



(12) **EUROPEAN PATENT APPLICATION**

(43) Date of publication:
18.01.2012 Bulletin 2012/03

(51) Int Cl.:
B21D 53/26 (2006.01)

(21) Application number: **11173709.4**

(22) Date of filing: **12.07.2011**

(84) Designated Contracting States:
AL AT BE BG CH CY CZ DE DK EE ES FI FR GB GR HR HU IE IS IT LI LT LU LV MC MK MT NL NO PL PT RO RS SE SI SK SM TR
Designated Extension States:
BA ME

(71) Applicant: **Agla Power Transmission S.p.a. Avigliana (IT)**

(72) Inventor: **Bonu', Oscar 10051 Avigliana (IT)**

(74) Representative: **Jorio, Paolo et al Studio Torta S.p.A. Via Viotti, 9 10121 Torino (IT)**

(30) Priority: **12.07.2010 IT TO20100602**

(54) **Method for producing a pulley for motor vehicle applications and the like provided with a plurality of V-shaped peripheral races**

(57) A method for producing a pulley (1) for motor vehicle applications and the like provided with a plurality of V-shaped peripheral races (7) is described; the method is carried out from a flat disc (11) and comprises the steps of:

- performing a drawing operation on the disc (11) to obtain a first cup-shaped semifinished product (12) having a flat base wall (13) and a side wall (14) joined to the base wall (13);
- obtaining a through-bore (16) through the base wall (13) of the first semifinished product (12);
- plastically deforming the first semifinished product (12) so as to fold an end portion, opposite to the bore (16), of the side wall (14) towards the axis (A) of the first semifinished product (12) obtaining a second semifinished product (17);
- plastically deforming the second semifinished product (17) radially compressing it so as to reduce the differences in diameter between the axial sections thereof; and
- roll forming the races (7) on the outer surface of the body obtained thereby.

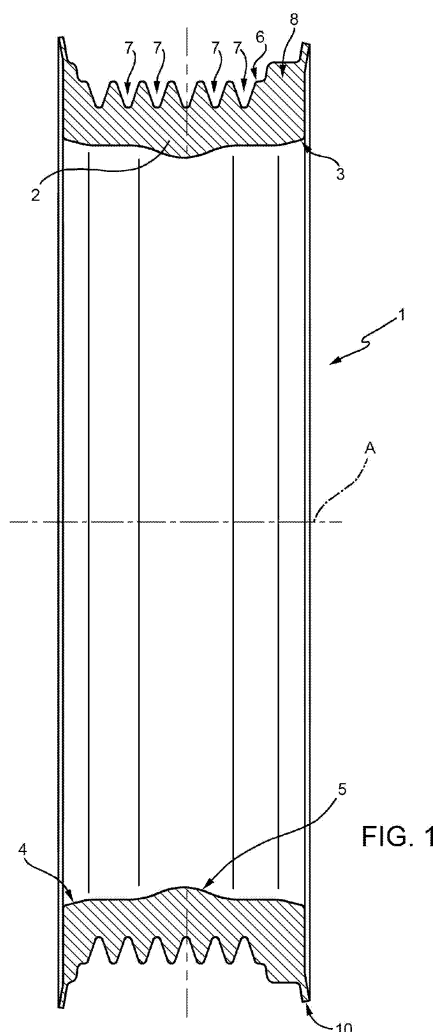


FIG. 1

Description

[0001] The present invention relates to a method for producing a pulley for motor vehicle applications and the like provided with a plurality of V-shaped peripheral races.

[0002] In the automotive sector it is known to transmit motion from a motor member, e.g. a crankshaft, to a plurality of accessory members by using a first pulley fed by the crankshaft and a second pulley feeding an accessory member, and a driving belt fed by the first pulley and feeding the second pulley.

[0003] Each pulley has a plurality of V-shaped peripheral races adapted to couple with respective trapezoidal ridges carried by the driving belt, and may have, with particular reference to the first pulley, a peripheral annular protrusion, which defines a seismic mass adapted to limit the transmission of vibrations from the crankshaft to the accessory member.

[0004] It is particularly felt in the sector the need for limiting the wear of the driving belt in order to increase the durability thereof. For this purpose, the surfaces of the races in contact with the belt must be made with high surface accuracy.

[0005] Pulleys are generally obtained by means of a process comprising a first casting of a tubular element and a second chip-forming machining so as to define, on a peripheral edge of the aforesaid tubular element, the peripheral protrusion and the V-shaped races.

[0006] The method described above, while allowing to obtain races having a high surface accuracy, has relative high costs and uses material in sub-optimal manner, because part of the material is lost during chip-forming machining. Due to the cost of such material, such a waste is particularly costly.

[0007] In order to solve the aforesaid drawbacks, the applicant has devised an alternative method of manufacturing of the pulleys of the type described above, illustrated in patent EP-B-1747827.

[0008] Such a method essentially includes the following steps:

- making a semifinished product comprising a main tubular portion and an outer annular end flange folded towards the main portion itself;
- plastically deforming by rolling the flange to fold it and take a peripheral surface thereof into contact with an outer surface of the main portion; and
- making the aforesaid races by means of several rolling passes on a second peripheral surface of the flange itself.

[0009] Thus, the pulley resulting from the application of the described method appears formed by two tubular layers of materials, integral to each other at an axial end, superimposed and adherent to each other along the remaining part of the pulley itself.

[0010] The applicant has observed that the junction

line between the two layers may cause some problems during the subsequent step of painting by cataphoresis; during such a step, the pulley is subjected to washing and degreasing with water and acid, to a proper painting operation by immersion in a painting tank and to a final drying operation in oven at approximately 180°.

[0011] In practice, during the aforesaid washing, degreasing and painting operations infiltrations of liquids may occur along the aforesaid junction line, which may then be brought to the boil when the pulley is introduced into the drying oven; such a boiling may determine the ejection by spraying of the infiltrated liquids with possible alteration of the painted surfaces and consequent rejection of the finished product.

[0012] It is the object of the present invention to provide a method for producing a pulley for motor vehicle applications and the like provided with a plurality of V-shaped peripheral races which allows to solve the drawbacks related to the known methods specified above in simple and cost-effective manner.

[0013] The aforesaid object is reached by the present invention in that it relates to a method for producing a pulley for motor vehicle applications and the like provided with a plurality of V-shaped peripheral races as defined in claim 1.

