Master WATCHMAKING

SHOP TRAINING
JOB GUIDES

LESSON 17

Poising Balance Wheels

—

Sections 366 - 375

CHICAGO SCHOOL OF WATCHMAKING

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MASTER WATCHMAKING

A Modern, Complete, Practical Course

CHICAGO SCHOOL OF WATCHMAKING

Founded 1908 by Thomas B. Sweazey

Lesson 17

Sections 366 to 375

POISING BALANCE WHEELS

SEC. 366 — Definition of Poising

Poising a balance wheel is the art of obtaining perfect balance.. Too many watchmakers are apt to feel that it is not necessary to check the poise on every wheel. On inexpensive watches where the factory is not too careful about poising balance wheels, it is hard for a watchmaker to bring these wheels into poise. However, in the better grade watches the wheels are poised before the watch is brought to time and if carefully handled by good repair men, these wheels will remain in poise. A watch will not keep accurate time unless the wheel is poised, and immediately after checking the wheel to see if it is true, it should be tested for poise. A balance wheel cannot be poised if it is magnetized and a magnetized balance wheel will act as if it were out of poise. Lesson 11 explains magnetism, and by now you should be in the habit of testing each watch for magnetism.

In poising a balance wheel, remember that the pivots must be perfectly true, the wheel must be true in the flat and in the round and must be free of magnetism. The wheel is poised with the roller table in place, the roller jewel must be set and all excess cement removed, and the wheel and the jaws of the poising tool must be clean. Use pithwood to clean both.

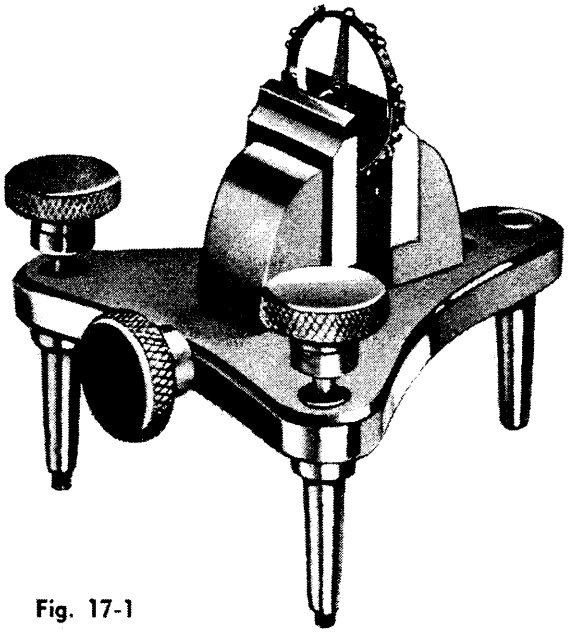

Fig. 17-1

SEC. 367 — The Poising Tool

There are many types of poising tools on the market. One of the most popular models is shown in figure 17-1. Two of the legs are on screws and are used to insure perfect level at all times. The jaws are of synthetic ruby with a high polish. Some poising tools are equipped with a spirit level. Steel jaw poising tools will serve the purpose well but the jaws must be kept at a knife edge and highly polished.

SEC. 368 — Poising the Balance Wheel

1. The balance wheel is set between the jaws of the poising tool with the pivots (not the cones) resting on the polished, knife-like edges of the poising tool, figure 17-2.

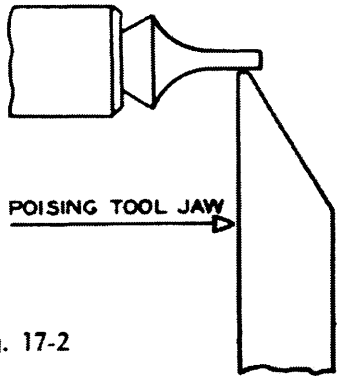

Fig. 17-2

2. Carefully turn balance wheel with pegwood and release.
3. If the wheel is out of poise the heavy side will be at the lowest point on the rim B, figure 17-3.
4. Removing weight from the balance screw located at this point will tend to bring the wheel into poise.

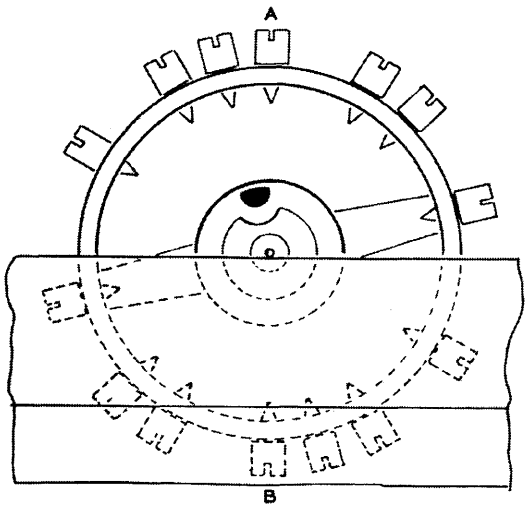

Fig. 17-3

5. Adding weight to the screw A opposite the heavy side A, figure 17-3, will obtain the same result.

6. It is best to add a little weight to the light side and remove a little from the heavy side.

To remove weight, use balance screw undercutter, having hole in the center to allow the threaded portion of the balance screw to enter (figure 11-19, Lesson 11).

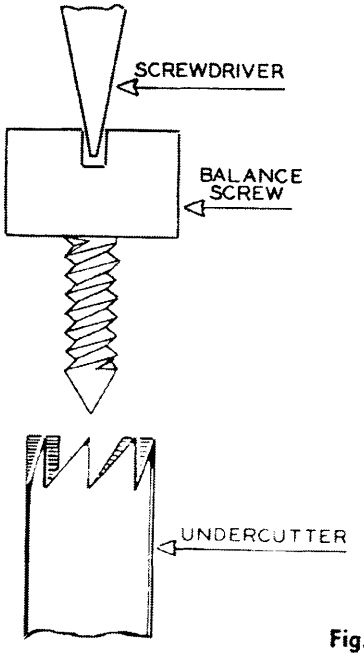

Fig. 17-4

Figure 17-4 illustrates the screw in place over the undercutter. Notice that the undercutter is smaller in diameter than the head of the screw. Turning the screw with a screwdriver will remove a slight amount of metal, depending upon how many revolutions the screw is turned. Do not use too much pressure. Figure 17-5 illustrates a balance screw that has been undercut.

