CHAPTER 7

A PINION HEAD DEPTHING TOOL

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DEPTHING TOOLS

The Classical Tool--The hinged, 4-runner depthing tool of the general form shown in **Fig 7.1** has been in use since the very early days of clockmaking. A wheel and its mating pinion are mounted in appropriate runners near the center of the tool. The thumb screw near the base is then adjusted until proper meshing has occurred. The pointed ends of the runners are then used as a compass to scribe an arc representing the proper center distance between pivot holes for this meshing. A scaled down version has also been in use in the watchmaking field for about an equal number of years.

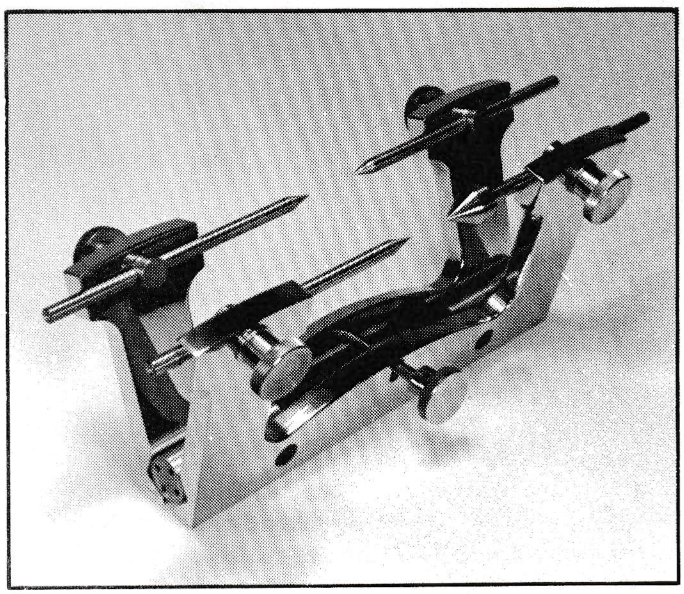


Figure 7.1

Because of the large distance between where the wheel and its pinion are depthed, to the end of the runners used for scribing, it is difficult to maintain accuracy unless the tool is built with great precision. Thus, good ones are quite expensive and often difficult to justify for use in hobby work.

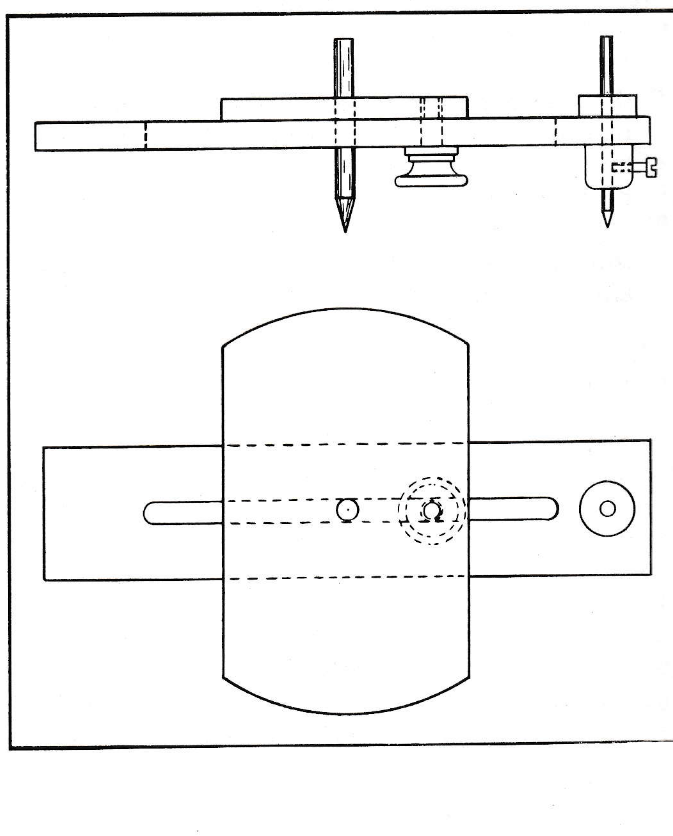
With the advent of modern adhesives, and the simplification of some of the clockmaking techniques to render them more suited for execution in the hobby shop, there has arisen a need for a different type of depthing tool--one with which an unmounted wheel and its mating pinion can be properly depthed and the center distance laid off for placement of the pivot holes.