[0014] For a better understanding of the present invention, a preferred embodiment will now be described only by way of non-limitative example, and with reference to the accompanying drawings, in which:

- figure 1 is an axial section view of a pulley made according to the method object of the present invention;
- figures 2 and 3 illustrate, in axial section and in two different operative conditions, a forming unit for making a drawing operation on a flat disc within the scope of the method object of the present invention;
- figures 4 and 5 illustrate, in axial section and in two different operative conditions, a shearing unit for carrying out a boring operation on the semifinished product obtained in the preceding step of drawing within the scope of the method object of the present invention;
- figures 6 and 7 illustrate, in axial section and in two different operative conditions, a forming unit for carrying out a flanging operation on the semifinished product obtained in the preceding step of boring within the scope of the method object of the present invention; and
- figures from 8 to 12 illustrate in axial semi-section a unit for carrying out a series of rolling operations on the semifinished product obtained in the preceding step of flanging within the scope of the method according to the present invention.

[0015] With reference to figure 1, numeral 1 indicates as a whole a pulley for automotive applications and the like obtained with the method according to the present

invention.

[0016] In the description that follows, for the sake of simplicity and without therefore losing in generality, the pulley 1 receives motion from the motor member (not shown and is adapted to rotably feed an accessory assembly (also not shown) by means of a belt (not shown) coupled to the pulley 1 itself.

[0017] The pulley 1 essentially comprises a tubular body 2 extending along an axis A and displaying circular shape opposite axial openings 3, 4.

[0018] The body 2, furthermore, is delimited in a radial direction, by an inner surface 5 having wavy conformation adapted to be angularly connected to the motor member, and an outer surface 6, on which a plurality of races 7, six in the illustrated case in point, are obtained, adapted to couple with respective trapezoidal ridges carried by a belt (not shown).

[0019] The surface 6 further comprises an annular, flat protrusion 8, which is adapted to define a seismic mass to reduce the entity of the vibrations transmitted to the belt and to the accessory assembly.

[0020] More specifically, the protrusion 8 extends starting from an axial end 10 of the surface 6 corresponding to the opening 3 and is joined to the race 7 closest to the end 10 itself.

[0021] Pulley 1 is obtained from a flat disc 11 (figure 2) essentially by means of the following operative steps:

- performing a drawing operation (figures 2 and 3) on the disc 11 to obtain a first cup-shaped semifinished product 12 (figures 3 and 4) having a flat base wall 13 and a cylindrical side wall 14 joined to the base wall 13 by means of a joining segment 15 having a progressively decreasing diameter towards the base wall 13 itself;
- obtaining a through-bore 16 through the base wall 13 of the semifinished product 12 (figure 5);
- plastically deforming the semifinished product 12 so as to generate a second semifinished product 17 having tubular conformation and a progressively increasing diameter starting from the opposite axial ends 18, 19 towards an intermediate axial section 20 which projects the most on the outside (figure 6 and 7);
- plastically deforming the semifinished product 17 radially compressing it at the intermediate axial section 20, locking the opposite axial ends 18, 19 thereof at the same time so that they can neither move away from one another in an axial direction nor reduce the diameter thereof, allowing a controlled radial expansion at such axial ends 18, 19 (figures from 8 to 10); and
- roll-forming the races 7 on the outer surface of the body obtained thereby.

[0022] With reference to figures 2 and 3, the drawing operation is carried out by means of a forming unit 21 essentially comprising a fixed half mould 22, a mobile

half mould 23 facing the fixed mould 22 and cooperating, in use, with the latter along an axis B, and an actuating assembly (not shown) of the mobile half mould 23 along axis B itself between an opening position (figure 2), wherein the mobile half mould 23 is separated from the fixed half mould 22, and a closing position (figure 3), wherein the mobile half mould 23 cooperates with the fixed half mould 22.

[0023] As can be observed in figures 2 and 3, the fixed half mould 22 is coaxial to axis B and essentially comprises a base 24 and a die 25 integrally and overhangingly carried by the base 24. The die 25 is delimited by a cylindrical side surface 26 and by an upper flat surface 27 peripherally jointed to the side surface 26 by means of a convex annular portion 28; as illustrated, the annular portion 28 has, with reference to the base 24, a decreasing height towards the side surface 26. In practice, the upper surface 27 and the annular surface 28 define a sort of upper "dome" of the die 25 having a flat top region.

[0024] The fixed half mould 22 further carries a blank holder element 30 of tubular configuration, mounted in axially mobile manner along axis B on the side surface 26 of the die 25.

[0025] In particular, the blank holder element 30 has a cylindrical tubular shape and ends, on the part opposite to the base 24, with a flat head surface 31.

[0026] The blank holder element 30 is mobile between a first raised operating position, in which the head surface 31 thereof is aligned with the upper surface 27 of the die 25, and the second lower position, wherein the head portion 31 thereof is approached to the base 24.

[0027] The insertion of the disc 11 in the stamping forming unit 21 is carried out in the condition in which the mobile half mould 23 is in the opening position and the blank holder 30 is in the first raised operating position; the disc 11 is positioned coaxially to axis B and rests on the upper surface 27 of the die 25 and on the head surface 31 of the blank holder element 30.

[0028] The mobile half mould 23 essentially comprises a support wall 32 and a punch 33 overhangingly carried by the support 32 extending coaxially to axis B towards the die 25 and the blank holder element 30.

[0029] In particular, the punch 33 is formed by a tubular element 34, facing the blank holder element 30, and by a cylindrical core 35, facing the die 25 with a flat head surface 38 adapted to slide with respect to the tubular element 34 along axis B.

[0030] The tubular element 34 ends, towards the blank holder element 30, with a flat head surface 36 forming a convex rounding edge 37 on the inner side facing the core 34.

[0031] The core 35 is mobile between a retracted operating position, in which it is arranged in contact with the support wall 32 and has the head surface 38 thereof arranged at the maximum axial distance from the head surface 36 of the tubular element 34, and an advanced operating position, in which it is arranged axially spaced out from the support wall 32 and has the head surface

38 thereof arranged at the minimum axial distance from the head surface 36 of the tubular element 34.

[0032] During the drawing operation, the punch 33 descends axially towards the fixed half mould 22 to first take the tubular element 34 into contact with a peripheral portion of the disc 11; the further descent of the punch 33 determines the start of the deformation of the peripheral portion of the disc 11 under the bias of the tubular element 34 and the contact between the core 35 and the central portion of the disc 11 itself which will form the base wall 13 of the semifinished product 12; at this point, continuing the descending action of the punch 33, the core 35 remains axially locked by the contrast action of the die 25, and the entire assembly formed by the support wall 32 and by the tubular element 34 may further descend along axis B with respect to the core 35 pushing, by means of the contact between the head surfaces 36 and 31, the blank holder element 30 in the second lowered operating position and folding the peripheral portion of the disc 11 onto the annular portion 28 and onto the side surface of the die 25 so as to form the joining segment 15 and the side wall 14 of the semifinished product 12.

[0033] During this step, the core 35 reaches the retracted operating position thereof with respect to the tubular element 34 and to the support wall 32.

[0034] The mobile half mould 23 is then taken to the opening position and the blank holder element 30 is moved to the first raised operating position so as to determine the extraction of the semifinished product 12 from the die 25.

