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TRAINING UNIT
NUMBER 9B

FRICITION JEWELING

BULOVA SCHOOL *of* WATCHMAKING

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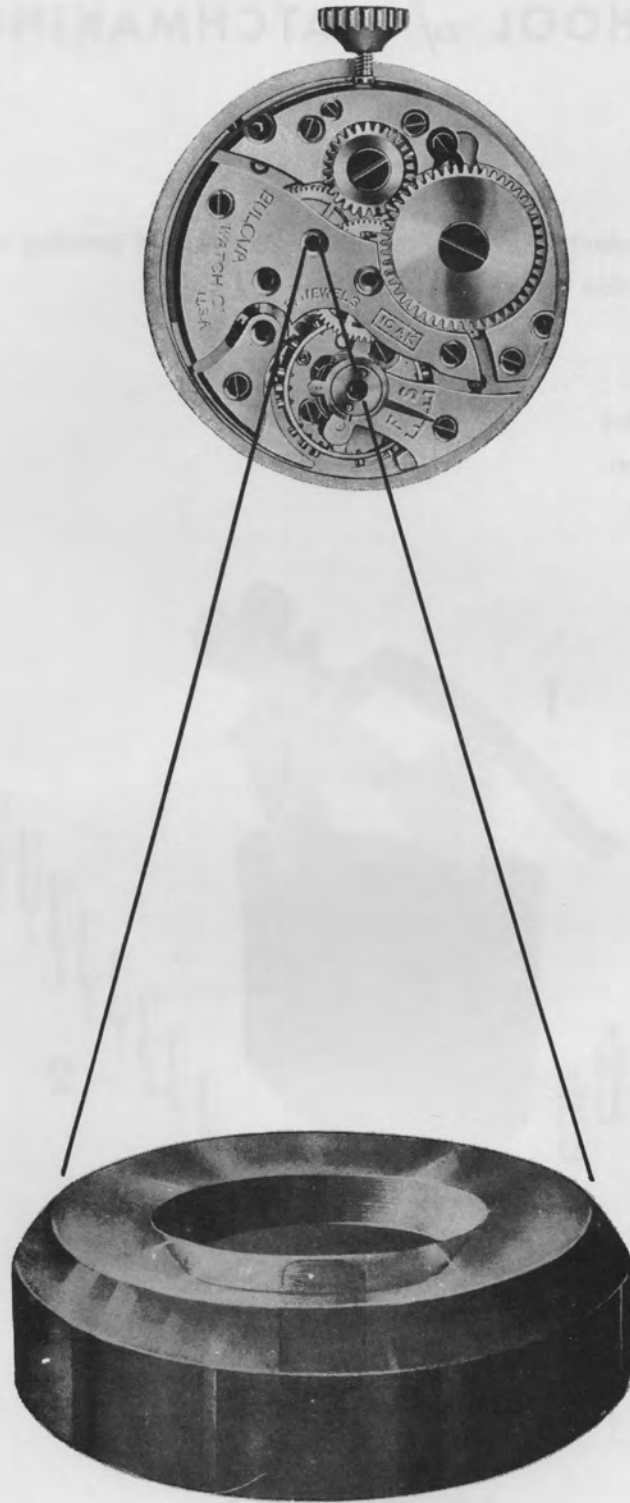


Jeweled bearings are a very essential part of modern watches. The quality of a watch is usually judged by the number of jewels employed in its manufacture. Some of the advantages for the wide use of jewels in watches and instruments are:

1. Reduction of friction.
2. Less wear on the pivots and bearings.
3. More efficient utilization of available power.
4. Longer life to the watch.

Synthetic ruby and sapphire jewels which are used in the better grade of watches are made up in a variety of shapes, diameters and hole sizes.

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Subject:

