March 9, 1954 M. H. ARMS 2,671,297

METHOD OF FINISHING INTERNAL BORES

Filed April 6, 1951

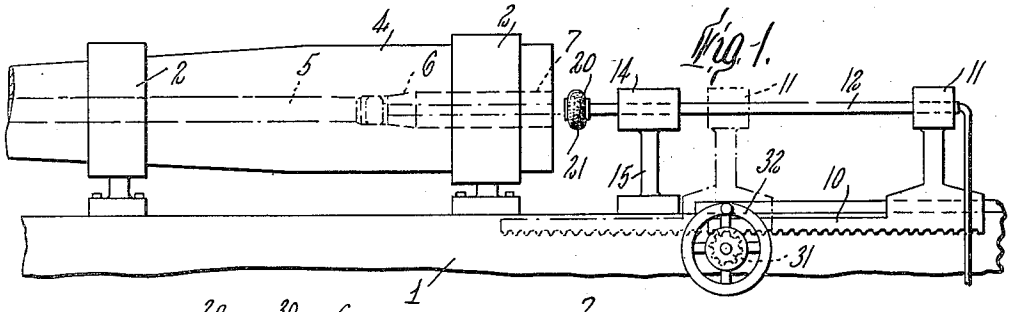


Fig. 1.

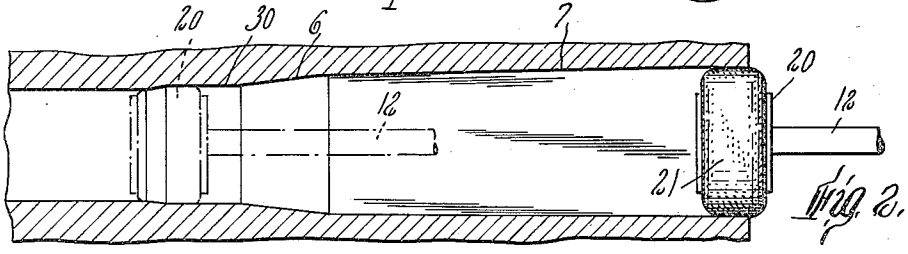


Fig. 2.

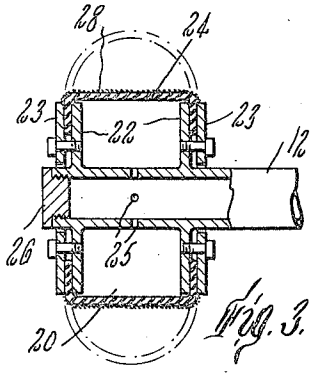


Fig. 3.

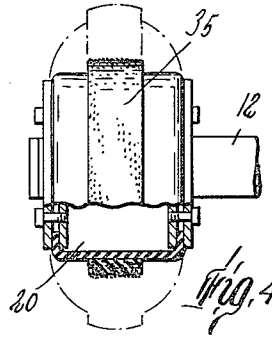


Fig. 4.

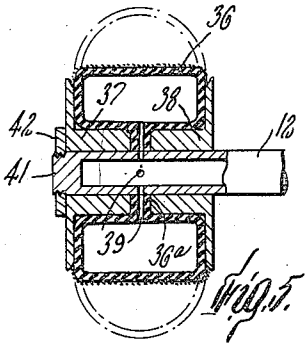


Fig. 5.

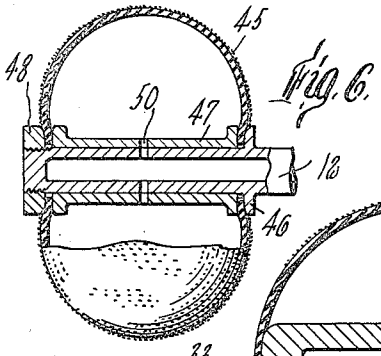


Fig. 6.

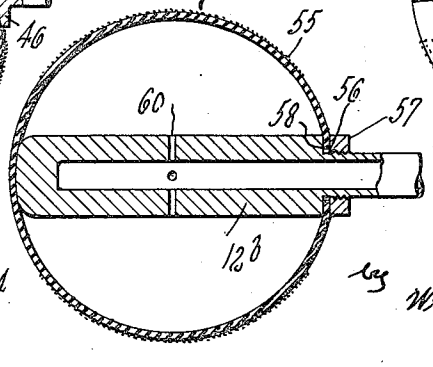


Fig. 7.

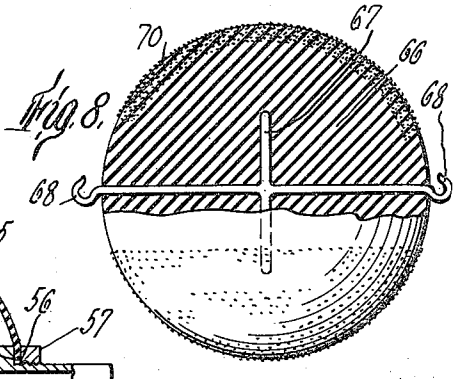


Fig. 8.

