

*T*RAINING UNIT
NUMBER 4



BURNISHING BALANCE
PIVOTS

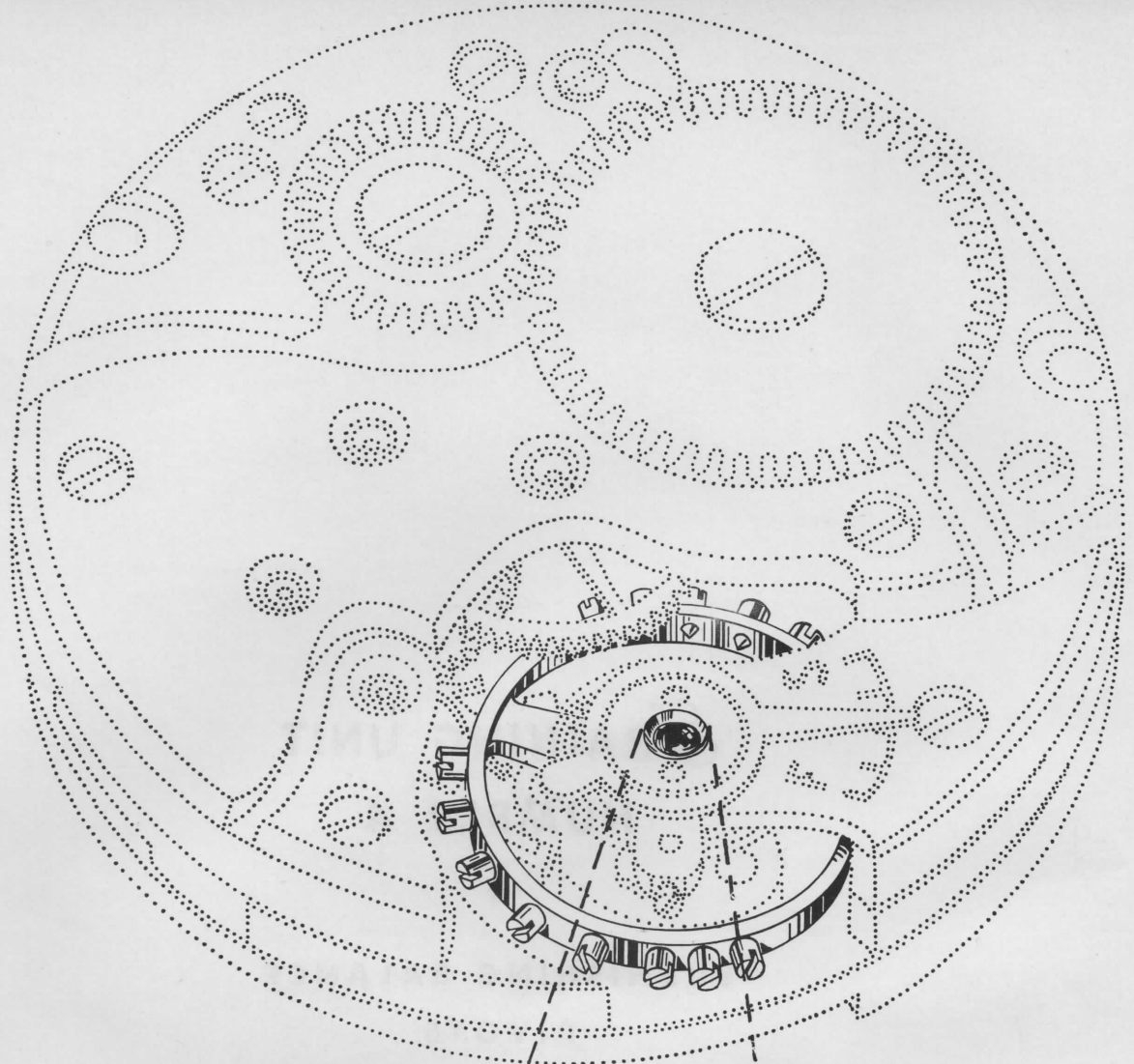
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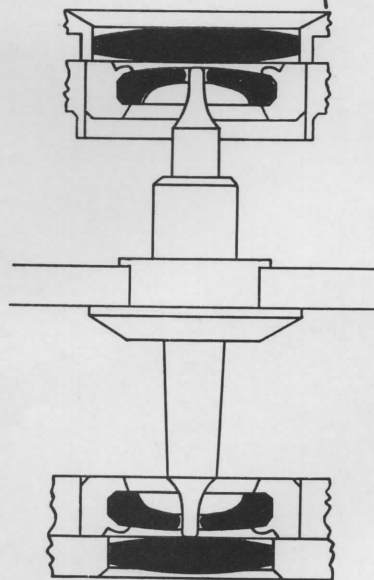
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Since the balance wheel and hairspring constitute the timekeeping element in the watch, it follows that the condition of the balance staff pivots can add to or detract from its timekeeping qualities.

Therefore, it is important at this time to make a study of balance staff pivots and to acquire a skill necessary in preparing them to operate at maximum efficiency.



