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BROACH

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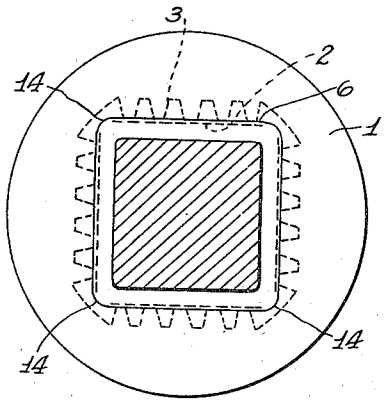


Fig. 2.

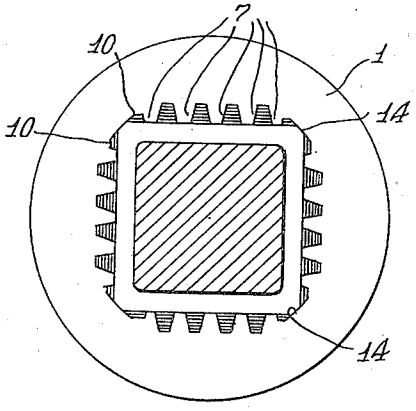


Fig. 3.

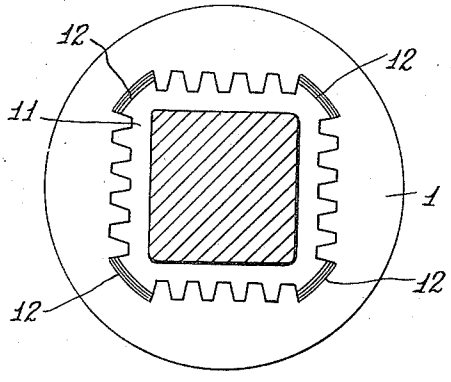


Fig. 4.

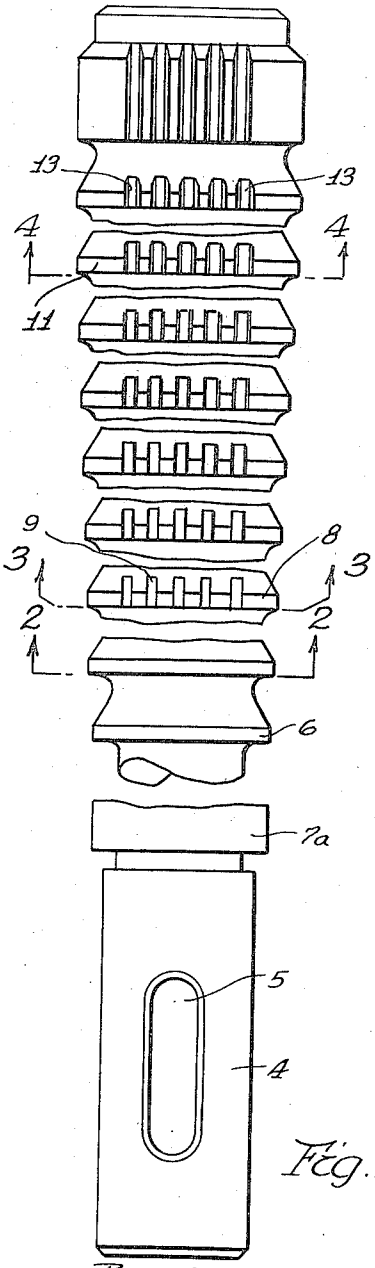


Fig. 1.

BROR GUSTAF VON REIS
LEO I. KAPLAN
INVENTOR.

BY

ATTORNEY.

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BROACH

Leo I. Kaplan and Bror Gustaf von Reis, Detroit, Mich., assignors to Detroit Broach Company, a corporation of Michigan

Application March 22, 1938, Serial No. 197,443

10 Claims. (Cl. 29—95.1)

This invention relates to broaches for cutting internal surfaces of a member wherein it is desired to form a final contour rectangular in cross-section with the sides of the rectangle splined and with the corners of arcuate shape for use as bearing surfaces.

The broach herein revealed is of a type generally similar to that described in my copending application Serial No. 195,673, filed March 14, 1938. It differs therefrom in the manner of cutter staging, it having been found that the tool may be shortened by altering the stages as to those cutters having the function of forming the arcuate corners of the rectangle.

Also, it is recognized that a broach will often leave its course and thereby cut an imperfect formation. It is an object of this invention to provide a broach with guide means therefor active throughout its length.

More particularly it is an object to provide a broach having guide surfaces at each cutter, these surfaces changing along the length of the broach.

