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(54) RIFLED BARREL OF A FIREARM

BÜCHSENLAUF EINER SCHUSSWAFFE

CANON RAYÉ D'UNE ARME À FEU

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EP 3 742 103 B1

Description

Field of application

[0001] In its more general aspect, the present invention relates to the field of firearms.

[0002] In particular, the present invention relates to a rifled barrel of a firearm such as particularly, but not exclusively, a rifle and the like, characterized by a new rifling profile therein having a curvilinear trend.

[0003] The present invention also relates to a method for producing a rifled barrel as above.

Prior art

[0004] As it is known, the barrels of firearms, such as for example rifles and the like, are usually manufactured from a solid piece of steel or other metal. In traditional machining operations, a central hole is obtained by drilling through the centre of the barrel using for example a drilling equipment with a straight-flute drill and the external profile of the barrel is thus obtained by means of an appropriate operating machine. The size of the initial hole is generally slightly greater than the calibre of the barrel of the firearm when the barrel is manufactured by hammering. Thus, in the context of the manufacture of rifled barrels, twisting grooves are formed inside the barrel to create a rifling pattern. The rifling pattern inside the barrel confers a rotation to the projectile or to the bullet which is fired. The rifling makes the projectile rotate around the longitudinal axis thereof, so stabilizing the flight of the projectile and improving the aerodynamic stability thereof and the precision. The rifling is provided inside the barrel as equidistant projections (or lands) separated by grooves (or voids) along the circumference of the barrel. The projections are designed to keep the contact with the sides of the projectile while it is projected along the barrel, so imparting a rotation to the projectile which leaves the muzzle of the firearm.

[0005] The rifling inside the barrel can be made by various methods, particularly by cold hammering or plastic deformation.

[0006] Figure 1 shows a more common kind of conventional rifling, adopted inside a barrel of a firearm, which is globally indicated with the reference number 1. The rifling 1 is composed of projections 2 and grooves 3 with relatively pointed edges which grip the projectile surface. The top and the side walls of the projections 2 can be substantially at a right angle to each other or alternatively the top can form with the side walls an angle which is greater than the right angle.

[0007] Figure 2 shows another kind of conventional rifling, globally indicated with the reference number 10, which is characterized by the fact that it has a polygonal profile in cross section.

[0008] Although the rifling referred to in Figure 1 which is universally adopted by almost all the manufacturers is substantially suitable from the functional point of view, it has the drawback of an important friction between the internal rifled profile of the barrel and the sides of the projectile while the latter is projected along the barrel, because of the presence of edges between the projections (lands) and the grooves (voids). This involves that the projectile is substantially notched and subject to high stresses on it and moreover it increases the wear of the rifled barrel with subsequent reduction of the useful service life thereof.

[0009] Another drawback of the above-described conventional riflings lies in the fact that the projectile doesn't succeed in fastly sealing the hole of the barrel when the latter is being crossed. This involves a forward leak of the propellant gas in the first section of the barrel and consequently a reduction of the muzzle speed of the projectile. This drawback is particularly important for conventional polygonal-profiled riflings because of the fact that this configuration has edges which are difficult to fill by the projectile which crosses the barrel. Moreover, it should be pointed out that the technology which is most used at present to manufacture the rifling of the barrels is cold hammering, but this technology is not particularly suitable for creating riflings with sharp edges as required by traditional-profiled riflings.

[0010] US 3,786,589 discloses a barrel for rifles and pistols equipped with lands and grooves, wherein the greatest measure of the groove calibre of the barrel corresponds to the minimum measure of the diameter of the projectile, and the land calibre amounts to about 96 percent of the groove calibre.

[0011] US 3,643,364 discloses a rifled barrel intended for use with small arms, particularly in combination with steel-jacketed soft-core ammunition having no special rotating bands provided on the exterior thereof, which barrel has a cross-sectional configuration such that the interior surface of the barrel defines a regular polygon with rounded sides and corners, which corners form the rifling in the barrel wall and represent arc segments spaced uniformly about the interior surface and having a common radius of curvature, the rounded sides of the polygon extending between the rounded corners and representing arc segments having a common radius of curvature of lesser magnitude than the first-mentioned radius of curvature, the transitional regions between adjacent arc segments having different radii of curvature being continuous.

[0012] US 2015007479 discloses a gun barrel comprising a bore traversing the length of the barrel; a plurality of lands, each of said plurality of lands having a predefined height and a top surface; a plurality of grooves on the surface of the bore, each sequential pair of said plurality of grooves being separated by one of the plurality of lands; and a trailing edge face on each one of said plurality of lands; wherein each of the plurality of lands has a land top to trailing edge ratio of no greater than 1:8.

[0013] DE 20002361 U1 discloses a barrel with an inner profile having a polygonal shape and without sharp edges.

[0014] The main aim of the present invention is hence to provide a rifled barrel for a firearm such as a rifle or the like, which is satisfactory from the functional point of view without having the drawbacks mentioned above with reference to the prior art.

[0015] Another aim of the present invention is to provide a rifled barrel for a firearm as indicated above which can be manufactured in a simple way and at low cost and particularly suited to the manufacture by cold hammering.

Summary of the invention

[0016] These aims are achieved by a barrel for a firearm according to claim 1.

[0017] The barrel comprises a hole extended along a longitudinal axis of the barrel and delimited by an internal surface, wherein said internal surface has a closed curvilinear profile in cross section comprising concave projections (lands) having a first radius of curvature which are alternated with concave grooves (voids) having a second radius of curvature which is different from said first radius of curvature.

[0018] The concave projections are connected to the concave grooves in an alternate sequence along the closed curvilinear profile of the internal surface of the barrel.

