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

(11) Publication number: **0 249 804**
A2

(12) # EUROPEAN PATENT APPLICATION

(21) Application number: 87108005.7

(22) Date of filing: 03.06.87

(51) Int. Cl.⁴: D02G 1/16

(30) Priority: 17.06.86 GB 8614727

(43) Date of publication of application: 23.12.87 Bulletin 87/52

(84) Designated Contracting States: CH DE GB IT LI

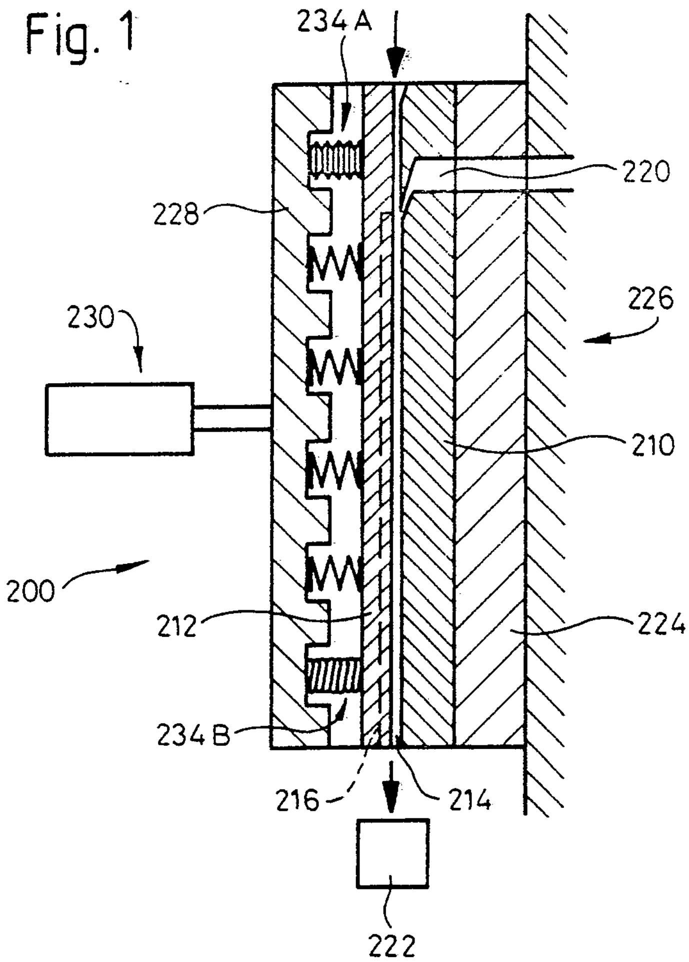
(71) Applicant: MASCHINENFABRIK RIETER AG
Postfach 290
CH-8406 Winterthur(CH)

(72) Inventor: Werner, Nabulon
Schneehalde 116
CH-8455 Rüdlingen(CH)

(54) **Thread treating nozzles.**

(57) An openable and closable thread treating nozzle is partly defined by a plate which is elastic under closure forces applied in use to create sealing zones adjacent and on each side of a thread passage through the nozzle.

Fig. 1



EP 0 249 804 A2

THREAD TREATING NOZZLES

The present invention relates to modifications and improvements in the thread treating nozzle described and claimed in our European Patent Application No. 85112265.5, which is to be published on 18 June 1986 under the Publication No. 184625, and in the corresponding U.S. Patent Application S.N. 06/677591 filed December 3, 1984, in the name of Werner Nabulon. These Patent Applications will be referred to hereinafter as the "prior applications". Great Britain is specified in the "designation of states" in the prior European Application.

The prior applications describe and claim an arrangement which, for convenience, will be referred to briefly as an "elastic-sided" thread treating nozzle. The nozzle comprises a plurality of parts, which define a thread treating passage between them, and which are movable relative to each other to enable opening of the nozzle for thread insertion, and subsequent closing of the nozzle with the thread in the passage. In accordance with the prior applications, at least one part is made elastic under closing forces applied in use, so as to ensure that sealing contact is made between the parts around the passage. It now appears, however, that this concept is broadly disclosed in British Patent Specification No. 1310227 (corresponding with German published Application No. 2049740), in particular in claim 2 thereof. These prior-published specifications propose that the elastic part of the nozzle should be made of polyurethane rubber. Furthermore, closing forces are applied to the nozzle by way of a lever acting adjacent a hinge joining the two nozzle parts. For reasons which will be explained in further detail in the course of the description of the drawings, such an arrangement is unlikely to be suitable under a wide range of operating circumstances, involving in particular significant closing forces (high operating pressures in the nozzle passage) and/or high temperatures.

