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US-A- 4 297 414
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EP 0 232 944 B1

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Description

The invention relates to a process for the manufacture of prestressed concrete, in which prestressing of the concrete is effected by means of at least one elongated tendon, which is tensioned while subjected to an external tensile load, said external tensile load being removed thus prestressing the concrete matrix and being exerted by tensioning said tendon by means of an anchoring device, which device comprises a clamping body contained in an anchoring housing so that said external tensile load may be exerted in longitudinal direction of the tendon, the anchorage housing or an element coupled with it and the clamping body, which is substantially formed of a synthetic material, being provided with cooperating contact surfaces which are in a slanting position relative to the tendon, for transmitting the external tensile load to the tendon, which slanting surfaces are positioned at an acute angle with the longitudinal direction of the tendon which extends from the inside of the device to some other point of attachment, said clamping body consists of two or more solid parts and forms a block-shaped, compact element, which parts are already solid before insertion in the anchorage housing, during tensoning the clamping body is releasably and directly coupled to the tendon through frictional contact and pressure force.

In the art on prestressed concrete there is a growing tendency to replace conventional tendons consisting of steel bars or steel cables with tendons consisting of fibes embedded in a resin matrix. Particularly because of environmental aspects said tendency has been accelerated during the last ten years.

When manufacturing prestressed concrete the tensile forces exerted on the tendons are very high, requiring intensive cooperation between the tendon and the applied anchoring device. It is clear from the art that this has led to difficulties in finding a suitable combination of cooperating tendons and anchoring devices particularly because of the specific fibre reinforced tendons, which, respect to anchoring, are relatively vulnerable.

In the anchorage of prestressed tendons the tensile force prevailing in the tendon will vary. At the point in the anchoring device where the tendon leaves the clamping body while subject to the full tension lead or prestress, i.e. on the inside of the anchoring device, there will prevail the maximum tensile force in the tendon. At the other side, called the end face, of the anchoring device where the tendon enters the clamping body while in the tension less state, there will prevail practically no tensile force in the tendon. Therefore, the magnitude of the tensile force in the tendon held by the clamping body will vary from a maximum value near the inside to a value nil near the end face of the anchoring device. The tensile force acting in longitudinal direction of the tendon is transmitted to the anchorage housing as a result of the friction between the tendon and the clamping body. At the contact surface between the tendon and the clamping body transverse forces will be exerted between the tendon and the clamping body, which forces are directed perpendicular to the longitudinal direction of the tendon, their magnitude being dependent on the tensile forces. Consequently, on the inside of the anchoring device there will generally prevail an unfavourable biaxial state of stress in the tendon as a result of the combination of a maximum tensile force and a maximum transverse force. From the inside to the end face of the anchoring element both the tensile force and the transverse force in the tendon will gradually decrease. If use is made of conventional tendons of steel, said unfavourable state of stress on the inside of the anchoring element is not objectionable because steel tendons are sufficiently homogeneous to take up a high force both in longitudinal and in transverse direction. Apart from the various advantages, however, the tendons formed of a synthetic matrix reinforced with endless filaments hasve the disadvantage as compared with steel tendons that they are softer, so that said high transverse force gives rise to prohibitive local deformation of the tendon. This in combination with said high tensile force contributes considerably to the chance of failure inside the anchoring device of a tendon of synthetic material. To reduce the problem of the unfravourable state of of stress on the inside of the anchioring device it is proposed in EP 0 025 856 B1 that limiting means for the transverse forces should be incorporated, for which various embodiments are described.

The anchoring device according to Fig. 1 of EP 0 025 856 B1, which is particularly meant for anchoring tendons formed of a synthetic matrix reinforced with fibres, such as glass fibres or carbon fibres, comprises an internally conical anchoring housing. In the conical housing is a conical clamping body of synthetic material. Between the fixed bottom on the inside of the anchorage housing and the clamping body is a buffer layer of a compressible synthetic material, such as polyvinyl chloride. Symmetrical with the longitudinal axis are a number of tendons in the anchoring device. When use is made of the anchoring device according to Figure 1 of EP 0 025 856 B1 the tendons must after introducing buffer layer be set to and kept at the desired prestress with the aid of a tensioning device. Subsequently, the clamping body must be formed by pouring a liquid epoxy resin, optionally reinforced with fillers or fibres, into the conical bore of the anchorage housing. Then the resin is left until it is sufficiently cured, during which process the tensioning device remains in operation. During the curing of the epoxy resin the tendons will irremovably adhere to the clamping body. After the resin curing process the tensile force exerted by the tensioning device may be reduced, preferably gradually. The then hard conical clamping body together with the fixed tendons will shift relative to the housing toward the inside of the anchoring device, with the buffer layer becoming compressed and finally acting as a "hard" abutment plate. In this way the clamping body will be sufficiently compressed in transverse direction to retain the tendons and moreover the magnitude of the transverse forces acting transverse to the longitudinal direction of the tendons will be restricted.

