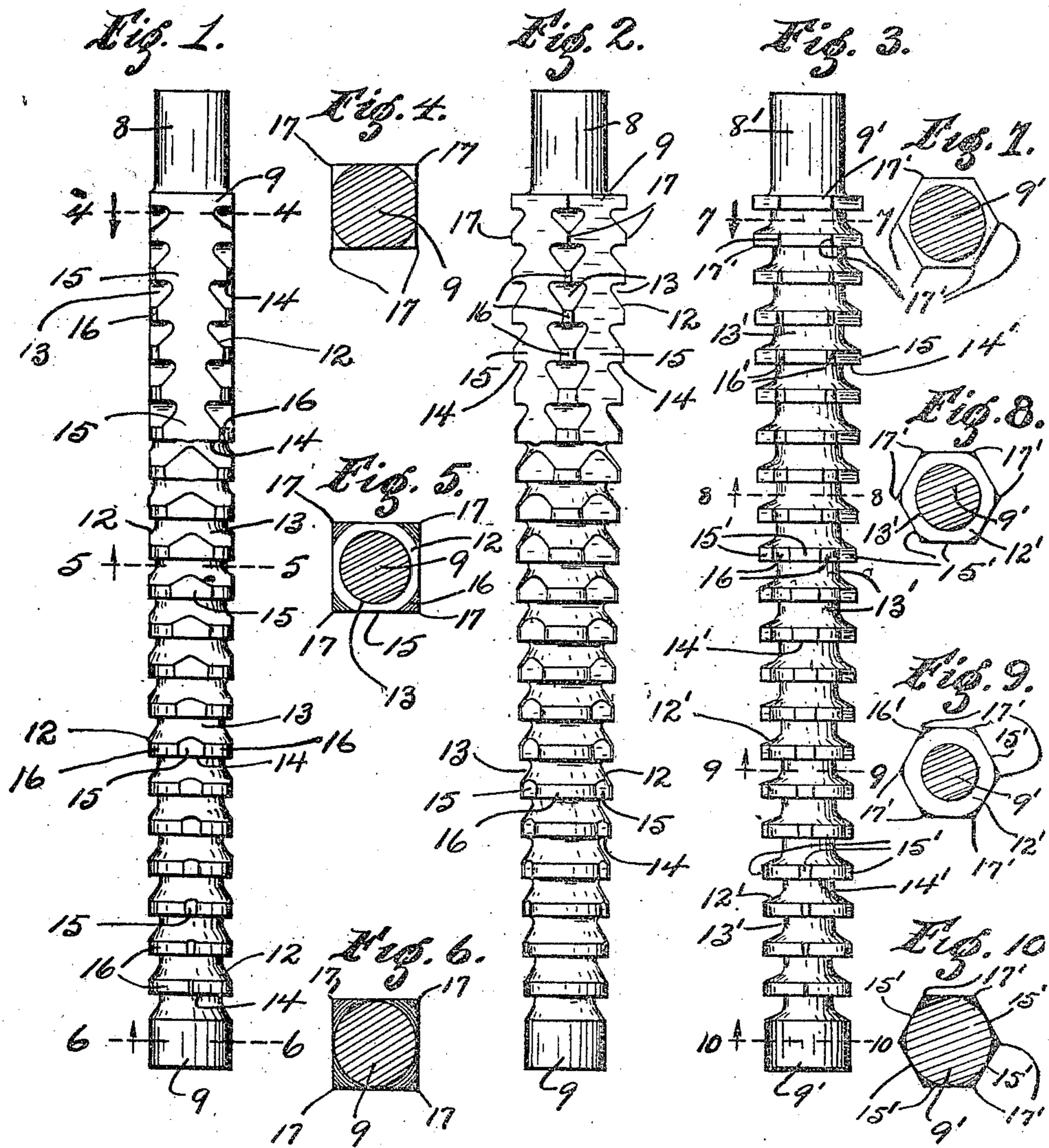


995,809.

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Witnesses:
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UNITED STATES PATENT OFFICE.

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BROACH.

995,809.