The basic nozzle structure to which the present invention is to be applied is disclosed in the prior applications referred to above. This structure comprises first and second parts which define between them a thread passage through the nozzle, the parts being movable relative to each other in order to open the nozzle to enable insertion of thread into the passage and to close the nozzle around the thread. The structure further comprises infeed means for feeding a treatment fluid to the passage to flow therethrough and draw the thread along the passage. The first part of the nozzle has first and second sealing surfaces disposed on respective opposite sides of the passage, and corresponding first and second sealing surfaces are provided on the second part. Closure force applying means is provided to apply closure forces urging the first and second sealing surfaces on the first part into engagement with the first and second sealing surfaces respectively on the second part. At least one of the parts is flexible under the action of the applied closure forces. The closure force applying means engages the flexible part on a face opposite to and substantially aligned with said passage.

The result is that the lines of action (vectors) of the forces applied by the closure force applying means to said one part extend in directions substantially at right angles to said first and second sealing surfaces. This is in strong contrast to the arrangement shown in British Specification No. 1310227, in which the closure forces are created by application of a turning moment tending to swing the elastic part around a hinge pin.

The arrangement also enables face to face sealing contact to be made on both sides of the passage in sealing zones immediately adjacent the passage. This means that the parts can be formed to provide a predetermined passage cross-section, which will be maintained even under the application of closure force in use. This defines broad limits for the flexibility of the one part; the flexibility must be high enough to enable the part to deform if necessary under the closure forces to enable such face to face sealing contact to be made on both sides of the passage; on the other hand, the flexibility (deformability) must be low enough to prevent deformation of the part under said closure forces, or under the pressure of fluid in the passage, so as to cause variation of the passage cross-section in use. The passage cross-section is not, of course, necessarily uniform along the length thereof; it may vary in a predetermined fashion along that length, but should not change in an uncontrolled fashion in response to application of operating forces.

Closure force may be applied to the one part by contact of the closure force applying means with a zone of the part which is localized relative to said first and second sealing surfaces on the parts, i.e., the area of the zone may be much less than that of the surfaces. As indicated in the prior applications, however, the closure force applying means preferably contacts the one part at positions on respective different sides of the passage, so that closing pressure is effectively generated on both sides of the passage.

By way of example, some embodiments of the invention will now be disclosed with reference to the accompanying diagrammatic drawings, in which :

Fig. I is a longitudinally sectioned view of a thread treating nozzle in accordance with the invention,

Fig. 2 is a transverse section of one form of nozzle in accordance with the view shown in Fig. I,

Fig. 3 is a transverse section of an alternative form of nozzle, also in accordance with the view shown in Fig. I,

Fig. 4 is a section of a plate mounting suitable for use in the embodiments of Figs. 2 and 3,

Fig. 5 A, B, C and D show details of sealing zones under varying circumstances, and

Fig. 6 is a diagrammatic side elevation of a thread texturizing apparatus employing a nozzle in accordance with Fig. I.

The nozzle assembly 200 shown in Fig. I comprises a thread treating nozzle made up of a relatively rigid block 2I0 and a relatively elastic plate 2I2. As in the case of the corresponding element (block I0) shown in the prior applications, block 2I0 has a groove 2I4 extending from end to end thereof and forming a thread passage through the nozzle. In the preferred embodiment, the thread passage is provided solely by this groove 2I4 in block 2I0. As indicated in dotted lines, however, a corresponding groove 2I6 can be provided in plate 2I2, so that at least part of the thread passage is made up by the combination of grooves 2I4, 2I6. An embodiment of this type is illustrated in Fig. 2, in which the thread passage made up by grooves 2I4 and 2I6 is indicated at 2I8.

Block 2I0 is provided with infeed means generally indicated at 220, by means of which a treatment fluid is fed into the thread passage at a position between the ends thereof. A suitable arrangement for this purpose is shown in the prior applications, and also in our European Patent No. I23829. Accordingly, those details will not be repeated here. The treatment fluid flows from its entry point into the thread passage downwards as viewed in Fig. I, thereby drawing a thread in the passage in the same direction as indicated by the arrows at the top and the bottom of the nozzle shown in this figure. It will be noted that the upstream portion of the thread passage, i.e. the portion thereof upstream from the entry point of the treatment fluid, is in any event provided simply by a groove in block 2I0 without any corresponding groove in plate 2I2.

In contrast to the nozzles shown in the prior applications, the nozzle illustrated in Fig. I does not include an integral texturizing chamber. The illustrated nozzle is designed primarily to exert a forwarding effect on the thread. By heating the infeed fluid (air, or possibly steam), the fluid may be arranged to heat the thread, or at least to maintain a thread temperature previously achieved by preheating. The box 222 in Fig. I represents a receiving device for receiving the thread forwarded by the nozzle. As will be described with reference to Fig. 6, device 222 can be designed to texturize the thread, but in a manner radically different from that illustrated in the prior applications. Of course, the nozzle shown in Fig. I could equally be used in conjunction with a texturizing chamber as shown in those prior applications. However, receiving device 222 could also take other forms.

As in the case of the prior applications, the nozzle is of the openable and closable type to facilitate insertion of thread into the thread passage, such as passage 2I8 in Fig. 2. In the arrangement shown in that figure, block 2I0 is mounted in a housing portion 224 which is fixed to a suitable carrier generally indicated at 226. Carrier 226 and housing 224 have suitable openings aligned with infeed means 220 in Fig. I to enable suitable supply of the treatment fluid.

