The invention will be understood from the attached drawing wherein:

Fig. 1 illustrates, partly in section, an apparatus capable of carrying out the process;

Fig. 2 is a cross-sectional view on the line 2—2 of Fig. 1, looking in the direction of the arrows;

Fig. 3 is a cross-sectional view on the line 3—3 of Fig. 1, looking in the direction of the arrows;

Fig. 4 is a cross-sectional view showing the chamber and throat portion of the tube and a portion of the mandrel utilized for that purpose; and

Fig. 5 illustrates a modification of the process and apparatus.

In said drawing, the numeral 10 designates generally a mandrel of relatively hard material provided, in the form shown, with raised helically disposed ribs 11 of any suitable form, construction and dimensions which may be required for the production of the grooves or other configuration desired within the tube to be made. The numeral 12 designates generally a tube partly compressed upon the mandrel. As will be noted in Fig. 2, the tube 12 is originally of such an internal diameter as to just receive the mandrel 10 and ribs 11. The tube is now compressed upon the mandrel by any suitable means such as swaging or by pushing or drawing the mandrel and tube one or more times through a compressing die. If a swaging machine is used the mandrel with the tube therein is simply passed through the swaging machine which delivers a very large number of blows or squeezes upon the tube to cause it to be contracted and to lie in close proximity to the mandrel at all points so that it assumes an internal configuration the reverse of the mandrel. The result of such a compressing operation is indicated in Fig. 3. It will be noted that the external diameter of the tube has been slightly reduced to supply the material which has been caused to flow between the ribs 11. One apparatus for producing this effect is shown, more or less schematically, in Fig. 1, wherein the member 13 may be understood to be the tool chuck of an ordinary broaching machine to which the mandrel 10 may be attached by any suitable means as by the key 14. 15 represents a compressing die which may be formed of one or more working surfaces. In the form shown the section 15a, is more or less chamfered to facilitate the entry of the uncompressed tube into the die. Section 15b, indicates the approximately conical compressing section wherein the tube is contracted from its original external diameter to its original external diameter.
final external diameter. Section 25 is preferably cylindrical and serves as a burnishing die. The die 15 may be held in any usual die holder as used in broaching machines for internal broaching, and if desired, may be provided with an anti-friction thrust bearing, as bearing balls 16, located in grooves in the die 15 and the annular member 17, which may be formed with a cylindrical extension 18 and locking ring 19 to keep the parts in assembled relationship. If desired, positive gearing or other connecting means may be provided to rotate the die in accordance with the lead of the rifling, or in such direction and at such speed as may be desirable to secure the best results under any particular circumstances. In the form of apparatus shown, it is desirable to have a collar or bushing 20 located upon the mandrel of a diameter at least as small as the finished diameter of the tube so that the entire tube can be drawn through the die. Furthermore, an abutment, such as the collar 21, should be provided which may be attached to the mandrel by any suitable attaching means such as the key 22. In carrying out the process, the mandrel would preferably be removed from the chuck 13 of the drawing head, the collars 20 and 21 put in place and thereupon the tube slipped over the mandrel. Thereafter the forward end of the mandrel is passed through the die and inserted into chuck 13 and clutched in place, it being understood that at this time the chuck 13 is in its extreme left position and quite close to the die. At this time the forward end of the tube is ready to enter the die. The machine is now started and the mandrel with tube thereon is slowly drawn through the die until the entire length of the tube has passed through the die. Thereupon the collar 21 may be removed and the die removed from its holder. If it is desired to use the same machine to withdraw the mandrel from the tube the machine is reversed and the chuck 13 returned to its original position, the mandrel removed from the chuck and a plain cylindrical stripping die substituted for the die shown. This collar will have an internal diameter just large enough to clear the rib 11. Thereupon the machine is started and the mandrel withdrawn from the tube. If a split stripping die is used it will not be necessary to remove the mandrel to enter the chuck. As the mandrel is withdrawn the tube and mandrel must be rotated relative to each other. This may be provided for by an anti-friction thrust bearing or by positive gearing or other means for rotating the die relative to the mandrel.

