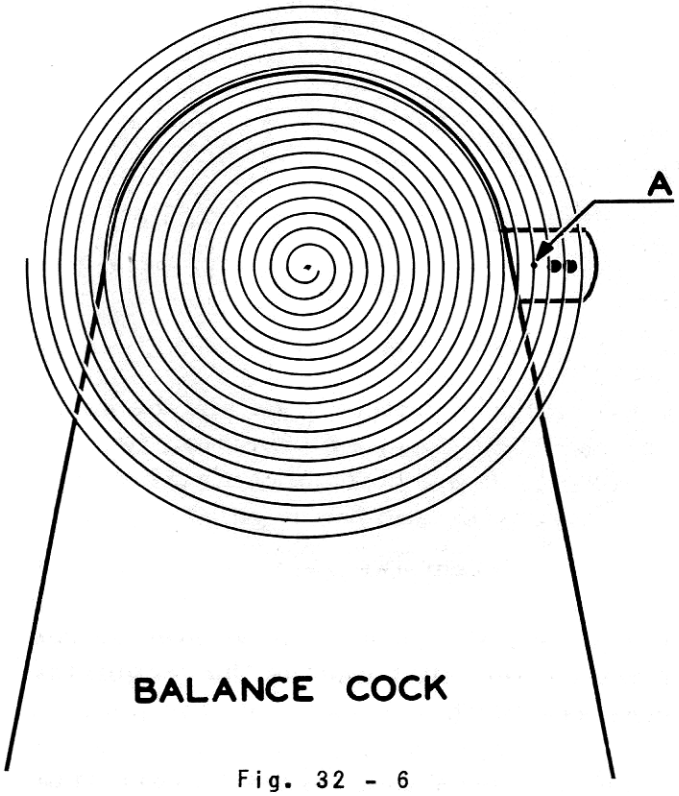



Fig. 32 - 6

3. The desired point of vibration should be approximately one coil inside of Regulator Pins - A, figure 32-6, and the hairspring from this point to the collet should have approximately 11 or 12 coils.

4. Place hairspring on balance and push collet on staff which will hold hairspring in place securely enough for a vibration test. A small amount of beeswax can be used if desired.

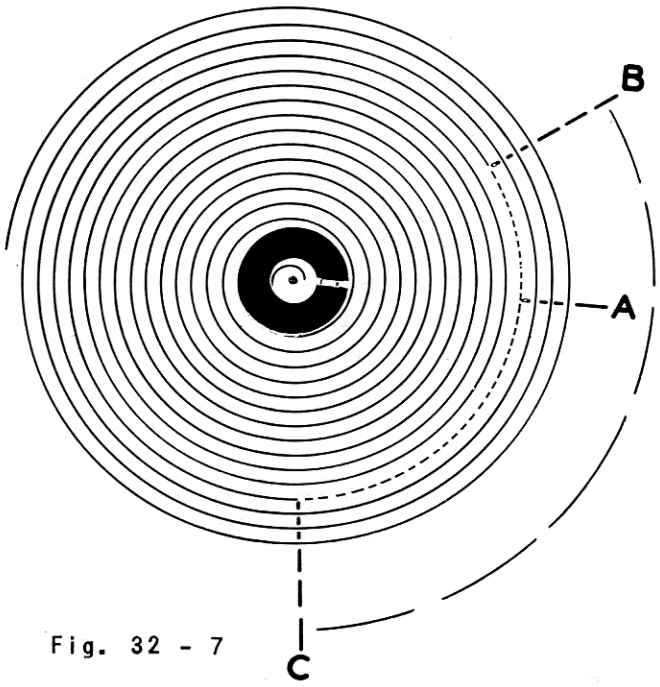



Fig. 32 - 7

5. Grasp hairspring somewhere along a section of coil B-C, figure 32-7, which corresponds to either side of desired vibration point A in figure 32-6 and 32-7, and place in vibrating stand.

6. Count number of vibrations. In this manner it is easy to ascertain whether or not a weaker or stronger hairspring is required.

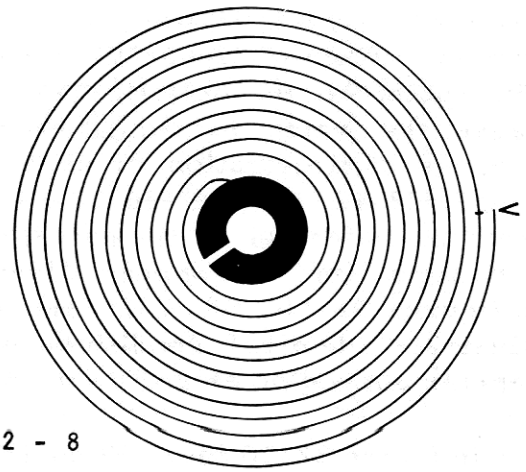


Fig. 32 - 8

7. When hairspring of the approximate correct diameter and strength is selected, collet the hairspring and true in the round and flat (Lesson #18.)

8. Vibrate to the number of vibrations calculated in Step 1 and break off hairspring exactly one coil larger, figure 32-8.

## SEC. 555 -- Outer Terminal Pinning Point

The exact location of the point of vibration is extremely important when pinning the outer terminal coil of the

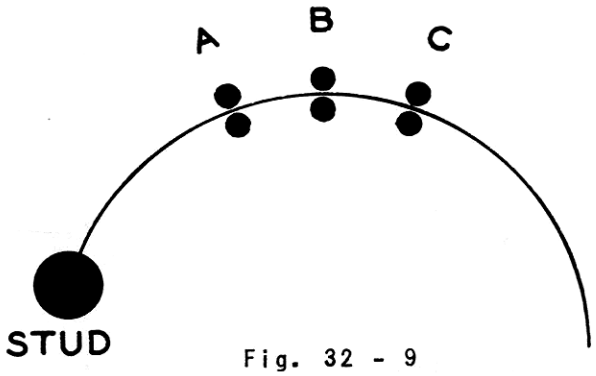



Fig. 32 - 9

hairspring to the stud. Figure 32-9 illustrates the outer coil of a hairspring pinned to a hairspring stud. The regulator pins at B represent their position with the regulator in the center of the index (not shown). Moving the regulator pins from B to A would lengthen the hairspring by moving the point of vibration away from the inner terminal pinning point (at the collet). This would cause the watch to run slower. For purpose of illustration, figures 32-10, 32-11, 32-12, 32-13, and 32-14 illustrate the outer coil of the hairspring as a straight line. The upper illustration in figures 32-10 and 32-11 are used to illustrate identical conditions when a regular shaped outer coil is used.

