the joints to tie them securely. Not long since I made one of these, using the kind of lock joint that has already been described in these columns, page 178, Vol. 24, and for strength I think it can hardly be equalled. The piece between the ends was sawed to match into the turned halves while still a solid block; then the outline was marked with all three fitted together. It was then removed and bandsawed to shape.

In making templets for any thin turning, of which this job will serve as an example, where it is necessary to have two, one for outside and another for inside, instead of laying out each separately, make the entire necessary layout at once on a thin piece, as shown in section at Fig. 4, and separate them with the point of a sharp knife. Then cut away the part representing the thickness of the piece turned, and the outline around what is shown in section.

For thin templets to use in fitting surfaces, either at the lathe or at the bench, I have learned that a stick of rouge rubbed on the edge of the templet is much more lasting than chalk. It seems to charge the pores of the templet, and leaves its mark on the work it comes in contact with a greater number of times, without a fresh application of color.

JOHN M. RICHARDSON.

A Test Indicator and Holder.

Editor American Machinist:

The accompanying drawings illustrate a test indicator which I have found to be very useful. Fig. 1 shows the body of the instrument with the cover removed. The tool carries, as shown, a pointer *A* which is of tool steel, hardened, ground and lapped to fit sleeve *B* and bushing *C*, rod *A* being shouldered near *D* to prevent it falling out of the sleeve. Member *A* is of course the "feeler" to be brought in contact with the work to be tested or trued up. The sleeve *B* is bored to clear *A* except at the point indicated at *D*, and after being hardened is lapped out to fit the reduced end of the "feeler". *C* is a hardened bushing which supports the inner end of *A;* it is beveled internally to leave only about 1-32 inch bearing and is forced in the tap hole in *E* by screwing sleeve *B* down on top of it. The pin *A* after passing through *B* and *C* passes through a clearance hole in *E*, where it engages with the forked lever *F* which works on a pivot carried between an adjusting screw in the body and a conical seat at *G* in the cover (Fig. 2). A silk thread fastened to one of the arms at the forked end of the lever (the other arm being merely a stop for the lever) passes several times around drum *H*, thence through a hole in the lower end of the latter which is countersunk at one side so a knot to fasten the thread may be drawn into it.

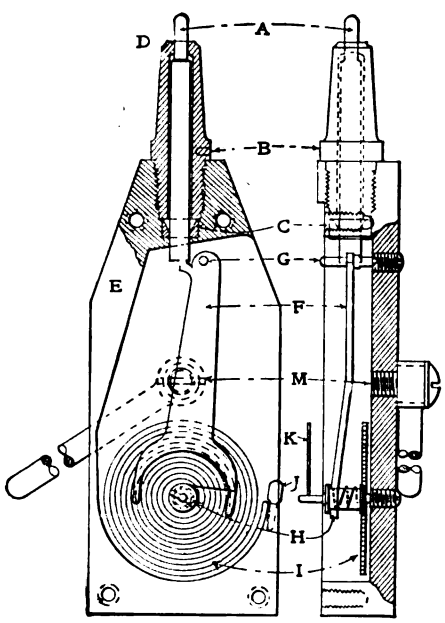

FIG. 1

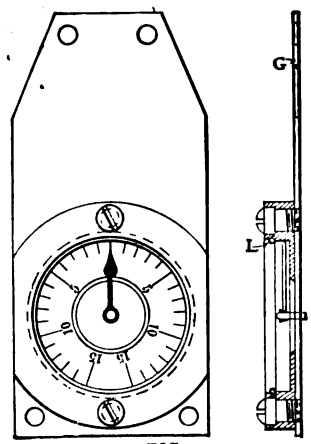

FIG. 2

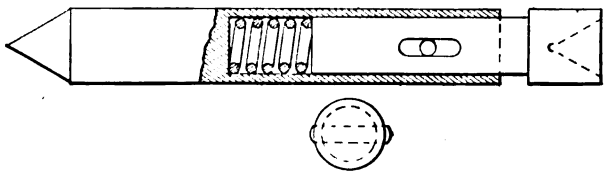
FIG. 3

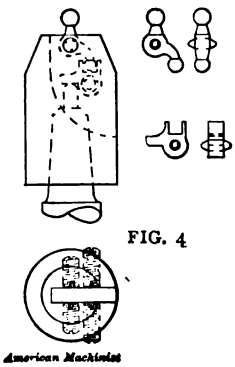

FIG. 4

TEST INDICATOR.

At *I* is shown a hair spring which is driven on the drum shaft, and held at *J* in a drilled hole in the body of the tool by a small knurled plug forced into the hole. The hair spring keeps an even tension on the thread by pulling on the drum from the opposite direction. On the upper end of the drum shaft is a watch hand *K* which is revolved by any movement of pin *A* and lever *F*.