If the cartridge body is not much larger than the diameter of the bore, as is the case, for example, in .22 caliber ammunition, it is possible to use this process for forming not only the barrel proper, but also the chamber and throat. In this case, the rear portion of the mandrel is made as shown in Fig. 4, with an enlarged section 10, for producing the chamber and also with a conical section 10, for forming the throat.

In the drawing the dimensions of the height of ribs 11 have been somewhat exaggerated in order to make the drawing more clearly understood. In practice the depth of grooves is usually proportionately less than shown.

In the form shown in Fig. 1, the force required to pass the tube through the die is transmitted through the mandrel 18. As in small caliber guns the mandrel may be of small diameter; it is sometimes desirable to avoid this. Furthermore, in the form of Fig. 1, the tube is in compression which is not usually desirable. These objections are overcome in the form of apparatus shown in Fig. 5 wherein the mandrel is not subjected to either tension or longitudinal compression. With the use of this form of apparatus the tube is preferably first slightly reduced its forward end, as shown at 12B, by any usual method and apparatus, such as an ordinary swaging machine. The forward portion 12B of the reduced section is attached to the drawing 10 head of the machine by any suitable means such as by being clamped into the clamping jaw clutch 13B carried by the drawing head of the machine. The section 12B of the reduced section is of sufficient length to permit the passing of the tube 15 through the die and into the clamping clutch when the clutch is returned to a position adjacent the die. The mandrel 10B is merely laid more or less loosely within the tube. With this apparatus the tube is under considerable tension 20 which improves the reducing operation. In this case an abutment such as the collars 28 and 21 of Fig. 1 is not necessary. After the tube was passed through the die the mandrel will be withdrawn preferably by applying tension to the end 25 10B thereof. The forward end of the tube 12B is, of course, unusable and will be cut off.

The resulting rifled tube is of rather small wall thickness and can, therefore, not always be used as the barrel of a firearm. In such cases, the tube, made as described above, may be inserted into a larger tube of appropriate wall thickness so that the two tubes together will comprise the barrel proper.

Barrels for certain uses, particularly for machine guns, wear out rather rapidly and as a result must be thrown away and new barrels substituted. By using tubes made according to the present invention, it is merely necessary to withdraw the rifled tube and insert a new one in its place.

However, it is not always essential that such rifled tube be inserted into another tube, as these relatively thin walled tubes may, in some cases, be used without a surrounding and confining tube, as for example, as barrels of air guns or in many connections where an internally rifled or otherwise grooved tube of relatively small wall thickness is required. Among other uses of the invention are the production of bearing bushings with oil grooves. While in the form illustrated the internal configuration of the tube produced comprises helical grooves formed by the helical ribs 11, it is to be understood that other configuration may be produced which is of the nature that the mandrel may be withdrawn from the tube. While preferred forms of the invention have been illustrated and described above, it will be apparent that changes and modifications may be made in the form of apparatus and in the steps of the process without departing from the spirit and scope of the invention.

What is claimed is:

1. The process of forming helical grooves in a rifle barrel liner, comprising the steps of placing a thin tube upon a mandrel formed with helical ribs, and thereupon pulling said tube and mandrel together through a reducing die, whereby the tube is swaged down upon the mandrel and its interior surface is formed with helical grooves and thereupon removing the mandrel from the tube.

2. The process of making a rifle barrel formed with internal helical grooves and an enlarged..
chamber section, comprising the steps of placing a tube upon a mandrel formed with helical ribs and an enlarged chamber forming section, and thereupon passing said tube and mandrel through a reducing die by applying tension to the tube, whereby the tube is compressed upon the mandrel and its interior surface is formed with helical grooves and an enlarged chamber section, and removing the mandrel from the tube.

3. The process of rifling the interior surface of thin tubes comprising the steps of reducing the diameter of said tube at one end, placing said reduced end into the chuck of a drawing machine, placing within said tube a mandrel formed with a reversed rifling, and thereupon pulling said tube and mandrel together through a reducing die, whereby the tube is compressed upon the mandrel and its interior surface formed with the desired rifling, removing the mandrel from the tube and cutting off the reduced end portion.

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