



CHICAGO SCHOOL OF WATCHMAKING

*Founded 1908 by* THOMAS B. SWEAZEY

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### SEC. 500 -- Metals Used

This lesson deals with lathe work as concerned with base metals. The base metals used in watchmaking are brass and nickel and occasionally oreide, which has a high copper content. These metals are easy to work and if the student will keep the cutting edge of his graver polished, a smooth polished finish can be obtained. Polishing the graver is best done with a 4/0 emery buff.

### SEC. 501 -- Steps in Setting a Train Jewel

1. Select train jewel to be set. Push a pointed piece of pegwood through the hole in jewel keeping the oil cup down, figure 30-1. Tap slightly on bench plate in order to flatten pointed end of pegwood. This will hold jewel securely and make it easy to handle.

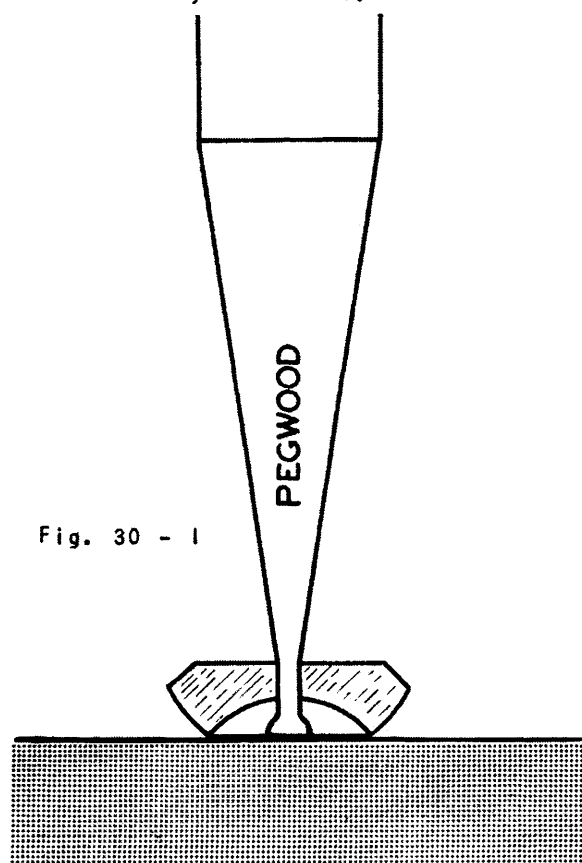


Fig. 30 - 1

2. Place brass, nickel or oreide rod in lathe chuck and center, figure 30-2.

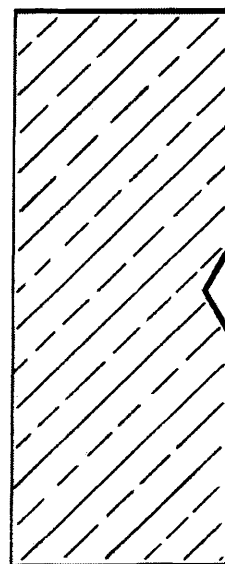


Fig. 30 - 2

3. Select a drill about 2/3 the diameter of the train jewel. Drill a hole fairly deep into the rod, figure 30-3.

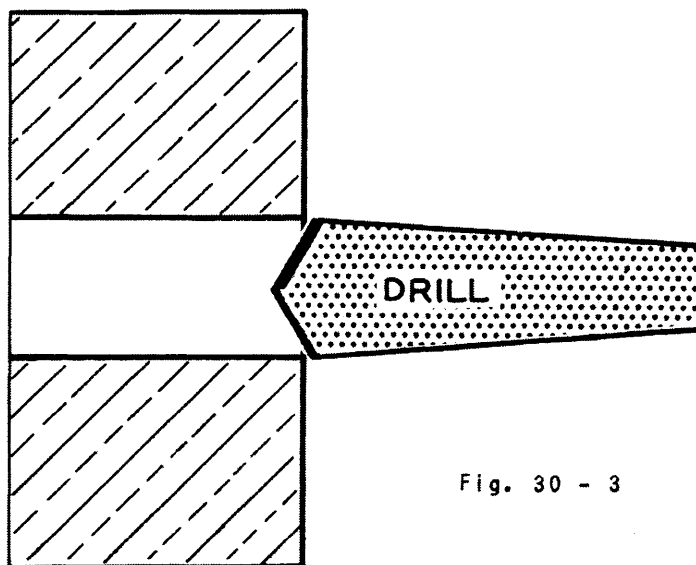


Fig. 30 - 3

4. Place seat cutting tool in position shown in figure 30-4, cut a seat by running lathe in reverse and moving seat cutting tool with left forefinger in the direction of Arrow A.

5. The train jewel is then tried into the seat, figure 30-5. The jewel should fit freely without side play and the face

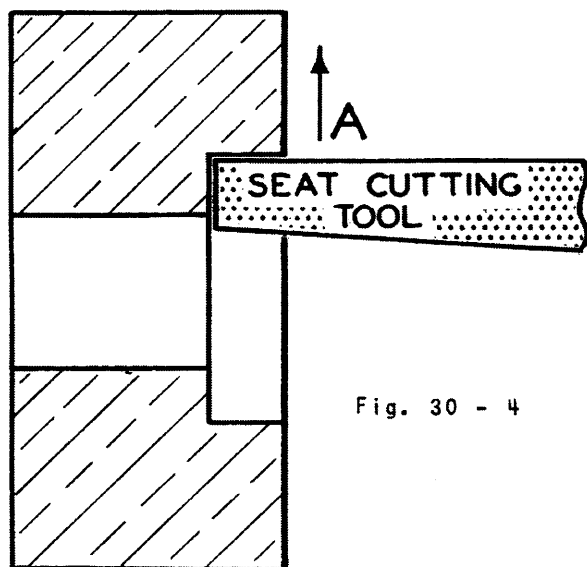


Fig. 30 - 4

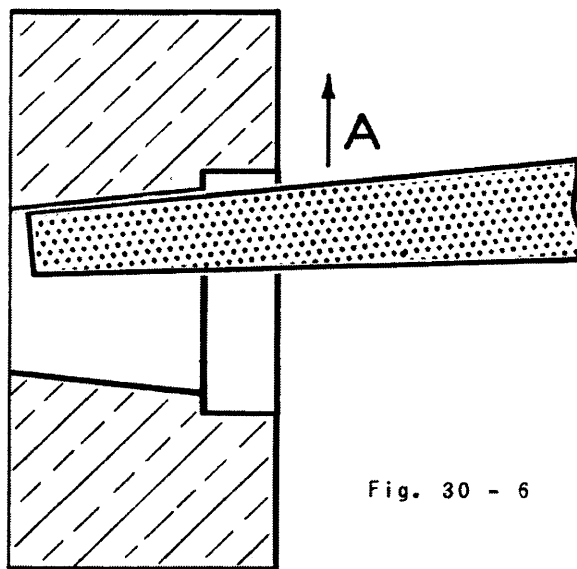


Fig. 30 - 6

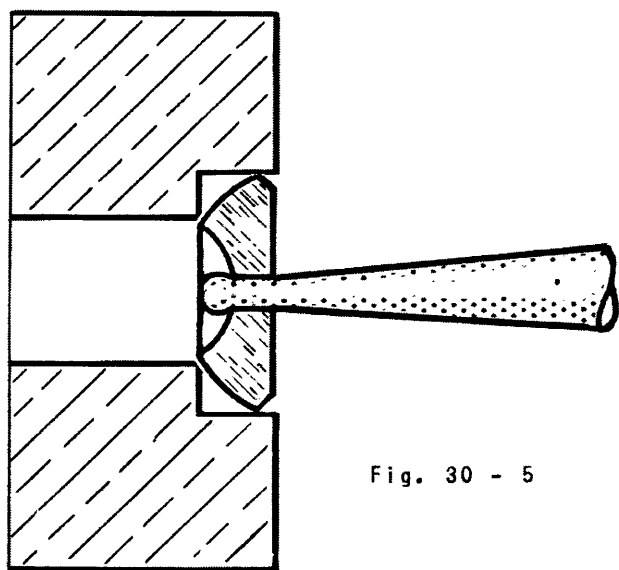


Fig. 30 - 5

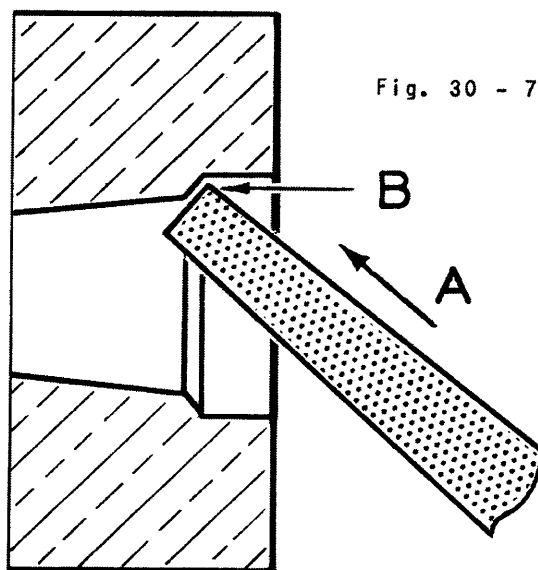


Fig. 30 - 7

of the jewel should be just below the surface.

6. Open the back of hole with seat cutting tool, running the lathe in reverse and moving the tool in direction of Arrow A, leaving a small shoulder, as shown in figure 30-6.

7. Bevel the corner of shoulder B with seat cutting tool, moving tool in direction of Arrow A, as illustrated in figure 30-7. This will allow the curved portion of train jewel on side of oil cup to rest securely in place. Face off rod

until the jewel is just below the surface. It is now ready to be burnished in place.

8. With a square graver or a long pointed stripping tool, make a small cut to the edge of the hole as in figure 30-8. This is called the bezel.