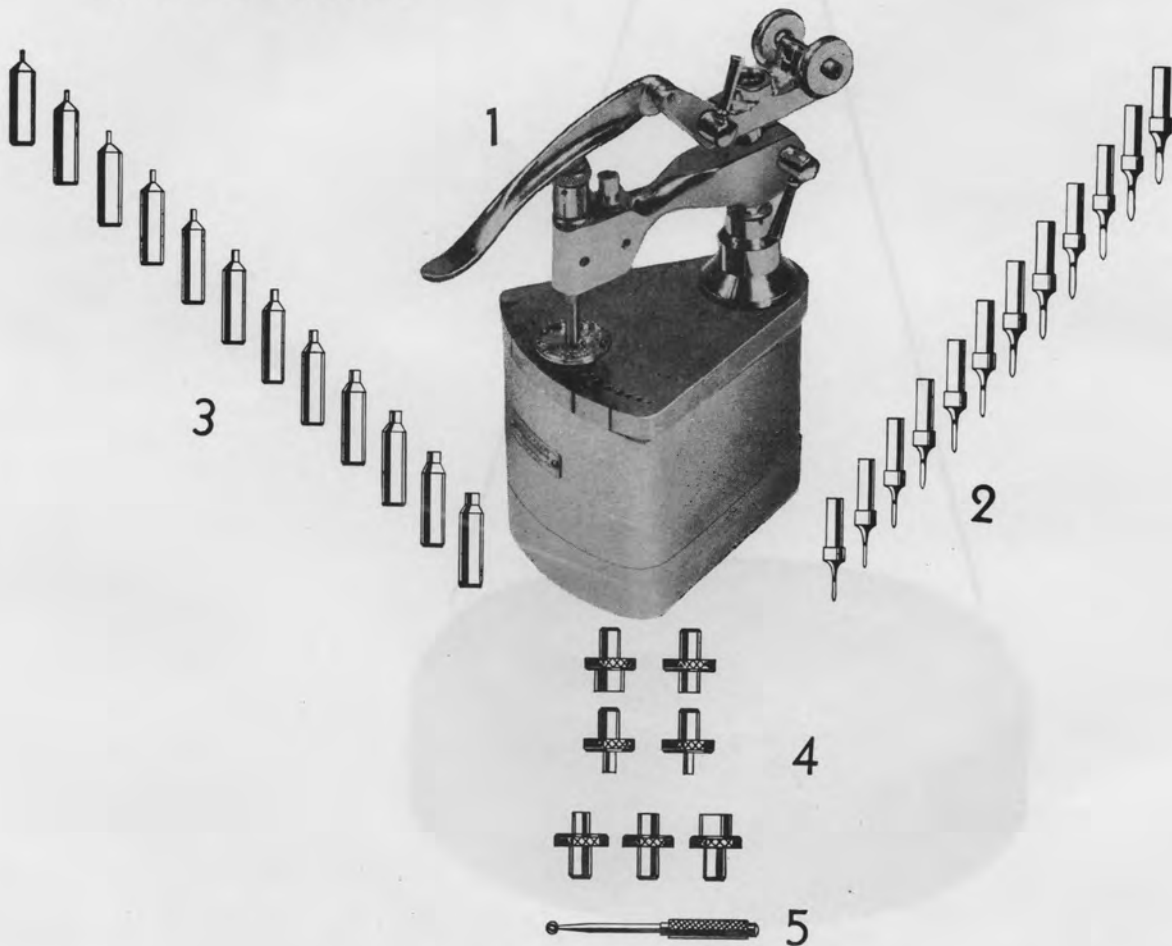
Friction Jeweling.

Objectives:

1. To familiarize the student with types of bearing jewels and jewelers tools.
2. To teach modern friction jewelers methods.

New Tools Required:

1. Jeweler Tool
2. Set of jewelers reamers
3. Set of jewelers pushers
4. Assortment of stumps
5. Countersinking Tool

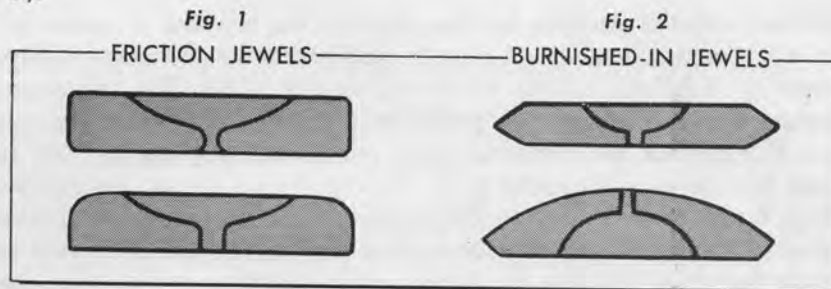


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TYPES OF BEARING JEWELS

All bearing jewels are made either with straight edges for friction setting or with beveled edges for the burnished-in type of setting. The straight edged jewel is known as the friction jewel (Fig. 1) and the beveled jewel is termed the bezel or burnished-in type jewel. (Fig. 2).

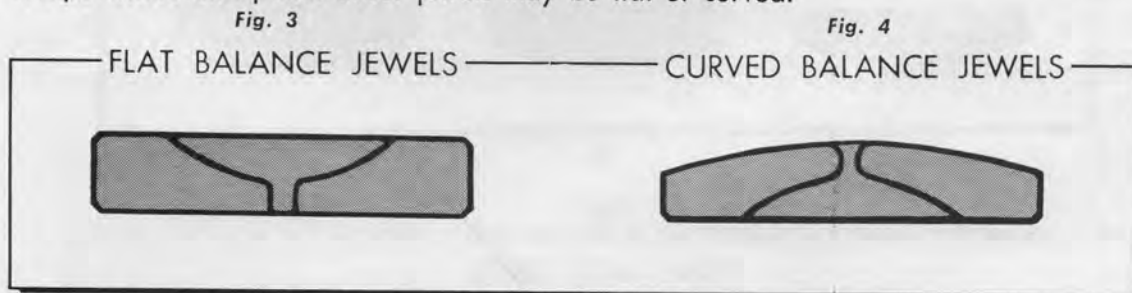


Jewels may have flat or curved surfaces as shown in Figs. 3 and 4. Curved jewels are more favorable to balance, escape wheel and pallet arbor pivots because of the oiling advantages.

To explain this further, oil or any liquid has a tendency to flow into a narrow space. For example, if two plates were held together so that their edges touched on one side and were slightly separated at the other side, a drop of oil between the plates would tend to run towards the touching sides. This is known as capillary action, and has a direct bearing on the use of curved jewels.

When a curved jewel is placed against a flat jewel, the oil will have a greater cohesion at the pivot than with a flat jewel. Also more oil may be stored, which in larger quantity may offer better resistance to chemical change and evaporation.

Train wheels which are generally uncapped use flat surfaced jewels, but balance, escape wheel and pallet arbor jewels may be flat or curved.

