Oct. 22, 1957 A. SIMONS 2,810,185

RIFLING GUN BARRELS

Filed June 28, 1954 4 Sheets-Sheet 1

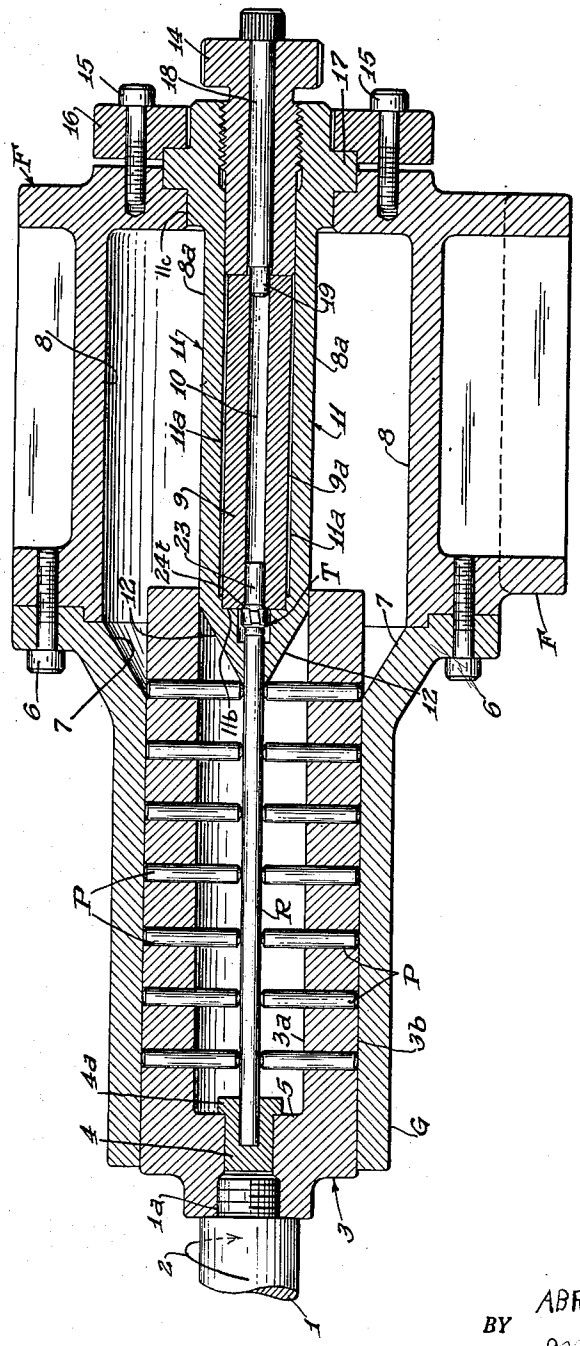

FIG. 1.

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RIFLING GUN BARRELS

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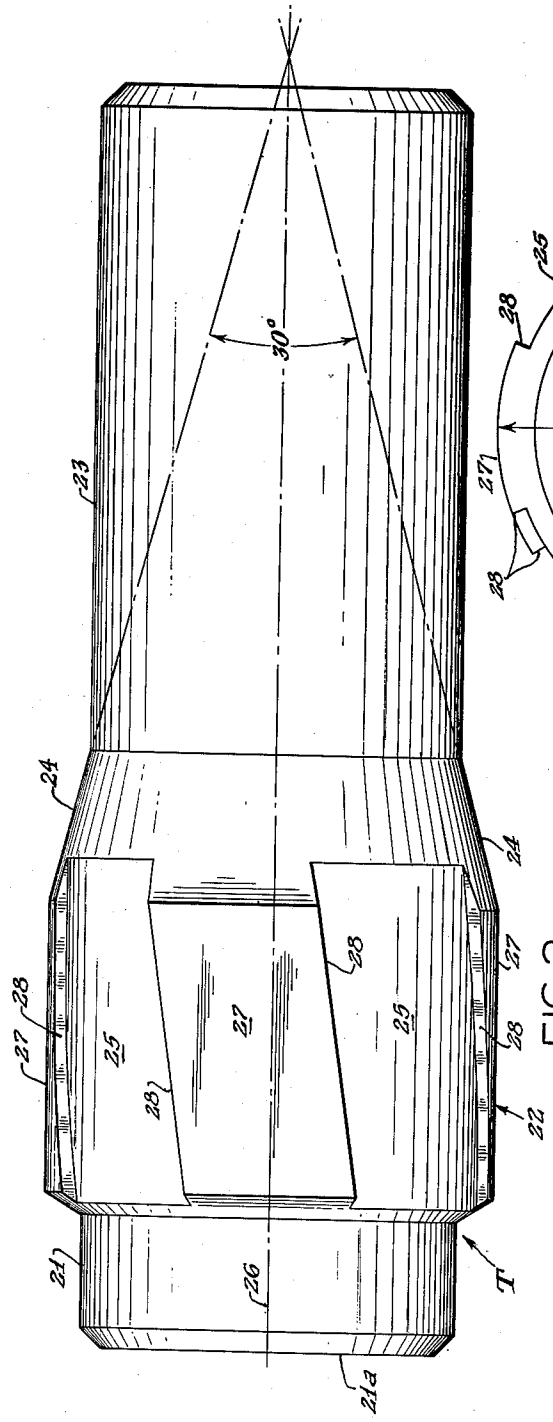

FIG. 2.

