

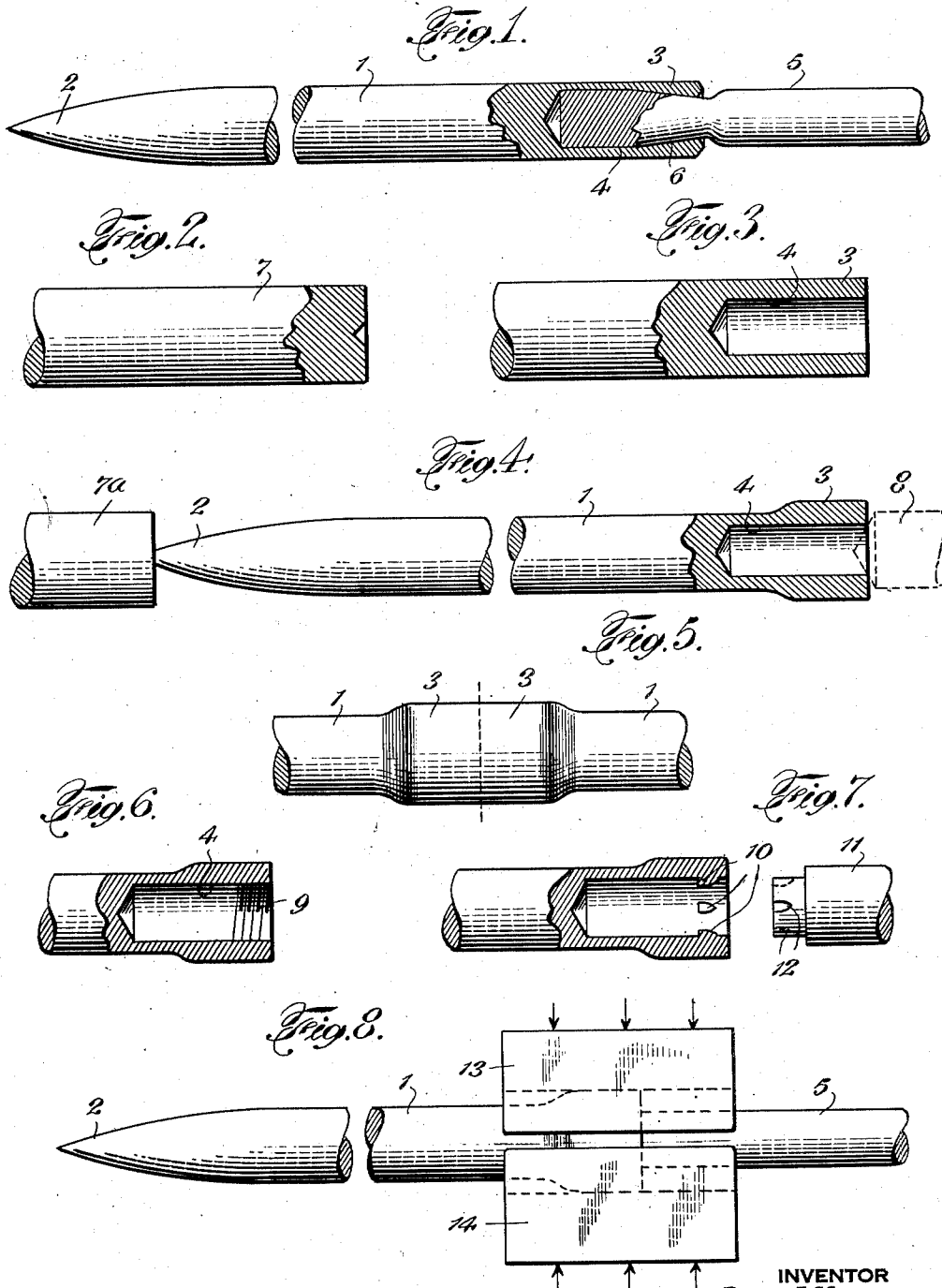
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METHOD OF MANUFACTURING SURGEONS' NEEDLES

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## METHOD OF MANUFACTURING SURGEONS' NEEDLES

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The present invention relates to the production of surgeons' needles and the like of the type wherein a suture is received and held within an axial bore formed in the shank end of the needle. It is an object of this invention to provide an improved procedure for the manufacture of such needles, and more particularly to improve the procedure disclosed and claimed in Patent No. 2,411,079 granted to G. H. J. Baule on November 12, 1946.