[0019] Preferably, the concave grooves have a first radius of curvature having an origin on the longitudinal axis of the barrel and a set length preferably corresponding to half of the dimension provided in the standards by the C.I.P. (Permanent International Commission for the Proof of Small Arms) where it is called "F", according to the selected calibre.

[0020] The concave projections have a second radius of curvature which is bigger than said first radius of curvature of the concave grooves. In particular, the second radius of curvature of the concave projections originates from a point which is diametrically misaligned with respect to the point from which the first radius of curvature of the concave grooves originates.

[0021] According to an embodiment of the present invention, the curvilinear profile in cross section of the internal surface of the barrel has an even number of projections (rifling lands) and the projections and the grooves are arranged in diametrically opposed pairs, i.e. the projections are opposed to the projections and the grooves are opposed to the grooves along the above curvilinear profile.

[0022] According to another embodiment of the present invention, the curvilinear profile in cross section of the internal surface of the barrel has an odd number of projections and the projections and the grooves are not diametrically opposed to each other. This embodiment has the additional advantage that the projectile is better driven in the rotary path thereof inside the barrel due to the fact that it meets in opposed positions grooves and respective projections rather than pairs of opposing projections like in barrels with even riflings.

[0023] The rifled barrel according to the invention is particularly suitable for use on a firearm, such as in particular a rifle, intended for sports or competitive use. Nevertheless, the rifled barrel according to the invention is not limited to such a use.

[0024] The above aims are also achieved by a method for producing a barrel as above, wherein the concave projections and the concave grooves are formed by rotary hammering along the profile of the internal surface of the barrel.

[0025] Further features and advantages of the present invention will be apparent from the following description of some preferred embodiments, said description being given by way of non-limiting example with reference to the attached figures.

Brief description of the figures

[0026] In the figures:

- Figure 1 shows a cross-sectional view of a rifled barrel for a firearm according to an embodiment of the prior art;
- Figure 2 shows a cross-sectional view of a rifled barrel for a firearm according to another embodiment of the prior art;
- Figure 3 shows a cross-sectional view of a first embodiment of the present invention;
- Figure 4 shows a cross-sectional view of a second embodiment of the present invention;
- Figure 5 shows a cross-sectional view of a third embodiment of the present invention.
- Figure 6 schematically shows in cross section a portion of the first section of a rifled barrel according to Figure 1 at the projectile forcing cone.
- Figure 7 schematically shows in cross section a portion of the first section of a rifled barrel according to the invention at the projectile forcing cone.

Detailed description

[0027] Figures 1 and 2 show each a rifled barrel according to an embodiment of the prior art which has already been described above.

[0028] With reference to Figure 3, a rifled barrel according to a first embodiment of the present invention is globally indicated with the reference number 30.

[0029] The rifled barrel 30 has a substantially cylindrical tubular shape having an external surface 31, an internal surface 32 and a substantially central hole 33 delimited by the internal surface 32, the hole 33 being extended along the longitudinal axis of the barrel substan-

tially on the whole length of the barrel 30.

[0030] The internal surface 32 has a plurality of projections (lands) 35 and a plurality di grooves (voids) 36 wherein the projections 35 and the grooves 36 are alternated with each other.

[0031] In accordance with the present invention, the internal surface 32 has a closed curvilinear profile in cross section wherein the projections (lands) 35 and the grooves (voids) 36 are both concave and are alternately connected to each other.

[0032] More particularly, each groove 36 is shaped as an arc of a circle having a first radius of curvature R1 which originates from an origin point O located on the longitudinal axis X of the barrel 30. The first radius of curvature R1 has a set length which preferably corresponds to half of the dimension in the standards provided by the C.I.P. (Permanent International Commission for the Proof of Small Arms) where it is called "F" which varies according to the selected calibre.

[0033] Differently, each projection 35 is shaped as an arc of a circle having a second radius of curvature R2 which is bigger than the first radius of curvature R1 of the grooves 36. More in detail, the second radius of curvature R2 of the projections 35 originates from a point which is diametrically (or radially) misaligned with respect to the point O located on the longitudinal axis X from which the first radius of curvature R1 of the grooves 36 originates and which can be considered as located on a circumference C (shown in dotted lines in Figure 3) of a circle having the origin in the point O on the longitudinal axis X of the hole 33 of the barrel 30.

[0034] According to the invention, the measure (length) of the second radius R2 which defines the arc of each projection 35 is defined based on the following criteria

1) the double of the distance between the midpoint of the arc 35 defined by the second radius R2 and the origin point O of the first radius R1 must correspond to the dimension "F" of the above C.I.P. standards; and

2) the internal area of the hole in the cross-section thereof is equal to the area provided by the C.I.P. standards where it is indicated as "Q".

[0035] The determination of the measure (length) for the first radius of curvature R1 of the grooves 36 and/or of the measure (length) for the second radius R2 of the projections 35 using the conditions as above based on the above-mentioned parameters of the C.I.P. standards allows to absolutely guarantee the shooter's safety and the integrity of the weapon in the use of commercial ammunition.

[0036] In particular, the consideration of the internal area of the barrel hole based on the "Q" value which is uniquely determined by the C.I.P. standards allows to determine the volume of bullet that will be deformed, which has a very high impact on the way in which the pressures develop and on their maximum peak with important consequences in terms of safety of use of the firearm.

[0037] Differently, in the rifled barrels of the prior art, such as those disclosed in US 3786589, the greatest measure of the grooves corresponds to the minimum measure of the diameter of the projectile, and the land measure amounts to 96 percent of the grooves measure.