JOSEPH BULOVA SCHOOL *of* WATCHMAKING

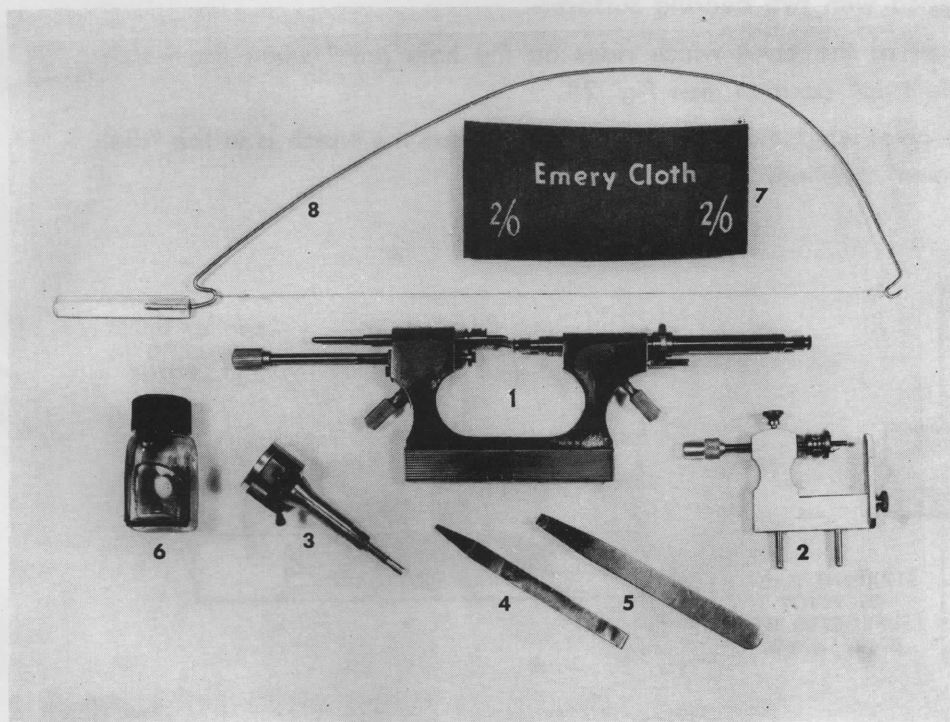
TRAINING UNIT NUMBER 4

Subject: Burnishing Balance Staff Pivots.

- Objectives:**
1. To study the various types of pivot defects and the methods for eliminating them.
 2. To develop a high degree of skill in burnishing balance pivots.

New Tools and Materials Provided:

1. Jacot Lathe.
2. Dorrington Pivot Polisher.
3. Balance Chuck.
4. Hardened steel burnisher.
5. Heavy brass or soft steel tweezers.
6. Watch oil.
7. 2/0 Emery cloth.
8. Fiddle bow.



BALANCE STAFF PIVOTS AND JEWELS:

The jewel bearings in which the balance staff pivots are mounted consist of a hole jewel and an endstone.

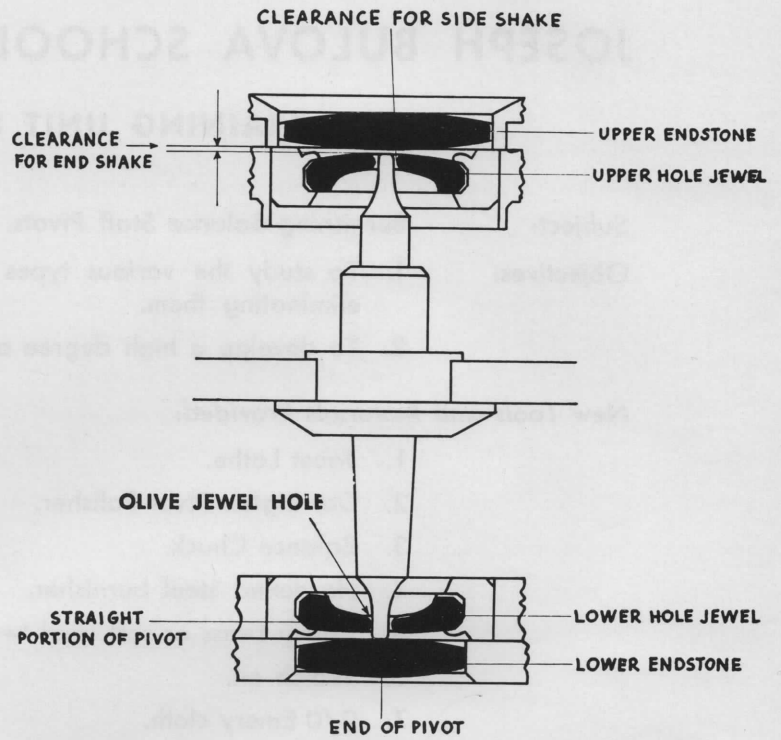


Fig. 1

The pivot itself is equipped with two bearing surfaces:

- a. The straight part of the pivot which rides on the hole jewel when the watch is in the "pendant up" position. See Fig. 2A.
- b. The end of the pivot which rides on the endstone when the watch is in the "dial up" or "dial down" position. See Fig. 2B.