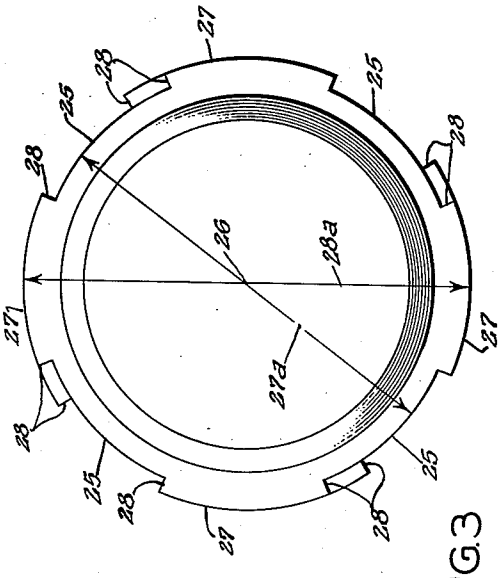

FIG. 3

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RIFLING GUN BARRELS

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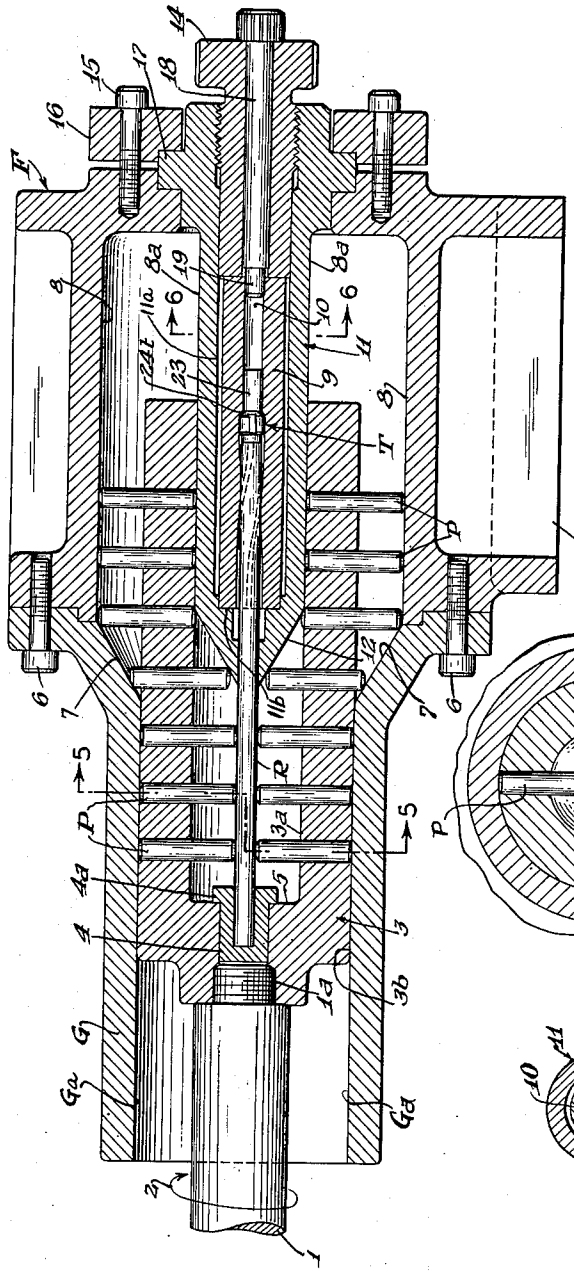

FIG. 4.

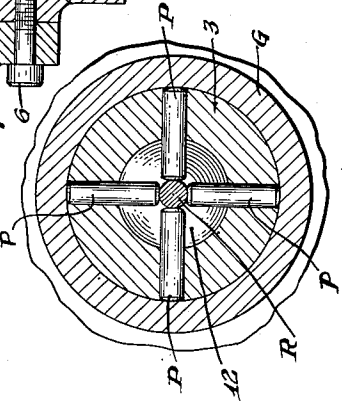

FIG. 5.

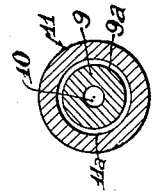

FIG. 6.

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RIFLING GUN BARRELS

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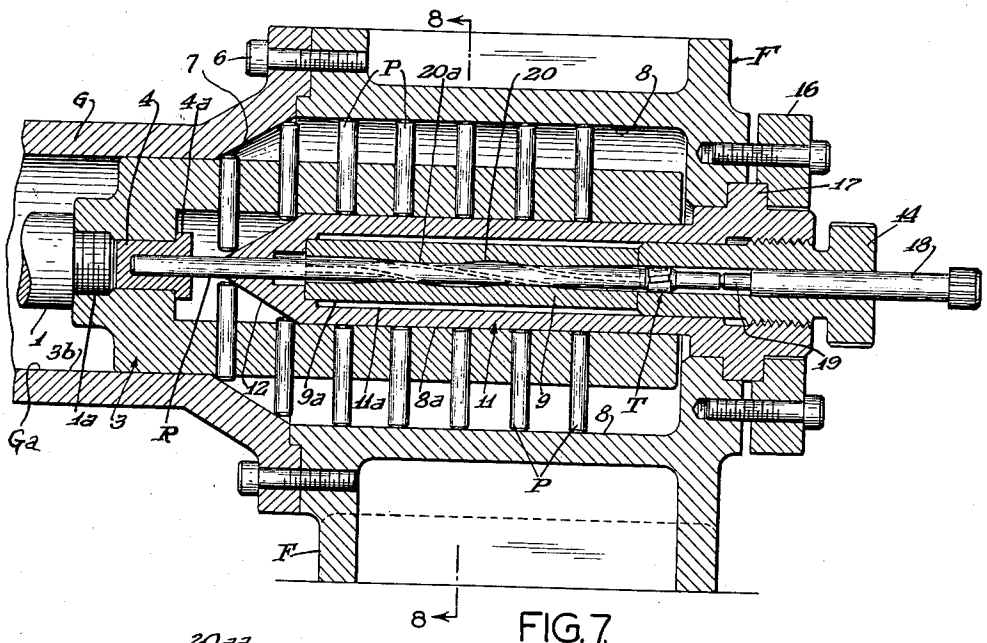