[0038] However, the dimensions for the rifled barrels determined with the above parameters for lands and grooves are not able to guarantee the safety of the shooter using a commercial ammunition.

[0039] Moreover, the dimensions of the projections 35 and of the grooves 36 are defined by the above-described geometric calculation and by the number that the person skilled in the art decides to apply according to contingent and specific requirements and/or in order to obtain the best possible performances.

[0040] The rifling of the barrel according to the invention, that is the multi-radial curvilinear profile of the internal surface of the hole of the barrel, can be manufactured in a simple way and preferably by cold rotary hammering which advantageously ensures a better geometric consistency of the profile of the rifling along the whole barrel.

[0041] In the embodiment depicted in Figure 3, the barrel 30 is equipped with five projections 35 wherein each projection 35 joins two consecutive grooves 36 along the internal surface 32 of the barrel 30.

[0042] Figures 4 and 5 show respective rifled barrels for a firearm according to further embodiments of the invention which are globally indicated with the reference number 40 and 50, respectively.

[0043] The elements of the rifled barrel 40 or 50 which are structurally and/or functionally equivalent to corresponding elements of the above-described rifled barrel 30 will be assigned the same reference numbers as the latter and they will not be further described for the sake of conciseness.

[0044] The rifled barrel 40 substantially differs from the above-described barrel 30 in that it is equipped with six projections wherein each projection joins two consecutive grooves along the internal surface of the barrel.

[0045] Differently, the rifled barrel 50 substantially differs from the above-described barrel 30 in that it is equipped with seven projections wherein each projection joins two consecutive grooves along the internal surface of the barrel.

[0046] It should be noted that in the riflings with an even number of projections, as in Figure 4, the projections are opposed to the projections and the grooves are opposed to the grooves. Vice versa, in the riflings with an odd number of projections, as in Figures 3 and 5, the projections tend to be opposed to the grooves and vice versa.

[0047] A portion of the first section di a rifled barrel according to Figure 1 and one of a rifled barrel according to the invention respectively at the projectile forcing cone are schematically shown in cross section in Figures 6

and 7.

[0048] It can be noted that in the case of the rifled barrel of Figure 1 the forcing cone turns out to be narrower because of the presence of the square-profiled projections. This involves, among other things, that the projectile 60 is driven to a lesser extent during the insertion into the barrel and it can thus be inserted into the barrel according to a direction not coinciding with the axis of the barrel.

[0049] Vice versa, in the case of the rifled barrel according to the invention, the absence of square-profiled projections 2 and their replacement with curvilinear-profiled projections 35 which are alternated with grooves 36 which are also curvilinear involves obtaining a bigger forcing cone which allows the projectile 60 to be inserted in a simpler and more reliable way in the riflings, causing the axis of the projectile to better align with the longitudinal axis of the barrel.

[0050] In view of the above, the rifled barrel for a firearm according to the invention achieves the set aims and it obtains several advantages with respect to the rifled barrels of the prior art.

[0051] As a matter of fact, due to the fact that the projections follow a curvilinear concave and not right profile with a radius of curvature which is greater than the radius of curvature of the grooves, the rifled barrel according to the invention allows the sliding surface of the projectiles to be deformed to a lesser extent. In particular, projectiles are slightly deformed according to alternated arcs of a circle having two different radii and not being notched as in the riflings of conventional barrels, hence avoiding high stresses to the projectiles themselves. This advantageously allows the deposits of residues (copper for example) inside the barrel to be reduced, the other conditions being the same, thus requiring less frequent and much-easier-to-perform cleaning operations. As a consequence, because of the different geometry of the resulting forcing cone, the rifled barrel for a firearm according to the invention has a bigger useful service life with respect to the above-described conventional rifled barrels. This makes the barrel according to the invention particularly suitable for use in automatic and semi-automatic weapons.

[0052] The smaller deformation of the projectile achieved by the rifled barrel according to the invention also allows the speed of the outgoing projectiles (muzzle speed) to be increased for the same calibre of the barrel and the same dose of propellant. This increase in speed can be up to 8%. This is due to the fact that, due to the absence of edges in the rifling, in particular of edges that are impossible to fill as in polygonal riflings, the projectile succeeds in sealing much better the hole of the barrel limiting the forward leaks of gases and hence using the energy of the propellant in a more efficient way.

[0053] Moreover, the particular multi-radial geometry of the rifled barrel according to the invention also allows the dimension of the pattern to be reduced since the ball is inserted in a more precise and reliable way into the riflings, causing the axis of the projectile to better align with the longitudinal axis of the barrel. This allows the number of the so-called "flyers" to be reduced, that is of the anomalous shots out of the typical firearm pattern and not attributable to an error of the shooter.

[0054] A further advantage of the rifled barrel according to the invention lies in the fact that the absence of edges allows the barrel to be polished in an easier way simply using felt pads and a lapping paste. The polishing of the barrel potentially helps to improve the shot concentration.

[0055] A further advantage of the rifled barrel according to the invention lies in the fact that the particular geometric shape of the barrel allows the deposits of coating material of the projectiles (brass) in the barrel to be reduced.

[0056] A further advantage of the rifled barrel according to the invention lies in the fact that, due to the different geometry of the forcing cone, the latter will be subject to a lower erosion by the incandescent beam of the combustion flame of the propellant preserving the weapon accuracy (ability to group shots) for a much bigger number of shots.

