XXV

HOW TO MAKE A VERGE

Most requests from good watchmakers regarding the verge fusee watch are for instruction in making the verge (staff) because these repairs bring good and uncontested prices from their owners. These watchmakers can make the more exactingly precise lever balance staff, but the seeming complexity of the verge promotes caution even among the best of them. Yet, very little detailed instruction on making the verge is available; most references to its production are vague and exist in old out-of-print volumes.

As an introduction to making the verge, we must know what the word *verge* really means. In America, it is often used incorrectly by some clockmakers and in some texts to describe cheap anchors in American and German pressed brass clocks. But Webster's "Standard Dictionary of the English Language" (second edition) says that the verge is "the spindle of a balance wheel, especially in an old-fashioned vertical (verge) escapement." Most dictionaries agree with this definition.

Figure 1 shows the complete balance of the verge escapement watch bottom-side-up to show more components of the complete balance. The hairspring is the underslung variety, positioned under the balance and over the upper plate.

Figure 2 shows the complete balance from the upper side. Observe the upper arbor extension of the verge as it emerges from the balance.

Figure 3 shows the complete balance in exploded view.

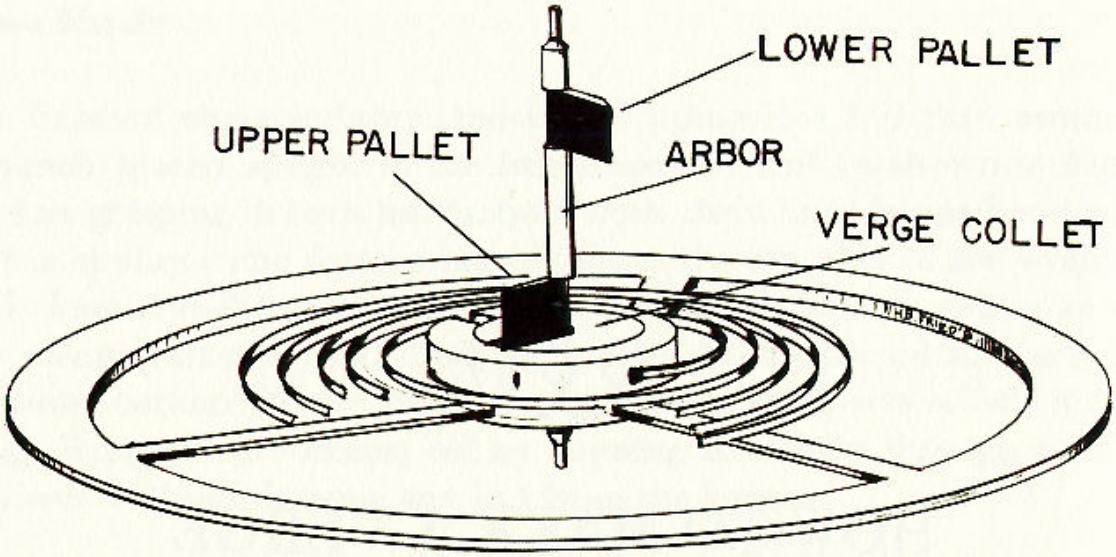


FIG. 1.

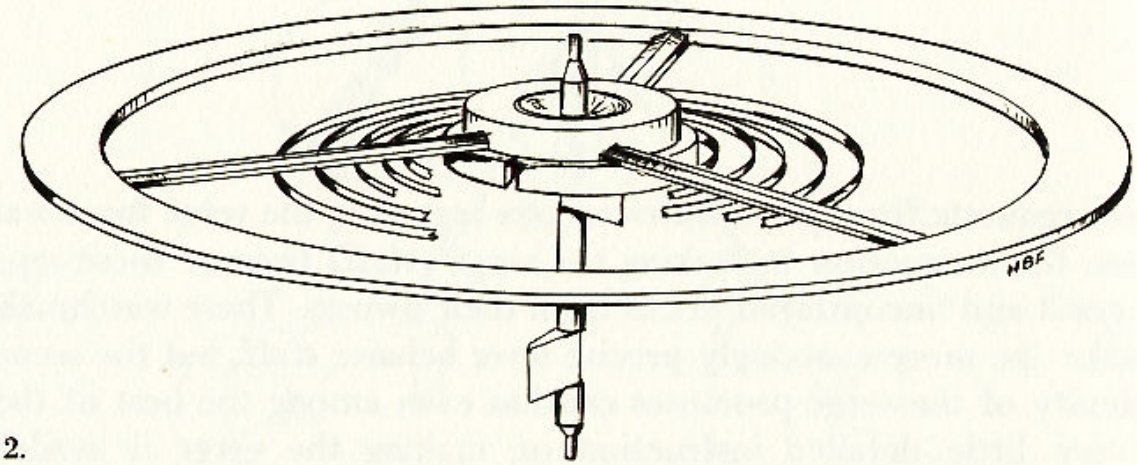


FIG. 2.

A Broken Verge Pivot

If a verge's upper pivot (which emerges from the balance wheel collet) is broken, it is comparatively easy to replace. This is possible because the verge, with balance attached and hairspring removed, can be held in the lathe by the brass collet into which the verge is driven and secured. The verge and its brass collet also may be removed from the balance and placed in the lathe for repivoting.

Before removing the verge from the balance, scratch a mark on the underside of the balance. This indicates the end of the hairspring in relationship to the verge pallets and the "in-beat" position. Remember that another such mark was placed on the top plate when instructions about its dismantling were discussed earlier. So, the same regulation position must be maintained when reassembling.

The mark scratched on the balance should also be a radial extension of the pallet directly under the balance. (Incidentally, sometimes these pallets are referred to as flags because they resemble the historical verge of the master from which a small flag denoted his authority and rank.)

Figure 4 shows the verge attached to the brass collet as it is held in the lathe chuck. The sharpened point of a graver, resting on the lathe's T-rest, is carefully guided into the center point of the pivot stump while the lathe is slowly turned. When a true center is "struck", a pivot drill in a light pinvise is hand-held and lightly pressed with applied lubrication to drill the axial hole in the verge's arbor. After this, the pivot plug or tampon is pressed in and secured. The pivot is then ground and polished to the correct thickness. (For details on repivoting, see *Bench Practices for Watch and Clockmakers* by this author.)

Some watchmakers drill away part of the upper arbor to replace its pivot. Then they prepare a pivot plug which is driven into the brass collet friction-tight. This is shown in the cross section in Figure 5.

A Lower Pivot Break

Should the lower pivot break, it may be capped by a pivot cap which

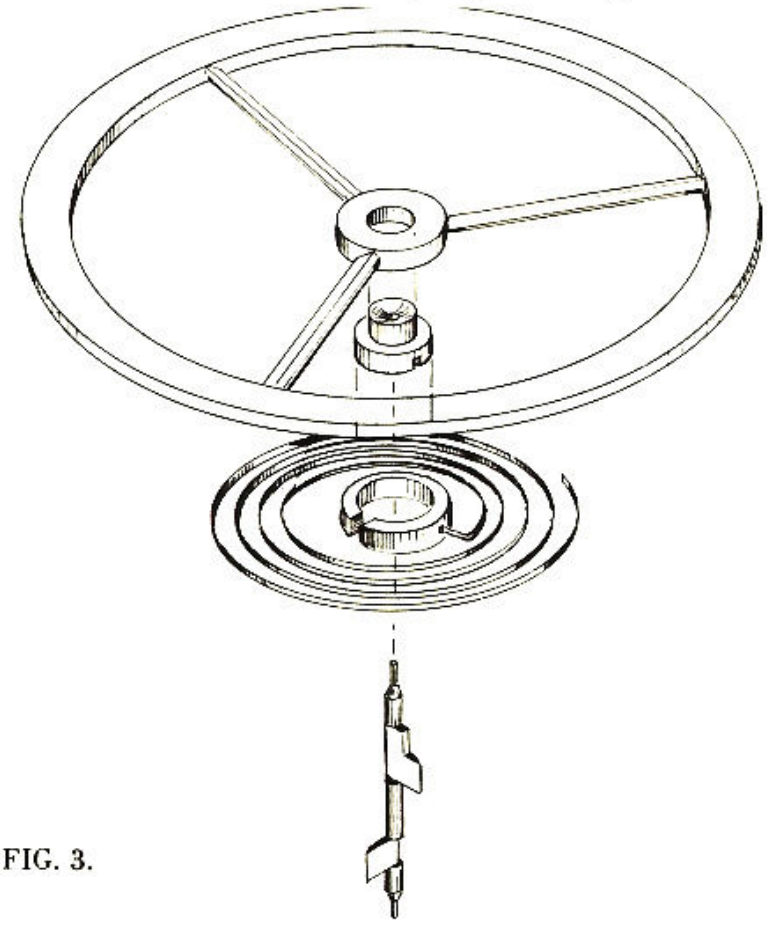


FIG. 3.

fits over the cylindrical portion of the lower pivot arbor. This removes part of that arbor to allow the original overall height to be maintained. Figure 6 shows the pivot attached. Staking the plug onto the arbor stump requires support on a split stump, while the pivot punch (shown in partial cross section) is carefully rested over the pivot's shoulder to drive the plug onto the arbor-end.

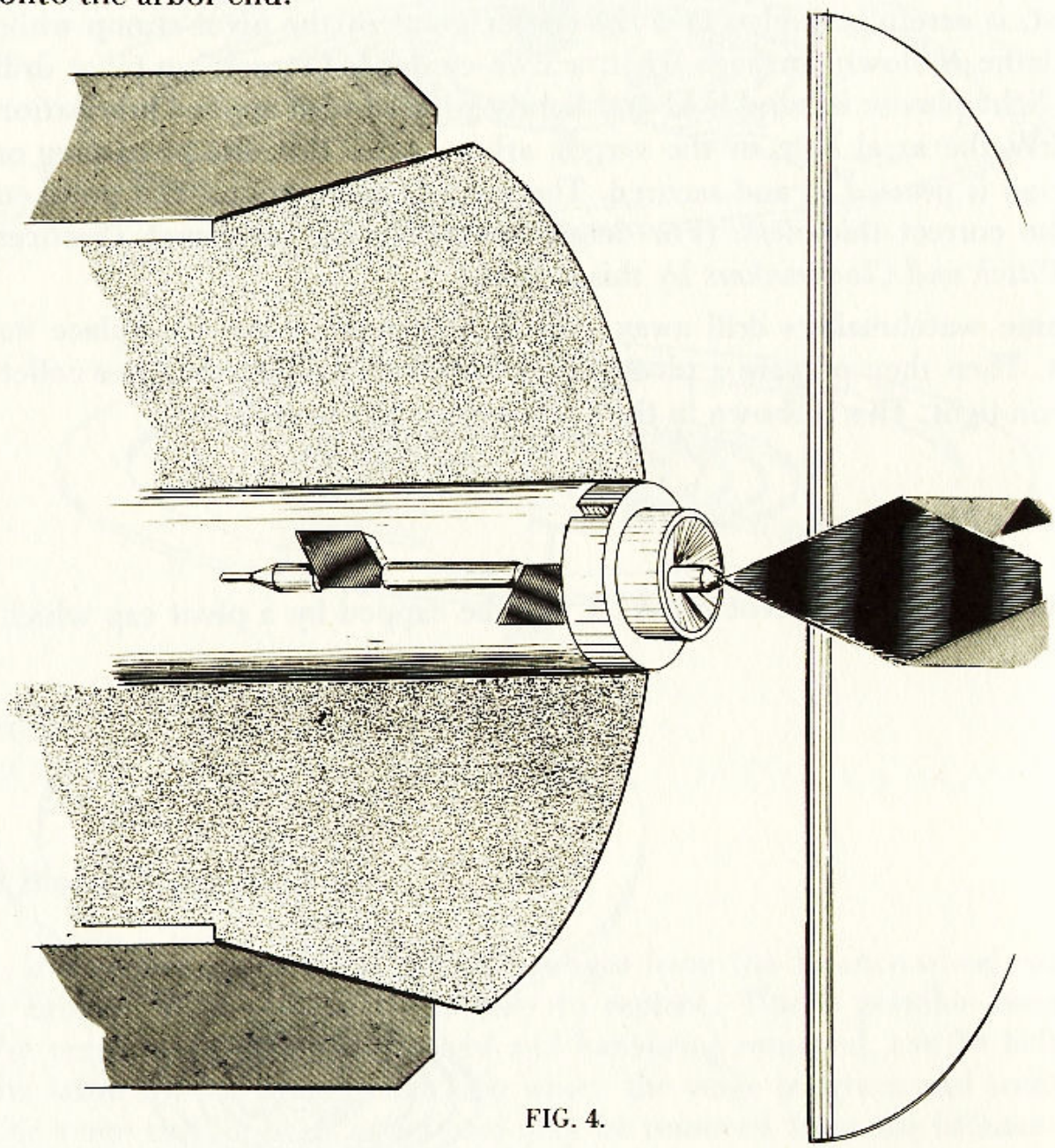


FIG. 4.

When making such a plug, make the pivot a little longer to allow later adjustment for height alignment of the pallets with the teeth of the escape wheel. The pallet of the verge is rested on the stump. The staking die is adjusted so that the guided pivot punch is exactly over the pivot plug. The pallet is turned to provide the greatest support for that operation.

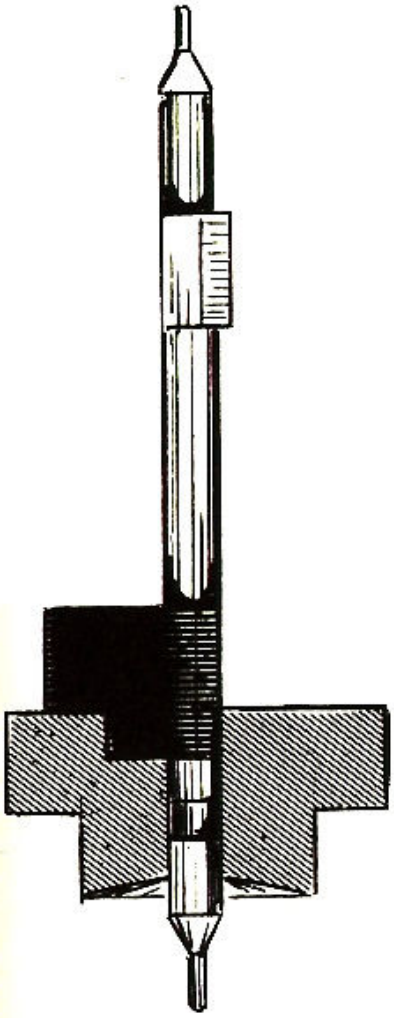


FIG. 5.