Although the material here is intended to describe the making and use of a simpler version, the classical depthing tool is still required when wheels and pinions must be depthed while mounted on their arbors.

A Pinion Head Tool--The use of modern adhesives has allowed bonding of many parts which were once made only as one piece. This has made it much easier for such parts to be built in the average hobby shop. A clock wheel and its mating pinion are examples of this. The wheel collet may now be bonded to its arbor with Loctite, and the pinion head, whether of the cut type or the lantern type, may also be bonded to its arbor. Thus, a simple tool with which to depth these parts while still unmounted was needed.

Strangely enough, an interesting deviation of the standard depthing tool, and exactly what was needed, has been described in the literature for possibly more than 75 years. **Figure 7.2** is based on a drawing of such a tool in F. J. Britten's, THE WATCH AND

Figure 7.2



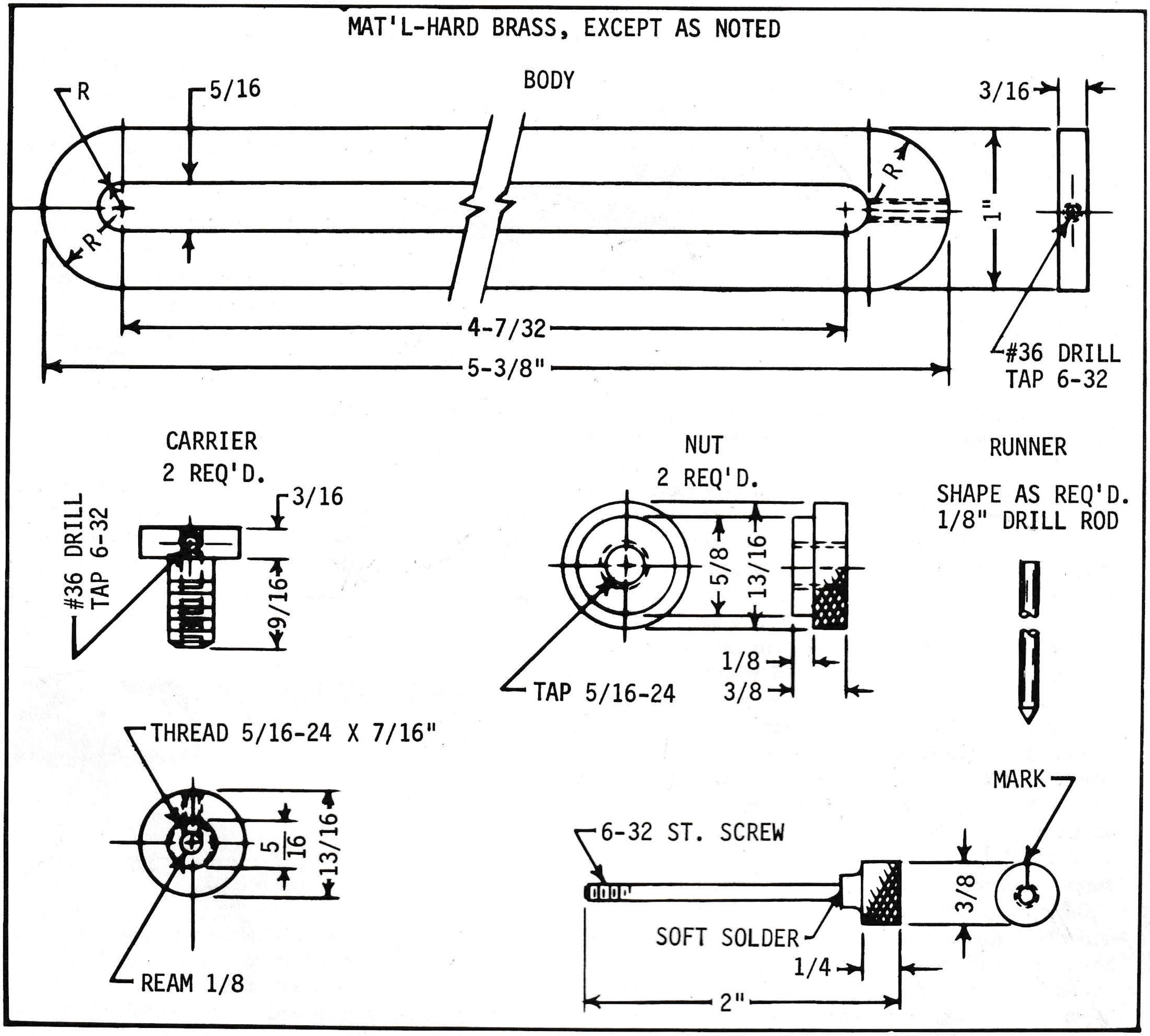


Figure 7.4: THE PINION HEAD DEPTHING TOOL

CLOCKMAKER'S HANDBOOK, 11th Edition. The original Britten handbook was first published in 1892 but I have no way of determining if the tool was included in that edition since my library contains no text earlier than his 11 edition, first printed in 1907. The tool has, however, been shown in the 11th through the 15th editions.