Claims

1. Barrel (30;40;50) for a firearm comprising a hole (33) extended along a longitudinal axis (X) of the barrel and delimited by an internal surface (32), wherein said internal surface (32) has a closed curvilinear profile in cross section comprising concave grooves (36) having a first radius of curvature (R1) which are alternated with concave projections (35) having a second radius of curvature (R2) which is bigger than said first radius of curvature (R1) and **characterized in that** the second radius of curvature (R2) is defined based on the following criteria:

    1) the double of the distance between the midpoint of the arc (35) defined by the second radius (R2) and the origin point (O) of the first radius (R1) is equal the dimension in the standards provided by the Permanent International Commission for the Proof of Small Arms (C.I.P.) where it is called "F" according to the selected calibre; and
    2) the internal area of the hole in the cross section thereof is equal to the area provided by said C.I.P. standards where it is indicated as "Q" according to said selected calibre.

2. Barrel (30;40;50) according to claim 1, wherein the concave projections (35) are connected to the concave grooves (36) in an alternate sequence along the closed curvilinear profile of the internal surface of the barrel.

3. Barrel (30;40;50) according to claim 1 or 2, wherein the concave grooves (36) have a first radius of curvature (R1) having an origin point (O) located on the longitudinal axis of the barrel and a set length preferably corresponding to half of the dimension provided by said C.I.P. legislation where it is called "F", according to the selected calibre.

4. Barrel (30;40;50) according to any one of the previous claims, wherein the concave grooves (36) have a first radius of curvature (R1) having an origin point (O) located on the longitudinal axis of the barrel, wherein the second radius of curvature (R2) originates from a point which is diametrically misaligned with respect to the point (O) from which the first radius of curvature (R1) of the concave grooves (36) originates.

5. Barrel (30) according to any one of the previous claims, wherein the curvilinear profile in cross section of the internal surface of the barrel has an even number of projections (35), the projections (35) are arranged in diametrically opposed pairs and the grooves (36) are arranged in diametrically opposed pairs.

6. Barrel (40) according to any one of the previous claims 1 to 4, wherein the curvilinear profile in cross section of the internal surface of the barrel has an odd number of projections (35) and the projections (35) and the grooves are not diametrically opposed to each other.

7. A method for producing a barrel (30) according to any one of the previous claims, wherein the concave projections (35) and the concave grooves (36) are formed by rotary hammering along the profile of the internal surface (32) of the barrel (30).

Patentansprüche

1. Lauf (30; 40; 50) für eine Schusswaffe umfassend ein Loch (33), das sich entlang einer Längsachse (X) des Laufs erstreckt und durch eine innere Oberfläche (32) begrenzt wird, wobei die innere Oberfläche (32) im Querschnitt ein geschlossenes krummliniges Profil aufweist, das konkave Rillen (36) umfasst, die einen ersten Krümmungsradius (R1) aufweisen, die mit konkaven Vorsprüngen (35) abwechseln, die einen zweiten Krümmungsradius (R2) aufweisen, der größer ist als der erste Krümmungsradius (R1), **dadurch gekennzeichnet, dass** der zweite Krümmungsradius (R2) basierend auf den folgenden Kriterien definiert ist:

   1) das Doppelte des Abstands zwischen dem Mittelpunkt des Bogens (35), der durch den zweiten Radius (R2) definiert ist, und dem Ursprungspunkt (O) des ersten Radius (R1) ist gleich der Abmessung in den Normen, die durch die Ständige Internationale Kommission für die Prüfung von Handfeuerwaffen (C.I.P.) bereitgestellt werden, wobei der Wert entsprechend dem ausgewählten Kaliber als "F" bezeichnet wird, und
   2) die Innenfläche des Lochs ist in seinem Querschnitt gleich der Fläche, die durch die C.I.P.-Normen bereitgestellt wird, wobei sie entsprechend dem ausgewählten Kaliber als "Q" gekennzeichnet wird.

2. Lauf (30; 40; 50) nach Anspruch 1, wobei die konkaven Vorsprünge (35) mit den konkaven Rillen (36) in einer abwechselnden Sequenz entlang des geschlossenen krummlinigen Profils der inneren Oberfläche des Laufs verbunden sind.

3. Lauf (30; 40; 50) nach Anspruch 1 oder 2, wobei die konkaven Rillen (36) einen ersten Krümmungsradius (R1) aufweisen, der einen Ursprungspunkt (O), der sich auf der Längsachse des Laufs befindet, und eine Soll-Länge aufweist, die vorzugsweise der Hälfte der Abmessung, die durch die CIP-Rechtsvorschriften bereitgestellt wird, entspricht, wobei sie entsprechend dem ausgewählten Kaliber als "F" bezeichnet wird.

4. Lauf (30; 40; 50) nach einem der vorhergehenden Ansprüche, wobei die konkaven Rillen (36) einen ersten Krümmungsradius (R1) aufweisen, der einen Ursprungspunkt (O), der sich auf der Längsachse des Laufs befindet, aufweist, wobei der zweite Krümmungsradius (R2) von einem Punkt entspringt, der bezüglich des Punkts (O), von dem der erste Krümmungsradius (R1) der konkaven Rillen (36) entspringt, diametral versetzt ist.

5. Lauf (30) nach einem der vorhergehenden Ansprüche, wobei das krummlinige Profil im Querschnitt der inneren Oberfläche des Laufs eine gerade Zahl von Vorsprüngen (35) aufweist, wobei die Vorsprünge (35) in diametral gegenüberliegenden Paaren angeordnet sind und die Rillen (36) in diametral gegenüberliegenden Paaren angeordnet sind.

6. Lauf (40) nach einem der vorhergehenden Ansprüche 1 bis 4, wobei das krummlinige Profil im Querschnitt der inneren Oberfläche des Laufs eine ungerade Zahl von Vorsprüngen (35) aufweist und die Vorsprünge (35) und die Rillen einander nicht diametral gegenüberliegen.