Although under some circumstances reasonable results can be obtained with the device and process according to Fig. of EP 0 025 856 B1 for anchoring fibre-reinforced tendons of synthetic material, said known device has several disadvantages. In the first place the casting of the clamping body is relatively difficult, particularly at low temperatures, because of the special provision, such as sealing, which will have to be made then. Further, there may be problems as to the position, viz. horizontal, vertical or otherwise, of the cavity into which the resin is to be poured. It should also be realized that casting will generally have to be done at some building site under difficult working and/or weather conditions, with each complication forming a potential risk of additional difficulties, delays or mistakes which may detrimentally affect the quality of a building structure with prestressed concrete elements. Moreover, the casting of clamping bodies from epoxy resin requires special skill. Another disadvantage consists in that the tensioning device must remain in operation until the resin is sufficiently cured. This is not only time consuming, but may also lead to serious defects in the event of the tensioning device already being out of operation at a moment when the resin is still insufficiently cured. Besides, the known anchoring system is not very economical. For, it can be used only once, in that it is fixedly cast in the concrete element and the cured clamping body cannot be re-used.

The anchoring system according to Fig. 2, 3, 4 and 5 of EP 0 025 856 B1 have generally the same disadvantages as the ones discussed with regard to the construction according to Fig. 1 of EP 0 025 856 B1.

Although the anchoring system according to Figure 6 of EP 0 025 856 B1 also comprises a buffer layer serving as a limiting means for the transverse forces, it is somewhat different. A considerable disadvantage to the anchoring system according to Fig. 6 of EP 0 025 856 B1 consists in that the fibre-reinforced tendons of synthetic material are in direct contact with and fixed by a heavily constructed clamping body of steel or aluminium. Therefore, the softer synthetic tendons may be readily damaged, so that there will be an increased chance of failure under the influence of the high tensile force and the transverse force, which although it is limited is still considerable. The metal clamping body in the anchorage housing is surrounded by a compressible material serving as buffer, which is to be subjected to the appropriate pressure by means of bolts and nuts. Said buffer may be up of several layers. The magnitude of the transverse force exerted by bolts is difficult to control. For, the force exerted will depend on the stiffness of the plates, the stiffness of the bolts and the friction between bolts and nuts. Besides, it is not known whether the surfaces properly join. The construction of this known anchoring system and it use in actual practice will therefore be rather complicated. As also this known construction is fixedly cast in the pre-stressed concrete elements, it can only be used once.

For a further prior art disclosure reference is made to DE 2 515 423. It describes an anchoring device for a flat tendon made up of 31 steel wires measuring 1 mm in diameter, which are embedded in synthetic material and surrounded by an impervious sheath. The tendon is clamped between two clamping plates, apparently of a relatively hard material such as steel, which are on their outside provided with wedge shaped clamping surfaces that cooperate with matching surfaces of the steel anchorage housing. To reduce the chance of damage and fracture of the tendon an additional clamping plate in the form of some kind of buffer layer is placed between the tendon and the two clamping plates over the entire clamping length thereof. Said buffer may consist of, for instance, an aluminium plate or a layer of elastomeric material, such as rubber or plastic. The relatively thick buffer layers on either side of the tendon serve to bring about a more equal transmission of transverse force between the tendon and the clamping plates and the transverse force will be approximately constant over the entire length. Nevertheless, the transverse force on the inside of the anchoring device will have a fairly high value, as will the tensile force, as a result of which the aforementioned unfavourable biaxial state of stress may occur. Apart from the complication and the additional cost of said clamping plate in the form of a buffer layer, particularly when use is made of a large number of tendons, which in reality will be general practice rather than exceptional, the presence of the resulting additional layers will increase the chance of creep.