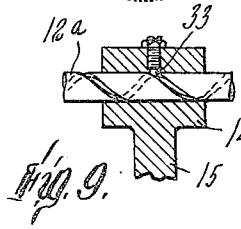


Fig. 9.

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Patented Mar. 9, 1954 2,671,297

UNITED STATES PATENT OFFICE

2,671,297

METHOD OF FINISHING INTERNAL BORES

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Application April 6, 1951, Serial No. 219,745

4 Claims. (Cl. 51—290)

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In the finishing of internal bores, high accuracy and excellent finish may be obtained by grinding, but in grinding by the rotation of a grinding wheel, fine circular marks are made by the grains of abrasive material used. While such marks may be very fine, for some articles as where relative axial motion between the members containing the bores and some contacting member is to be effected, grain lines are undesirable, particularly grain lines in the bore which are transverse to the direction of the bore axis. Examples of this are engine cylinders and gun barrels. In the case of gun barrels explosion of the charge expands the cartridge case into irregularities of the gun cartridge chamber, thus indenting complemental irregularities in the surface of the case. If these irregularities are transverse to the bore, the interengagement thereof makes it difficult to remove the empty case. Since, also, gun cartridge chambers are often made tapering axially, which further complicates the problem, this invention will be described with particular reference thereto, though it should be understood that it is not limited to gun barrels.

For a complete understanding of this invention, reference may be had to the accompanying drawings in which

Figure 1 is a somewhat diagrammatic front elevation of a machine for operating on gun barrel cartridge chambers.

Figure 2 is a central longitudinal sectional view of a gun barrel cartridge chamber illustrating the method used in the finish grinding.

Figure 3 is a central sectional view through a grinding element which may be employed.

Figure 4 is a view partly in side elevation and partly broken away and in section of a modified construction of grinding element.

Figures 5 to 8, inclusive, are sectional views showing further modifications.

Figure 9 is a view similar to a portion of Figure 1, but showing a modification.

Referring to Figure 1, at 1 is indicated a machine bed having a pair of supports 2 for receiving a work piece, herein shown as a gun barrel 4, and having an axial bore 5. Toward its rear end this axial bore 5 is of increased internal diameter tapering sharply in the axial zone 6 and less sharply in the axial zone 7, which extends from the end of the zone 6 to the open rear end of the barrel. At 10 is shown a carriage mounted on the bed 1 for motion lengthwise of the gun barrel. It is provided at its rear end with an upstanding support 11 into which may be secured the rear end of a pipe 12. This pipe is slidably

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guided through a bearing 14 of a post 15 secured to the bed 1 of the machine, so that as the carriage 10 is moved axially, the pipe 12 is also moved axially. This pipe at its forward end carries a body 20, preferably expansible, and which is provided with an abrasive surfacing 21. By motion of the carriage 10 relative motion between the body 20 and the work piece axially of the work piece is produced. This body is of a diameter normally larger than the bore to be finished, but is deformable to enter this bore.

One construction of such a body is shown in Figure 3 wherein the forward end of the pipe 12 is provided with spaced flanges 22 against the outer faces of which are clamped, as by clamping rings 23, a flexible and extensible strip 24 which may be of rubber or rubber-like material. The pipe 12 leads into the space betwen the flanges 22, as through the openings 25, and its forward end is closed off as by means of a threaded plug 26. By introducing fluid under pressure through the pipe 12, the strip 24 may be stretched so that its outer face, which is covered by abrasive grains 28, may take an enlarged diameter configuration shown in dash and dotted lines in Figure 3. When such a body is introduced into the bore 7, as shown in Figure 2, fluid pressure within the body causes its external face to expand as far as permitted by the size of the bore 7, thus pressing the abrasive surface of the member 24 into contact with the inner wall of the work piece. As the body is moved into the bore, it will be noted that the body is deformed inwardly but at all times its abrasive outer surface maintains tight engagement with the interior wall of the bore, the body being so formed that it can expand and contract throughout the full range of variations in internal diameter of the taper portion. For example, as shown in Figure 2 in dotted lines, the body has been pushed through the sharply tapered portion 6 and into the substantially parallel portion 30 of the gun barrel. By maintaining a desired fluid pressure within the body, its abrasive periphery may be kept pressed against the internal wall of the bore with as great pressure as may be desired, and it will be noted that under such conditions the traversing motion of the body within the work piece will produce grain lines running axially of the work bore.