In figure 32-10 there is no freedom

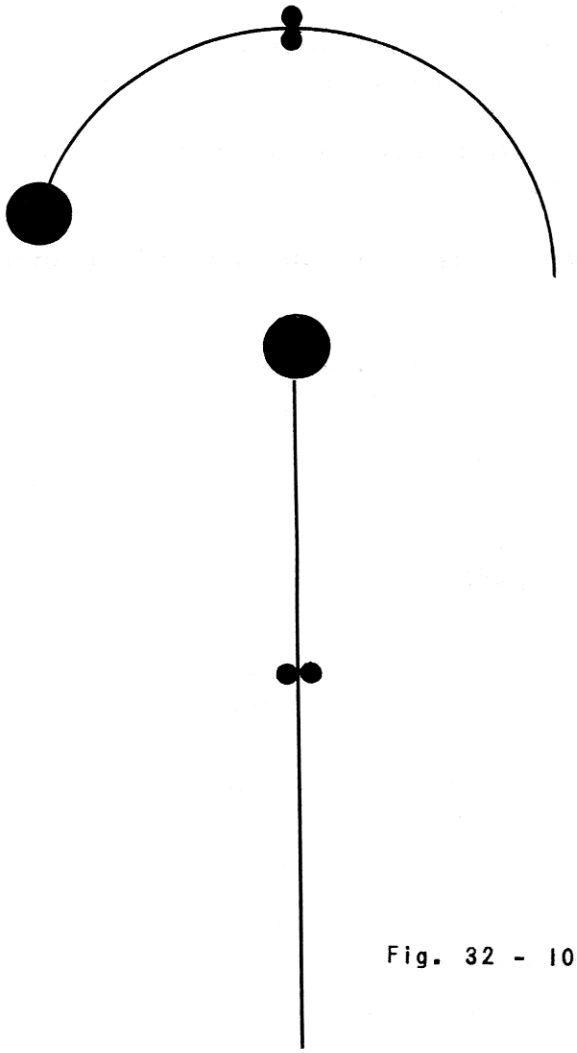


Fig. 32 - 10

between the regulator pins and the hairspring. The point of vibration is theoretically at the point of contact between the hairspring and the regulator pins.

The instant the regulator pins are separated more than the width of the hairspring the point of vibration moves towards the stud and as the regulator pins are further separated, the point of vibration approaches the stud until the regulator pins are further apart than the maximum arc of the hairspring, at which point the stud is the point of vibration. This is illustrated by figure 32-11. Using figure 32-11 as the starting point, the point of vibrations move closer to the regulator pins as the distance between the regulator pins is

decreased until the minimum amount of clearance between the regulator pins and hairspring has been reached.

In figure 32-12 the regulator pins have been closed until the hairspring comes in contact with each regulator pin at the maximum arc of the balance wheel.

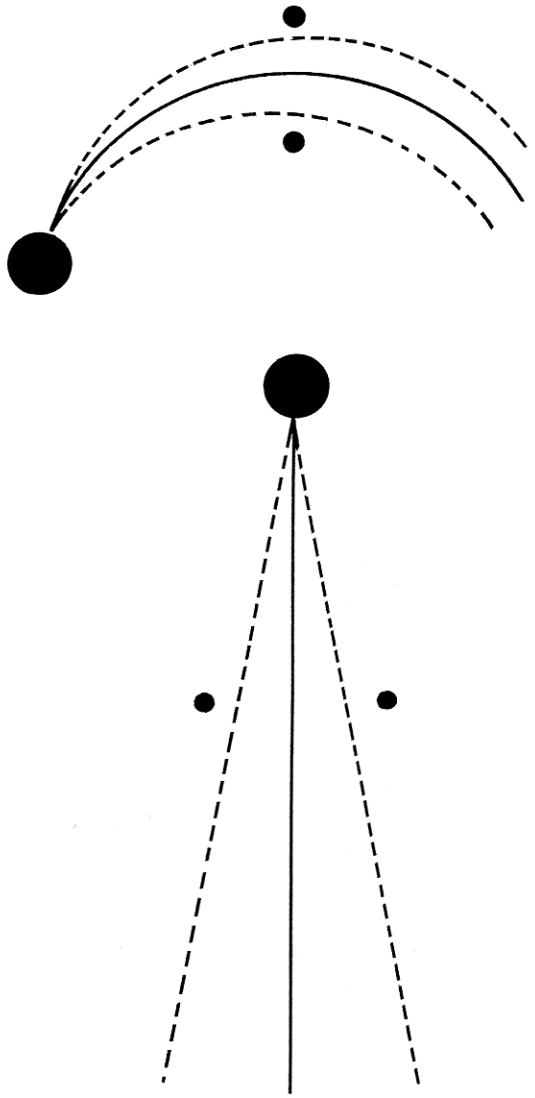


Fig. 32 - 11

When the hairspring is in contact with regulator pin A, the length of the hairspring will be from A to the inner terminal pinning point (the collet). The instant the balance starts on its return excursion the hairspring will move away from A toward B. When the hairspring comes in contact with regulator pin B, the length of the hairspring will be the same as from A. However, during the excursion of the balance from the time the hairspring leaves A until it reaches B, the length of the hairspring will be from pinning point C (the stud) to the inner pinning point of the hairspring (the collet). Therefore, when the regulator pins are separated excessively, the point of vibration will be closer to the stud as illustrated by arrow D figure 32-12.

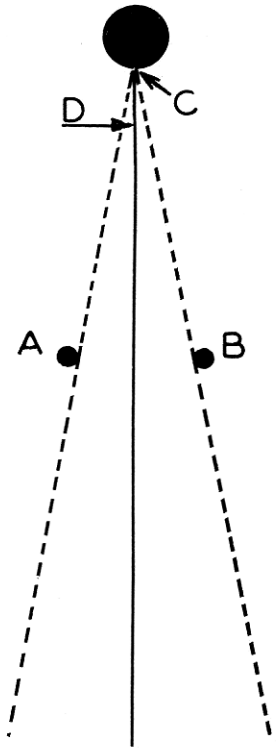



Fig. 32 - 12

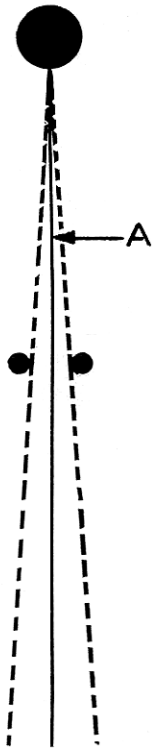



Fig. 32 - 13

Closing the regulator pins as in figure 32-13 will move the point of vibration closer to the regulator pins as illustrated by Arrow A, figure 32-13.

Illustration 32-13 is an excellent one to illustrate why it is possible for a watch to gain when fully wound and lose when it is run down or say after 20 hours of running. When the watch is fully wound and the balance is taking a full motion (long arc) the hairspring is

contacting first one regulator pin and then the other, and the point of vibration is considered at the regulator pins when contact is made. When the hairspring is away from either of the regulator pins the point of vibration is from the stud. Consequently, the average point of vibration when the watch is fully wound is, we will assume, at Arrow A, figure 32-13.

Let us now assume that the watch gains when fully wound. After the watch has run a sufficient length of time the hairspring does not come in contact with either of the regulator pins (short arc). Then the point of vibration is from the stud at all times and the watch loses. Therefore, the point of vibration varies according to the distance between the regulator pins. It is obvious that the closer the regulator pins are together the less error in time between the long and short arcs.