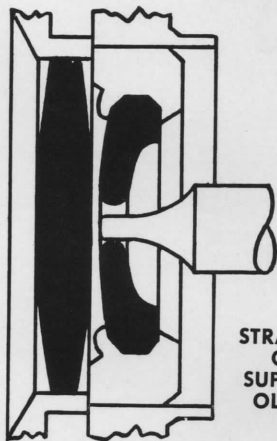


Fig. 2A

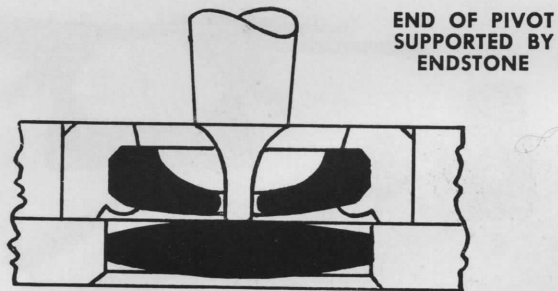


Fig. 2B



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The clearance between the hole jewel and the straight part of the pivot is called "side shake" and the clearance between the endstone and the end of the pivot is called "end shake". The purpose of any bearing is to reduce friction. However, no bearing can completely eliminate friction. Therefore, this friction must be taken into consideration when designing or repairing a watch. Being a portable timepiece, a good watch must function with a high degree of accuracy in all positions. This means that the frictional losses between the pivots and jewels must not only be minimized, but equalized insofar as possible for any operating condition. More precisely, it means that the friction between the hole jewel and the straight portion of the pivot must be as close as possible to the friction between the endstone and the end of the pivot.

The solution of the problems involving the equalization of frictional loss in various positions lies in the shape given to the pivot. If the pivot is designed so that the end offers as much friction to the endstone as the straight portion does to the hole jewel, the problem is solved within reasonable limits. This is accomplished by making the end of the pivot almost perfectly flat. The edge is rounded just enough to insure an even surface without ridges or burrs.

After the shape of the pivots has been established, the frictional losses must be decreased as much as possible. This is best accomplished by burnishing the pivots with a steel burnisher. It is the function of the burnisher to remove tarnish, slight scratches, burrs, superficial rust and corrosion. The burnisher acts as a superfine file. The process of burnishing also tends to work-harden the outer surface of the pivot. It must be emphasized that in the event a pivot has other than superficial defects, the process of removing them may reduce the diameter of the pivot so that it will not fit correctly in its jeweled bearing. The excessive side shake that would result in such a case would interfere with the proper functioning of the balance wheel assembly. Where pivot defects are too great, the watchmaker would be well advised to replace the staff with a new one.



PIVOT DEFECTS

For comparison purposes a correctly shaped pivot is shown in Figure 3A.

In Figure 3B is shown a bent pivot. This type of pivot causes erratic timing and may even stop the watch.

In Figure 3C a scratched pivot is shown. This condition may be brought about by a broken hole jewel or dirt in the hole jewel. This type of fault may also be present on the very end of a pivot, which may be caused by a cracked or pitted cap jewel or dirt on the inner surface of the cap jewel.

In Figure 3D is illustrated a pivot with a burr at its edge. This may be brought about by burnishing the end of the pivot and neglecting to put the finishing touch to the whole procedure by drawing the burnisher across the edge of the pivot. This fault may also result from dropping the watch.

In Figure 3E are shown the pitted and surface-marked effects due to corrosion and rust.

In Figure 3F is shown a pivot with its end too rounded.

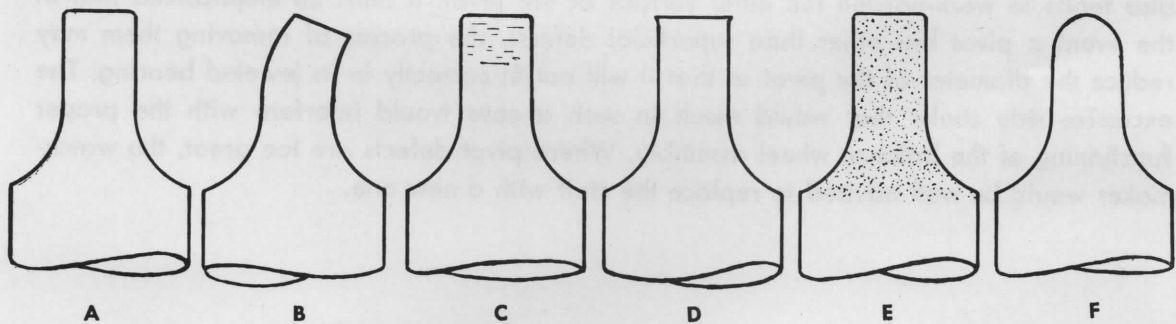


Fig. 3



ELIMINATION OF PIVOT DEFECTS

The Burnisher and Its Preparation

The object in burnishing is to reduce the friction between the staff and its jewel bearing to a minimum. By use of a hardened steel burnisher the surface of a pivot will be made smoother. In Figure 4 is shown a portion of a pivot as it might appear under a high powered microscope.