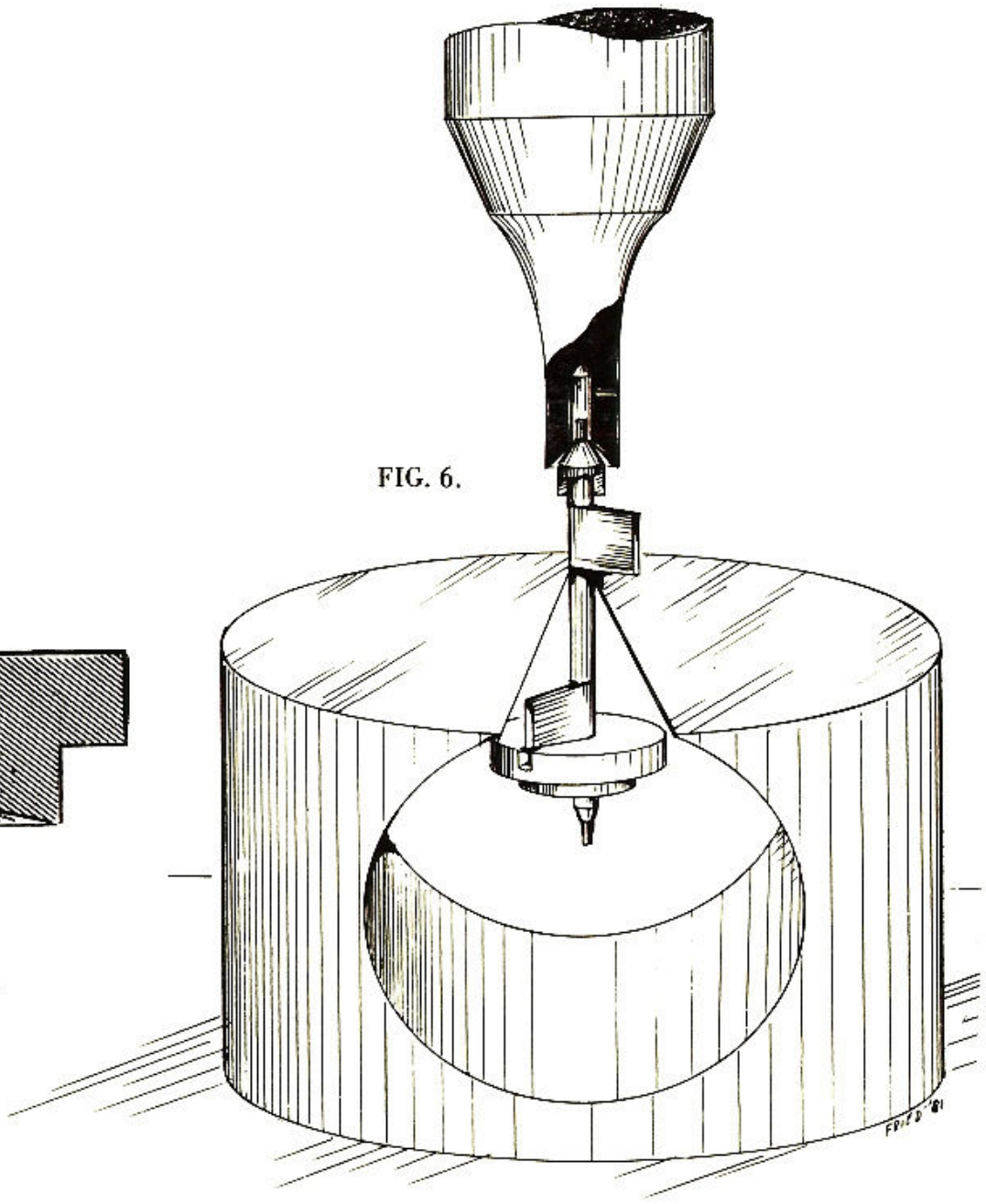


FIG. 6.

The lower arbor's broken and missing pivot also can be replaced by repivoting this end of the arbor, the verge held in a shellac "chuck", and by drilling an axial pivot hole. A shellac chuck is not really a chuck in the literal sense of securing a cylindrical object. A true chuck has its split jaws tightened around the object to be turned. Instead, this is a brass rod which itself is thus secured.

Most such "chucks" are made for a particular task. In our case, the brass rod should be 32 millimeters thick, fitting a number 32 chuck and about 20 millimeters long. The brass rod is grasped in the lathe chuck so that at least half its length extends from the face of the chuck (see Figure 7).

The end of this brass rod becomes a shellac chuck when it is partially hollowed out to axially hold the verge. When heated, it is filled with heat-softened flake shellac which when cooled securely holds part of the verge.

The partially drilled rod remains in the lathe chuck during the entire operation so its precision center alignment won't be disturbed.

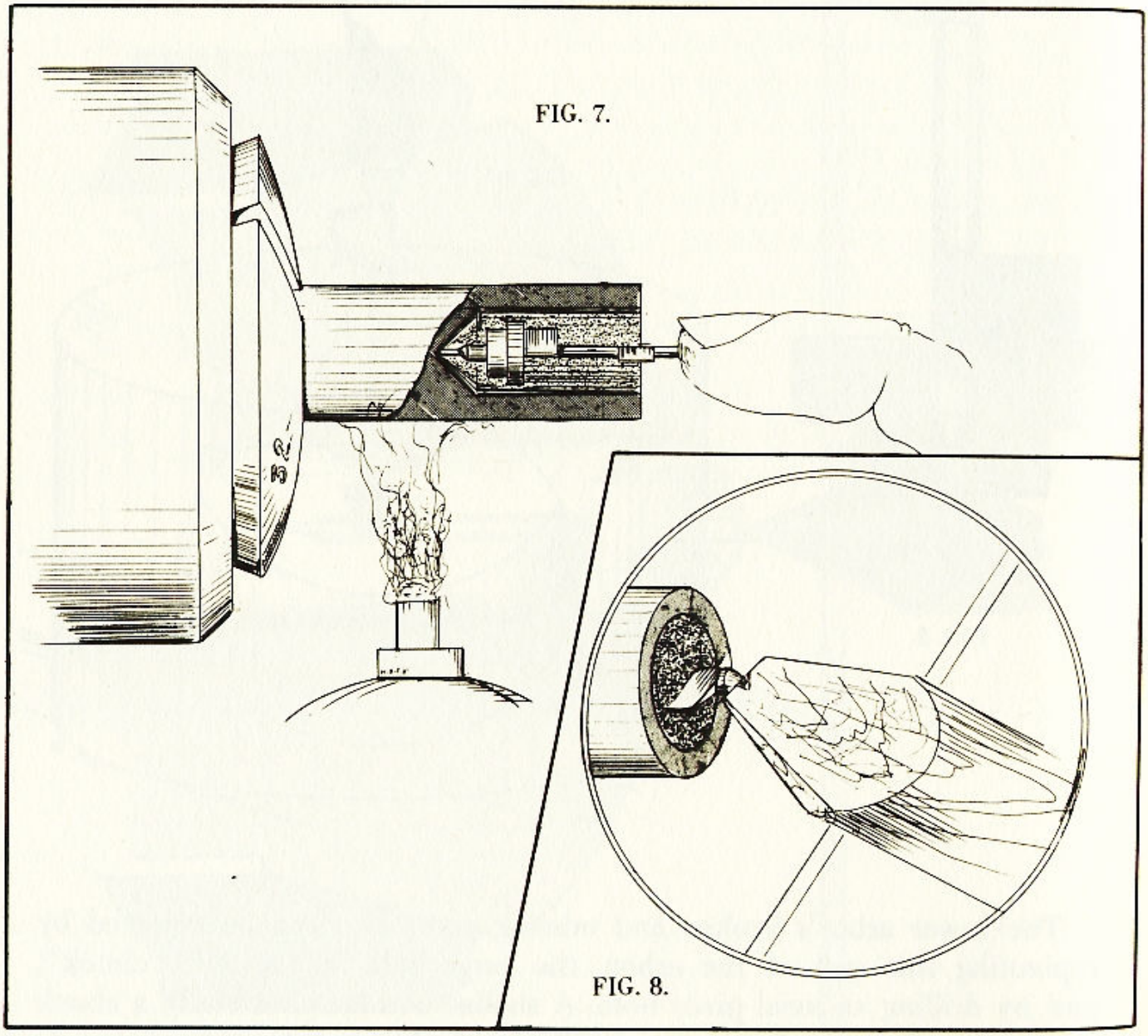


FIG. 7.

FIG. 8.

Applying Shellac

The brass rod is then heated mildly so the flake shellac originally applied to the drilled hole will melt and fill it. *Do not overheat the shellac.* Overheating will not only burn the shellac, but probably also soften the lathe chuck. The best method of heating is to use an alcohol lamp; its heat is mild and clean. This is shown in Figure 7.

To insert the verge, grasp it so that its damaged end is outward, and its brass collet and pivot can be gently pushed into the softened shellac. Do this until its good pivot is companion center in the concave "V" cup of the brass rod, made by the drill.

If the shellac has cooled in the meantime, apply the alcohol flame or torch carefully to soften the shellac. Then, while the shellac is still soft, spin the lathe slowly while applying the fingertip as inward mild pressure. The spinning will cause the verge to center itself. Figure 7 illustrates a cross section of the brass chuck held by the lathe chuck, with the fingertip centering the end of the verge needing a new pivot. A pegwood tip, instead of the finger can also aid in centering the turning arbor of the verge (Figure 8). The pegwood has a light V-groove or convex V-cone applied instead of the finger.

Repeat the centering process until satisfied that the emerging end is perfectly centered. The pressure by the finger or pegwood should barely touch the revolving arbor. Use just enough to make its errant eccentricity self-correcting. Apply this until the shellac has cooled enough to retain the arbor in its position for later manipulation.

When the unit has cooled, aided by continued turning of the lathe, the arbor is treated as in any pivoting job.

After this, the brass and its contents may be removed from the lathe chuck. The brass is again mildly heated to soften the shellac, and the verge extended from the brass rod. The residual hardened shellac may be removed by allowing the verge to remain immersed in alcohol for a few minutes. After this, it is replaced in the balance, in the relative position coincident with the scratch marks previously placed there for this purpose.

Staking the Brass Collet

To replace or stake the brass collet again to the balance, center the hole in the staking die most closely fitting the balance shoulder of the collet hole of the balance. Select a flat-faced hollow punch which also will file closely over the balance shoulder of the verge's brass collet. This should be lightly tapped to drive the balance onto this shoulder. Again, remember those positioning scratch marks. The flat-faced punch will also cause a bit of the countersunk collar to rivet itself over the balance's center hole, securing the verge to the balance.

While the verge pivots are thin and vulnerable to breakage, the greatest danger is to the verge itself. An examination of its construction shows

that the spindle between the pallets or flags, as they are sometimes called, is very thin, especially in the French verges. This thinness, however, allows a deeper engagement with the escape teeth, closer to the line of centers and a better balance motion. At the same time, it allows the potence, which must still reach into the recess of the escape wheel where the arbor pivot is well below the level of the escape teeth tips. If this potence is thick or if the verge arbor is overly thick, it may make contact with the outer surface of the potence causing stoppage.

Breakage of the verge itself is a result of inexperienced handling of the balance or verge. In this case, breakage occurs most often at the junction of the arbor with the pallet closest to the balance, as shown by the arrow in Figure 9. A new verge will have to be made. These are no longer available as replacement parts. The last were listed and illustrated for sales in English catalogues in the 1930s. These were available with brass collets attached in assorted sizes. Some watchmakers have suggested silver or gold soldering the broken ends together, but I have never tried this, nor have I ever seen it done.

Retrofit, replacement, or unfinished verges are no longer available, but there are many ways to make a verge. Watchmakers each have their own preferred methods. Some are simpler than others, but each requires some skill.

Some of these will be explained here. Those methods used for over 200 years, and found in some books—including those by Berthoud and older makers—will be included, as well as methods used by modern specialists who today make verges to order.

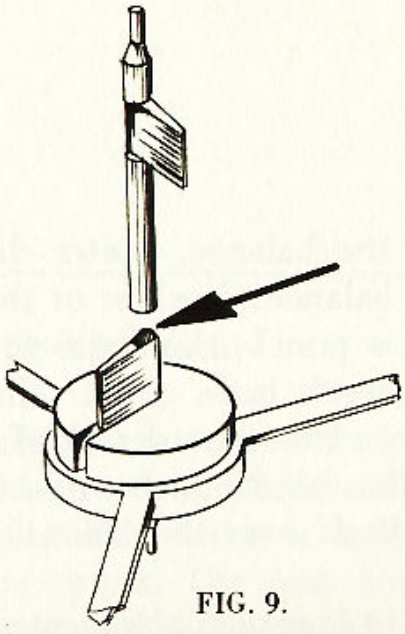


FIG. 9.

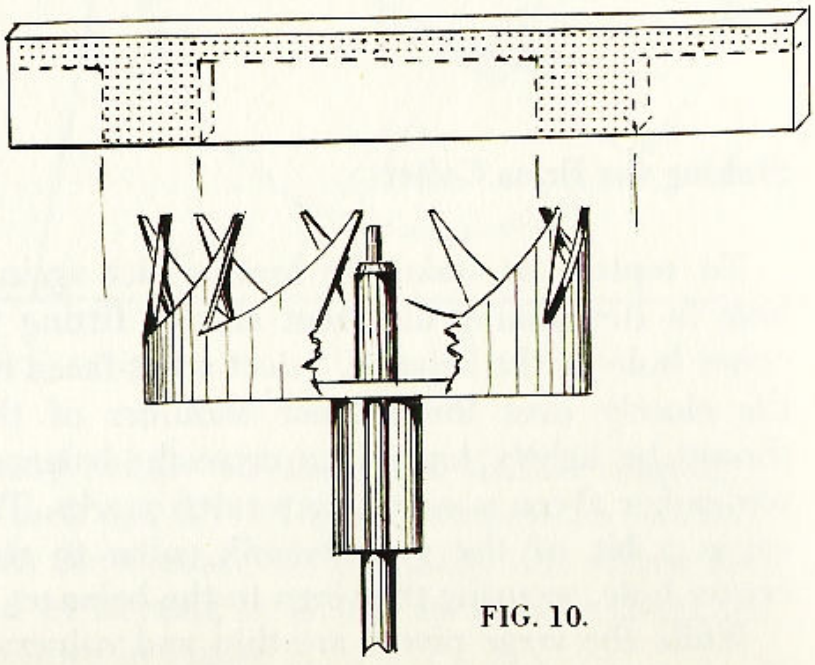


FIG. 10.

Using Clock Mainspring

The first method used a short strip of clock mainspring or flat steel stock whose thickness is close to 0.3 mm to 0.4 mm. Its width should be just a little wider than the flags or pallets. If the stock is about 1.5 mm wide, it should be more than enough to cover almost all verge watch needs.

A rough profile of the verge is cut or filed to match the space between the pallets. This ensures the diametrically opposite escape wheel teeth are centered on these pallets, and that the extending stock is at least sufficient for the arbor and pivot lengths. This outline is shown in Figure 10.