9. Place train jewel in seat, place tweezers over face of train jewel and extract pegwood. A very small amount of beeswax applied to jewel before placing in hole will help keep jewel in place until burnished.

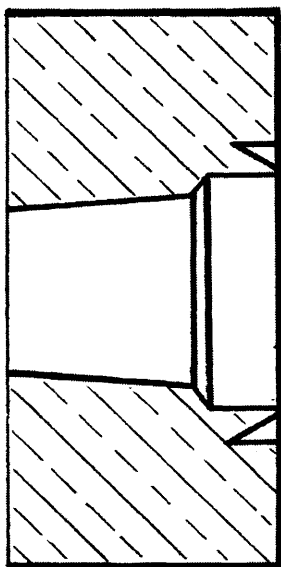


Fig. 30 - 8

10. Place burnisher in bezel, figure 30-9, and roll bezel over train jewel while running the lathe forward. Face off rod until jewel is slightly below surface and jewel will appear as in figure 30-10.

11. Figure 30-11 illustrates the train jewel in place and the burnisher held in position to burnish the edge of metal over the jewel without a cut bezel.

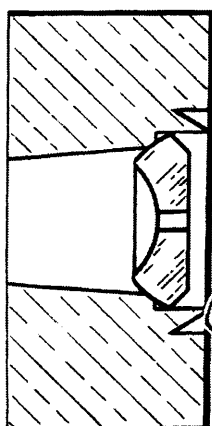


Fig. 30 - 9

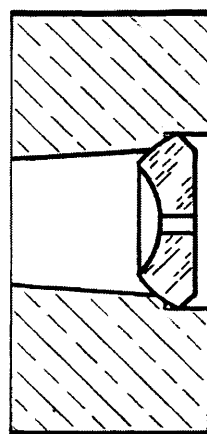


Fig. 30 - 11

12. Cut diameter of rod to preselected diameter, figure 30-12.

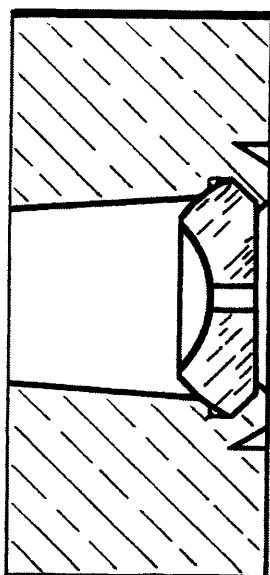


Fig. 30 - 10

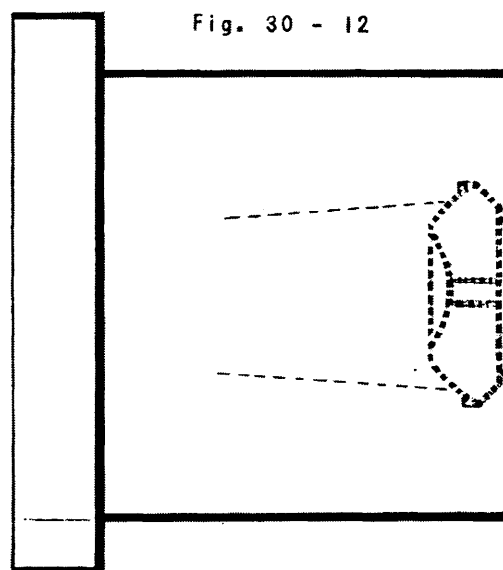


Fig. 30 - 12

13. Cut square shoulder on end of stock to correct depth and diameter as in figure 30-13.

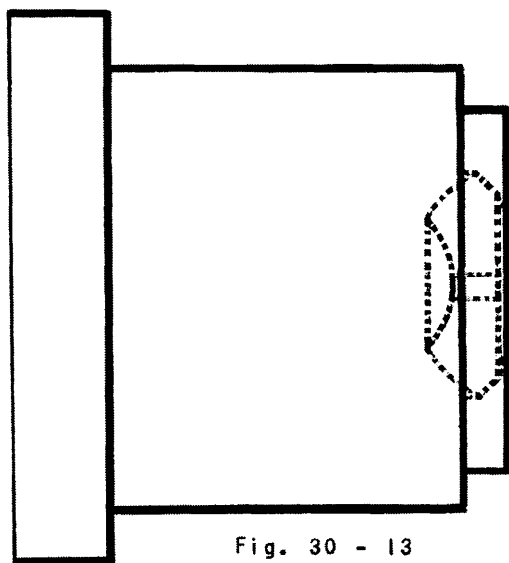


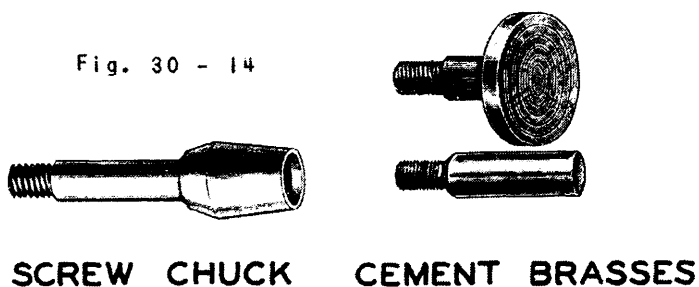
Fig. 30 - 13

### SEC. 502 -- Steps in Stripping a Train Jewel Setting

Figure 30-14 illustrates a screw chuck. The screw chuck is made up of a steel chuck tapped to receive the threaded end of a cement brass. These come in assorted diameters. The face of the cement brass should be faced off. This will insure a true flat surface upon which to cement and center the jewel setting. The best cement to use is pure orange shellac in stick form. Be careful not to overheat or burn the shellac as it loses its adhesive qualities. In case this happens, remove burned cement and start over.

1. Figure 30-15 illustrates the method used to face off a cement brass prior to cementing a jewel. Be sure that the cement brass has been screwed securely into the chuck. Before proceeding any further, it might be well to make a little experiment. Heat the end of your stick shellac with the flame of an alcohol lamp and quickly press against the face of the cement chuck. It will be seen that the cement does not adhere to the cold metal, thus illustrating clearly that the metal must be heated to a temperature which

Fig. 30 - 14



SCREW CHUCK

CEMENT BRASSES

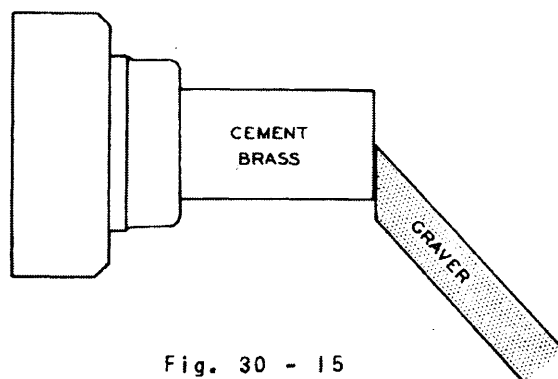


Fig. 30 - 15

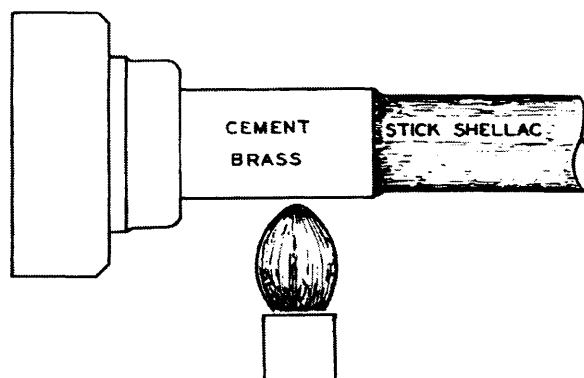


Fig. 30 - 16

will melt the cement before it will adhere properly.

2. In figure 30-16, the flame of the alcohol lamp is held directly beneath the cement brass. With the lathe turning, hold the stick shellac against the face of the cement brass until the cement melts and covers the face of the cement brass.

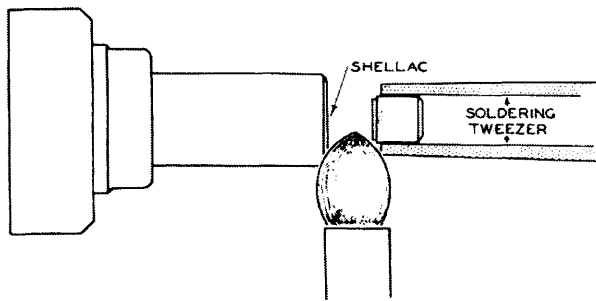


Fig. 30 - 17

3. Hold the jewel setting with a pair of soldering tweezers as illustrated in figure 30-17 and with the flame of the alcohol lamp placed in the position shown, keep the cement brass warm while heating the jewel setting. When the jewel setting has been heated, push it against the face of the cement brass and pull away. If the cement adheres to the face of the setting, the cement is of the proper temperature.

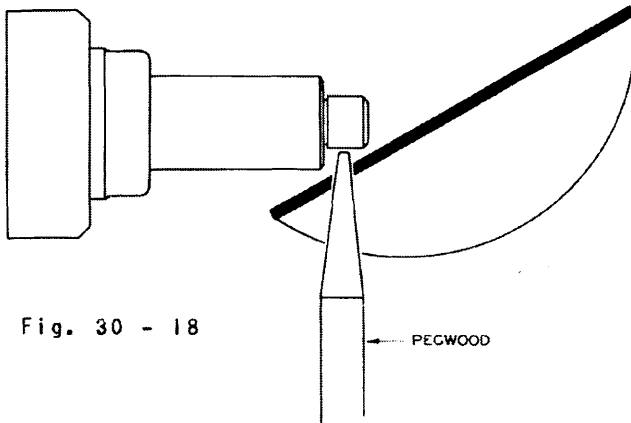


Fig. 30 - 18

4. Set jewel setting on cement chuck and set T Rest as close to the cement brass and setting as possible, as shown in figure 30-18. With a piece of pegwood in position shown, true the setting up by running the lathe forward and holding the pegwood lightly against the side of the jewel setting. If it does not adhere properly or run true, warm the cement brass again and repeat the truing process until

your setting runs absolutely true. The setting should now appear on the face of the cement chuck as shown in figure 30-19. With a stripping tool, which has had the edge polished with a 4/0 emery buff, place in the position shown in this figure and face off the setting to the proper thickness.