FIG. 7

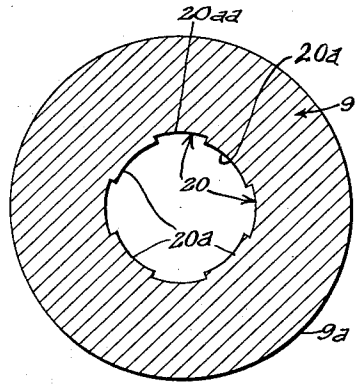

FIG. 9

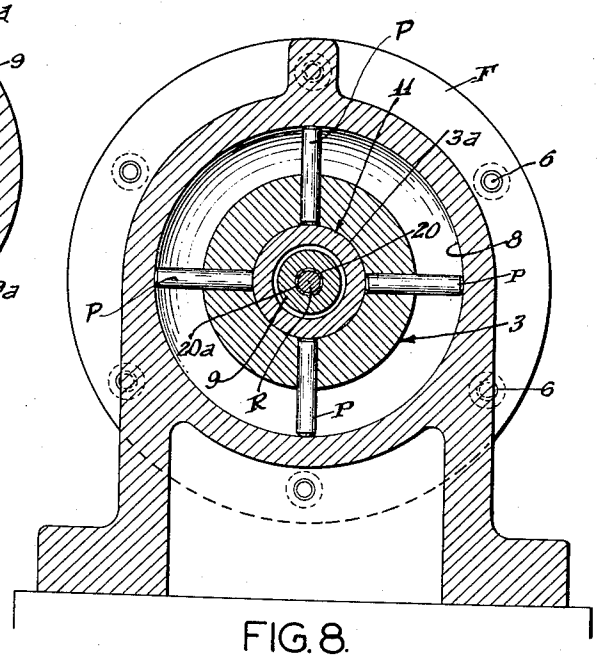

FIG. 8

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United States Patent Office 2,810,185
Patented Oct. 22, 1957

2,810,185

RIFLING GUN BARRELS

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Application June 28, 1954, Serial No. 439,797

3 Claims. (Cl. 29—1.1)

This invention relates particularly to rifling a gun barrel.

The invention includes a new and improved rifling method; a new and improved rifling machine; a new and improved rifled gun barrel; and a new and improved rifling tool.

Heretofore, in order to rifle a gun barrel, the general practice has been and is to drill a longitudinal bore in a metal blank. This drilled bore is substantially cylindrical, with surface irregularities which result from the use of the drill.

The next operation is to remove some of the material at the face of the bore, by the use of a reamer. This operation slighly increases the diameter of the drilled bore, and it makes the drilled bore more smooth and accurate.

The helical rifling grooves are then formed in the face of the reamed bore. This is done by cutting or otherwise removing the material of the blank at the face of the bore, along spaced helical zones or areas, with the use of broaches or other metal-removing tools. The rifling grooves are separated from each other by intermediate faces of the original reamed bore. These intermediate faces have the shape which results from the reaming. These intermediate faces are generally designated as "lands."

In the more expensive rifles, the rifling grooves and intermediate faces are finished by a cutting or polishing operation, as by a lapping tool, in order to make the rifling grooves and the intermediate faces or lands more smooth and accurate.

According to this invention, the rifled bore can be formed and finished in a single operation, thus greatly reducing the cost of manufacture. A better rifled bore is also produced.

According to this invention, the original blank may be provided with the usual initial longitudinal drilled hole, which is substantially cylindrical, with surface irregularities which result from the operation of the drill.

The helical rifling grooves and the helical intermediate faces or "lands" of the rifled bore are then formed in a single operation by pressure-shaping, without cutting away or removing the original material of the hollow blank in any other manner.

As one example, and for purposes of convenient explanation, the outer longitudinal wall of the drilled blank may be cylindrical.

The pressure-shaping which rifles the bore may not substantially change the original shape of the outer longitudinal wall of the drilled blank. The change in the original shape of said outer longitudinal wall of the drilled blank may be imperceptible, or so slight as to be immaterial.

The pressure-shaping increases the original density of the metal or alloy or other material of the hollow blank. This increase in density is a maximum at the faces of the rifling grooves and at the intermediate faces or "lands"

of the rifled bore. This increase in density diminishes towards the outer longitudinal wall of the rifled blank. The increase in density may result in some increase in hardness. The increase in density at and adjacent the faces of the rifling grooves and adjacent the intermediate faces or "lands," is desirable, because it increases the life of the rifled bore.

The pressure is exerted outwardly from the face of the bore towards the outer longitudinal wall of the drilled blank. This outward pressure is exerted upon helical zones or areas of the drilled bore, which correspond to the desired helical rifling grooves. Some outward pressure may be exerted upon the helical zones or areas which correspond to said intermediate faces or "lands" of the rifled bore. The outward pressure thus reshapes the original drilled bore, in order to pressure-shape the rifling grooves and the intermediate walls or "lands" in a single operation, thus reducing the cost of rifling.

The rifled blank has substantially the same volume as the original hollow blank, because the increase in original density produces only a slight change in the original volume.

The hollow blank may be at ordinary room temperature of 20° C.– 30° C. at the beginning of the rifling operation. The pressure-shaping may be conducted slowly, so that the resultant rise in the original temperature of the blank is insignificant.