If the spring material is chosen with qualifying dimensions and has been blue tempered, it needn't be softened. While manipulating and filing the metal, it can be held in a small toolmakers' clamp or in the jaws of a pin-vise, as shown in Figure 11.

The top pivot can be filed or roughly finished initially, with final finishing later in the Jacot lathe or by similar means. The end nearest the balance should be tapered, as shown in Figure 12, so that it can be driven into the brass balance collet.

The thin shaft between the flags then is filed so that this section represents a square. For example, if the thickness of the initial stock is 0.35 mm, then it should be filed so that the middle section is 0.35 mm square.

FIG. 11.

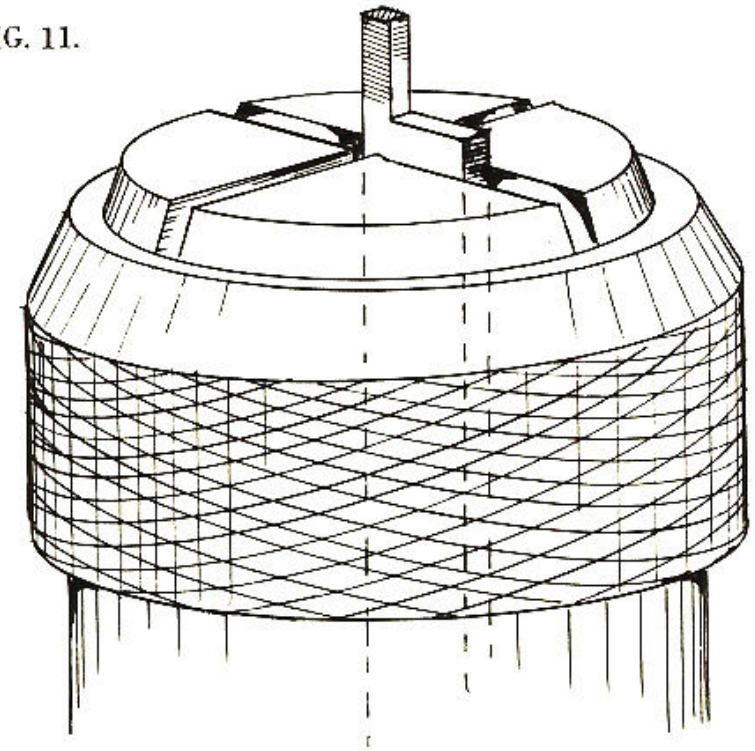


FIG. 12.

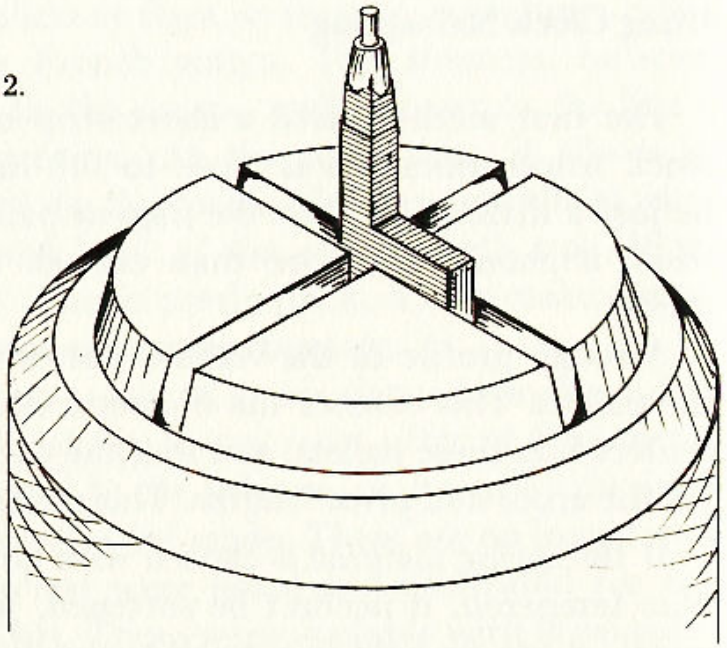
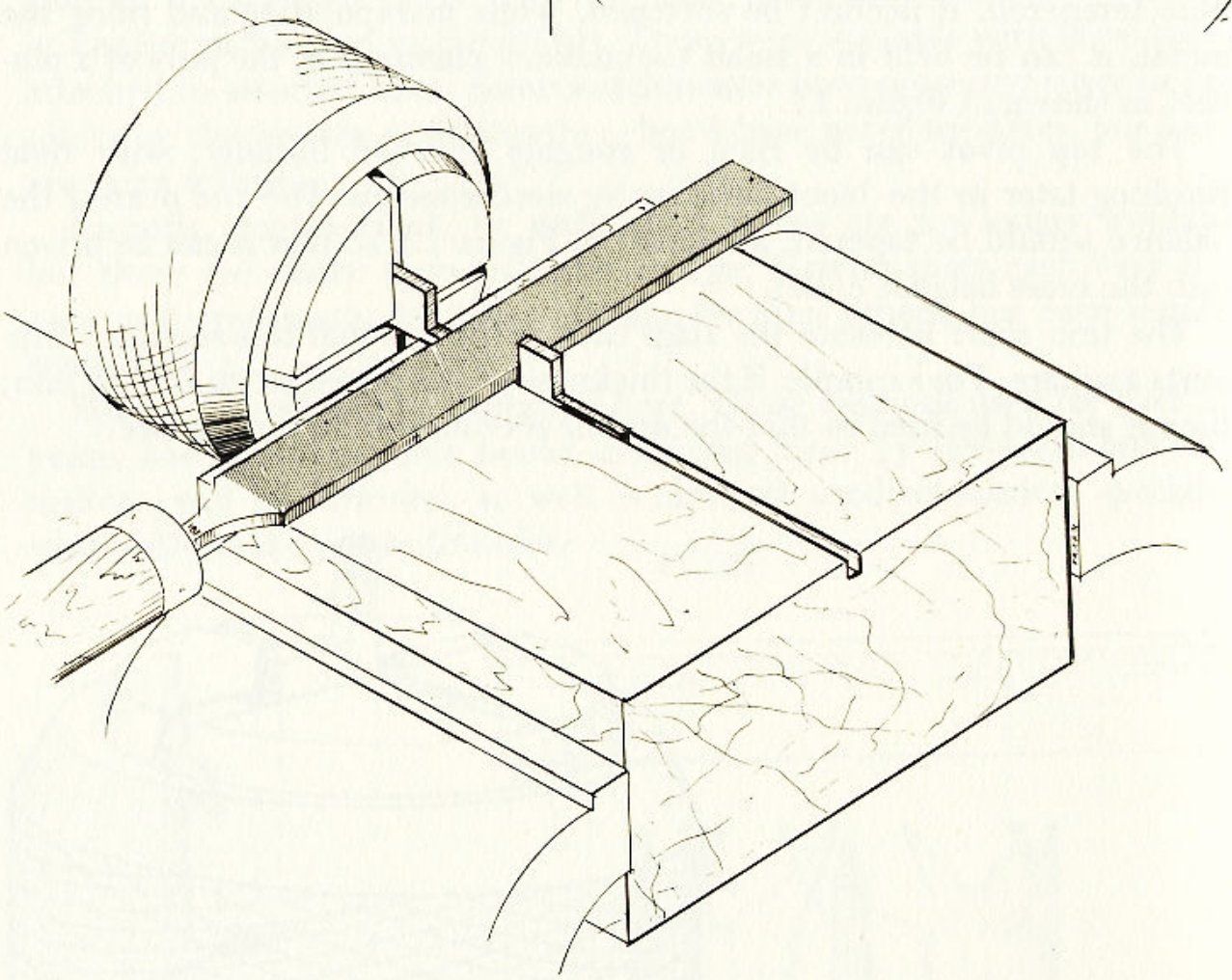


FIG. 13.



Filing can be facilitated by using a wood block into which a shallow groove has been cut. Then rest the flat steel piece edgewise in this groove as shown in Figure 13. The material is held in the pinvise while a needle file cuts down the middle section, which becomes the shaft.

Next, the pallet on the opposite side is shaped. Remember the required

height dimensions. In considering the height of the verge, its pallets' relationship to the escape wheel teeth also must be considered. And remember this: the pallets *must not* touch the balance pivots' potence, after the pivots are finished later, so the pallets must be clear of these potences. Finally, the pallets *must not* be contaminated with any oil that might migrate or drip down from the pivot holes.

Some watchmakers prefer to finish potences at this stage, than wait until the pallets are twisted to the desired angle. Others stake the balance's brass collet onto the unfinished verge at this stage because it is sturdier, rather than when metal is removed for finishing the pallets and the arbor, when the verge is again more delicate.

However, it is best to finish the pivots after the verge has been twisted to the correct angle; its center shaft filed and honed; and the verge hardened, tempered, and straightened so that its axis is true from pivot to pivot.

Getting the Angle

Now it's time for the pallets to be twisted to the required angle. The twisting angle chosen for our verge is 96° although some verges have pallet twist angle spans between 90° and 110°. This is shown in Figure 14. Looking down the axis of the verge, the bottom pallet is almost always twisted to the left of the upper pallet just under the balance position, depending on the direction of thrust of the escape wheel teeth.

A precise and time-honored method of twisting the verge for the desired angle is to place it in the lathe chuck with the pallet grasped between two of its three jaws and as close to the chuck's center as possible. Have the pallets face directly upward as shown in Figure 15. Use a female center of the tailstock into which the opposite end of the verge is rested.

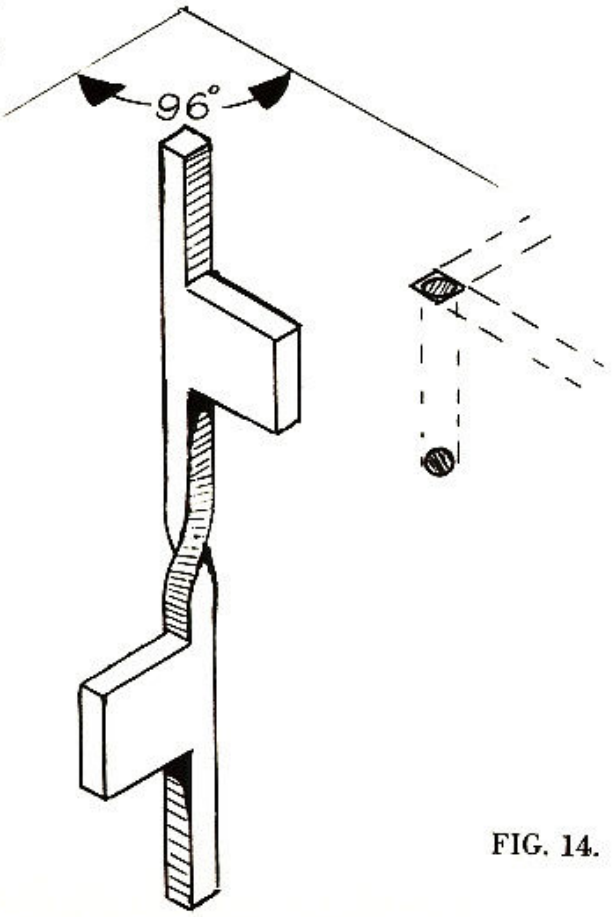


FIG. 14.

Next, lightly split the blunt end of a pegwood stick which is forced over the pallet nearest the tailstock. The split end should grasp the pallet quite securely and shouldn't twist or fall off.

In almost all lathe heads, the back spindle has an index plate of 60 holes. So, each of these are 6° apart. Thus, if the pallet faces directly upward, the opposite pallet need only be twisted one quarter turn, plus one more hole. Most often, if the original stock from which the verge was filed was blue or allowed filing, twisting won't tear, crack, or shear off the thinner center section. Otherwise, as in our present operation and instruction, the center section will have to be softened by directing a thin flame at it.

To obtain the precise angle, examine Figure 15. Here the T-rest is utilized. First, take note of the spindle index hole which is closest to the

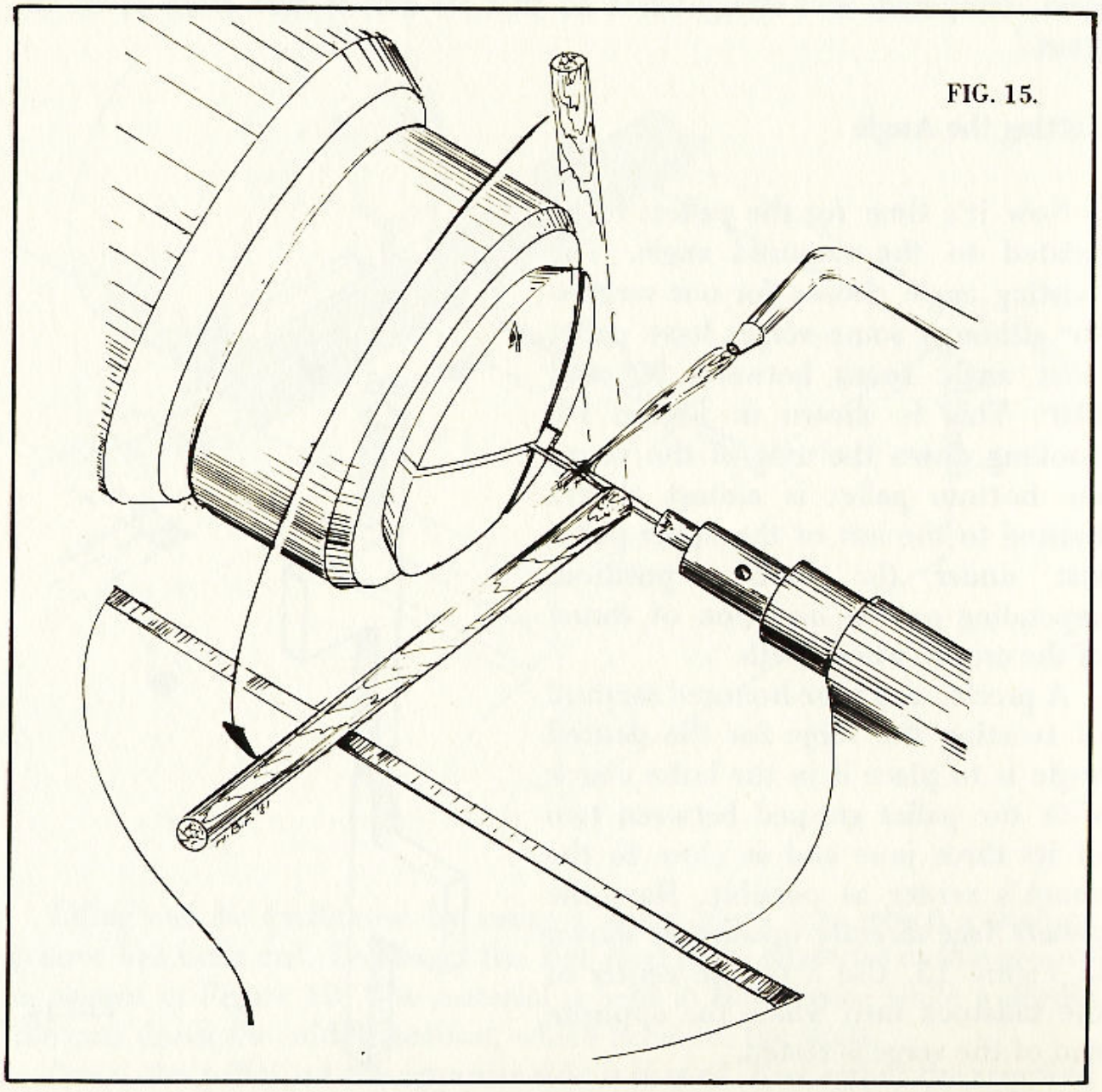


FIG. 15.

spindle locking pin while both pallets (including the one with the pegwood attached) are upright. Then count off 16 holes and again lock the headstock with the spindle index plate pin.