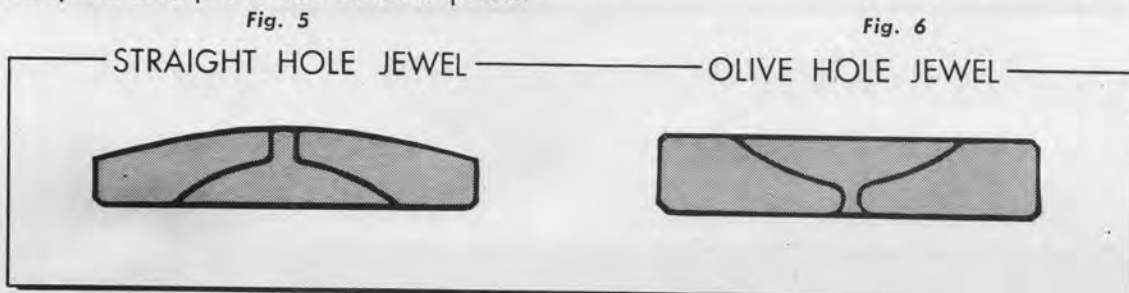


There are two types of holes in jewel bearings:

1. The regular straight hole which makes a sharp corner with the top and bottom surface of the jewel. See Fig. 5.
2. The olive hole which is made by grinding off the sharp corners at the top and bottom of the hole. See Fig. 6.

This process has the effect of reducing the area of contact between the jewel hole sides and the pivot which turns in the hole.

Straight holes are usually used for train pivots, and olive holes are preferred for escape wheel, pallet and balance pivots.



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Balance hole jewels are always backed with cap jewels (also called endstones) such as those shown in Fig. 7, and in the higher jeweled watches, the escape wheel and pallet arbor jewels are also made this way. Fig. 8 shows how the olive hole jewel and endstone assembly appears in the watch plate.

These endstones make it possible for the pivot of the balance or arbor to rotate on its end when in a horizontal position. A steady lubrication for the pivot is dependant on the staying power or capillary action of the oil at the pivot. This, of course, will be considerably influenced by the type of endstone used. The flat endstone shown at A, Fig. 7 provides a flat surface on which the pivot can rotate, but the oil may run off into the seam between the metal setting and jewel. As mentioned above, the curved endstone shown at B in Fig. 7 surpasses the flat endstone, but the proper theoretical curve must be maintained. Practical experience has proven such a consistency in the curve is often found to be lacking, with the result that the pivot may not be rotating at the dead center of the curved surface. In other words, the pivot end will tend to wear on one side because it is not centered over the flattest or most central part of the curved endstone.

However, best results have been obtained with the latest development in endstones shown at C, Fig. 7. With this type of endstone, a roomy, flat surface is always present, and if the oil should tend to flow towards the metal setting, then the capillary action of the oil will keep it from going beyond the start of the beveled edge of the endstone.

Fig. 7
TYPES OF ENDSTONE

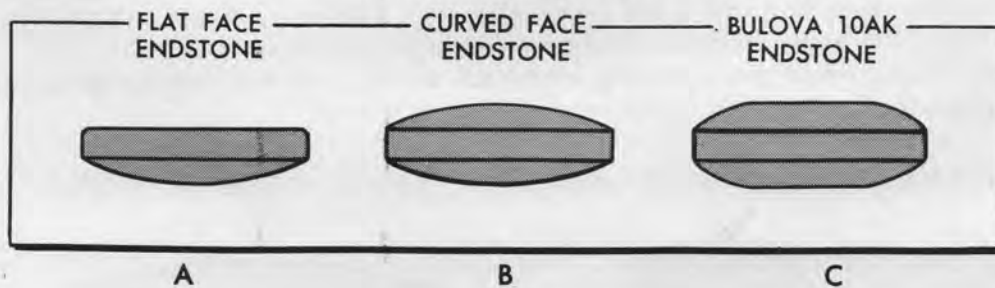
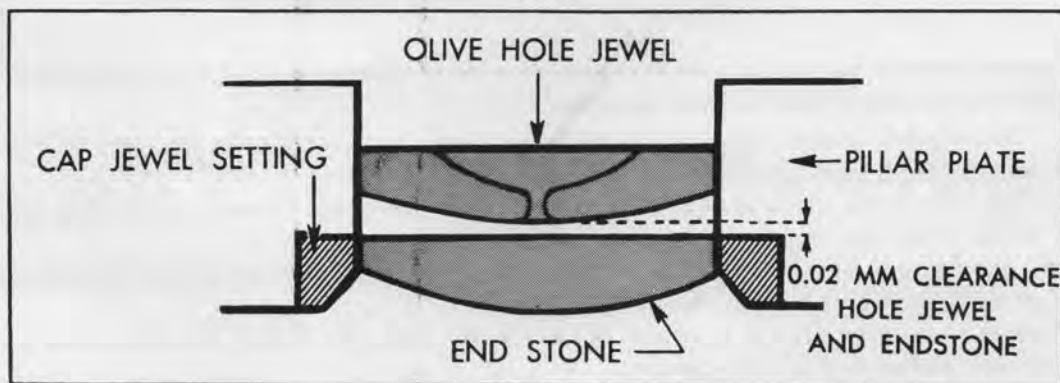