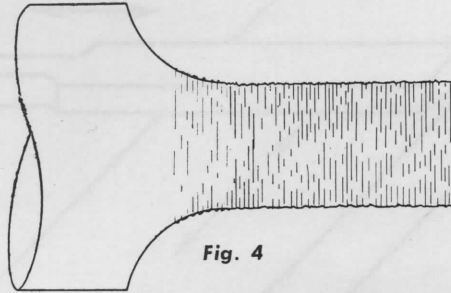


Fig. 4

The result of the burnishing is shown in Figure 5. The uneven and irregular surface (Figure 4), is now smoothed out.

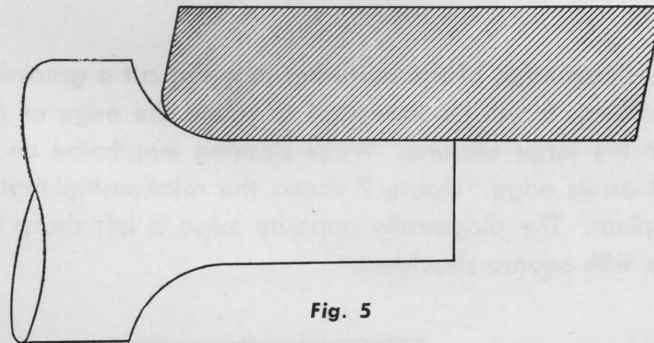


Fig. 5

Due to the fact that many steel burnishers, as they are received from the tool manufacturer, do not have the finish and flatness required for effective burnishing. It therefore, is necessary to discuss the method of refinishing them. Generally, the lines are too rough and the edges do not have the proper form.



Training Unit No. 4

Preparing the Burnisher

1. Place the burnisher flat on the oilstone which is covered with a thin film of light machine oil. Figure 6. It should be stroked at an angle of about 90° to the edge of the stone. While using the lengthwise stroke, an in and out stroke along the length of the burnisher should also be carried out. This technique will make sure that the entire surface of the burnisher will be affected. Stone all four sides.

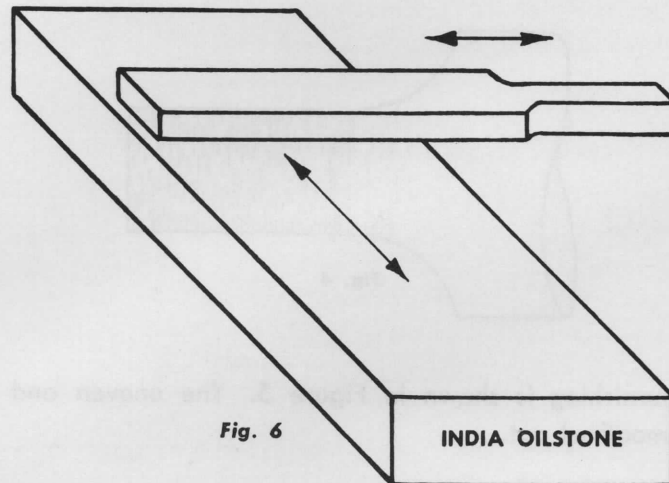


Fig. 6

2. In order that the sharp edge of the burnisher may not cut a groove at the base of the cone while burnishing, it will be necessary to round the edge of the burnisher. This may be done on the large oilstone. While stroking lengthwise on the stone the burnisher is rotated on its edge. Figure 7 shows the relationship that the burnisher will then have to a pivot. The diagonally opposite edge is left sharp for the purpose of burnishing pivots with square shoulders.