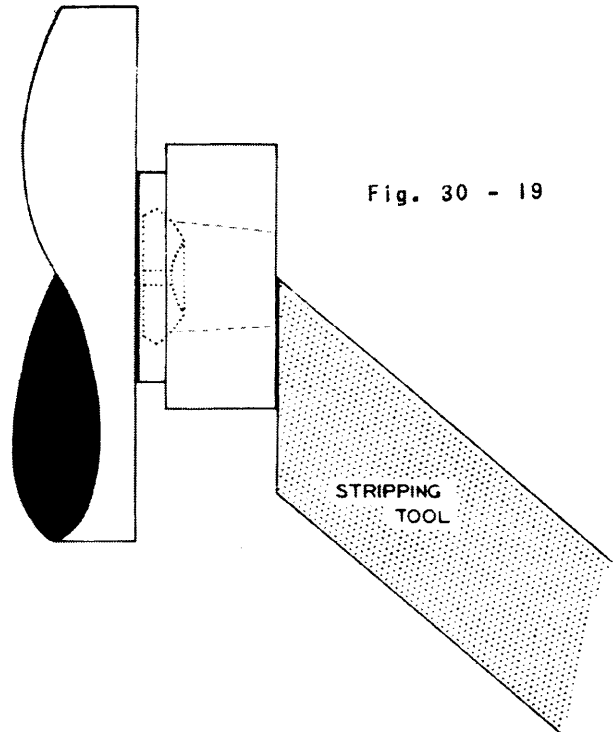


Fig. 30 - 19

5. Place the stripping tool in the position shown in figure 30-20 and open

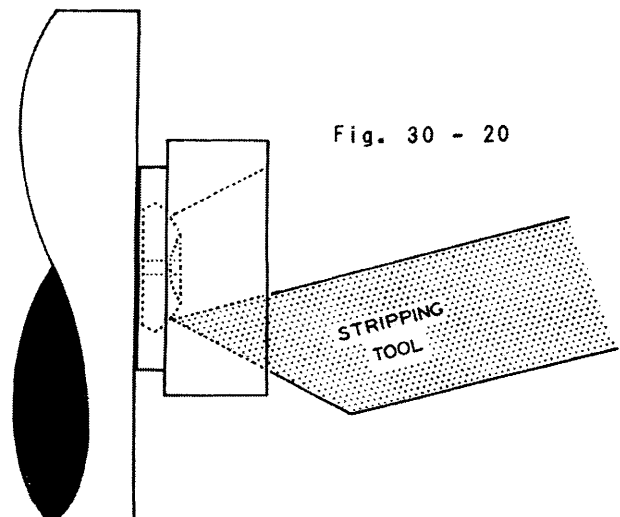


Fig. 30 - 20

up the hole leaving a small rim around the top of the setting. The finished setting should appear as shown in the cross section view in figure 30-21.

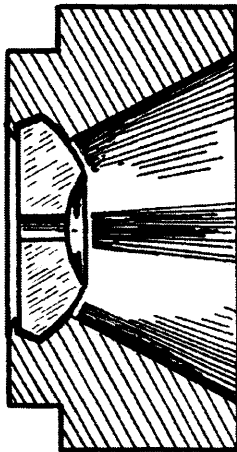


Fig. 30 - 21

### SEC. 503 -- Cleaning Cement from Jewel Settings

Put the jewel or jewels to be cleaned in a small bottle about half full of alcohol. This bottle should have a screwcap, figure 30-22, through which a hole has been drilled. Place the bottle in a boiling pan about half full of water, and heat carefully over flame of alcohol lamp until alcohol has boiled violently for several minutes. It is not necessary for the water to boil. Remove setting from bottle and place between two pieces of pithwood which have been wet with alcohol,

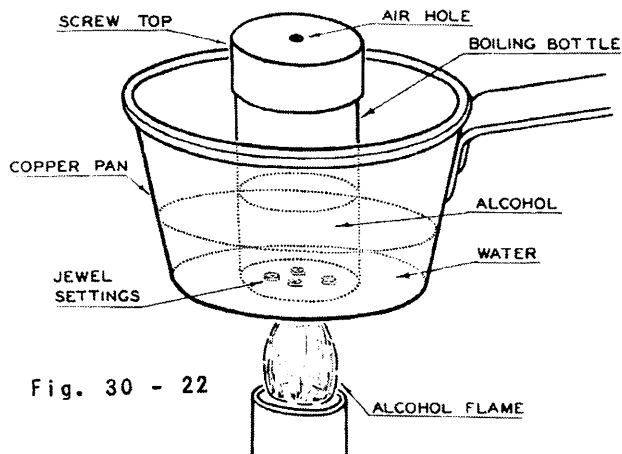


Fig. 30 - 22

and twist pithwood back and forth. With a piece of pegwood wet in alcohol, clean hole in jewel.

### SEC. 504 -- Steps in Setting a Balance Hole Jewel

1. Select balance hole jewel to be set. The balance hole jewel is held with pegwood as illustrated in figure 30-26.
2. Center stock as in figure 30-23.



Fig. 30 - 23

3. Select drill about  $\frac{2}{3}$  the diameter of the balance hole jewel and drill hole into rod as shown in figure 30-24.

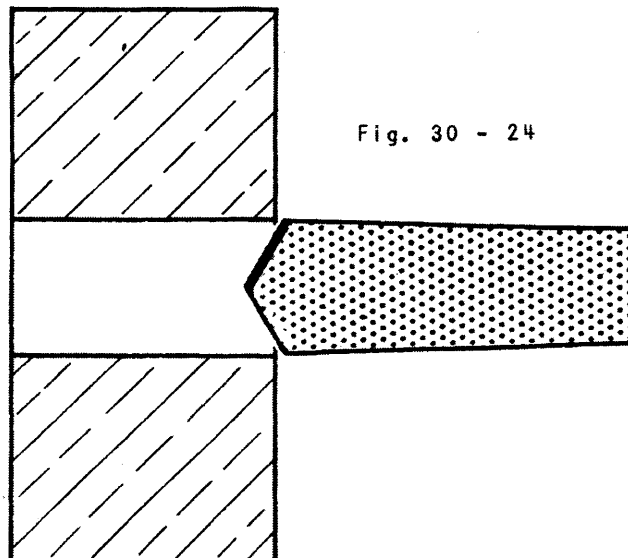


Fig. 30 - 24



4. Place seat setting tool in position as shown in figure 30-25. Cut seat for balance hole jewel.

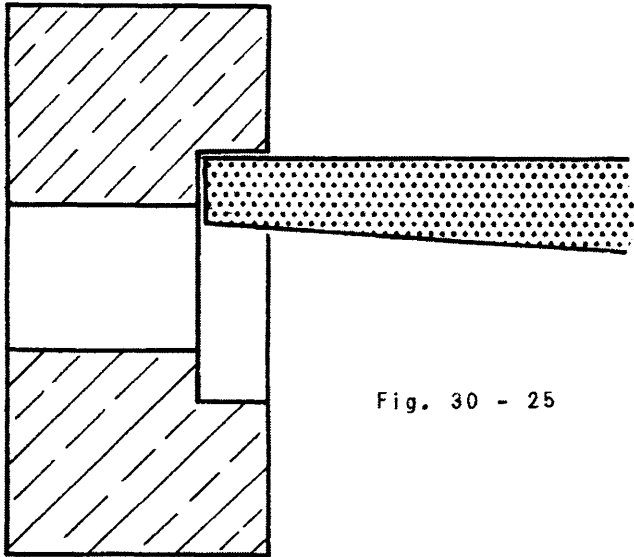


Fig. 30 - 25

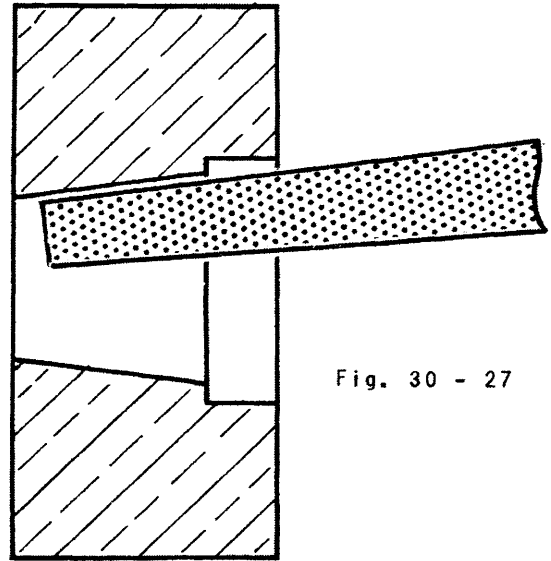


Fig. 30 - 27

5. The jewel should fit freely without side play and just below the surface of the rod as illustrated in figure 30-26.

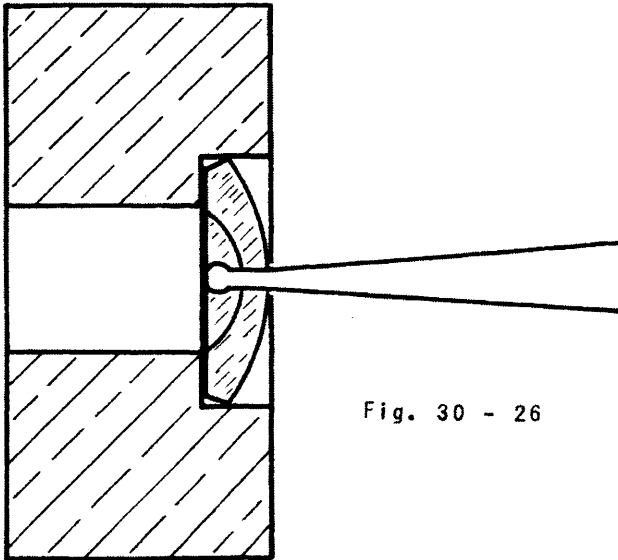


Fig. 30 - 26

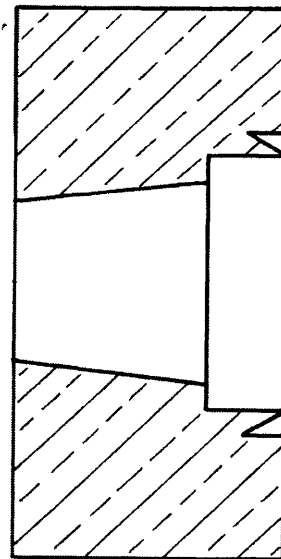


Fig. 30 - 28

6. Open the back of the hole with seat cutting tool as in figure 30-27, leaving a small shoulder as illustrated. Do not cut off the corner!