[0035] The subsequent boring operation of the semifinished product 12 is carried out on a shearing unit 40 (figures 4 and 5).

[0036] The semifinished product 12 is positioned on a tubular die 41 of axis C having a convex head surface 42, conformed so as to couple with the convex side of the side wall 14 and the joining segment 15.

[0037] The unit 40 further comprises a blank holder element, also with axis C, adapted to cooperate with the side wall 14 and the joining segment 15 of the semifinished product 12 from the side opposite to that resting on the die 41 so as to lock the semifinished product 12 itself in the boring position.

[0038] In this condition, by actuating a cylindrical punch 44 along axis C so as to engage it inside the die 41, the base wall 13 of the semifinished product 12 can be bored.

[0039] Preferably, during the step of boring, the base wall 13 is completely removed.

[0040] The centrally bored semifinished product 12 is then positioned in a forming unit 45 for carrying out a flanging operation adapted to generate the semifinished product 17.

[0041] The unit 45 essentially comprises two half moulds 46, 47, respectively lower and upper in the figures 6 and 7, which have similar structure and conformation and can be matched to one another along an actuating axis D.

[0042] In particular, the half mould 46 comprises a main wall 48, in which a tubular die 49 of axis D and a core 50 slidably mounted inside the die 49 axially protrude.

[0043] The core 50 has approximately a cylindrical conformation with a slightly tapered head portion 51 connected to the remaining part of the side surface by means of an annular shoulder 52 facing the half mould 47.

[0044] The die 49 also has a shape approximating a cylindrical configuration ending on top with a flat head surface 53; the head surface 53 is connected to the inner side surface by a segment 54 of conical conformation with concavity facing towards the main wall 48.

[0045] The half mould 47 has a configuration entirely similar to that of the half mould 46 and is described hereinafter only for that which differs therefrom; in particular, in the description that follows, parts equal or corresponding to the half moulds 46, 47 will be indicated with the same reference numerals.

[0046] As shown in figures 5 and 6, the half mould 47 differs from the half mould 46 essentially in that it is free from the shoulder 52.

[0047] The semifinished product 12 is accommodated inside the forming unit 45 in the opening configuration of the latter, wherein the half moulds 46 and 47 are mutually separated along axis D and the respective cores 50 are arranged in the maximum axial protrusion position with respect to the corresponding dies 49; in particular, the semifinished product 12 is positioned with the free axial end of the side wall 14 resting on the region of the segment 54 of the die 49 of the half mould 46 immediately adjacent to the head surface 53.

[0048] At this point, the relative approach between the half moulds 46, 47 along axis D determines the contact between the cores 50. During this step, the core 50 of the half mould 47 engages the hole 16 of the semifinished product 12.

[0049] The further relative approach between the half moulds 46, 47 determines the movement of the cores 50 to a retracted position in which their head surfaces are aligned with the head surfaces 53 of the dies 49. By effect of this movement, a forming annular cavity 55 is generated between the dies 49 and the cores 50, delimited, in radially innermost position, by the side surfaces of the approached cores 50 and, in radially outermost position, by the conical segments 54 of the dies 49.

[0050] The semifinished product 12 is thus stretched and forced to fold towards the axis A thereof at the terminal end of the side wall 14 opposite to the hole 16, until the semifinished product 17 is obtained.

[0051] As previously indicated, such a semifinished product has a tubular conformation with a gradually increasing diameter starting from the opposite axial ends 18, 19 towards an intermediate axial section 20 which projects the most on the outside; the semifinished product 17 further has, at the axial ends 18, 19 thereof, respective openings 56, 57 having circular conformation coinciding at the end of the method object of the present

invention, with opening 3 and opening 4 of the pulley 1, respectively.

[0052] The subsequent steps are carried out by means of a rolling unit 60 (illustrated in figures from 8 to 12), which comprises a locking/actuating fixture 61 of the semifinished product 17 and a plurality of rollers, in the illustrated case in point four, indicated by 62, 63, 64, 65, adapted to plastically deform the semifinished product 17 according to a predetermined operative sequence.

[0053] More specifically, the fixture 61 is adapted to lock the semifinished product 17 in a predetermined radial and axial position and to annularly and rotably feed it with respect to an axis (not shown) coinciding with axis A of the semifinished product 17 itself. The rollers 62, 63, 64, 65 are actuated one at a time and sequentially in radial direction towards the semifinished product to be plastically deformed.

[0054] The fixture 61 comprises a pair of elements 66, 67, which press of the semifinished product 17, on axially opposite parts the axial ends 18, 19, delimiting the openings 56, 57, respectively. The elements 66, 67 further have respective axial end surfaces 68, 69, which are accommodated inside the semifinished product 17 and which are pressed to each other.

[0055] In greater detail, the element 66 is arranged coaxially with the semifinished product 17; the element 66, further comprises an axial portion 70, which is partially accommodated, through the opening 56, inside the semifinished product 17, and a flange 71 overhangingly extending from the portion 70 and adapted to exert a compression action on the axial end 18 of the semifinished product 17.

[0056] More specifically, the portion 70 defines at an axial end thereof accommodated in the semifinished product 17 the surface 68, which has a flat conformation and radial development. The portion 70 further has a calibrated outer surface 72 adapted to define at the end of the rolling operations a corresponding part of the wavy inner surface 5 of the body 2 of the pulley 1.

[0057] The flange 71 comprises a first radial profile segment 74, extending directly from the portion 70, and a second end segment 75, tapered in direction opposite to the segment 74 and, having from the side facing the element 67, an inclined profile diverging with respect to the element 67 itself towards its free radial end thereof so as to not to interfere during the step of rolling with the rollers 62, 63, 64, 65.

[0058] Similarly to element 66, element 67 is arranged coaxially to the semifinished product 17 and comprises an axial portion 76, which is partially accommodated by means of the opening 57, inside the semifinished product 17, for pressing the element 66 and a flange 77 overhangingly extending from the portion 76 and adapted to exert a compression action on the axial end 19 of the semifinished product 17.

[0059] More specifically, portion 76 defines, at an axial end thereof accommodated in the semifinished product 17, surface 69, which has a flat conformation and radial

development. Furthermore, portion 76 has a calibrated outer surface 78 adapted to define, at the end of the rolling operations, a corresponding part of the wavy inner surface 5 of the body 2 of the pulley 1.

[0060] The flange 77 comprises a first radial profile segment 80, extending directly from the portion 76, and a second end segment 81, tapered in direction opposite to the segment 80 and having, from the side facing the element 66, an inclined profile diverging with respect to the element 66 itself towards the free radial end thereof so as to not to interfere, during the step of rolling, with the rollers 62, 63, 64, 65.

[0061] Figures 8 and 9 show a first rolling pass of the semifinished product 17, during which the roller 62 exerts a radial compression action on the intermediate axial section 20.