Plate 2I2 is mounted in a second housing portion 228 which is acted upon by a piston and cylinder unit 230. When the latter is suitably pressurized, housing portion 228 is forced to the right as viewed in Figs. I and 2 so as to engage housing portion 224 at a contact surface 232. The nozzle is closed simultaneously, but the closure forces are not applied directly from the piston and cylinder unit 230; instead, they are applied by resilient means indicated at 234 in Fig. 2. This resilient means may comprise packets of cup springs (Belleville washers) as indicated at 234 A in Fig. I, or spiral compression springs as indicated at 234B in Fig. I.

A method of mounting the plate 2I2 on housing portion 228 without interfering with the closing action applied by the resilient means 234 is indicated diagrammatically in Fig. 4. As illustrated there, a packet of Belleville washers 234A encircles a mounting pin 236 which is fixedly secured at one end, for example by screws, to plate 2I2. Pin 236 extends into a bore 238 in a sleeve 237 fixed (for example by screws) to housing portion 228, and is movable in that bore within limits defined by confining means now to be described.

At its end adjacent plate 2I2, sleeve 237 has an inwardly projecting flange 240 engageable with a flange 24I on pin 236 to limit movement of plate 2I2 to the right (as illustrated in Fig. 4) relative to the housing portion. Plate 2I2 can, however, be forced to the left (as viewed in Fig. 4) relative to housing portion 228 against the bias applied by springs 234A until plate 2I2 sits on sleeve 237. This back and forth movement of plate 2I2 is limited in the transverse direction by confinement of the free end of pin 236 in a bore of guide ring 243 which is itself guided in the bore of sleeve 237 and is pressed against housing 228 by the springs 234A. Pin 236 has sufficient play relative to all guiding/confining surfaces to avoid interference as plate 212 flexes in use.

As indicated by the simple diagram in Fig. 2, plate 212 and block 210 ideally make sealing contact at all points on a sealing plane which intersects the passage 218 and which may be considered to be defined by a first pair of sealing surfaces 242 lying above passage 218 as viewed in Fig. 2, and a second pair of sealing surfaces 244 lying below the passage in that figure. Each pair of surfaces comprises one surface on block 210 and one surface on plate 212.

In practice, it is not a simple matter to obtain the required contact of sealing surfaces 242, 244, and some of the difficulties in this respect will now be explained with reference to the diagrams in Figs. 5 A, B, C and D. For purposes of illustration, an embodiment has been selected in which the thread passage, corresponding to the passage 218 in Fig. 2, is provided by a groove 214A in the block 210 only. Groove 214A is assumed to be of triangular cross-section, but again, this is merely for purposes of illustration; the groove cross-section can be adapted to the operating circumstances. Plate 212 is designed to present a planar surface to block 210, giving a thread passage accurately designed by the groove 214A in block 210. A zone of contact between plate 212 and the closure force applying means (resilient means 234) is indicated by the diagrammatically illustrated element 246 of the closure force applying means. This element can, for example, be one of the Belleville washers 234A, a part of the compression spring 234B, or (as in the preferred embodiment according to Fig. 4) a pressure plate interposed between the resilient means 234 and plate 212. As seen in Fig. 5 A), the region of contact defined by element 246 is aligned with groove 214A (as previously disclosed in the prior application) thereby ensuring sealing contact of the surface pairs 242, 244 in the regions immediately adjoining groove 214A.

Fig. 5 B indicates an alternative arrangement based upon principles shown in German published Patent Specification (Auslegeschrift) No. 2049740. In this arrangement, closing force is not applied in alignment with groove 214A, but adjacent a non-illustrated hinge joining plate 212 and block 210 at one longitudinal edge thereof, assumed to be to the left of Fig. 5 B.

Where plate 212 has a degree of elasticity, there is the danger that a gap 248 will open up between the sealing surfaces 242 on the side of groove 214A opposite the non-illustrated hinge.

If a further closure force is applied to correct the defect in Fig. 5 B by urging the edge region of plate 212 remote from the hinge into contact with block 210, then the result illustrated in Fig. 5 C may be obtained. In this case, sealing contact is made by the surface pairs 242, 244, but this sealing contact occurs in regions spaced from the groove 214A. Due to high operating pressure in the thread passage, the elastic plate 212 bows slightly as indicated at 250 in the region of groove 214A, and the effective cross-section of the thread passage is no longer determined solely by the form of the triangular-section groove.

These effects have, of course, been exaggerated for purposes of illustration in Figs. 5 B and 5 C. However, at least in texturizing of synthetic filament threads, even minor deviations from the required conditions illustrated in Fig. 5 A can cause significant variation in thread characteristics from one texturizing nozzle to another. As previously noted in the prior applications, however, provided sealing contact is made between the surface pairs 242, 244 immediately adjacent groove 214A, it is not important whether sealing contact is made in the edge regions of those surface pairs remote from the groove; when the nozzle is closed, those edge regions are in any event isolated from groove 214A by the illustrated regions of sealing contact to either side of that groove.