Britten describes it as a substitute for the conventional depthing tool, if one if sufficient size is not available, and attributes it to "...the late Mr. Gray... to receive a wheel and pinion or a wheel and pallets." This, without doubt, is one of the earliest of tools to embody all of the principles of the simple depthing tool form made popular in recent years by England's John Wilding and presently used by many clockmakers for the depthing of wheels with their pinion heads or lantern pinions, and for escapement design, testing and depthing work.

The Design—Many years ago I designed and built the tool shown in **Fig. 7.3.** Some years later, a drawing of the tool was included in my serial, The Grasshopper Skeleton Clock, Model Engineer, 20 July 1984. This

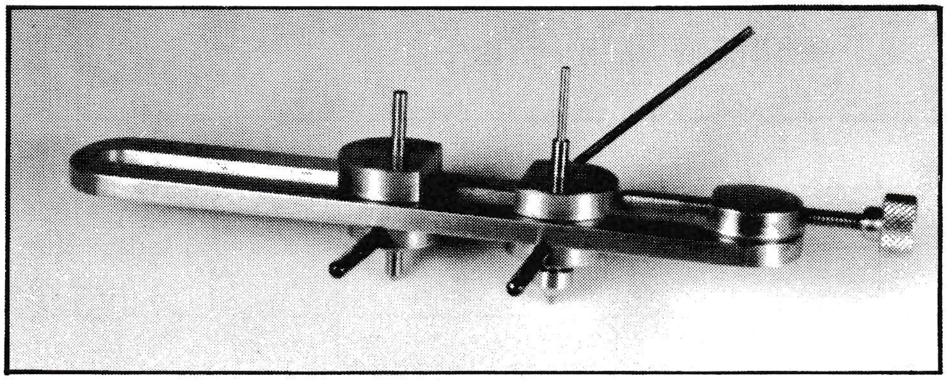


Figure 7.3

serial has since been updated, corrected, and is now available in workshop manual form (**Ref. 1**). The basic design is that of the Gray tool; however, in order to make it more versatile, a number of new features have been incorporated. The body has been made long enough to depth a wheel of up to seven inches in diameter. At this size, the tool is not awkward but allows a great range of wheel sizes. Both carriers are made identical and movable, with one being moved by a thumb screw for fine adjustment during depthing. Because I much prefer a tool in which each of the runners is removable, the carriers are reamed through to receive standard diameter, surface ground, drill rod stock. This provides far greater versatility than tools having one or both runners fixed. The design allows complete removal, height adjustment, or interchange of either runner.