7. Ein Verfahren zum Herstellen eines Laufs (30) nach einem der vorhergehenden Ansprüche, wobei die konkaven Vorsprünge (35) und die konkaven Rillen

(36) durch Drehhämmern entlang des Profils der inneren Oberfläche (32) des Laufs (30) gebildet werden.

Revendications

1. Canon (30 ; 40 ; 50) pour une arme à feu comprenant un trou (33) s'étendant le long d'un axe longitudinal (X) du canon et délimité par une surface interne (32), ladite surface interne (32) présentant un profil curviligne fermé en section transversale comprenant des rainures concaves (36) ayant un premier rayon de courbure (R1) qui sont alternées avec des saillies concaves (35) ayant un deuxième rayon de courbure (R2) qui est plus grand que ledit premier rayon de courbure (R1), et **caractérisé en ce que** le deuxième rayon de courbure (R2) est défini en fonction des critères suivants :

   1) le double de la distance entre le point milieu de l'arc (35) défini par le deuxième rayon (R2) et le point d'origine (O) du premier rayon (R1) est égal à la dimension présente dans les normes fournies par la Commission Internationale Permanente pour l'Épreuve des Armes Légères (*Permanent International Commission for the Proof of Small Arms,* C.I.P.) dans lesquelles elle est appelée « F » selon le calibre choisi ; et
   2) la surface interne du trou en section transversale de celui-ci est égale à la surface fournie par lesdites normes de la C.I.P. dans laquelle elle est appelée « Q » selon ledit calibre choisi.

2. Canon (30 ; 40 ; 50) selon la revendication 1, dans lequel les saillies concaves (35) sont reliées aux rainures concaves (36) selon une séquence alternée le long du profil curviligne fermé de la surface interne du canon.

3. Canon (30 ; 40 ; 50) selon la revendication 1 ou 2, dans lequel les rainures concaves (36) présentent un premier rayon de courbure (R1) ayant un point d'origine (O) situé sur l'axe longitudinal du canon et une longueur définie correspondant de préférence à la moitié de la dimension fournie par ladite législation de la C.I.P. dans laquelle elle est appelé « F », selon le calibre choisi.

4. Canon (30 ; 40 ; 50) selon l'une quelconque des revendications précédentes, dans lequel les rainures concaves (36) présentent un premier rayon de courbure (R1) ayant un point d'origine (O) situé sur l'axe longitudinal du canon.,
   le deuxième rayon de courbure (R2) partant d'un point qui est diamétralement désaligné par rapport au point (O) d'où part le premier rayon de courbure (R1) des rainures concaves (36).

5. Canon (30) selon l'une quelconque des revendications précédentes, dans lequel le profil curviligne en section transversale de la surface interne du canon présente un nombre pair de saillies (35), les saillies (35) sont agencées par paires diamétralement opposées et les rainures (36) sont agencées en paires diamétralement opposées.

6. Canon (40) selon l'une quelconque des revendications précédentes 1 à 4, dans lequel le profil curviligne en section transversale de la surface interne du canon présente un nombre impair de saillies (35), et les saillies (35) et les rainures ne sont pas diamétralement opposées les unes aux autres.

7. Un procédé de réalisation d'un canon (30) selon l'une quelconque des revendications précédentes, dans lequel les saillies concaves (35) et les rainures concaves (36) sont formées par martelage rotatif le long du profil de la surface interne (32) du canon (30).

