(19) Europäisches Patentamt
European Patent Office
Office européen des brevets

(11) EP 3 520 923 A1

(12) EUROPEAN PATENT APPLICATION

(43) Date of publication:
07.08.2019 Bulletin 2019/32

(51) Int Cl.:
B21D 41/02 (2006.01)

(21) Application number: 19154917.9

(22) Date of filing: 31.01.2019

(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
Designated Validation States:
KH MA MD TN

(30) Priority: 01.02.2018 IT 201800002291

(71) Applicant: Boin, Matteo
36027 Vicenza (IT)

(72) Inventor: Boin, Matteo
36027 Vicenza (IT)

(74) Representative: Bettello, Pietro
Via Col d'Echele, 25
36100 Vicenza (IT)

(54) PROCESS FOR MACHINING WELDED PIPES

(57) The present invention relates to a process for machining welded pipes, which consists of an expansion calibration machining of said welded pipe, where the controlled widening of the inner diameter of the pipe is achieved and where a radial expansion spindle (1) is used, consisting of a punch (2) that penetrates coaxially in a die (3) on which is inserted the pipe (T) to be widened exercising an expansion calibration action consequently to the radial displacement of said radial sectors (5). Said process being characterised in that it uses a punch (2) provided with a reciprocating roto-translational incremental movement (F_1, F_2), with a number of sides equal to the number of radial sectors (5), which constitute the die (3), where said radial sectors (5) undergo, after each step of penetration of the punch (2) in the matrix (3), an angular rotation that is caused directly by the angular rotation of the aforesaid punch (2) whose movement is obtained through an axial advance/return station (10) and an angular rotation station (20) arranged cooperating at the end of said punch (2) and commanded by a PLC.

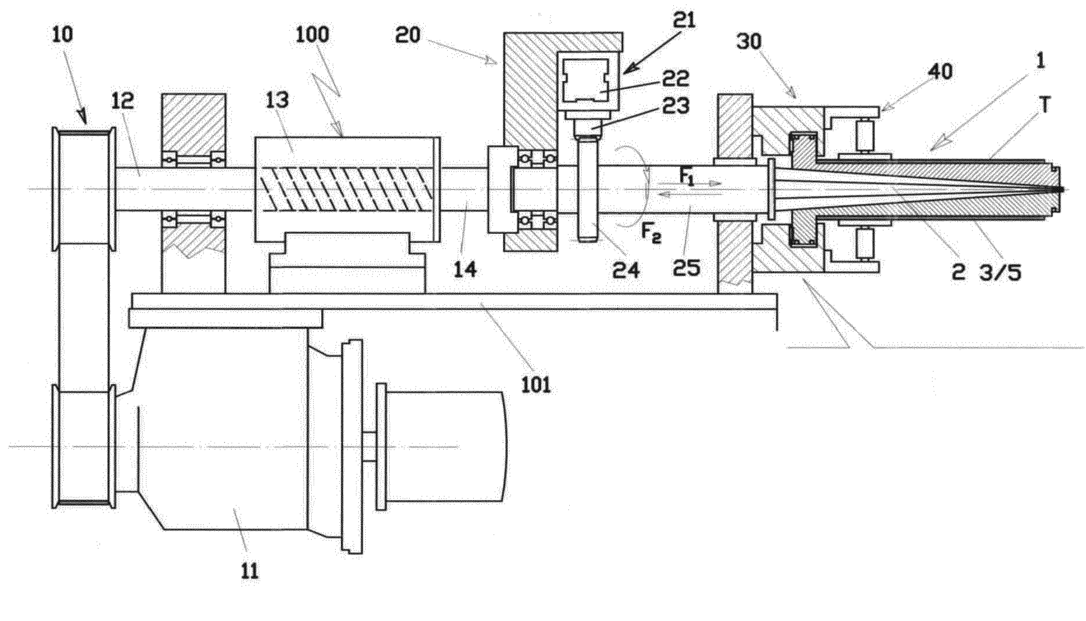

FIG.20

EP 3 520 923 A1

Description

[0001] The invention relates to a process for machining welded pipes, according to the general part of claim 1, and to a machine that operates according to said process.

[0002] In many industrial applications it is necessary to use metal pipes, which must have an inner diameter with minimal tolerance, of the order of +0/+0.05 mm.

[0003] By way of example, reference is made to the pipes used in the tubular motors used for the automation of shutters, shades, roller blinds and the like.

[0004] This type of automation, commonly known by the name of "tubular motor", comprises a gear motor that is pushed inside a pipe, where a pipe/gear motor interference occurs, necessary to ensure that the two components are assembled.

[0005] Once in place, to assure a stable coupling, such as to avoid overheating that would compromise the elasticity of the locking system, with the consequence that, when said gear motor operates at full load, it would tend to vibrate, causing unacceptable noisiness, it is necessary to establish a design interference value between the inner diameter of the pipe and the outer diameter of the gear motor that is minimal and highly precise; this is achieved by making the inner diameter of the pipe to have a very tight tolerance, of the order of +0/+0.05 mm.

[0006] In the current state of the art, the cylindrical pipe used in tubular motors for the aforesaid automations, as well as for other similar uses, is obtained from a semifinished pipe of the two following types:

a) cold drawn weldless pipe, normally used to make hydraulic cylinders, having an inner diameter with tight dimensional tolerances, which manifests the drawback of a high cost, not justified for some specific use, such as that of casing for a tubular motor.

b) welded pipe, obtained from sheet steel in coils, that is cut longitudinally for the width corresponding to the development of the section of the profile to be produced and given cylindrical shape with the lateral edges placed in contact to allow their welding; it has the advantage of being very economical but, at the same time, it has the disadvantage of presenting an imprecise section, with shape errors (ovalisation) and wide tolerance (inner diameter of the order of +0/0.1 mm), which are not tolerable in specific applications, such as that of a casing of tubular motor.