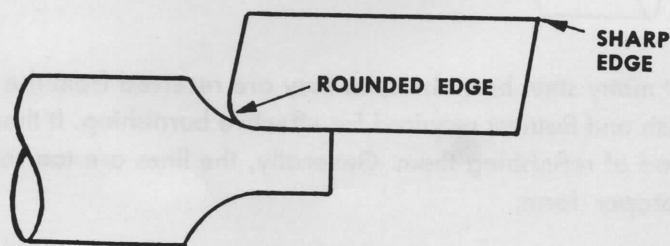


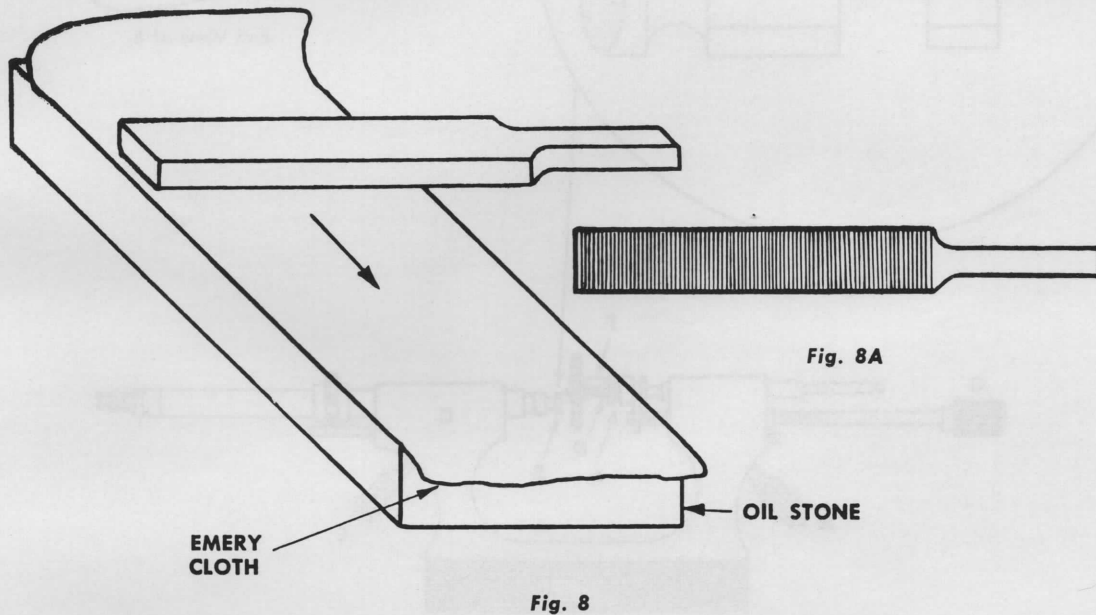
Fig. 7



Training Unit No. 4

3. The final stage in preparing the burnisher consists in putting on the lines. It is these lines which convert the burnisher into a superfine file. The burnisher will now be able to smooth out most defects and leave in their place a very even, mirror-like surface which will produce less friction.

Hold a strip of 2/0 emery cloth taut on the surface of the oilstone, Figure 8. Lay the burnisher on the cloth right angles to its edge. Using a moderately heavy pressure on the burnisher, draw it along the cloth in one direction only. Lift the burnisher and repeat for a few more times. Lines should also be formed on the rounded edge. The flat working surface of the burnisher with its lines is shown in Figure 8A.



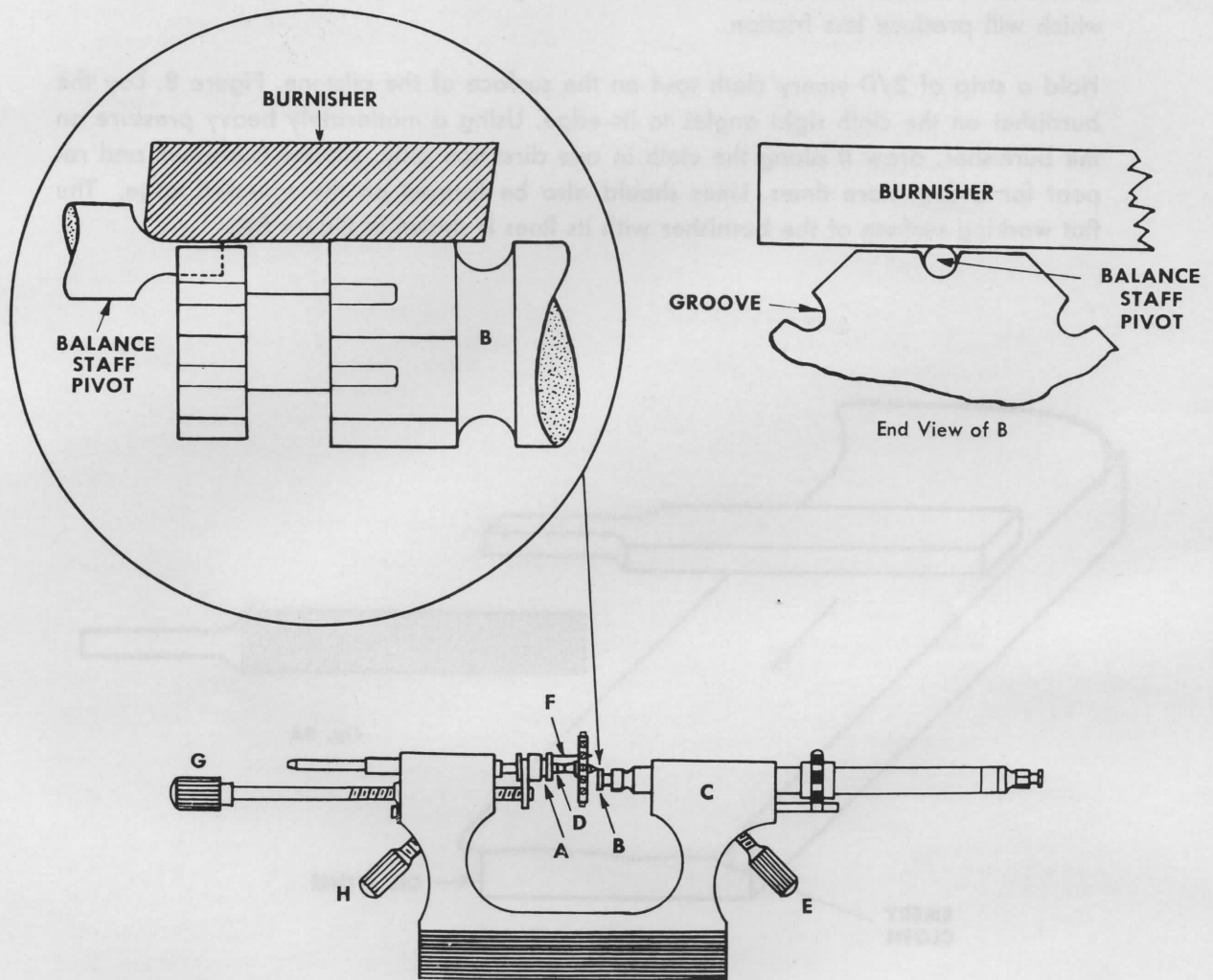
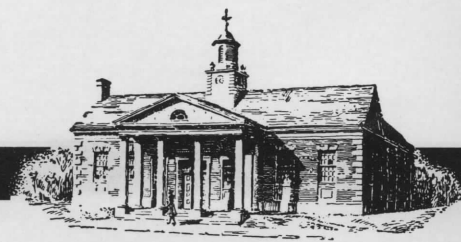