Figure 32-14 illustrates the regulator pins adjusted to a width of approximately 3 times the thickness of the hairspring and the point of vibration is approximately at Arrow A.

The distance between the regulator pins varies according to the grade of watch. In the better grades twice the thickness of the hairspring is recommended. Therefore, each watch is a problem in itself and the watchmaker can only estimate just where to place the point of vibration when pinning the outer coil of the hairspring to the stud.

## SEC. 556 -- Pinning and Centering Hairspring

1. Screw stud in cock and slide the outer coil of hairspring through stud, figure 32-15.

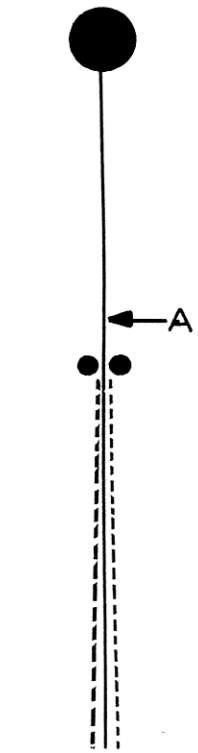



Fig. 32 - 14

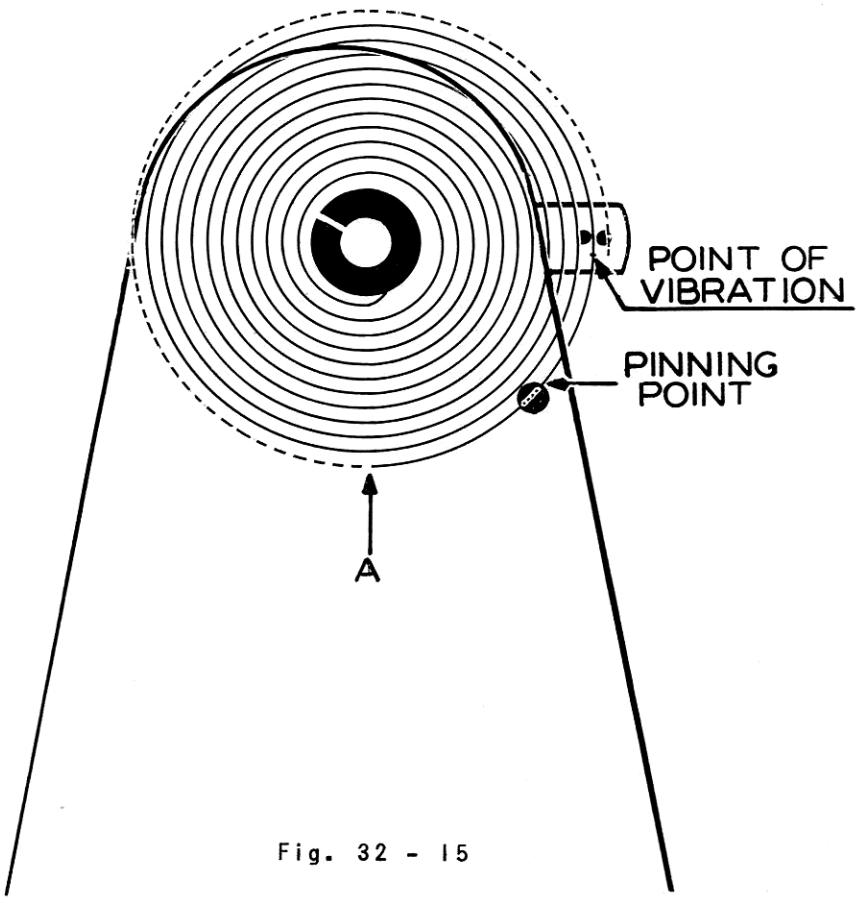



Fig. 32 - 15

2. Figure 32-15 shows approximately the outer terminal pinning point with the regulator pins apart slightly as in the average watch using a flat hairspring. The pinning point is at the stud and the point of vibration back of the regulator pins. The center of the hairspring collet will not be over the center of the balance jewel.

After pinning the hairspring to the stud, break off at A, figure 32-15. This excess section of the hairspring can be used in case of further adjustment when regulating. When the watch is regulated, this excess portion should be broken off at the stud.

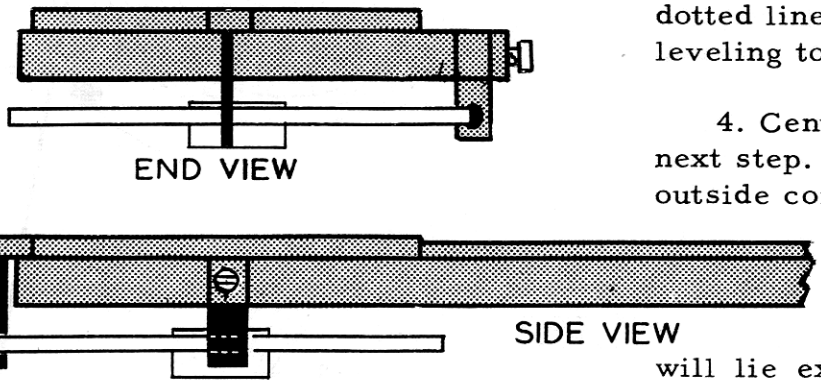



Fig. 32 - 16

3. Level the hairspring to the bridge, figure 32-16. Any bending necessary to level the hairspring to the bridge should be made as close as possible to the stud. Figure 32-17 illustrates a flat hairspring with the stud in place. The outside coil does not lie in the same plane as the body of the hairspring; consequently, it is impossible to level the hairspring to the bridge until the outside coil has been bent downward and again lies in the same plane as the body of the hairspring, figure 32-16. Figure 32-18 illustrates the bent hairspring removed from the balance cock. Grasp the outer coil at A with two pairs of fine pointed hairspring tweezers and

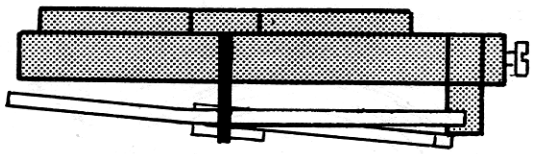


Fig. 32 - 17

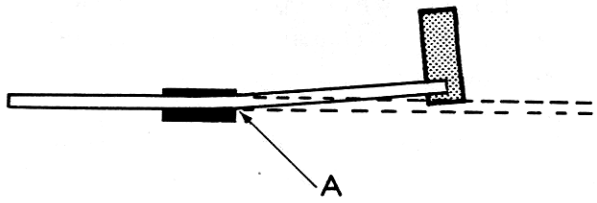



Fig. 32 - 18

bend the coil downward until it lies in the same plane as the body of the hairspring which is illustrated by the two dotted lines. This must be done before leveling to the bridge.

