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TUBE SIZING BROACH

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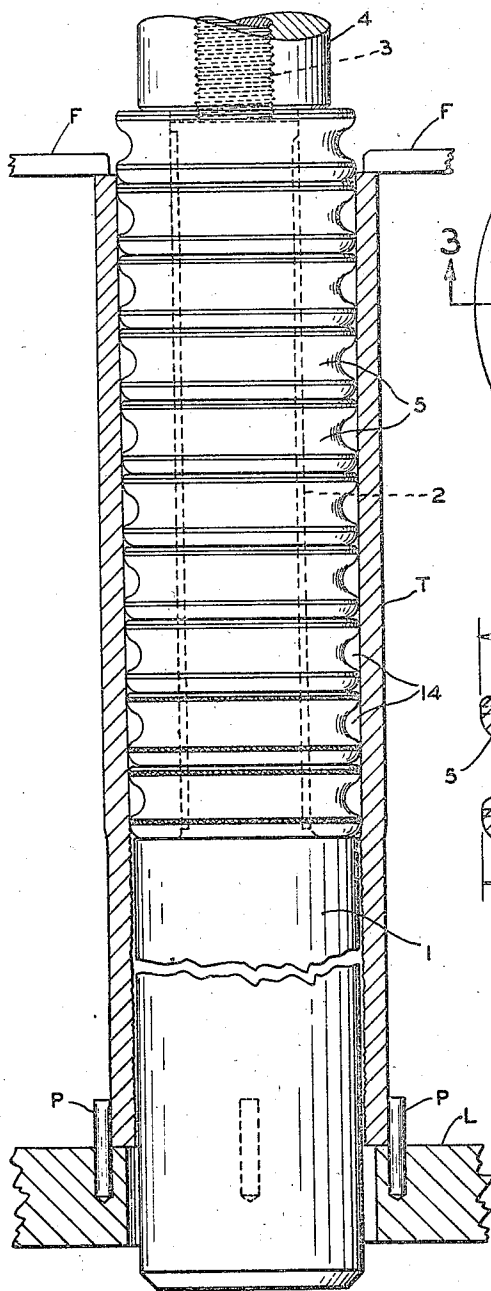


FIG. 1.

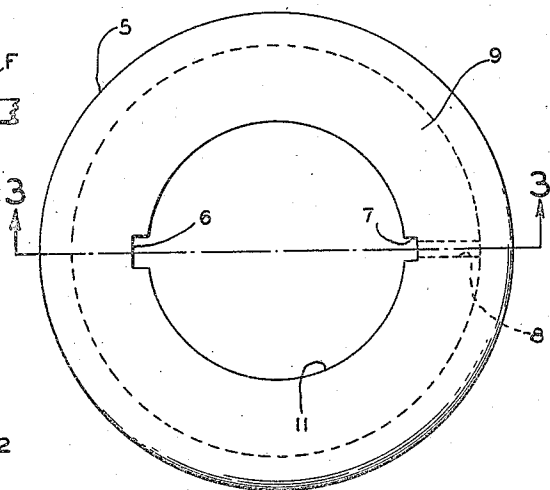


FIG. 2.

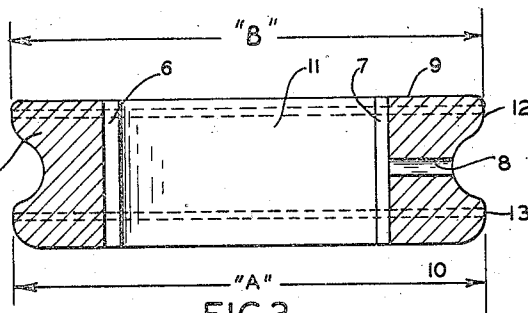


FIG. 3.

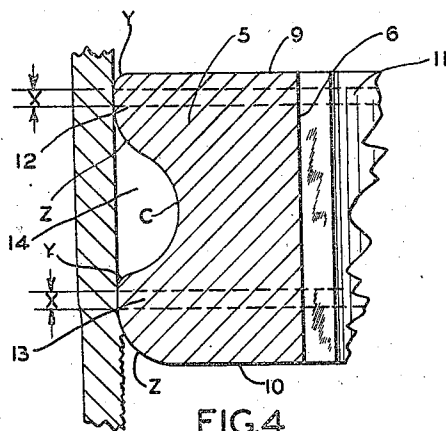


FIG. 4.