7. With a square graver or long pointed stripping tool, cut bezel as shown in figure 30-29.

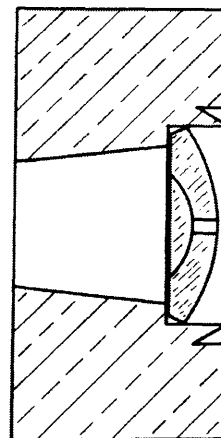


Fig. 30 - 29

8. Place balance hole jewel in position and holding tweezers over face of hole jewel, extract pegwood. Burnish bezel over face of balance hole jewel as shown in figure 30-29. The jewel should now appear as in figure 30-30.

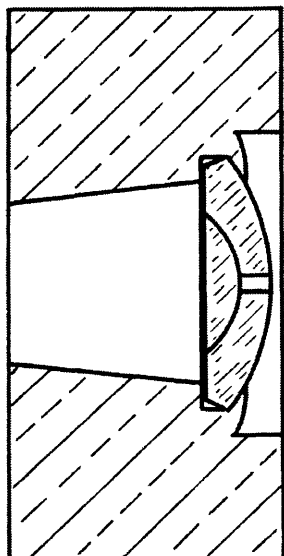


Fig. 30 - 30

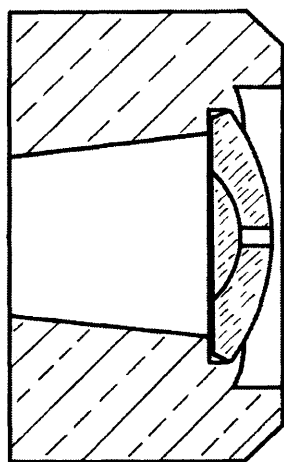


Fig. 30 - 31

9. Face off rod until the face of the balance jewel sets just below the surface as shown in figure 30-31. Turn outside diameter to correct dimension.

10. Bevel corner of setting as shown in figure 30-31.

### SEC. 505 -- Stripping a Balance Hole Jewel

The balance hole jewel is secured to cement chuck in the same manner as is a train jewel as explained in Sec. 502.

1. Face off setting to proper thickness, figure 30-32. With a square graver, cut shoulder on setting as shown in figure 30-33. In most cases there is not very much stripping on a balance hole jewel setting but it is accomplished by holding the stripping tool in position as shown in figure 30-33.

2. Figure 30-34 illustrates a cross section of a finished balance hole jewel

setting. Notice that the corner has been beveled slightly at A. This makes for a finished job.

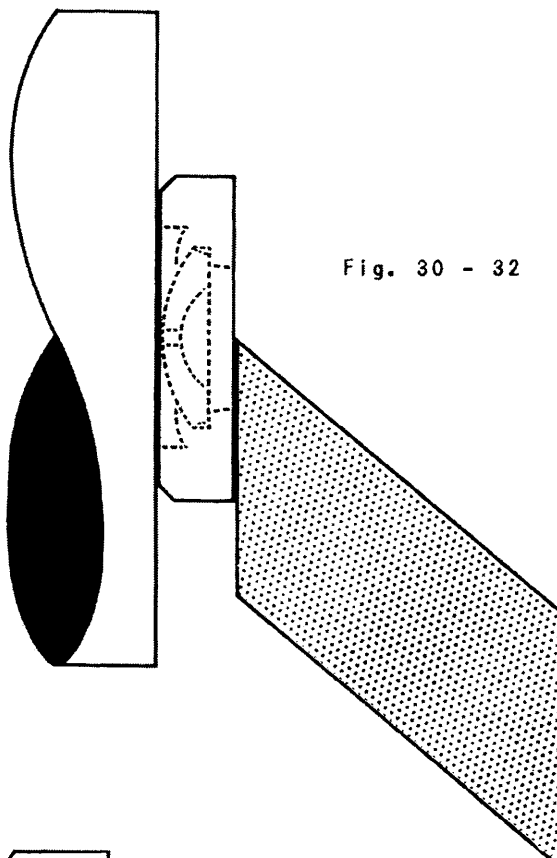


Fig. 30 - 32

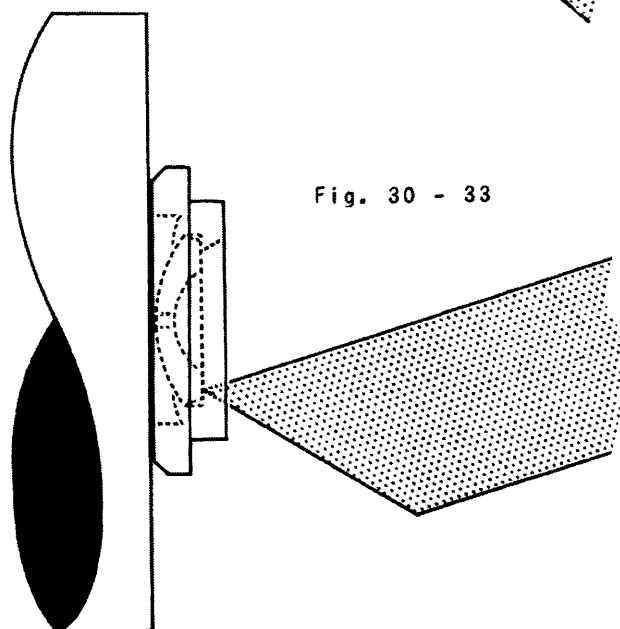


Fig. 30 - 33

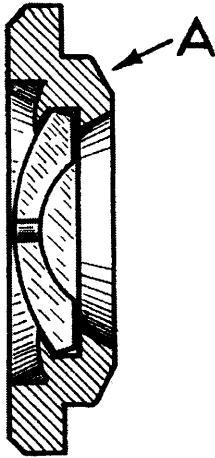


Fig. 30 - 34

### SEC. 506 -- Steps in Setting a Cap Jewel

1. Select cap jewel to be set. Put a small amount of beeswax on a piece of pegwood and place against the flat side of cap jewel, figure 30-38. If the cap jewel has a curved surface, the procedure is identical to that for setting a train jewel. If the cap jewel is flat instead of being curved on the upper surface, it is set the same as a balance hole jewel.

2. Place stock in lathe chuck and center, figure 30-35. Select drill about  $\frac{2}{3}$  the diameter of the cap jewel and drill hole into stock as in figure 30-36.

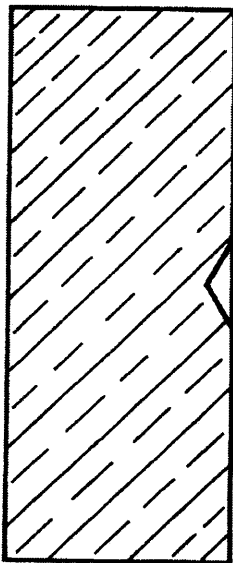


Fig. 30 - 35

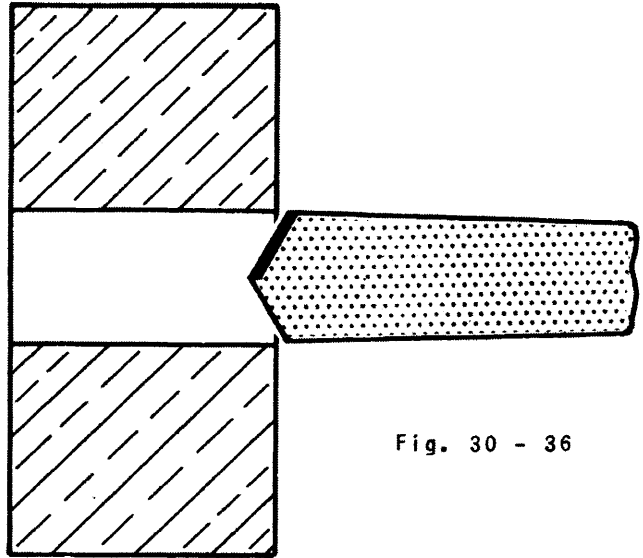


Fig. 30 - 36

3. Place seat cutting tool in position shown in figure 30-37 and cut seat while running the lathe in reverse.

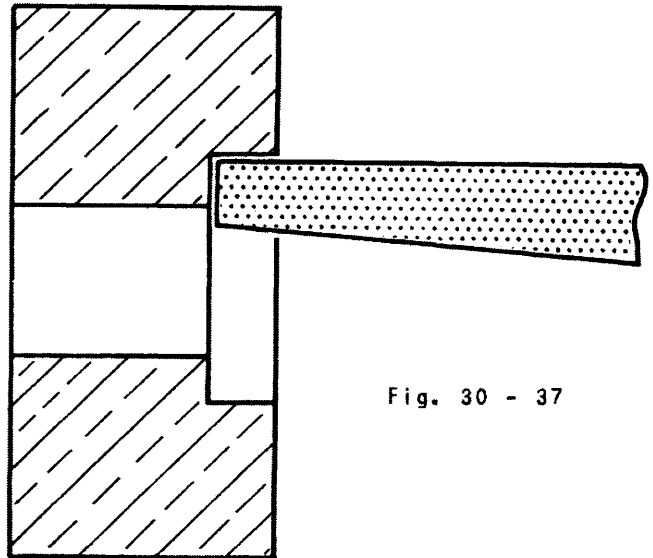


Fig. 30 - 37

4. The cap jewel can be tried as in figure 30-38. The jewel should fit freely without side play and the face of the cap jewel should be just below the surface.