For this type of tool, there is really no "correct" runner diameter. If made small enough for some situations, the runners will indeed be too small for other conditions and parts will have to be bushed. On the other hand, if made too large the runners will have to be reduced in diameter for the mounting of most parts. I have chosen 1/8" diameter drill rod as a reasonable compromise for the runner size. Such stock is readily available, inexpensive, has a ground surface, is large enough to suffer little distortion from the force of the set screw, is easily machined or bushed to size, and allows the use of a standard reamer when making carriers and the bushings for larger parts. Others may wish to use smaller, blued pivot steel since it is also readily available and already hardened and tempered. However, the ground drill rod stock is usually much straighter than the blued pivot steel and more uniform throughout its length. Also, there is really little need for hardening of the runners since they will seldom be called on to scratch more than layout blue on a brass surface.

MAKING THE DEPTHING TOOL

The Body--Despite having proven itself to be an excellent tool during years of use, my original design was a bit more difficult to build than I liked. For this reason, I have recently redesigned it for greater simplicity. The new design, shown in **Fig. 7.4**, still embodies most of the desirable features of the original tool but requires simpler machining and can be made in much less time, with greater accuracy and with considerably less attention to detail.

The body is laid out on a piece of 3/16" thick sheet brass that has been coated with layout blue. A hole is drilled at each end of the center slot and reamed to 5/16" diameter. Two lines representing the edges of the central slot are drawn tangent to the two reamed holes, **Fig. 7.5,** and the metal between them removed

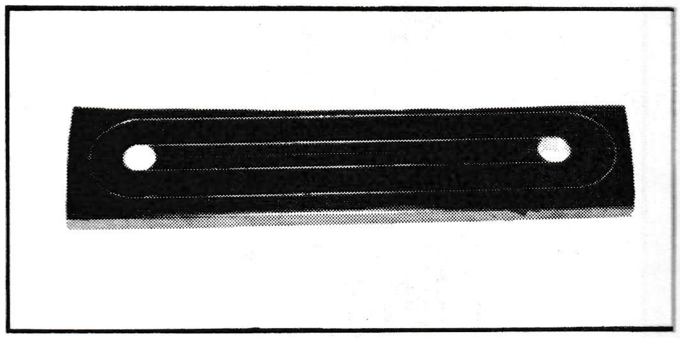


FIGURE 7.5

using a piercing saw as illustrated in **Fig. 7.6.**

The sawing should be kept inside the lines and the resulting slot draw filed to final form while making frequent checks of its width using the shank of a 5/16" twist drill or a length of 5/16" diameter ground stock. The outside of the body is next sawed and draw filed to final form. The hole for the adjusting screw is then drilled and tapped. Note the use of the bench lathe as a means for drilling the hole truly on the centerline of the body, **Fig. 7.7.** A center is pip marked into each end of the work. A center drill in the chuck is used to make a starting seat for the drill while the other pip is engaged by the tailstock. A twist drill is then used to drill the hole. The entire body is given a good finish with emery paper.

The Carriers--In order to ensure the utmost in final accuracy, fabrication of the carriers is done in a special, but simple manner. The stock for machining the carrier