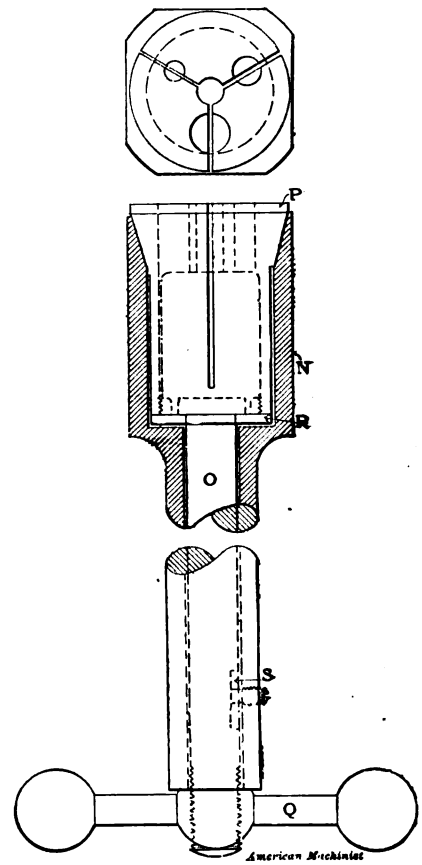

FIG. 5. INDICATOR HOLDER.

Fig. 2 shows the cover and dial with the watch hand at zero on the dial. The cover is a piece of sheet steel fastened to the indicator body with small machine screws and having a hole through it to act as the upper bearing for the drum shaft. The dial has a beveled edge as represented and is fastened in place by means of a ring and two small screws. A piece of photographic film with the emulsion washed off is cut out and laid on the shoulder just above the pointer and held in place by a round spring of piano wire in the beveled seat *L*, thus effectually keeping the dial free from dust.

In graduating the dial I fastened the disk in place on the cover of the indicator, then placed the indicator in a tool-holder and held it in the lathe tool-post and brought the end of *A* in contact with the face-plate of the lathe, first, however, scribing a zero line on the dial. Then I forced the pointer against the face-plate till the indicating hand was at zero. Next I slipped a piece of sheet metal .015 inch thick under *A* and scribed a line where

the hand showed the .015-inch line should be. Then with the sheet metal still under the pointer I brought the hand back to zero, and when I removed the sheet metal the hand indicated .015 inch the other side, the total range established thus being .030 inch. I then proceeded to divide the distances each side of zero into fifteen equal spaces, placed the dial in the lathe, trued it up, and, with a V-pointed tool set on the exact center of the lathe, by the movement of the cross-feed I cut the graduations at the points previously spaced off, very easily, and, as subsequent tests proved, fairly accurately.

In Fig. 1, at *M*, is shown a handle which is fastened to the indicator body by a screw which, when tightened against its shoulder, binds the handle sufficiently to allow the indicator to be turned about in any position desired and yet prevents it from being moved by an accidental jar. This indicator will be found to be almost entirely free from the vibration of the needle so common to indicators which are composed of two or more levers, as the vibration seems to be stopped by the hair spring, and when in use the watch hand moves around the dial with a smoothness I have not yet found in lever indicators. To those who may object to the use of the silk thread I would recommend a gear segment and pinion of very fine pitch in place of the lever fork and the thread; but after experimenting with segment and pinion I will say that the other arrangement has given me the best results—being more sensitive and less liable to become gummed up with oil and dust—and is, apparently, just as accurate. The indicator as drawn shows any movement of pointer *A* multiplied about 96 times on the dial, which result can be changed very easily by increasing or diminishing the size of the dial and the length of the hand. This tool may be used not only for testing and truing up work in the lathe, shaper or planer, but also for milling machine and surface plate work.

Now for some little appliances to be used in connection with the indicator. Fig. 3 shows a pointed instrument for use in setting center punched work true in the lathe. This device is, of course, too familiar to require any special description. Fig. 4 illustrates an attachment for indicating internal surfaces, and which will also be understood without explanation, as it is shown in place on the indicator nose and the working parts are all shown in detail. In Fig. 5 is represented a holder which is very handy for mounting the indicator in the lathe and also makes a good holder for small boring and inside threading tools. It consists of a tool-steel body *N* which is bored from end to end to allow the rod *O* to pass through it, and chambered out and beveled at the front end to receive the split collet *P* which is drawn into *N* by rod *O*, the latter being threaded at the back end to fit handle *Q*, and having at its front end a head which draws back against a threaded disk *R* which is screwed tight into the body. Rod *O* is grooved at *S* and the end of a small screw entering this groove prevents the rod and chuck from turning when the handle *Q* is tightened. It will be noticed that this arrangement allows the collet to be turned around in its seat to raise or lower the tool you may be using. This collet is the same as the ordinary one for the lathe except that it has three more holes in it—one in each slot—one of which should be made to fit the indicator handle and the others to receive small boring or inside thread tools made of drill rod or Stubs' steel. A set of plugs should be fitted nicely to the holes in the collet and each of the outside holes not carrying a tool should be plugged before the collet is tightened. One advantage of this holder is that the outside holes in the collet have a vertical adjustment of ½ inch merely by turning the collet around in its holder.