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TUBE SIZING BROACH

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1 Claim. (Cl. 29—90)

This invention relates, as indicated, to a tube sizing broach and method of using the same.

It has heretofore been proposed to broach articles such as cast thick-walled phosphor-bronze bushings and the like by means of smooth-tooth broaches having teeth which are rounded at the top instead of being finished to a cutting edge as in the ordinary type of broach. In broaching such articles, the design of the broach teeth is usually such that the metal in the sides of the hole is slightly compressed with perhaps a slight increase in the hardness of the metal, but no appreciable increase in the outer diameter of the work is effected. In other words, the wall thickness is usually such as to form a primary factor limiting the attainment of a desired flow of metal and a maximum increase in the hardness and smoothness of the broached wall of the article, and the design of the broach is a secondary limiting factor in this respect.

I have discovered that I can attain a desired flow of the metal and a maximum increase in hardness and smoothness of the wall in a broaching operation by decreasing the wall thickness of the article being broached, and by utilizing for the broaching operation a broaching tool or broach having an improved tooth design.

Another object of the invention is to provide a broach or broaches having novel means for facilitating lubrication of the broach during the broaching operations.

A further object of the invention is to provide a novel method of making shells for munition purposes.

A still further object of the invention is to provide a novel semi-finished product suitable for manufacture into shells for munition purposes.

To the accomplishment of the foregoing and related ends, said invention, then, consists of the means hereinafter fully described and particularly pointed out in the claims; the annexed drawings and the following description setting forth in detail certain means and one mode of carrying out the invention, such disclosed means and mode illustrating, however, but one of various ways in which the principle of the invention may be used.

In said annexed drawing—

Fig. 1 is a vertical longitudinal cross-sectional view showing the broaching of a seamless tube by means of the novel broaching tool of the present invention;

Fig. 2 is a top plan view of one of the broaches shown in Fig. 1;

Fig. 3 is a transverse cross-sectional view of

the broach of Fig. 1, taken on the line 3—3 of Fig. 2, and

Fig. 4 is a fragmentary view, on an enlarged scale, of a portion of Fig. 1, and showing more clearly the action of the broaching tool.

Referring more particularly to the drawing, the broaching tool will be seen to comprise an arbor having a portion 1 beveled at its lower end and having a diameter somewhat less than the diameter of the hole to be broached, a broach-supporting portion 2 of smaller diameter than the portion 1, and a portion 3 of still smaller diameter, and which is threaded to permit attachment of the broaching tool to a plunger or ram 4 of a suitable press (not shown).

Mounted on the portion 2 of the arbor, between the portion 1 thereof and the plunger 4 is a multiplicity of broaches 5, these broaches having suitable keyways 6, whereby they may be splined to the portion 2 of the arbor. Each broach is also provided with a second keyway 7, diametrically opposite the keyway 6, the keyways 7, when aligned with each other, providing a vertical passageway for feeding a lubricant therethrough and to the radial openings 8 in the broaches, which communicate with the keyways 7 as shown in Fig. 3.

Each of the broaches 5 has faces 9 and 10 which are flat, smooth, and parallel with each other, as well as perpendicular to the bore 11 in the broach. Each broach, moreover, has a pair of axially-spaced teeth 12 and 13, the teeth 13 having a diameter A, which is slightly smaller than the diameter B of the teeth 12. Each tooth has a cross-sectional contour consisting of a portion X which is parallel to the axis of the broach, a portion Y in the form of an arc of relatively small radius, and a portion Z in the form of an arc of considerably larger radius than the arc Y. The portions Y of the teeth 12 connect the portions X thereof with the face 9 of the broach, while the portions Z of the teeth 13 connect the portions X thereof with the face 10 of the broach. The portions Z of the teeth 12 and portions Y of the teeth 13 are joined by a reentrant arc C of relatively large radius, providing an annular space or recess 14, which serves a purpose to be presently described.