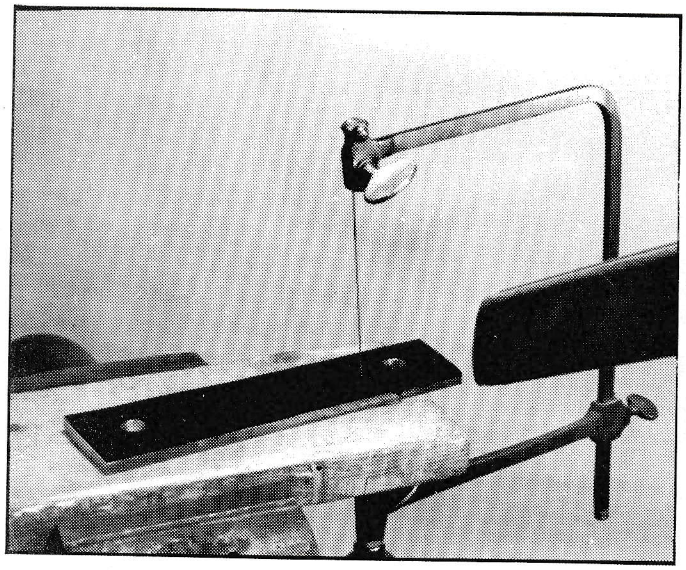


Figure 7.6

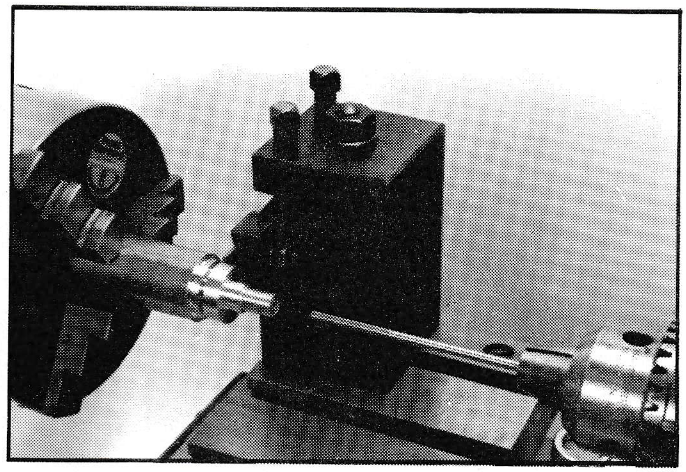


Figure 7.8

is mounted in the lathe and all dimensions machined slightly oversize. The screw portion is next machined to exact diameter, proper length, and threaded. Following this, the center hole is drilled and reamed with a 1/8" diameter, straight flute chucking reamer, **Fig. 7.8**, and

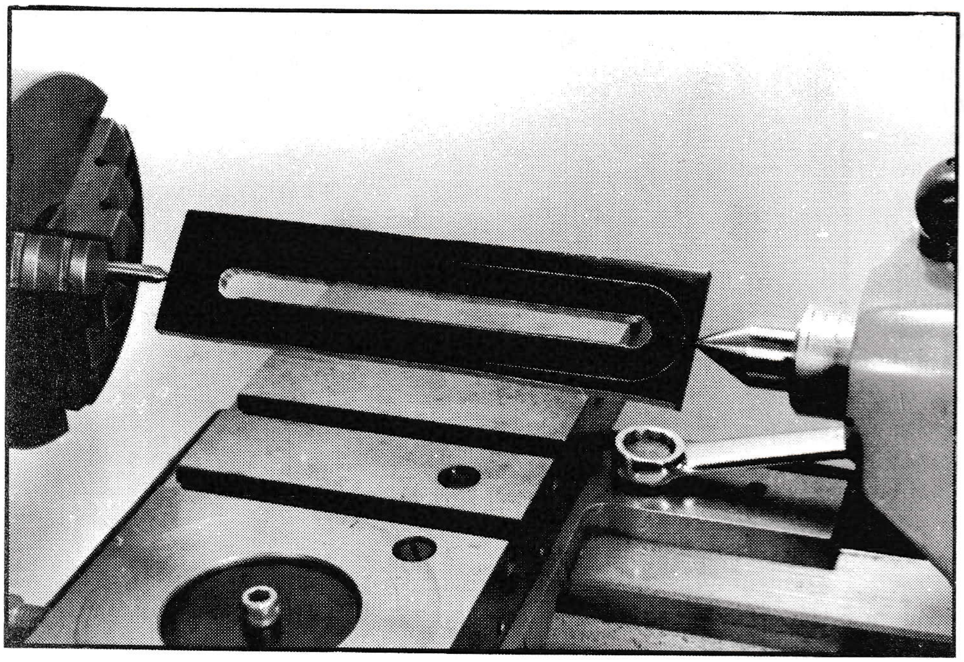


Figure 7.7

the carrier parted from the parent stock. Both carriers are machined in this manner.