I. N. DICATOR.

Machining a Gas Engine Piston.

Editor American Machinist:

In machining a gas-engine piston, the requirements are: a true, straight surface, ring grooves smooth and accurate in width and a hole for the piston pin exactly perpendicular to the axis and at a determined distance from the closed end to insure correct compression.

The pistons are first centered upon the closed end and the bell end is chamfered out to an angle of 60 degress, for location upon the driver shown in Fig. 1. The face-plate of a lathe is recessed to receive the driver, and it is secured by cap-screws. The rectangular projecting plug engages the piston-pin bosses on the inside and affords an effective drive. After turning to the required diameter a gang grooving tool, shown in Fig. 2, is used. This has a complement of roughing cutters on one side slightly narrower than the finished groove, and by loosening the binding nut it may be reversed on the tool-block and the finishing cutters, the full width of the grooves, presented to the work.

After the lathe operations are completed, the jig Fig. 3 is employed for cross-boring and facing the piston-pin bosses. The binding screw *A* has a collar upon it half of which is recessed in the clamping ear and half in the hardened plate *B* which is attached to it, thus acting to clamp the jig upon the piston, and when changing the work to force the fixture open against the spring of the heavy rib at the back. The locating stop *C* serves to bring the compression uniform, and the forked gage, Fig. 4, is applied with its tongue in the slot *D* to determine the perpendicular location of the bosses.

A twist drill ⅛ inch small, a three-groove chucking reamer .008 inch small,

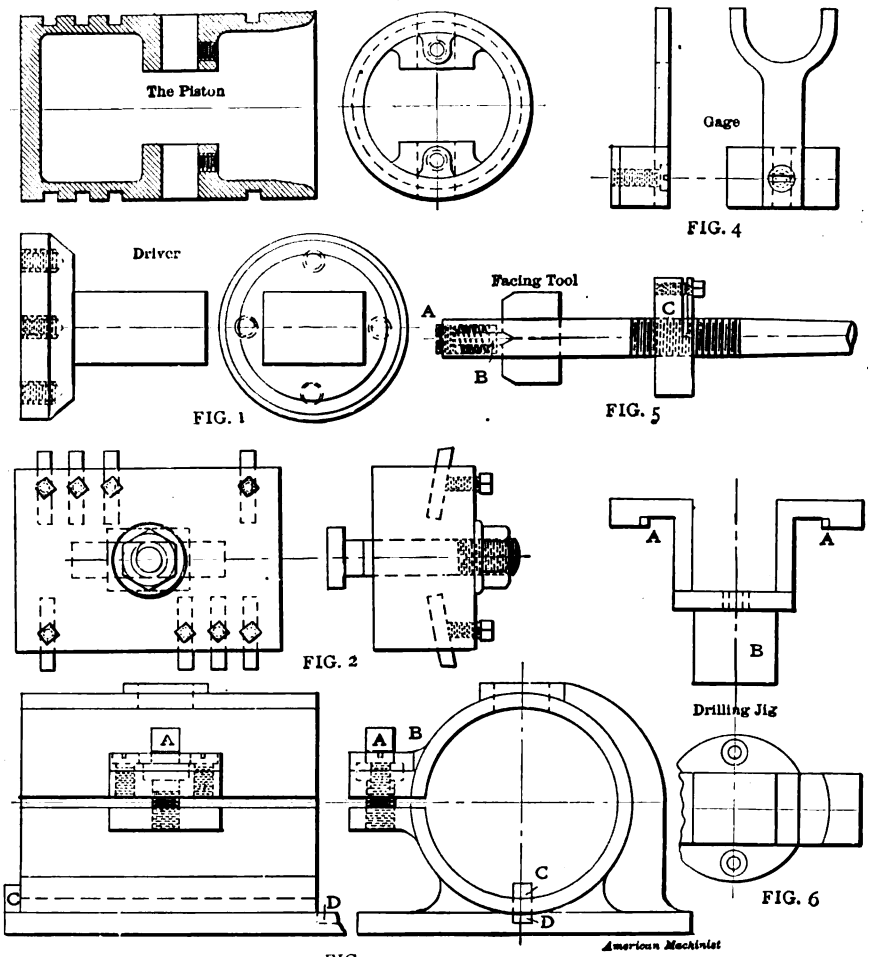

FIG. 3

TOOLS FOR MACHINING A GAS ENGINE PISTON.