The general requirements of surgeons' needles are well known and do not require restatement herein. The production of such needles presents several manufacturing difficulties due principally to the small diameters of the needles which may range from .010 to .060 of an inch, and the requirement that the suture be securely attached without substantial enlargement of the needle shank. The finished needle described in the Baule patent is admirably suited for use by surgeons but the production thereof as described in said patent is attended with certain difficulties. For example, the expanding of the shank end of the needle has a tendency to harden the metal of that end and render the subsequent drilling operation more difficult than it otherwise would be. Moreover, the engagement of the needle shank by suitable dies during the enlarging operation is apt to mar the surface in an undesirable manner. It is also difficult to cause the metal to flow evenly during the enlarging operation, with the result that the axial bore may not be properly centered and the surrounding walls may not be of uniform thickness. Furthermore the enlarging operation is not easily carried out upon automatic machines which must be employed in the manufacture of these needles in order that they may be produced at an economical price.

With the foregoing and other considerations in mind the present procedure has been invented whereby the basic operations can be carried out largely upon automatic machinery to produce needles of this type in an efficient and economical manner.

The invention will be described in connection with the accompanying drawings wherein

Figure 1 illustrates a surgeon's needle with attached suture which may be produced according to the present invention, the shank end being partially sectionalized to show the interior construction;

Figures 2 and 3 are partially sectionalized views of the shank end of the needle of Figure 1 illustrating two steps in the production thereof;

Figure 4 is a partially sectionalized view of the needle of Figure 1 illustrating another step in the production thereof;

Figure 5 illustrates a modification of the procedure illustrated in Figure 4;

Figures 6 and 7 illustrate additional steps which may be performed if desired; and

Figure 8 illustrates the step of securing a suture to a needle shank.

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Referring to the drawings it will be seen that a needle 1 has a pointed end 2 and a shank end 3. The shank end 3 has an axial bore 4 which, in the finished needle, is of less diameter in the neighborhood of its open end than at its inner or closed end. A suture 5 has its end lying in the bore 4 and is engaged firmly by the constricted portion 6 thereof, thus securely attaching the suture to the needle. Such a needle is shown in the Baule patent, but although the resulting structure is substantially the same the method of producing it in accordance with the present invention is different as will hereinafter appear.

The procedure about to be described starts with the selection of wire having the desired composition. The diameter of the selected wire should be slightly greater than that of the finished needle while the length may be sufficient to make a number of needles. For example, a wire of .0255 or .0250 of an inch in diameter may be used to produce a needle having a finished diameter of .022 of an inch.

The end 7 of such a length of wire after it has been straightened may then be faced and centered as shown in Figure 2. This may be accomplished by chucking the wire in a suitable lathe, preferably an automatic lathe. The next operation, as illustrated in Figure 3, consists of drilling the hole 4 in the shank end as by bringing a suitable drill into alignment with the wire while still held in the chuck used for the first operation. Either the chuck or the drill or both may be rotated. The diameter of the drilled hole will, of course, be selected with relation to the size of wire used, and the diameter of the suture ultimately to be inserted therein. For example, in the case of a finished needle of .022 of an inch in diameter, the diameter of the hole should be about .006 of an inch to accommodate a suture of about .005 of an inch in diameter. The depth of the hole will vary with different sizes of suture but generally a depth of  $\frac{3}{8}$  or  $\frac{1}{4}$  of an inch will be satisfactory.

The end of the wire is now released from the chuck and advanced so that a length of wire slightly longer than the desired length of the finished needle is exposed, whereupon the chuck is again engaged with the wire. A center 8 may be moved into engagement with the outer end of the wire as indicated in Figure 4. An appropriate cutting tool is now brought into engagement with the wire at a point slightly removed from the shank end 3, the wire is rotated and the cutting tool is fed along the wire from right to left in order to reduce the diameter by about .003 to .0035 of an inch until the region of the pointed end is reached, whereupon the cutting tool is gradually fed forward to form the pointed end 2 and to sever the needle from the wire 1a remaining in the chuck.

The purpose and effect of this operation is to form a needle with a shank end 3 of larger diam-

eter than the major portion of the needle and of a more limited extent longitudinally of the needle than the depth of the suture receiving hole 4.