It will be understood that the successive broaches as seen in Fig. 1, have teeth of gradually increasing diameter, beginning with the lowermost broach and proceeding upwardly. In a typical broaching operation, involving the broaching of seamless tubes of a diameter suitable for

manufacturing 4.2 inch shells, the dimensions, A and B, for the teeth of the successive broaches, will be approximately as follows:

Broach No.	"A"	"B"
	Inches	Inches
1.....	3.6896	3.6924
2.....	3.6952	3.698
3.....	3.7000	3.7028
4.....	3.7056	3.7084
5.....	3.7112	3.714
6.....	3.7168	3.7196
7.....	3.7224	3.7252
8.....	3.728	3.7308
9.....	3.7336	3.7364
10.....	3.7392	3.742

The portions X of the first two broaches may, if desired, be knurled as shown in Fig. 1 to facilitate initiation of the broaching operation.

In the use of the broaching tool, the seamless tube T which is to be broached, is mounted vertically on the bed L of a press, and is loosely or approximately centered with respect to the broaching tool by means of pins P.

The broaching tool is then pushed downwardly through the tube T, the several broaches of the tool acting in succession to enlarge the bore of the tube by an operation which compresses and smooths the metal in the sides of the bore, resulting in a maximum increase in the hardness of the metal, a smooth and highly burnished wall surface and a general increase in the toughness and strength of the tube.

These results are believed to be due, in part at least, to the fact that the tube or article which is being broached has a relatively thin wall, which permits the tube to expand laterally to a very small degree, but sufficiently to take up some of the stresses created by the wave-like flow of the metal which is set up by the teeth of the broach. In other words, the teeth of the broaches force the metal of the tube inwardly as indicated in Fig. 4, and this metal, in advance of each tooth, is then forced rearwardly into the annular spaces 14. If the walls of the tube were of such thickness as to be unyielding, the opposition to this flow would be so great as to render difficult the production of a smooth-walled bore. However, since the walls do yield to a slight extent, possibly a few thousandths of an inch, the stresses created by the wave-like flow of metal are taken up sufficiently to produce a bore of considerable hardness, which presents a smooth highly burnished surface.

The design of the teeth of the broach further facilitates the flow of the metal as well as the production of the desired finish of the bore of the tube. The portions Z of the teeth, are gently curved so as to force the metal inwardly very gradually and smoothly. The portions X of the teeth are instrumental in producing a desired smoothing effect on the metal, and the portions Y are curved sufficiently to relieve the flowing metal at these points. The annular spaces 14 are sufficiently large to readily accommodate move-

ment of the flowing metal and to hold a fairly large supply of the lubricant.

During the broaching operation, a lubricant is admitted through the passageway formed of the keyways 7, and such lubricant finds its way through the radial openings 8, into the annular spaces 14 and to the internal surface of the tube, providing a film of lubricant between the tool and bore of the tubular article, which greatly facilitates the broaching operation.

After the broaching operation, the broaching tool is withdrawn from the tube, stripper fingers F being employed to hold the tube during such withdrawal.

It may be apparent from the foregoing that a method has been provided by which tubular articles may be formed of considerable toughness and strength, and having bore, the walls of which are relatively hard and smooth.

The foregoing method is particularly adapted for the manufacture of shells for munition purposes. In such manufacture, a desired internal finish can be obtained, which is very smooth and unlikely to result in injury to persons handling the shells. While a slight increase in the outer diameter of such shells results from the broaching operations, this is not objectionable, since a finishing cut or cuts may be taken to reduce the external diameter to the size necessary for loading, and at the same time, a desired external smoothness and concentricity obtained.

Instead of mounting separate broaches on an arbor, as described, a single broach unit may be employed having teeth corresponding to the teeth of the separate broaches shown.

Other forms may be employed embodying the features of my invention instead of the one here explained, change being made in the form or construction, provided the elements stated by the following claim or the equivalent of such stated elements be employed, whether produced by my preferred method or by others embodying steps equivalent to those stated in the following claim.

I therefore particularly point out and distinctly claim as my invention:

A broach having faces which are parallel with each other and perpendicular to the axis of the broach, and a pair of axially-spaced teeth, one of which is of slightly smaller diameter than the other, each tooth having a cross-sectional contour consisting of a portion which is parallel to the axis of the broach, a portion in the form of an arc of relatively small radius and a portion in the form of an arc of considerably larger radius than that of the first-named arcuate portion, the smaller arcuate portion of one tooth connecting the parallel portion of said tooth with one of said faces and the larger arcuate portion of the other tooth connecting the parallel portion of the other tooth to the other of said faces, and the other arcuate portions of said teeth being joined by a reentrant arc of relatively large radius, providing an annular space between said teeth.

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