NL 7 702 741 describes an anchoring device for a synthetic tendon reinforced with glass fibres, which at least at the point where the tensile force is introduced is built up of several layers between each of which metal wedges are provided. Also in the anchoring device according to NL 7 702 741 the transverse force will be maximal on the inside, which is unfavourable. Further, the great difference in hardness between the metal wedges and the tendon of synthetic material will considerably enhance the chance of damage to the tendon, which will readily give rise to fracture.

Reference is also made to GB 1 139 841, which describes a gripping device for ropes, in particular for ropes having a parallel filamentary core. At the end to be attached the rope is split to assume an annular form, use being made of a loose cone which is forced into the core of the rope end. The annular rope end is clamped between the conical wall of a housing and the loose cone with the aid of a nut. In order to provide a constant annular area with increasing diameter the two cooperating cones have such different slopes that the annular slit will narrow with increasing diameter. This anchoring device is of a totally different type in that the tendon in it is anchored between the clamping body and the anchorage housing. This device is not suitable for anchoring fibre-reinforced synthetic tendons in the manufacture of pre-stressed concrete.

DE 1 609 722 shows a device for anchoring a plurality of wires in a structural element. The wires which are expanded at their ends, are flaringly placed in a relatively wide bore provided in the structural element. The bore will then be provided

with a filler of metal granules and an optionally thermoplastic binder. This type of system is unsuitable for anchoring fibre-reinforced synthetic elements in the manufacture of prestressed concrete.

NL 6 413 152 shows an anchoring system for a number of steel wire cables, which are clamped in the annular opening between two cones of steel, one of which is provided with a roughed surface.

US 3 111 569 relates to a fibre reinforced tendon of another type with thickened ends of an eye-like shape (se Fig. 3–7) like certain steel tendons. Particularly for fibre reinfored tendons said thickened ends will lead to several disadvantages, such as unfavourable and unequal stress situations, many tendons with different lengths and a wide variety of distances between said thickened ends.

NL 293 083 describes an anchoring device for tendons consisting of steel. Surprisingly, according to the present invention it was found that this type of anchoring device is particularly suitable for use in a process for the manufacture of prestressed concrete using fibre-reinforced tendons.

The invention has for its object to provide a process for the manufacture of prestressed concrete of the type mentioned in the opening paragraph which no longer displays said disadvantages of known systems. The process according to the invention is characterized in that a tendon is applied, which is formed by a matrix based on a thermoplastic or a thermosetting synthetic material, such as epoxy resin and/or bismaleimide resin or unsaturated polyester resin, containing more than 5000, more particularly more than 20,000, practically parallel continuous filaments formed from a material selected from the group of aromatic polyamides, such as polyparaphenylene terephthalamide, or carbon or glass or from solvent spun polyethylene, polyvinylalcohol or polyacrylonitrile. In a preferred embodiment the clamping body extending over at least 50–80% of the length of the anchorage housing. Favourable results are obtained if according to the invention the clamping body is substantially formed of a thermoplastic synthetic material, such as nylon 6, nylon 6,6, polyester, polyethylene or polypropylene, and the hardness value of the clamping body is lower, preferably about 10 to 15%, than that of the tendon, as determined in conformity with the Shore-D hardness measurement, and the anchorage housing, which may formed of, for instance, alloyed structural steel, has a greater stiffness than the clamping body, particularly transverse to the longitudinal direction of the tendon.

It is preferred that use should be made of a tendon of which the cross-section transverse to the longitudinal directional is substantially rectangular, as in that case a relatively large contact surface area is provided. For the anchoring device according to the invention use may also very well be made of a tendon of which the cross-section transverse to the longitudinal direction is substantially circular.

When use is made of a tendon having a rectangular cross-section it is according to the invention of advantage if the ratio of the thickness to the width is smaller than 1:2, and more particularly is in the range of 1:8 to 1:90.

A preferred embodiment of the anchoring device according to the invention is characterized in that the acute angle α which said cooperating sloping surfaces of the anchorage housing and the clamping organ make with the longitudinal direction of the tendon is in the range of about 0.5 to 15°.

A simple embodiment of the device according to the invention is characterized in that in the anchorage housing the sloping surface is formed by a conical bore of which the cone which cooperates with the conical bore in the anchorage housing and may consist of two or more parts provided with a recess for receiving a tendon at the common boundary surfaces of said parts.

A practical embodiment of the device according to the invention is characterized in that of the sloping surface in the anchorage housing the height decreases towards the inside and the claming body is formed by an undivided or divided wedge-shaped element cooperating with said sloping surface in the anchorage housing, which wedge-shaped element is provided with a recess for receiving a tendon.