Flexibility of plate 212 is determined by the material of the plate, and its form and dimensions. The flexibility of the plate must also be considered in relation to the applied closure forces. Consider, for example, the arrangement illustrated in Fig. 5 D. In this case, contact is made between the sealing surface pairs 242, 244 in the required regions adjacent groove 214A. However, with a highly localized closure force F, and a material of high malleability in the plate 212, the latter may be deformed into the groove 214A as indicated in exaggerated fashion by the ridge 252 in Fig. 5 D. With a highly deformable (rubber-like) material in the plate 212, the effect illustrated in Fig. 5 D might be obtained even without the "point contact" application of closure force F indicated in that figure. This deformation of plate 212 clearly alters the cross-section of the thread passage from that determined by groove 214A, and also carries with it the danger of plastic deformation of plate 212 (a permanent set in the material of the plate).

As far as material is concerned, a metal is preferred for the heat conductivity reasons already discussed in the prior applications. However, the better heat conducting metals (such as bronze or brass) are often not resistant to substances present in the treatment fluid (for example, to spin finish applied to synthetic filament threads before they enter the texturizing stage of the production process). Chemical interactions may destroy the nozzle surface in the thread passage and/or have an undesirable effect on the threads processed. This is especially true at higher processing temperatures. Nozzle temperatures in the range 150 °C to 400 °C are used in texturizing synthetic filament threads, but temperatures in the range 160 °C to 280 °C are most common.

The metal can be provided with a protective coating, but this will wear away and expose the underlying metal sooner or later. Accordingly, the preferred solution is to form the passage itself in parts made of a hard metal, which is inherently chemically resistant, and to enclose these parts in a housing having relatively good heat conducting properties. Stainless steel (rust-resistant steel) is a convenient, chemically resistant material, but other tough, chemical and erosion-resistant metals can be used provided plates thereof can be manufactured in the required dimensions (with an adequate degree of flexibility).

As far as form is concerned, the simple rectangular form (with or without a groove to define the thread passage) is preferred as illustrated in Fig. 2. This form of plate is relatively simple to manufacture. However, it is not essential to the invention; for example, the sealing surfaces 242, 244 could be curved in transverse cross-section when the nozzle is closed.

The thickness of the plate 212 in a direction at right angles to the sealing surfaces will exert a major influence upon the flexibility of the plate. A further dimension exerting a significant influence upon the relevant flexibility of the plate is its width (dimension at right angles to the thickness as defined above, and to the length of the thread passage). In a nozzle forming part of a thread texturizing system using hot air as a treatment fluid, a stainless steel plate in the form shown in Fig. 2 may have a thickness in the range 2 to 8 mm, and a width in the range 12 to 25 mm. The lower limit of the plate thickness is given by the conveniently available means for manufacturing such a plate in the required form, while the upper limit of the thickness range is given by the loss in flexibility arising with increasing thickness. The preferred thickness range is 3 to 6 mm. For purposes of comparison, it is mentioned that the thickness of a corresponding stainless steel block 210 may lie in the range 8 to 15 mm. This thickness is relatively unimportant as far as flexibility/rigidity of the structure is concerned because the block is in any event extensively supported by the corresponding heat conductive housing portion 224. The thickness of the steel block is preferably kept low for reasons of conductivity, however.

The length of the plate 212 is clearly dependent upon the details of the nozzle design; there will be a radical difference, for example, between a plate for use in a nozzle comprising an integrated texturizing chamber (as illustrated in the prior application) and a plate for use in a nozzle providing primarily a forwarding action urging a thread into a separately formed texturizing section, as generally indicated in Fig. 1 and as will be subsequently described with reference to Fig. 6. In any event, the length of the plate is of less significance as regards flexibility than the width thereof. If the plate is sufficiently flexible in the transverse direction (across its width) it will almost certainly prove to have sufficient flexibility in the longitudinal direction (along its length). As shown in Fig. 1, a number of closure force applying devices (resilient means 234) can be spaced along the length of the nozzle to ensure that strip-like sealing contact zones are created to either side of the passage 218 along the full length thereof. The devices may be longitudinally spaced by a distance (center to center) of between 15 and 30 mm along the length of the thread passage. The overall length of a nozzle as shown in Fig. 1 (corresponding to the overall length of plate 212) may lie in the range 60 to 150 mm. Shorter nozzles generally are associated with higher operating temperatures.

Each closure device (resilient means 234, in the form of a spiral compression spring or packet of Belleville washers) may be adapted to apply a force in the range 400 to 800 N. The total closure force applied to plate 212 by all of the closure devices aligned with the thread passage 218 may lie in the range 1'000 to 3'500 Newton, and there will commonly be four to six such devices in a nozzle of the form shown in Fig. 1. The piston and cylinder unit 230 is preferably adapted to apply a greater force to the housing portion 228, for example a force exceeding the total closure force applied to plate 212 by approximately 50%.