Another object of this invention is to provide a multiple stage broach for forming a groove, one stage having dual cutters in the groove and another stage having single finishing cutters, the cutting edges of each dual cutter being normal to each other and each single cutter having arcuate cutting edges in continuation of the cuts begun by the dual cutters.

A further object is to provide a broach for cutting groups of internal splines circumferentially spaced and separated by arcuate bearing surfaces, the cutters being arranged in stages in such manner that the splines are completely cut simultaneously with starting the initial cuts of the bearing surfaces. The cutters thereafter being relieved of all duties except that of finishing the bearing surfaces.

Other objects and advantages will become more fully apparent as reference is had to the accompanying drawing wherein my invention is illustrated, and in which,

Fig. 1 is a side elevation of my improved broach.

Fig. 2 is a transverse section taken along the line 2—2 of Fig. 1,

Figs. 3 and 4 are transverse sections taken along the lines 3—3 and 4—4 respectively of Fig. 1, showing the spline and bearing surface formation respectively.

More particularly, 1 indicates a work piece in the interior walls of which it is desired to form internal splines and bearing surfaces. The piece 1 is generally of cylindrical exterior and is originally of cylindrical interior shape and machined or otherwise preferably formed into a rectangular shape with rounded corners as indicated by the dotted lines 2. The broach herein provided enlarges the opening 2 to the final form indicated by the dotted lines 3.

The broach, as illustrated in Fig. 1, is composed of three longitudinally spaced stages of cutters, the section of Fig. 2 being taken at the final cutter of the first stage and the sections of Figs. 3 and 4 being taken at the first cutter of the second and third stage, respectively. A section 4 at the smallest end of the broach has a slot 5 therein for attachment of the broach to a machine by which it may be pulled or pushed through the work piece either vertically or horizontally. Between the section 4 and the first cutter 6 is a section 7 which is rectangular in cross section, and which guides the first cutter 6 to its cutting position.

The cutters of the first stage are all rectangular in cross-section, the first cutter 6 of this stage being of such size as to take a small cut from each of the sides of the rectangle 2. If the rectangle 2 is properly sized and centered by the operations preceding those by the broach herein described the corners of the cutters 6 of the first stage may be rounded at the corners 14 as illustrated in Fig. 2, but if this broach must assume the duty of centering this hole then it is recommended that the cutters 6 be true rectangles with sharp corners thus cutting away the stock of the corners of the opening 2. It is recommended that the hole 2 be accurately centered before broaching. The corner portions 14 then have no other function than to guide. The cutters 6 of the first stage have straight sidewalls and continue to take cuts until the opening 2 has reached the surfaces of the splines 7 to be cut as shown in Fig. 2.

The splines 7 are herein illustrated as being five in number along each side of the rectangle, each set of five splines being considered a group which is peripherally spaced from each adjacent group by a distance greater than the width of a spline. The first cutter 8 of the second stage of cutters has a plurality of shallow grooves or cut out portions 9 along each side thereof thus forming a plurality of cutting edges, and begins to form all of these splines 7 simultaneously, each succeeding cutter in this stage taking a progressively deeper cut as illustrated in Fig. 3 until all splines are completely formed. The outside surfaces of the end splines of each group are only partially formed in this stage, the cutting edges 10 therefor being progressively narrower and terminating before a groove depth equal to that of the splines

are cut. These cutting edges are each parallel to the other spline forming cutting edges so that two of these edges 10 normal to each other are cutting out each of the portions circumferentially separating the groups of splines simultaneously with spline formation. The corner surfaces 14 separate the corner cutters 10 into pairs, or into dual cutters, and continue to serve no other purpose than guides during cutting by this second stage, also.

The first cutter 11 of the final stage of the cutters has four arcuate cutting edges 12, which grow progressively larger as illustrated in Fig. 4. Separating the arcuate cutters are grooves 13 which accommodate the splines 7 which have been completely formed. The grooves 13 now cooperate with the splines to constitute guides while the corners are being cut. The cutting edges 12 complete the cutting of the portions separating the groups of splines, the portions thus cut into the member 1 constituting bearing surfaces for engagement with similar surfaces of a male member (not shown) in order to relieve the splines of all but driving functions.