The shaping pressure which rifles the bore, is not applied simultaneously along the entire length of the bore. On the contrary, the shaping pressure is always applied only to a section or part of the bore. The axial length of this pressure-applying section or part of the bore is only a small fraction of the entire axial length of the bore. This pressure-applying section is shifted axially and longitudinally from one end of the bore to the other end of the bore.

As part of a single operation, the original diameter of the original drilled bore is laterally enlarged directly preceding the application of the groove-forming, in the same single stroke of the improved tool. Said original diameter of the original bore is thus enlarged to provide an internal tapered face of the bore of the blank, directly in front of the application of the groove-forming pressure, so that the rifling grooves are formed initially in said internal tapered face. Said internal tapered face of the bore is also progressively longitudinally formed by pressure which is longitudinal and which is outwardly directed towards the outer longitudinal wall of the drilled blank.

The method can be practiced by many different machines.

The invention is further disclosed in the annexed description and drawings, which illustrate a preferred embodiment of the improved machine and improved tool.

Fig. 1 is a longitudinal vertical section, partially in elevation. It shows the parts of the machine and the blank at the beginning of the rifling operation.

Fig. 2 is an enlarged elevation of the improved tool.

Fig. 3 is an end-view of Fig. 2, at the left side of Fig. 2.

Fig. 4 is similar to Fig. 1, showing the tool in termediate the ends of the original bore.

Fig. 5 is a section on the line 5—5 of Fig. 4.

Fig. 6 is a section on the line 6—6 of Fig. 4.

Fig. 7 is similar to Fig. 1, showing the tool forced out of the blank, at the end of the rifling operation.

Fig. 8 is a section on the line 8—8 of Fig. 7.

Fig. 9 is a cross-section of the rifled bore which results from a rifling operation according to this invention.

The invention applies, if only a single internal rifling groove is formed along the entire length of the face of the bore of the blank, or along only a part of said bore.

In this example, four identical helical rifling grooves **20** of uniform pitch are formed. The rifled bore has four identical helical faces or "lands" **20***a* between said grooves **20**.

The machine comprises a front shaft **1** which is simultaneously moved longitudinally and turned around the axis of said shaft. The arrow **2** indicates the direction in which shaft **1** is turned in this example. The shaft **1** may be turned in the reverse direction. The relation between the longitudinal movement of shaft **1** and its turning movement, is exactly the same as the uniform pitch of the rifling grooves **20**.

A reduced and threaded extension **1***a* of shaft **1** is screwed into an internally threaded socket of a carrier **3** which has longitudinal inner and outer walls **3***a* and **3***b* of cylindrical shape.

These walls **3***a* and **3***b* have a common longitudinal axis, which is coincident with the common longitudinal axis of shaft **1**, cylindrical rod R, axis **26** of tool T, the longitudinal axis of the original bore **10** of the original hollow blank **9**, and the cylindrical walls **8** and **8***a*. In this example, the original hollow blank **9** has an outer cylindrical wall **9***a*, whose longitudinal axis is also coincident with said common longitudinal axis. The original bore **10** may be a drilled bore.

The carrier **3** is moved longitudinally and turned in exact unison with shaft **1**.

The outer cylindrical wall **3***b* of carrier **3** fits closely and slidably and turnably in the longitudinal cylindrical wall G*a* of a fixed guide G, whose flange is fixed by members **6** to the fixed frame F of the machine.

The shaft **1** is made of metal of suitable strength, so that it can apply the necessary high pushing force to the cylindrical push-rod R, through the plug **4**, which has an enlarged head **4***a*. This plug **4** is made of hard and rigid metal or alloy. Its shank is fixed rigidly in a longitudinal cylindrical bore of carrier **3**, so that plug **4** is moved longitudinally and turned in exact unison with shaft **1** and carrier **3**. The left or front end of push rod R, which is also made of hard and rigid metal or alloy, is rigidly fixed to plug **4**, so that rod R is moved longitudinally and turned in exact unison with shaft **1**, plug **4** and carrier **3**.

In many cases, the cylindrical rod R must be long and of small diameter.

The caliber of a rifle is the diametral distance between two diametrically opposed "lands" or intermediate walls or faces **20***a* of the rifled bore. As one example, the length of the distance between the median points of two diametrically opposed intermediate faces or "lands" **20***a* may be 0.30 inch or approximately 7.50 millimeters, corresponding to 30 caliber. In such case, the length of the bore **10** of blank **9** may be 30 inches or approximately 750 millimeters. In such case, the diameter of rod R must be substantially 7.50 millimeters, and its length in advance of plug **4** must exceed 750 millimeters, in order to force the tool T from its initial position of Fig. 1 to its final position of Fig. 7.

The longitudinal thrust which is exerted on rod R by shaft **1** through plug **4** may be as high as 80,000 pounds per square inch, or approximately 284 kilograms per square millimeter. In such case, the long and slender rod R, whose diameter is only 0.30 inch or 7.50 millimeters in this example, may be subjected to a longitudinal thrust as high as approximately 5600 pounds or approximately 12.320 kilograms. This high thrust will buckle the long free part or advance part of rod R out of straight shape, even if rod R is made of strong and hard material, such as the steel which is used to make a drill.

Hence the pins P are a very important part of the invention, because they prevent the rod R from buckling in advance of the holder **11**, in which the original blank **9** is held fixed during the operation of the machine.

In this example, there are four longitudinal rows of the pins P, which are made of strong and hard material, such as the steel which is used to make a drill. In this example, the pins P are arranged in lateral sets, with four laterally alined and radially located pins P in each set. These longitudinal rows of pins P are equally angularly spaced by angles of 90°, as shown in Fig. 5 and Fig. 8.

