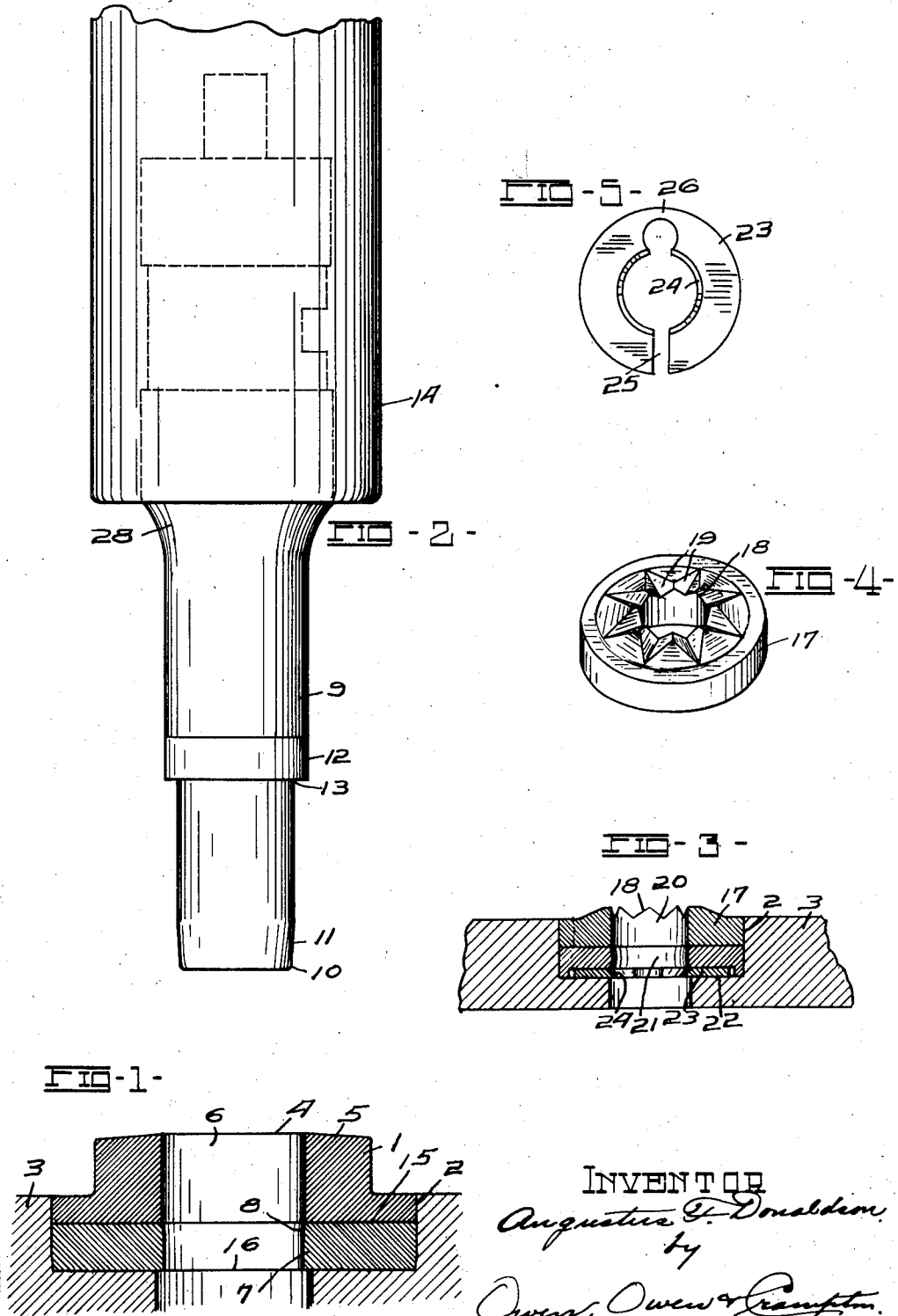


A. F. DONALDSON.
 OUTSIDE BROACH.
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INVENTOR
 Augustus F. Donaldson
 by
 Owen, Owen & Crampton.

UNITED STATES PATENT OFFICE.

AUGUSTUS F. DONALDSON, OF TOLEDO, OHIO, ASSIGNOR TO THE BUNTING BRASS & BRONZE COMPANY, OF TOLEDO, OHIO, A CORPORATION OF OHIO.

OUTSIDE BROACH.