[0007] Hence, it is necessary to manufacture steel pipes with an inner diameter having precise section and tight tolerance (of the order of +0/+0.05 mm) equal to cold drawn weldless pipes, but at a considerably lower cost; this is obtained using welded pipes with wide dimensional characteristics and hence low cost, that are subjected to a machining operation that makes it possible to obtain pipes with tight dimensional characteristics, equal to those of cold drawn weldless pipes, all this at a considerably lower and more competitive cost than the cost of similar pipes, which are currently produced only by a few pipe mill.

[0008] In practice, this machining operation is connected with a process that consists of an expansion calibration action where, through the use of a specific radial expansion spindle, which operates according to determined steps, the regular and controlled widening of the inner diameter of the pipe is achieved, exploiting the properties of the metal to be deformed plastically, when its elastic limit is exceeded.

[0009] Constructively, the expansion calibration spindle is connected with a stamping die consisting of a conical punch provided with a die with sectors, on which the pipe to be widened is inserted, so that, with the advance of the conical punch inside the die with sectors, a radial expansion of said die is caused and, consequently, a radial deformation of the pipe inserted thereon, in particular the widening of the inner diameter, all known in itself.

[0010] In the current state of the art, there are numerous types of machines suitable for this purpose, commonly known with the generic term of "pipe end forming machines", which operate in the manner described above.

[0011] By of example, the patent document no. EP 2 167 255 B is cited, where (see its fig. 1 - the references that follow relate to this application) a device is described in which a conical punch (ref. 2), which moves only by reciprocating in the axial direction and hence does not rotate, penetrates in a die with radial sectors or expander head (ref. 6), whereon the pipe to be widened is inserted, comprising radial sectors (ref. 10), commonly known by the generic term of "jaws", which expand radially at each step of penetration of said punch.

[0012] Moreover, after each expansion step, the jaws (ref. 10) are rotated by a determined quantity in the circumferential direction through the insertion of a rotating sleeve (ref. 12), whose structure and manner of operating are shown in figs. 2, 3, 4.

[0013] Specifically, the rotating sleeve (ref. 12) is provided with inner grooves (ref. 13) in which pins (fig. 14), with which the conical punch is provided (ref. 2), slide; in this way, because of the geometry of the aforesaid grooves (ref. 13), the reciprocating and non-rotating axial motion of the aforesaid conical punch (ref. 2) is transformed into a rotational motion of the aforesaid rotating sleeve (ref. 12).

[0014] Also by way of example, the patent document no. EP 1 938 950 A1 is cited, where (see its figs. 1,2 - the references that follow relate to this application) a device is described in which a conical punch (ref. 3), which moves only by reciprocating in the axial direction and hence does not rotate, penetrates in a die or expander head (ref. 2), whereon the pipe to be widened is inserted, comprising radial sectors or jaws (ref. 20), which expand radially at each step of penetration of said punch.

[0015] Moreover, after each expansion step, the jaws (ref. 20) are rotated by a determined quantity in the circumferential direction through the insertion into the body (ref. 1) of a ring (ref. 4), axially mobile, which holds the jaws (ref. 20) while allowing their axial movement and the securing on the conical punch (ref. 3) of a drum cam (ref. 5) that co-operates with the pins (ref. 4) integral with the aforesaid ring (ref. 4).

[0016] Specifically (see fig. 3), the drum cam (ref. 5) peripherally has a cam path (ref. 50) alternating longitudinal grooves (ref. 51) of equal depth to diagonal grooves (ref. 52) of variable depth and appropriately shaped, while the pins (ref. 42) are extensible under the action of a spring (ref. 43), so that they remain in contact with the path marked out on the cam (ref. 50); the conformation of the grooves (refs. 51, 52) and the manner of co-operation between the ring (ref. 4) and the cam (ref. 5), to cause the jaws (ref. 20) to be rotated automatically at each expansion, are described in the paragraphs from 0028 to 0031.

[0017] In essence, the two devices described above, indicated in their entirety with the references "A" and "B", both have two operating characteristics:

- the conical punch (ref. 2 of A and ref. 3 of B) moves only by reciprocating in the axial direction and hence does not rotate;
- the angular rotation of the jaws (ref. 10 of A and ref. 20 of B), after each expansion thereof, is obtained with the insertion of a mobile mechanism (rotating sleeve ref. 12 of A or mobile ring/drum cam ref. 4 of B, ref. 5 of B), which is inserted externally and coaxially with respect to the conical punch (ref. 2 of A and ref. 3 of B) and to the jaws (ref. 19 of A and ref. 20 of B).

[0018] Also, according to the prior art, to assure a regular contact of the jaws when they rest on the punch, as shown in figs. 1A and 1B, a punch is used that has, at least in its conical portion, the one that penetrates in the jaws to cause its radial displacement, a polygonal instead of a circular section.

[0019] By way of example, the patent document no GB 1 524 149 A is cited, which (see its figs. 1, 2 - the following references relate to this application) describes a manual tool used, in particular in the sector of plumbing, to expand the inner diameter of the end of a pipe, to obtain a seat adapted to receive a tap, another pipe, composed of a body (ref. 10) which contains a punch with hexagonal section (ref. 15) which is made to slide axially, by means of a ratchet (ref. 20) to be inserted in the cavity (ref. 34) defined by the jaws (ref. 28) which, consequently expand radially.

[0020] A purpose of the present invention is to define a process for machining a device, of the type relating to a process that consists of an expansion calibration action through the use of a specific spindle, which is innovative with respect to known similar processes.

[0021] Specifically, a purpose of the present invention is to define a process for machining an expansion calibration device, also called "calibrated widening" of welded pipes, which is constructively simple while allowing to expand, precisely and in very short times, a welded pipe from the initial diameter "d" to the final diameter "D"; by way of example, a commercial welded pipe is used with inner diameter "d" = 48.20 mm, with tolerance +0/+0.1 mm, to obtain a final pipe with inner diameter "D" = 53.10 mm, with a linear tolerance of +0/+0.08 mm and a shape tolerance of +0/+0.05 mm.