Each pin P fits closely and slidably in a respective radial bore of the carrier **3**, so that the pins P are moved longitudinally and are turned in exact unison with the carrier **3** and the rod R. Said pins P support rod R and keep rod R straight up to the front tapered and frustoconical wall **12** of the fixed holder **11** and the corresponding tapered wall **7** of the fixed guide G.

Each pin P is rounded at each end thereof. In advance of the wall **12** of holder **11**, the inner end of each pin P closely abuts the cylindrical rod R, and the outer end of each pin P closely abuts the cylindrical wall G*a* of the fixed guide G, thus closely supporting rod R and keeping it straight. The outer ends of pins P slide readily on the cylindrical wall G*a* of the fixed guide G.

The longitudinal spacing between adjacent pins P is sufficiently small so that the pins P provide sufficient abutments for rod R in advance of the holder **11**, to prevent rod R from bending out of accurate straight longitudinal shape. This longitudinal spacing depends upon the diameter and length of the free part of rod R. The longitudinal spacing of pins P may be greater in the case of a rod R of large diameter, and the pins P must be longitudinally close to each other if rod R is of small diameter. In many cases, it is sufficient if the longitudinal spacing of pins P is one inch or approximately 25 millimeters.

The rod R fits closely and slidably in the bore of the holder **11** which is provided at wall **12**. The rod R also fits closely and slidably between the four intermediate walls or "lands" **20***a*, thus preventing the buckling of rod R in the bore of holder **11** at wall **12** and also in the final rifled bore.

Hence the rod R is kept straight in the rifled part of the bore **10**, as the rifling progresses from one end of the bore **10** to the other end thereof.

The carrier **3** can be made of bronze or other bearing metal of low friction, so that the hard and strong steel pins P can slide easily in the radial bores of carrier **3**. The hard and strong plug **4**, which abuts or is very close to the end of the extension **1***a* of shaft **1**, is provided to take up the longitudinal thrust and the turning force of the shaft **1**, and to apply said thrust and turning force directly to rod R, thus eliminating excessive stress on carrier **3**.

As above noted, the blank **9** is the original blank. This blank **9** is held rigidly in the fixed holder **11**, so that blank **9** is not shifted longitudinally or turned in holder **11**. This holder **11** has an inner longitudinal cylindrical wall **11***a*. The blank **9** has an outer and longitudinal wall **9***a*, which is cylindrical in this example. The holder **11** has a longitudinal outer wall **8***a* of cylindrical shape. The inner cylindrical wall **3***a* of carrier **3** fits closely and slidably and turnably on the outer fixed cylindrical wall **8***a* of the fixed holder **11**.

Adjacent the initial position of tool T which is shown in Fig. 1, the holder **11** has a vertical and planar wall **11***b*, against which the planar adjacent wall of blank **9** fits tightly. In this example, this part of holder **11** also has a short cylindrical wall, of smaller diameter than cylindrical wall **11***a*. The adjacent part of the outer cylindrical wall **9***a* of blank **9** fits tightly in this short cylindrical wall, so that blank **9** is always accurately centered at its front in the holder **11**. The outer wall **9***a* of blank **9** may be of smaller diameter than inner wall **11***a* of holder **9**, to provide a slight clearance between walls **9***a* and **11***a*. As above noted, there may be a small increase in the diameter of wall **9***a* of blank **9**, as the result of the rifling pressure, and this slight clearance is provided for this purpose. In some cases, the entire inner wall **11***a*

of the holder **11** may be of uniform diameter up to its vertical planar front wall **11***b*, and the entire outer wall **9***a* of the blank **9** may fit closely in wall **11***a*.

The blank **9** is held fixed against longitudinal movement and turning movement in holder **11**, by means of a clamping plug **14**, whose shank has a cylindrical part which fits slidably and closely in the cylindrical wall **11***a* of holder **11**. The shank of plug **14** also has a threaded part, and the bore of holder **11** has a corresponding threaded part, so that clamping plug **14** can be screwed tightly into holder **11** to exert sufficient longitudinal pressure upon blank **9**, so that friction prevents the blank **9** from turning in holder **11**.

The holder **11** has another longitudinal cylindrical wall **11***c*, which fits closely in a corresponding longitudinal cylindrical wall of the fixed frame F of the machine. The holder **11** also has a flange or head **17**. A clamping collar **16** and clamping members **15**, clamp the head **17** of holder **11** to frame F, so that holder **11** is held against turning relative to frame F.

The blank **9** is thus prevented from turning while the tool T is longitudinally shifted and turned around its axis **26**.

The tool T has a rear cylindrical guide shank **23** which fits closely and slidably and turnably in the original cylindrical bore **10** of blank **9**.

Tool T has a head **22**. In this example, the tool T has four high walls or high faces **27**, and four recesses **25**. In this example, the four high faces **27** are parts of a cylinder whose axis is the longitudinal axis **26** of tool T, and whose diameter is the larger diameter **28***a* of Fig. 3. In this example, the four recesses **25** are identical, and they have the same width and depth from end to end. Each recess **25** is open at each end thereof.

Each recess **25** has two edges **28**. The longitudinal shape of each recess **25** is the shape of a part of the helix of a respective intermediate face or "land" **20***a* of the rifled bore, so that each edge **28** has a part-helical shape.

That is, after the rifled bore has been formed by a tool T, said tool T can be moved through said rifled bore, while turning the tool T around its axis **26** in proper ratio to the longitudinal movement of tool T, corresponding to the pitch of the rifling grooves **20**. In such case, the high faces **27** of the tool T will interfit with and move through the rifling grooves **20**, and the recesses **25** of the tool T will interfit with and move along and in contact with the intermediate faces or "lands" **20***a* of the rifled bore, while the tool T is moved completely through the rifled bore.