4. Centering the hairspring is the next step. This is done by circling the outside coil of the hairspring so that it will lie exactly between the regulator pins when the center of the collet is directly over the hole in the balance jewel. Lay the hairspring over the inverted balance cock with the center of the collet directly over the pivot hole of the balance jewel. The outside coil will fall similar to the dotted coil of the hairspring in figure 32-19.

It is necessary to ascertain the approximate distance the outside coil will have to be bent away from the body of the hairspring in order to lie between the regulator pins. This is called circling.

5. Place the hairspring on a ground glass plate and grasp the outside coil at about C, figure 32-19, with a pair of fine pointed hairspring tweezers.

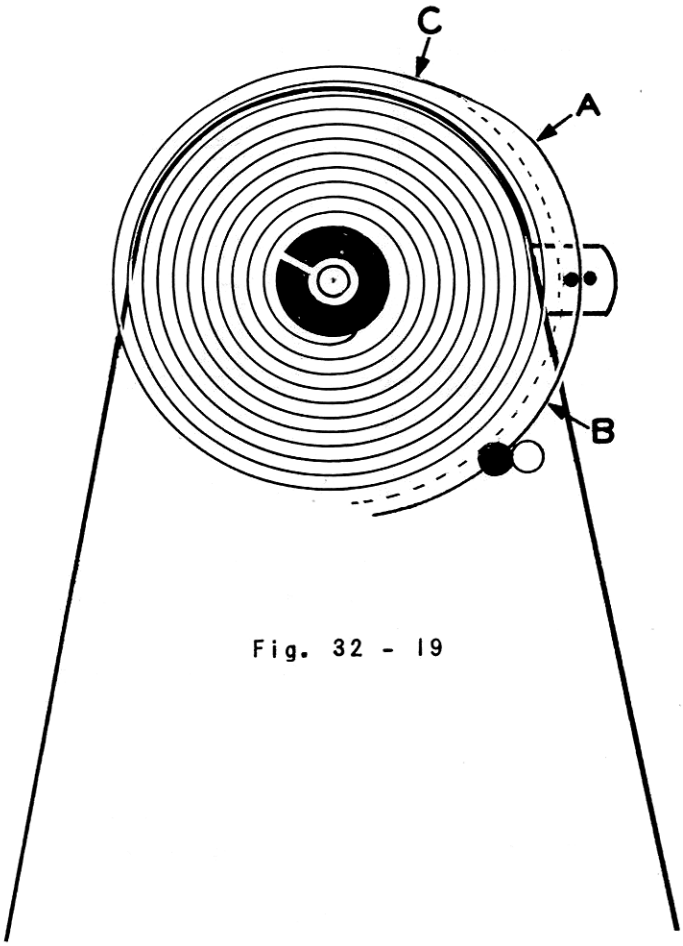



Fig. 32 - 19

6. With a taper pin, open the outside coil slightly. Then place the tweezers at A and bend the outside coil at A so that the section from A to B falls between the regulator pins and the center of the collet is directly over the pivot hole in the balance jewel. Any further adjustments of the outside coil are made only at A and C. When making these adjustments, be certain to place the tweezer in exactly the same spot as when making the first bend.

7. When this has been accomplished, place the stud in position and tighten stud screw. The outside coil may or may not fall between the regulator pins. However, knowing that the outside coil is circled properly, it is only necessary to make a bend close to the stud to bring the coil between the regulator pins. Next check the center of the collet to see if it is directly over the hole in the balance jewel. If necessary, make another bend near the stud in order that the collet will be directly over the center of the balance jewel when the stud is in place and the outside coil lies between the regulator pins. This is illustrated by dotted lines in figure 32-20. When this has been done, check for level, figure 32-16.

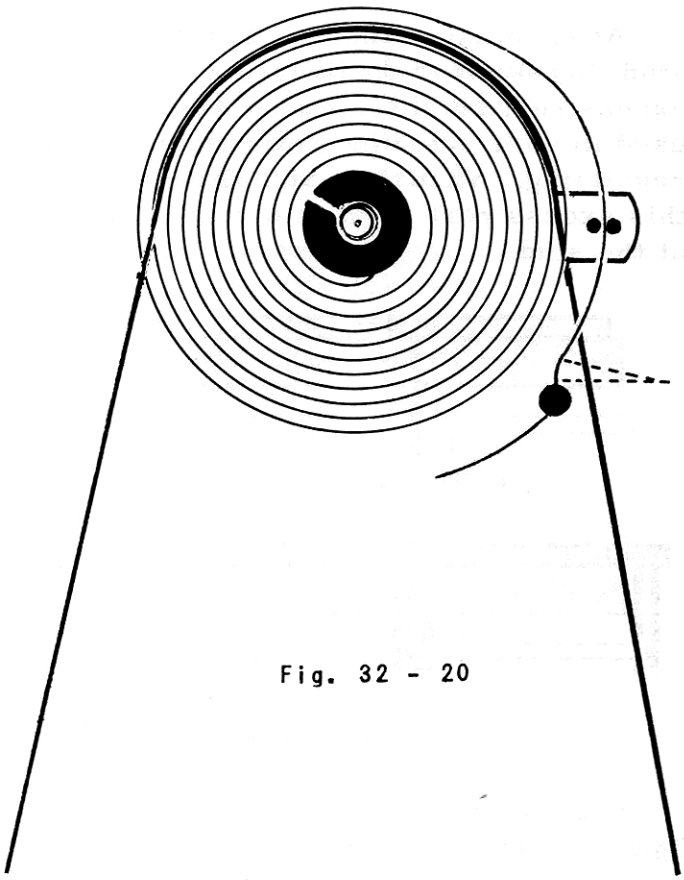


Fig. 32 - 20

## SEC. 557 -- Replacing Hairspring

"Putting a watch in beat" seems to hold a horror for many. Actually it means to replace the hairspring so that the roller jewel is in line with the escapement. Many Swiss watches make a small indentation on the balance rim to help you line up the stud. However, any changes that other watchmakers have made when replacing a balance staff are apt to change the location of the hairspring stud. The following method will assure you of placing the stud in the

approximate location. This method is used for either flat or breguet hairsprings.

Place the balance cock in position and screw in place.

Place a pair of tweezers on the underside of the roller table with the roller jewel exactly in the center of the jaws of the tweezers, figure 32-21. Hold the balance directly over the balance cock with the lower pivot centered directly over the upper cap jewel. Turn the balance so that an imaginary line A running through the center of the roller jewel and midway between the jaws of the tweezer will run directly over the center of the upper pivot hole in the pallet bridge, figure 32-21.

The dotted line B, figure 32-21, runs from the center of the balance through the center of the stud receptacle in the balance cock, in this case approximately in the center of the two balance screws C & D. Keeping this location in mind, replace the hairspring using a staking tool and with the stud in position. After the hairspring is in place, repeat the operation and move the hairspring to the left or right, whichever the case may be, until with the balance held in position with tweezers as in figure 32-21, the stud is directly over the hole or receptacle in the balance cock. The balance will be very close in beat. To put it in absolute beat, refer to Section 455 of Lesson #26.

Do this with every watch. Practice until you become proficient.