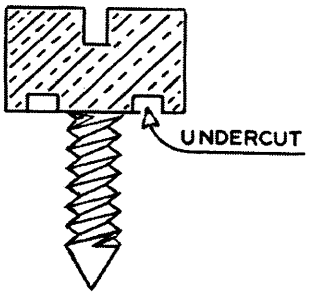

Fig. 17-5

The undercutter mounted in a lathe and the screw held in a balance screw holder is the most satisfactory method of all but is another method that cannot be used without a lathe. The first method works as well but is a little slower.

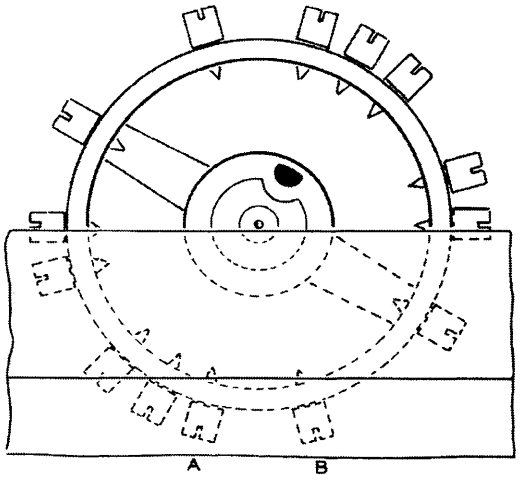

Fig. 17-6

Figure 17-6 illustrates a balance which has come to rest with the heavy side between the screws A and B. In such a case we would remove a little weight from each of the screws A and B with the undercutter.

Light weight timing washers may be added if it is desirable to add weight in order to bring the wheel into poise. In this connection, in our lesson on lathe work we will illustrate the procedure used in making punches for any size balance screw which will in turn allow us to make washers from brass, copper or in some cases gold and platinum. These punches will also serve us well in making special timing washers.

Remove weight from and add weight to the balance wheel carefully as it is very easy to get the wheel out of true. When the balance wheel

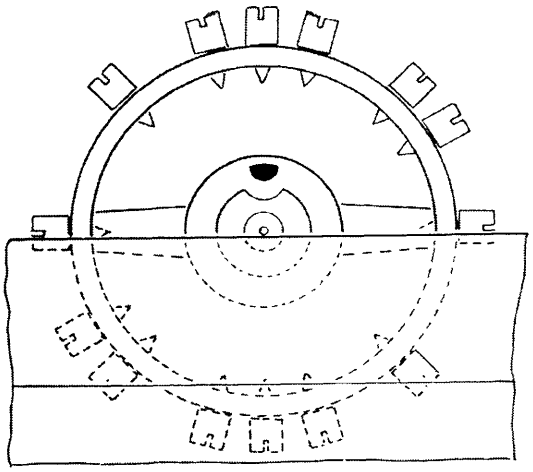

Fig. 17-7

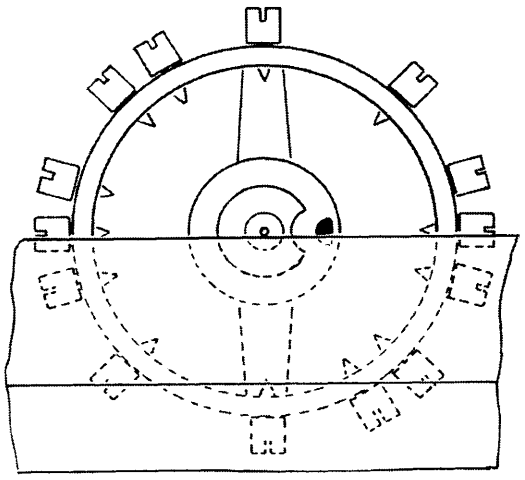

Fig. 17-8

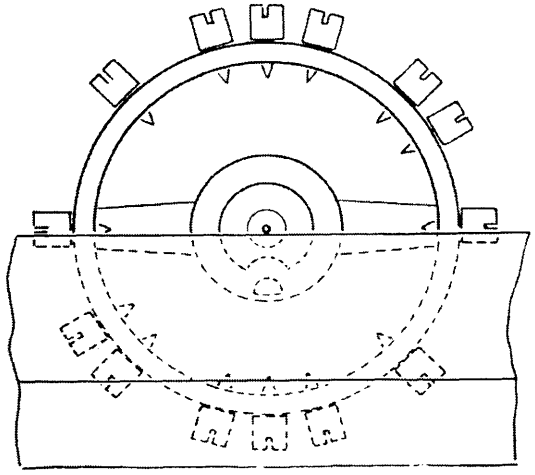

Fig. 17-9

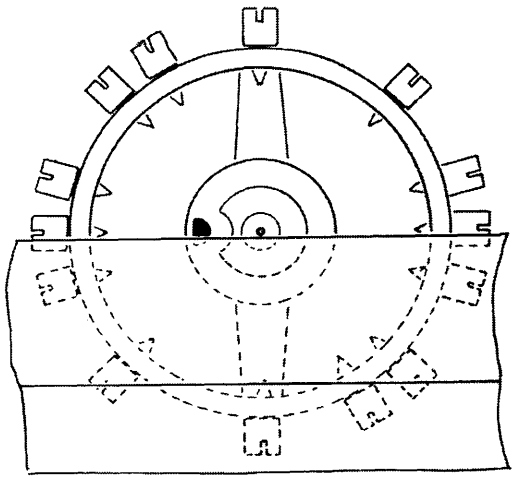

Fig. 17-10

will remain at any position on the jaws of the poising tool, it will be in poise. Try four positions by using the roller jewel as a guide. Figure 17-7 illustrates the roller jewel in a vertical position. Turn the roller jewel a quarter turn to the right, figure 17-8. Turn the roller jewel another quarter turn to the right, figure 17-9, and once more, figure 17-10. Tap poising tool lightly when the wheel is in each of the above positions. If it remains in each of the positions described the wheel will be in poise.