Adjust the T-rest so that it just touches the lower side of the pegwood. This insures an angle of 96°. If a greater angle is required, adjust the T-rest accordingly.

Now, again lock the headstock with both pallets and pegwood upright attached firmly to the outer pallet. Carefully direct a thin flame jet at the center section. *Don't overheat* because as soon as the center section is soft enough, the leverage of the pegwood on the pallet will twist the verge until the pegwood rests on the preadjusted T-rest, as shown in Figure 15.

The verge-to-be is grasped in the jaws of the pinvise with the upper pallet also within the jaws of the pinvise. The opposite pallet is grasped in flat-faced tongs and twisted, trying to maintain a true axis. Ancient tool catalogs picture small special devices for twisting the verge, some with protractor caliper-dials to assist in obtaining the correct angle.

A method of filing the center twisted portion to a round appearance is shown in Figure 16. Here the verge with a pallet in the jaws of a pinvise is made to rest on the edge of a thin piece of wood whose surface has been prepared with a thin groove upon which to rest the center twisted portion. The edge of a fine needle file is made to go across this as the pinvise is rotated against the motion of the file.

Because the verge is sturdier at this stage, it would be best to stake the brass collet onto the verge.

The verge and its collet are removed from the balance as a unit. Select a unit in the staking set die that will allow the hairspring collet shoulder under the balance to rest closely fitted. Center this hole and lock it in place. Place the balance and the collet in the die. Select a hollow round-bottomed (or flat-faced) punch to rest on the brass collet from which the top pivot emerges. The punch's hole should fit closely around the arbor extension. A light hammer tap should cause the brass collet with the damaged verge to drop out of the balance. If the collet hasn't been mutilated, and its hole is smaller than the pivot arbor of the new verge, it may be used.

While it is possible to use the collet from the broken verge, it is best to make a new one in the lathe from the brass rod. The dimensions are simple. The larger dimension of this collet must be turned to provide a snug friction-fit for the hairspring collet. Its height should be no greater than the height of the hairspring collet.

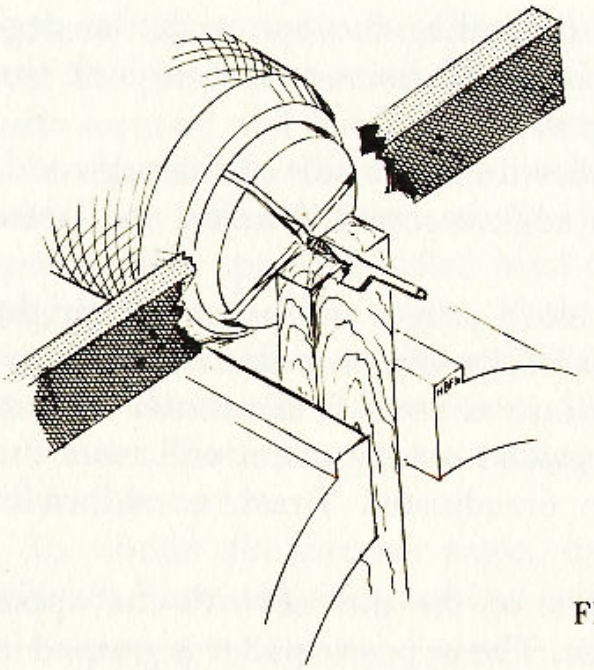


FIG. 16.

The smaller diameter should be turned to later fit tightly into the balance hole, and its height shouldn't exceed the thickness of the balance's hub by more than 0.2 mm. It is best to countersink the top of this collet. When this has been turned, a hole is drilled into the collet-to-be. The diameter of this hole should be the width of the square extension of the arbor above the pallets, *not* its diagonal. This is shown in Figure 17.

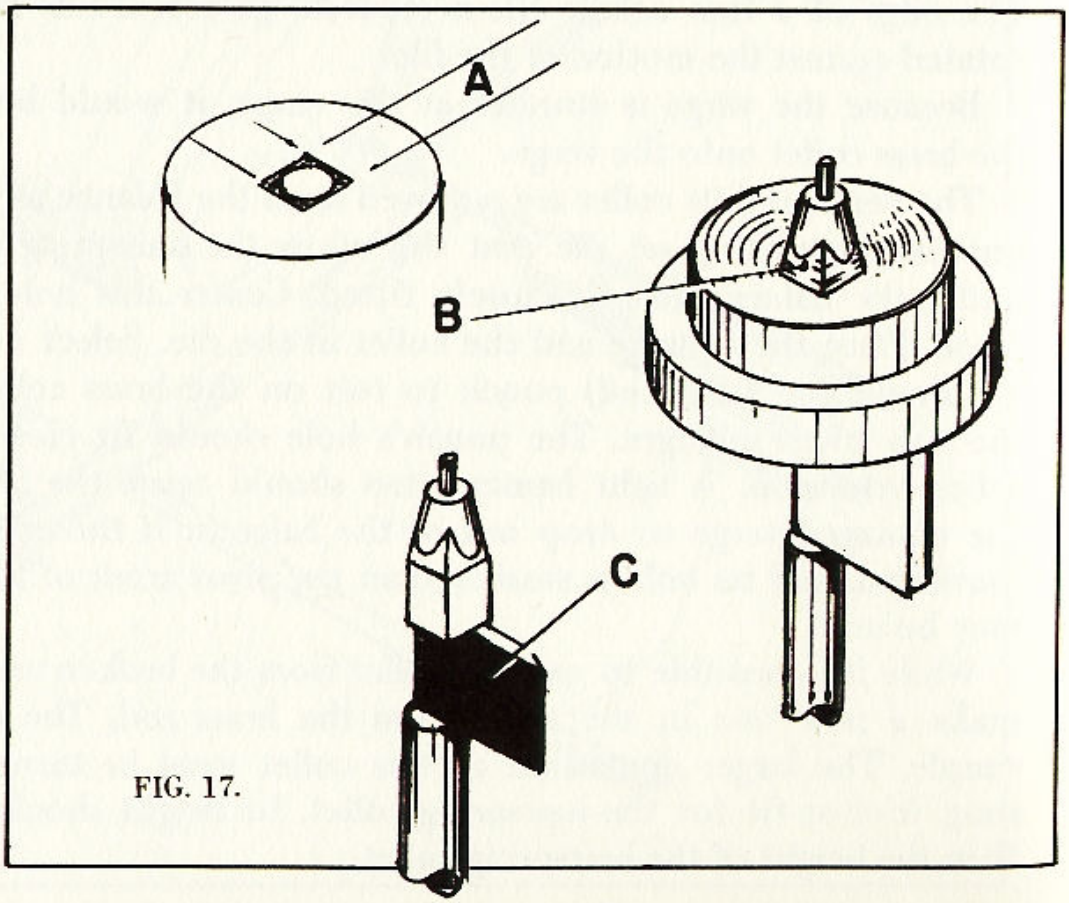


FIG. 17.

Thus, when the arbor extension is pushed into this hole, the square corners of the arbor extension will displace metal at four points on this round hole. This is shown in the shaded area around the hole at this figure at "A". The square sharp corners will provide a very tight fit and prevent twisting of the verge outside the collet. To facilitate an initial entry of this arbor extension into the collet, it should be lightly tapered, as shown at "B". The collet is driven into the arbor by placing the verge again on the grooved staking set stump, as shown in Figure 6. The collet then is driven down tightly against the edge of the pallet using a flat-faced hollow punch staking which fits closely (but not tightly) over the protruding upper arbor extension.

Notice that in Figure 17C the thickness of the pallets has been made thinner. This allows the impulse to take place closer to the line of centers and insures surer drop space and increased balance motion. This should be done while the verge is still in a softened state. The pallet is rested on the wood block hold in the vise and the part made thinner. In doing the thinning operation, be very careful from which side you remove the metal. It must be from *the side which makes contact with the escape wheel tooth.* Many verges in the making have had to be abandoned when this precaution was overlooked.

After filing to the required depth (ideally when this face is close to the center of the axis), use an oilstone slip to prepare the pallet for later polishing. (Some makers of these staffs prefer to provide unfinished rudimentary pivots before the verge hardens.)

Using the Screw Ferrule

Figure 18 shows a method of either rough finishing or completely finishing the pivots. A screw ferrule shown in this illustration is used to grasp the middle portion, strengthening and providing support for the thinned center section. A piece of pegwood of proper thickness is cut to fit along the center section of the verge. A sector is cut from the pegwood and retained after a small flat on its sharp ridge is removed.

The verge is inserted into the screw ferrule. The screw ferrule is a very small pulley with a center hole section and a rectangular boss. The screw block then is secured like a tiny vise around the pegwood and its verge shaft. This provides a strengthening of that thinned part but also allows, with the pulley, for the unit to be turned on its center.

At left in the illustration is shown the female center into which one pivot or the other is rested, while the opposite pivot or extension pivot-to-be rests in the properly chosen groove of the "runner".

The grooves of the runner are a die-hard series of V-grooves into which the pivot to be turned and finished rests. The pivot file, or burnisher, files or burnishes the extension until its diameter is reduced to a point where its circumference is just level with the top flat edge of the runner, denoting the thickness as marked on the runners.

The runner then is turned to a more shallow section and the verge operation repeated until the desired thickness is reached. This operation can be preparatory while the verge is soft, or applied again when the verge is hardened, tempered, and finished.

The pulleyed screw ferrule is used most often with the Jacot tool or as attachments to the lathe. In the absence of a screw ferrule (no longer shown in current tool catalogs), the pegwood and wedge can be secured by binding wire around the inner section. The outer pivot-end rests on a runner which most often is an attachment to the tailstock of the watchmakers' lathe. This supplies strength to the center section.

The pivots also may be finished by the use of the (flake) shellac chuck as described earlier in the pivoting operation. Some prefer to wait until the brass verge collet has been staked to the verge because the balance's top pivot can be finished while being held by this collet in the lathe, the pivot then being concentric with the balance's center. When the opposite pivot requires finishing, the verge is reversed in the lathe and the opposite pivot rested in the tailstock runner attachment for finishing. The balance also can be staked to the verge collet and the pivots finished in the Jacot tool or pivot lathe.

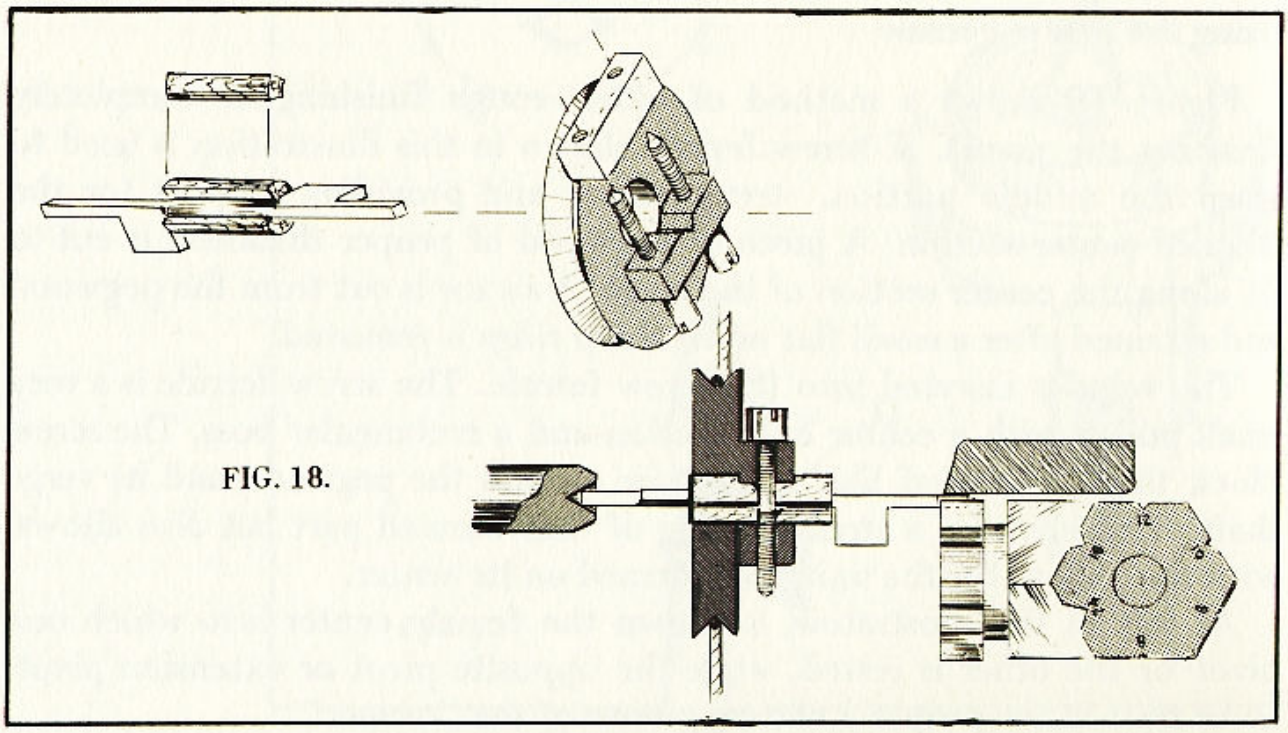


FIG. 18.

To harden the verge requires that its mass or body be built up to retain the heat required to harden by quenching. Such small pieces of steel when heated red hot cool before they are quenched in the coolant fluid.

Therefore, to build up the mass, thin soft wire is wrapped around the verge to resemble a cocoon. When this mass is large enough, heat it to a red hot degree and plunge it *vertically* into oil or water. Then, remove the wire wrapping and place the verge into a small metal watch parts box filled with brass filings. The verge should be covered by filings, but shouldn't touch the bottom of the little can.

A spare polished head of a ratchet screw is placed head up and the box of filings heated until the screwhead turns a dark blue. Remove the flame *immediately.* In fact, when performing this operation, it is best to anticipate the color (from a straw hue to a dark straw hue, to wine color and then to blue) so that the residual heat won't cause the color to go beyond dark blue. That would soften the metal. This color, of course, indicates that enough brittle hardness has been removed, leaving the tensile strength and hardness in the verge. This allows finishing by fine pivot files or burnishers.