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To all whom it may concern:

Be it known that I, AUGUSTUS F. DONALDSON, a citizen of the United States, and a resident of Toledo, in the county of Lucas and State of Ohio, have invented a certain new and useful Outside Broach; and I do 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 appertains to make and use the same reference being had to the accompanying drawings, and to the characters of reference marked thereon, which form a part of this specification.

My invention has for its object to provide a broach for cutting the exterior surface of cylindrical objects. The cylindrical objects may be in the form of plugs, that is, solid cylinders as distinct from hollow cylinders, or they may be in the form of bushings.

My invention may be contained in broaches of different forms. To illustrate a practical application of my invention I have selected two broaches that contain my invention as examples and shall describe them hereinafter. The broaches selected are illustrated in the accompanying drawings, in which,—

Figure 1 of the drawings illustrates a sectional view of one form of broach containing my invention. Fig. 2 illustrates a mandrel that may be used in connection with the exterior broaches illustrated in the drawing when the exterior surfaces of bushings are broached. Fig. 3 illustrates a sectional view of a modified form of broach. Fig. 4 illustrates a perspective view of the cutting member shown in the form of the broach illustrated in Fig. 3, and Fig. 5 illustrates a stripper plate for removing the bushings from the mandrel or other device that is used for forcing bushings through the form of broach shown in Fig. 3.

In the broaching operation the exterior broaches are preferably secured in the bed plate of a plunger press and the cylindrical objects are forced through the broaches. If the cylindrical objects are solid they are punched through by the ram, that is, a suitable tool is attached to the ram which forces the cylindrical object through the broach by pressure on the upper end of the cylindrical object. In broach cutting the exterior surfaces of bushings, the wall of the bushing is elastic and must be sustained

against the compression that is produced by the exterior broach. This is done by placing the bushing over the end of a mandrel and when the bushing strikes the exterior broach the bushing is forced along the mandrel. The size of the mandrel is such as to fully sustain the wall and preferably slightly expands the bushing or compresses the inner surface of the bushing, in order that it may be securely held in position on the mandrel and concentric with the exterior broach, that its wall may be fully sustained from the compressing action of the exterior broach and slipping of the metal of the bushing by the cutting edge of the broach without sufficient amount being removed by the cutting edge, may be prevented. Also means is provided for removing the circular chips that crowd up on the mandrel.

In Fig. 1, 1 is the cutting member of the broach. It is an annular member that accurately fits in a recess 2 formed in the bed 3 of the plunger press. It has a circular cutting edge 4. The edge 4 has a very slight rake formed by a very slight inclination of the upper surface 5 of the cutting member 1 of the broach, that is, the surface 5 is conical although its altitude is very slight. The cutting member 1 is provided with a broad burnishing surface 6 that rubs over the surface of the cylindrical object and against which the cylindrical object presses with considerable pressure. The burnishing surface 6 has a very slight taper, the lower end being very slightly smaller than the upper end.

Beneath the cutting member 1 of the broach, is located a compacting member 7. It is annular in form and also accurately fits the recess 2 in the bed 3 of the plunger press. It has at the upper edge of the interior surface of the annulus a very slightly tapered portion 8 that prevents the upper edge of the ring 7 from engaging or operating upon the skin of the bushing that is formed by the broad burnishing surface 6 of the cutting member 1. Except for the upper third of the inner surface on the ring 7, the inner surface is cylindrical. It has a diameter smaller than the smallest diameter of the burnishing surface 6 of the member 1 in order to compact the surface of the bushing and to give it a high polish. At the point of connection between the tapered

portions 8 and the cylindrical portion of the inner surface on the ring 7 it is rounded so as to knead the surface of the bushing or other cylindrical object as it passes through the compacting member 7. The smaller diameter of the inner surface of the ring 7 is considerably smaller comparatively speaking, than the diameter of the finished cylindrical object. The diameter of the cutting edge 4 may be slightly smaller than the diameter of the finished cylindrical object by reason of the compressibility of the metal. The degree of the compressibility depends upon the alloy or character of metal of which the cylindrical object is formed. It particularly depends on the thickness of the wall of the cylindrical object operated upon. The metal may yield by reason of its elasticity, but it will return to a more or less extent after the operation has been completed. The size of the exterior of the finished cylindrical object will also vary according to the way that its wall is sustained as by a mandrel.