SEC. 369 — Some Observations to Make Before Poising a Balance

In making repairs on watches, it is an excellent idea to make certain notes as follows:

Notice position of regulator before removing balance from the movement. If the regulator is as far toward the F (fast) as possible we would assume this watch has a tendency to run slow. In this case, when poising the wheel it would be better to remove more weight from the balance than we add. Just the opposite is true if the regulator is toward the slow side. In this case it would be reasonable to assume that more weight should be added than removed when poising the balance wheel.

When a balance wheel is ready to be trued in the round and the ends of the balance rim are slightly toward the center, the weight which is contained in the balance rim will be moved away from the center. This will cause the watch to run slower. After the wheel has been trued properly it would in all probability be wiser to remove weight from the balance when poising the balance.

If the rims of the balance had to be trued toward the center it would be wise to add

weight to the balance wheel when poising, as truing the ends of the balance rim toward the center moves the weight toward the center, thus causing the watch to gain.

These conditions must be observed carefully when making repairs and the more careful you are with your observations the easier it will be for you to bring your watch to time.

If your watch runs slow after you have trued and poised the balance wheel and the regulator is in the center, it is possible to speed it up by removing an equal amount of weight from a pair of balance screws which are directly across from each other. If the watch runs fast with the regulator in the center, a pair of washers of equal size and weight added to opposite pairs of screws will increase the weight of the balance wheel and cause the watch to slow down. (Lesson 11).

When poising the balance wheel, do not add to or remove weight from the meantime screws, but instead make any required adjustment on the balance screws on either side.

To poise a monometallic balance use the same method as is used to poise the regular balance wheel. However, in watches using this type of balance, you will find that the wheel is seldom out of poise if the staff has been properly replaced. If your wheel is out of poise, be sure to check the pivots carefully to see that they are perfectly true and have a high polish.

SEC. 370 — Swiss Type Balance Screw Cutter

Figure 17-11 illustrates a balance screw cutter which will cut the balance screw without having to remove the screw from the balance wheel. These come in sets of six and are recommended for bringing ordinary Swiss type balances to poise or for timing.

Use as follows:

1. Select collar which fits over balance screw

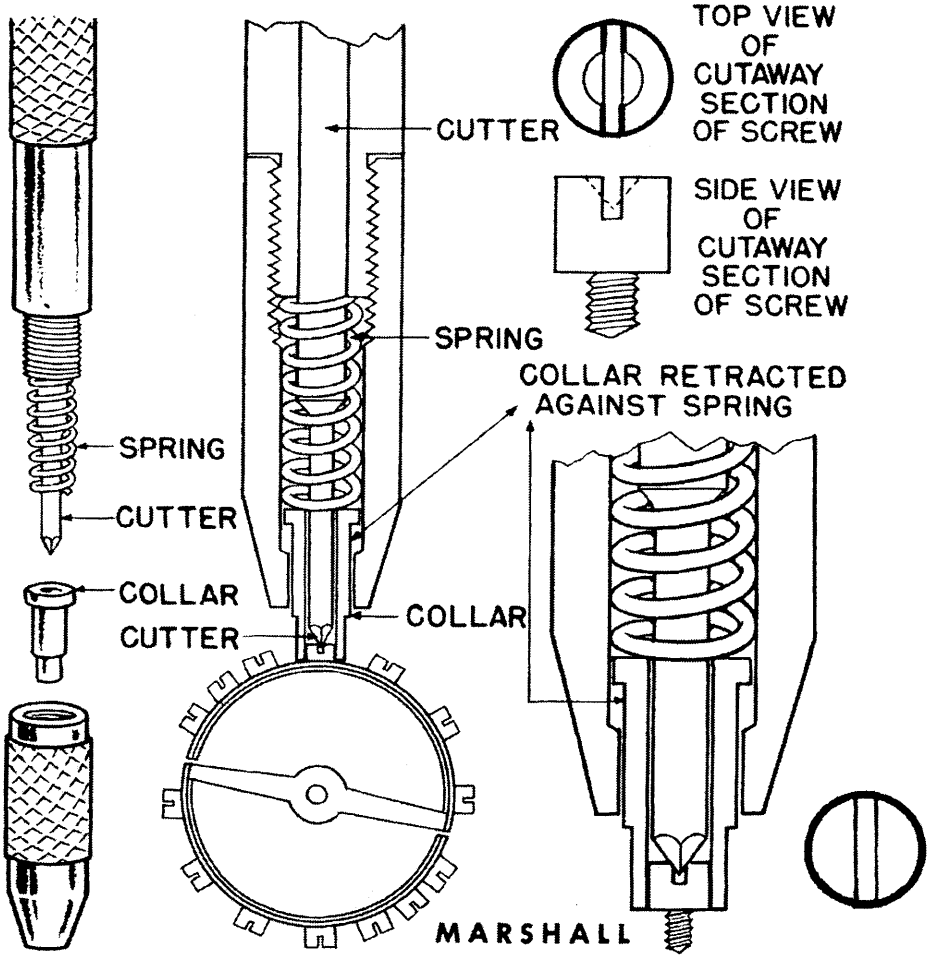

Fig. 17-11

to hold it in position . . . the collar retracts against the spring and automatically centers the cutter.

2. Turn handle as you would a screwdriver. The three bladed cutter countersinks (hollows out) the center of the top of the screw.

3. Remove cutter and test.

SEC. 371 — Train Wheels and Pinions

The wheel and pinions of a watch do not need replacing very often. The pivots are sturdy and it takes a hard knock to break the train pivots. There are times when a student will accidentally break a train pivot; this usually happens when too much force is exerted in assembling the watch. If a train wheel and pivot will not slip into place easily, check carefully to see if you might have overlooked interference at some point. There may be times when it seems as though the wheel and pinion do not fit properly. But REMEMBER that if it fit properly before you took it apart it should go back in easily. Any time you are in doubt, remove all wheels in the train and try the wheel and pinion you are having trouble with, in the watch by itself. This holds true for every operation in watchmaking, wheels and pinions, balance staffs, jewels, winding and setting parts. Try each part separately until you are positive that each and every part is functioning correctly. When you are certain that each part works smoothly, proceed with the next operation.