Fig. 9



THE JACOT LATHE

The Jacot Lathe offers one of the very best means of burnishing pivots. Figure 9.

The pivot to be burnished is placed in a cylindrical groove of the spindle. This groove is on a precise line of centers with the pulley rod which supports the other pivot. The risk of breaking or bending a pivot while burnishing is reduced because it is solidly supported in the groove. The cone and the end of a pivot as well as its cylinder surface may be easily and efficiently burnished in the Jacot Lathe. The progressive steps listed below explain how this may be accomplished.

Burnishing the Pivot Cylinder

1. Mount the fiddle bow. To do this, place the silk thread on the bottom of the pulley A with the handle pointing away from you. Hold the thread in the pulley groove with one hand; with the other hand bring the handle forward so as to form a complete loop around the pulley.
2. Select the proper size cylindrical groove in the spindle B that will accommodate the pivot to be burnished. The requirements are that the pivot rests on the bottom of the groove and extends a few hundredths of a millimeter above the level of the flat top.
3. Insert the spindle in the main frame of the tool C with the selected groove uppermost.
4. Oil the burnisher with watch oil, also the pivot — supporting end of the centering arbor D.
5. Carefully insert a pivot in the centering arbor D. Tighten screw H.
6. Adjust the spindle containing the selected groove so that there is a bit of endshake. Not quite all of the cylinder is supported in the groove. This prevents the edge of the groove from cutting a ridge in the cone. Tighten screw E.
7. Move the wire dogs F toward the balance wheel until they straddle one of its arms. This is done by turning screw G.
8. Place the burnisher on the top of the pivot resting in the groove. Do not permit the wheel to turn until this step has been taken, otherwise damage to the wheel and pivot will result. While burnishing, keep the rounded edge of the burnisher in contact with the cone of the pivot and the flat part of the burnisher in solid contact with the cylinder of the pivot.
9. Move the bow downward and the burnisher forward; then the bow up and the burnisher toward you. The pivot and burnisher at the point of contact will thus move opposite to each other. This establishes the action necessary to burnish the pivots and should be continued until the pivots are restored to a high finish. This action is the same as is used in "roll filing."



Training Unit No. 4

Burnishing the End of a Pivot

One of the arbors or spindles of the Jacot Lathe set is provided with two discs which contain a series of graduated holes. Each of the holes is chamfered so that it will accommodate the cone of a pivot. This permits more of the pivot cylinder to extend beyond the outside of the disc and provides a stronger working support for the pivot while its end is being burnished.

1. Select a hole in the disc which will permit its chamfer to support the cone of the balance staff. Figure 10.
2. Rotate the balance with the fiddle bow and keep the oily burnisher held solidly against the end of the pivot while moving it back and forth as was done while burnishing the cylinder surface of the pivot.
3. To flatten or shorten the end of a pivot keep the burnisher moving on a line perpendicular to the axis of the pivot.
4. Burnishing either the cylinder surface or the end of a pivot may produce a sharp or burred edge around its end. This must be removed and is accomplished by presenting the oily burnisher on an angle to the axis of the pivot. Figure 11. The burnisher and wheel are moved in the same manner as before.

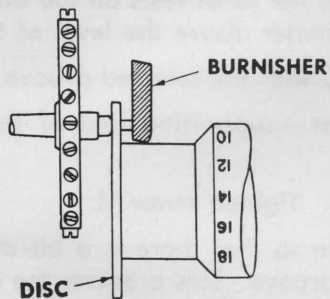


Fig. 10

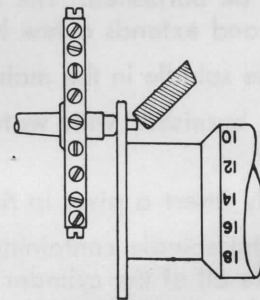


Fig. 11

Burnishing Train Wheel Pivots

The Jacot Tool offers a very effective and efficient means for burnishing train wheel pivots. Figure 12. The procedure for selecting the proper groove in the spindle is the same as that used when burnishing conical pivots. The one selected should permit the pivot to be cradled in the bottom with a few hundredths of a millimeter extending above the level of the two flat surfaces. The sharp edged side of the burnisher is used for square shouldered pivots.