[0062] The roller 62 has a working profile 90 parallel to axis A and adapted to cooperate with the intermediate axial section 20 of the semifinished product 17, and two head surfaces 91, 92 oblique with respect to the profile 90 having extension converging towards the profile 90 itself. More specifically, the surfaces 91 and 92 respectively face segment 75 and segment 81 of the elements 66 and 67 during the step of advancing of the roller 62.

[0063] Figure 10 shows a second rolling pass of the semifinished product 17, during which the roller 63 exerts a further radial compression action on the semifinished product 17 so as to allow the material of the latter to completely fill the annular chamber 93 formed between the roller 63 itself and the elements 66 and 67. In practice, during this step, a further reduction of the differences of diameter between the axial sections of the semifinished product 17 are obtained.

[0064] Roller 63 is similar to roller 62 and is described only in that which differs from roller 62 itself; in particular, roller 63 comprises a working profile 94, which has, proceeding from surface 91 to surface 92, a stepped segment 96 of increasing diameter, a segment 98 parallel to axis A, a stepped segment 99 of decreasing diameter and a segment 100 also parallel to axis A. Therefore, the segment 98 protrudes from the roller 63 with respect to the segment 100 in direction of the semifinished product 17.

[0065] Consequently, the action of the roller 63 defines the protrusion 8 having conformation corresponding to the segment 100.

[0066] Figure 11 shows a third rolling pass during which the roller 64 deforms the radially outer surface of the semifinished product obtained during the previous steps so as to define an alternating plurality of cavities 101 and solids 102 having wavy shape on the same.

[0067] Roller 64 is similar to roller 63 and is described only for that which differs from roller 63 itself; in particular, roller 63 has, in position corresponding to segment 98 of the roller 63, a segment 103 having an alternating plurality of wavy profile protrusions 104 and voids 105 also having wavy shape.

[0068] Figure 12 shows a fourth and last rolling pass

during which the cavities 12 are plastically deformed by means of the roller 65 to obtain the V-shaped races 7.

[0069] Roller 65 is similar to roller 64 and is described only for that which differs from roller 64 itself; in particular, roller 65 has, in position corresponding to the ridges 104 and the voids 105, an alternating plurality of trapezoidal shape teeth 106 and V-shaped voids 107.

[0070] From an examination of the features of method 1 made according to the present invention the advantages that it allowed to obtain are apparent.

[0071] In particular, the method according to the present invention uses the material in optimal manner avoiding waste and at the same time allows to obtain V-shaped races 7 with high surface precision so as to reduce the wear of the driving belt.

[0072] Furthermore, the described method allows to obtain a consistent difference of radial dimension between the protrusion 8 and the bottom of the races 7 by means of rolling, i.e. by means of a plastic deformation machining operating by compression; in other words, by virtue of such an inventive solution, the difference of radial dimension between the portions of the same part no longer constitute a limit to the application of the machining by rolling.

[0073] Finally, the obtained pulley is made in one piece without junction lines or superimposition of layers which could determine the risk of infiltration of liquid during the painting process with consequent ejection by spraying of the same during the step of drying the oven. In this manner, it is possible to drastically reduce the number of rejected finished products at the end of the production process.

[0074] It is apparent that changes and variations can be made to the method of the invention without departing from the scope of protection of the claims.

Claims

1. A method for producing a pulley (1) for motor vehicle applications and the like provided with a plurality of V-shaped peripheral races (7), **characterized by** being produced from a flat disc (11) and by comprising the steps of:

- a) performing a drawing operation on said disc (11) to obtain a first cup-shaped semifinished product (12) having a flat base wall (13) and a side wall (14) joined to the base wall (13);
- b) obtaining a through-bore (16) through said base wall (13) of said first semifinished product (12);
- c) plastically deforming said first semifinished product (12) so as to fold an end portion, opposite to said bore (16), of said side wall (14) towards the axis (A) of the first semifinished product (12) obtaining a second semifinished product (17);

d) plastically deforming said second semifinished product (17) radially compressing it so as to reduce the differences in diameter between the axial sections thereof; and

e) roll forming said races (7) on the outer surface of the body obtained thereby.

2. The method according to claim 1, wherein said step of boring is carried out on the inner base wall (13) of said first semifinished product (12).

3. The method according to claim 1 or 2, wherein said side wall (14) of said first semifinished product (12) obtained in step a) has a cylindrical configuration and is joined to said base wall (13) by means of a joining segment (15) having a progressively decreasing diameter towards the base wall (13).

4. The method according to any of the preceding claims, wherein said second semifinished product (17) obtained in step c) has a progressively increasing diameter from the opposite axial ends (18, 19) towards an intermediate axial section (20) which projects the most on the outside.

5. The method according to claim 4, wherein, in said step d), the radial compression is exerted on the most projecting intermediate axial section (20) of said second semifinished product (17), locking the opposite axial ends (18, 19) of the second semifinished product (17) at the same time so that the latter can neither move away from one another in an axial direction nor reduce the diameter thereof.

6. The method according to any of the preceding claims, wherein said step e) is performed by several passes so as to first obtain a plurality of wavy grooves (101) and then said V-shaped races (7).

7. The method according to any of the preceding claims for producing a pulley (1) having said peripheral V-shaped races (7) and further provided with a peripheral protrusion (8) defining a seismic mass to reduce the transmission of vibrations outside said pulley (1), in which, in said step d), the radial outer surface of said second semifinished product (17) is deformed so as to comprise at least one area radially projecting outwards from said races (7).

