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METHOD OF MAKING RECEPTACLES FOR PYROTECHNIC FILLINGS

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FIG. 1

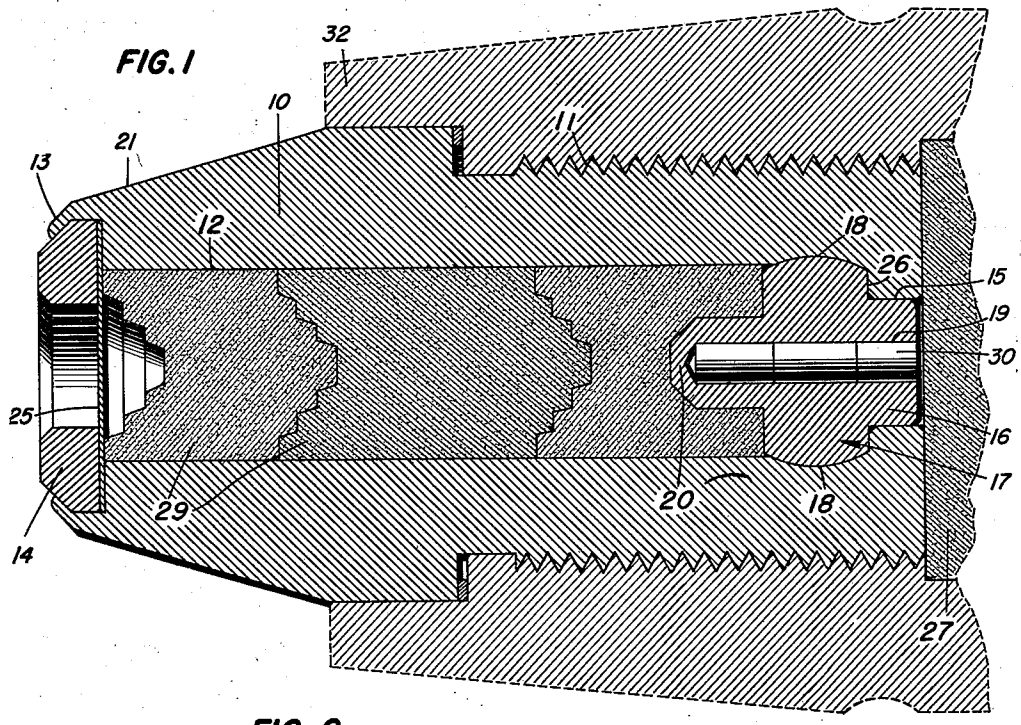
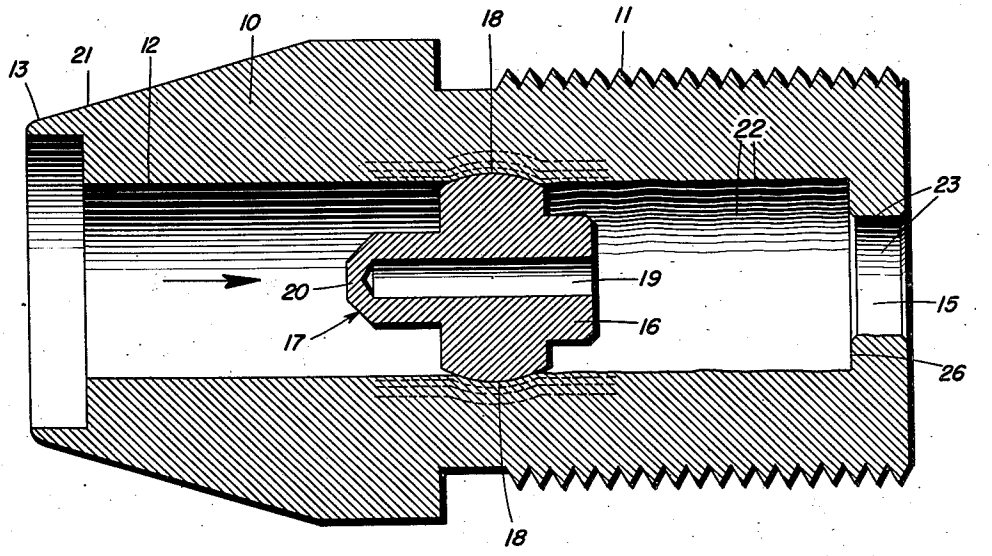


FIG. 2



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METHOD OF MAKING RECEPTACLES FOR PYROTECHNIC FILLINGS

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1 Claim. (Cl. 29—148)

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The present invention relates to a method of simultaneously sizing and finishing internal chambers in metallic bodies. An important object of the invention is to provide means whereby such a chamber may in a single rapid and simple operation be accurately sized to close tolerances while the walls of the chamber are at the same time work-hardened and burnished.

A related object is to provide an improved article of manufacture having a sized, burnished and work-hardened orifice possessing the indicated characteristics.

The method and article embodying the present invention are designed primarily for use in mass production manufacturing operations. The relatively low cost of simultaneously sizing and finishing such an internal chamber, according to the present invention, permits the use of the method and article in many applications in which the costs of conventional methods make such uses commercially prohibitive.