In this example, and without limitation thereto, the shape of the high faces **27** of tool T, in each lateral plane which is perpendicular to axis **26** of tool T, is the shape of a part of a circle which is concentric with axis **26**, and which has the greater diameter **28***a* of Fig. 3; and the shape of the inner wall of each recess **25**, in each said vertical lateral plane, is the shape of a part of a circle which is concentric with said axis **26** and which has the smaller diameter **27***a* of Fig. 3. While the tool T is operated by being longitudinally shifted and turned around its axis **26**, said axis **26** is coincident with the axis of the original bore **10** and with the axis of the finished rifled bore. This axis **26** is the common axis of shanks **23** and **21** of tool T.

Hence, in this example, referring to Fig. 9, each line **20***a* is part of a circle which is concentric with the axis of the rifled bore, and which has the larger diameter **28***a* of Fig. 3; and each line of Fig. 9 which represents a face or "land" **20***a*, is part of a circle which is concentric with the axis of the rifled bore, and which has the smaller diameter **27***a* of Fig. 3.

Intermediate the shank **23** and head **22**, the tool T has a tapered wall **24**, which has a frusto-conical shape. The broken lines in Fig. 2 indicate the internal angle of the cone of which the frusto-conical wall **24** is a part. In this example, said internal angle is 30°.

As above noted, the cylindrical guide shank **23** of tool T fits closely and slidably and turnably in the original bore **10**. The function of the tapered wall **24** is to enlarge the front end of the original bore **10** progressively as the tool T is moved in its simultaneous longitudinal and turning movement through the original bore **10**, so as to provide a tapered and frusto-conical enlargement **24***t* at the front part of the bore of blank **9** which has not yet been reshaped from its original cylindrical shape by wall **24**.

The recesses **25** extend into a part of said frusto-conical wall **24**, as shown in Fig. 2, and said recesses **25** also extend into the rounded junction between the head **22** and cylindrical shank **21** of tool T. Said shank **21** has a front planar and vertical wall **21***a*, against which the rear vertical and planar wall of rod R abuts while the tool T is operated. These vertical abutting walls may be smooth.

For convenience, the longitudinal axis of the machine is shown as being horizontal but the invention is not limited to this position of said axis.

A cylindrical centering pin **18** fits closely and slidably in a cylindrical bore of clamping plug **14**. This pin **18** has a cylindrical centering extension **19**, which fits closely and slidably in the rear part of original bore **10**. This centering pin **18** remains in the centering position of Fig. 1, until the guide shank **23** contacts with the end of centering extension **19**, at about the end of the rifling operation. The shank **23** then slides the centering pin **18** to its final position which is shown in Fig. 7, which evidences the end of the rifling operation. The tool T is then located wholly in the bore of plug **14**. The high faces **27** of the tool T may fit closely and slidably in the cylindrical bore of clamping plug **14**.

The operation is as follows:

The wall of the original bore **10** is provided in the usual manner with a very thin lubricating film of metallic copper, if a gun barrel is to be rifled. This film of copper is produced by precipitation or by electro-deposition in the well-known manner. This operation, like many other well-known operations which may precede or follow the rifling operation, is not described, because this invention relates to the rifling operation.

The rear guide shank **23** of tool T is inserted into the front end of the original bore **10**, while the blank **9** and tool T are out of holder **11**. The pre-assembled tool T and blank **9** are then inserted into the holder **11**. There is a clearance between head **22** and the adjacent longitudinal inner and cylindrical wall of the holder **11**. The clamping plug **14** is then screwed into its position of Fig. 1, thus clamping blank **9** in holder **11**, so that blank **9** cannot turn or shift in any manner. The centering pin **18** is inserted into the position of Fig. 1.

At this time, the shaft **1**, carrier **3** and rod R are approximately in the positions of Fig. 1. The rear-end part of rod R is located in the bore of holder **11**. The longitudinal axis of bore **10** is coincident with axis **26** of tool T, and the common axis of shaft **1** and rod R.

The rear set of four laterally alined rear pins P is close to the frusto-conical front wall **12** of holder **11**.

The shaft **1** is now forced longitudinally and rearwardly by any suitable mechanism, such as by a hydraulic press, and the shaft **1** is simultaneously turned around its axis by any suitable mechanism. The hydraulic press and the turning mechanism for turning shaft **1** are not shown, because they are well-known.

Shaft **1**, rod R, carrier **3**, its pins P, and tool T are moved longitudinally and simultaneously turned in exact unison, without any angular slip.

Due to the construction of tool T, it is automatically turned around its axis **26** to produce rifling grooves **20** of the selected pitch, even if tool T is subjected only to a longitudinal thrust. The pitch of a rifling groove is long, so that tool T requires only a slight turning movement relative to its longitudinal movement.

The rod R also provides a turning force on tool T, due to the friction between the adjacent faces of rod R and shank **21**. This frictional turning force on tool T may be substantial, due to the high longitudinal pressure between the rear vertical face of rod R and the front vertical face **21***a* of shank **21**. For this reason, the relation of the turning movement of rod R to the longitudinal movement of rod R is exactly the same as the selected pitch of the rifling grooves **20**.

The rod R and shank **21** may be fixed to each other by releasable fastening means, but this is not ordinarily necessary or even possible.

The tapered bore-enlargement **24***t* is thus progressively formed at the front end of the original bore **10**. The axial length of bore-enlargement **24***t* is obviously much less than the axial length of bore **10**. The diameter of shank **21** is less than the original diameter of bore **10**.

As above noted, the rear ends of the recesses **25** of tool T extend into the tapered wall **24** of tool T, and said recesses are optionally and preferably open at their respective ends, and said recesses **25** may be of equal width and of equal depth from end to end.