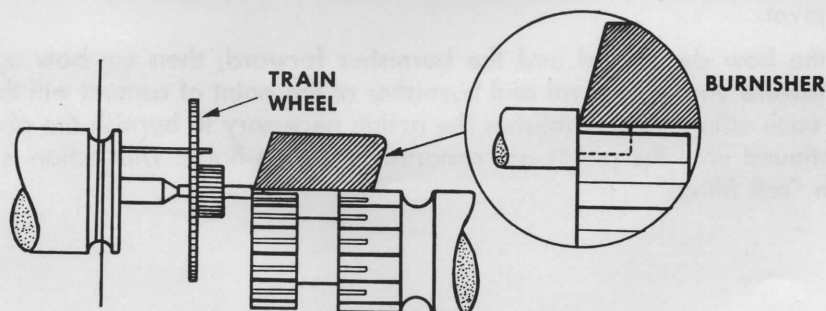


Fig. 12



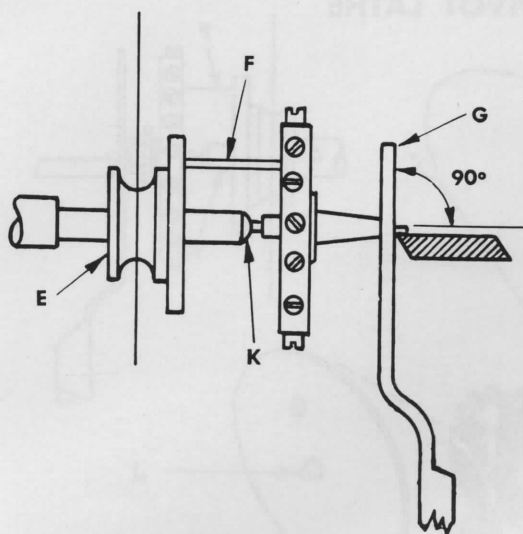


Fig. 13A

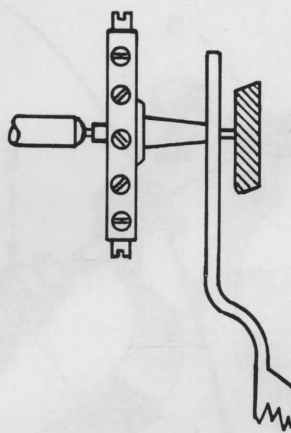


Fig. 13B

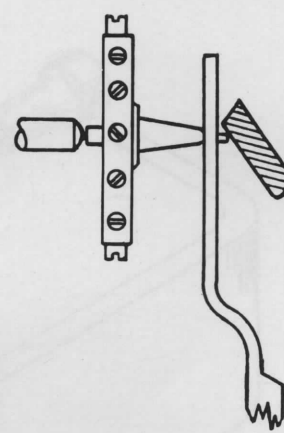


Fig. 13C

The fiddle bow is mounted as in the use of the Jacot Lathe. The pivot to be burnished is then inserted in the proper hole in the disc and the rod is brought forward until the other pivot is inserted in its end. There should be no end shake in the staff between the rod hole and the disc hole. The height of the disc must be adjusted so that the plane of the wheel is parallel to the disc. This will make certain that the pivot to be burnished will be perpendicular to the disc. Before burnishing, the burnisher and hole K in rod C should be moistened with watch oil. Figure 13A.

Care should be taken not to apply the burnisher against the pivot with too much pressure. As the fiddle bow is pulled downward the burnisher, which is held underneath the pivot, should be pushed forward. This will produce opposing motions between the burnisher and pivot. Failure to keep the burnisher flush against the pivot may develop a forward or a back taper.

To burnish the end of the pivot, the wheel is rotated with the fiddle bow while the burnisher is moved back and forth across the end of the pivot. Figure 13B.

Any burrs or sharp edges that have been formed after burnishing the cylinder or the end of the pivot should be removed by presenting the burnisher at an angle to it while turning the wheel with the bow. Figure 13C. A few very light strokes of the burnisher should successfully remove the sharp edge.

The burnisher used with this type of tool should be very slightly rounded on its edge in order to prevent wearing a groove in the pivot. However, the amount of roundedness used on the burnisher for the Jacot Lathe would be too great to do a successful job of burnishing with the Dorrington type of tool.



Use of the Balance Chuck

The balance chuck, which is an accessory for a regular jeweler's lathe, offers the watchmaker another means for burnishing pivots. Though it is advisable to remove the hairspring before attempting to burnish, it is not always necessary, especially where the hairspring is stronger and bigger as in pocket watches.