The set screw hole for each runner is drilled and tapped 6-32. The end of each Allen head set screw is turned slightly rounded, polished, installed, and the carriers laid aside. The polished ends on the screws will avoid raising severe burrs on the runners that would make their removal or height adjustment difficult. If the screws are operated with just enough force to lock the runner, burrs on the runner will be avoided and no flattening of its side will be needed.

A length of 1/8" diameter ground stock is mounted in a dead true collet, or an oversize piece of steel is mounted and turned to exact runner diameter for use as a stub arbor. The runner is put in place on the arbor and the set screw tightened. Using very light cuts, all surfaces are turned to final form, **Fig. 7.9.** This use of the stub arbor avoids problems due to drill run-off or skew and ensures that the reamed hole will be truly perpendicular to the seating surfaces of the carrier and concentric with its body.

Leaving the arbor undisturbed in the collet, the first carrier is removed and the second one mounted and finished.

The Nuts--The two carrier locking nuts are next machined, given a fine knurl, and threaded. The thumb screw nut is machined from brass, knurled, and soldered to a length of 6-32 threaded stock having a rounded end. A thin saw cut mark should be made in the end of the thumb screw on one side at the periphery. By viewing this mark as a hand on a clock face it is very helpful in remembering the region of best depth during several trials as the thumb nut is turned

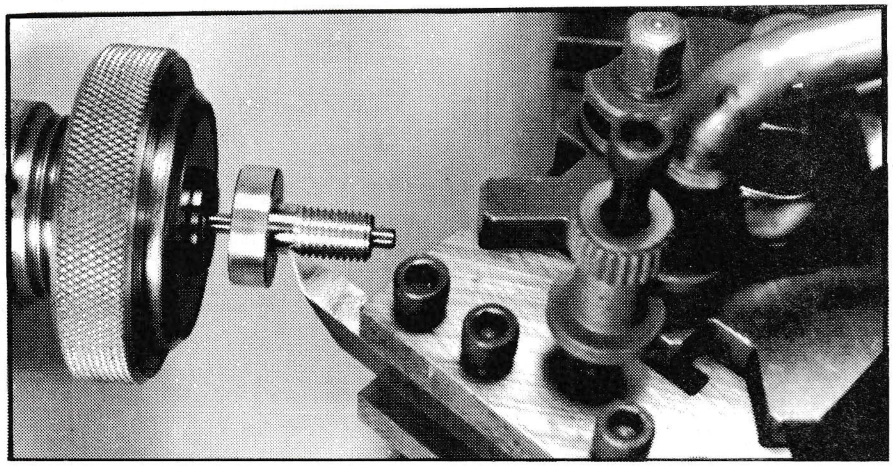


Figure 7.9

from position to position. It also allows returning the tool to the exact setting determined to be the position of best meshing.

The Runners--As a general rule, the top of the runners must be machined to a smaller diameter for use with lantern pinions or cut pinion heads and will need to be bushed for use with wheels. This does not constitute a real problem because, after a few uses an assortment of runners and bushes will soon be accumulated that allow quick use of the tool for most of the wheels and pinions encountered. The design is quite versatile because the runners may be removed or interchanged without altering the depthing already locked into its body. Thus, a wheel and pinion may be depthed on one pair of runner types and a different runner or set of runners used to lay off the center distance. This allows the replacement of an ordinary runner with a trumpet runner when one of the holes is very large.