## SEC. 558 -- Other Adjustments

Figure 32-22 illustrates a cut away view of a flat hairspring in which the outer coils are higher than the inner coils. The hairspring has been leveled to the bridge and this saucer shape appears after the hairspring has been replaced in the watch.

Fig. 32 - 22

In most cases, lowering the stud will lower the outside coils to the correct level.

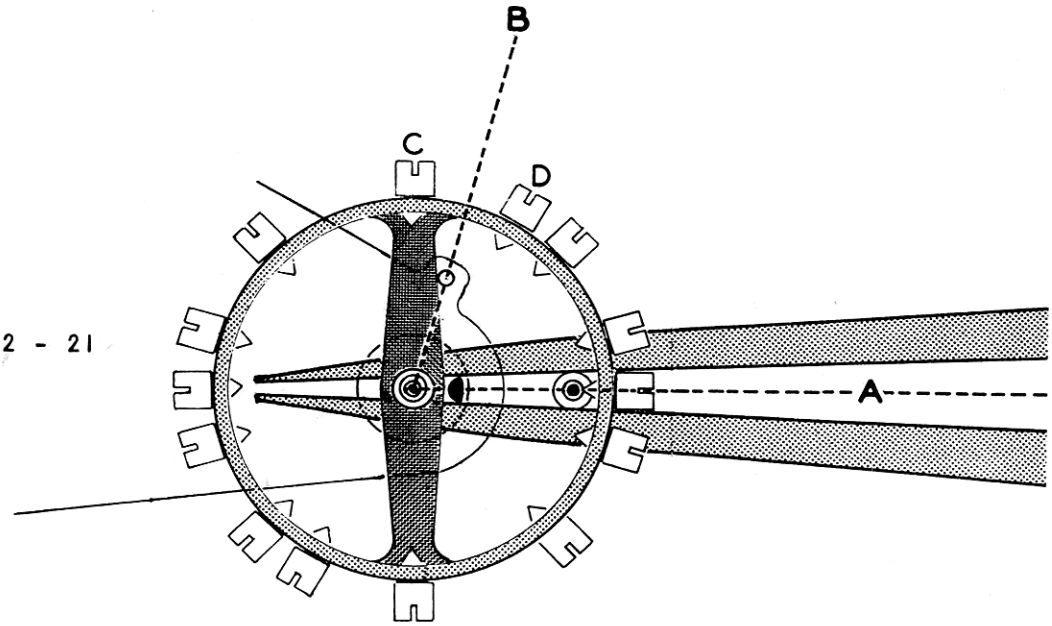



Fig. 32 - 21

If the collet shoulder is too low and the stud cannot be lowered because the outside coil would drop out of the regulator pins, the balance staff is probably incorrect.

Figure 32-23 illustrates a flat hairspring which is somewhat umbrella shaped. In most cases, raising the stud would overcome this fault. If raising the stud and outside coil does not correct the error, you may find the collet is similar to the one in figure 32-24. Notice that the hole in the collet is above the center of the collet, which holds the center coils up too high. It is then necessary to recollet the hairspring, reversing the collet in order that the center coils will be lowered.

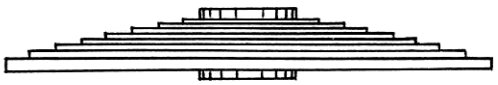


Fig. 32 - 23

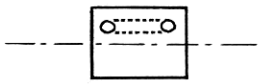


Fig. 32 - 24

Always replace the hairspring with a staking tool. Use a flat face hollow punch as in figure 32-25. This figure illustrates a single roller set in the die plate of the staking block. Figure 32-26 illustrates a double roller in position over the die plate when replacing a hairspring.

## SEC. 559 -- Fitting a Breguet Hairspring to a Watch

The Breguet Hairspring should have from 13 to 16 coils exclusive of the outside coil which will be used as the overcoil.

1. Calculate train and determine number of vibrations per minute (Sec. 551).

Fig. 32 - 25

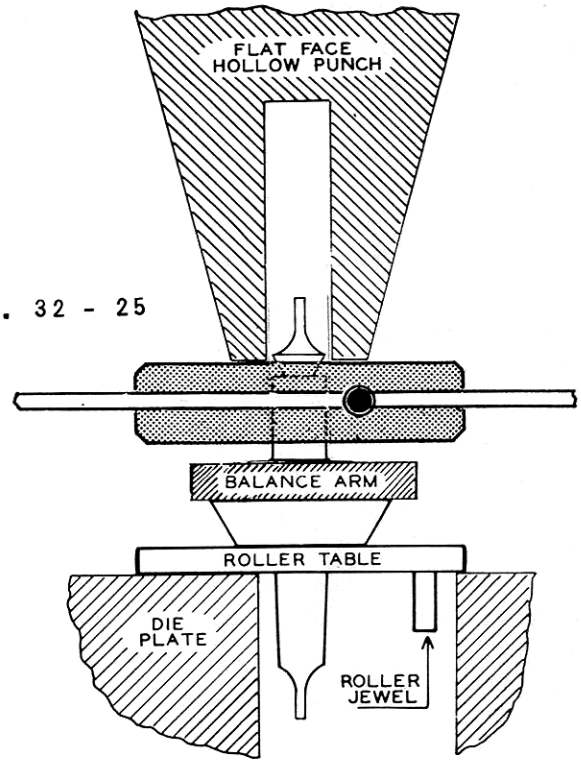
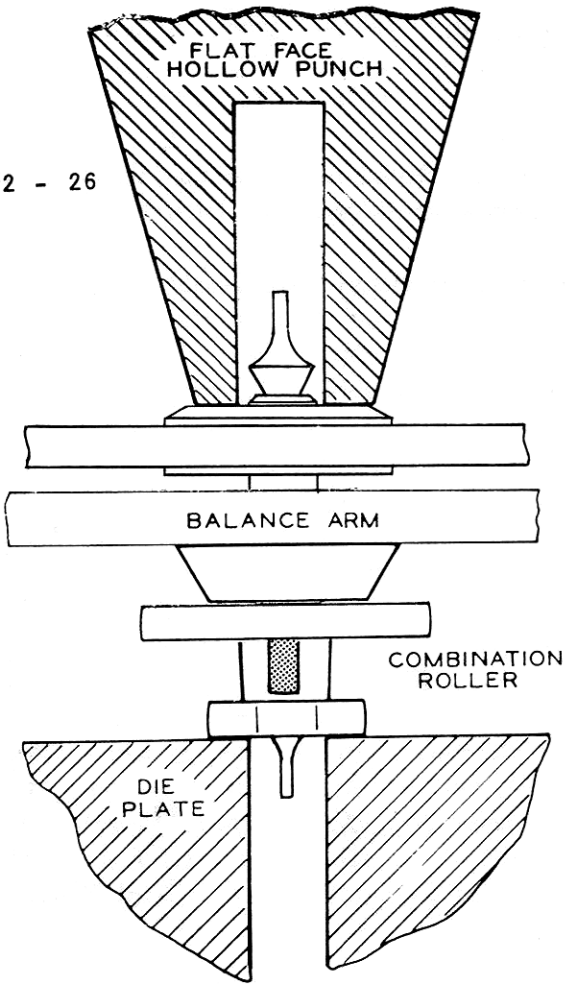