What is claimed is:

1. A broach comprising a plurality of longitudinally spaced stages of cutters with the cutters of each stage having a contour similar to that of the other cutters in the same stage and different from that of any other stage, the stages and the cutters of each stage progressively increasing in size from front to rear of the broach, the cutters of the first stage all being substantially rectangular, the cutters of the second stage being rectangular and having a plurality of spline forming grooves in each side thereof, the cutting surfaces of the lands on each side of said grooves of any cutter being coplanar throughout any side of the rectangle, the cutters of said third stage being rectangular and having spline accommodating grooves separated by non-cutting lands formed in each side thereof, said sides being connected by arcuate cutters of progressively increasing size, the arcuate cutters on the final cutter of the last stage being at a greater distance from the center of the rectangle than any portion of any of said lands or grooves.

2. A male broach comprising a broach body having a plurality of enlarged portions regularly spaced along the major portion of the length thereof, each of said portions comprising peripherally spaced cutting edges separated by non-cutting surfaces, said non-cutting surfaces constituting guides for said cutting edges, said non-cutting surfaces shifting their angular position between the first and last of said portions.

3. A male broach comprising a broach body having enlarged portions regularly spaced along the major portion of the length thereof, a part of the periphery of each of said portions constituting a cutting edge, the remainder of each of said portions constituting guiding means, said cutting edges increasing in diameter from portion to portion, said guiding means being of constant radius from portion to portion, that part of said peripheries constituting cutting edges for some of said portions becoming guide surfaces for others of said portions, that part of said peripheries constituting guide surfaces becoming cutting edges upon the adjacent parts becoming guide surfaces whereby all of said portions comprise guide means and cutting edges.

4. A male broach for forming an opening in a work piece to provide groups of splines separated circumferentially by bearing surfaces, said broach having cutters for forming the splines, and cutters for forming the bearing surfaces, the cutters for forming each bearing surface comprising a first series of cutters of progressively increasing size, each cutter of said first series being composed of cutting edges arranged in pairs with the edges of each pair at right angles to each other, and a second series of cutters longitudinally behind the first series and also of progressively increasing size, each of the last named cutters being arcuate and of a circumferential extent equal to that of the bearing surface to be formed, the arcuate cutters of the second series being aligned with the pairs of cutters of the first series.

5. A male broach for forming an opening in a work piece to provide groups of splines separated circumferentially by bearing surfaces, said broach having cutters for forming the splines and cutters for forming the bearing surfaces, the cutters for forming each bearing surface comprising a series composed of a plurality of aligned pairs of cutters with the cutters of each of said pairs normal to each other, said pairs of cutters progressively increasing in size from front to rear of the broach, and a second series of aligned arcuate cutters aligned with said pairs, the cutters of said second series progressively increasing in size, the final one of said second series having a peripheral portion equal to the width of the bearing surface being cut.

6. A male broach for forming a plurality of groups of splines separated circumferentially by bearing surfaces having arcuate bases and a common center of curvature, said broach having cutters for forming the splines and cutters for forming the bearing surfaces, the cutters for forming each bearing surface comprising a first longitudinal series of cutters of progressively increasing size, each cutter of said series being composed of spaced sets of two cutting edges, the cutting edges in each of said sets being normal to each other, and a second series of cutters having cutting edges of arcuate shape, said arcuate cutting edges each continuing the cuts started jointly by the sets of cutting edges of the first series.

7. A male broach for forming an opening having splines separated circumferentially by bearing surfaces, said broach having a series of spaced parallel cutting edges for forming the splines and non-cutting surfaces between certain of said cutting edges, said surfaces constituting guide means for said cutting edges during formation of the splines, and cutting edges for completing the formation of said bearing surfaces subsequent to the formation of the splines.

8. A male broach for forming an opening having splines separated circumferentially by bearing surfaces, said broach having a series of spaced parallel cutting edges for forming the splines and non-cutting surfaces between certain of said cutting edges, said surfaces constituting guide means for said cutting edges during formation of the splines, cutting edges for completing the formation of said bearing surfaces subsequent to the formation of the splines, and guide surfaces on said broach adapted to coact with the formed splines for guiding the broach during the formation of said bearing surfaces.

9. A male broach having cutters for forming a rectangular hole with splines in the sides thereof and bearing surfaces at the corners, said broach having guide means coacting with the corner surfaces of the hole for guiding the broach during formation of the splines, and means coacting

with surfaces of said hole after formation of the splines, and means for guiding the broach during formation of said bearing surfaces.

10. A male broach having cutters for forming a rectangular hole with splines in the sides thereof and bearing surfaces at the corners, said broach having guide means coacting with the corner surfaces of the hole for guiding the broach during formation of the splines, and non-cutting surfaces for engaging the formed splines for guiding said broach while the bearing surface cutters are operative.

BROR GUSTAF VON REIS.
LEO I. KAPLAN.