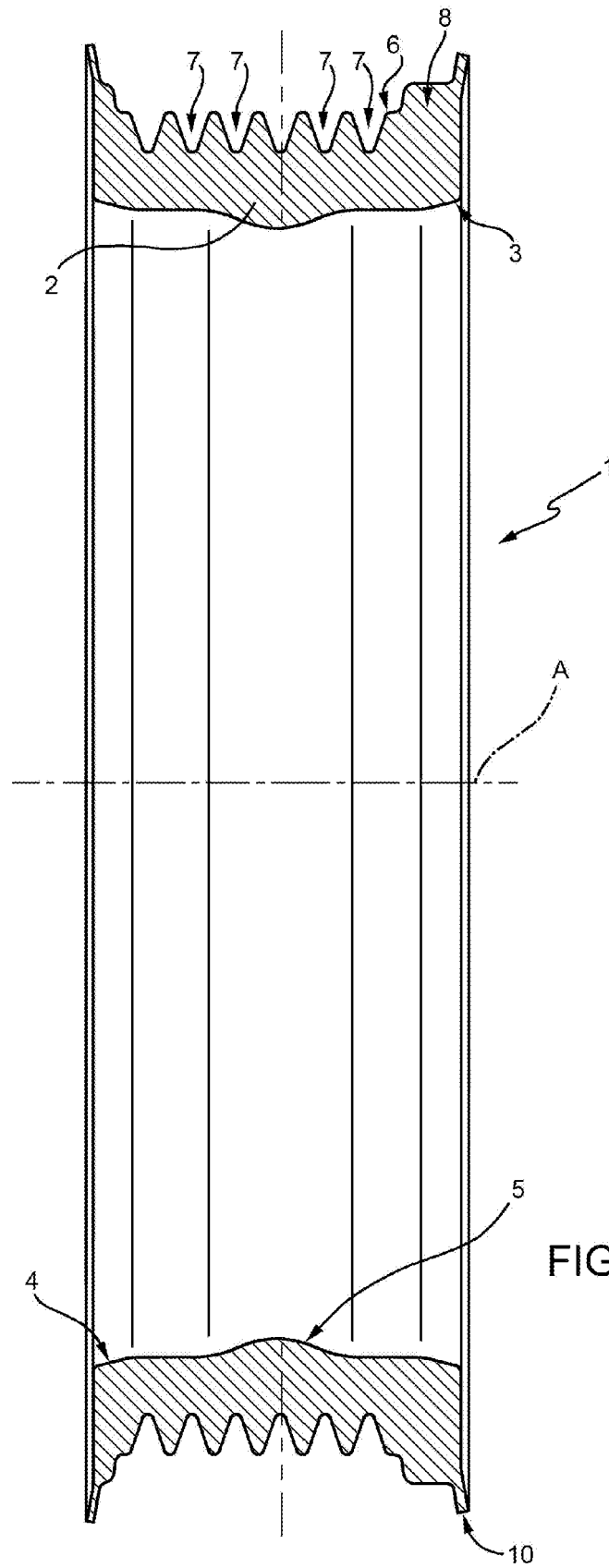
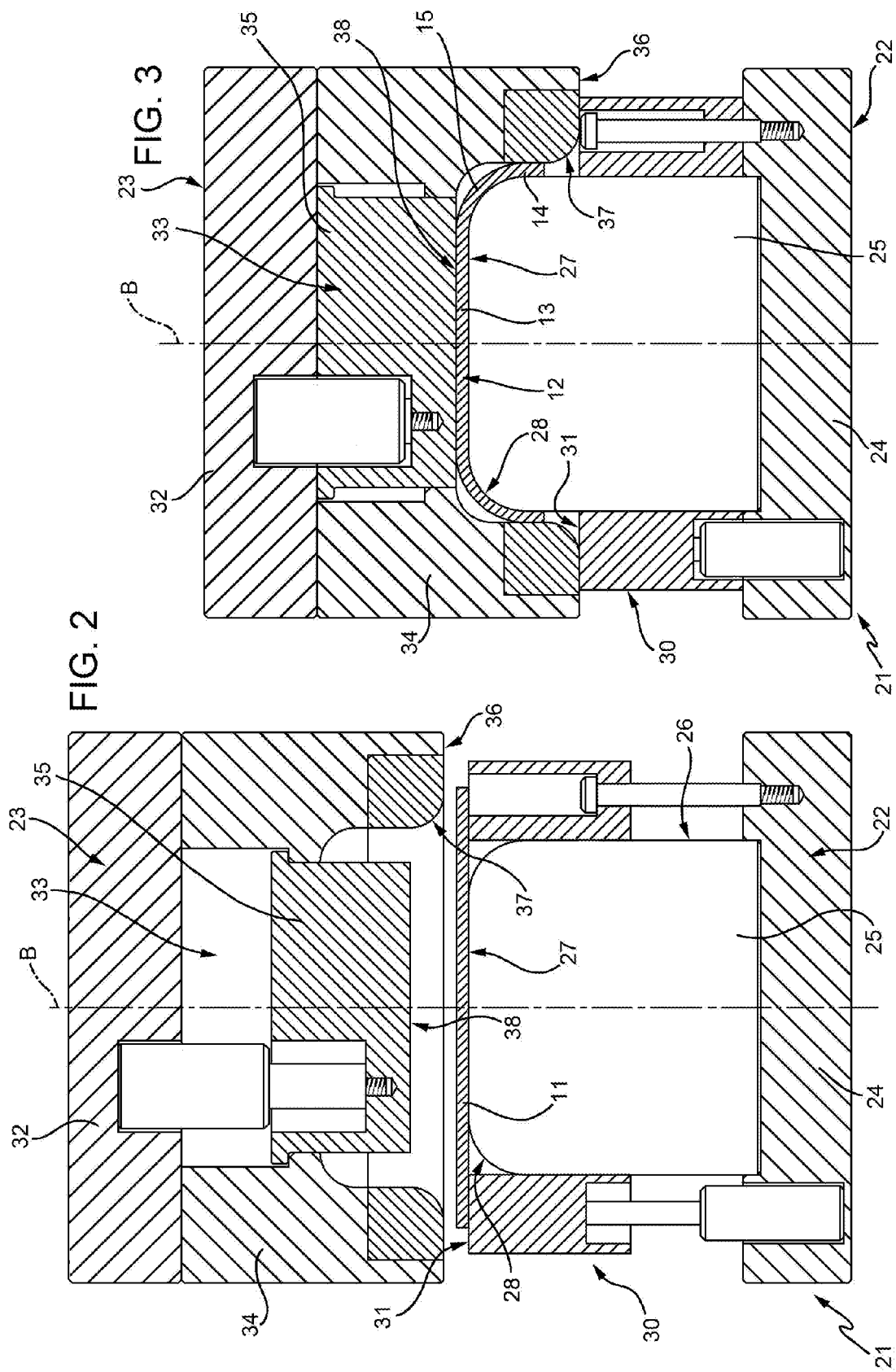
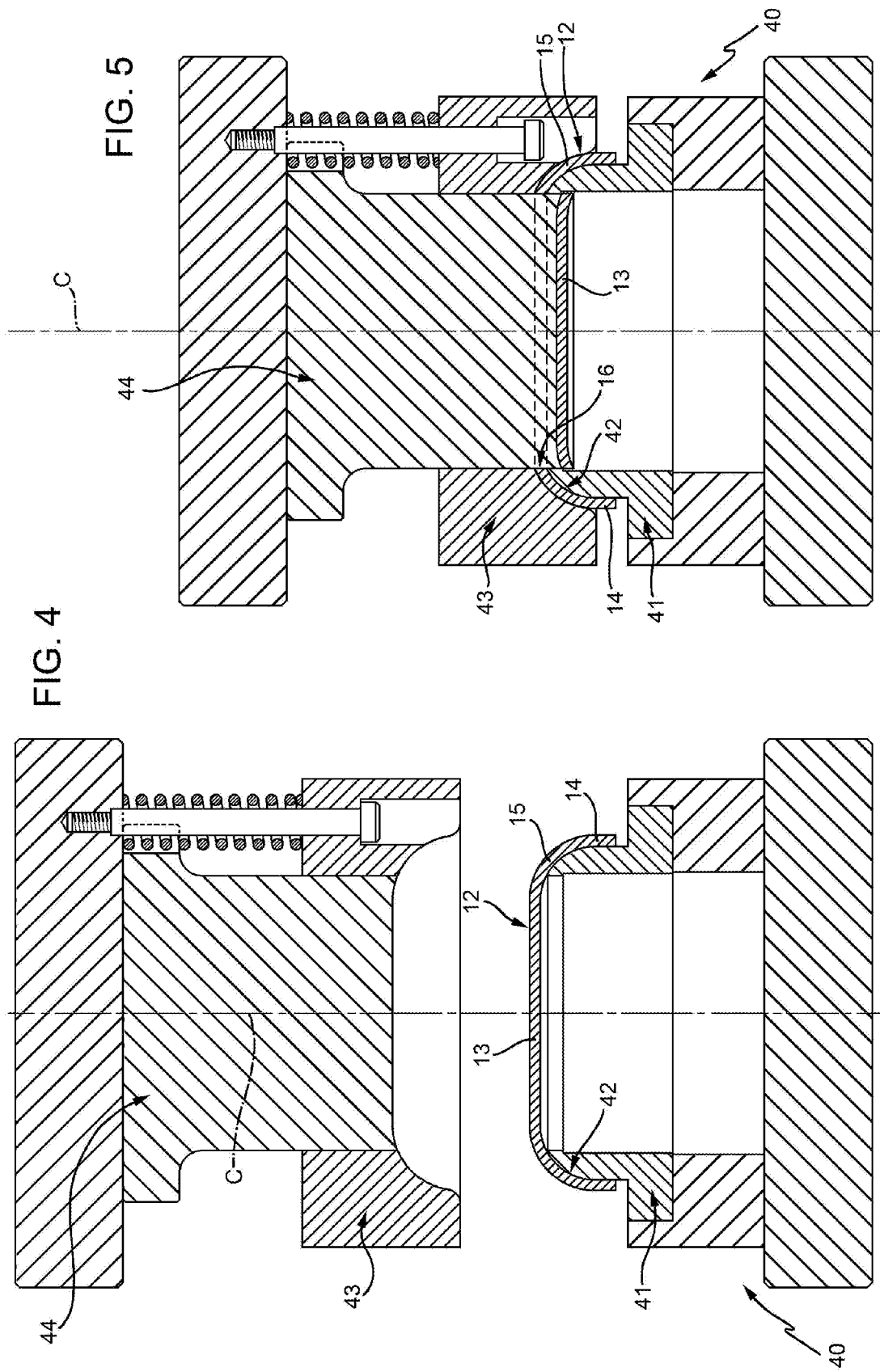
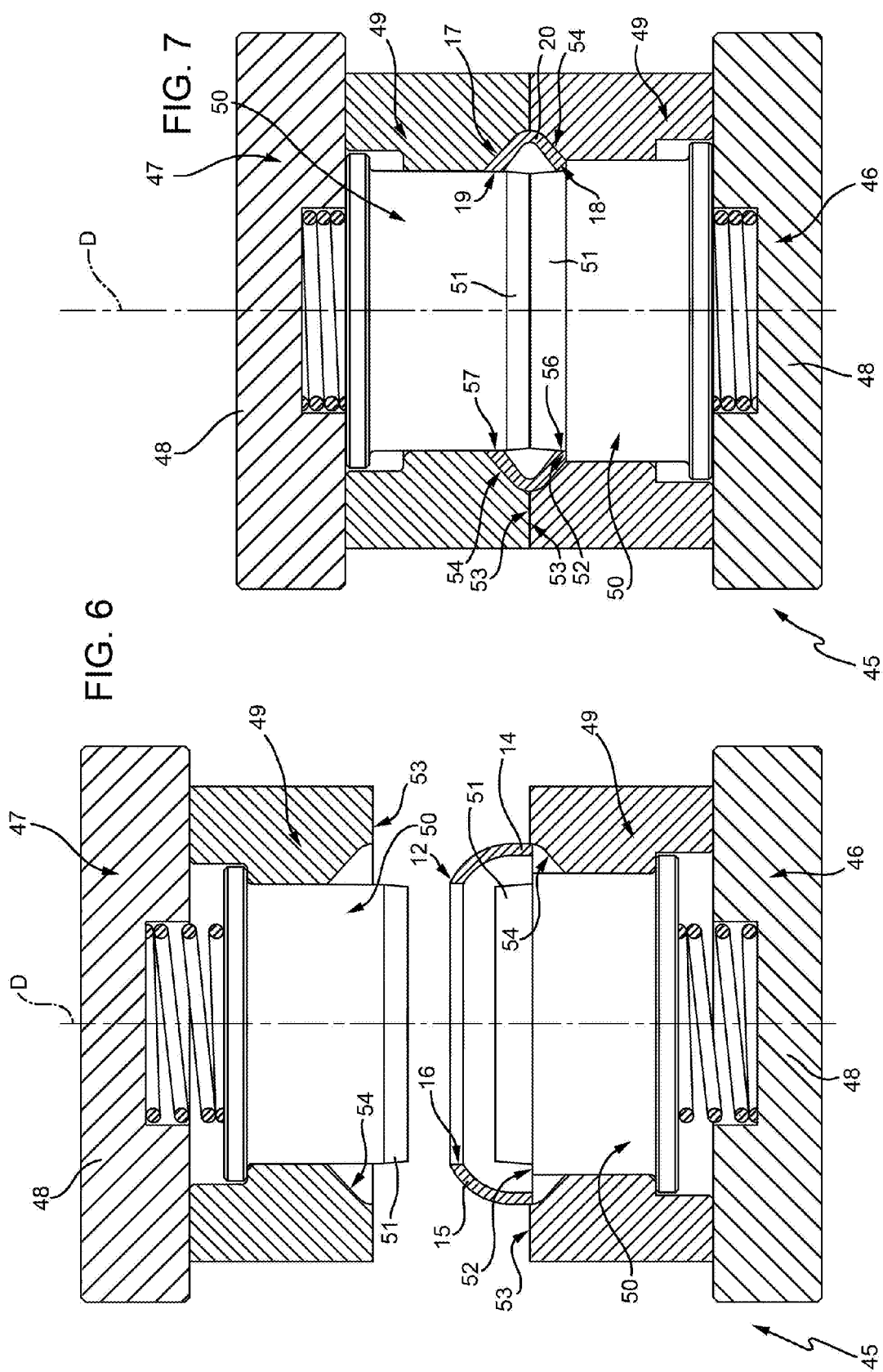