In the finishing of a bore in this manner, preferably the bore is first ground to size by a rotating grinding wheel as is well known in the art, and after the bore has been ground to the size and finish desired, the rotary grinding wheel is removed from the bore and the work piece is subjected to the axial motion of the body 20 to

change the circular grain lines resulting from the effects of the rotary grinding wheel to longitudinal or axial lines. Thus whenever a cartridge is exploded in the gun and the casing is expanded into the slight irregularities of the inner wall of the cartridge chamber, since these slight irregularities comprise longitudinally extending abrasive lines, this expansion affords little hold on the shell casing of the gun in directions to interfere with the axial removal of the shell casing therefrom.

As shown in Figure 1, the carriage 10 is provided with rack teeth with which mesh pinion teeth on a pinion 31 connected for rotation by a hand wheel 32. It will, of course, be evident that the work piece could be moved while the abrasive body remains stationary, producing the same results of the longitudinally extending abrasive scratches in the interior of the gun barrel. It is also apparent that the body could be rotated during its retraction, thus to produce spiral scratches on the work, if desired, as this will not materially hinder the extraction of a used cartridge case which can be rotated as it is being moved axially out from the gun barrel. This, for example, could be done by externally threading the pipe 12*a* and providing a follower 33 on the guide member riding between the threads, as shown in Figure 9. It will be noted that the axial motion of the abrasive body is substantial in amount relative to any rotational motion given to it, this being in contrast to the usual grinding treatment where the tool rotates at a relatively high rate and is traversed at a much slower rate, it being a primary purpose of this invention to produce any abrasive scratches in the final bore extended primarily axially.

Instead of forming the expansible and contractible body as shown in Figure 3, it might be made as shown in Figure 4, in which the abrasive is carried entirely by an expansible ring 35 within which the hollow body 20 is positioned, fluid pressure within this hollow body expanding the ring 35 into contact with the interior wall of the work piece.

In Figure 5 a further modification is shown in which the expansible body comprises a tubular ring 36 which has an inner flange 36*a* clamped between flanged collars 37 and 38 upon the pipe 12. Suitable radial holes 39 through the flange 36*a* provide an access to the interior of the body from the interior of the pipe. The other end of the pipe may be closed off as a 41 and this portion may be externally threaded for the reception of a nut 42 by which the outer collar flange may be held in position.

In Figure 6 a further modification is shown in which the side margins of an expansible strip 45 are clamped between a flange 46 of the pipe, a flange collar 47, and a nut 48 threaded on the outer end of the pipe member 12. Ports 50 lead through the pipe and the collar 47 into the interior of the body and provide access for fluid pressure directed into the pipe 12.

In Fig. 7 a still further modification is shown in which a generally spherical expansible body 55 has the inner end portion of the pipe member 12*b* projecting thereinto through an open neck portion 56. A nut 57 threaded on the pipe adjacent to the annular shoulder 58 of the pipe clamps the margin of the member 55 at its opening through which the pipe is extended against the shoulder 58. Openings 60 leading outwardly from the bore of the pipe and within the member 55 provide access for the fluid pressure which maintains the member 55 expanded.

In Figure 8 a still further modification is shown in which no outside fluid pressure supply is necessary, the body comprising a ball of readily compressible material such as sponge or foam rubber at 66 and having embedded therein a suitable anchor member 67 supporting the hooks 68 by which the ball may be grasped and be pulled axially through the bore. This ball is surfaced with abrasive as at 70 and is suitable where the amount of taper, if there be any, of the bore to be finished, is not sufficiently large to prevent close engagement of the abrasive material against the wall of the bore.

From the foregoing description of certain embodiments of this invention it should be evident to those skilled in the art that various further changes and modifications may be made without departing from the spirit or scope of this invention.

I claim:

1. The method of finishing a tapered bore, which comprises traversing said bore with an abrasive body contacting therewith throughout its circumference to leave grain marks in the wall of said bore extending generally longitudinally thereof.

2. The method of finishing a tapered bore, which comprises grinding the wall of said bore with rotary motion to leave generally circular grain marks about the axis of said bore, and then traversing said bore with an abrasive body contacting therewith throughout its circumference sufficiently to remove said circular grain marks and substitute grain marks extending generally longitudinally thereof.

3. The method of finishing a tapered bore, which comprises traversing said bore with an expanding and contractible body of a size to fill the cross sectional area of said bore throughout its desired length for finishing, said body having an abrasive external surface for contact throughout its circumference with the wall of said bore.

4. The method of finishing a tapered bore, which comprises traversing said bore with a diametrically expansible and contractible hollow body of a size to fill the cross sectional area of said bore throughout its desired length for finishing, while maintaining internal pressure within said body sufficient to cause it to engage the wall of said bore throughout its circumference, said body having an abrasive external surface for contact throughout its circumference with the wall of said bore.

MERTON H. ARMS.

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