Favourable results are obtained with an anchoring device which is characterized according to the invention in that the tendon has a substantially rectangular cross-section transverse to the longitudinal direction, of which the ratio of the thickness to the width is smaller than 1:2, and the height of the recess for the tendon in the clamping body, measured transverse to the width of the tendon, is at least 10% smaller, preferably 20 to 60% smaller than the thickness of the tendon. Thus, the tendon can be properly clamped by the clamping body without using any further means. When use is made of a tendon having a circular cross-section the clamping body may be provided with a recess of which the diameter is at least 10% smaller than the diameter of the tendon.

The chance of fracture or damage of the tendon can still be considerably reduced if the anchoring device according to the invention is characterized in that on the inside of the anchoring device the end edge of the clamping body in contact with the tendons is rounded, more particularly to a radius of at least 0.5 mm, preferably 1–4 mm.

The anchoring device according to the invention is in essence particularly simple and effective. The synthetic clamping body in the form of a block-shaped element ready for use and consisting of a cone or wedge can be directly inserted in the anchorage housing and be placed in its proper position on the tendons. As there is no further need for the clamping body first to be formed from a thermosetting compound, the clamping organ can without delay or difficulty and regardless of weather conditions be inserted into the anchorage housing, irrespective of the position in which the same is placed. Another advantage to the anchoring device according to the invention consists in that it need not be cast into the concrete and can therefore often be reused, as a result of which the cost thereof can be reduced considerably. Owing to the absence of specially adjustable means of limiting transverse forces or other means the anchoring device is particularly simple to manufacture. The simple construction

of the anchoring device according to the invention permits problem-free application in actual practice, without requiring any special operating instructions.

Although the anchoring device according to EP 0 025 856 dates back to 1979, the paper "Erste mit Glasfaser Spanngliedern vorgespannte Betonbrücke" by Dipl. Ing. M. Weiser of the firm of Strabag Bau-AG at Cologne in West-Germany (see Beton- und Stahlbetonbau 2/1983, pp. 36–40) in Section 4, first paragraph, says that the anchoring of so-called HLV tendons is still under development. Also from that paper it may therefore be concluded that the anchoring systems known in 1983 for fibre-reinforced synthetic tendons were not without problems. It may be further concluded that the very practical and simple anchoring system according to the invention was apparently not obvious to a man skilled in the art.

The invention also comprises prestressed concrete structures or elements made by the process according to the invention.

The invention well be further described with reference to the accompanying drawing.

Fig. 1 is a view in side elevation of the anchoring device suitable for the process according to the invention.

Fig. 2–5 are sectional views of the anchoring device of Fig. 1, along the lines II–II, III–III, IV–IV and V–V, respectively.

Fig. 6 shows a longitudinal section of the anchorage housing.

Fig. 7–12 are different views of the clamping body formed by two conus halves.

Fig. 13–21 show various embodiments of the anchoring device suitable for the process according to the invention.

Figures 1–5 are schematic illustrations of a first embodiment of the anchoring device suitable for the process according to the invention. The anchorage housing 1 of alloyed steel has a conical bore 2, the angle of inclination of the bore being indicated by the acute angle α. In the bore 2 are two half cones 3 and 4 of nylon 6, of which the angle of inclination is also α and which together form a clamping body for the tendon in the form of a flat strip 5. One the anchorage housing is a collar 6 on which an external tensile force may be exert in the direction of the arrows 7 by means of a hydraulic or mechanical device not shown in the drawing. The sloping surfaces of the conical bore 2 in the anchorage housing and of the clamping body both make the same acute angle α with the longitudinal direction of the tendon. The tendon 5 projects outside the end face 9 of the anchoring device over a distance of, say, 5 mm and transversely extends through the clamping body in a recess 8 formed in one of the cones 3, 4 towards the inside 10 of the anchoring device. From the inside 10 the tendon 5 extends through formwork (not shown) to a fixed point (not indicated in the drawing), which may be several metres away from the inside 10, the distance depending on the concrete element to be made. The tendon 5 in this construction consists of a strip of about 20 × 1,3 mm formed by an epoxy resin matrix containing 10,000 endless polyparaphenylene terephthalamide filaments each having a diameter of about 12 µm. The breaking load of such a tendon is at least 35 kN. During pretensioning of the tendon 5 it is subjected to a gradually increasing tensile force in the direction indicated by the arrow 11. As mentioned before, the tensile force is initiated by applying to the anchorage housing 1 and external tensile force in the direction indicated by the arrows 7. Said external tensile force is transmitted to the cooperating sloping surfaces of the conical bore 2 and the half cones 3, 4 of the clamping body via pressure and frictional forces. The transverse forces in the direction indicated by the arrows 12 set up frictional forces in the longitudinal direction of the tendon 5. In the clamping body these frictional forces are directed as indicated by the arrow 13 and set up the prestressing force in the tendon.