Prior to the present invention, the sizing and finishing to precision limits of an internal chamber in a metallic article was a costly and time consuming operation requiring several separate steps. In forming a cylindrical chamber, for example, one conventional method included a rough drilling of the body portion to provide two holes of different diameters and thereafter required a separate operation to size and then to finish each hole. When forming and sizing such a chamber within close precision limits, it was necessary to change the sizing tool frequently and even then variations due to the wear of the tools caused the rejection of many parts. When the chamber is to be formed in a shape other than cylindrical, such for example as when it is to be elliptical, square, hexagonal, rectangular, triangular or the like, the existing conventional methods required an even greater number of separate expensive and time consuming sizing and finishing operations. Also, if the interior chamber was to be formed in the shape of a helix or spiral, the conventional methods were not satisfactory because of the poor results achieved, as well as because of the cost of the part and the time required for the sizing and finishing of such an internal chamber.

Among the principal objects of the present invention, therefore, the following should also be stated:

To provide a novel method of manufacturing a metallic article having a sized and finished internal chamber of a regular configuration, the dimensions of which are held to predetermined dimensions within close precision tolerances.

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To provide a novel article having an internal chamber of any desired regular configuration in a metallic body, and in which the said chamber is sized and finished in a single operation to hold the sizes thereof to dimensions maintained within close precision tolerances.

To provide a novel mass production method of simultaneously sizing and finishing within close precision limits an internal chamber provided in the metallic body portion of an article.

To provide a novel method of simultaneously sizing and finishing an internal chamber in a metallic article while maintaining the chamber in the desired shape and holding its dimensions within close precision tolerances.

To provide a novel method of simultaneously sizing and finishing an internal chamber in an article to provide a burnished, densified, work-hardened surface on the interior walls thereof, while maintaining the dimensions of the chamber within close precision tolerances.

To provide a novel method of simultaneously sizing and finishing an internal chamber in an article by using an integral structural element of the finished article as a single use sizing and finishing tool, the said element after its use as such tool being seated in the chamber to become an integral structural element of the finished article.

Other objects of this invention will appear in the following description and appended claim, reference being had to the accompanying drawings forming a part of this specification wherein like reference characters designate corresponding parts in the several views.

In the drawings:

Fig. 1 is a longitudinal section of a completely finished and loaded tracer assembly constructed in accordance with the present invention, showing the same installed in a projectile which is fragmentarily illustrated;

Fig. 2 is a similar sectional view of the tracer body and relay portions prior to completion of the simultaneous sizing and finishing of the internal chamber in the body.

Before explaining in detail the present invention, it is to be understood that the invention is not limited in its application to the details of construction and arrangement of parts illustrated in the accompanying drawings, since the invention is capable of other embodiments and of being practiced or carried out in various ways. Also it is to be understood that the phraseology or terminology employed herein is for the purpose of description and not of limitation.

A tracer assembly embodying the present in-

vention is shown by way of example but not of limitation in the drawings forming a part of this application and comprises a body portion 10, having a threaded cylindrical forward portion 11 and a tapered or frusto conical rear section 21, altho of course the size, shape and configuration may be varied and any desired type of metal employed. The tracer body is by means of threaded portion 11, secured in a projectile body 32 which is only fragmentarily illustrated. An internal chamber 12 is provided in the body 10 for the pyrotechnic tracer filling, generally designated 29, the details of which form no part of my present invention and accordingly will not be considered. The open rear end of the chamber 12 is provided with a counterbored portion forming a flange 13 which is adapted to be staked over, as shown in Fig. 1, to retain the washer 14. A shoulder 26 is formed by the plane of juncture between the chamber 12 and a reduced continuation thereof 15. The smaller chamber 15 is so formed that it holds the stem 16 of a relay plug 17 which is drilled inwardly from the forward end, as indicated 19. It will be noted that the drilled hole 19 does not extend completely through the relay plug, a relatively thin wall 20 being left at the rear end.

The plug 17 is formed from any desired material which is harder than the material of the walls of the chamber 12. For example, similar free-machining steels may be used for both the body and the relay plug, but the latter may be heat-treated while the body is left in the natural condition. A partly spherical surface 18 extends around the head of the plug 17. The diameter of the spherical portion is slightly greater than the internal diameter of the chamber 12. The section of greatest diameter may correspond to the equator of the spherical section of the plug 17 or it may be located at some other point with relation to the poles thereof.

The internal chamber 12 is simultaneously sized and the inner surfaces thereof are finished by forcing the plug 17 into it as shown in Fig. 2, which shows the article in a preliminary stage of its manufacture. The chambers 12 and 15 are rough formed in the body 10 in any desired manner, as for example by drilling. When so formed, the side walls are relatively rough and unfinished as indicated by the exaggerated irregular lines 22 and 23. The plug 17 is forced into the chamber 12 and the end 16 is forced into the smallest chamber 15. Due to the greater diameter of the curvilinear surface 18 on the head of the plug 17, a force is exerted on the interior walls of the chamber 12 in a line substantially at right angles to the center line of the plug 17, and to the directional movement of the plug 17.