[0022] This purpose is achieved with a calibrated widening that is characterised in that it uses a punch with polygonal, not circular, section, provided with reciprocating roto-translational motion, instead of only translational reciprocating, where the circumferential rotation of the radial sectors that compose the die on which the pipe to be expanded/calibrated is inserted, after every step of penetration of the punch, is caused directly by the equal rotation of the punch on its surfaces, which define the frustoconical polyhedral surface of said punch, go rest on the inner surfaces of the corresponding radial sector, with no need to insert other auxiliary devices and where the micrometric incremental reciprocating roto-translational movement of the aforesaid punch is obtained by means of two distinct stations, one axial advance/return station and one angular rotation station, arranged cooperating at the end of said piston and commanded by a PLC.

[0023] These and further characteristics of the invention will become more readily apparent through the description of a possible embodiment thereof, given solely by way of non-limiting example, with the aid of the attached drawings, wherein:

- figs. 1, 2 represent two views, respectively, exploded and assembled, of the spindle of the invention;
- figs. 3-11 represent, respectively, front, lateral and section views of the components of the spindle of fig. 1;
- figs. 12-16 represent the steps of execution of the method of the invention;
- figs. 17-19 represent the steps for making the die;
- fig. 20 represent a sectioned elevation view of a machine that operates according to the process of the invention;
- figs. 21, 22 represent, respectively, the detailed and section view, according to the line XXII-XXII of fig. 21, of the radial sliding guide of the radial sectors.

[0024] As visible in figs. 1-11, the process of the invention uses a radial expansion spindle, indicated in its entirety with the reference 1, comprising a punch 2, which penetrates and support a radial sector die 3, on which is inserted the pipe "T" to be widened. The punch 2 has conical configuration with polygonal section, with a number of sides 4 equal to the number of the radial sectors 5, that constitute the die and that are mutually held and kept resting on the corresponding sides 4, by means of the elastic rings 6.

[0025] As shown by the succession of figures 3-11, at the beginning of the machining (fig. 12), the radial sector die 3, inserted on the punch 2, is fully closed, with the radial sectors 5 mutually mating, so as to form a cylindrical body on which is inserted the pipe "T" that has a diameter "d" smaller than the diameter "D" that has to be obtained at the end of the machining.

[0026] The machining starts (fig. 13) with the punch 2 that advances axially inside the die 3 of a portion "X" (first calibrated step), so that it causes a first widening of the die 3, with radial sliding of the sectors 5, which separate from each other and consequently cause a first increase "Δ_1" of the initial diameter, which becomes $d_1=d+\Delta_1$.

[0027] Subsequently (fig. 14) the punch 2 moves backwards axially by a minimal portion "k", so that the radial sectors 5, by effect of the containing action of the elastic rings 6, return radially, detaching from the inner wall of the pipe that has undergone the first widening "Δ" of the inner diameter and going back to rest on said punch 2.

[0028] Subsequently (fig. 15) the punch 2 rotates by an angular portion "α" and, consequently, it sets in rotation by an equal angular portion also the entire die 3 coupled thereto.

[0029] The operation proceeds with the repetition by "n" times of the steps described above (fig. 16), i.e. with "n(k+X)" calibrated steps, until the increase "n Δ" of the initial inner diameter "d" allows to reach the value of the final diameter "D" ($D = n\,\Delta + d$), with a pre-set tolerance.

[0030] Operatively, with the succession of the combined movement of return-rotation-advance of the punch 2, successive widenings of the die 3 are caused, because, by effect of the axial advance of the punch 2, there is a new radial sliding of the sectors 5, which separate from each other and, consequently, cause a further increase "Δ" of the initial diameter, which becomes $d_2= d_1+\Delta$. In addition, by effect of the angular rotation, said sectors 5, extended radially, go rest on the inner wall of the pipe "T" on portions different from those whereon the aforesaid sectors 5 rested during the previous widening step, in order to cancel out the eccentricity caused by the radial notches present between the sectors 5, when they are extended, so as to obtain a perfect circularity of the section of the pipe "T".

[0031] Constructively, the die 3, comprising the radial sectors 5, is obtained from an element (fig. 17) consisting of a tang 30, with a diameter "D_1" equal to the diameter "D" of the pipe "T" at the end of the machining, which is divided in radial sectors 5 by radial notches 31 that have a width "l" (fig. 18) such that, when the aforesaid sectors 5 are mutually approached, the tang 30 assumes a diameter "d1" equal to the diameter "d" of the pipe "T" at the start of the machining (fig. 19).

[0032] As shown in fig. 20, the machine that operates with the aforesaid process, indicated in its entirety with the reference 100, comprises a structure 101, which supports the advance/return station, indicated in its entirety with the reference 10, an angular rotation station, indicated in its entirety with the reference 20, a support station of the spindle 1, indicated with the reference 30, and a device for locking the pipe "T", indicated with the reference 40.

[0033] Constructively, the advance/return station 10 consists of a gear motor 11, such as a brushless motor provided with encoder, which sets in rotation a shaft 12, which engages in a ball screw 13, that generates the longitudinal sliding of a motorised axle 14 and, consequently, also the longitudinal sliding (arrow F_1) of the advance/return station 20 connected thereto and where, through a PLC, the position of the aforesaid motorised axle 14 is constantly modified, based on the value obtained by adding to the value of the diameter of the pipe that was just machined, measured, for example by means of a bore gauge, the nominal value "Δ", so as to maintain the value of the measurement of the inner diameter of the pipe within the predefined tolerance values. The angular rotation station 20 of the punch 2 comprises a transmission set 21, such as an axial pneumatic cylinder 22 that meshes, through a rack 23, with a pinion 24, splined on the tang 25 of the punch 2 so as to impart on the aforesaid punch 2 a micrometric angular rotation (arrow F_2) where the value of the transmission ratio is defined by the PLC according to the value of the amplitude of the angular rotation to be imparted to the radial sectors 5 of the die 3.