Fig. 8



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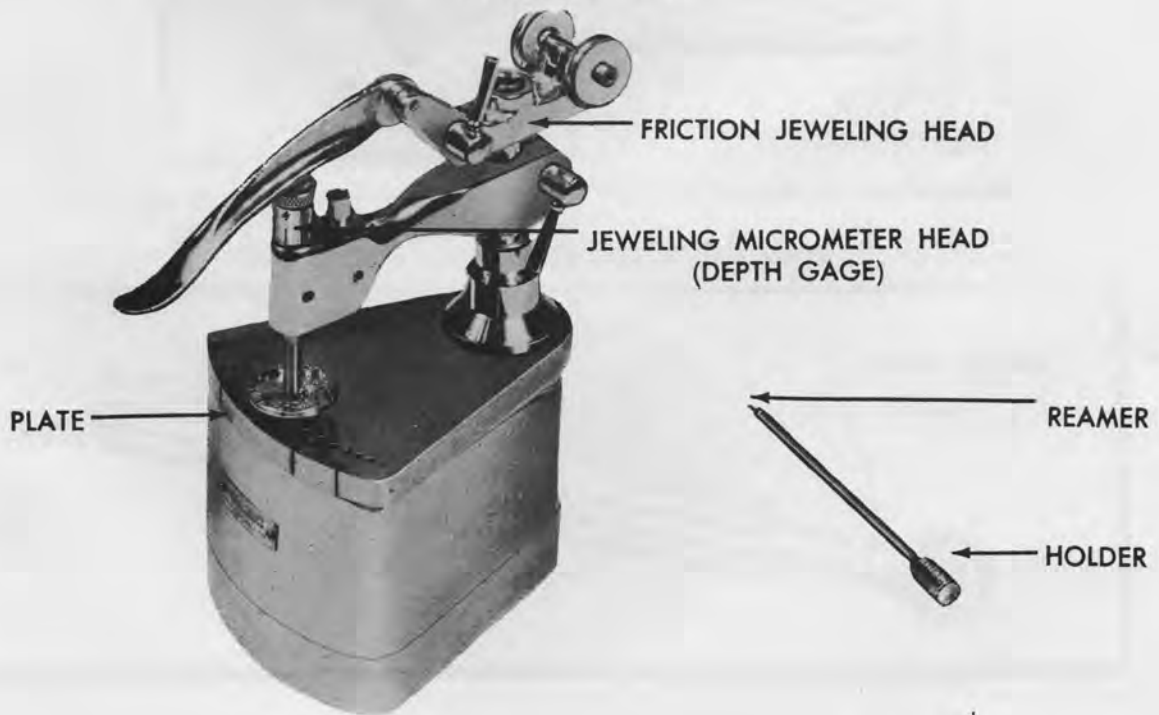
In the last few years, the leading watch manufacturers have adopted the improved system of friction jewel in place of the older and less efficient method of setting the jewels in individual brass or gold settings. Not only is the friction jewel process a time saver for the manufacturer and watch repairer alike, but the friction jewel is more rugged than its predecessor, the bezel jewel. Being much thicker throughout its entire diameter, the friction jewel will be less apt to chip or crack than the older type (see Fig. 2) with its thin edge. Another valuable advantage of the friction jewel is the ease with which it may be shifted in the plate hole to obtain the desired endshake.

The jewelng tool consists of a lever device, a set of reamers, a set of pushers, and an assortment of stumps. Before inserting the jewel, the hole in the plate must be reamed out perfectly straight by a precision-gauged self-centering reamer. These reamers are numbered to correspond to the diameters of the jewels which may be purchased for this purpose. Actually, the reamer is .01 mm smaller in diameter than the jewel. The jewel can then be pressed to any required depth by means of the jewelng lever which applies a pressure of 30 to 35 lbs. to force the jewel in and 6 to 15 lbs. to push out the jewel. A micrometer stop adjustment or depth gauge controls the depth to which the jewel is to be inserted.

Various types of jewelng tools are available for the purpose of removing and replacing broken jewels. All of them are good and serve the purpose well. Fig. 9 shows a jewelng tool and its accessories.