Fig. 32 - 26



2. Select, test and vibrate a hairspring until one of suitable strength and diameter is obtained.

3. Collet, true in flat and round.

4. Vibrate accurately and break off one coil too large, figure 32-27.

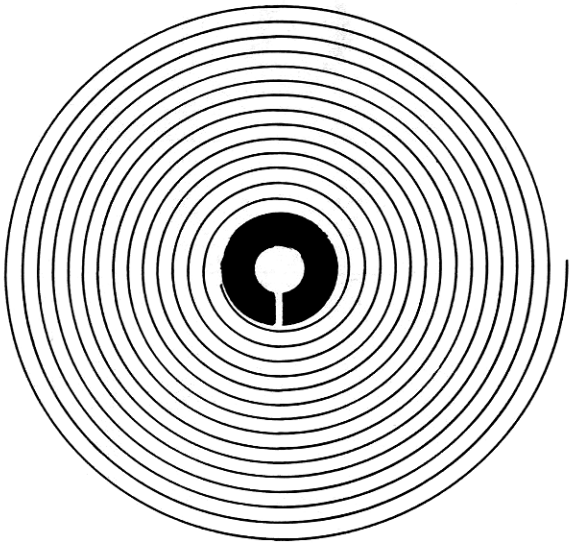
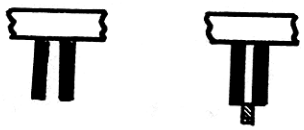


Fig. 32 - 27

5. Adjust regulator pins allowing approximately 1/100 mm for clearance.

Adjusting regulator pins for a Breguet type hairspring can be done accurately if the watchmaker will obtain a set of gauges of varying thicknesses. These can be made from pieces of mainspring of thickness .05 mm, .06 mm, .07 mm, .08 mm, etc. To use, measure the tip of the outside coil of the hairspring with a micrometer. Select a gauge which is 1/100 of a millimeter larger than the thickness of the hairspring. Close regulator pins until the outside coil of the hairspring or a gauge of the same thickness of the hairspring will not enter, figure 32-28. This is called "No. Go". Open regulator pins carefully until gauge will enter but have no side play. This is called "Go", figure 32-29.



OPEN NO GO

Fig. 32 - 28

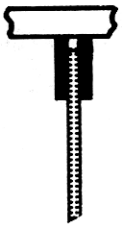


Fig. 32 - 29

GO

Make certain that the regulator pins are parallel.

This adjustment is extremely important for position adjusting.

6. Pull outside coil of hairspring through stud until the point of vibration is just back of regulator pins A, figure 32-30. This point should be very close to the regulator pins as the regulator pins are closer together (Sec. 555).

7. Pin hairspring to stud and break off excess spring. It is advisable to leave a small amount as in figure 32-30 until certain the watch will time properly.

8. Place hairspring over bridge as in figure 32-31 with the center of the collet directly over the center of the balance jewel. Note which coil or space between coils lies directly over the space between the regulator pins. In this figure, this is between the 3rd and 4th coil exclusive of the outside coil.

9. Form overcoil to follow coil or

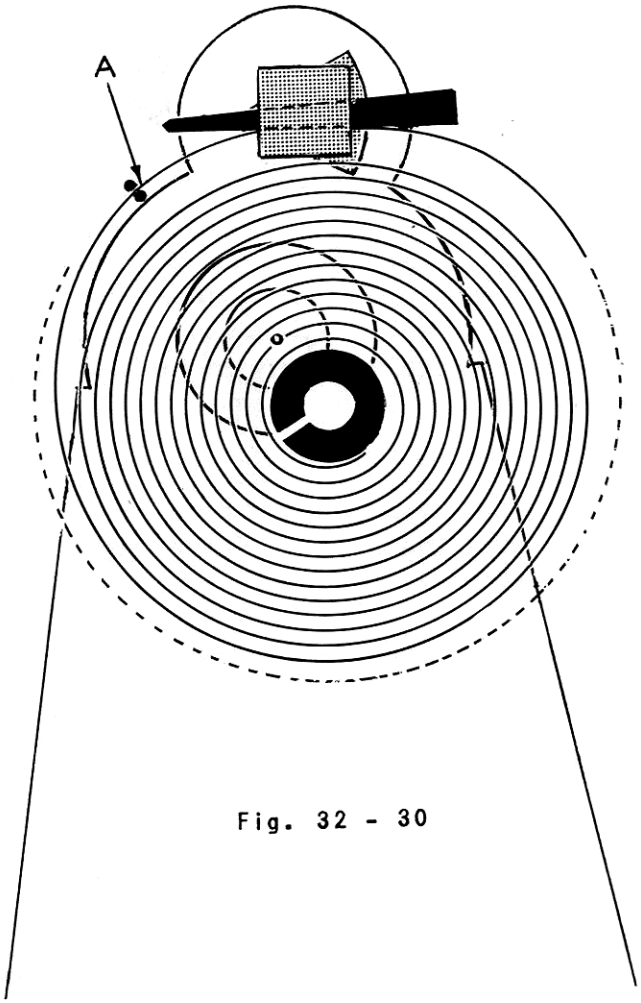



Fig. 32 - 30

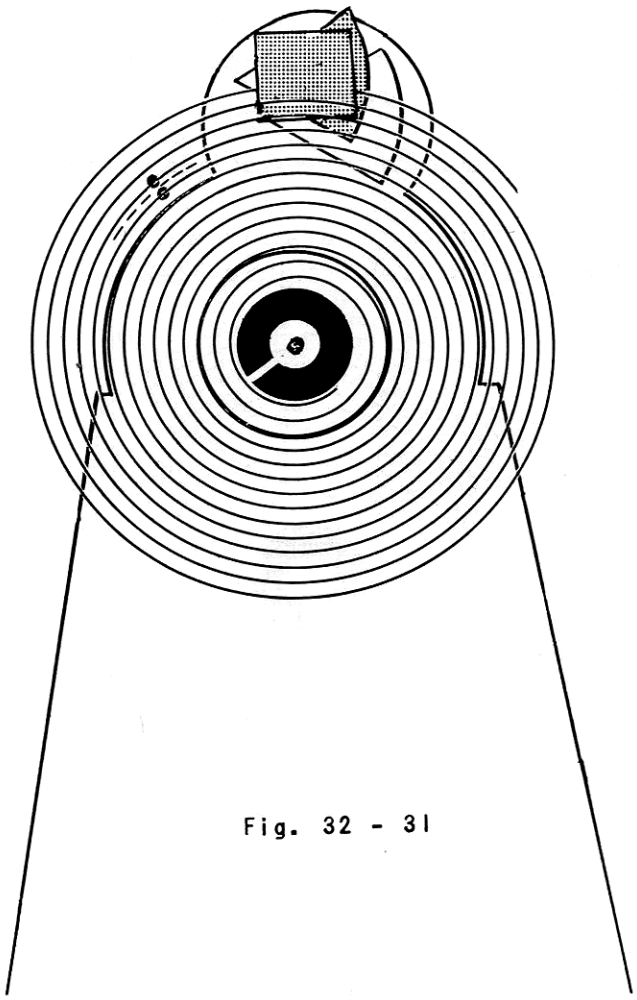


Fig. 32 - 31

space between coils, in this case between 3rd and 4th coil.