[0034] As shown in figs. 21-22, in the block 30, which supports the die 3, and the blocking device 40 of the pipe "T", is inserted a mechanism 50, which constrains and regulates the radial expansion motion of the radial sectors 5 so as to assure a controlled deformation of the pipe "T" for the entire axis of expansion of the tongs, in which each radial sector 5 is provided with a key 51, engaged to slide in a corresponding radial slot 52, obtained on a disk 53 inserted in the aforesaid block.

[0035] In practice, with the process and the machine of the invention it is possible to produce pipes for tubular motors of the "motor blind" type, which require a pipe with external diameter 54/54.6 mm with thickness of 0.8 mm, using the commercial welded pipe that is closest to these values, which has an outer diameter of 50 mm and a thickness of 0.8 mm, widening it from the interior, maintaining tight tolerances, by using a die 3 with sectors 5, which expand radially.

[0036] Exemplifying, to obtain a pipe with outer diameter De = 54.6 mm and inner diameter Di = of 53.00 mm, with tolerance of +0/0.08 mm, the die 3 has a tang 30 with diameter D_1= 55.08 mm which, after it is divided in radial sectors 5, assumes a smaller diameter "di" into which can be inserted, without interference, the starting pipe, with an outer diameter De = 50 mm and thickness of 0.8/0.9 mm.

[0037] Obviously, different embodiments of the invention are possible and its components can be replaced by equivalent elements, provided that there is no departure from the inventive concept defined by the following claims.

Claims

1. PROCESS FOR MACHINING WELDED PIPES, in which commercial, low cost welded pipes are used that have an imprecise section, with shape errors (ovalisation) and ample tolerances of an inner diameter (d), in order to obtain welded pipes that have a perfectly circular section and a greater inner diameter (D) with considerably reduced tolerances, of the order of +0/+0.05 mm, and that consists of an expansion calibration machining operation, where, through the use of a spindle and exploiting the properties of the metal to deform plastically, when its elastic limit is exceeded, the regular and controlled widening of the inner diameter of the pipe is achieved, and where a radial expansion spindle (1) is used, comprising a punch (2) that penetrates coaxially in a die (3), composed of radial sectors (5), on which a pipe (T) to be widened is inserted exercising an expansion calibration action consequently to the radial displacement of said radial sectors (5),
said process being characterised in that
a punch (2) is used, which has frustoconical configuration with polygonal, not circular, section, with a number of sides (4) equal to the number of the radial sectors (5), which constitute the die (3) and which are mutually held and maintained supported on the corresponding sides (4), by means of elastic rings (6), where said punch (2) is provided with a reciprocating roto-translational incremental movement (Fi, F_2) and said radial sectors (5) undergo, after each step of penetration of the punch (2) in the die (3), an angular rotation that is caused directly by the angular rotation of the aforesaid punch (2), on whose surfaces of the sides (4) the inner surfaces of the corresponding radial sectors (5) rest and where the aforesaid reciprocating roto-translational incremental movement of the punch (2) is obtained by means of two distinct stations, and specifically by an axial advance/return station (10) and an angular rotation station (20) arranged cooperating at the end of said punch (2) and commanded by a PLC.

2. PROCESS FOR MACHINING WELDED PIPES, according to claim 1, **characterised in that** the succession of the movements of return-rotation-advance of the punch (2), that take place with the following steps:

- at the start of the machining, the radial sector die (3), inserted on the punch (2), is fully closed, with the radial sectors (5) mutually mating, so as to form a cylindrical body on which is inserted the pipe (T) that has a diameter (d) smaller than the diameter (D) that has to be obtained at the end of the machining;
- the machining starts with the punch (2) that advances axially inside the die (3) by a portion (X), first calibrated step, so that it causes a first widening of the die (3), with radial sliding of the sectors (5), which separate from each other and consequently cause a first increase (Δ) of the initial diameter (d), which becomes equal to $d_1 = d+\Delta$.
- subsequently the punch (2) moves backwards axially by a minimal portion (k), so that the radial sectors (5), by effect of the containing action of the elastic rings (6), return radially, detaching from the inner wall of the pipe (T), that has undergone the first widening (Δ) of the inner diameter and go back to rest on said punch (2);
- subsequently the punch (2) rotates by an angular portion (α) and, consequently, it sets in rotation by an equal angular portion also the entire die 3 coupled thereto.
- the operation proceeds with the repetition by "n" times of the steps described above, i.e. with "n(k+X)" calibrated steps, until the increase ($n\Delta$) of the initial inner diameter (d) allows to reach the value of the final diameter (D) equal to $D = n\,\Delta_1 + d$, with a pre-set tolerance,

this causing successive widenings of the die (3), because, by effect of the axial advance of the punch (2), there is a new radial sliding of the sectors (5), which separate from each other and, consequently, cause an additional increase (Δ) of the initial diameter ($d_2 = d_1+\Delta$) and in addition, by effect of the angular rotation, said sectors (5), extended radially, rest on the inner wall of the pipe (T) on different portions from those whereon the aforesaid sectors (5) rested during the previous widening step, in order to cancel out the eccentricity caused by the radial notches present between the sectors (5), when they are extended, so as to obtain a perfect circularity of the section of the pipe (T).

3. MACHINE FOR MACHINING WELDED PIPES, which operates according to the process according to one or more of claims 1 or 2,
said machine (100) **being characterised in that** that the advance/return station (10) of the punch (2) consists of a gear motor (11), which sets in rotation a shaft (12), which engages in a ball screw (13), that generates the longitudinal sliding (Fi) of a motorised axle (14) and of the advance/return station (20) connected thereto and where, through a PLC, the position of the aforesaid motorised axle (14) is constantly modified, based on the value obtained by adding to the value of the diameter of the pipe that was just machined, the nominal value "Δ", so as to maintain the value of the measurement of the inner diameter of the pipe within the predefined tolerance values.