For this reason, it is wise to provide one or more trumpet runners. Such runners may be made easily. Also, because the runners are interchangeable, there is never a need to machine the top portion of the trumpet runner. Mount a length of runner stock in a dead true collet and bond a piece of reamed brass to it with super glue and turn the cone to final form. The bond may be broken with heat, the super glue washed away with acetone, and the cone used by slipping it over any runner being used. However, if the trumpet is to be kept in place permanently, the original bond should be made with Loctite 609. The completed parts of the depthing tool are shown in **Fig. 7.10.** This illustrates a trumpet runner as well as the shouldering of normal runners in a manner typical of that encountered in many instances for the mounting of a pinion head. At other times, small, shouldered brass bushings with a 1/8" I. D. holes may be required to adapt the runner diameter to the larger diameter of the hole in the wheels encountered. It is also wise to provide an assortment of small brass washers with 1/8" I. D. holes and of several thicknesses for use as shims under the wheel bushing. These are often needed to raise the wheel above the top of the carrier to the center of a lantern pinion or pinion head. The assembled tool is shown in **Fig. 7.11.** Note the threaded holes containing the Allen head set screws.

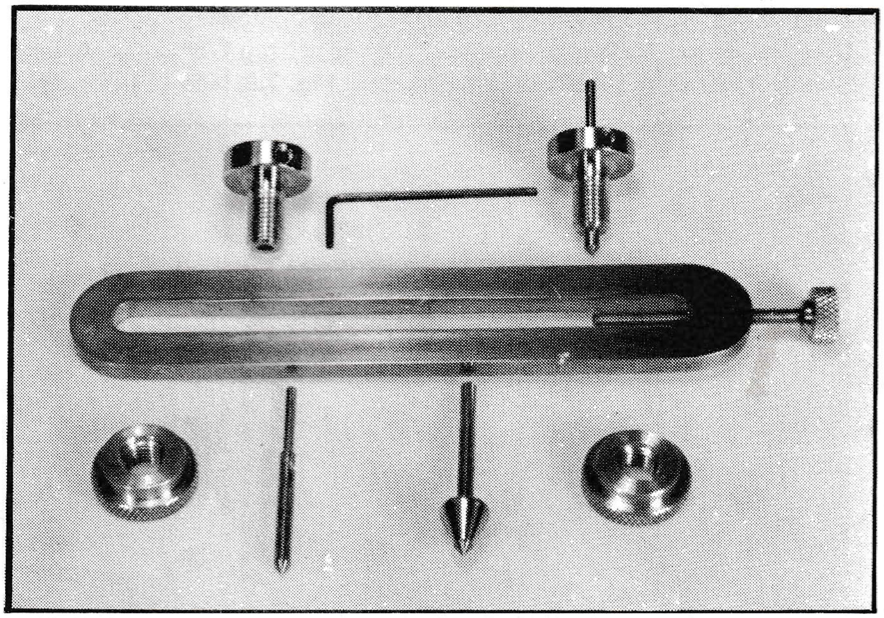


Figure 7.10

USING THE PINION HEAD DEPTHING TOOL

In use, the wheel and pinion are mounted by turning the runners to diameter and/or by bushing the parts. When all is well, the carriers are set slightly too far apart--i.e., with the wheel teeth and pinion leaves engaged, but far enough apart to produce a very rough gearing action. The nut of the carrier farthest from the