5. Open the back of the hole with seat cutting tool as shown in figure 30-39.

6. Bevel corner as in figure 30-40.

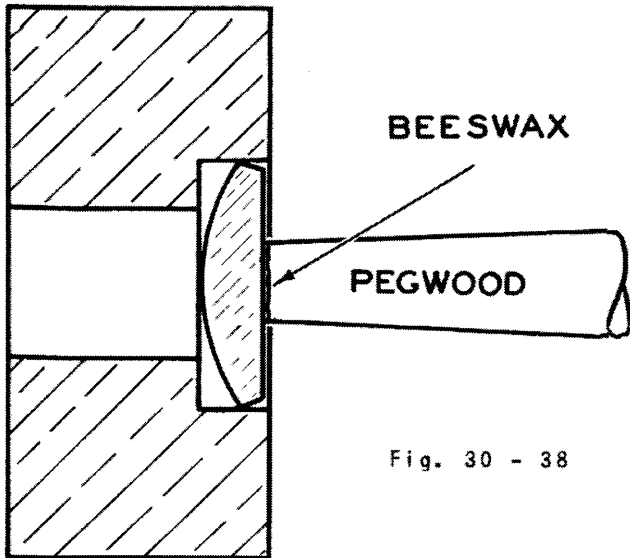


Fig. 30 - 38

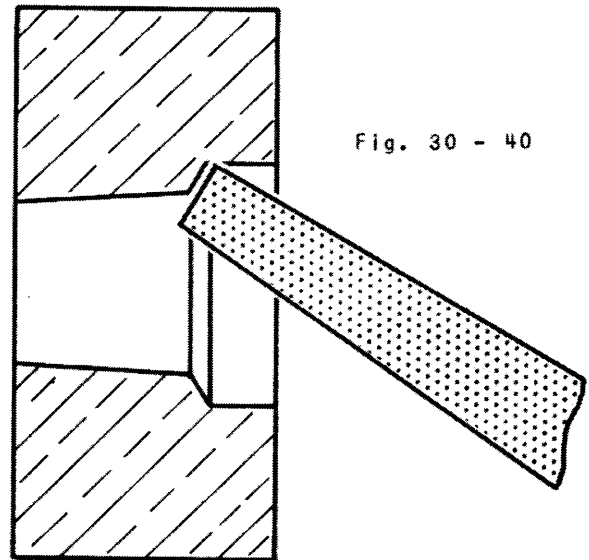


Fig. 30 - 40

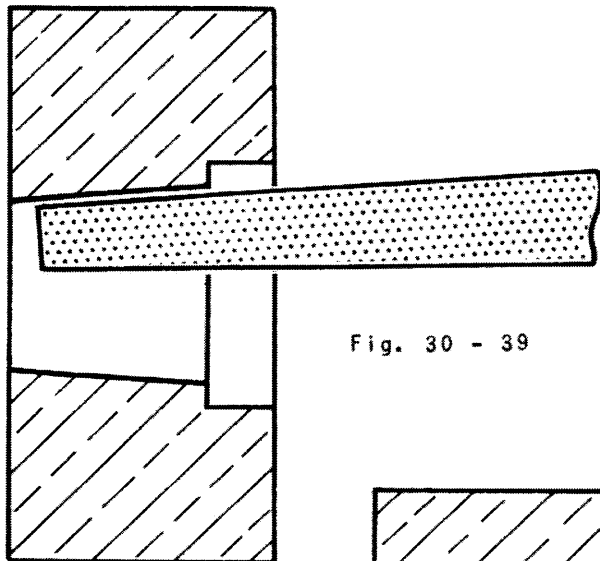


Fig. 30 - 39

Fig. 30 - 41

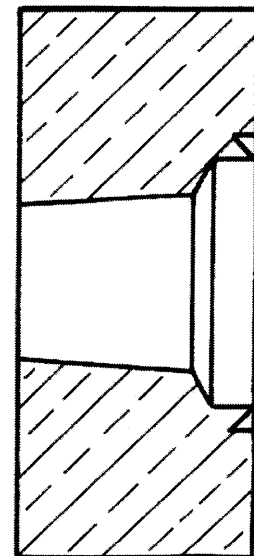
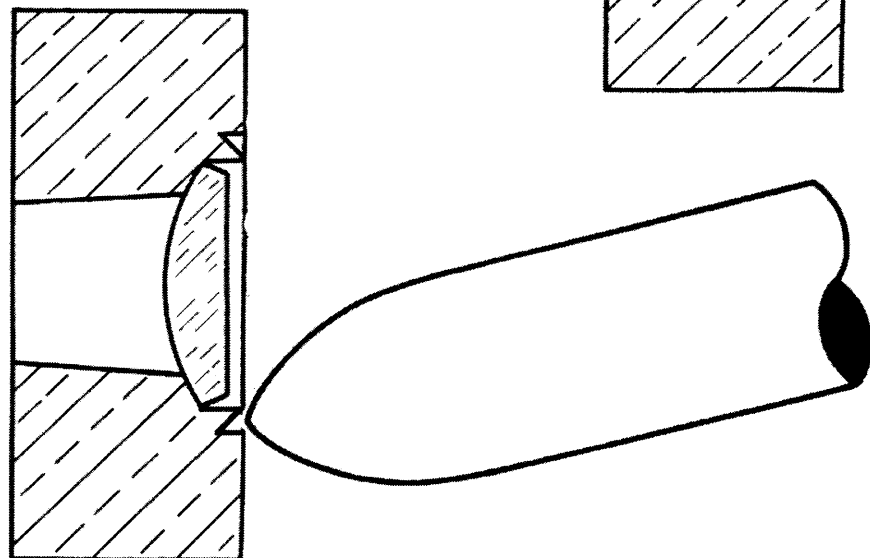


Fig. 30 - 42



7. Cut bezel as in figure 30-41.
8. With cap jewel in place as shown in figure 30-42, burnish bezel over cap jewel as shown in figure 30-43.

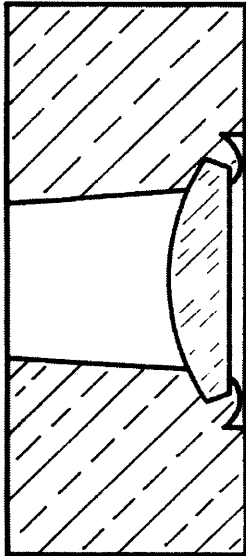


Fig. 30 - 43

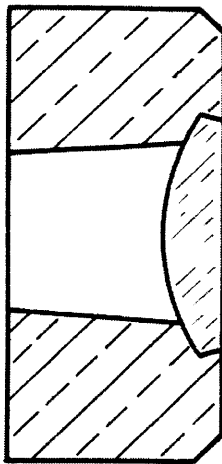


Fig. 30 - 44

9. Face off setting so that the face of cap setting is flush with rod as shown in figure 30-44.

10. Bevel corner of setting as shown in figure 30-44.

#### SEC. 507 -- Steps in Stripping a Cap Jewel

The cap jewel setting is cemented to a cement brass as previously explained and then faced off to the proper thickness as in figure 30-45. It is then stripped out as illustrated. Figure 30-46 illustrates a cross section view of a cap jewel in setting.

#### SEC. 508 -- Setting Train Jewels in Watches

1. Measure pivot and select train jewel, allowing .02 mm for side shake.
2. Cut diameter of stock to fit plate or to the diameter of old setting.
3. Set train jewel. (Steps 2, 3, 4, 5, 6,

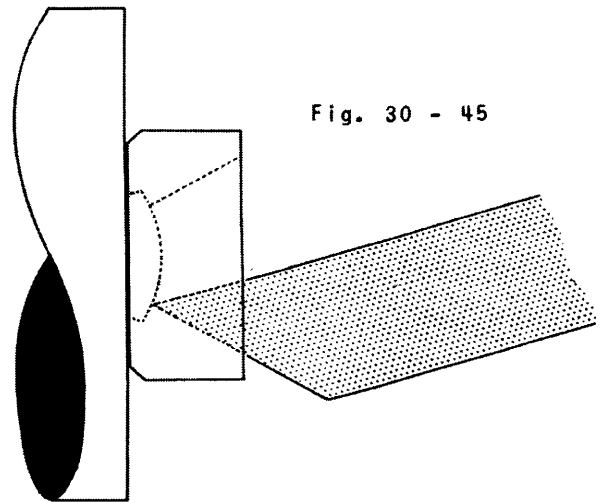


Fig. 30 - 45

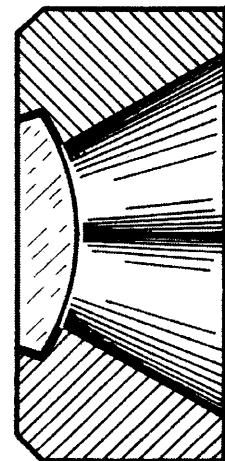


Fig. 30 - 46

- 7, 8, 9, and 10, of Sec. 501).

4. Cut shoulder to proper diameter and depth. As this depth determines the correct amount of end shake, it can be compared with the old setting as in figure 30-47.