4. MACHINE FOR MACHINING WELDED PIPES, which operates according to the process according

to claims 1 or 2,
said machine (100) **being characterised in that** the angular rotation station (10) of the punch (2) consists of a block that supports said punch (2) and comprises a transmission set (21), such as an axial pneumatic cylinder (22) that meshes, through a rack (23), with a pinion (24), splined on the tang (25) of the punch (2) so as to impart on the aforesaid punch (2) a micrometric angular rotation (F_2) where the value of the transmission ratio is defined by a PLC according to the value of the amplitude of the angular rotation to be imparted to the radial sectors (5) of the die (3).

5. MACHINE FOR MACHINING WELDED PIPES, which operates according to the process according to claims 1 or 2,
said machine (100) **being characterised in that** it comprises a mechanism (50) that constrains the radial expansion displacement of the radial sectors (5), in which each radial sector (5) is provided with a key (51) engaged to slide in a corresponding radial slot (52), obtained on a disk (53) inserted in a support block (30) of the die (3) and of a locking assembly (40) of the pipe (T).

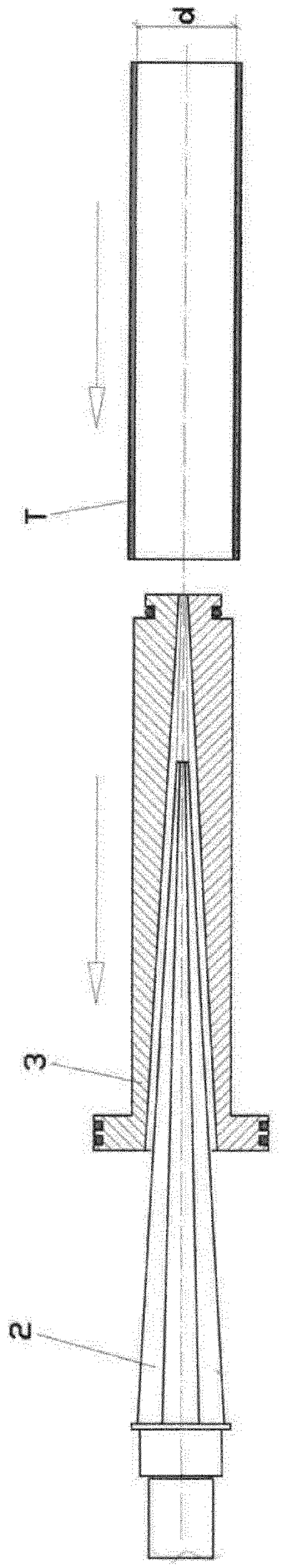

FIG.2

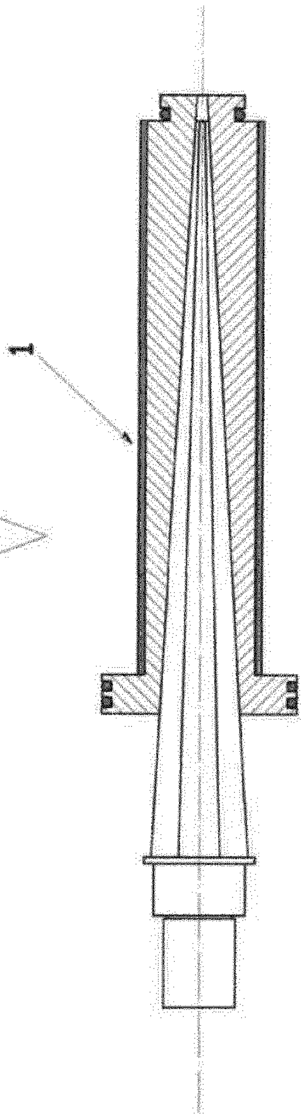

FIG.1

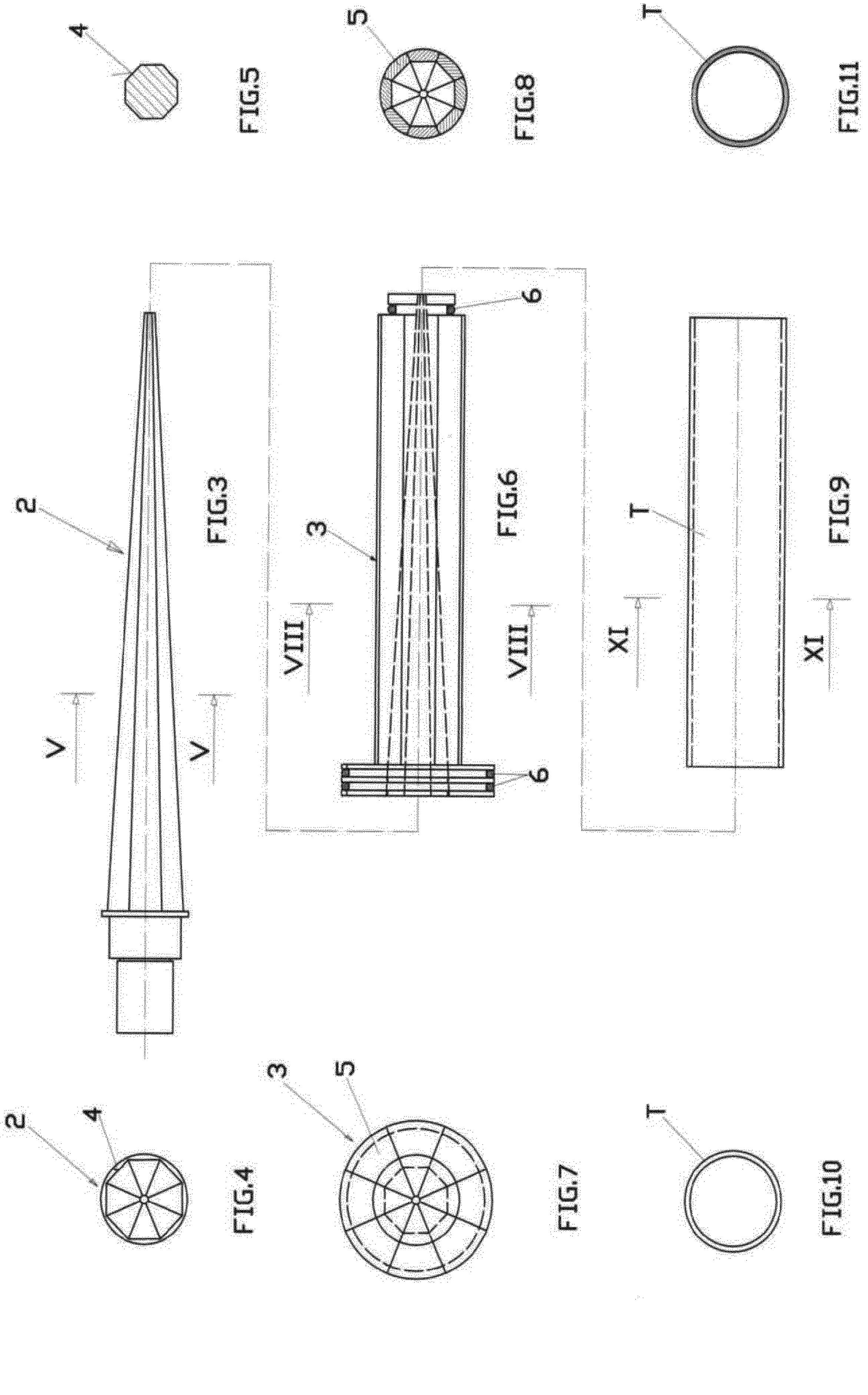
FIG.5
FIG.8
FIG.11
FIG.3
FIG.6
FIG.9
FIG.4
FIG.7
FIG.10
2
3
4
5
6
T
V
VIII
XI