There are many occasions in which the student will have trouble when making repairs. For example: On certain Swiss watches in which the lower escape pivot is capped, the screw which holds the cap jewel in place can be interchanged with the lower balance cap jewel screw. However, the balance cap jewel screw is slightly longer, and if replaced as the escape cap jewel screw it may protrude enough to cause interference with the escape wheel. This example and many others cannot be considered part of your course as they are primarily due to carelessness or lack of experience. Your ability to locate these difficulties will mean the difference between an expert and a "botchmaker." Ability is determined by the skill in locating trouble quickly and making the necessary repairs.

Figure 17-12 is an illustration of a badly worn square shoulder pivot which should be replaced. Before replacing, however, ascertain the condition of the jewel, as it is possible that a cracked or broken jewel has caused the excessive wear. Or it may have been cut by accumulated dirt

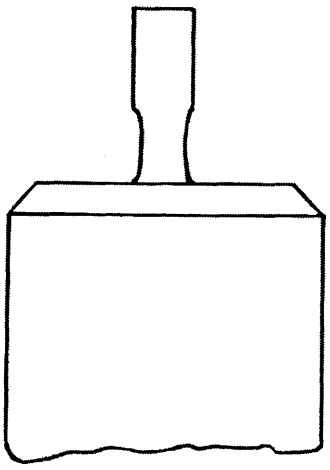

Fig. 17-12

and grime mixed with the old oil. If the jewel is cracked or broken, replace it before attempting to replace the wheel and pinion. In cases where the pivot turns directly into the plate or bushing, it will be necessary to close the pivot hole slightly.

SEC. 372 — Repairing a Worn Pivot Hole

In watches that do not have jewels for bearings the pivots of the train wheel pinions turn directly in the plates or metal bushings and we may find the pivot holes have become worn. This is especially true in watches that have been in use for a good many years. Excessive wear is easily determined by testing for sideshake and if the sideshake is noticeable, it is evident that the pivot hole is too large, figure A-17-13. For a thorough test, examine each wheel and pinion separately, testing for excessive sideshake.

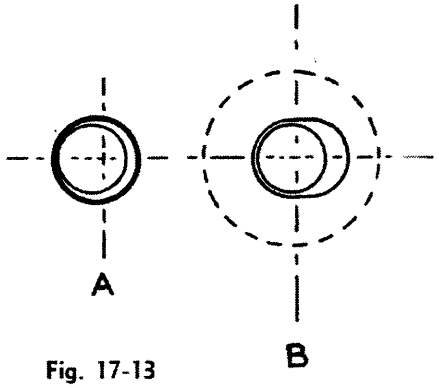

Fig. 17-13

Whenever a watch is taken apart it should be carefully examined to see if any such condition exists. Not all pivot holes that are worn can be satisfactorily closed. Figure B-17-13 shows a pivot hole that is worn so badly that it would be

wasted effort to attempt to close it so that it would function properly. The recommended procedure in such a case would be to ream out the old pivot hole with a cutting broach large enough to accept a friction jewel. The large dotted circle in figure B-17-13 represents this hole. This bearing can now be put in first class order easily and quickly by fitting a friction jewel to the opening. If the pivot needs to be polished or replaced this must be done before fitting the friction jewel in order that you may select the proper size pivot hole in the jewel. Before friction jewelling came within reach of the watchmaker, it was necessary to "plug" the plate or bridge with a brass bushing and then drill a pivot hole of the correct size in the bushing. This, of course, has to be done on a watchmaker's lathe and, in some cases, necessitates the use of a face plate to "upright" the bridge or plate.

SEC. 373 — Closing Hole In Plate or Bridge

To close a pivot hole in a plate or bridge, select a flat face staking tool stump that will cover the bearing surface of the hole to be closed, figure 17-14. Select a small round face solid punch that will fit inside the oil cup. Tap the punch lightly until the hole is closed enough that the pivot will not enter it. Select a small pivot broach (a small reamer) that will enter the hole, and carefully open hole by rolling the broach back and forth between your thumb and forefinger. Do this from both sides until pivot fits correctly.

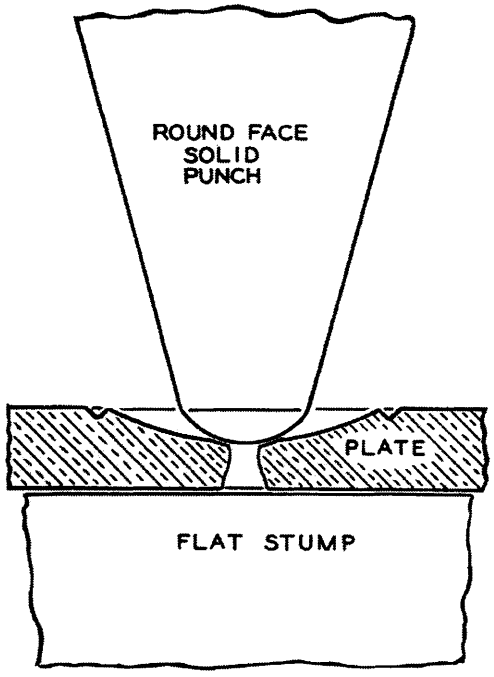

Fig. 17-14

SEC. 374—Ordering Wheels and Pinions

In replacing a worn wheel and pinion in a Swiss watch, it is usually necessary to order the wheel and pinion complete as the wheels are staked on at the factory. This assures the watchmaker of an accurate fit. When replacing a wheel and pinion, carefully try pivot in jewel bearing to determine if pivot fits properly. If the wheel and pinion are from the factory that made the watch, it will usually fit correctly. If the pivot fits a little snugly, it will have to be ground down slightly and repolished. However, that is another job that will have to wait until we reach lathe work.

In most American watches the wheel and pinions can be purchased separately and are of a friction fit. Figure 17-15 illustrates the method used to remove this type of pinion from the wheel. The wheel is placed over a hole in the die plate large enough to receive the pinion leaves. A flat face hollow punch is then used to force out the pinion. The pinion is replaced by reversing the above procedure, figure 17-16.