10. The height of the overcoil can usually be determined by the eye using the old hairspring as a guide, usually about 2-1/2 times the width of a coil, figure 20-10, Lesson #20.

11. Form overcoil, Lesson #20.

12. Lay hairspring over bridge with overcoil between the regulator pins and the stud in line with the hole receptacle in cock.

13. If the overcoil is correct, the collet will lie directly over the center of balance jewel. The fact that the stud does or does not lie directly over the hole in the balance cock is not important at this time.

14. Next place the stud in receptacle in balance cock and tighten stud screw. The overcoil may or may not fall between the regulator pins. However, knowing that the overcoil is circled properly, it is only necessary to make a bend close to the stud to bring the coil between the regulator pins, figure 32-32.

15. Check the center of the collet to see if it is directly over the hole in the balance jewel. If necessary, make another bend near the stud in order that the center of the collet will be directly over the center of the balance jewel when the stud is in place and the over-

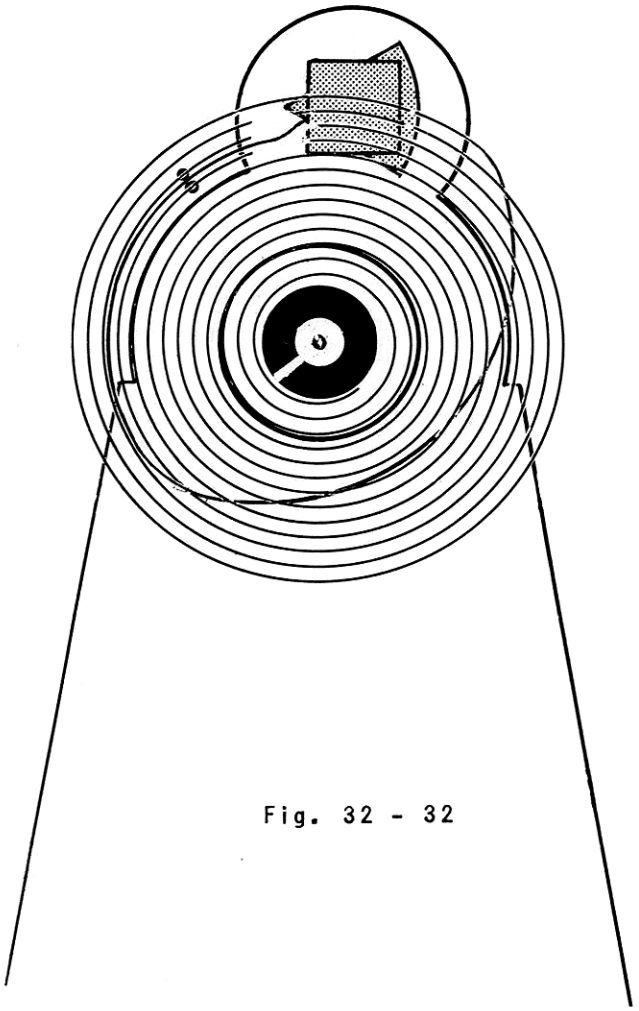


Fig. 32 - 32

coil lies between the regulator pins. See figure 32-32.

## SEC. 560 -- Levelling the Overcoil Hairspring

Level the hairspring to the balance cock, figure 32-33. If the body of the hairspring is not level with the balance cock, remove hairspring and level the overcoil to the body of the hairspring. When level, check to see that it is centered.

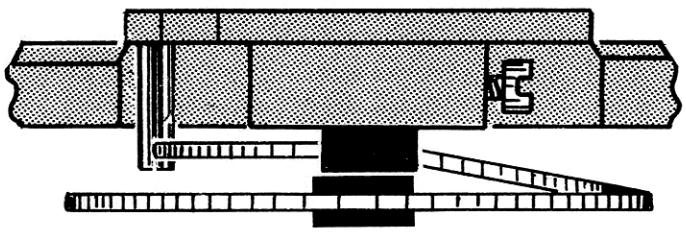
The hairspring must be leveled and centered to the bridge before replacing on balance.

Locate position of the stud as in Section 557.

Use staking tool to replace hairspring. Check beat as in Section 455, Lesson #26.

If the body of the hairspring is saucer shaped, lowering the stud may correct it provided the overcoil remains between the regulator pins. Otherwise the overcoil may have to be raised slightly.

If the body of the hairspring is umbrella shaped, raising the stud may correct it. Otherwise, the overcoil may have to be lowered slightly. Check hairspring collet making certain it is down to the base of the collet shoulder.



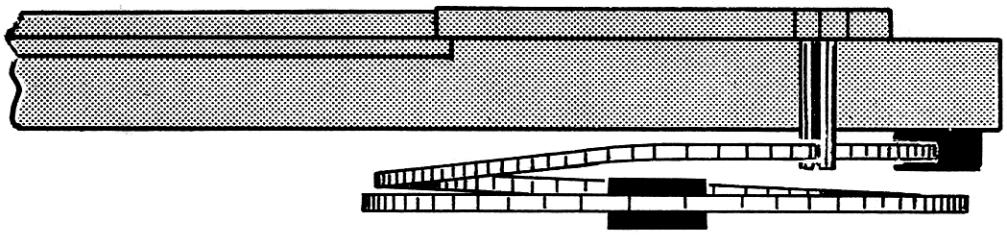


Fig. 32 - 33

TABLE OF CONTENTS: Unit VI - Lesson 32 Part 1

JOB SHEETS

| UNIT | W VI |
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| LESSON | 32 1 |