Fig. 6–12 are separate views of the most important parts used for a particularly embodiment of the anchoring device suitable for the process according to the invention. Figure 6 is a view in longitudinal section of the anchorage housing 1 of alloyed structural steel 42 $CrMo_4$. The acute angle α between the wall of the conical bore 2 and the longitudinal axis of the tendon is about 3.5°. The anchorage housing has a length of about 100 mm and at the two ends the inner diameters of the bores are about 45 mm and 33 mm, and the outer diameters are about 63 mm and 47 mm, respectively. The collar 6 has a length of about 30 mm. The clamping body consists of two half cones 3 and 4, which are drawn in Figures 7–12 and of which the acute angle α with the longitudinal axis of the tendon is also 3.5°. The axial length of the half cones 3 and 4 is about 95 mm. Figures 9 and 10 are views of the nylon 6 cones 4 and 3, respectively, viz. of the sides having the largest diameter. At the end of the largest diameter the radii of curvature of the two half cones are 22.5 mm. At the end of the smallest diameter the radii of curvature of the two cones are about 16.5 mm. The half cone 4 is semi-circular in cross-section all along its length. The half cone 3 is provided all along its length with a recess 8 having a width of about 22 mm and a depth of about 0.75 mm for receiving the described tendon 5 measuring about 20 × 1.3 mm. Except for the recess the cone 3 is also semi-circular all along its length. On the inside of the anchoring device the end edges of the clamping body that are in contact with the tendon 5 are rounded to a radius R of 2 mm. In a practice experiment favourable results were obtained with the simple anchoring device according to the invention having the dimensions as indicated for Figures 6–12. A tensile force of the order of 79 kN could readily be applied. When the tendons were subjected to a fatigue test it was found that even after 2 million load reversals, at an average load of about 15 kN, the tendon did not fracture, nor did there occur any slippage in the anchoring device. The tendon has a hardness of 88–89 and the nylon 6 clamping body has a hardness of 78–80, both hardnesses being Shore-D values.

Figure 13 and 14 are views respectively in longitudinal section and in side elevation of a different em-

bodiment of the anchoring device suitable for the process according to the invention, corresponding parts being referred to by like numerals. This embodiment comprises three tendons 5, which are enclosed in a steel anchorage housing 1 by means of two nylon 6 wedges 22, 23 and flat plates 24, 25 which are also of nylon 6. The flat sloping surfaces of the wedges 22, 23 cooperate with the corresponding flat wedge surfaces in the anchorage housing 1.

Figures 15 and 16 show an embodiment in which three superimposed tendons 5 are held together by a clamping body formed by two wedges 22, 23 of nylon 6, which cooperate with corresponding wedge surfaces in the anchorage housing 1.

Figures 17 and 18 show an embodiment in which three adjacent tendons 5 are clamped together in the housing 1 between two wedges 22 and 23 of nylon 6.

Figure 19 shows an embodiment in which a great many anchoring units 26, for instance of the type according to Fig. 17, 18 or Fig. 15, 16 or Fig. 13, 14 are contained in one and the same block 27.

Figures 20 and 21 show an embodiment which also is provided with an internal conical anchorage housing 1 containing a cone of nylon 6 consisting of three parts 28, 29 and 30 for anchoring a tendon 5 having a circular cross-section. The three parts 28, 29 and 30 together form the clamping body.

Within the scope of the invention various modifications may be made. For instance, the cooperating sloping surfaces are not necessarily conical or wedge shaped and in principle also curved sloping surfaces may be used. Although in the drawn embodiments with cones only a single tendon is used, the anchoring system according to the invention may also in that case be provided with a great many adjacent and/or superimposed tendons contained in one and the same anchorage housing. The invention also comprises embodiments in which during pretensioning a thin sheet material is provided at the contact surface between the one or multiple-part clamping body and the tendon, so that there is still a practically direct contact between the clamping body and the tendon. The clamping organ of synthetic material may optionally contain a certain amount of filler, such as glass fibres or a mineral material. The filaments of polyparaphenylene terephthalamide contained in the tendons may be of the type described in US 4 320 081.