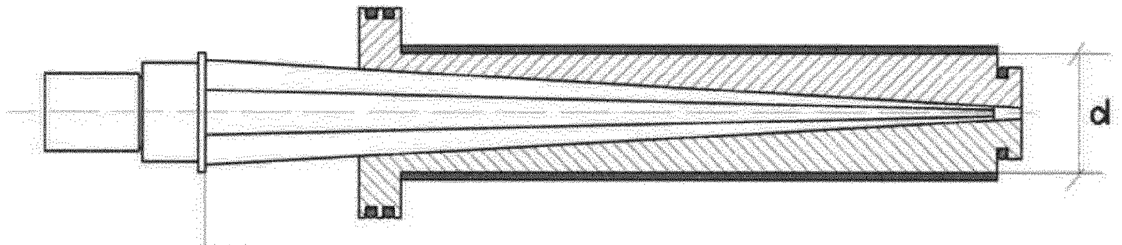

FIG.12

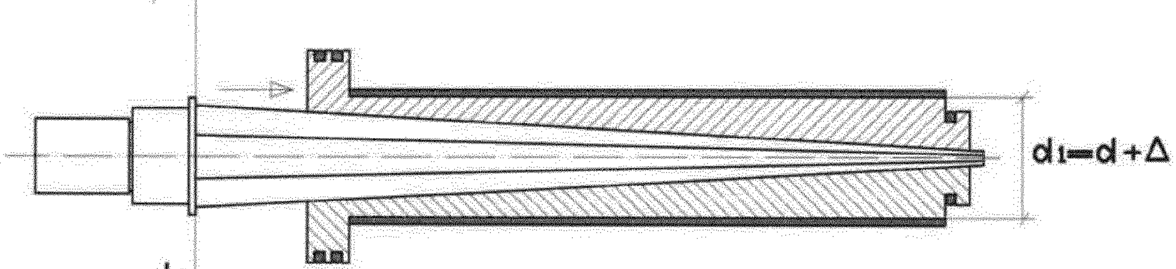

FIG.13

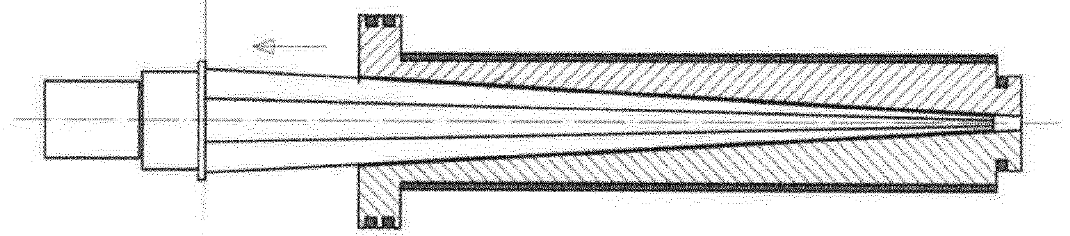

FIG.14

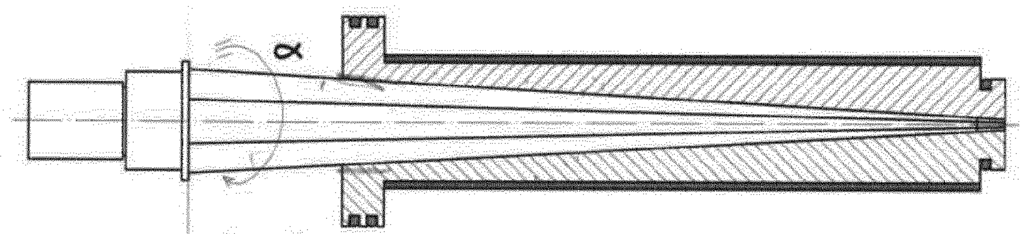

FIG.15

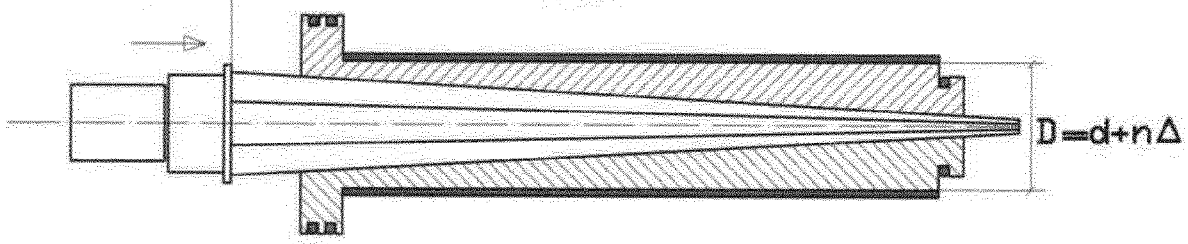

FIG.16

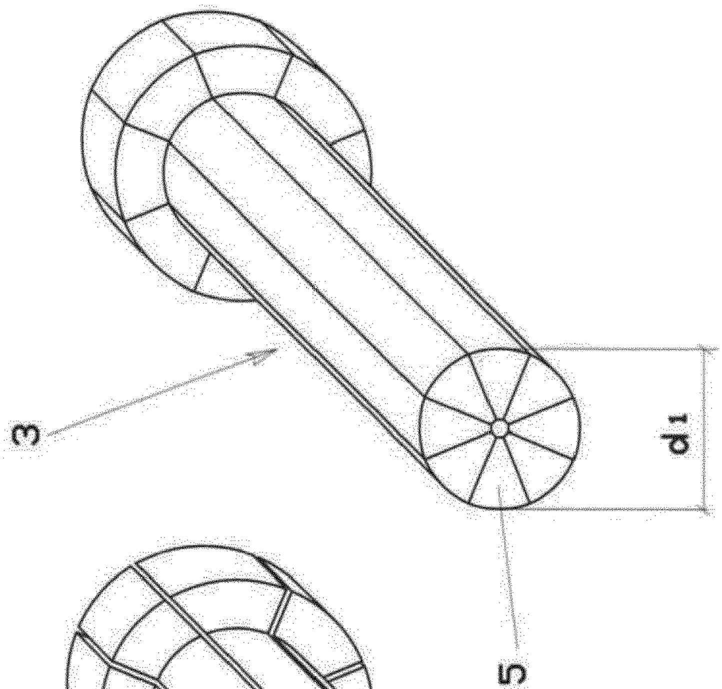

FIG.19

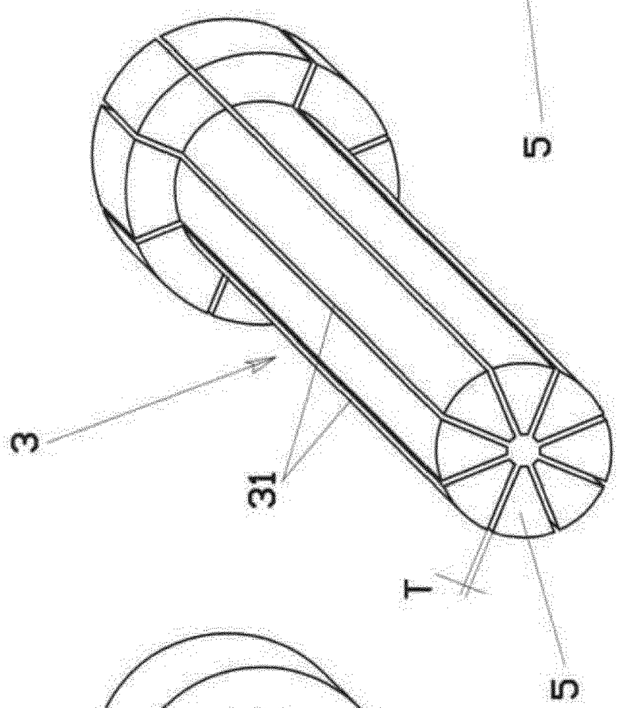

FIG.18

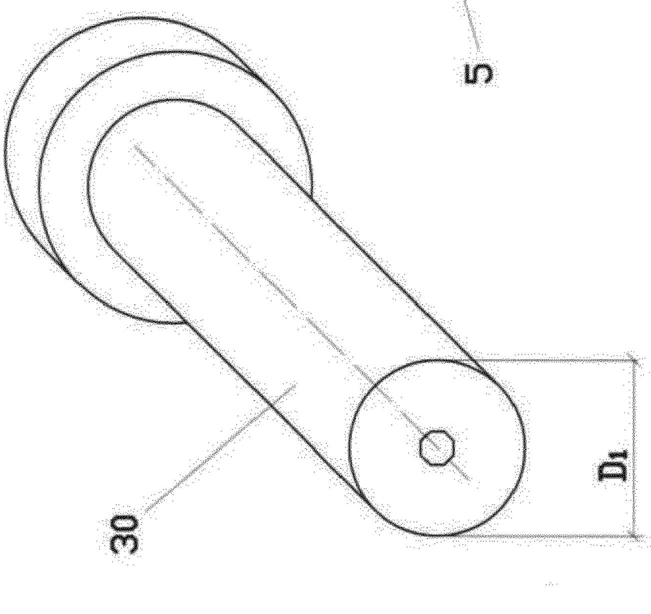

FIG.17

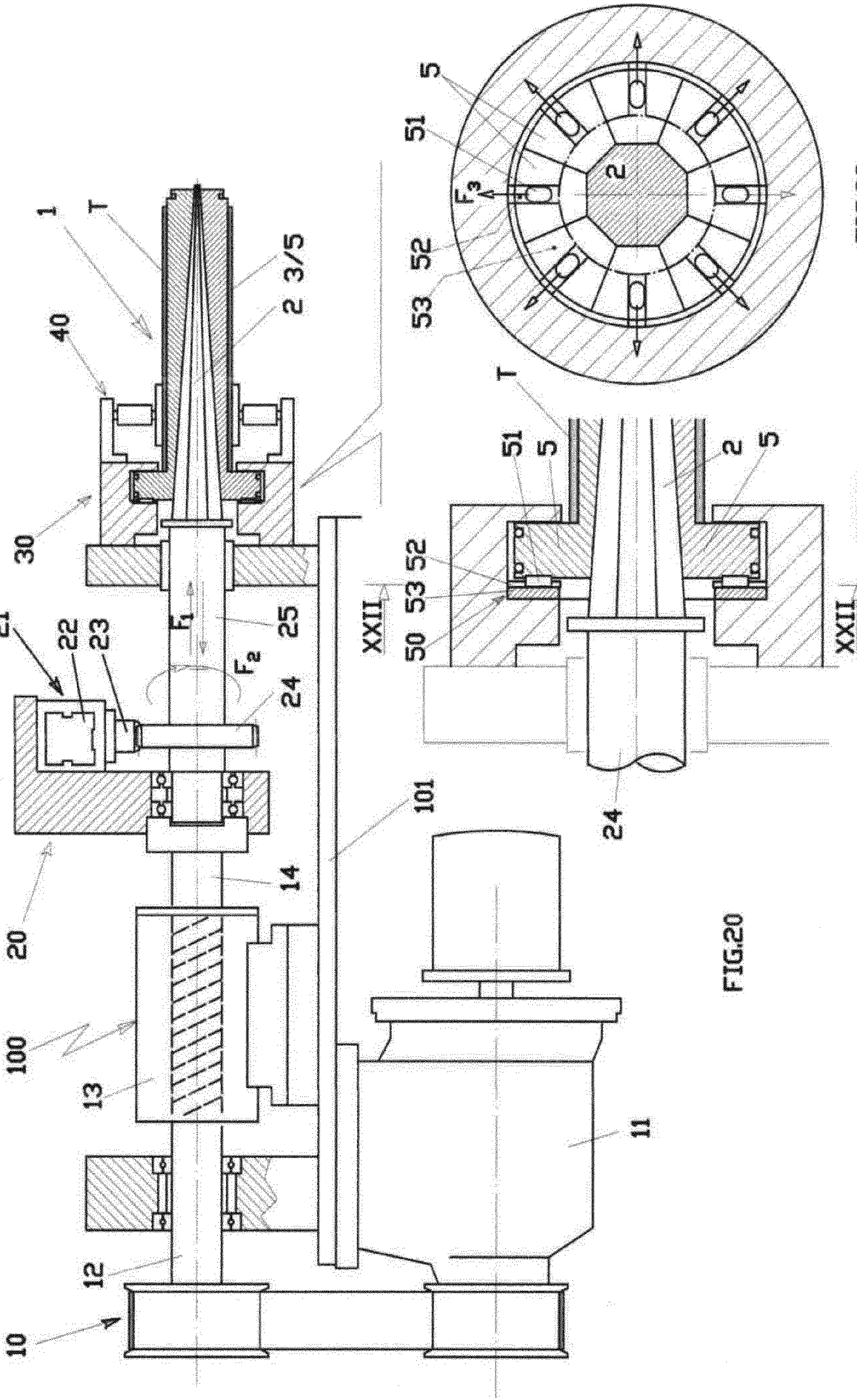

FIG.20

FIG.21

FIG.22

Europäisches Patentamt
European Patent Office
Office européen des brevets

EUROPEAN SEARCH REPORT

Application Number
EP 19 15 4917

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,D	EP 2 167 255 B1 (UPONOR INNOVATION AB [SE]) 3 July 2013 (2013-07-03) * paragraph [0027] - paragraph [0039]; figure 1 * -----	1-5	INV. B21D41/02