Although the plate 212 must be flexible to enable sealing contact to be made as described above, the material of the plate must be able to resist localised deformation in the region of the thread passage. This has been explained by reference to Fig. 5 C and Fig. 5 D for the case in which the plate is designed to bridge a preformed groove in the other nozzle part. It applies equally, of course, where the passage is made up by grooves in both parts. In texturizing of synthetic filament threads, the passage cross-section may lie in the range 2.5 to 10 square millimeters at the junction region where the thread and treatment fluid are first brought together, and it may increase to a value in the range 6 to 20 square millimeters at the downstream end of a nozzle as shown in Fig. I. The high pressures at the junction region are likely to lead to the greatest deformation problems.

As shown in Fig. 3, the elastic plate (and the corresponding block) can be arranged to define more than one thread passage. In this case, plate 212A and block 210A define two thread passages 218A and 218B. A separate set of closure force applying devices is provided for each thread passage, one set being indicated at 234X and the other set at 234Y Furthermore, if each thread passage 218A and 218B is designed to treat the same thread type under the same treating conditions as the passage 218 illustrated in Fig. 2, then the width of plate 212A is approximately double the width of plate 212; thus, a stainless steel plate 212A preferably has a width in the range 24 to 30 mm. The thickness of plate 212A still lies in the range 2 to 8 mm, however. Piston and cylinder unit 230A must be adapted to apply to housing portion 228A a force exceeding the total force applied to plate 212A by both sets of closure devices 234X, 234Y acting together.

As indicated diagrammatically in Fig. 5 A, the lines of action (vectors) of the force applying means acting on the plate 212 preferably extend substantially at right angles to the sealing surfaces 242, 244. The play provided in the mounting shown in Fig. 4 enables this effect to be maintained even when plate 212 flexes to accomodate slight misalignments in the nozzle structure - there is a corresponding tilt in the pin 236 relative to sleeve 237 in the flexed region of the plate.

The sealing surfaces themselves are preferably finished by grinding operation during manufacture. There is no need for fine finishing operations such as lapping, polishing or superfinishing.

Fig. 6 indicates in a highly diagrammatic manner the use of a nozzle in the form shown in Fig. I in a thread texturizing system which differs from that shown in the prior application. The nozzle structure is again generally indicated at 200. Housing portion 228 and the elastic plate 212 provided therein are generally as shown in Fig. I, but housing portion 224 is formed at one end to match the surface of a rotating drum 260 which receives the thread from the forwarding nozzle 200. Drum 260 rotates in an anti-clockwise direction as viewed in Fig. 6. When the thread 262 has traveled with drum 260 through approximately half a revolution thereof, it is transfered to a cooling means which is not shown in Fig. 6. A casing portion 264 encircles drum 260 between the outlet from nozzle 200 and the location of transfer to the cooling means. Drum 260 and casing portion 264 are heated and form the actual texturizing chamber receiving thread from the forwarding nozzle 200. This form of texturizing system is of a known type, being described for example in U.S. Patent Specifications No. 4024611, 4074405 and 4019228. Accordingly, details of such arrangements will not be provided in this specification.

In the specification, the terms "flexible" and "elastic" have been used to some extent interchangeably. Clearly, the plate 212 (or equivalent flexible part in an alternative nozzle design) should not be subjected to plastic deformation. "Perfect elasticity" is, however, obviously not essential.

In the present specification, the term "treatment" or "treating" is intended to cover any application of a pressurised fluid to a thread, whatever the purpose of the application. Thus, even the creation of a simple drawing or forwarding effect is considered in this context as a "treatment". In most cases, however, there will be ancillary purpose such as heating or cooling the thread.

Clearly, both nozzle parts could be made flexible, but this may adversely affect the thermal conducting characteristics of the nozzle taken as a whole, bearing in mind the desirability of making the passage defining parts from a corrosion and erosion resistant metal. Good thermal conducting contact of at least one nozzle part with a body of relatively good thermal conductivity is advantageous.

Claims

I. An openable and closable thread treating nozzle comprising

first and second parts which define between them a thread passage of predetermined cross section through the nozzle, the parts being movable relative to each other to open the nozzle to permit insertion of thread into the passage and to close the nozzle around the thread in the passage,

infeed means for feeding a treatment fluid to the passage to flow therethrough and draw the thread along the passage,

first and second sealing surfaces on the first part disposed on respective opposite sides of the passage, and corresponding first and second sealing surfaces on the second part,

closure force applying means adapted to apply closure forces urging the first and second sealing surfaces on the first part into engagement with the first and second sealing surfaces respectively on the second part,

at least one of said parts being flexible under the action of the applied closure forces, and

the flexibility of said one part being such that the part can deform if necessary under said closure forces to make sealing contact between said first and second surfaces on both sides of the passage but such that the part will not deform under the closure forces or the pressure of the fluid to cause variation of the passage cross section in dependence upon the closure forces or fluid pressure.