The pallets should be polished on their frictional surface. Use an oilstone slip first, stroking it across, at right angles to the axis of the verge and *not along the axis.* Then it can be polished to a bright finish with a boxwood or pegwood slip whose surface is correctly prepared flat and with the jewelers rouge applied. (See Figure 17C.)

When staking the balance onto the brass verge collet (the verge is already attached to it), the verge and collet are centered in the staking set die, and the die locked in place. The hole in the die should be large enough to accommodate the verge and still allow sufficient surface upon which to rest the attached collet. A flat faced hollow punch that fits closely, but not tightly, is placed over the upper extension of the verge arbor. Then the balance is pressed onto the verge collet.

To make certain that the balance is fully seated on the brass collet, a flat faced hollow punch, whose diameter is just larger than the hole in the balance, is placed over the arbor. This provides the positive seating for the balance on the brass collet.

If the verge collet was slightly countersunk, as recommended earlier, it can provide a riveting shoulder to slightly secure the balance to this collet by placing the first flat faced punch over the balance. Its flat surface tapped against the countersunk edge of the collet will spread this edge outward against the walls of the balance hole. Before staking the balance to the verge, first make certain that the position of the balance

relative to the verge pallets has been observed according to the preparatory markings recommended earlier.

Fitting the Verge

When fitting the verge to the watch make certain that the lower pallet doesn't foul the lower potence. Also be sure that the escape teeth and pallets are both centered and that the potence reaching into the escape wheel's pivot doesn't touch the verge arbor (if left too thick or if the screw adjusting the escape wheel's endshake was advanced too far). This would also cause an escape tooth-pallet engagement that is either too deep, or make the necessary endshake disappear, and prevent the watch from running. Remember, too, that the pallets of these escapements shouldn't be oiled, especially in watches.

I will now describe how I make verges for watches. My method requires only a watchmaker's lathe and everyday bench tools. I believe it to be the simplest to use and most likely to maintain precision.

The material used is the same type blued-steel round rod from which regular staffs are made. Thus, no tempering is required. The stock thickness should be at least as thick as the shoulder upon which the hairspring collet will be placed. The balance, hairspring collet shoulder, and verge pallets are made all in one piece in this system.

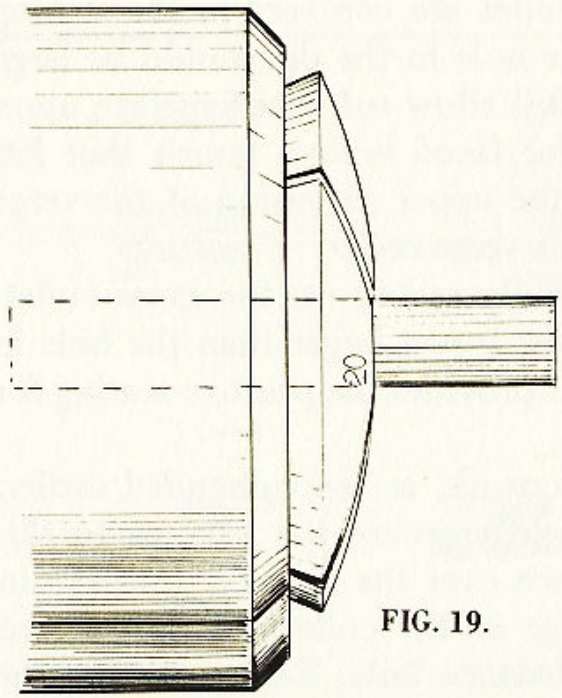


FIG. 19.

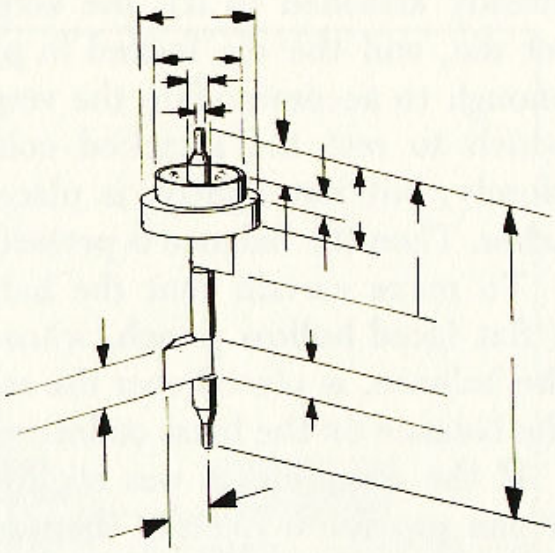


FIG. 20.

In the absence of blued-steel stock, old phonograph needles—annealed to a rich dark blue, or drill stock hardened and tempered to the same color—may be used. Provide a length of such steel that will be at least six millimeters longer than required.

The stock should be placed in the lathe so that about four millimeters emerge from the lathe chuck as shown in Figure 19. Before cutting any part of the verge, the watchmaker should be prepared with all dimensions, as shown in Figure 20. These should include the overall height, from one pivot end to the other; the height of the collet shoulder; the heights of the pallets, and their distances from the pivot ends; the space separating the pallets; the angle between pallets (I've chosen 96°); and the width of the pallets, generally obtained from the old verge.

The Pivot

First, cut the lower pivot and arbor (farthest from the balance). It is a good idea to make the pivots a little longer than needed. These can be shortened later to accommodate for minor adjustments to endshake and for the escape teeth engagement with the pallets.

The arbor thickness shouldn't exceed 40 hundredths of a millimeter. This requirement is necessary to provide a clearance between the potence which reaches into below the level of the escape teeth to support the escape wheel's outer pivot.

The pivot thickness can be brought to shape and thickness with progressive use of the graver, pivot file, oilstone slip, or small sapphire files which are now available. Polishing is done by careful burnishing or with rouge applied to a flattened piece of pegwood. Upon completion, this should look like Figure 21.

The next step is to decide the width of the lower pallet (or "flag" as it is sometimes called). This is the measurement from the back of the finished pallet near the verge's axis to the edge where the escape tooth drops off after supplying an impulse.

The metal extending from the lathe can be turned to a diameter equal to twice the width of the pallet. This is measured from the back of the pallet to its let-off edge, less half the thickness of the arbor from which the lower pivot was cut.

The height of the pallets, measured axially, should be adequate to provide engagement by the escape teeth. Cut a groove with the graver that marks the height of the pallet. The depth of the groove should be about two millimeters—sufficient to have a good small file start the filing of a

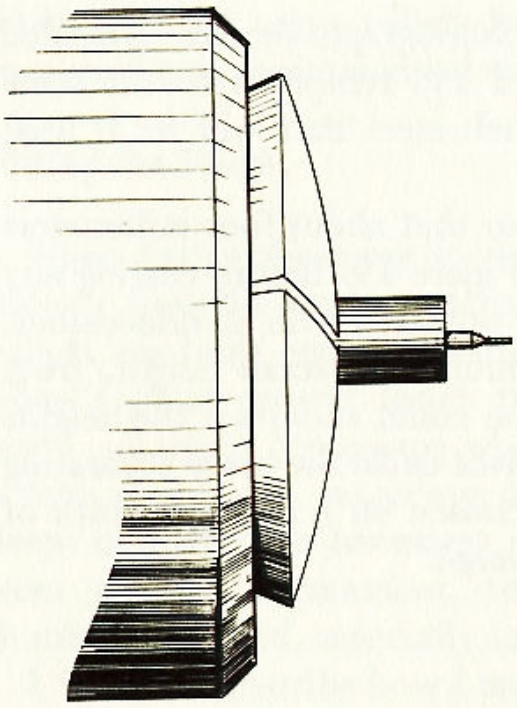


FIG. 21.

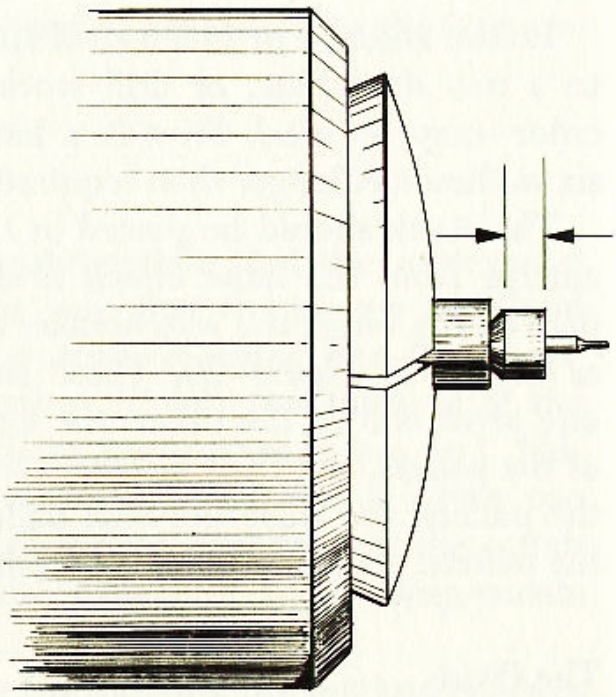


FIG. 22.

flat, as in Figure 22.

Figure 23 shows how the first stage of the pallet should appear after the file has produced the first flat of the pallet, after locking the headstock index plate at one of the quarter holes in the 60-holed plate. Use a fine file whose safe edge faces the lathe chuck. File the flat until the metal is filed down to the arbor previously cut with the graver.

Next, unlock the headstock and turn this over 180° and repeat the process. Figure 24 illustrates how the verge-to-be should appear at this stage.

File away the edge nearest you so that the result appears as in Figure 25. A good pallet should have its active flat surface level with the exact center of the verge arbor. This allows the escape teeth to provide the impulse closer to the line-of-centers with better impulses, less friction, and wear. Square needle files whose width is narrower than the pallet's thickness to the required dimension. This operation can weaken the arbor, and may cause it to bend or break. Therefore, it's best to support the arbor during this final filing and polishing.

Providing Support

To provide a support for the arbor during the thinning of the pallet,

use a wood dowel stick that will fit snugly into the T-rest. File the leading section of this wood-end flat so that it is about 0.20 mm below the flat upper level of the wood stick, as shown in Figure 26. File a shallow groove as well to support the round back of the arbor. The step on this wood-end should be well-defined and not sloping.

The pegwood and T-rest are brought against the bottom of the pallet, with the pallet facing you, as shown in the illustration. The file can then cut away metal, making the pallet thinner up close to the center of the arbor, allowing for just a little bit of metal to be removed to remove the file lines. Provide a nice, glossy finish with a pegwood slip to which jewelers rouge has been applied.

Don't use great pressure when filing, but employ patience as these small fine files don't bite deeply and great pressure won't hasten the job. It may, in fact, cause the arbor to break or bend.

The next operation is to cut the verge shaft section between the pallets. This section separates the pallets and must be thin enough to provide potence clearance, as mentioned earlier. If this section is between 0.3 and 0.4 mm, most often it will be thin enough. An inspection of this area or comparison with the old verge should reveal whether this thickness will provide the necessary requirements.

Once the lower pivot, arbor, and pallet are finished, the center arbor may be cut in the lathe, using a slotting graver, whose width can manipulate between the pallets. If the graver is well sharpened and finished on an

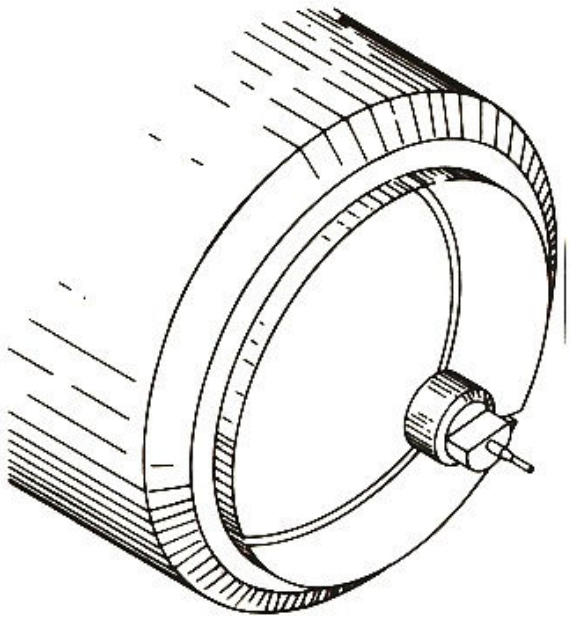


FIG. 23.

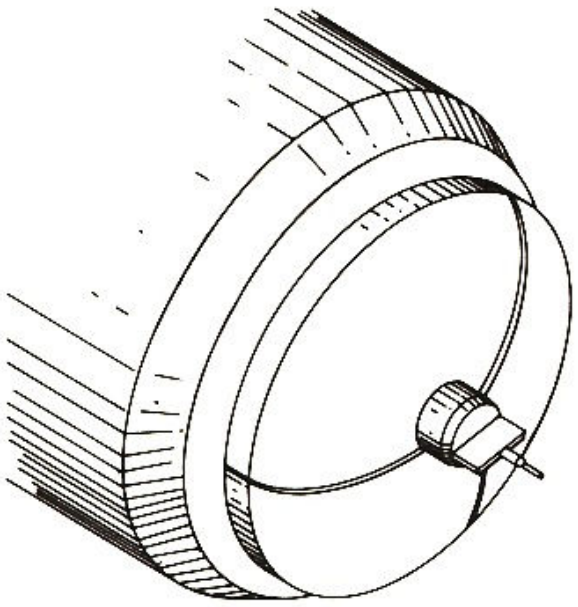


FIG. 24.

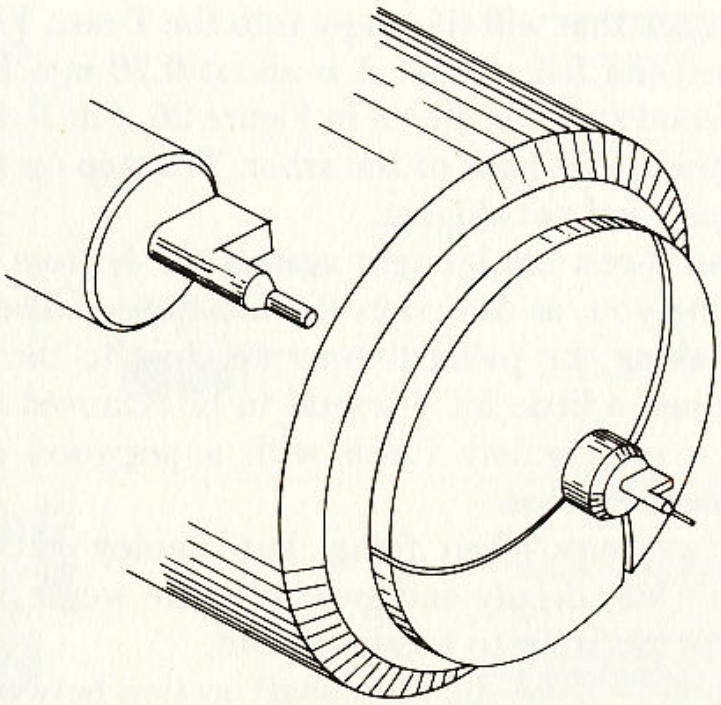


FIG. 25.

oilstone—and then on a crocus cloth rested on a flat, hard surface—it will cut cleanly and will leave a fine smooth bright finish. This should minimize or negate the need for finishing with an oilstone slip or polishing chip.