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To all whom it may concern:

Be it known that I, EMIL SLAPAK, a citizen of the United States of America, residing at Cleveland, in the county of Cuyahoga and State of Ohio, have invented certain new and useful Improvements in Broaches; and I hereby declare the following to be a full, clear, and exact description of the invention, such as will enable others skilled in the art to which it pertains to make and use the same.

This invention relates to improvements in broaches or broaching tools, and particularly to broaches designed for converting circular openings to polygonal openings, such as square, hexagonal and octagonal openings.

Heretofore circular openings have been converted to polygonal openings either by filing in the sides of the polygon or by driving through the circular opening a series of broaching tools each of polygonal shape and of gradually increasing sizes. Both of the above methods are unsatisfactory and expensive because of the time required in forming the polygonal openings or the large number of tools required. Furthermore the openings are frequently not accurately formed particularly when formed by filing.

The object of the present invention is the provision of a broach which is inexpensive to manufacture and which is so constructed that when driven through a circular opening by one operation forms a polygonal opening with great accuracy.

In carrying out my invention I provide a broach comprising a body portion which is provided with a series of alternately arranged shoulders and recesses extending about the body portion, the shoulders having a series of flat faces corresponding in number and arrangement to the faces of the polygonal opening which is to be formed, and the faces of the different shoulders being of successively increasing length until at the last or final shoulder the flat faces merge forming the corners of a polygon.

More specifically considered the invention relates to a broach having at one end a shank adapted to be gripped by a clutch or similar holding device of a suitable press and having a body portion which is formed from tapered stock circular in cross section, the body portion being provided with a series of alternately arranged shoulders and recesses spaced lengthwise thereof, the lowermost

shoulder being preferably circular in cross section and of a diameter slightly less than the diameter of the circular opening, and each of the remaining shoulders having a cutting edge and a series of flat faces corresponding in number and arrangement to the sides of the polygon and having between the flat faces arc-shaped portions, the flat faces of the different shoulders being of gradually increasing length and the arc-shaped portions of the different shoulders being of gradually decreasing length but of increasing radius until at the last or final shoulder the flat faces merge forming the corners of the polygon.

My invention may be further briefly summarized as consisting in certain novel details of construction which will be described in the specification and set forth in the appended claims.

For an understanding of my invention reference is had to the accompanying sheet of drawings wherein—

Figure 1 is a side elevation of a broach which is utilized for converting a circular opening to a square opening. Fig. 2 is a view of same rotated on its longitudinal axis through an arc of 45°. Fig. 3 is an elevation of a broach which is utilized for converting a circular opening to a hexagonal opening. Figs. 4, 5 and 6 are transverse sectional views along the lines, 4—4, 5—5 and 6—6, respectively of Fig. 1, looking in the direction indicated by the arrows. Figs. 7, 8, 9 and 10 are transverse sectional views along the lines 7—7, 8—8, 9—9 and 10—10, respectively, of Fig. 3 looking in the direction indicated by the arrows.

Referring now to Figs. 1, 2, 4, 5 and 6 showing a broach for forming a square opening, 8 represents the shank portion of the broach and 9 represents the body portion. The shank portion is designed to be secured in a clutch or similar portion of a press, such as a mandrel press, when it is desired to form a square opening from a circular opening in metal or stock. At its lower end the body portion is circular in cross section and the diameter thereof is substantially the same or slightly less than the diameter of the circular opening which is to be converted to the square opening. The body portion at its upper end is square in cross section the length of each side being equal to the diameter of the lower end of the body portion. The body portion 9 is

provided with a series of alternately arranged shoulders 12 and recesses 13 extending about the body portion and spaced longitudinally thereof. All the shoulders are provided with lower cutting edges 14 and may therefore be termed cutting shoulders. These cutting shoulders are each provided with four flat faces 15 which correspond in number and arrangement to the sides of the square and are of increasing length on the different shoulders from the lowermost cutting shoulder to the uppermost. These flat faces are formed by planing or otherwise forming on the body portion of the broach four sides or faces which coincide with the sides of the square, the opposite sides being parallel to each other and to the axis of the broach. Located between the flat faces 15 of each shoulder are four arc-shaped portions or faces 16. These arc-shaped portions of the different shoulders are of gradually decreasing length from the lowermost cutting shoulder to the uppermost shoulder and are of gradually increasing radius. The arc-shaped portions on each shoulder overhang slightly the arc-shaped portion on the shoulder just beneath and thereby form cutting edges, as shown clearly in the transverse sectional views. At the uppermost shoulder the flat faces merge, as shown most clearly in Figs. 5 and 6, forming the corners 17 of the square.