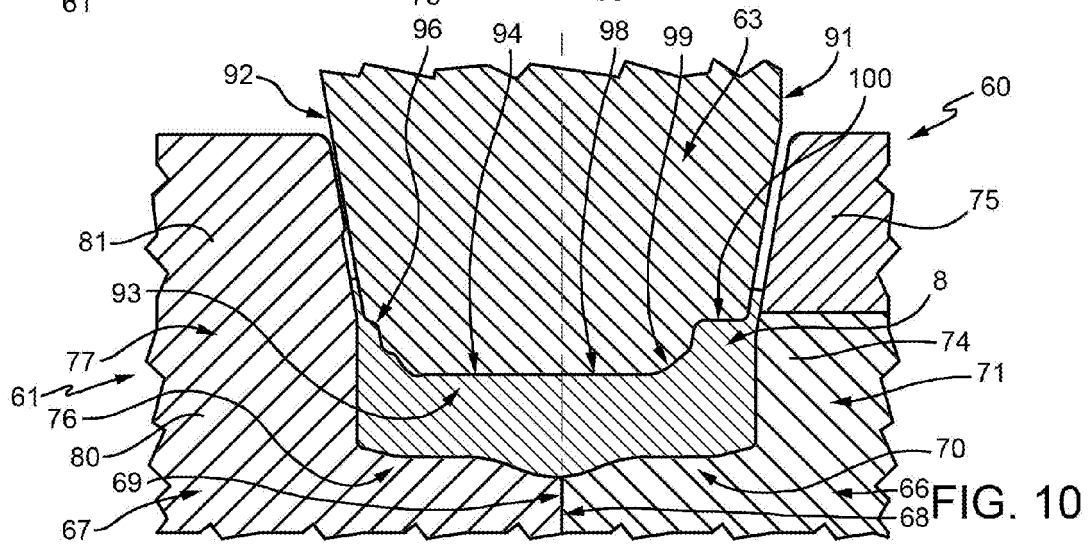
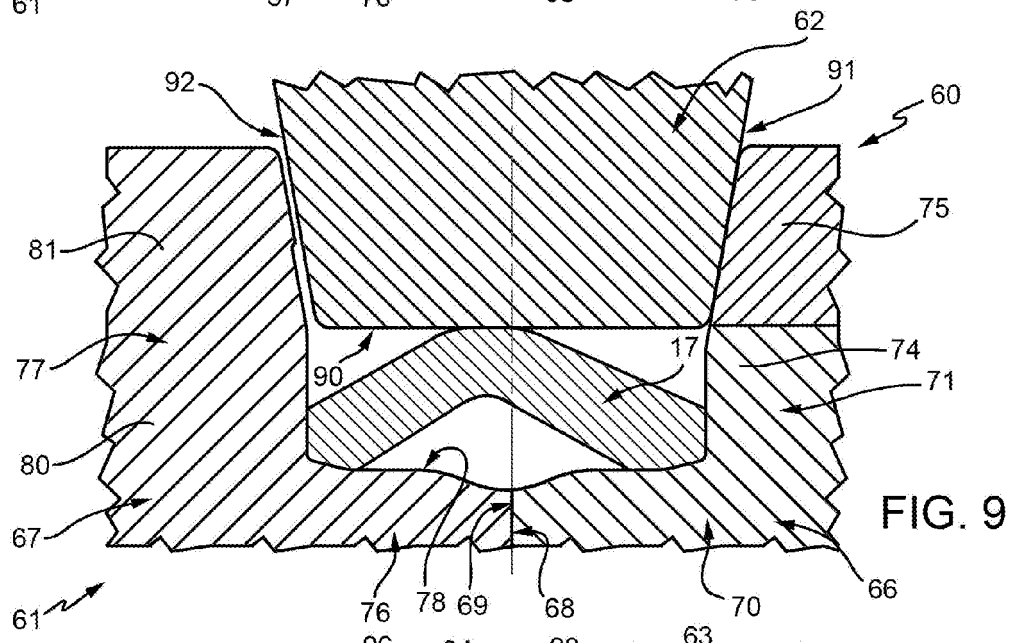
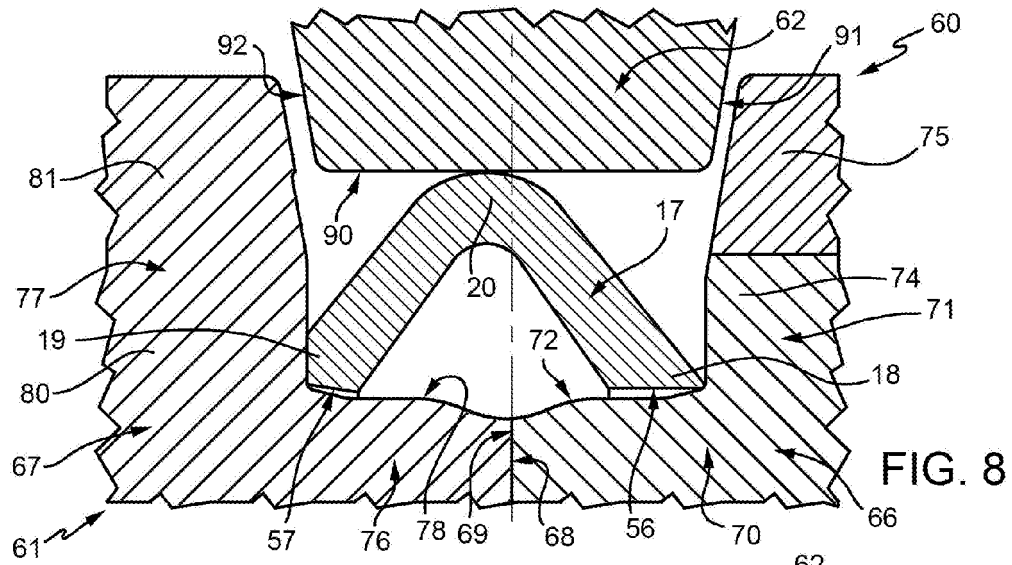