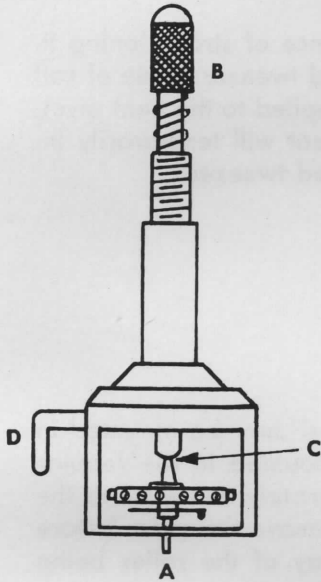


Fig. 14

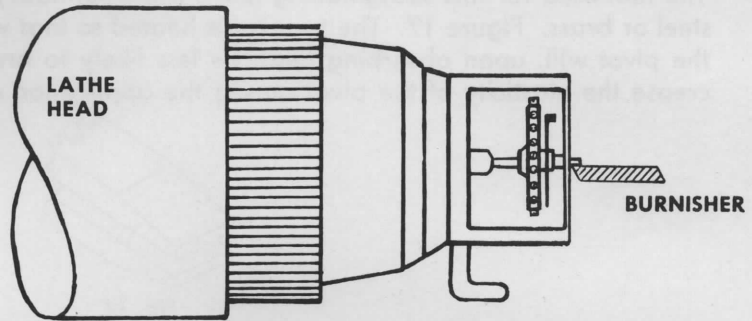


Fig. 15

After inserting the pivot A (Figure 14) through the front end of the chuck, the plunger B is brought down until pivot C can be inserted into the pivot hole of the plunger. The plunger is fixed in this position by tightening locking screw D.

The balance chuck and wheel may now be inserted into the jeweler's lathe head. Figure 15. A high speed may be used if the hairspring has been removed from the wheel. However, if the hairspring has been left on the wheel, then consideration must be given the possible harmful effect of centrifugal force. In such cases the speed should not be too high or else the hairspring may be damaged.

The steel burnisher used with the balance chuck should have a slightly rounded edge similar to that used with the Dorrington type of burnishing tool.

Care should be taken to present the burnisher to the pivot evenly along its surface, otherwise a forward or a back taper may develop in the pivot. While the chuck is turning in the lathe, a back and forth stroke is executed with the oily burnisher under the cylindrical side of the pivot.



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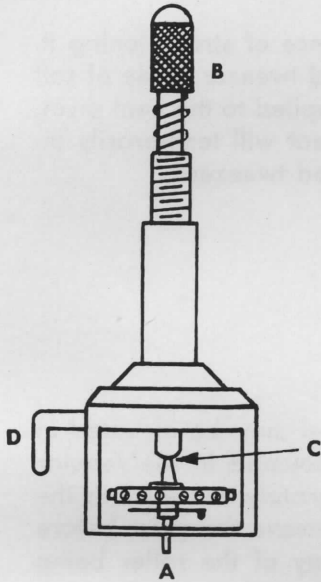


Fig. 14

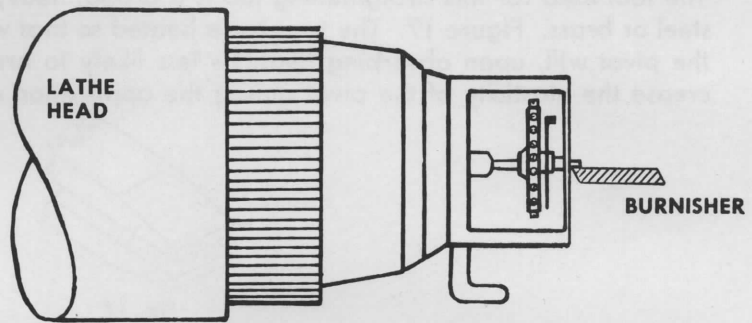


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Straightening Bent Pivots

If it is found that the bent pivot has a kink or double bend in it, Figure 16, any attempt to straighten it will be futile. In cases like this, the balance staff should be replaced.

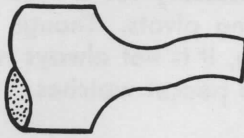


Fig. 16

However, if the bend is a smooth, single one, there is a good chance of straightening it. The tool used for this straightening job is a broad, heavy, snubnosed tweezer made of soft steel or brass. Figure 17. The tweezer is heated so that when it is applied to the bent pivot, the pivot will, upon absorbing heat, be less likely to break. The heat will temporarily increase the elasticity of the pivot during the application of the heated tweezer.

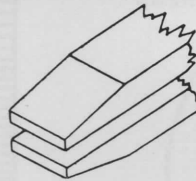


Fig. 17

The balance wheel and staff with the bent pivot to be straightened may be mounted in either the regular lathe head or the Dorrington Pivot Lathe. If mounted in the regular jeweler's lathe, care should be taken to see that the staff is accurately centered in the chuck before finally tightening up on the chuck. It is advisable to remove the roller before attempting to straighten the upper pivot because of the uncertainty of the roller being concentric with respect to the staff.

When the staff is centered, it is possible to determine how true or bent it is by using the tee rest as a fixed reference. By adjusting the left side edge of the rest so that a very narrow space of light appears between the pivot and the tee rest, the condition of the pivot may be seen by rotating the lathe head by hand.

After the error has been located, hold the pivot between the jaws of the tweezer and apply a pulling, bending action to it. Figure 18.

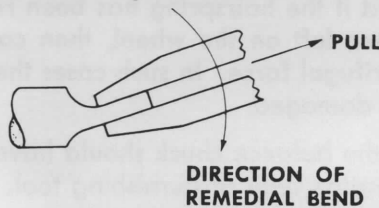


Fig. 18

Pivot straightening may also be accomplished by holding the balance wheel in the hand and using the straightening tweezer in the manner described before. The results should be checked for trueness by use of the Dorrington pivot lathe or the regular jeweler's lathe.

Every pivot straightening job should be followed by a burnishing operation to assure a proper finish to the pivot.