Due to the curving of the surface 18, the effect of this movement of the plug is to apply the force continually throughout the chamber and thus to smooth out the surface irregularities of the side walls thereof.

The oversize character of the spherical surface of the plug 17 with relation to the internal diameter of the chamber 12 in combination with the pressures exerted on the plug 17 and transferred through its head surface 18 to the internal surfaces of the said chamber, causes a cold flow to occur on the surface of the metal in the side walls of the chamber as indicated schematically by the dotted lines shown in Fig. 2. The cold working of these metal surfaces produces a burnished, densified, work-hardened surface covering the internal side walls of the chamber 12 at

the same time that the said chamber is sized to the desired dimensions. This is primarily a surface reaction for the resiliency of the mass of the material in the body portion 10 causes the interior walls of the chamber 12 to move or spring back a desired amount after the plug 17 has been passed therethrough. This acts to lock the plug 17 in the chamber 12. In the drawings the sized and finished surfaces of the chamber 12 are illustratively shown as of a smaller diameter than the greatest diameter of the spherical surface 18. When the plug 17 has passed along the side walls of the chamber 12, the entire interior surface thereof will have been simultaneously smoothed, sized and finished as above described.

A sealing disc 25 retained beneath washer 14 normally closes the pyrotechnic chamber. The disc may be formed of half-hard brass which is adapted to be punctured and/or melted when the projectile is fired. The propelling charge (not shown) then ignites the pyrotechnic filler 29, which burns progressively to furnish the trace while the projectile is in flight. If the tracer pyrotechnic material burns to the end without the main explosive charge 27 having been detonated by other means (as by actuation of the fuzing means by a target) the combustion of the tracer charge adjacent wall 20 heats such wall and deflagrates the ignition charge 30 contained in the bore 19. The ignition charge in turn detonates the main charge.

It will be recognized that for accurate and uniform performance, the chamber 12 must be accurate as to size, and must be initially concentric and remain so during flight. The herein disclosed method of treating internal bores and passages is equally applicable to other parts and devices, however, and while the internal chamber shown in the accompanying drawings is cylindrical, it will be understood that it is within the purview and scope of the present invention to finish chambers of other shapes. Finished chambers may be made to any desired cross-sectional shape or contour by first forming a rough chamber cavity and thereafter simultaneously finishing and sizing it by the use of a plug member corresponding to the desired finished cross-sectional shape or contour of the chamber.

The plug members utilized will be of the desired cross-sectional shape to finish the chamber as required and may be formed of any desired type of material, such for example as hard steel, sintered powdered metals or the like. Similarly, the plugs may be formed by any suitable method according to the material used. For example, if they are formed from hard steel, they are preferably formed on a screw machine and thereafter hardened and ground to the desired limits. They may be provided or not with a passage or passages therein as may be desired, depending upon the use for which the finished article is intended.

The present invention thus permits the formation of internal chambers having cross-sectional shapes other than circular. For example, they may be triangular, rectangular, square, hexagonal, elliptical, or any other desired geometric shape or form. Regardless of the shape of the chamber, it is first blocked out to its rough shape in the body of the article and the walls are thereafter sized and finished by passing the finishing plug therethrough.

It will be seen that the present invention thus provides a novel method of sizing and finishing

an internal chamber in the body of an article and permits the holding of the chamber to dimensions held within desired precision limits, depending upon the production requirements. If desired, the internal walls of the chamber may be finished on a mass production basis to within ± .0005 inch of a fixed dimension. Other tolerances may be held by practicing the method of the present invention in manufacturing such an article.

Such plug members may be formed with a small duct or series of ducts in a body of very hard material, such for example as sintered tungsten carbide, and thus the plugs will provide a hard wear-resistance jet for high pressure fluids or gases as in various types of fluid atomizing devices, pressure control valves, and the like. It is to be understood, therefore, that the present invention is not expressly limited in its use to the particular article herein disclosed. It is to be understood also that the external shape and dimension of the body of the article may be varied somewhat as a result of the chamber finishing and sizing operations herein disclosed. If it is essential to hold a preformed shape and dimension, the body may be held in any suitable die member which will support it against the forces employed in sizing and finishing the internal chamber. The external contour is preferably formed prior to sizing and finishing the internal chamber, but in some instances, as for example in forming a thin side wall part, or a part in which the thicknesses of the walls may be varied, it is desirable to form, size and finish the chamber first and thereafter to form the external contours of the part.

We claim:

The method of making a receptacle for a pyrotechnic filling, comprising forming a body having a bore of uniform diameter and terminating in an end wall having a central small opening, forming a plug having at one end a stem of substantially the same diameter as the central small opening and having an enlarged central portion the peripheral surface of which is a section of a sphere, the diameter of which is larger than the diameter of the aforesaid bore and the hardness of which is greater than that of the body, and forcing said plug with said stem foremost through the bore until the enlarged central portion engages said end wall and its stem enters the opening, said enlarged central portion during its passage through the bore cold-working and hardening the wall of the bore, the surface reaction of the body causing the bore-wall to spring back into the bore and lock the plug in place.

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