Move out from the lathe chuck sufficient stock to cut the center shaft, and a bit more for later production of the upper pallet. The operation is illustrated in Figure 27.

The Upper Pallet

The upper pallet now may be filed in the same manner as was the lower pallet. Before starting to file this, first make certain of the diameter of the metal from which this pallet will be filed. This operation is shown in Figure 28. Here the graver cuts the shoulder from which the upper pallet will be filed. A short groove is cut to enable the file to cut a flat surface. After this, the safe edge of the file is placed closest to the lathe. Before starting to file this, first make certain that the angle of the upper pallet to be filed is in the correct angular direction. Otherwise, it may mean starting all over again.

Let's recap. The direction of the pallets relative to each other should be: Pallets facing you, the upper pallet facing to the right and the lower pallet facing 96° to the left. It makes no difference whether the verge is turned upside down or not.

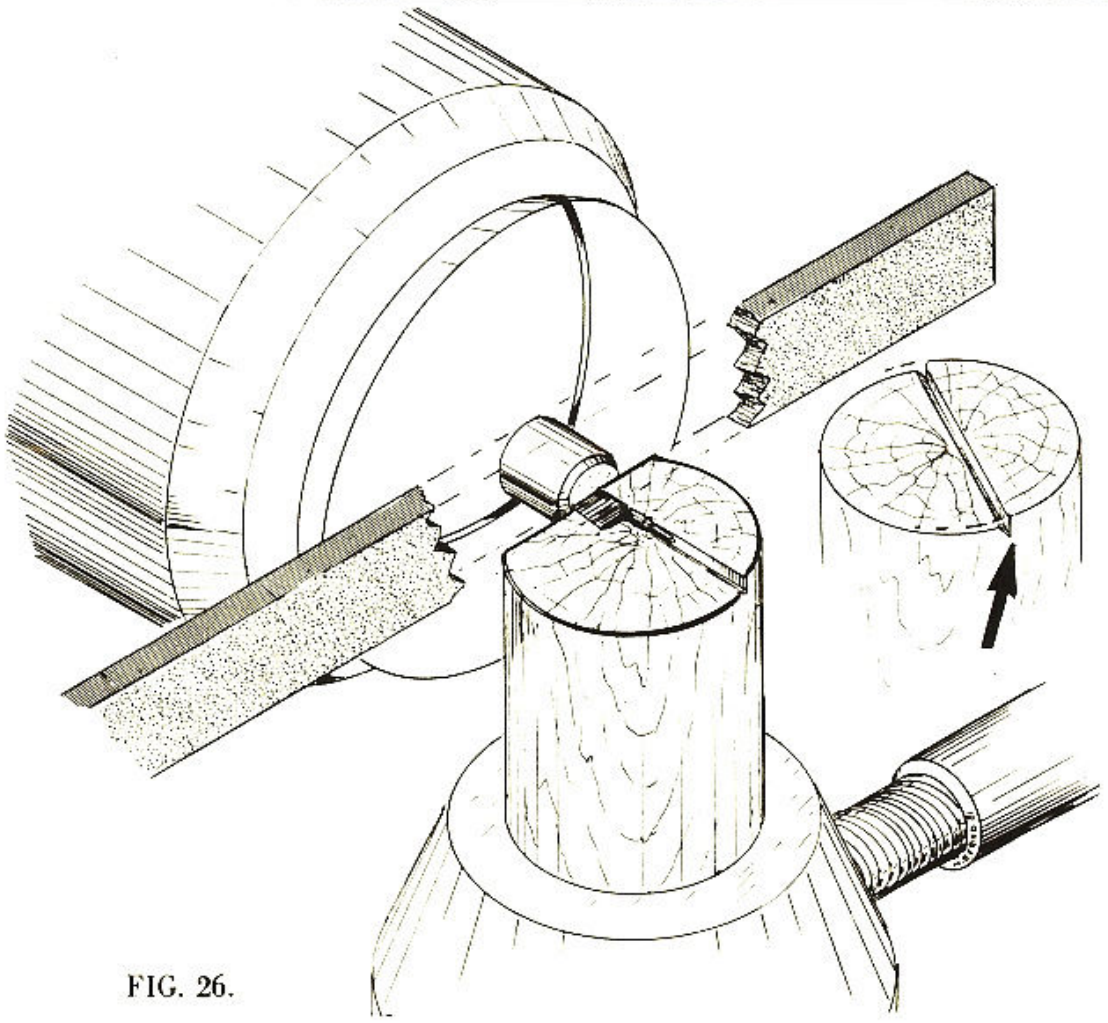


FIG. 26.

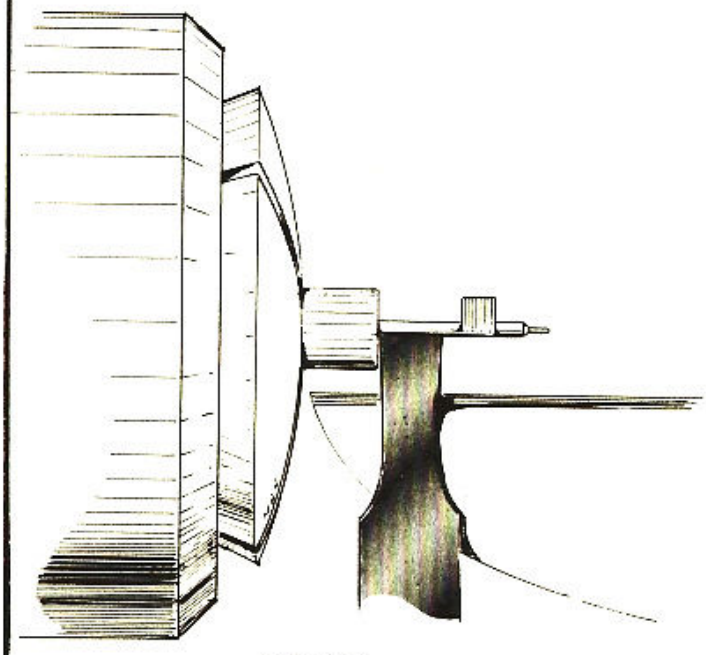


FIG. 27.

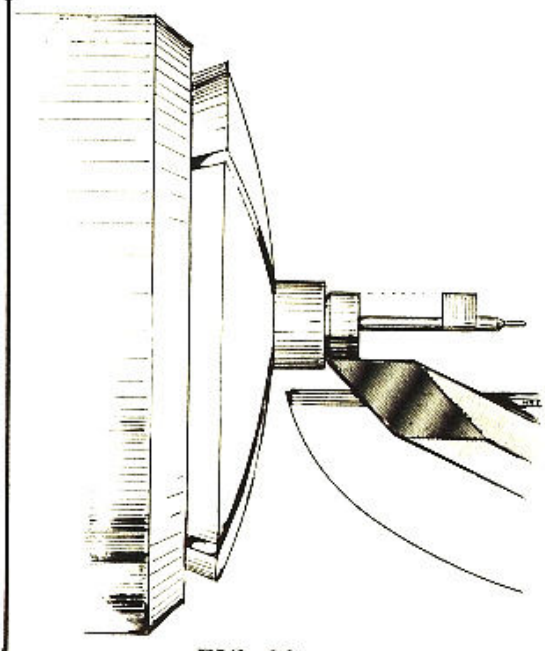


FIG. 28.

Put another way, looking down through the axis of the verge, with an escape wheel tooth moving from top left to bottom right, the top pallet in your view should be 96° to the right, and the lower pallet at its left. Should the pallets' directions be incorrect, one pallet will be rotated out of contact with the diametrically opposite oncoming escape teeth.

Getting Correct Position

To obtain the 96° separation and correct relative position, first locate the exact horizontal position of the first pallet while it is facing you. Secure this position in the lathe chuck. Then turn your attention to the rear of the lathe head in which the 60 indexing holes are situated. Remember, you have locked the lathe with the first finished pallet in a horizontal position, with the lead of that pallet facing you.

Then, as shown in Figure 29, rotate the lathe head 14 holes or 84° counterclockwise as viewed from the rear. From the front of the lathe with the verge pallet view, you will be providing a 96° angle between

FIG. 29.

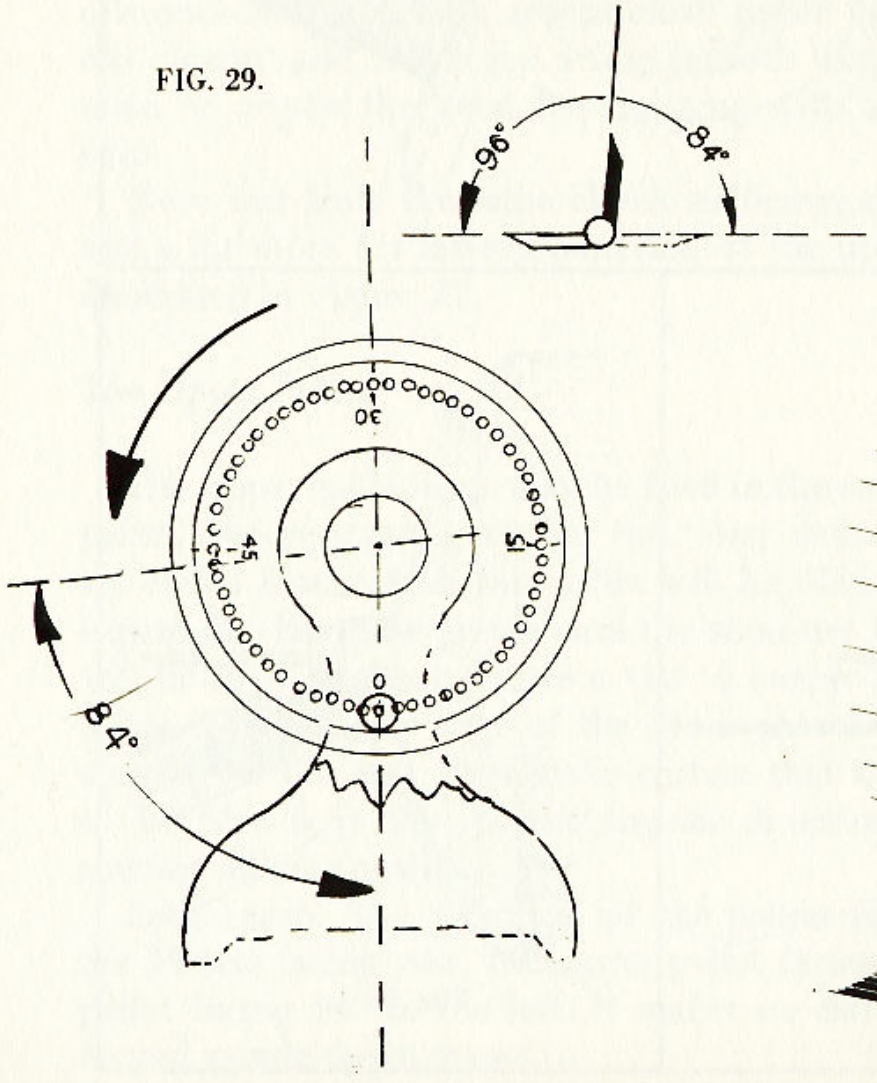
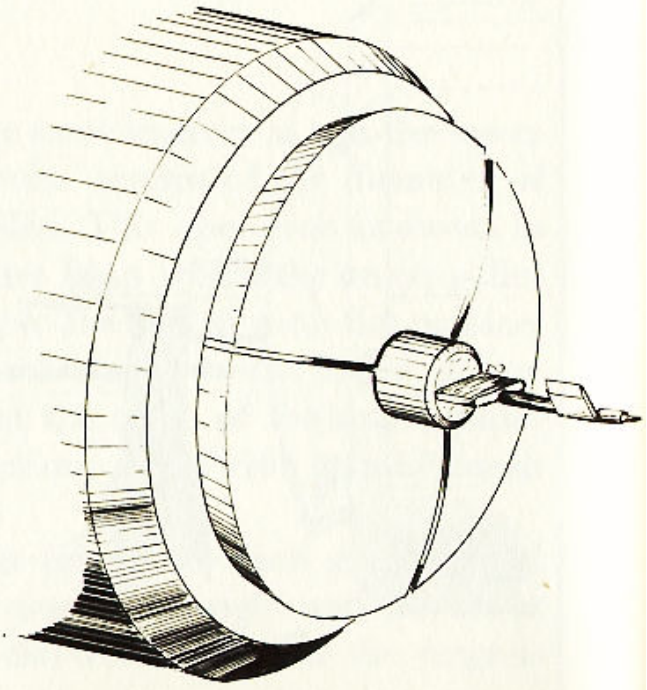