If bushings are to be broached on their exterior surfaces they may be placed on the end of the mandrel 9. The end of the mandrel 9 is rounded as at 10 and is provided with a tapered portion 11. The tapered portion 11 has a very slight taper but sufficient to enable the proper setting of the bushing on the end of the mandrel. The mandrel may be provided with a ring 12 in order to form the square corner 13 into which the inner corner of the upper end of the bushing fits when the bushing has been forced over the end of the mandrel. Downward movement of the ram 14 forces the bushing against the surface 5 of the broach which pushes the bushing over the surface of the mandrel or which enables the mandrel to be forced into the bushing. The mandrel will then support the wall of the bushing and preferably stretch or slightly compress the inner surface of the bushing. The bushing is then forced by the plunger through the broach 15 and its surface is cut and compacted by the broach. The circular edge of the broach forms ring chips of the metal that is removed from the bushing and these engage and collect on the shank 9. During sequential operations they are crowded up until they reach the frustum shaped part 28 at the top of the shank 9 when they will be split open and finally crowded off of the mandrel.

The broach 15 is securely locked in the bed 3 and the diameter of the inner cylindrical surface of the ring 7 being considerably smaller, relatively speaking, than the diameter of the exterior surface of the finished bushing, and moreover the material of the bushings being elastic, particularly if the bushing is formed of bronze, it will expand when released from the ring 7,

so that the bushing will upon the return of the ram 14 engage the edge of the ring 7 and be stripped from the mandrel, whereupon the bushing will drop from the bed plate.

In the form of the broach illustrated in Fig. 3, the cutting member 17 has a serrated cutting edge 18 that has a very slight rake formed by the slightly inclined plane surfaces 19 that intersect with the cylindrical surface 20 on the inner side of the cutting member 17. The serrations operate to break up the chips, that is, prevent the formation of ring chips. The cutting member 17 is secured in the recess 2 of the bed 3 of the plunger press and beneath the cutting member 17 is located an annular compacting member 21 which may be provided with a compacting bead that has a diameter smaller than the diameter of the cylindrical surface 20 on the cutting member 17. The compacting bead 21 acts upon the surface of the cylindrical object to knead and compact the surface. The annular compacting member 21 may be provided with a recess 22 in which may be located a stripper plate 23 having a beveled or coned inner surface 24, the diameter of the opening in the plate 23 at its upper side being larger than the diameter of its lower side. The plate 23 is slotted at one side such as at 25 and the width of the annulus is reduced on the opposite side as at 26 so as to give considerable elasticity to the jaws of the plate that are thus formed. When the bushings are forced through the broach 27, the jaws of the stripper plate 23 are forced open, the bushings operating upon the beveled edge of the jaws to cause them to spread and when the bushing is passed through the plate the jaws snap behind the bushing so that upon the return movement of the ram 14, the plate 23 will engage the upper end of the bushing and strip it from the mandrel.

I claim,—

1. In an exterior broach, a cutting part having a cutting edge and a rounded bead-like compacting part having a diameter smaller than the cutting part for kneading the surface of the object.

2. In an outside broaching means, an outside cutting part having tapered portions for preventing the formation of ring chips by the outside cutting part, a mandrel for supporting and forcing the objects through the outside cutting part.

3. In an exterior broach, an outside cutting part having a serrated cutting edge.

4. In an exterior broach, an outside cutting part having a serrated cutting edge formed by the intersection of plane surfaces inclined to the axis of the broach.

5. In an exterior broach, an outside cutting part having a serrated cutting edge, and a rounded compacting part.

6. In an exterior broach, an outside cutting part having a serrated cutting edge, and a rounded compacting part, and a stripper means for preventing the return of the objects through the broach.

7. In an exterior broach, a cutting part, a compacting part having a taper and a cylindrical burnishing surface located on the following side of the tapered surface.

8. In an exterior broach for broaching cylindrical objects, a cutting part, a compacting part having a taper and a cylindrical burnishing surface located on the following side of the tapered surface, the smaller diameter of the compacting part being smaller than the cylindrical object and the lower edge of the compacting part forming a stripper means.

9. In an exterior broach, a cutting part, having a cutting edge followed by a broad burnishing surface, a compacting part on the following side of the cutting part having a slightly tapering inner surface near

the leading side of the compacting part and a cylindrical surface near the following side of the compacting part.

10. In an exterior broaching means for bushings, a mandrel having a leading tapered surface and a following cylindrical surface for tightly fitting bushings, an exterior broach having a cutting edge and means for stripping the bushings from the mandrel.

11. In an exterior broaching means for bushings, a mandrel having a tapered leading surface and a following cylindrical surface for tightly fitting the bushings, an exterior broach having a cutting edge and a broad burnishing surface and a compacting part having a leading tapered surface and a following cylindrical surface and a diameter smaller than the cutting edge.

In testimony whereof I have hereunto signed my name to this specification.

AUGUSTUS F. DONALDSON.