Referring now to Figs. 3, 7, 8, 9 and 10, wherein I have shown a broach for forming a hexagonal opening, it will be seen that I have here shown a broach, the principal, general features of the design, and manner of construction are substantially the same as those first described. This broach has a shanks portion 8' and a body portion 9'. The body portion is provided with alternately arranged shoulders 12' having cutting edges 14' and annular recesses 13'. The cutting shoulders are each provided, in this case, with six flat faces 15' formed by planing six sides on the body of the broach, the opposite six sides being parallel to each other and to the axis of the broach and being located equal distances therefrom. The shoulders are also provided between the flat faces with arc-shaped faces or portions 16', and, as in the first instance, the flat faces on the different shoulders are of increasing length from the lowermost cutting shoulder to the uppermost shoulder while the arc-shaped faces or portions are of decreasing length until at the uppermost shoulder the flat faces merge forming the six corners 17' of the hexagon, these corners being shown clearly in the sectional views.

It will be seen that I have provided a tool, which, although inexpensive to manufacture, will convert a circular opening to a polygonal opening having any number of

sides very quickly and without requiring the expenditure of a great deal of time as with the methods heretofore employed. All that is necessary is to place the broach in a suitable press and then lower the same through the circular opening in the stock, the polygonal opening being formed by a single stroke of the tool, and, as the tool is forced through the circular opening, the latter is gradually converted to the polygonal shape, the lower edges of the shoulders gradually cutting away the material and forming the corners. The material which is removed by these cutting edges of the shoulders passes to the recesses between the shoulders, and thus does not interfere with the cutting operation. It will be understood, of course, that the broach may have any number of sides or faces and may be utilized for forming polygonal openings of any number of sides.

What I claim is,—

1. A broach for converting a circular opening to a polygonal opening comprising a body portion having a series of shoulders and annular recesses spaced lengthwise thereof, said shoulders having cutting edges and having flat faces corresponding in number and arrangement to the sides of the polygonal opening to be formed and all but the last or final shoulder having arc-shaped portions between the flat faces, the flat faces of the different shoulders being of gradually increasing length from the lowermost shoulder to the uppermost shoulder until at the uppermost shoulder the faces merge forming the corners of a polygon, and the arc-shaped portions of the different shoulders being of gradually decreasing length but of increasing radius from the lowermost shoulder upwardly.

2. A broach for converting a circular opening to a polygonal opening comprising a body portion circular in cross section at its lower end and having a shank at its upper end and provided intermediate of the shank and lower end with a series of shoulders and recesses spaced lengthwise thereof, said shoulders having cutting edges and having flat faces corresponding in number and arrangement to the sides of the polygonal opening which is to be formed and all but the last or final shoulder having arc-shaped portions between the flat faces, the flat faces of the different shoulders being of gradually increasing length from the lowermost shoulder to the uppermost shoulder until at the uppermost shoulder the faces merge forming the corners of a polygon, and the arc-shaped portions of the different shoulders being of gradually decreasing length but of increasing radius from the lowermost shoulder upwardly.

3. A broach for converting a circular opening to a polygonal opening, comprising

a body portion having a shank at its upper end, and provided intermediate of the shank and lower end with a series of shoulders having cutting edges, and having straight
5 faces corresponding in number and arrangement to the sides of the polygonal opening which is to be formed, and having arc-shaped portions between the straight faces, the straight faces of the different shoulders
10 being of gradually increasing length from the lowermost shoulder to the uppermost

shoulder, and the arc-shaped portions of the different shoulders being of gradually decreasing length but of increasing radius, from the lowermost shoulder upwardly. 15

In testimony whereof, I sign the foregoing specification, in the presence of two witnesses.

EMIL SLAPAK.

Witnesses:

VICTOR C. LYNCH,
N. L. McDONNELL.