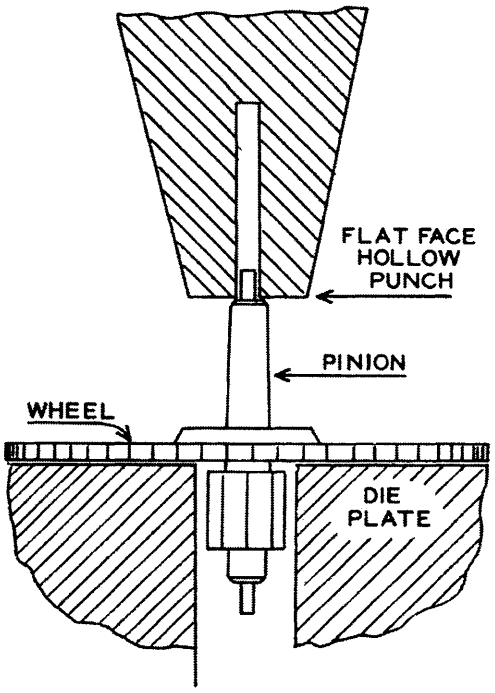

Fig. 17-15

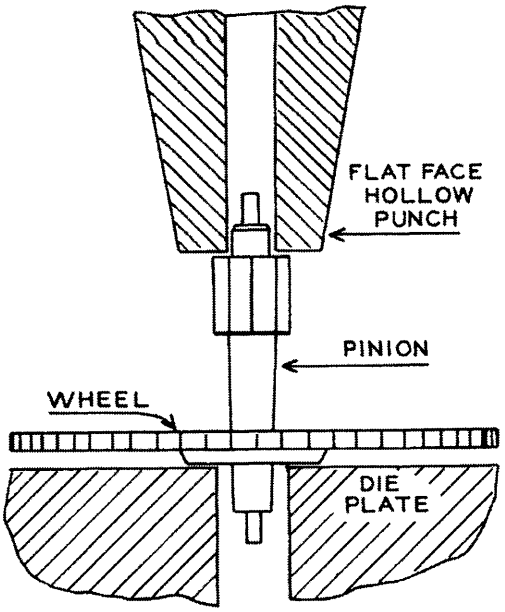

Fig. 17-16

Let us assume that the one we have ordered is the correct size. For practice, take one of your practice watches and remove the pinion from the wheel and then replace it.

When ordering, give the name of the part, describe name of watch and size.

Example: 1 Elgin 16 size 4th Pinion (Enclose sample if possible).

Figure 17-17 illustrates a round face hollow

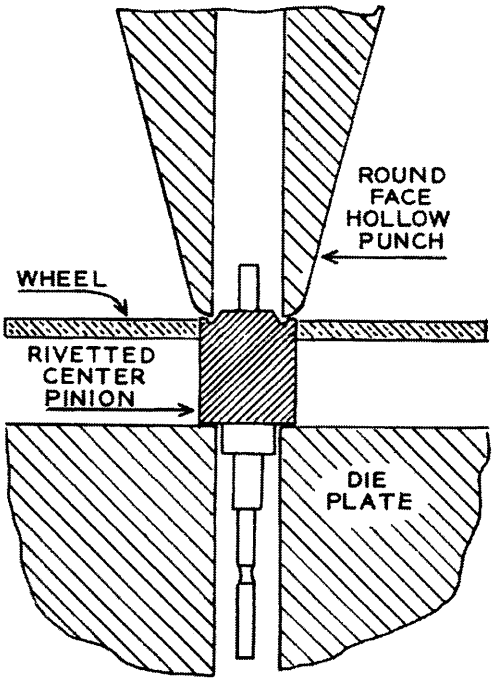

Fig. 17-17

punch used to rivet a center pinion to the center wheel. This procedure, with little variance, is used to tighten wheels which have become loose on other pinions of the rivet type.

SEC. 375 — Fitting Pallet Arbors

It is not often that a watchmaker is called upon to replace pallet arbors. They are rarely broken except through the misfortune of the repair man when replacing a pallet fork and arbor. They are one of the smallest and most delicate parts of a watch and difficult to handle.

The pallet arbors have either square shoulder or conical pivots and are usually very short. Some are threaded while others are friction fit, figure 17-18.

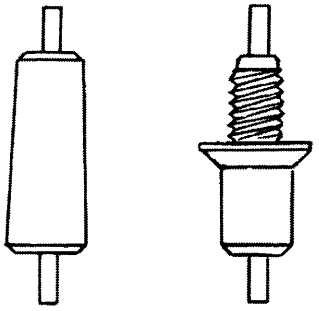

Fig. 17-18

In selecting a new pallet arbor, it is necessary to determine the type—a friction fit or screw type. The screw type can be removed easily by grasping arbor with a small pin vise and turning it out. Before replacing, be sure the lower pivot fits the lower jewel hole correctly and the upper pivot fits the upper jewel hole with proper sideshake.

Place pallet arbor in lower jewel. Put on pallet bridge and test for endshake. It is necessary to have endshake as previously explained in our lessons on jewels and staffs. If everything is now correct, replace arbor in fork. Here we have to mention the lathe again, this time as an excellent way of removing and replacing a pallet arbor in place of a pin vise. In the friction type they may be replaced with a staking tool using a small pivot punch or the tools furnished with the friction jewelling tool previously described. In doing work with a pallet fork and arbor, it cannot be stressed too much at this time that a student must use extreme care in handling each part. Be very careful not to bend the guard pin or loosen the pallet stones. As previously stated, it isn't often that these parts get out of order unless through carelessness of the workman.