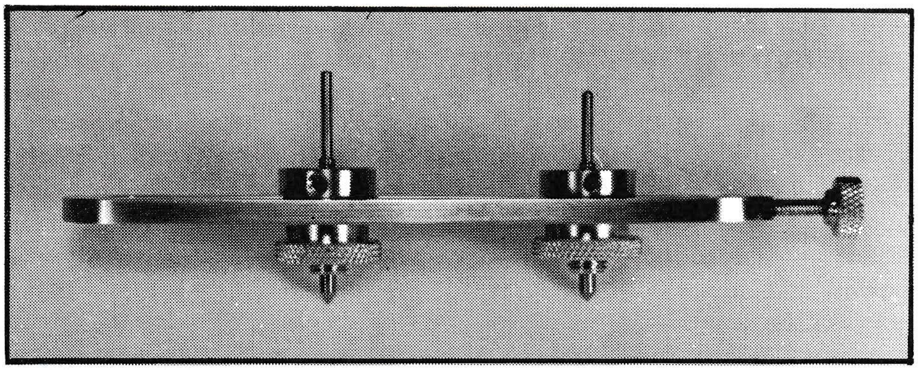


Figure 7.11

thumb screw is locked tightly. The nut of the carrier nearest the thumb screw is snugged but not locked.

While the index finger is held against the smooth wall of the lantern pinion spool (or a tooth pick against the smooth end of a cut pinion) to provide a light, constant frictional drag, the wheel is turned with the other hand, **Fig. 7.12**, and the roughness noted. The adjusting screw is turned a small fraction of a turn to

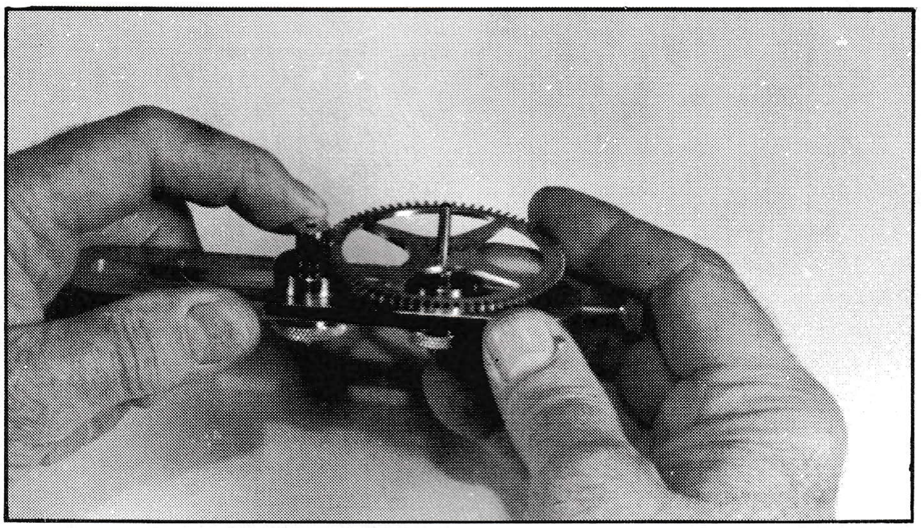


Figure 7.12

move the carriers together slightly and the gear action tried again. This will get smoother and smoother as the ideal depthing is approached and the mark in the end of the thumb screw should be viewed with each adjustment to determine this point. Watching the engagement of the wheel teeth and pinion leaves or pins also offers additional information regarding the proper meshing.

As the center distance for best meshing is passed the gear action will become rougher and rougher. If in doubt, this process may be repeated several times until convinced that the proper position has been found. The thumb screw is then set to the position thought to be the best and the carrier nearest it moved against the screw and locked.

The runners are next adjusted so the body of the tool will be parallel to the surface of the clock plate when in the actual position for scribing the center distance arc. This may be easily accomplished by slacking off on the set screw and moving or replacing the runner. Of course, if the hole from which the center distance is to be laid off is large, one of the runners must be replaced with the trumpet. They are adjusted again until the tool is parallel to the plane of the work and the center distance arc scribed.

As indicated by Britten, and as has been illustrated many times by Gazeley, Wilding, and others, a pinion head depthing tool of this general type is also very useful for laying out escapement parts and marking their center distances. In instances when a compass is not at hand, such a tool may also be pressed into use for drawing circles. It is a very necessary item for those who wish to build clocks. The cost is small and the time involved in making one is minimal.

REFERENCES

1. **How To Make A Grasshopper Skeleton Clock,** Gateway Clocks, 7936 Camberley Drive, Powell, Tennessee 37849, U.S.A.