Fig. 9

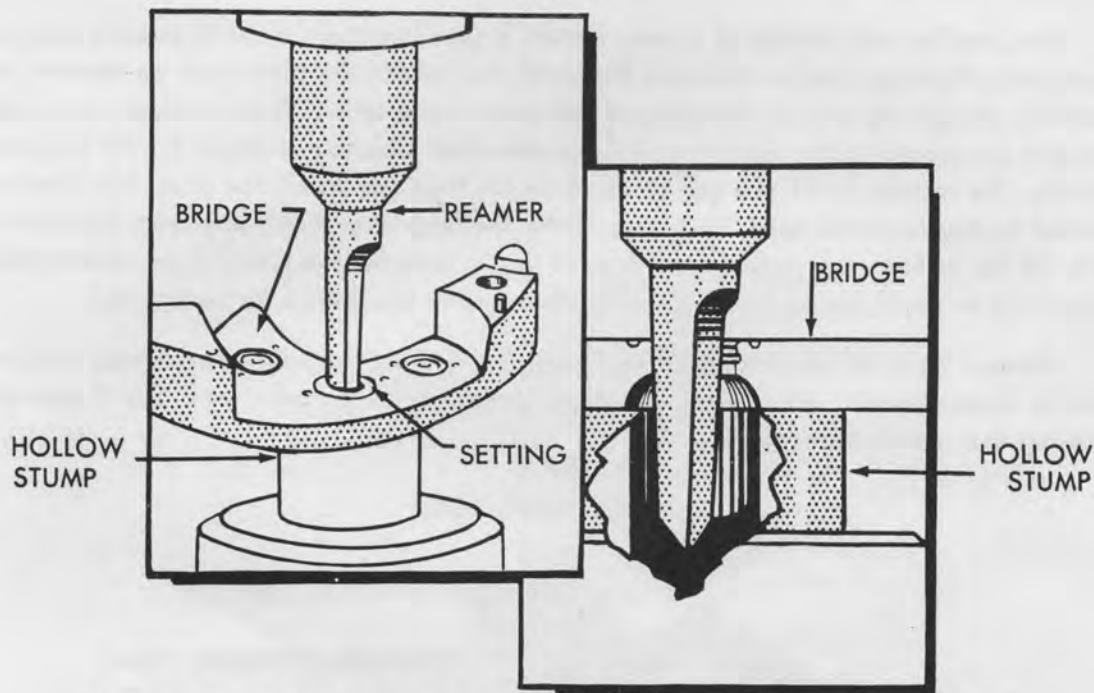
JEWELING TOOL



HOW TO USE THE FRICTION JEWELING TOOL

- A. When the plate is being fitted with a friction jewel for the first time,
Select a self-centering reamer which corresponds to the diameter of the available jewel. Its number will be the same as that on the jewel bottle. (If no system is being used the reamer must be .01 mm smaller than the jewel.)
Insert reamer in tool and ream plate hole to size.
If the jewel is more than .10 mm larger in diameter than the plate opening, step up the reaming job .10 mm at a time.

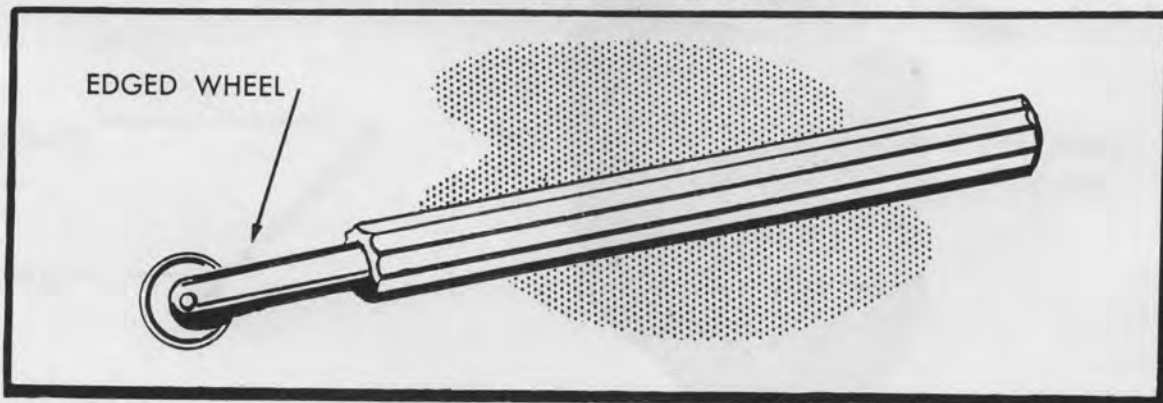
Fig. 10



Remove burr at edge of the hole with a countersinking tool. (See Fig. 11).

Fig. 11

Wheel Countersink for finishing a reamed hole



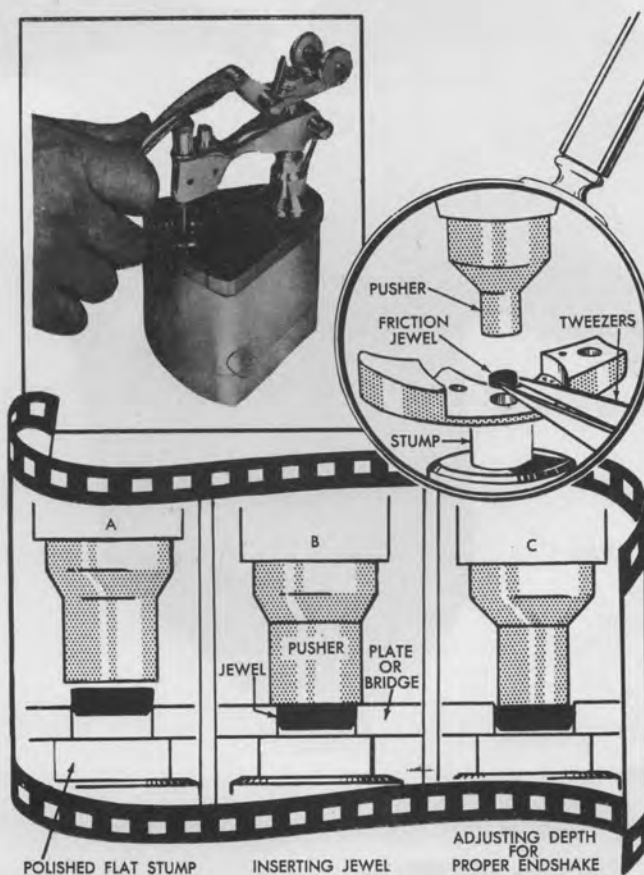
Training Unit Number 9B

Select proper jewel to correspond with reamer number. Pivot hole must be checked with diameter of wheel pivot for proper side shake.

When the face of the jewel is to be *flush* with the plate or bridge insert jewel by using a pusher larger in diameter than the plate hole (A-B Fig. 12).

When the face of the jewel is below flush with the plate or bridge, use a pusher smaller in diameter than the jewel (C, Fig. 12).