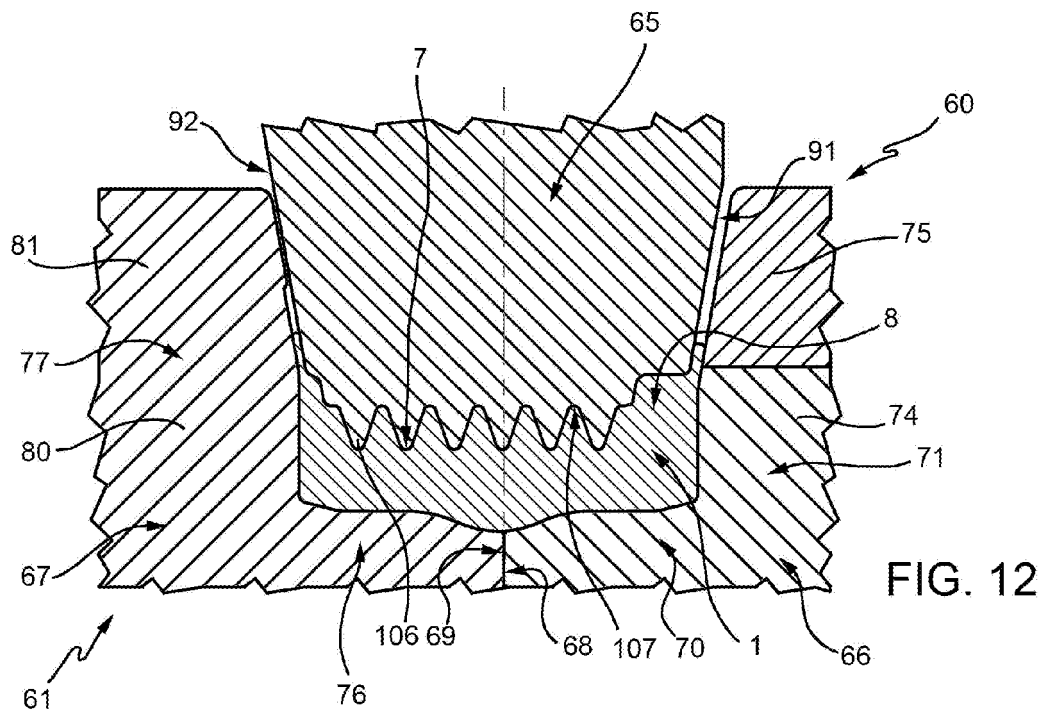
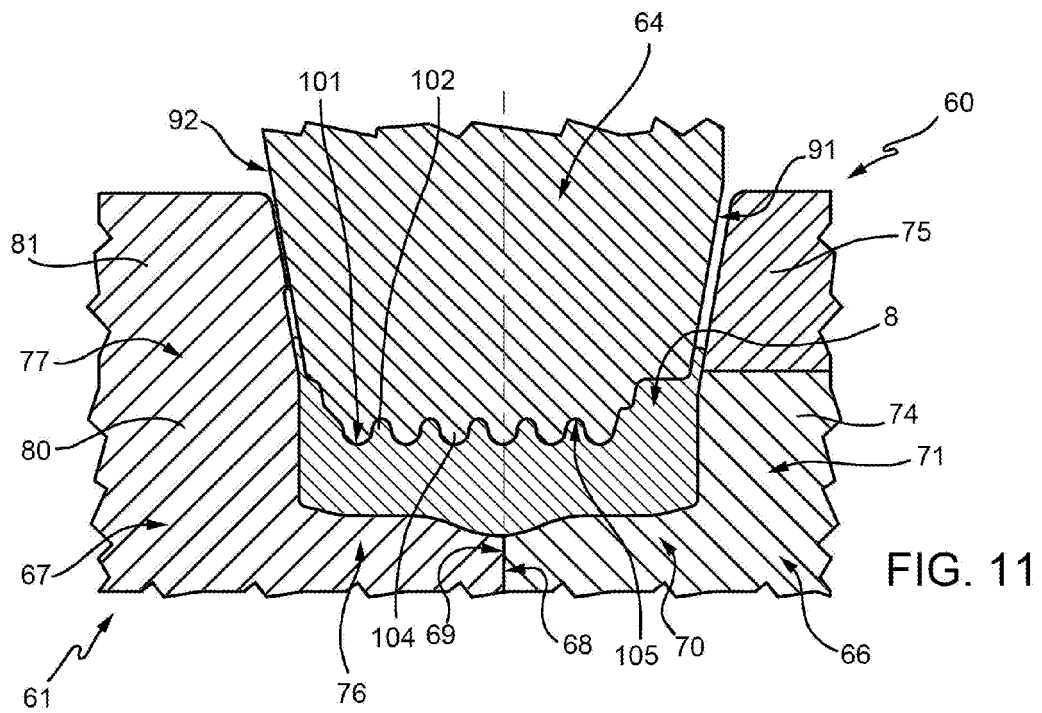
FIG. 1