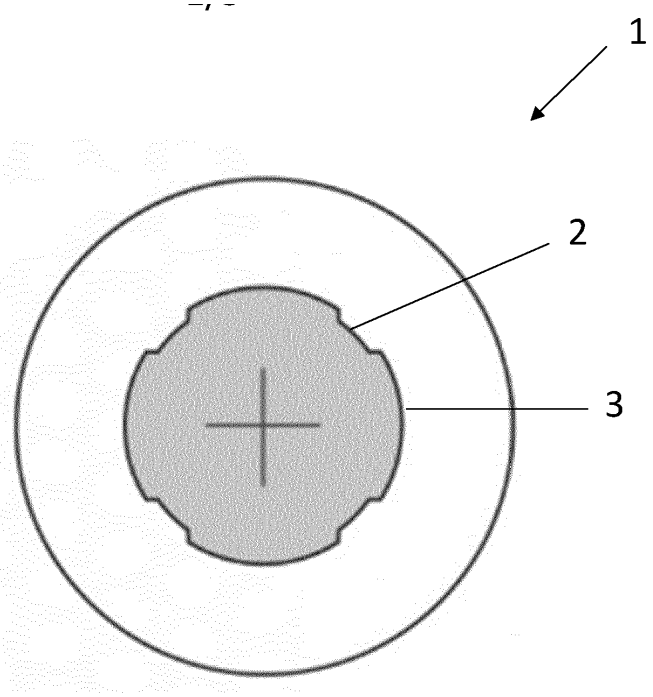

Fig. 1

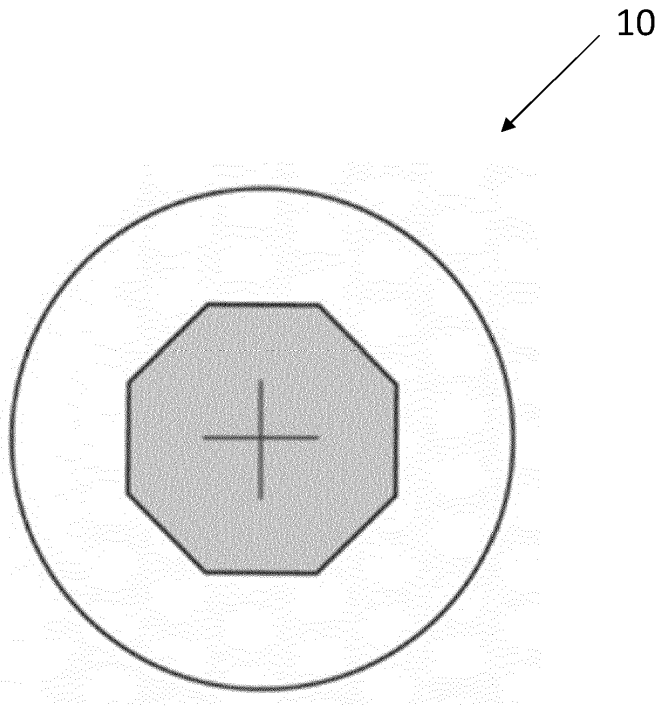

Fig. 2

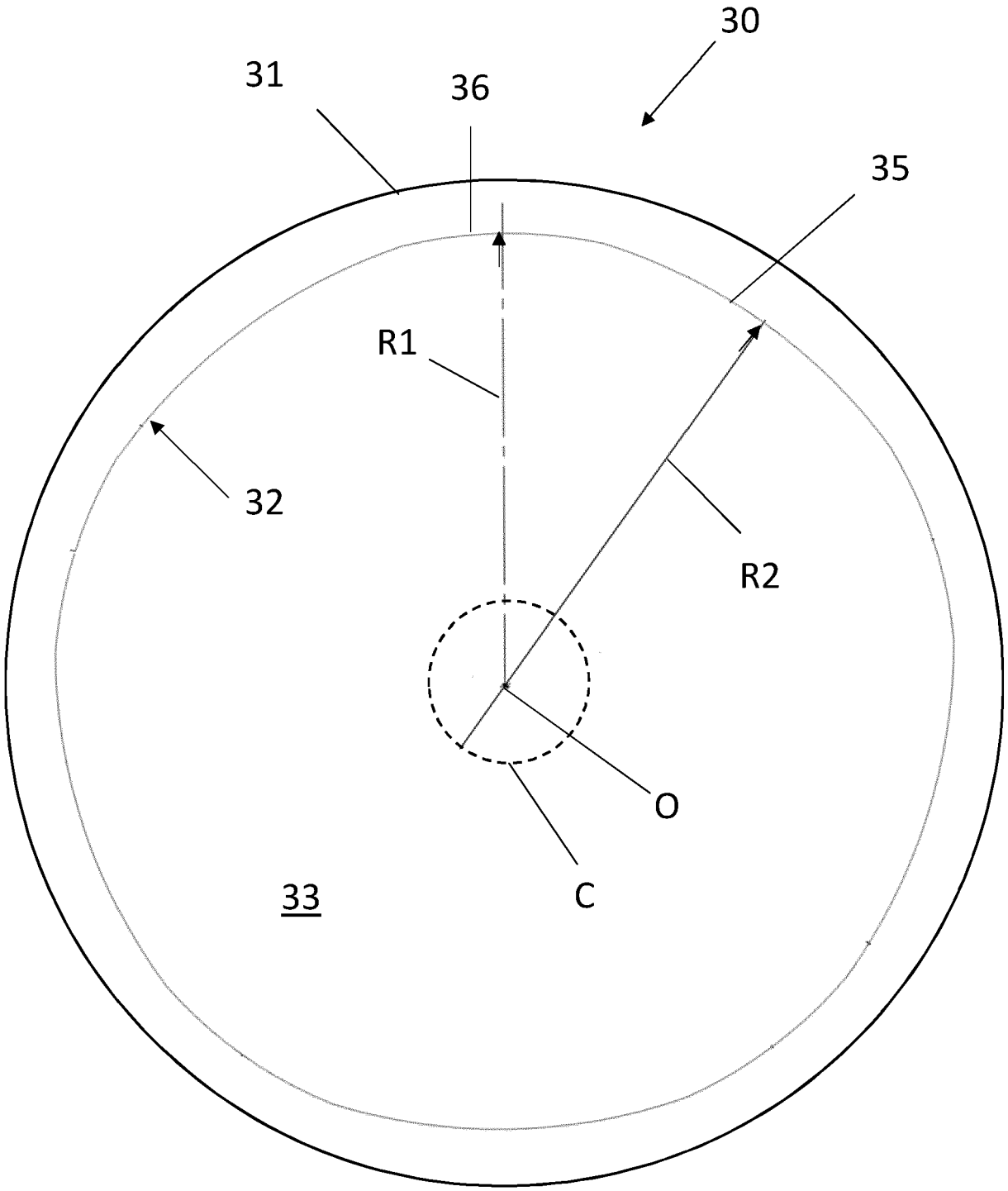

Fig. 3