Fig. 12



Check endshake of wheel mounted between the plates.

Endshake can be adjusted by raising or lowering the jewel in the *pillar* plate. (Keep bridge jewels the same depth).

Examine jewel for chips or cracks. Also check to see that the jewel is parallel with the plate.



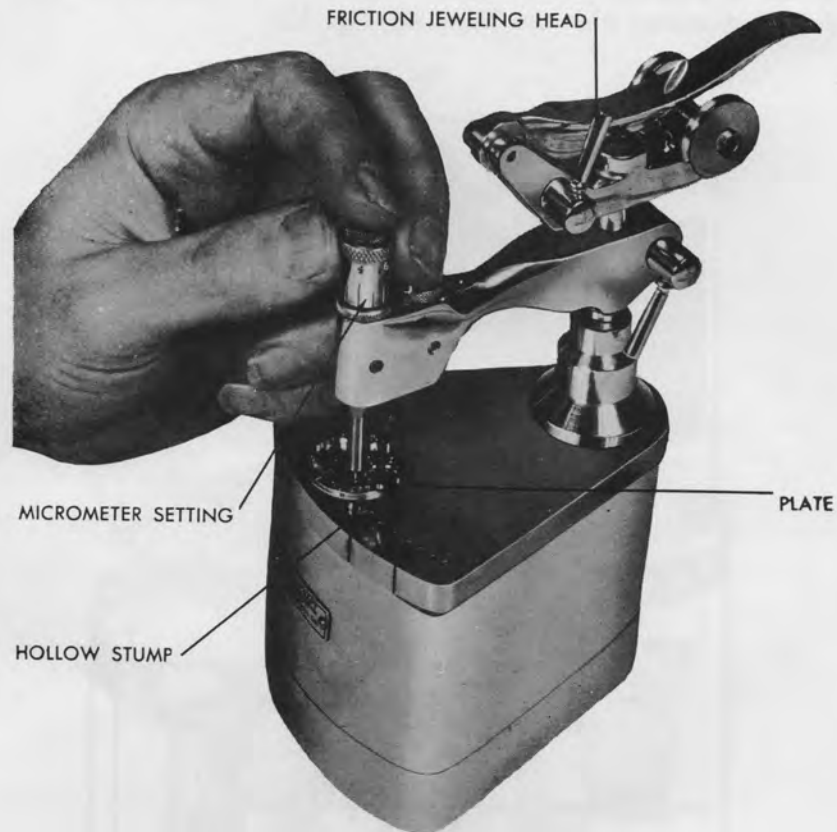
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B. When a broken jewel is being replaced,

1. Insert the pusher so that it rests on the old jewel, and then adjust the micrometer stop. (See Fig. 13.)

MEASURING THE DEPTH
OF BROKEN JEWEL

Fig. 13



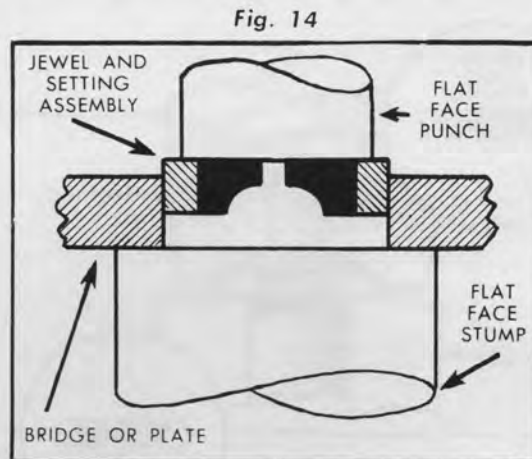
2. Remove pusher and cracked jewel.
3. Insert reamer which is just slightly larger than hole.
4. Ream hole to size. (See Fig. 10).
5. Remove burr with countersink.
6. Select proper fitting jewel to correspond with reamer number.
7. Insert jewel to depth determined by micrometer stop.

The remaining steps are exactly the same as those wherein the jewel is being inserted in a plate for the first time.



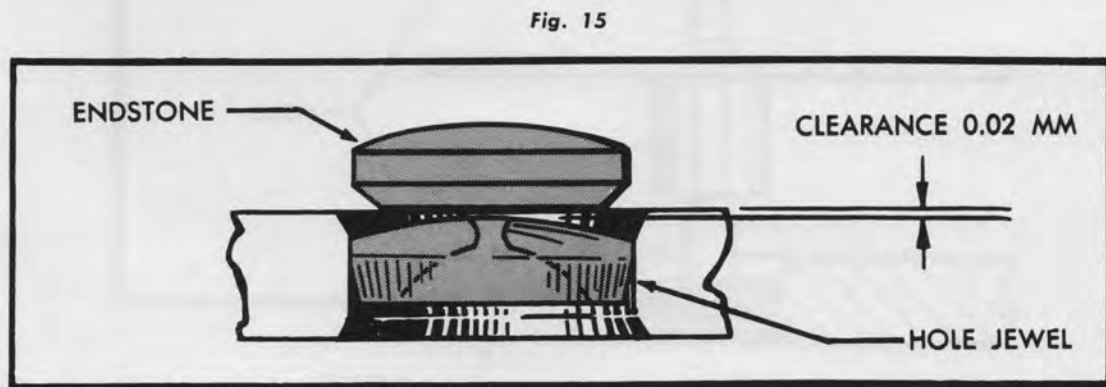
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In many models of watches, instead of inserting the jewel directly into the plate and bridges, the jewel is first mounted in a setting and then the jewel and setting assembly is fitted friction tight into the plate. In such cases, the procedure of inserting the jewel in the setting or adjustment of endshake by raising or lowering the jewel setting in the pillar plate is accomplished in exactly the same way as the unmounted friction jewel. See Fig. 14.