2. A nozzle as claimed in claim I wherein each part is made of a corrosion resistant metal.

3. A nozzle as claimed in claim 2 wherein the parts are housed in a housing made of a material having good thermal conductive properties relative to those of the corrosion resistant metal.

4. A nozzle as claimed in any preceding claim wherein the closure force applying means is such that closure forces applied to said one part act on vectors disposed substantially at right angles to said sealing surfaces.

5. A nozzle as claimed in claim I wherein the other nozzle part is relatively rigid, the passage cross section being defined by a groove formed in said relatively rigid part.

Fig. 1

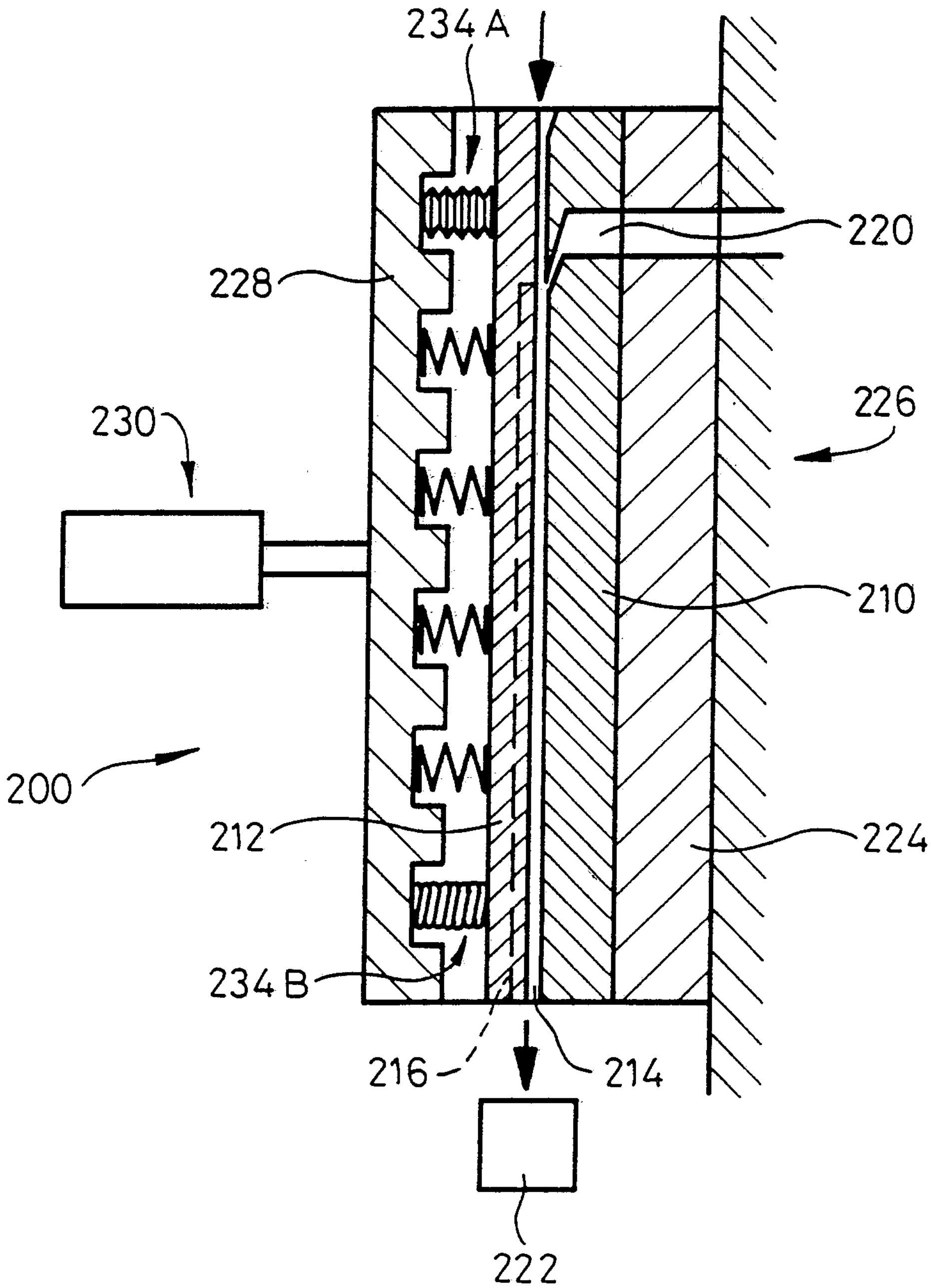


Fig. 2

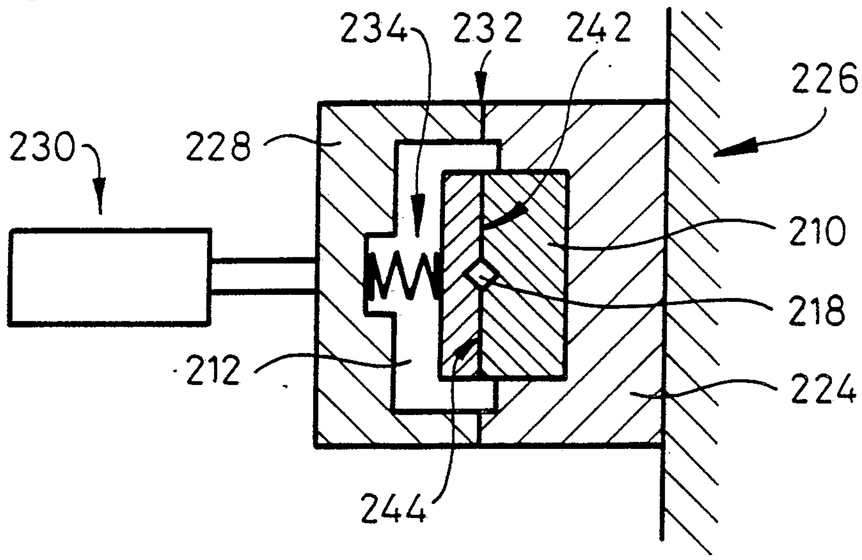
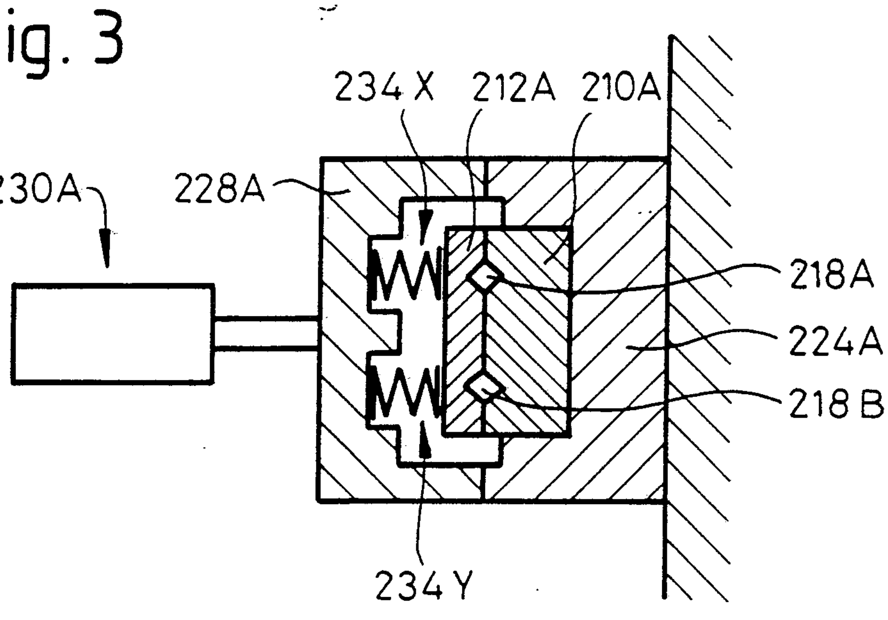