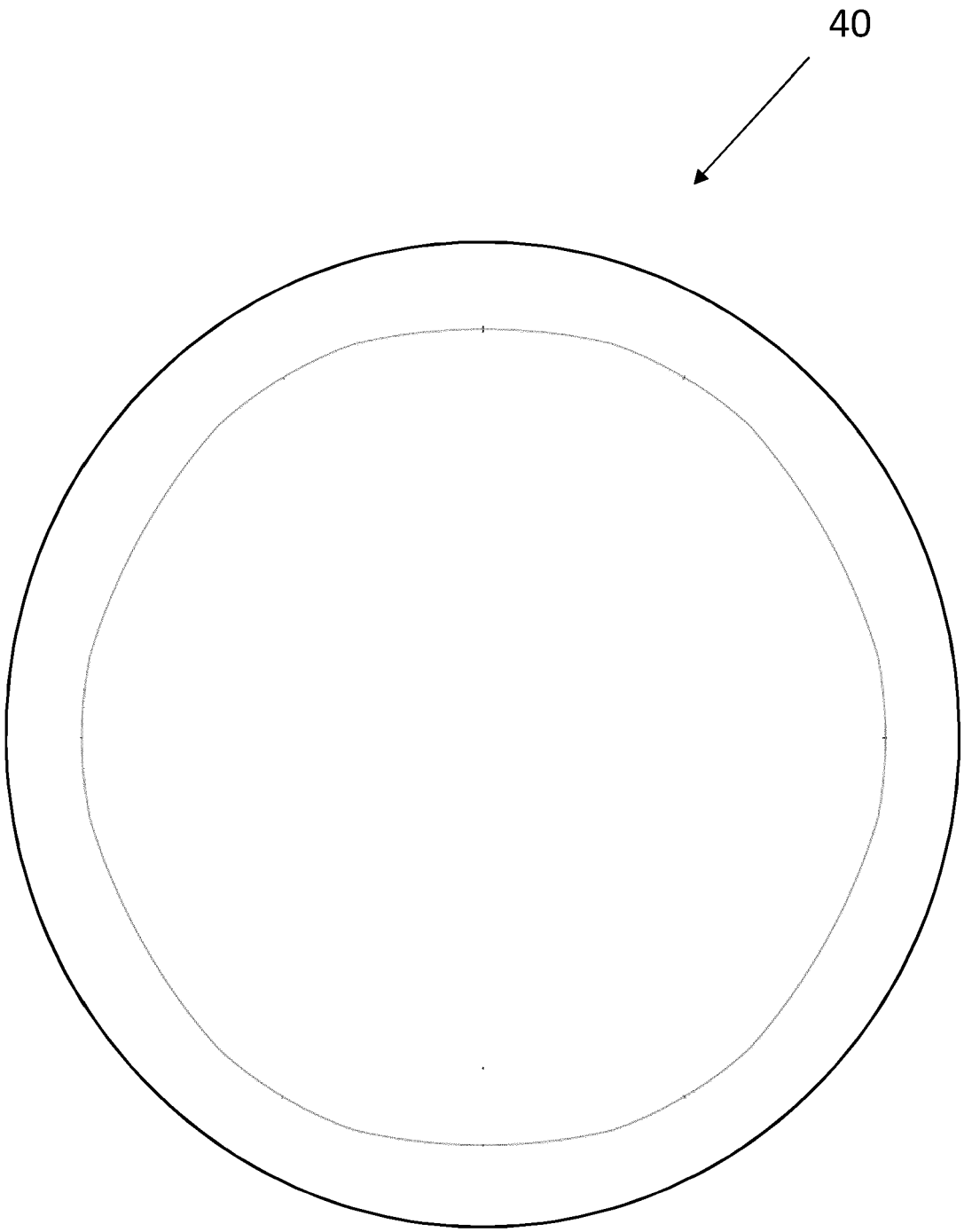

Fig. 4

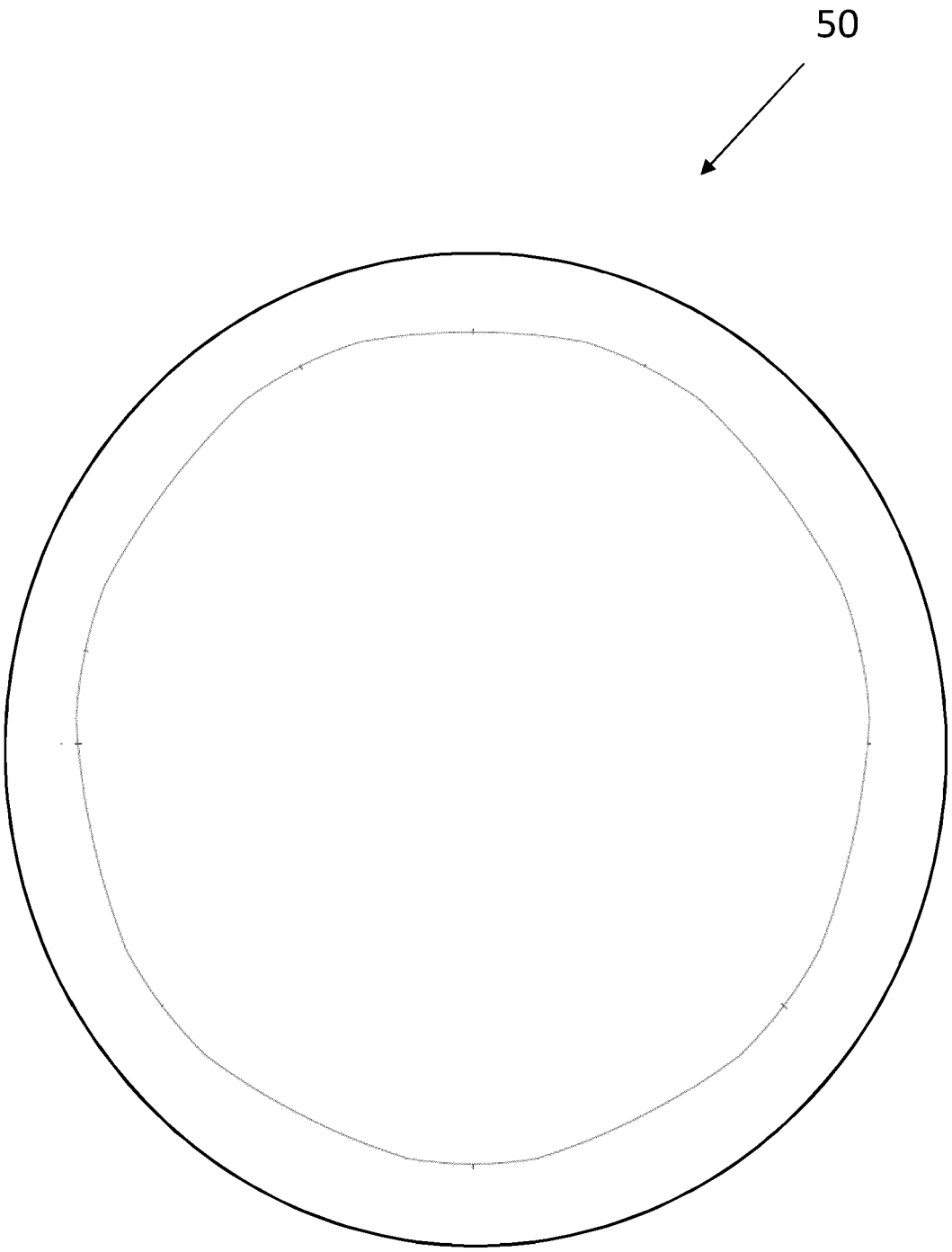

Fig. 5

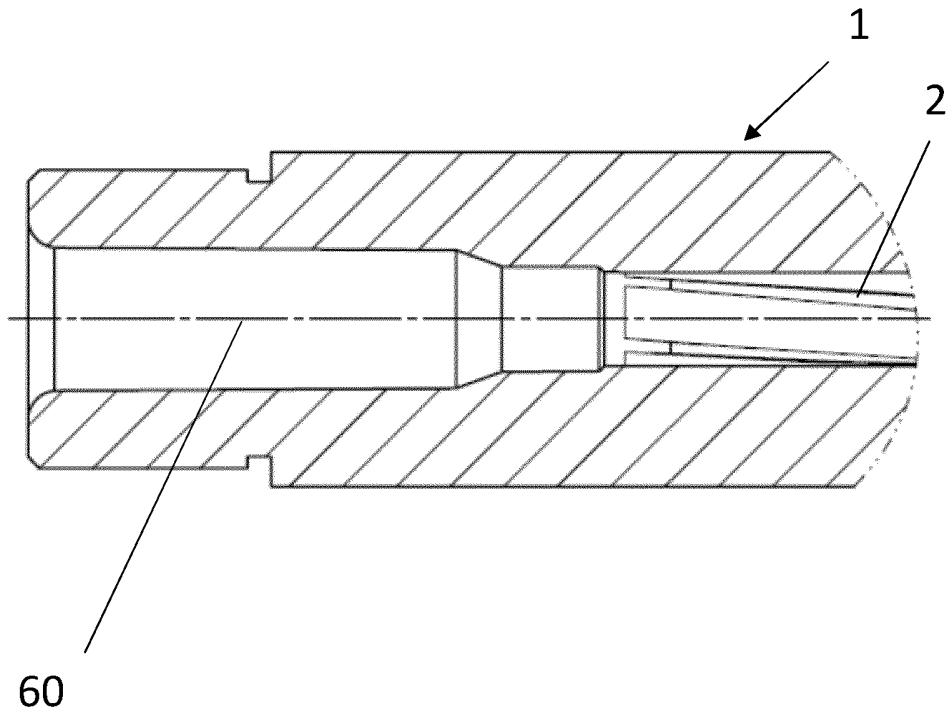