However, when a balance hole jewel is being replaced in its old setting, a clearance of .01 to .02 mm must be allowed from the bottom of the hole to the outer edge of the setting. This will insure the proper capillary action of the oil when the endstone is in place against the pivot.

In Fig. 15, it is demonstrated how careful measurements must be made so that the jewel is .02 mm below flush with the balance endstone cap.



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Occasionally it will be found that even a genuine factory made jewel setting will appear to be loose fitting. This can be due to careless handling or frequent removal and replacement of the setting. In such cases, the setting may be "spread" by tapping it on a staking stump with an inside taper punch. As shown in Fig. 16, the diameter of the punch must be wider than that of the jewel setting. The edge of the setting is thus rolled over, increasing its diameter sufficiently to make the necessary friction.

Fig. 16
"Spreading" a Jewel Setting

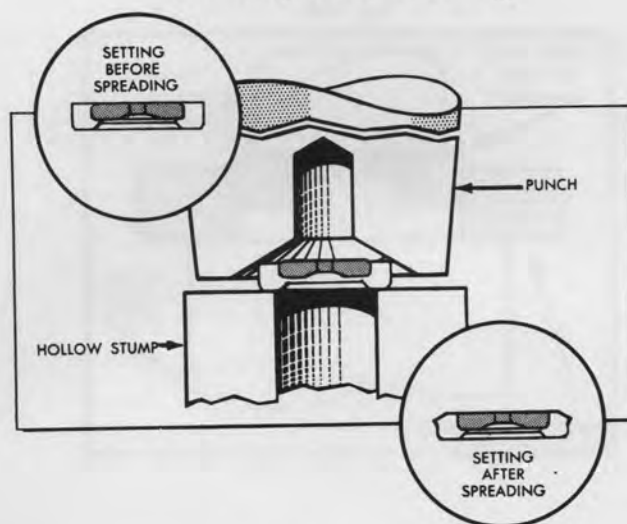
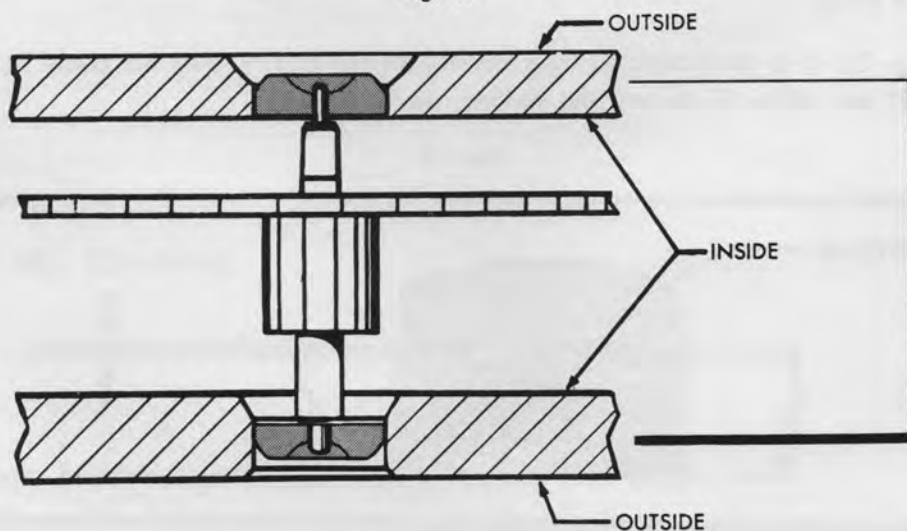


Fig. 17 Definitions

The terms "outside" and "inside" in the following description refer to the locations shown in figure 17. Inside designates a position between the plates and bridge.

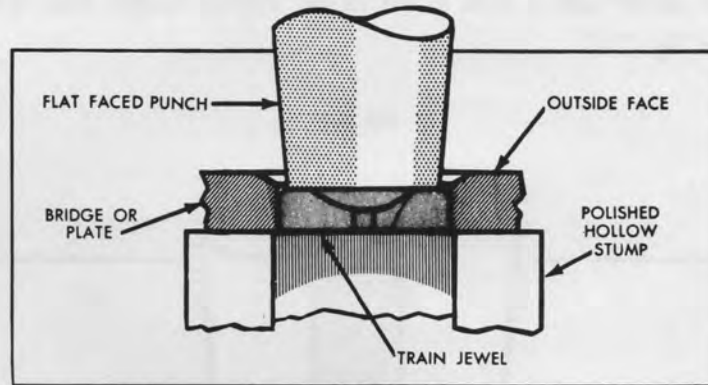
Fig. 17



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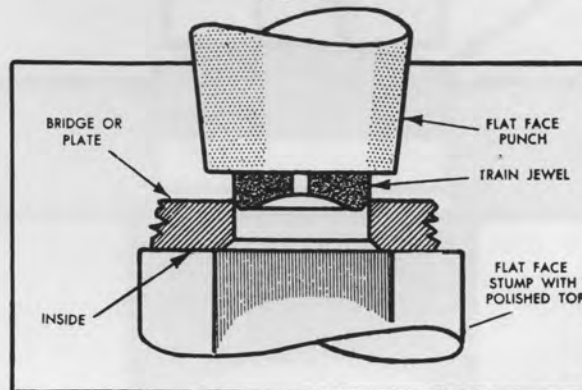
When replacing plate or bar jewels, it is good practice to remove the old jewels by driving from the outside as illustrated in Fig. 18.