More and more you will begin to realize the importance of lathe work. A regular watchmaker's lathe with a few more attachments than that of the average watchmaker's would enable you to manufacture a watch. It would hardly be profitable, but you should see by now that the student needs lathe work in order to become an expert. On the everyday job a lathe is required. Possibly you will only use it two or three times a day, maybe not at all, but it is impractical to think you can be without it; a pivot needs polishing, a jewel hole is out of upright, a balance shoulder must be undercut to stake balance properly. It is indispensable for cutting down roller seat, making tools, balance staff, setting jewels, etc. However, before you do lathe work it is to your advantage to become acquainted with the parts of the watch, their functions and failures. The next series of lessons concerns hairsprings followed by lessons on the escapement. These lessons will require a great deal of concentrated study and practice. There is very little practical work but with the experience gained in these lessons and the following lessons on lathe work your ability to repair watches will grow by leaps and bounds depending of course on the amount of watch repair you do. It is to your benefit to constantly review the previous lessons at every available opportunity.

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JOB SHEETS

UNIT	W 5
LESSON	17

Master Watchmaking

CHICAGO SCHOOL OF WATCHMAKING

JOB SHEET

Il7-Jl

REPLACING RIVET TYPE BALANCE STAFF: Single Roller

TOOLS, EQUIPMENT AND SUPPLIES:

Staking Tool - Brass Hammer - Tweezers - Staff Remover* - Lathe*
Graver* - Roller Remover - Hairspring Remover
*Dependent on staff removing procedure used

PROCEDURE: REFERENCE

HOW TO REPLACE A STAFF IN A WATCH HAVING A SINGLE ROLLER

1. Remove the balance cock and balance assembly. Les. 8

2. Remove balance and cap jewels. Les. 10 - Sec. 240

3. If balance hole or cap jewels are cracked or damaged, replace. Make certain upper and lower jewels have holes of same size.

4. Clean and replace balance hole and cap jewels.

5. Remove hairspring. Sec. 352

6. Using roller remover, remove roller from balance assembly. Sec. 353
NOTE: Mark rim of wheel opposite position of roller jewel with colored pencil so roller can be replaced in same position. Mark is easily removed with cleaning solution.

7. Remove staff from wheel. (See procedures in Job Guide Sheet W15-Jl

8. Select replacement staff. Les. 4 - Sec. 119 & Les. 15 - Sec. 356

9. Place staff only in movement with bridge in place and check end and side shake. Sec. 356

10. Remove staff from movement.

11. Check wheel and roller on staff to see that they will fit correctly, check collet seat diameter.

12. Select and align the hole in the die plate of staking tool that will accommodate roller seat and give proper support on the bottom of the hub of the staff. Sec. 357

13. With staff in die plate, set balance wheel in place being sure the wheel is firmly seated against the hub. If not firmly seated, use a flat face hole punch with hole larger than hole in wheel and press wheel down against the hub.

(OVER)

14. Select round face hole punch in size that will go down over collet seat with minimum of clearance. Fig. 15-15

15. Turn punch slowly as you tap on the punch to spread the rivet.

16. Select flat face hole punch with same size hole. Fig. 15-16

17. Turn punch slowly as you tap punch to rivet the staff.

18. Check to determine that staff is firmly rivetted.

19. True the wheel in flat and round. Les. 16

20. Place balance wheel in movement, pallet bridge should be in place, balance bridge in place.

21. Check endshake and free motion.
NOTE: A good test is to start the wheel turning slowly in either dial up or dial down position. The wheel should revolve freely, slowing very gradually at the same rate of speed in both positions. If wheel is not free in either or both positions, make the following checks to determine the fault:
    a. Magnatism Lessons 10-11-13-14-30-31
    b. Pivot bent, rough, burred, etc. Aids to Estimating & Repairing
    c. Rim clearance between center wheel and pallet bridge.
    d. Balance jewels dirty, cracked, chipped or loose.
    e. End shake.
    f. Balance screws protruding too far or timing washers rubbing.
    g. Wheel out of true.
    h. Jewel screws tight.

22. Make necessary correction for freeing motion.

23. Set roller on roller seat with roller jewel aligned with mark you made on rim.

24. Select hole in die plate that will accommodate the staff and the roller jewel and properly support the roller. Fig. 15-17

25. Using the flat face hole punch you used in rivetting, with pressure or a light tap drive the roller into place against the bottom of hub.

26. Poise the balance wheel. Les. 17
NOTE: On some balance wheels the manufacturer may have inserted either a pair or two pair of meantime screws. They are recognized by a screw shank longer than the other screws and the fact that they are not generally screwed all the way in to the rim of the wheel. A pair of meantime screws (screws placed opposite each other are considered a pair) turned an equal distance in toward the rim of the wheel will increase the rate of the watch by the fact that the movement of the screws has shifted the weight closer to center.

Continued next page

Turning a pair of meantime screws an equal distance away from the rim will slow the rate of the watch as weight has been shifted away from center. The weight of the meantime screws should never be altered by either adding or taking away weight from the screws, they are never used in poising.

27. Recheck step 19, make necessary adjustments.

28. Recheck step 26, make necessary adjustments.
NOTE: If either the truth or poise of the wheel is incorrect, it may be necessary to make correction to both. A wheel that is out of true in round, when trued would be out of poise.

29. Place balance in movement, pallet fork and bridge in place, balance bridge in place. Check the fork and roller action, make necessary adjustments. — Lessons 13-21-22-26

30. Replace hairspring, examine for truth, centered, overcoil properly formed, etc. Put in beat. — Lessons 26 & 32 pt. 1

31. Oil balance jewels. — Les. 10

32. Replace balance assembly and bridge, check for proper motion. — Les. 11

REPLACING RIVET TYPE BALANCE STAFF: Combination Double Roller

TOOLS, EQUIPMENT AND SUPPLIES:

Staking Tool - Brass Hammer - Tweezers - Staff Remover* - Lathe*
Graver* - Roller Remover - Hairspring Remover
*Dependent on staff removing procedure used.