A modified procedure includes the reduction of the needle wire for the major portion of its length by a swaging operation. For such an operation a piece of wire of sufficient length to make one or two needles may be selected. If the two needle length is preferred, first one end and then the other may be presented to a swaging machine so as to leave a mid portion of the original diameter as indicated in Figure 5, or the two needle length can be swaged simultaneously on both ends. If a single needle length is used an unreduced portion will be left at one end. By this swaging operation the diameter of the wire will be reduced to an extent similar to the reduction described with respect to the turning operation. Thereafter, if the two needle length is used, the wire may be cut along the dotted line of Figure 5 and each outer end may be pointed to form a pointed needle blank, or the pointing operation may be done before cutting the blank into two parts. If a single needle length is used it may be pointed after the reducing operation. Each needle blank, however obtained, may then be chucked for facing and drilling in the manner shown and described in connection with Figures 2 and 3, the difference being that the unreduced shank end 3 has already been formed on the needle wire and the turning down indicated in Figure 4 has become unnecessary.

If desired, the inner wall of the axial recess 4 may be roughened to increase the security of the engagement with the suture. This may be effected by the formation of internal threads 9 as indicated in Figure 6. A tapping operation to form these threads could advantageously be performed immediately following the drilling of the axial recess 4 as above described. Another roughening of the inner wall of the axial recess by means of nibs 10 is illustrated in Figure 7. At the appropriate stage in the production of the needle, as for example after the axial recess 4 has been formed and the diameter of the needle wire reduced thus leaving an enlarged shank end, a mandrel 11 having recesses 12 may be inserted in the axial recess 4 and external pressure applied by two die blocks of the type illustrated in Figure 8, to cause the metal of the shank end to flow into the recesses 12 and form the nibs 13.

Needles produced in accordance with the procedure above described may be subjected to the usual finishing operations, such as tempering, final pointing and polishing, and will then be ready for the attachment of the suture.

As illustrated in Figure 8, the end of the suture 5 of a diameter to fill the axial recess 4 is placed therein. The assembled needle and suture are then brought to a suitable press in which are mounted the two die blocks 13 and 14. Each of these blocks has a semi-cylindrical mating groove of a radius substantially equal to that of the major portion, that is, the finished portion, of the needle. Pressure exerted by the die blocks on the shank end of the needle will cause the metal of the larger shank end to flow inwardly around the suture thereby producing the structure shown in Figure 1 wherein the constricted portion 6 firmly engages the suture 5. If either of the modified forms shown in Figures 6 and 7 is used, the roughened inside wall of the axial recess 4 will also advantageously engage the end of the suture.

The invention herein described may be variously modified within the scope of the subjoined claims.

I claim as my invention:

1. The improvement in the art of making surgical needles of the type wherein the suture is engaged by the inner walls of an axial cylindrical bore at the shank end, which improvement consists in selecting a length of needle wire having a greater diameter than that desired for any portion of the finished needle, reducing the needle to a diameter less than the original diameter of the wire throughout the length of the needle except for a limited portion at the shank end thereof, boring a suture receiving hole axially to a depth greater than the longitudinal extent of the unreduced portion, inserting a recessed mandrel in the axial bore, forming suture engaging nibs projecting from the inner wall of the axial bore by pressing the unreduced shank end about the mandrel with a force that causes metal of the wall of the bore to flow into recesses in the mandrel, and leaving the unreduced shank end with its diameter larger than the diameter of the rest of the needle after the nib forming step thereby providing a relatively large shank end portion which after insertion of a suture in the axial bore to a distance exceeding the length of said end portion may be contracted about a portion of the suture spaced from the inner end thereof to securely attach the suture to the needle.

2. In the art of making surgical needles with the suture attached to the needle, the improvement which comprises providing a length of needle wire having a diameter greater than that desired for any portion of the finished needle, boring a suture-receiving hole axially to a predetermined longitudinal depth, reducing the needle to a diameter less than the original diameter of the wire throughout the length of the needle except for a limited portion of the shank end thereof, said limited portion having a longitudinal extent substantially less than the longitudinal depth of the bore, inserting a circumferentially recessed mandrel in the bore, forming suture-engaging nibs projecting from the inner wall of the axial bore by pressing the unreduced shank end about the mandrel with a force that causes the metal of the wall of the bore to flow into the recesses in the mandrel, leaving the unreduced shank end with its diameter larger than the diameter of the recess of the needle, withdrawing the mandrel, inserting into the axial bore a suture having a diameter slightly less than the diameter of the bore, and reducing the enlarged end of the needle to the same diameter as the adjacent reduced portion by forcing the metal inward to reduce the diameter of a portion of the bore so that the walls of the bore and the nibs firmly grip the suture.

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