A,D	EP 1 938 950 A1 (VIRAX SAS [FR]) 2 July 2008 (2008-07-02) * paragraph [0024] - paragraph [0034]; claims 1-4; figures 1-4a,4b,4c * -----	1-5	
A,D	GB 1 524 149 A (ROTHENBERGER GMBH CO) 6 September 1978 (1978-09-06) * figures 1-3 * -----	1-5	

TECHNICAL FIELDS SEARCHED (IPC)

B21D

The present search report has been drawn up for all claims

1

Place of search	Date of completion of the search	Examiner
Munich	17 June 2019	Vinci, Vincenzo

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 19 15 4917

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.

17-06-2019

Patent document cited in search report	Publication date	Patent family member(s)	Publication date
EP 2167255 B1	03-07-2013	CA 2690964 A1	31-12-2008
		EP 2167255 A1	31-03-2010
		ES 2433372 T3	10-12-2013
		PT 2167255 E	09-10-2013
		US 2010308503 A1	09-12-2010
		WO 2009000966 A1	31-12-2008
EP 1938950 A1	02-07-2008	AT 489219 T	15-12-2010
		AT 544577 T	15-02-2012
		EP 1938950 A1	02-07-2008
		EP 2226182 A2	08-09-2010
		EP 2258537 A1	08-12-2010
		EP 2332716 A2	15-06-2011
		ES 2356516 T3	08-04-2011
		ES 2378459 T3	12-04-2012
		ES 2391675 T3	28-11-2012
		FR 2910828 A1	04-07-2008
		US 2008160130 A1	03-07-2008
		US 2011151045 A1	23-06-2011
GB 1524149 A	06-09-1978	BE 848677 A	16-03-1977
		DE 2552607 A1	02-06-1977
		FR 2332082 A1	17-06-1977
		GB 1524149 A	06-09-1978
		NL 7612841 A	26-05-1977

EPO FORM P0459

For more details about this annex : see Official Journal of the European Patent Office, No. 12/82

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 2167255 B **[0011]**
- EP 1938950 A1 **[0014]**
- GB 1524149 A **[0019]**