234
232
242
226
230
228
210
218
212
224
244

Fig. 3


234 X
212A
210A
230A
228A
218A
224A
218 B
234 Y

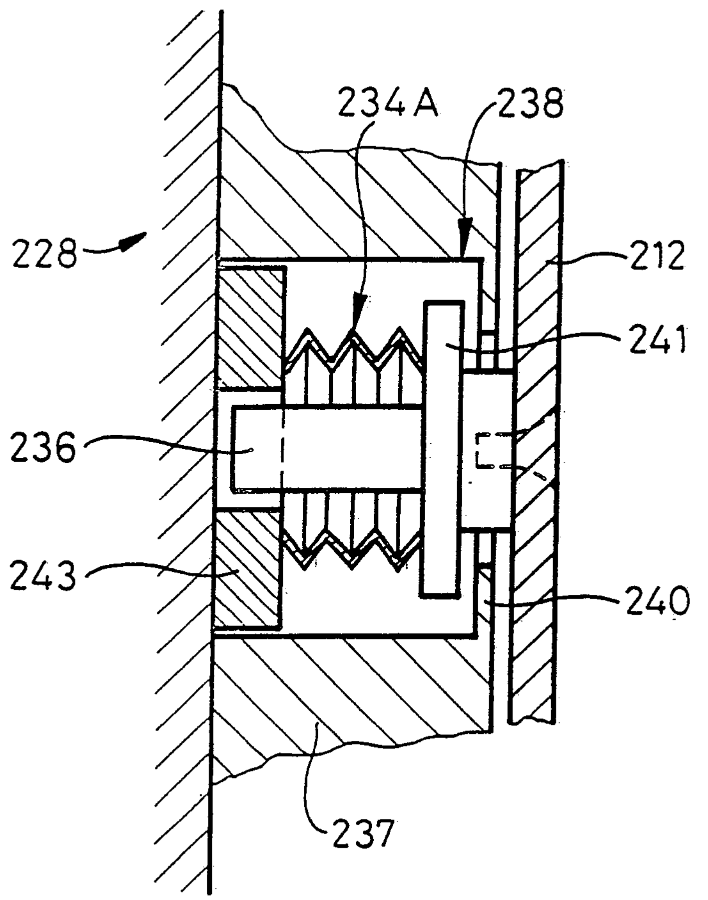

234A
238
228
212
241
236
243
240
237

Fig. 4

Fig. 6

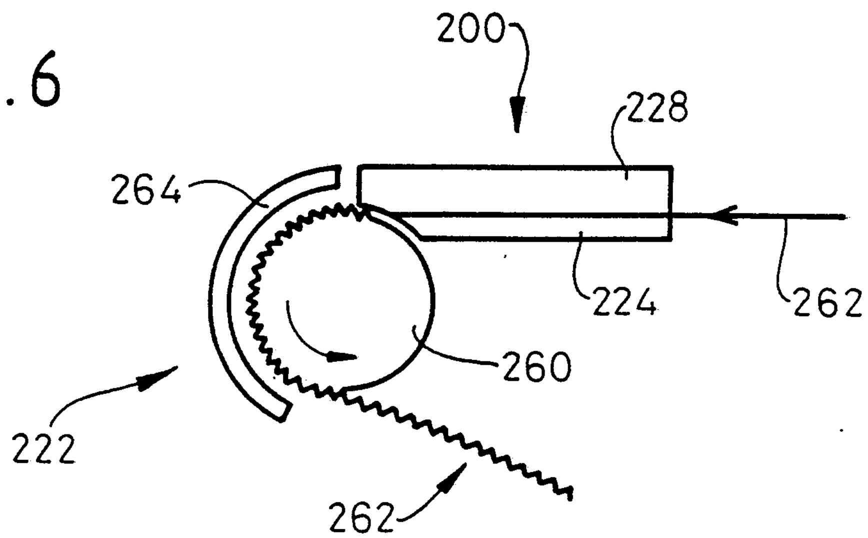

200
228
264
224
262
260
222
262

Fig. 5A

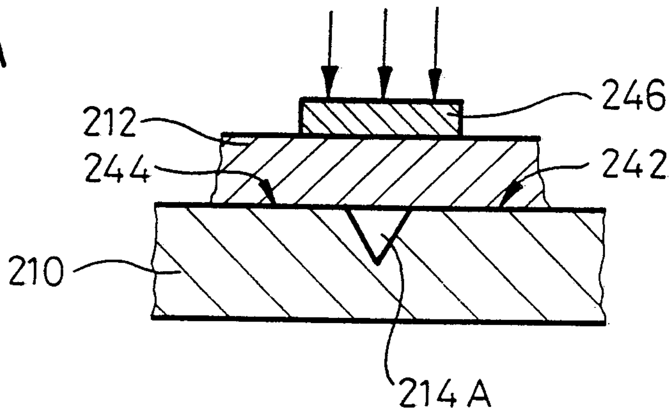


Fig. 5B

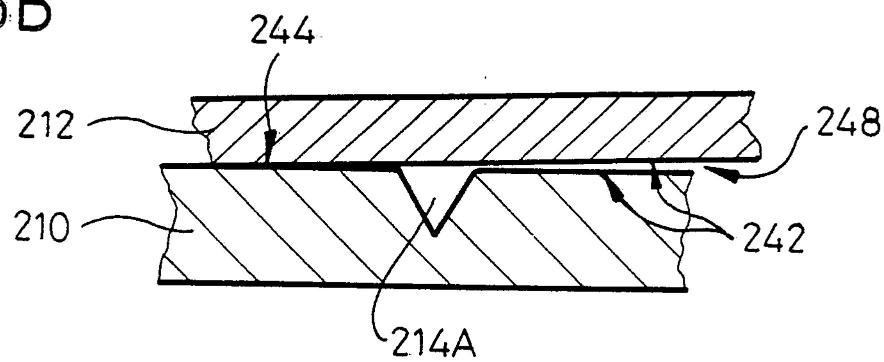


Fig. 5C

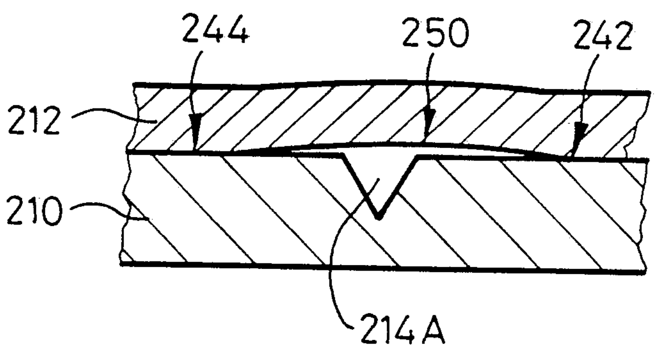


Fig. 5D