Fig. 6

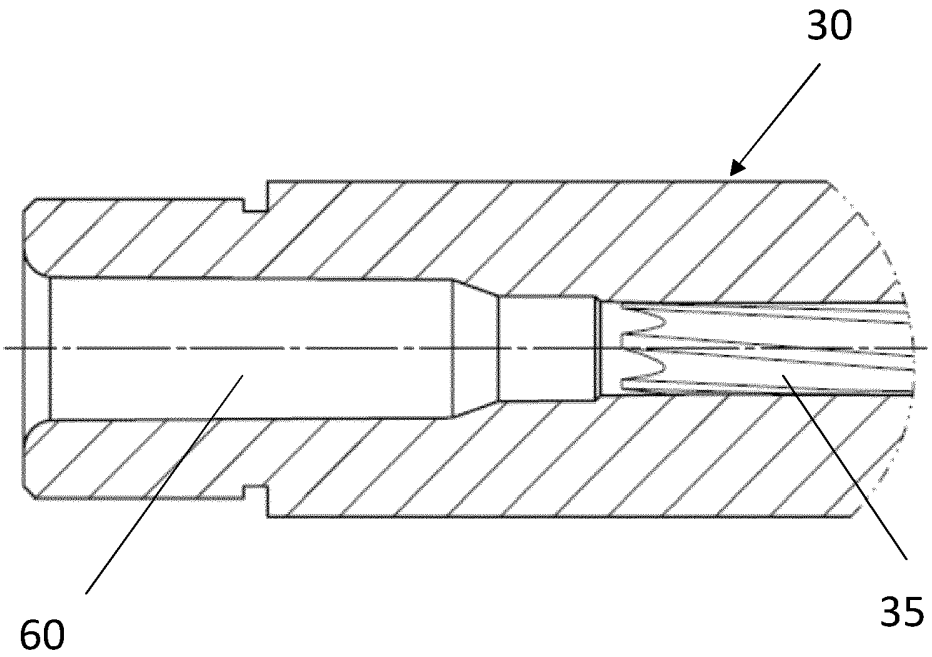

Fig. 7

REFERENCES CITED IN THE DESCRIPTION

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