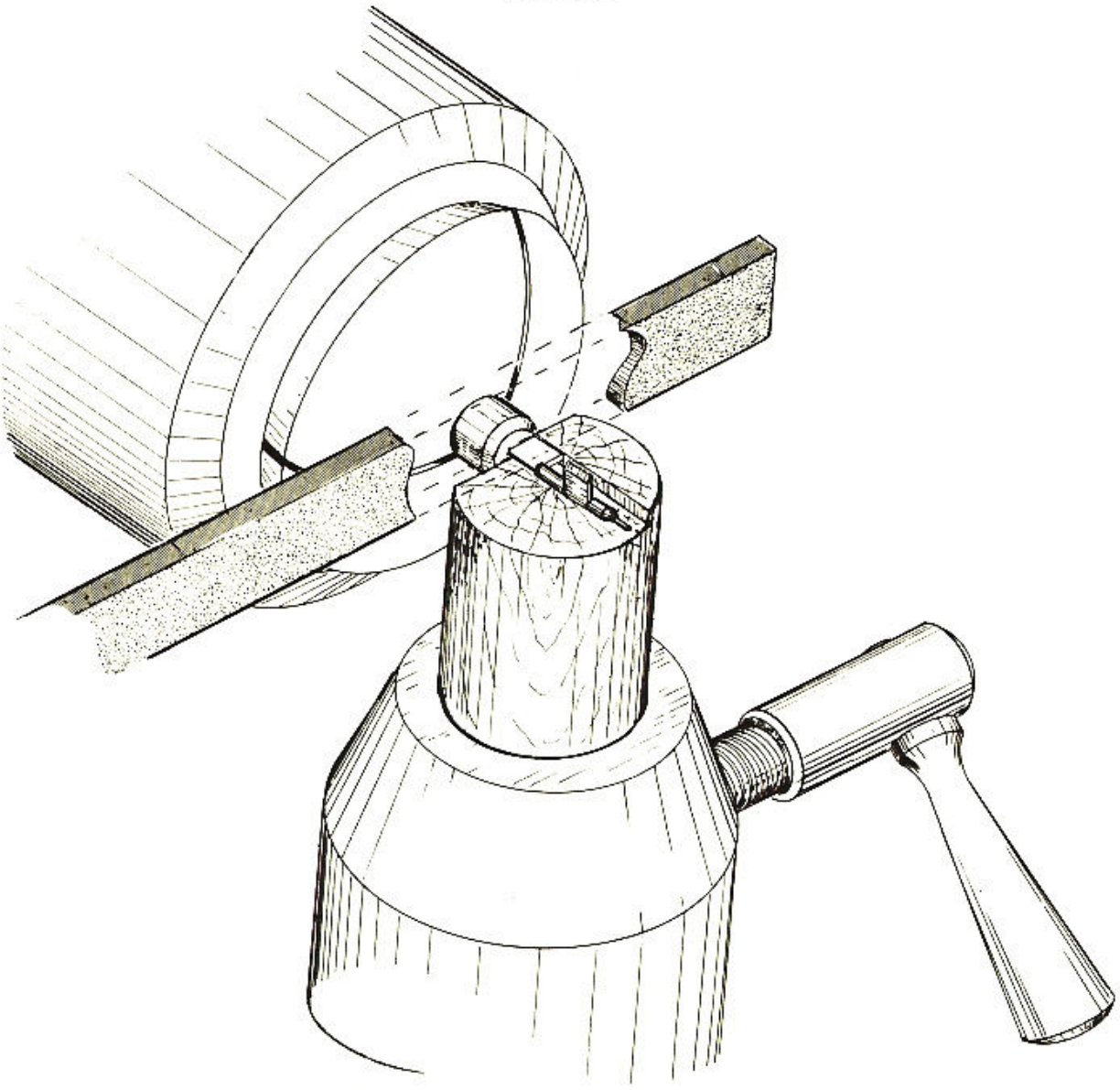
FIG. 30.



the finished pallet and the one to be made since it is the rear flat of the pallet which will be used and the front section filed away. This is shown in Figure 30, using the wood dowel support in the T-rest if needed.

After the flats have been provided for and the verge at this stage appears as in Figure 30, file away the front half of the pallet so that it appears as in Figure 31. Here the support in the T-rest is used to finish the pallet and polish it as noted earlier. However, this pallet's edge is rested against the lip-edge of the dowel because not only will the finishing file or polishing slips exert a downward pressure upon the verge, but a forward one as well. This step-edge supplies support for the verge with both pressures. An edge is given to both pallets bevelled from the rear. Don't bring this to a razor-edge, but leave a barely noticeable flat in case of wear.

FIG. 31.



The Hairspring Shoulder

When both pallets are finished, the metal may be advanced from the lathe chuck, so that the hairspring collet shoulder may be finished to the correct diameter and height. This should appear as in Figures 32 and 32A.

When the hairspring shoulder has been cut, make certain that the collet will be correctly seated upon it by actually trying the hairspring collet while the verge is still in the lathe. The stock may be removed from the lathe chuck and reversed. A new well-fitting lathe chuck which will grasp the verge by its hairspring collet shoulder is chosen and secured in the lathe. The emerging rod should appear as in Figure 33. Cut the emerging stock of steel so that the balance hole will be virtually friction tight onto the steel in the lathe chuck after the cut to the correct dimension.

Shorten the stock so that the upper pivot and arbor may be turned and cut in the lathe. Provide a slight undercut to the top shoulder for the balance in case this requires riveting over to provide a tight, non-shifting position relative to the markings upon the balance and upper plate for the in-beat and regulating positions. The finished verge, all in one piece, should look like that in Figure 34.

Though both pivots are made longer than needed, these can be shortened later to provide for the proper endshake, as well as an adjustment so that the pallets are centered on the escape tooth's thrust. In addition, one pivot may later be shorter than the other to favor the height clearance of

FIG. 32.

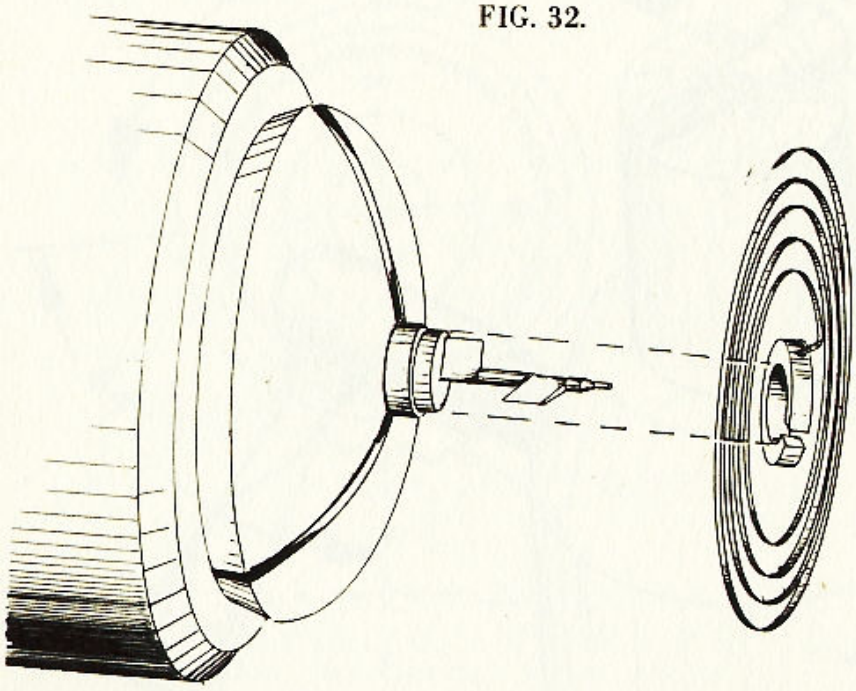
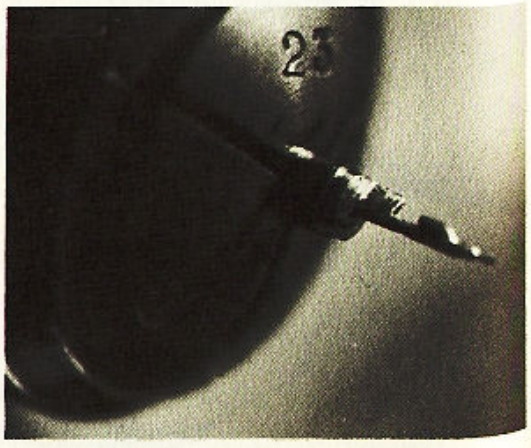


FIG. 32A



the opposite pallet from the lower potence or to provide the balance's and the hairspring's clearance from contact with the plate. Try the finished verge in the plate with both the balance cock or bridge connected to the upper plate while the escape wheel is secured. Doing this before the balance and hairspring are staked to the verge allows for minor adjustments.

In this system of making the verge, pivots are more likely to remain on the same exact axis. No tempering is required and the proper angles are assured. The time it takes is not as long as with other methods and success is more likely using only moderate skills.

Powell's Method

The following is the method used by Fred A. Powell, photographically illustrated by him. Powell claims that his method is more traditionally correct because he supplies the brass collet for the verge upon which the hairspring and balance will be staked, thus maintaining the traditional authenticity of the watch.

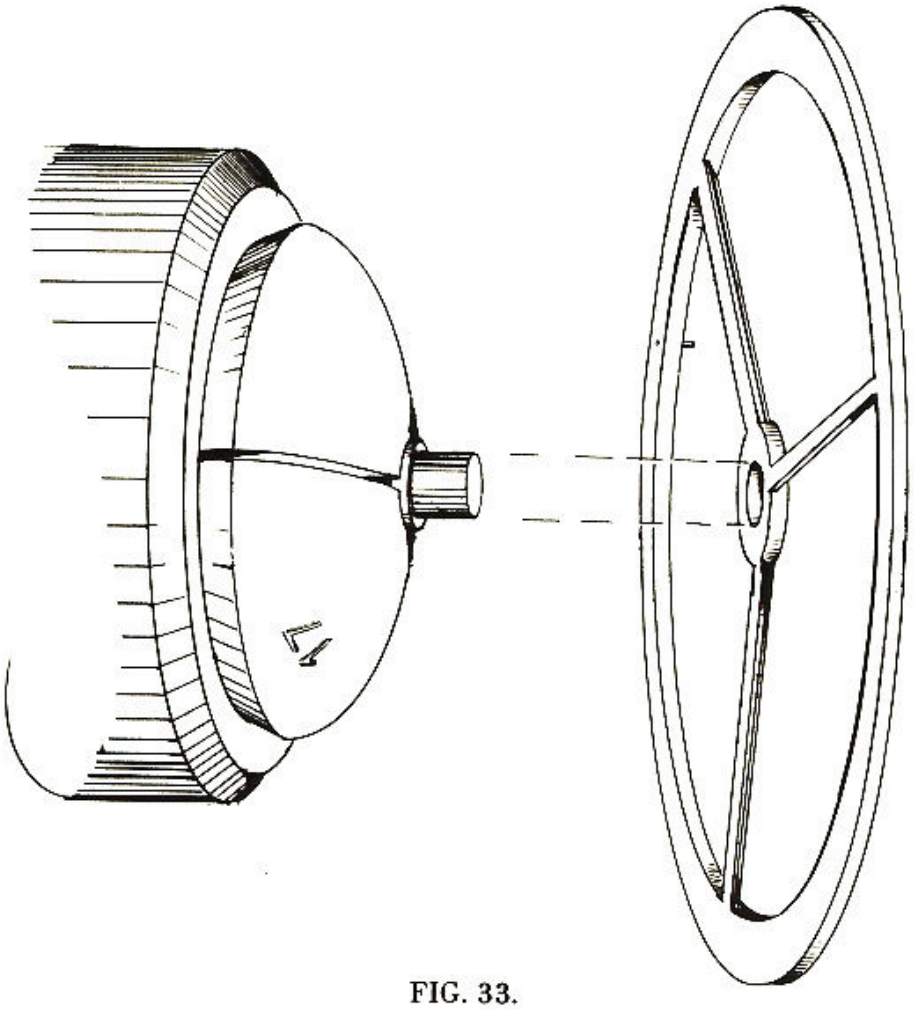


FIG. 33.

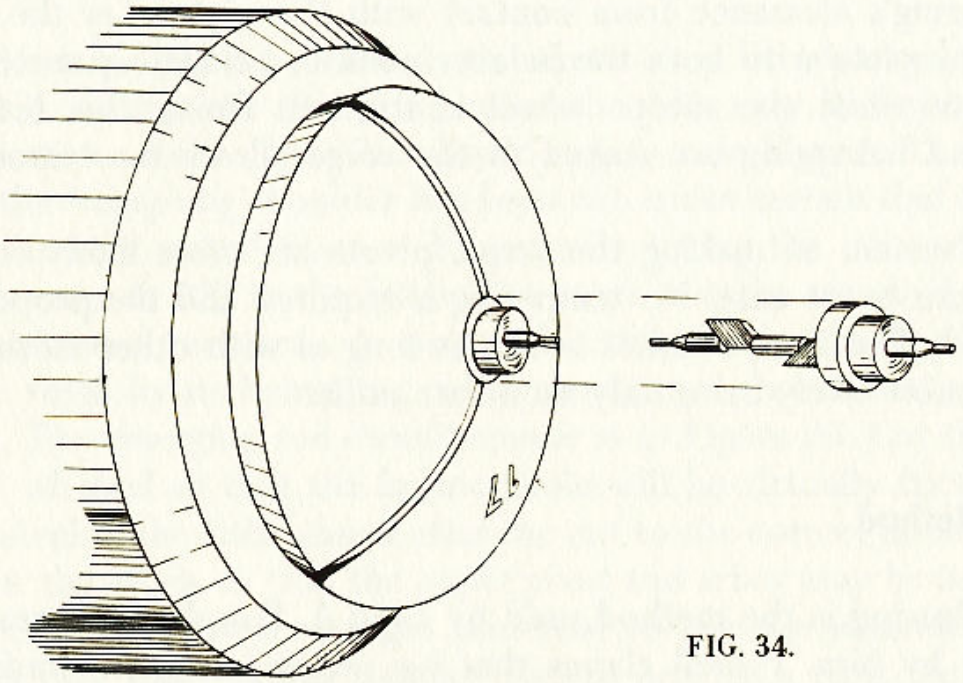


FIG. 34.

A bushing then is cut upon which will become the balance seat and the hairspring collet shoulder. Drilling this while in the lathe aids in securing concentricity. The verge is secured in the brass collet friction tight, but made solid with a minute bit of solder, much the same as original verges were secured. This completes the task.

Powell is not a watchmaker by trade, although he is more than amply qualified by skill and knowledge. He has a Ph.D. and an MA in mathematics from Harvard University, and from the University of Buffalo. His academic specialty is "Mathematical Scientist in Aerospace".

Powell uses the watchmaker's lathe, but with a milling attachment. For this photographic exposition, he makes a brass test piece to obtain the pivot diameters and the overall length. The watch for this project was English with "blind" holes for both pivots. The test piece is shown in Photo 1.

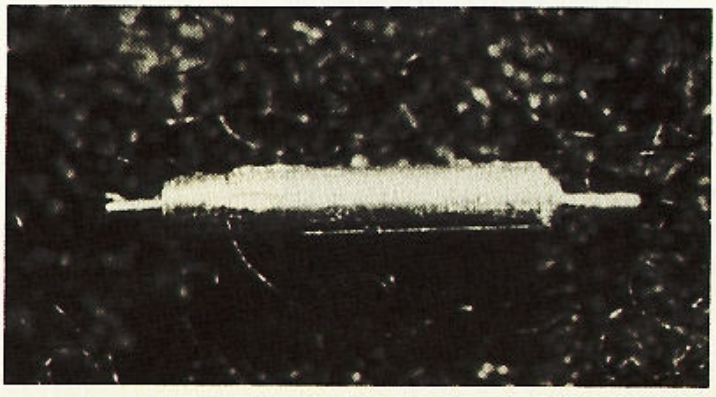


PHOTO 1.