PROCEDURE: REFERENCE

HOW TO REPLACE A STAFF IN A WATCH HAVING A COMBINATION DOUBLE ROLLER

1. Remove the balance cock and balance assembly. Les. 8
2. Remove balance and cap jewels. Les. 10 - Sec. 240
3. If balance hole or cap jewels are cracked or damaged, replace. Make certain upper and lower jewels have holes the same size.
4. Clean and replace balance hole and cap jewels.
5. Remove hairspring. Sec. 352
6. Using roller remover, remove roller from balance assembly. Sec. 353
   NOTE: Mark rim of wheel opposite position of roller jewel with colored pencil so roller can be replaced in same position. Mark is easily removed with cleaning solution.
7. Remove staff from wheel. (See procedures in Job Guide Sheet W15-J1
8. Select replacement staff. Les. 4 - Sec. 119 & Les. 15 - Sec. 356
9. Place staff only in movement with bridge in place and check end and side shake. Sec. 356
10. Remove staff from movement.
11. Check wheel and roller on staff to see that they will fit correctly, check collet seat diameter.
12. Select and align the hole in the die plate of staking tool that will accommodate roller seat and give proper support on the bottom of the hub of the staff. Sec. 357

OVER

13. With staff in die plate, set balance wheel in place being sure the wheel is firmly seated against the hub. If not firmly seated, use a flat face hole punch with hole larger than hole in wheel and press wheel down against the hub

14. Select round face hole punch in size that will go down over collet seat with minimum of clearance. Fig. 15-15

15. Turn punch slowly as you tap on the punch to spread the rivet.

16. Select flat face hole punch with same size hole. Fig. 15-16

17. Turn punch slowly as you tap punch to rivet the staff.

18. Check to determine that staff is firmly rivetted.

19. True the wheel in flat and round. Lesson 16

20. Place balance wheel in movement, pallet bridge should be in place, balance bridge in place.

21. Check endshake and free motion.

NOTE: A good test is to start the wheel turning slowly in either dial up or dial down position. The wheel should revolve freely, slowing very gradually at the same rate of speed in both positions. If wheel is not free in either or both positions, make the following checks to determine the fault:

a. Magnatism. Lessons 10-11-13-14-30-31
b. Pivot bent, rought, burred, etc.
Aids to Estimating and Repairing.
c. Rim clearance between center wheel and pallet bridge.
d. Balance jewels dirty, cracked, chipped or loose.
e. End shake.
f. Balance screws protruding too far or timing washers rubbing.
g. Wheel out of true.
h. Jewel screws tight.

22. Make necessary correction for freeing motion.

23. Set roller on roller seat with roller jewel aligned with mark you made on rim.

24. Select hole in die plate that will accommodate the staff and properly support the bottom of the combination roller. Fig. 15-16

25. Using the flat face hole punch you used in rivetting, with pressure or a light tap drive the roller into place against the bottom of hub.

Continued next page

26. Poise the balance wheel. Lessons 17 & 11 - Sec. 275

27. Recheck step 19, make necessary adjustments.

28. Recheck step 26, make necessary adjustments.

    NOTE: If either the truth or poise of the wheel is incorrect, it may be necessary to make correction to both. A wheel that is out of true in round, when trued would be out of poise.

29. Place balance in movement, pallet fork and bridge in place, balance bridge in place. Check the fork and roller action, make necessary adjustments. Lessons 13-21-22-26

30. Replace hairspring, examine for truth, centered, overcoil properly formed, etc. Put in beat Lessons 26 & 32 pt. 1

31. Oil balance jewels. Lesson 10

32. Replace balance assembly and bridge, check for proper motion. Lesson 11

UNIT	W 5
LESSON	17

Master Watchmaking

CHICAGO SCHOOL OF WATCHMAKING

JOB SHEET
W17-J3

REPLACING FRICTION TYPE BALANCE STAFF: Waltham

TOOLS, EQUIPMENT AND SUPPLIES:

Staking tool - Brass hammer - Tweezers - Roller remover - Hairspring remover.

PROCEDURE: REFERENCE:

HOW TO REPLACE A FRICTION STAFF (Waltham)

1. Remove balance assembly from movement. Lesson 8
2. Remove balance and cap jewels. Lesson 10 - Sec. 240
3. Select replacement if either balance hole or cap jewels are damaged.
4. Clean and replace balance hole and cap jewels.
5. Remove hairspring. Sec. 352
6. Mark underside of rim with colored pencil to indicate position of roller jewel
7. Using roller remover, remove roller from balance assembly. Sec. 353
8. Select and align hole in die plate of staking tool that will support the bottom of the hub but allow the shoulder on the staff clearance as it is driven out of the hub. Sec. 354 Fig. 15-8

   NOTE: Some staking tools are equipped with special stumps for use in removing and replacing a Waltham friction staff. T.M. of T.*
9. Using a cross hole staff removing punch, carefully drive out the balance staff. T.M. of T.*
10. Select the replacement staff. Lesson 4 - Sec. 119 Lesson 15 - Sec. 356
11. Fit staff in movement with bridge in place and check end and side shake. Sec. 356
12. Remove staff from movement.
13. Check wheel and roller on staff to see that they will fit correctly.

* Tools and Materials of The Trade.

(OVER)

14. Select flat face stump with hole in size that will accommodate collet seat of staff and support arms of wheel. Sec. 359

15. Place stump in staking tool and center hole of stump with centering punch.

16. Rest wheel on stump up-side down. Sec. 359

17. Place collet seat end of staff in hub of wheel. Sec. 359

18. Select round face hole punch in size that will give minimum clearance on roller seat but rest firmly against roller seat shoulder. Sec. 359

19. Tap punch until staff is firmly seated.

20. Place balance wheel in movement, pallet bridge should be in place, balance bridge in place.

21. Check endshake and free motion.

NOTE: A good test is to start the wheel turning slowly in either dial up or dial down position. The wheel should revolve freely, slowing very gradually at the same rate of speed both positions. If wheel is not free in either or both positions, making the following checks to determine the fault: (Lessons 10-11-13-14-30-31)(Aids to Estimating and Repairing)

A. Magnatism
B. Pivot bent, rough, burred, etc.
C. Rim clearance between center wheel and pallet bridge.
C. Balance jewels dirty, cracked, chipped or loose.
D. End Shake.
E. Balance screws protruding too far or timing washers rubbing.
F. Wheel out of true.
G. Jewel Screws tight.