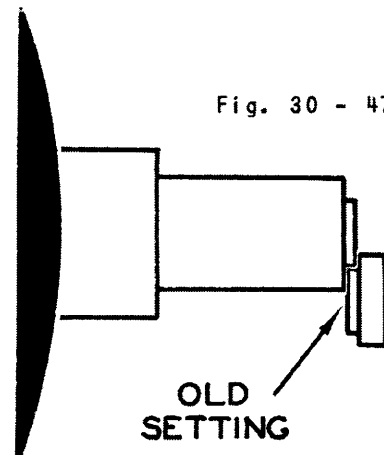


Fig. 30 - 47

5. Place bridge or plate on rod as far as it will go. With graver cut a notch which will end at the point of contact between the setting and the upper edge of bridge or plate, figure 30-48. Cut off setting.

6. Cement and face off to proper thickness. Strip as in Step 5 of Sec. 502.

7. Clean jewel setting in alcohol (Sec. 503).

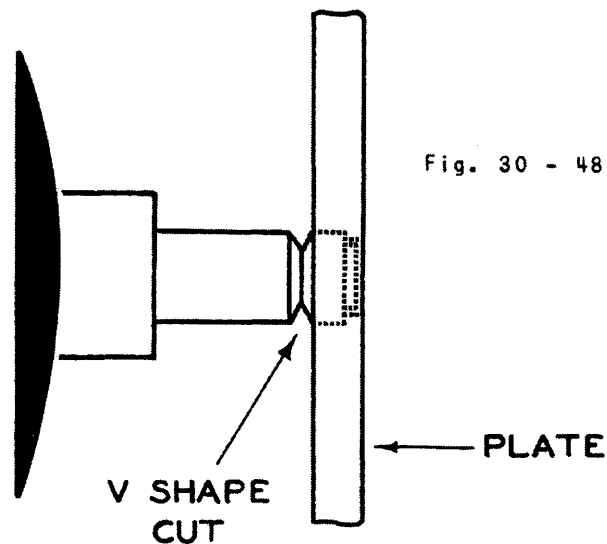


Fig. 30 - 48

### SEC. 509 -- Countersinking Jewel Screw

Figure 30-49 is an illustration of a jewel screw countersink with a centering pivot. The centering pivot is used as a guide when countersinking the jewel setting as in figure 30-50. It is best to place one jewel screw in position as at



Fig. 30 - 49

**JEWEL SCREW  
COUNTERSINK**

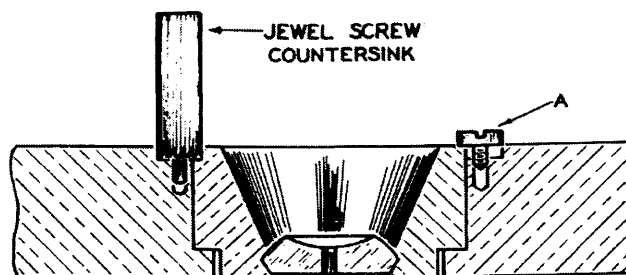


Fig. 30 - 50

A, figure 30-50, and countersink the opposite side. Then replace jewel screw in hole, which has just been countersunk, and countersink side at A. The jewel screws should be flush with the plate.

### SEC. 510 -- Steps in Rebushing a Worn Pivot Hole

There are times when a pivot hole becomes worn so badly that it is impossible to close it satisfactorily or to locate the center in order to fit a friction jewel. This is a common occurrence in seven jewel watches. Figure 30-51 illustrates such a hole. The actual center

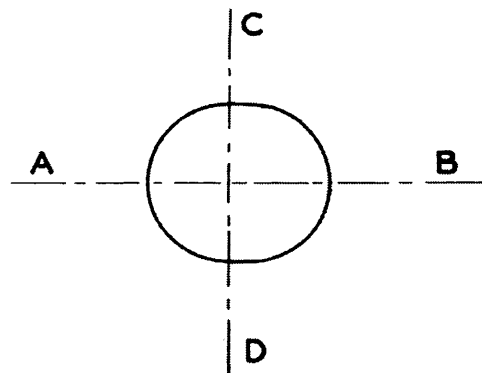


Fig. 30 - 51

is at the intersection of lines AB & CD. When a worn pivot hole has been uprighted and rebushed properly, the wheel and pinion will have the proper depth and the pinion will be perpendicular to the hole in the bushing or jewel. For this purpose we use a face plate, figure 30-52. The face plate is made up of three moveable jaws secured to a circular plate

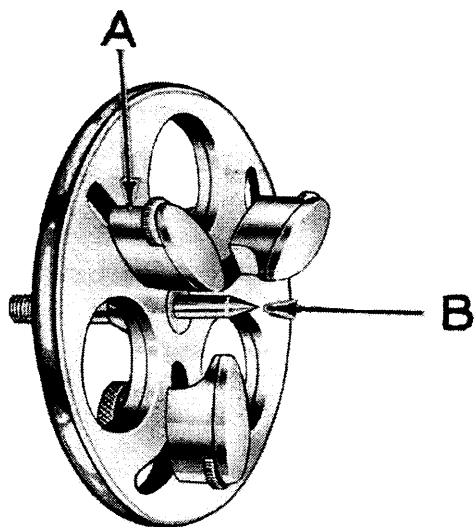


Fig. 30 - 52

and used in a watchmakers lathe. Notice that the jaw at A moves in a straight slot while the remaining two jaws move in curved slots. The pump center at B is used as a guide in locating the approximate center of the pivot hole which is to be uprighted. In uprighting a pivot hole in a bridge or upper plate of a watch, proceed as follows:

1. Place pillar plate with pivot hole A directly in line with center jaw B, figure 30-53, and place the other two jaws just over the edge of the pillar plate. The center of the pivot hole is located over the pump center, which is not visible in this view. Now remove

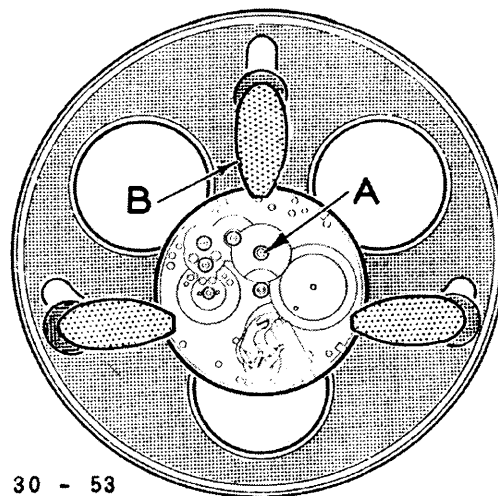


Fig. 30 - 53

pump center and tighten jaws with nuts A, figure 30-54, enough to hold plate in place. The knurled nuts at B are adjusted to keep the jaws parallel.

2. Figure 30-54 is a side view of the pillar plate held in position in the face plate with the T Rest set as close as possible and parallel to the face plate.

3. Place a long piece of pegwood as shown in figure 30-54 in pivot hole and rest on the T Rest. Now turn face plate slowly and pegwood will move up and down as illustrated by dotted pegwood. When the pegwood is at its lowest point A, figure 30-54, tap the top edge of pillar plate with a brass hammer. This will bring the pivot hole nearer to dead center. Continue turning the lathe and watching the low point of your pegwood while gently tapping the top edge of pillar plate until the end of the pegwood at

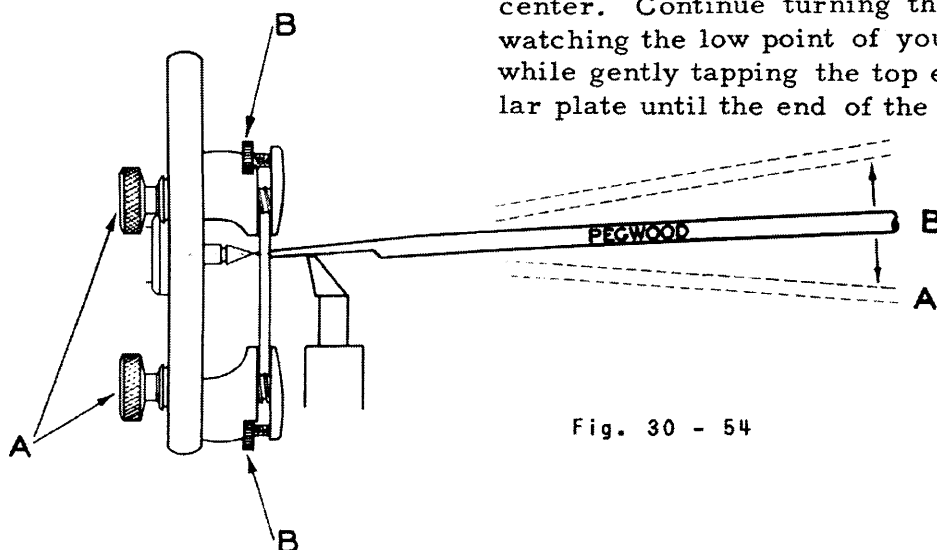


Fig. 30 - 54

B remains stationary. Tighten thumb nuts A. The pivot hole is then centered. Now screw the bridge in place on the pillar plate and bore out a hole for the new bushing. This hole can be of any convenient diameter. The bushing is made from a piece of brass rod turned to a diameter approximately  $1/100$  mm larger than the hole in the bridge. This bushing should be centered and the pivot hole made a trifle smaller than the diameter of the pivot for which it is intended. The bushing is then stripped out and pressed into position either with a friction jewelry tool or a staking tool. Broach pivot hole to fit pivot.

If the hole in the pillar plate was the one which needed to be rebushed, we would start off by uprighting the corresponding pivot hole in the upper bridge or plate; and after it was centered properly, remove the bridge and bore out a hole in the pillar plate and rebush as previously explained.

The most modern method today is to use a friction jewel instead of a bushing after a plate or bridge has been uprighted.