Fig. 18



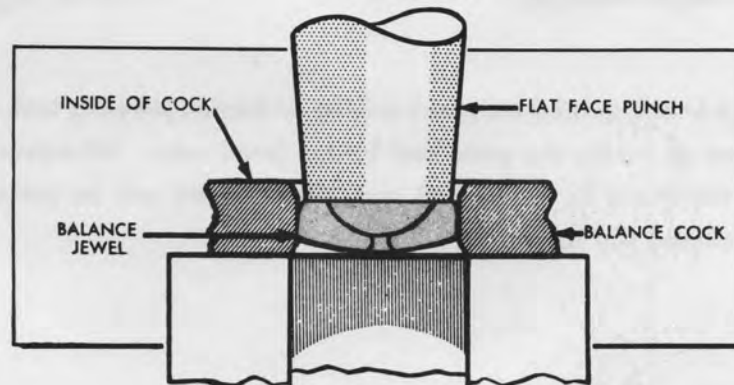
The new bar jewel should be inserted from the inside as shown in Fig. 19.

Fig. 19



Balance olive hole jewels should be driven out from the inside. (See Fig. 20).

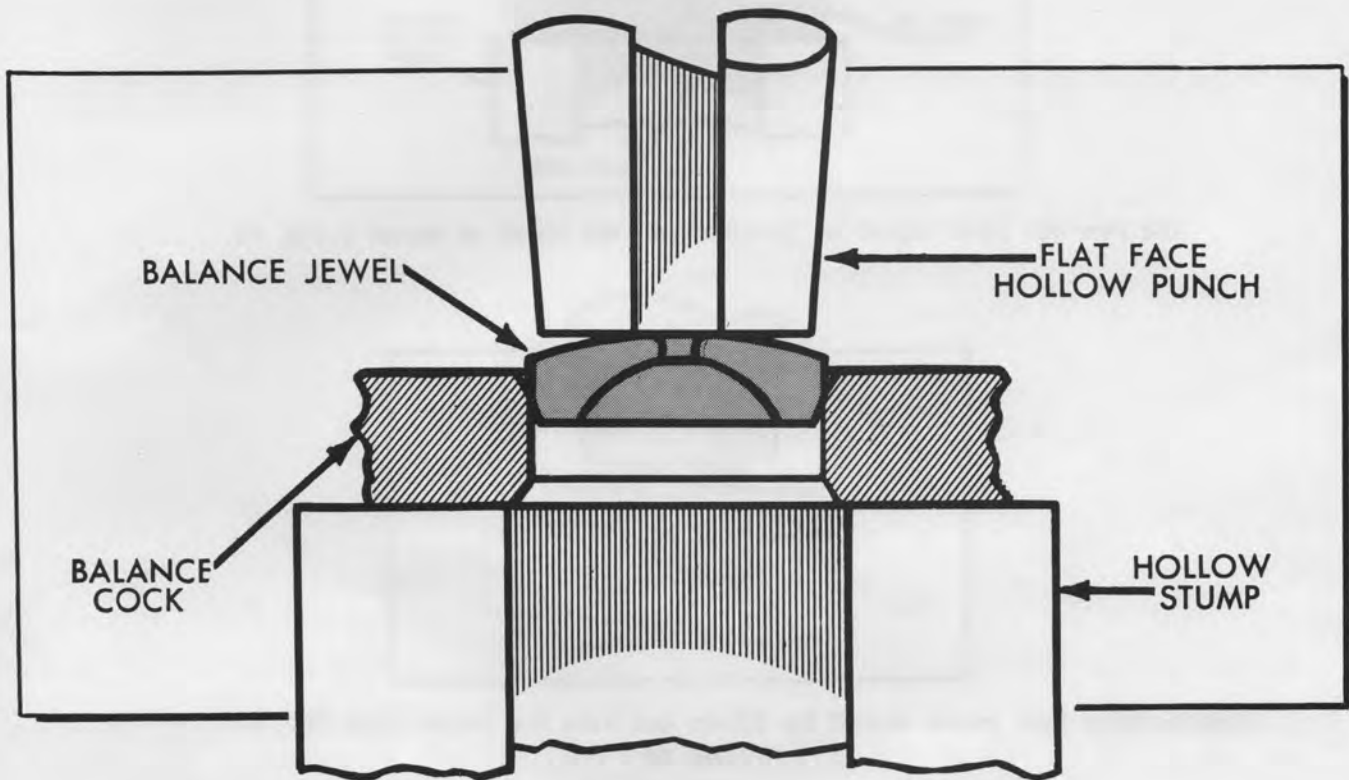
Fig. 20



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When balance olive hole jewels are being replaced, they should be pushed from the outside with a flat punch with a hole in the center slightly larger than the size of the hole in the jewel. (See Fig. 21.)

Fig. 21



With careful handling on a standard staking or friction jewelers tool, it will be seldom necessary to ream or modify the plate and bridge jewel holes. Wherever a bridge comes in contact with the stump as in Figs. 18 and 19, the finish will be preserved if a stump with a highly polished flat surface is used.