The unrecessed part of the tapered wall **24** subjects the metal or alloy or other material of blank **9** to considerable outward shaping pressure, in advance of the recesses **25**. One of the functions of this unrecessed part of tapered wall **24** is to provide a smooth and tapered frustoconical shoulder **24***t*, thus eliminating any surface irregularities which may be caused by the prior drilling operation, if the original bore **10** is formed by a drill. The invention is not limited to drilling the original bore **10**. Another function of the unrecessed part of tapered wall **24** is to subject the adjacent part of the material of blank **9** to permanent compression, so as permanently to increase the density of said adjacent part of said material.

The wall of blank **9**, between its outer face **9***a* and the bore **10**, is optionally sufficiently thick so that said outer face **9***a* retains its original shape, or substantially retains its original shape, during the entire rifling operation. The longitudinal movement and turning movement of tool T additionally permanently compresses the material of the blank at the high faces **27**, thus forming and shaping the rifling grooves **20** by the pressure of said high faces **27**, and permanently increasing the density of the material of the blank at the faces of said rifling grooves **20**. The recesses **25** form and shape the "lands" **20***a*, and said recesses **25** also permanently compress the material of the blank adjacent said "lands" **20***a*, thus permanently increasing the density of the material at said faces **20***a*.

As above noted, said permanent increase in original density is a maximum at the inner wall of the rifled bore which is shown in Fig. 9, and said permanent increase in original density diminishes towards the outer face **9***a* of blank **9**. Said permanent increase in original density is zero or negligible at the outer face **9***a* of the rifled barrel as the result of the rifling operation.

At the end of the pressure rifling operation, the weight of the rifled barrel is the same or substantially the same as the weight of the original blank, because little or no material is removed from the original blank. In contrast, when the rifling is formed by the old method, the weight of the rifled barrel is less than the weight of the original blank, the difference being the weight of the material which is removed to form the rifling grooves.

As the result of the one-step improved pressure-rifling operation, further finishing of the rifled bore is optional, and usually unnecessary.

At the beginning of the operation, the rod R cannot buckle in front of holder **11**, because this is prevented by the supporting pins P. The example shows four longitudinal rows of pins P, but there may be more than four rows.

As the rod R is moved longitudinally rearwardly or to the right, as viewed in Fig. 1, each set of four pins P slides in succession outwardly and radially away from the rod R. This is done by the tapered wall **12**, which has the same taper as wall **7**. The pins P fit between tapered walls **12** and **7**, and also between the cylindrical walls **8** and **8***a*. This fit need not be a tight fit.

In the rifled part of the bore, the high faces **27** fit closely in the rifling grooves **20**, and there is a close fit between the recesses **25** and the intermediate walls or "lands" **20***a*.

As above noted, the rod R fits closely and slidably between the intermediate faces or "lands" **20***a* of the rifled bore, so that the rod R is prevented from buckling within the rifled bore.

The rifling operation may be slow. Thus, it may be done in a period of eight to ten minutes, in rifling a steel barrel whose length is 750 millimeters, and whose rifled bore is 30 caliber.

At the end of the rifling operation, the tool T is located wholly in the clamping plug **14**. This plug **14** is then unscrewed and removed from holder **11**, thus removing the tool T from the machine.

The shaft **1** is then moved reversely or to the left, thus removing the rod R from the rifled bore. When the rod R is thus removed from the rifled bore, the movement of shaft **1** and rod R may be only longitudinal, or shaft **1** and rod R may be turned reversely to their original turning movement, with the same relation of turning movement to longitudinal movement.

The rifled blank or barrel can then be easily removed from the holder **11**.

If the rifled barrel has a length of 30 inches or approximately 750 millimeters, and its rifled bore is to have 30 caliber, the following dimensions illustrate one working example:

Length of blank **9**: 30 inches or approximately 750 millimeters.

Original diameter of bore **10**: 0.280 inch or approximately 7.00 millimeters.

Diameter of guide shank **23**: 0.278 inch or approximately 6.95 millimeters.

Larger diameter **28***a*: 0.306 inch or approximately 7.65 millimeters.

Smaller diameter **27***a*: 0.30 inch or about 7.50 millimeters. Hence the depth of each rifling groove **20** is 0.003 inch or approximately 0.075 millimeter in this example. This depth may be increased or decreased, depending upon the selected design.

Diameter of wall **9***a*: 1.25 inches or approximately 31.25 millimeters. Hence the thickness of the wall of the original blank is 0.97 inch or approximately 24.25 millimeters.

These factors will vary, depending upon the original bore of the blank, the selected caliber, and the material of the blank, etc.

The above example applies generally to a steel gun barrel of the "30–30" type, of 30 caliber, whose length is 30 inches.

The rifling period is 8–10 minutes. The blank is at 20° C.–30° C. prior to and during the rifling period.

Under the above mentioned conditions, the increase in the original diameter of the outer wall **9***a* of the original blank **9** is insignificant. Such increase is usually imperceptible. It may be in a range of 0.003 inch (approximately 0.075 millimeter) to 0.005 inch or approximately 0.125 millimeter.

In this example, as above noted, the original diameter of bore **10** is approximately 7.00 millimeters. This is permanently pressure-enlarged to approximately 7.65 millimeters at the rifling grooves **20**, and to approximately 7.50 millimeters at the intermediate faces or "lands" **20***a*.

As above noted, the depth of the rifling grooves **20** may be increased by increasing the larger diameter **28***a*.

The depth of the rifling grooves **20** depends upon the design and caliber of the rifle, so that such depth can be varied. While preferred, the invention is not limited

to a pressure-shaped rifled barrel whose outer face has the original shape of original outer face **9***a* of the original blank.