### SEC. 511 -- Plugging Swiss Bridge

Although this method of replacing a jewel in a Swiss Bridge has been outmoded in favor of friction jewelry, there may be times in your career as a watchmaker when it is the most practical method to use.

1. Open bezel, using a cutting broach from the upperside of our bridge, as illustrated in figure 30-55. Do not cut any larger than necessary; just cut out old bezel.

2. Turn down a piece of rod on a very slight taper until bridge will just start over end of rod as in figure 30-56.

3. Select jewel to fit pivot. Set in rod and push bridge securely on rod, figure 30-57.

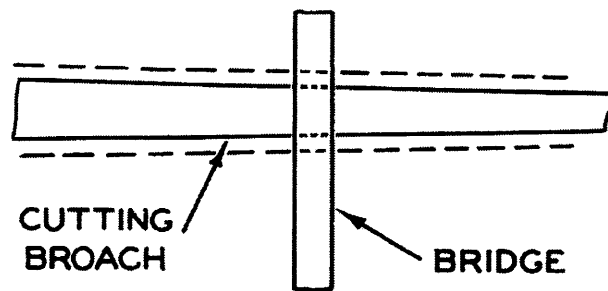


Fig. 30 - 55

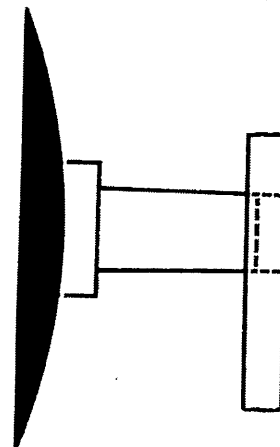


Fig. 30 - 56

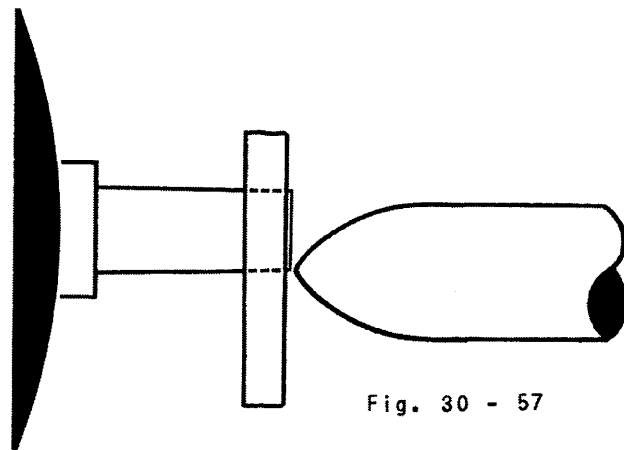


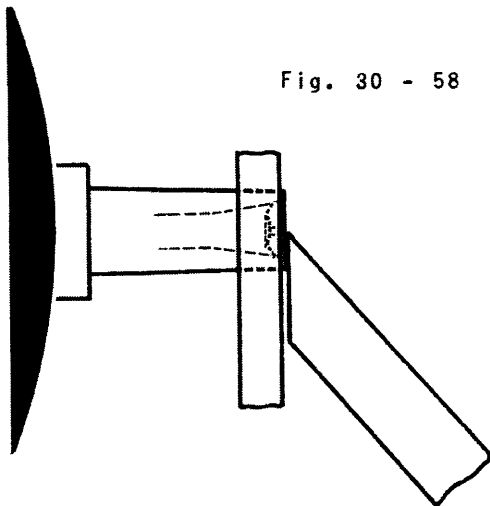
Fig. 30 - 57

4. Burnish edge of brass over setting and face off flush with bridge, figure 30-58. Cut a slot as at A, figure 30-59, and saw off. The jewel and setting are now burnished into the bridge. To finish, cement bridge to cement brass truing to hole in jewel as in figure 30-60, and strip along dotted lines, figure 30-60. Remove and clean with alcohol.



### SEC. 512 -- Setting Balance Jewels in Watches

Fig. 30 - 58



1. Select balance hole jewel to be set allowing .01 mm for side shake. Always try the jewel on the pivot as you will frequently find a slight variation in the hole sizes. The balance pivot should extend through and above the top of the jewel approximately the thickness of the pivot as shown in figure 30-61. Pivots should always be polished, if necessary, before selecting the jewel to be set.

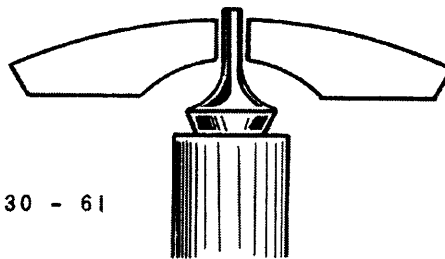
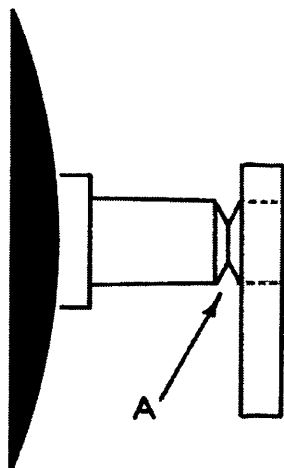


Fig. 30 - 61

Fig. 30 - 59



2. Turn stock to the diameter of the old setting or until it fits hole in cock or plate snugly.

3. Set balance jewel (Steps 1, 2, 3, 4, 5, 6, 7, 8, 9, and 10, Sec. 504).

4. Cut off setting, gauging the thickness by comparing with old setting.

5. Cement setting to cement chuck and face off to the proper thickness, using the old setting as a guide.

6. Cut square shoulder, using the old setting as a guide, figure 30-62. The thickness of the setting at A is very im-

Fig. 30 - 60

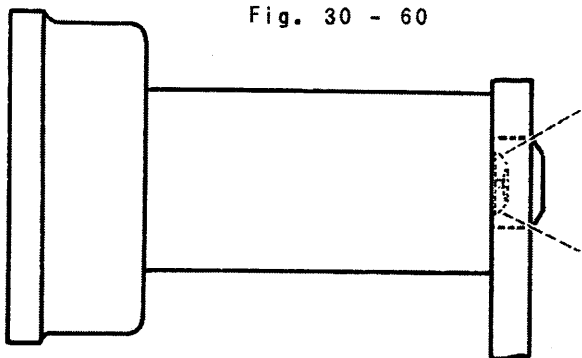
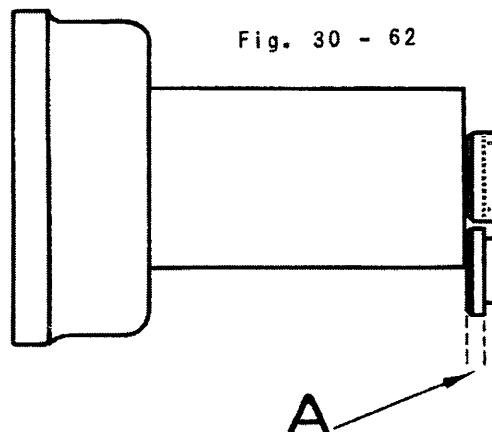


Fig. 30 - 62



portant and must be correct.

7. The diameter of the shoulder can be slightly smaller than the opening in the cock or plate and does not have to fit snugly.

8. Strip, remove and clean thoroughly.

### SEC. 513 -- Setting Cap Jewels in Watches

1. Select cap jewel.
2. Cut diameter of stock to fit plate or to the diameter of the old setting.
3. Set cap jewel as in Sec. 506 and face off. Face setting flush with the face of cap jewel.

4. Cut off, using old setting as a guide for thickness.

5. Cement and face off to proper thickness, using old setting as a guide, and strip out setting.

6. Place cap and balance jewel in cock or plate and countersink jewel screws as in Sec. 509.

Figure 30-63 illustrates a cut away

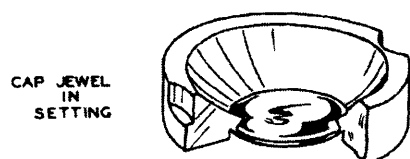
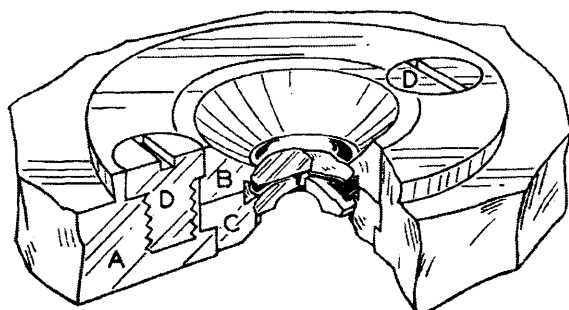
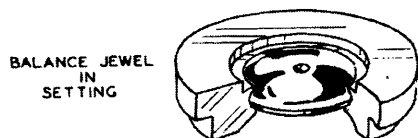


Fig. 30 - 63



A-BALANCE COCK  
B-CAP JEWEL IN SETTING  
C-BALANCE JEWEL IN SETTING  
D-JEWEL SCREWS

view of the cap and balance jewels in settings and their relative position in the cock or plate.