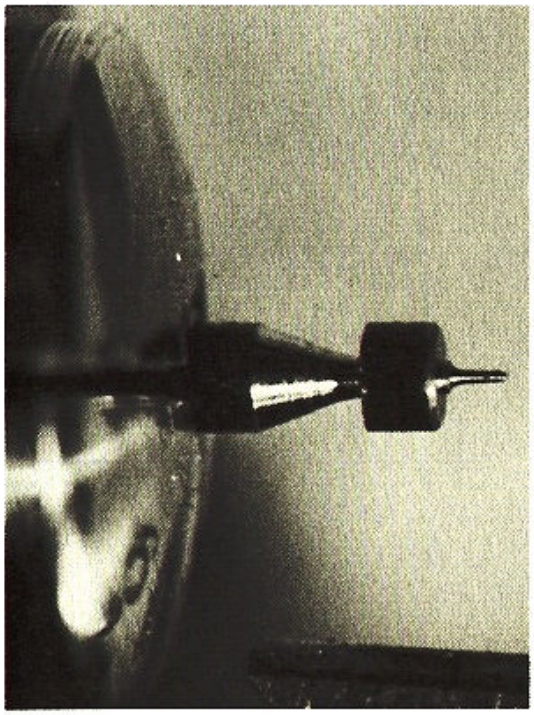


PHOTO 2.

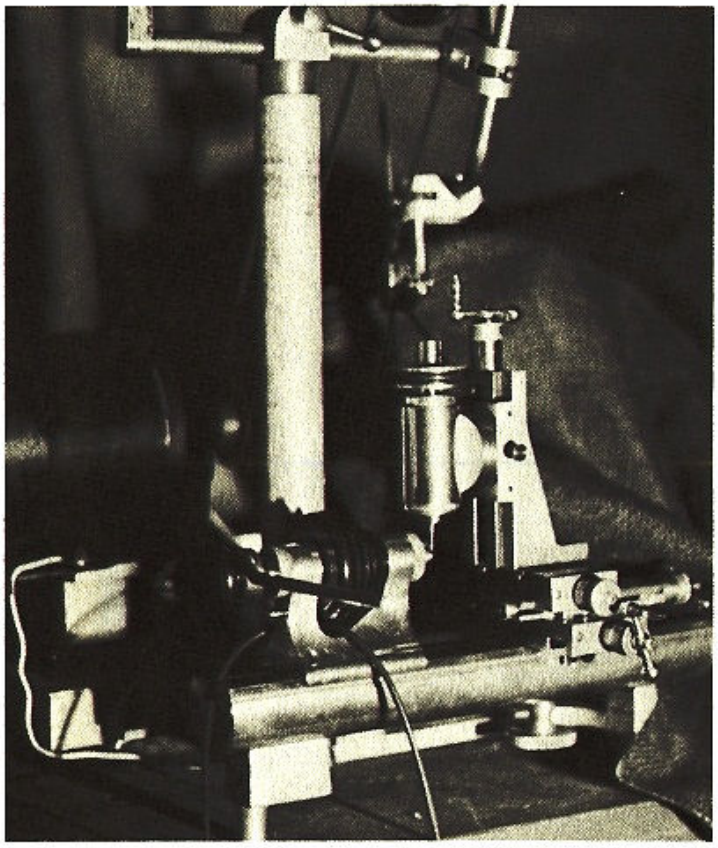


PHOTO 3.

Photo 2 shows a piece of steel, one and one-third times the inter-tooth space distance of the escape wheel. This will yield verge pallets (or "flags") with a radius slightly greater than correct. Powell then cuts the lower pivot and polishes it, making it complete.

Following this, a "drum" is formed from which he mills the lower pallet as well as cutting the beginning of the shank or arbor between the pallets. This reduces the chance of breaking off the lower flag during completion of the arbor.

Photo 3 shows the milling set-up for milling the pallets.

Photos 4 and 4A show a close-up of a new carbide dental miller used to mill the pallets from the drum previously described. Notice that in Photo 3 there is a horizontal rod attached to the rear of the headstock. This rod is set into a brass ring secured by set screws. This ring has two holes 90% degrees apart. Powell says, "I use the arm as a vivid statement of where the flag is, so that I don't cut off the flag, nor end up with it facing the wrong way!"

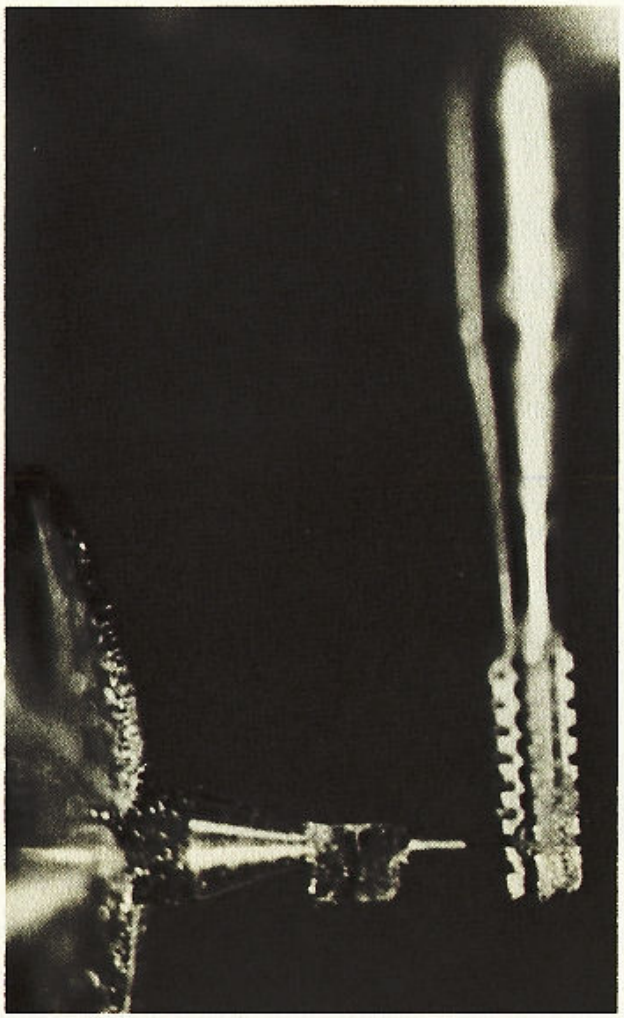


PHOTO 4.

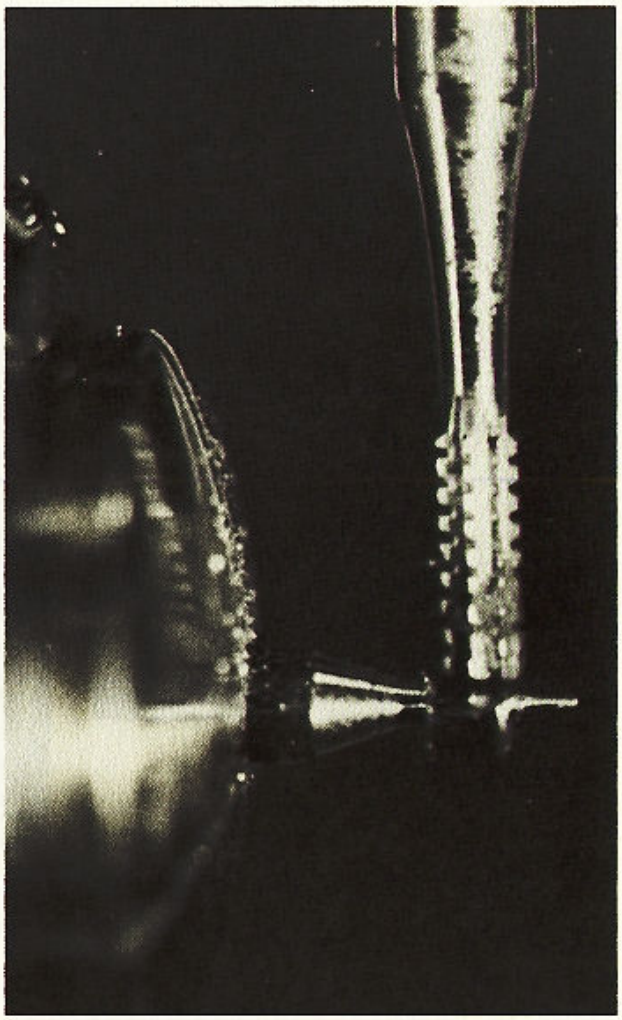


PHOTO 4A.

Next, the lower pallet is cut using a carbide cutter with a rectangular form, available from any dental supply house. Two passes from the miller are sufficient to cut one face. To provide a sure cut and less pressure upon the verge-to-be, Powell uses a fresh milling cutter after the first pallet is cut. The milling is done with the first side milled down to the center line of the arbor's axis. Then, he turns the work piece over and mills the opposite side. The final cut is the milling away of the back side of the pallet, using the side of the cutter instead of its end. This is shown in photos 5 and 6.

The next step is to remove the milling attachment and make a piece of brass with a hole drilled into it, which is held in the chuck-holding tail-stock. The brass piece is then brought up and secured to protect the pivot while Powell removes burrs and sharp corners from the new flag. After that, he polishes the flag-appearing pallets. Photo 7 shows the work to this point.

The staff-verge then is mounted in a balance chuck with the upper

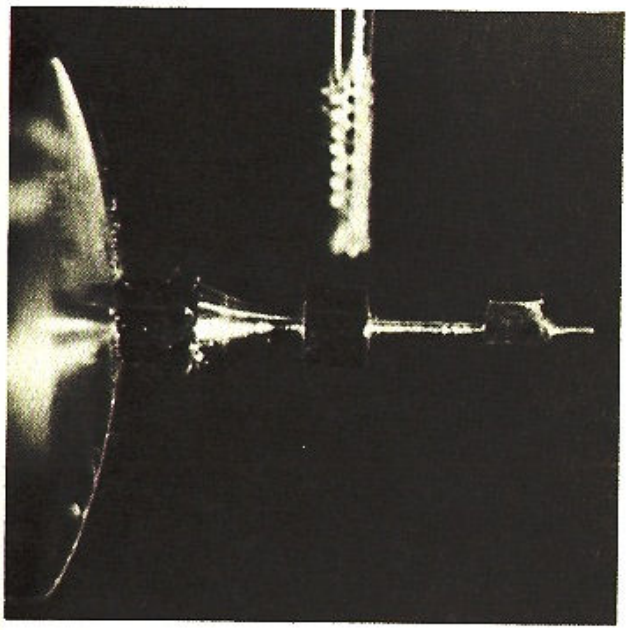


PHOTO 5.

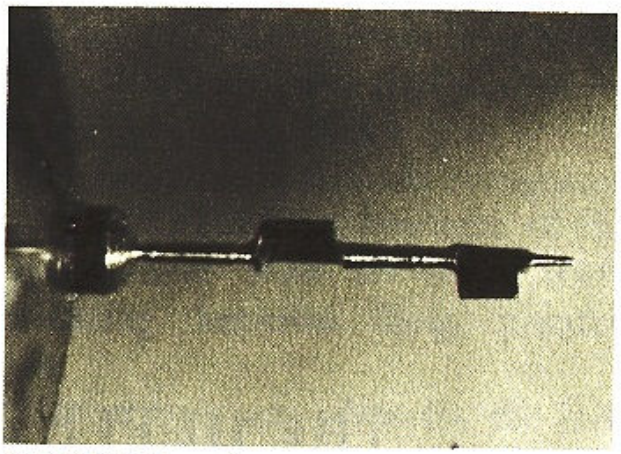
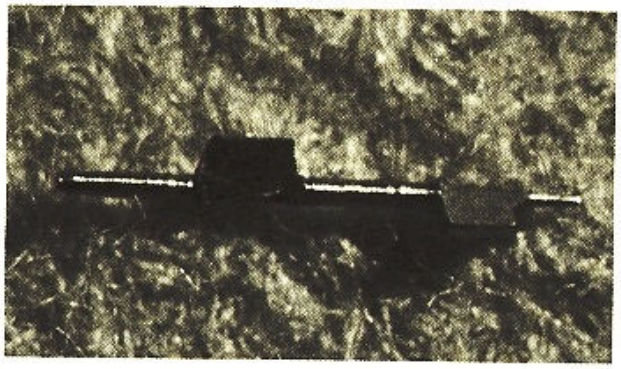


PHOTO 6 (above);
PHOTO 7 (below)



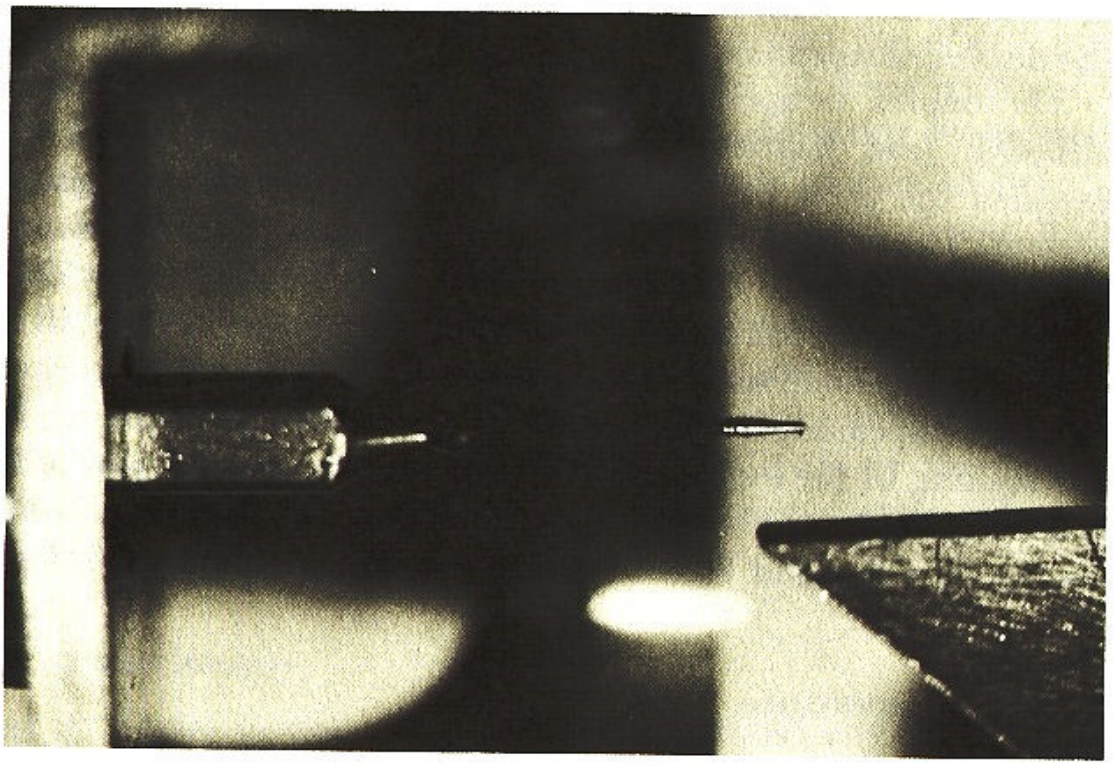


PHOTO 8.

shank exposed to enable cutting and polishing the upper pivot. Photo 8 is a close-up (side-view) of the verge held in the balance chuck with the upper shank extending from the hole plate in the balance chuck, the graver resting on the T-rest to finish the upper pivot.