The invention is not limited to the use of a blank which has an initial bore of cylindrical shape.

The scope of the invention includes every hollow body which has an internal face and one or more internal pressure-shaped helical grooves in said internal face, in which the weight of said hollow body, as the result of the groove-shaping operation, is substantially the same as the weight of the blank from which said hollow body was pressure-shaped.

The pressure-shaped rifling grooves **20** need not be identical, and the lands **20***a* need not be identical. Each high face **27** pressure-shapes a respective rifling groove **20** and each recess **25** pressure-shapes a respective land **20***a*. Hence it is within the scope of the invention to provide the tool T with different respective high faces **27** for pressure-shaping different rifling grooves **20**, and with different respective land-shaping grooves **25** for pressure-shaping different lands **20***a*.

All the factors described herein depend upon the caliber of the rifled bore and the material of the blank. The twist or pitch of the rifling grooves also depends upon the caliber of the rifle, so that the drawings are wholly diagrammatic in showing the pitch.

Also, the invention is not limited to pushing the tool through the bore of the original blank. The tool T may be shifted longitudinally through the bore of the original blank while the tool is turned, in any manner and by any means. The tool T may be forced through the bore **10** by liquid or grease under high pressure.

It is noted that the volume of the pressure-shaped body may be substantially equal to the volume of the original blank. The slightly lower volume of the pressure-shaped body may result solely from the increase in the original density of the original material. This is in sharp contrast with the volume of a rifled or grooved body which has been grooved by the use of a broach or other material-removing tool, in which the difference in volume between the grooved body and the original volume of the original body, is equal or substantially equal to the volume of the groove or grooves which are formed.

As above noted, the original blank is preferably cold-worked as at 20° C.–30° C., during the pressure-shaping operation, so that if the original material of the original blank consists of a metal or alloy, the properties of said original material are not changed substantially by cold-pressing at 20° C.–30° C. or at other suitable low temperature, save for the cold-working effect.

The cold-pressing of a steel blank is defined as pressing below the critical thermal range of the respective steel. As is well-known, the cold-working of steel increases its yield strength and tensile strength and reduces its ductility. It is therefore desirable to limit these effects of cold-working to substantially the inner face of the pressure-shaped rifle bore of a steel barrel. The hot-working of steel usually takes place in a range of 1093° C. to 1426° C. The critical thermal range of steel depends upon its composition.

After the metal or alloy blank has been rifled, the rifled barrel may be subjected to any heat-treating operation or operations or other operations.

Likewise, the metal or alloy blank or other blank may be subjected to any operation prior to the rifling operation, so that the initial hollow blank can be reshaped by using a tool T of high-speed steel or other material which is harder than the metal or alloy or other material of the blank **9**, in order to make pressure-reshaping possible, especially at the cold-working temperature of the respective metal or alloy.

I have disclosed a preferred embodiment of my invention, but numerous changes, omissions and additions and substitutions can be made without departing from its scope.

I claim:

1. A rifling machine which has a frame and which includes a shaft which has a longitudinal axis, said shaft being longitudinally movable and being turnable around said axis, a straight cylindrical push-rod which extends in front of said shaft, said push-rod and shaft being coaxial, the rear end of said push-rod being rigidly connected to said shaft to move in unison with said shaft in the longitudinal and turning movements of said shaft, a hollow carrier, said push-rod being located in the interior of said hollow carrier, said carrier being rigidly connected to said shaft to move in unison with said shaft in the longitudinal and turning movement of said shaft, a fixed carrier-guide in which said carrier is located, said carrier being longitudinally movable and turnable relative to said carrier-guide, said carrier guide having radial sockets, slidable supporting pins located slidably in said sockets, said pins having inner ends which abut said push-rod, said pins having outer ends which abut said carrier-guide, said pins being provided in angularly disposed sets which hold said push-rod straight against buckling force, a hollow blank-holder located in front of said push-rod, said blank-holder having a front guide longitudinal bore at the end of said blank-holder which is proximate to said shaft, said cylindrical push-rod having substantially the same diameter as said guide-bore, said machine having displacing means for laterally shifting said pins away from said push-rod at the front end of said blank-holder, said blank-holder having a blank-holding portion which is located rearwardly of said guide bore, said blank-holder having an intermediate hollow portion intermediate said guide-bore and said blank-holding portion, said intermediate guide portion being shaped to enclose a rifling tool which is movable longitudinally rearwardly by said push rod.

2. A machine according to claim 1, in which said displacing means consists of respective tapered walls of said blank-holder and said guide-carrier, said blank holder and the fixed frame of said machine have laterally adjacent cylindrical walls rearwardly of said tapered walls, the lateral distance between said cylindrical walls being at least equal to the lengths of said pins.

3. A machine which has a frame and which includes a shaft which has a longitudinal axis, said shaft being longitudinally forwardly movable and being also turnable about said axis, a straight push-rod which extends in front of said shaft, said push rod and shaft being co-axial, means connecting the rear end of said push rod rigidly to said push shaft to move the push rod in unison with said push shaft in the forwardly longitudinal and in the turning movements of said shaft, a hollow carrier, said push rod being located in the interior of said hollow carrier, said carrier being rigidly connected to said shaft to move in unison with said shaft in the longitudinal and turning movement of said shaft, a fixed carrier-guide in which said carrier is located, said carrier being longitudinally forwardly movable and being also turnable relative to said carrier guide, said carrier guide having radial sockets, slidable supporting pins located slidably in said sockets, said pins having inner ends which abut said push rod, said pins having outer ends which abut said carrier guide, said pins being adapted to hold said push rod straight against said buckling force, and means to move said pins radially outwardly away from said push rod during the forward stroke of said push rod.

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