Master Watchmaking

CHICAGO SCHOOL OF WATCHMAKING

**JOB SHEET**

W32-1-J1

FITTING HAIRSPRING TO WATCH: Flat

| PROCEDURE | REFERENCE Lesson 32-1 |
|---|---|
| HOW TO FIT A FLAT HAIRSPRING TO A WATCH | |
| 1. True balance wheel in flat and round. | Lesson 16 |
| 2. Poise balance wheel. | Lesson 17 |
| 3. Calculate train to determine number of vibrations. | Sec. 551 |
| 4. Select hairspring. | Sec. 554 |
| 5. Recollet using the collet that was in the watch. (see suppliment to section 386) | Les. 19 |
| 6. True hairspring in round and flat. | Les. 18 & 19 |
| 7. Vibrate hairspring. | Sec. 552-553-554 |
| 8. Check regulator pins and make any required adjustment. | Sec. 555 & Les. 11 |
| 9. Move regulator to center of scale. | Sec. 555 |
| 10. Stud hairspring. | Sec. 555 & 556 |
| 11. Level hairspring to balance bridge. | Sec. 556 |
| 12. Circle outside terminal coil between regulator pins. | Fig. 32-19 |
| 13. Center hairspring collet to the balance hole jewel in bridge. | Sec. 556 |
| 14. Replace hairspring on balance wheel. | Sec. 557 |
| 15. Put in beat. | Sec. 557 & Les. 26 |
| 16. Adjust and regulate watch to keep time. | Les. 11 |

| UNIT | W VI |
|---|---|
| LESSON | 32 1 |

Master Watchmaking

CHICAGO SCHOOL OF WATCHMAKING

**JOB SHEET**

W32-1-J2

FITTING HAIRSPRING TO WATCH: Breguet or Overcoil

| PROCEDURE | REFERENCE Lesson 32-1 |
|---|---|
| HOW TO FIT A BREGUET OR OVERCOILED HAIRSPRING TO A WATCH | |
| 1. True balance wheel in flat and round. | Lesson 16 |
| 2. Poise balance wheel. | Lesson 17 |
| 3. Calculate train to determine number of vibrations. | Sec. 551 |
| 4. Select hairspring. | Sec. 559 |
| 5. Recollet using the collet that was in the watch. (see suppliment to section 386) | Les. 19 |
| 6. True hairspring in round and flat. | Les. 18 & 19 |
| 7. Vibrate hairspring. | Sec. 552-553-559 |
| 8. Check regulator pins and make any required adjustment. | Sec. 559 |
| 9. Move regulator to center of scale. | Sec. 555 |
| 10. Stud hairspring. | Sec. 559 |
| 11. Form Overcoil. Les. 20 & Suppliment to sec. 392 in assignment sheet | Les. 20 |
| 12. Level hairspring to balance bridge. | Sec. 560 |
| 13. Circle overcoil between regulator pins. | Sec. 559 Par. 15 |
| 14. Replace hairspring on balance wheel. | Sec. 557 |
| 15. Put in beat. | Sec. 557 & Les. 26 |
| 16. Adjust and regulate watch to keep time. | Les. 11 |

INSPECTION SHEET:

Watches coming into a repair shop may require a minor adjustment to the hairspring.You have learned how to true, collet, form overcoils and fit hairsprings to watches. The main use you'll have for this knowledge is to be able to know how to make the necessary corrections after the error has been detected.

The following points should be checked, as they all affect the operation of the hairspring.

| | Reference |
|---|---|
| a. Magnatism | Les. 11 |
| b. Oil on spring | Les. 10 |
| c. Position of regulator - fast, slow, centered, etc. | Les. 11 & 32-1 |
| d. Regulator pins - straight, properly spaced, etc. | Les. 11 & 32-1 |
| e. Overcoil or outer coil formed to oscillate between pins | Les. 32-1 |
| f. Level to bridge | Les. 32-1 |
| g. Centered to bridge | Les. 32-1 |
| h. True in round | Les. 18 & 19 |
| i. True in flat | Les. 18 & 19 |
| j. Overcoil to high or low | Les. 20 & 32-1 |
| k. Overcoil hitting either bridge or wheel. | Les. 32-1 |
| l. Circling between regulator pins | Les. 32-1 |
| m. Rust | |
| n. Coils tangled or overlapped | |

If the watch is running, it is possible to examine spring on all these points and determine any error. Errors will appear differently in a watch than out of the watch due to the fact that spring is anchored both at collet and stud. The following analysis will be of help in your examination.

a. A spring may appear to be distorted and tangled. Checking with a demagnetized compass may indicate magnetism. The hairspring may be demagnetized while in the watch. If removed from the watch, it should either be wrapped in watch paper or enclosed in a capsule before being put in the demagnetizer.

b. A spot of oil, dirt, etc. may cause the coils to stick together.Cleaning will eliminate.

c. Checking position of regulator may give you an indication of whether the watch has been running slow or fast. For example; if the regulator is toward the fast side, it would indicate the watch has a tendency to run slow and has been adjusted by moving the regulator. It is desirable that regulator be centered. Examination of the regulator pins may indicate correction is necessary.

d. Regulator pins should be straight, parallel and properly spaced. If the regulator has been moved to the fast side, it is possible that space between regulator pins should be reduced.

e. Overcoil or outer coil should be adjusted so it is evenly spaced between regulator pins. As the balance wheel oscillates, the spring should first come to rest against one pin and then the other, resting against each an equal time. Correction may be to either adjust the hairspring for proper spacing or move the regulator pin.

(Inspection sheet continued)

f. Spring may be examined for level to bridge by observing if body of spring is level with the wheel. If one edge of the spring is tilted down it may rest against arm of wheel and prevent normal motion of the balance. The edge may be tilted up and be resting against the bridge or other part of the watch. This will affect the balance by causing it to oscillate more rapidly. Solution is to level spring to bridge.

g. Look down upon the flat of the hairspring to determine if spring is centered to the bridge. If not centered, the spacing between coils will be wider on one side. Correction is made with the hairspring off the wheel and on balance bridge as in Section 556.

h. An error in round or centering of the collet appears differently in a watch than out of the watch. When collet is not centered in the body of the spring, the coils will surge rapidly away from and back toward collet as it oscillates. Correction is made with balance out of the watch, Lessons 18 and 19.

i. An error in flat would appear as a wavy motion rather than the smooth spiraling motion of a spring true in flat. Correction is made with balance out of the watch.

j. A spring in the watch with outer coils pressing downward in an umbrella shape indicates either the stud is too low or the overcoil is too high. A spring with outer coils upward in a saucer shape indicates either stud too high or overcoil not high enough. Correction for both is made with spring out of watch.

k. An overcoil not parallel with the bridge can be seen readily by sighting between bridge and overcoil and determining if space between remains equal for full length of overcoil. Correction is made out of watch.

l. Moving the regulator from side to side will indicate whether the outer coil is circled correctly. If the spring shifts from side to side, throwing the spring off center with the bridge, it indicates the outer coil requires recircling. This is performed out of the watch, spring off the wheel and on balance bridge.

m. Rust may form on a hairspring. This will weaken and in time the spring will break. There is no effective method of removing or retarding rust. It is advisable to replace the spring.

n. Due to a sudden jar, the coils of a hairspring may overlap one or more of the other coils. Untangling requires great care. If you can determine the coil that is overlapped and you are able to reach this coil with a fine taper pin, it is advisable to untangle while spring is in the watch. Otherwise, remove the spring from balance wheel. Place collet on taper pin and place fine steel pin in between the coils at a point between tangle and the collet. Gradually work the pin outward between the spirals of the spring, thus working the tangle to the outer edge of the spring. Then with tweezers lift the overlapped coil out of the tangled coils.

IMPORTANT:

There are many combinations of errors you may encounter. Suggested procedure is to start at the collet and correct each as you come to it, just as if you were fitting a hairspring to a watch.