another 0.5 inch or until it touches a disk 0.2 inch diameter as at *C*. When hole 3 is bored the disks *c c* are removed and replaced by others 0.7 inch diameter, thus raising the master plate 0.5 inch as indicated at *D*. The operations described are repeated for holes 4, 5 and 6.

For this simple job we will need seven accurately ground disks, three 0.2 inch diameter, three 0.7 inch diameter and one 1.2 inch diameter. Instead of disks small parallel blocks can be employed, but disks being much easier ground on the bench lathe are generally used.

This method appeals to many people as being simple, quick and accurate. It certainly is a very quick method after the disks have been made and possesses the advantage that should one hole be spoiled or made too large all the holes can readily be rebored. Sometimes a very small amount can be rebored from all the holes without altering the adjustment of the boring tool.

INDICATOR DETAILS

The detailed sketch of the indicator shown in Fig. 76 may be of value in connection with the preceding matter relating to master plates as it is practically the same as the one illustrated in the group of tools in Fig. 68. It was designed principally for truing up buttons and small holes in face-plate work and for general use on the bench lathe. It may, however, be conveniently used for almost any kind of machine or bench work for which any indicator can be used.

The body or frame *A* is made from bright drill rod 0.277 inch diameter (J size). The lower lever *B* is not balanced. The pointer *C* is balanced with a $\frac{3}{16}$-inch commercial-steel ball annealed and sawed for the insertion of the pointer.

The shanks of the contact buttons *D* are made taper to facilitate changing for different styles of buttons, that shown being convenient for round work, but one about 0.3 or 0.5 inch diameter is sometimes desirable.

The nurled nut *E* is locked firmly to piece *F* (to which is attached the spring wire *H*) by means of check screw *G*, the whole being a friction fit in *A*, and is used for obtaining the spring pressure necessary to hold the pointer at either extremity of the scale *J*, according to which side of contact button *D* we wish to use against the piece being tested.

The scale *J* is a friction fit in *A*. The dimensions given on the drawing give the pointer a movement 171 times that of the contact point, but this can be easily modified by altering the distance of pin *K* from the pivots on which the pointer moves. The dimension from the pivot to the ball (0.22 inch) is approximate only, the correct distance for balancing the pointer being found by trial.

The construction of the spring center shown to the left of the indicator in Fig. 68 hardly needs any description. It is used in connection with the indicator for truing up work to center punch holes, on the lathe face

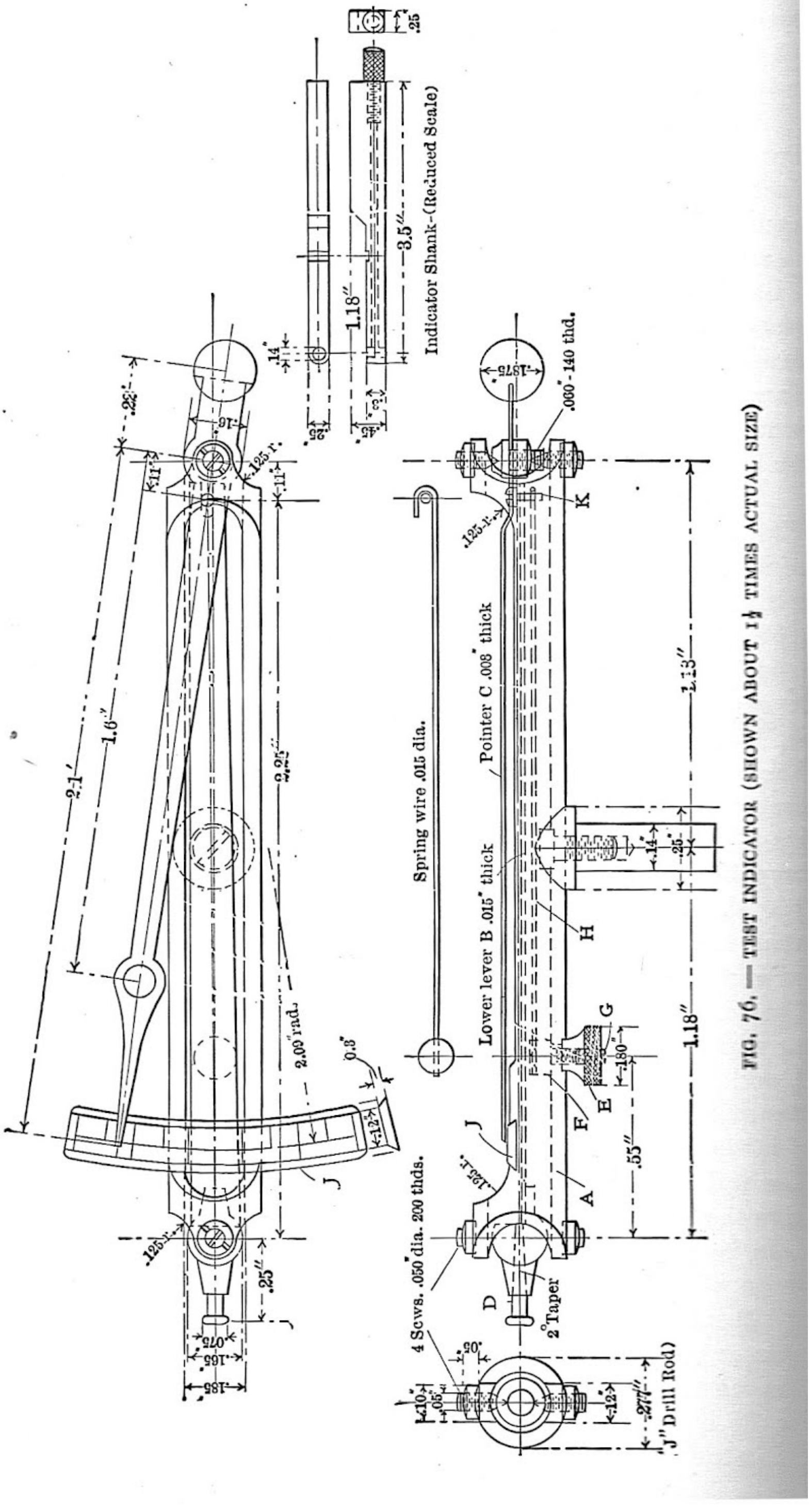

FIG. 76. — TEST INDICATOR (SHOWN ABOUT 1½ TIMES ACTUAL SIZE)

plate, it being possible to position such center marks accurately in about one-fourth the time required to set them even approximately with some of the old-style center indicators.

The attachment shown in Fig. 74 might be improved upon by offsetting to the left the part protruding from the chuck, so that the center line of the indicator could coincide with the center line of the machine spindle. It would then be more convenient for truing small holes in which no plug is used.

For attaching to a surface gage a retort-stand clamp may be used.

The drawings from which both this engraving and the indicator were made were furnished by S. Gahan, who, however, does not claim to be the originator of this style of indicator, but states that its present design is the result of suggestions received from many able mechanics, particularly W. H. Nichols, of Waltham, Mass.