22. Make necessary corrections for freeing motion.

23. Set roller on roller seat with roller jewel aligned with mark you made on rim.

24. Select hole in die plate that will accommodate the staff and the roller jewel and properly support the roller. Sec. 358 Fig. 15-17

NOTE: Double roller see Fig. 15-16

Continued next page

25. Using the flat face hole punch you used in riveting, with pressure or a light tap drive the roller into place against the bottom of hub. Lesson 17

26. Poise the balance wheel.

NOTE: On some balance wheels the manufacturer may have placed one or two pair of meantime screws. They are recognized by a screw shank longer than the other screws and the fact that they are not generally screwed all the way into the rim of the wheel. A pair of meantime screws (screws placed opposite each other are considered a pair) turned an equal distance in toward the rim of the balance wheel will increase the rate of the watch by the fact that the movement of the screws has shifted the weight closer to the center. Turning a pair of meantime screws an equal distance away from the rim will slow the rate of the watch as weight has been shifted away from the center. <u>The weight of the meantime screws should never be altered by either adding or taking away weight from the screws, they are never used in poising, their only use is in timing.</u>

Lesson 11

27. Recheck step 20, Make necessary adjustment.

28. Recheck step 27, make necessary adjustment.

NOTE: If either the true or poise of the wheel is incorrect, it may be necessary to make correction to both. A wheel that is out of true in round, when trued would be out of poise.

29. Place balance in movement - pallet fork and bridge in place, balance bridge in place. Check the fork and roller action. Lessons 13, 21, 22, 26

30. Replace hairspring, put in beat. Lessons 26 & 32 pt. 1

31 Oil balance jewels Lesson 10

32. Place balance and bridge in movement.

REMOVING AND REPLACING PALLET ARBOR: Screw Type

TOOLS, EQUIPMENT AND SUPPLIES:

Pin Vise.

PROCEDURE: REFERENCE:

HOW TO REMOVE AND REPLACE SCREW TYPE PALLET ARBOR: Lesson 17 - Sec. 375

1. Grip the bottom of the arbor in either a pin vise or in a lathe chuck.
2. Unscrew the pallet arbor counterclockwise.
3. Select replacement arbor and determine that pivot size and end shake are correct.
4. Place arbor in either a pinvise or lathe chuck and screw fork onto arbor clockwise.

   NOTE: As the pallet fork is delicate and precision adjusted it is important that the fork not be bent, stones shifted and so-forth while removing or replacing the pallet arbor. To minimize the chance of damaging the fork while removing or replacing the arbor, the fork should be gripped or supported as near the arbor as possible.

5. Replace pallet fork in movement. Check endshake.

UNIT	W 5
LESSON	17

Master Watchmaking

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JOB SHEET
W17-J5

REMOVING AND REPLACING PALLET ARBOR: Friction Type.

TOOLS, EQUIPMENT AND SUPPLIES:

Staking Tool.

PROCEDURE: REFERENCE:

HOW TO REMOVE AND REPLACE A FRICTION TYPE PALLET ARBOR. Lesson 17 - Sec. 375

1. With pallet fork up-side-down and properly supported on the staking tool and using a flat face hole punch with hole that will just fit over the lower pivot, tap gently to drive out friction pallet arbor.

   NOTE: If arbor is still snug in fork after driving level with fork, it will be necessary to use a punch with end of a smaller diameter than arbor to complete removal of the arbor.

2. Select replacement arbor.

3. Place arbor in movement with bridge in place to determine if end shake is correct.

   NOTE: The friction pallet arbor may or may not be tapered. You should determine if it is tapered and if so the taper end will be the end that protrudes farthest through the pallet fork and would be on the bottom of the pallet fork.

4. Place pallet fork on stump in staking tool which will give proper support to the fork and allow the arbor to be driven into and through the fork without obstruction.

5. Select flat face hole punch with hole of correct size to accommodate the pivot and give proper support on the pivot shoulder.

   NOTE: As the arbor is small and by comparison to other parts difficult to handle, exercise caution in putting this arbor into the fork. We suggest that a light application of oil or beeswax to the face of the punch will cause the pallet arbor to adhere to the punch making it possible to align and insert the arbor with a minimum of difficulty.

6. If the pallet arbor is tapered the small end will enter the fork from the top, if not tapered either end may be inserted in the fork. Tap arbor into the approximate position that the old one was resting.

(OVER)

7. Place the pallet fork in the movement with escape wheel and balance in place.

8. Check the alignment of the pallet stones with the escape wheel teeth and fork with roller.

9. Make necessary adjustment to height of fork.

UNIT	W 5
LESSON	17

Master Watchmaking

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W17-J6

CLOSING PIVOT HOLE IN BUSHING:

TOOLS, EQUIPMENT AND SUPPLIES:

Staking tool - Pivot broaches.

PROCEDURE: REFERENCE:

HOW TO CLOSE A WORN PIVOT HOLE IN BUSHING: Lesson 17 - Sec. 372

1. Set train bridge on stump in die plate of staking tool taking care that stump is correct size to support the bushing. Sec. 373

2. Select round face solid punch in a size slightly smaller than the oil cup depression of bushing.

3. With bushing properly supported and round face solid punch in oil cup side of bushing, tap gently.

   NOTE: It will take practice to close a hole the proper amount and so we suggest that you proceed with care checking carefully and when the pivot just barely starts into the hole it has been closed sufficiently. As this method has not allowed for side shake, it will now be necessary that you open the pivot hole to accommodate the pivot with correct side shake. There are two types of broaches used to open and polish the pivot hole. Cutting broaches to enlarge the hole and round broaches to polish the hole.

4. Using a cutting broach carefully broach pivot hole to the size that will just accommodate the pivot.

5. Using round polishing broach in pivot hole, it will polish and slightly enlarge hole for correct side shake.

6. Replace bridge on movement with only the one wheel in place. Before tightening screws determine if you have end shake. In closing the hole you may have reduced the end shake and in that case it will be necessary to remove bridge and with train bridge supported up-side-down on the die plate and using a flat solid punch, tap bushing gently to give end shake desired. After correcting end shake you may find it necessary to broach and polish the pivot hole again.

7. Recheck with wheel in place making any adjustment necessary until you have proper hole size and end shake.