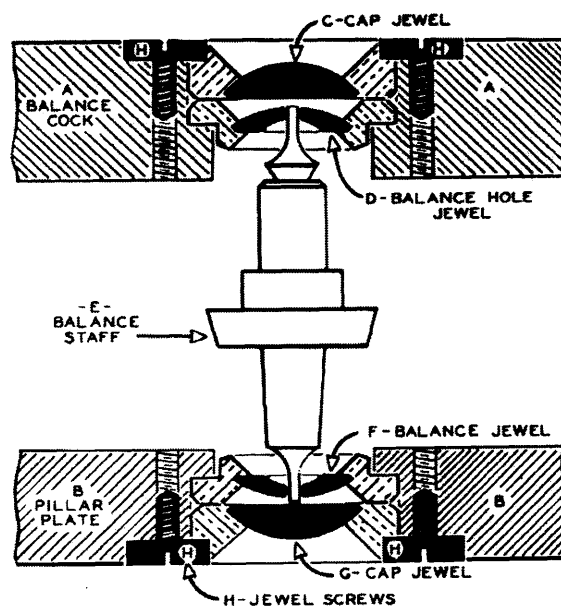


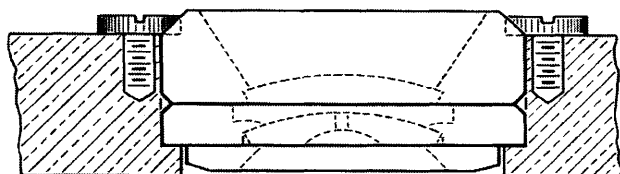
Fig. 30 - 64

Figure 30-64 is a cross section view of the balance cock and pillar plate with a balance staff placed in position. Notice that the lower pivot rests on the lower cap jewel and that the upper pivot is even with the top of the upper balance hole jewel. The space between the upper pivot and the upper cap jewel is the "end shake". This space is always determined by the fact that the balance hole jewel is set slightly below the surface of the balance jewel setting while the cap jewel is flush with the cap jewel setting.

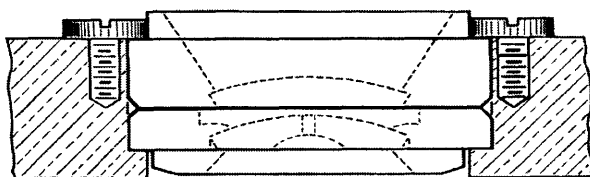
### SEC. 514 -- Raised Settings

Train jewel settings and cap jewel settings are found at times raised above the surface of the cock or plate. Figure 30-65 illustrates two types of raised settings. The one at A requires the countersinking of the jewel screws to the level of the bridge or cock. The one at B does not require countersinking but

the bottom of the shoulder should be flush with but not below the level of the bridge or plate.



A



B

Fig. 30 - 65

### SEC. 515 -- Replacing a Regulator Key, Swiss Style

1. Place in lathe a piece of brass rod which is thicker than the width of the regulator key at the thickest part, figure 30-66.

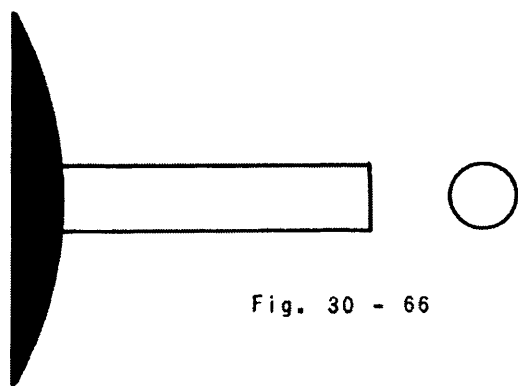


Fig. 30 - 66

2. Turn square shoulder to fit hole in regulator key, figure 30-67, the length to be slightly longer than the thickness of the regulator.

3. Turn another square shoulder, figure 30-68, the length of which is determined as shown in the drawing directly beneath it in which A represents the regulator and B the hairspring held in

Fig. 30 - 67

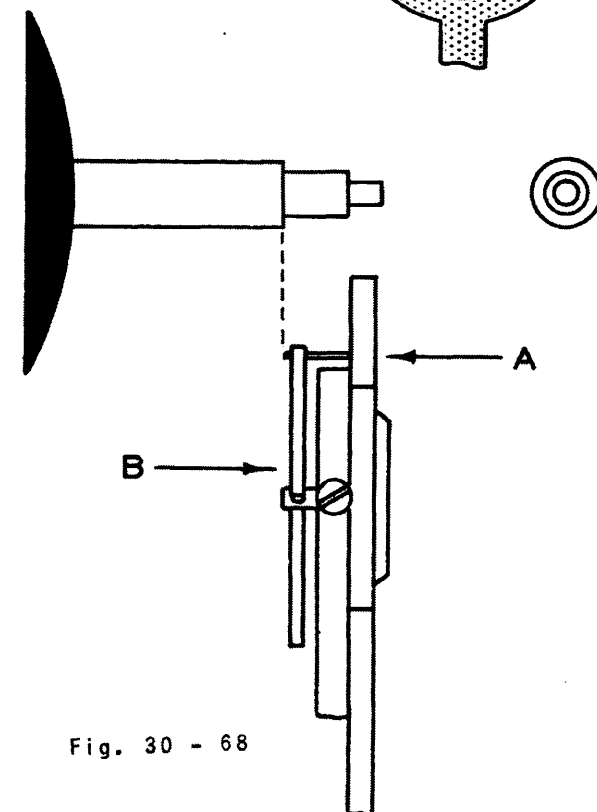
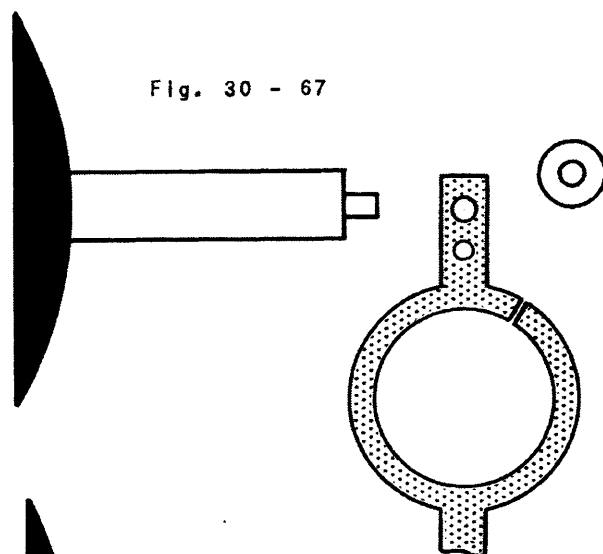


Fig. 30 - 68

place by the stud. Notice that this shoulder is slightly longer than the distance from the underside of the regulator to the underside of the hairspring.

4. File the sides flat, figure 30-69.

5. Cut off regulator key as in figure 30-70. Finish the end.

6. Rivet in place with staking tool punch, figure 30-71.

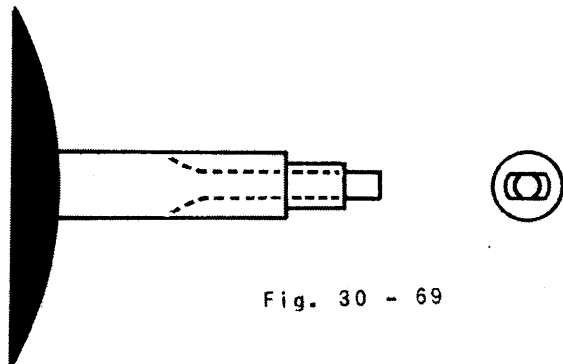


Fig. 30 - 69

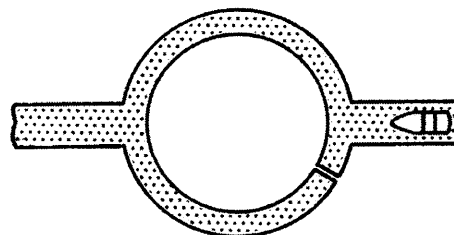


Fig. 30 - 72

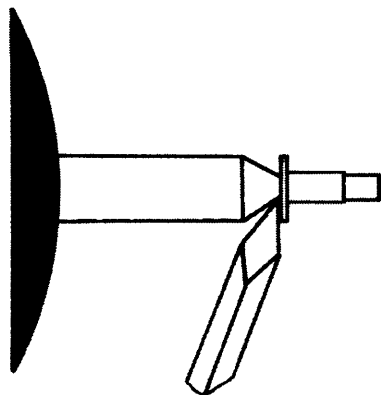


Fig. 30 - 70

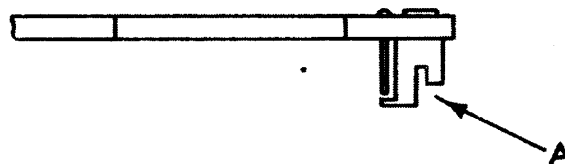


Fig. 30 - 73

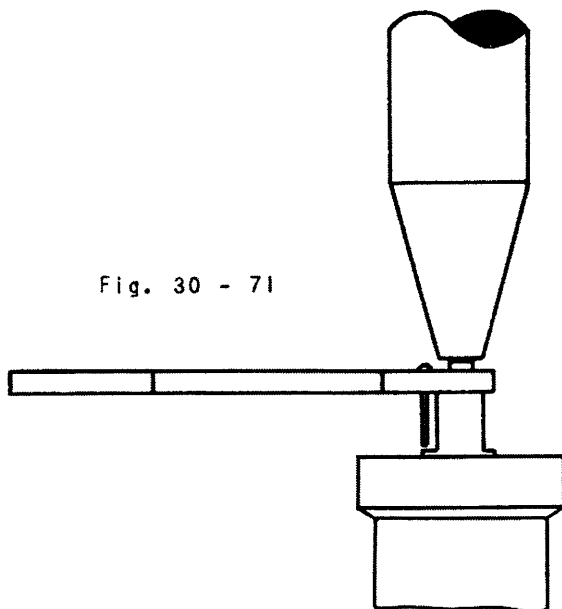


Fig. 30 - 71

7. Shape key with file as in figure 30-72.

8. With screw head file, put slot in key at A, figure 30-73.

Although you may find variations from the methods described in these lessons, you can accept our methods as practical and correct. Each has been proved in practice.

On all watch work, do not, as said before, be content with doing a job once. In order to be proficient you should practice at every opportunity. Work Sheets are used with these lessons to give you this practice and the work laid out on these sheets should be reviewed from time to time. If you are working on staffs, make it a point to review your jewel setting work from time to time. If you are working on jewels, brush up on the escapement. Each time you review a lesson, you will be greatly benefited.

**note:**

**(No job sheets are associated with Lesson 30)**