EUROPEAN SEARCH REPORT

Application Number
EP 11 17 3709

DOCUMENTS CONSIDERED TO BE RELEVANT			
Category	Citation of document with indication, where appropriate, of relevant passages	Relevant to claim	CLASSIFICATION OF THE APPLICATION (IPC)
A	GB 2 153 267 A (RADIO ELECTRO MEC SA CONST) 21 August 1985 (1985-08-21) * the whole document *	1	INV. B21D53/26
A	DE 197 23 073 A1 (FISCHER & KAUFMANN GMBH & CO K [DE]) 3 December 1998 (1998-12-03) * column 3, line 8 - line 43; figures 1-6 *	1	
A	US 2004/058764 A1 (KANEMITSU TOSHIAKI [JP] ET AL) 25 March 2004 (2004-03-25) * paragraph [0040] - paragraph [0056]; figures 1-11 *	1	
A,D	EP 1 747 827 A1 (AGLA SPA [IT]) 31 January 2007 (2007-01-31) * the whole document *	1	
The present search report has been drawn up for all claims			TECHNICAL FIELDS SEARCHED (IPC)
			B21D
1	Place of search Munich	Date of completion of the search 20 October 2011	Examiner Pieracci, Andrea
CATEGORY OF CITED DOCUMENTS X : particularly relevant if taken alone Y : particularly relevant if combined with another document of the same category A : technological background O : non-written disclosure P : intermediate document T : theory or principle underlying the invention E : earlier patent document, but published on, or after the filing date D : document cited in the application L : document cited for other reasons & : member of the same patent family, corresponding document			

EPO FORM 1503 03/82 (P04C01)

**ANNEX TO THE EUROPEAN SEARCH REPORT
ON EUROPEAN PATENT APPLICATION NO.**

EP 11 17 3709

This annex lists the patent family members relating to the patent documents cited in the above-mentioned European search report.
The members are as contained in the European Patent Office EDP file on
The European Patent Office is in no way liable for these particulars which are merely given for the purpose of information.

20-10-2011

Patent document cited in search report		Publication date	Patent family member(s)	Publication date
GB 2153267	A	21-08-1985	ES 8501652 A1	01-03-1985
DE 19723073	A1	03-12-1998	NONE	
US 2004058764	A1	25-03-2004	NONE	
EP 1747827	A1	31-01-2007	NONE	

REFERENCES CITED IN THE DESCRIPTION

This list of references cited by the applicant is for the reader's convenience only. It does not form part of the European patent document. Even though great care has been taken in compiling the references, errors or omissions cannot be excluded and the EPO disclaims all liability in this regard.

Patent documents cited in the description

- EP 1747827 B [0007]