Claims

1. A process for the manufacture of prestressed concrete, in which prestressing of the concrete is effected by means of at least one elongated tendon (5), which is tensioned while subjected to an external tensile load, said external tensile load being removed thus prestressing the concrete matrix and being exerted by tensioning said tendon (5) by means of an anchoring device, which device comprises a clamping body (3, 4, 22, 23, 28, 29, 30) contained in an anchoring housing (1) so that said external tensile load may be exerted in longitudinal direction of the tendon, the anchorage housing (1) or an element coupled with it and the clamping body (3, 4, 22, 23, 28, 29, 30), which is substantially formed of a synthetic material, being provided with cooperating contact surfaces which are in a slanting position relative to the tendon (5), for transmitting the external tensile load to the tendon (5), which slanting surfaces are positioned at an acute angle α with the longitudinal direction of the tendon (5) which extends from the inside (10) of the device to some other point of attachment, said clamping body consists of two or more solid parts (3, 4, 22, 23, 28, 29, 30) and forms a block-shaped, compact element, which parts are already solid before insertion in the anchorage housing (1), during tensoning the clamping body (3, 4, 22, 23, 28, 29, 30) is releasably and directly coupled to the tendon (5) through frictional contact and pressure for characterized in that a tendon (5) is applied, which is formed by a matrix based on a thermoplastic or a thermosetting synthetic material, such as epoxy resin or unsaturated polyester resin, containing more than 5000, more particularly more than 20,000, practically parallel continuous filaments formed from a material selected from the group of aromatic polyamides, such as polyparaphenylene terephthalamide, or carbon or glass or from solvent spun polyethylene, polyvinyl alcohol or polyacrylonitrile.

2. A process according to claim 1, characterized in that a tendon (5) is applied of which the section transverse to its longitudinal direction is substantially rectangular.

3. A process according to claim 2, characterized in that of said approximately rectangular cross-section the ratio of the thickness to the width is smaller than 1:2, and more particularly is in the range of 1:8 to 1:90.

4. A process according to claim 1, charcterized in that a clamping body (3, 4, 22, 23, 28, 29, 30) is applied of which the hardness value is lower, preferably about 10 to 50%, than that of the tendon (5), as determined in conformity with the Shore-D hardness measurement.

Patentansprüche

1. Verfahren zur Herstellung von vorgespanntem Beton, bei welchem das Vorspannen des Betons mit mindestens einem länglichen Spannglied (5) bewirkt wird, das unter Einwirkung einer äußeren Zugspannung gespannt wird, wobei die äußere Zugspannung aufgehoben wird und dadurch die Betonmatrix vorgespannt wird, und wobei die äußere Zugspannung durch Spannen des Spanngliedes (5) mittels einer Verankerungsvorrichtung erfolgt, welche Vorrichtung einen Klammerkörper (3, 4, 22, 23, 28, 29, 30) besitzt, der in einem Verankerungsgehäuse (1) enthalten ist, so daß die äußere Zugspannung in Längsrichtung des Spanngliedes ausgeübt werden kann, wobei das Verankerungsgehäuse (1) oder ein damit verkoppeltes Element und der Klammerkörper (3, 4, 22, 23, 28, 29, 30), der im wesentlichen aus einem Kunststoff besteht, mit zusammenwirkenden Kontaktflächen versehen sind, die sich relativ zum Spannglied (5) in Schrägstellung befinden, um die äußere Zugspannung auf das

Spannglied (5) zu übertragen, wobei die schrägen Flächen in einem spitzen Winkel α zur Längsrichtung des Spannngliedes (5) angeordnet sind, das sich von der Innenseite (10) der Vorrichtung zu einem anderen Befestigungspunkt erstreckt, wobei der Klammerkörper aus zwei oder mehr festen Teilen (3, 4, 22, 23, 28, 29, 30) besteht und ein blockförmiges kompaktes Element bildet, welche Teile bereits vor dem Einführen in das Verankerungsgehäuse (1) fest sind, und wobei der Klammerkörper (3, 4, 22, 23, 28, 29, 30) während des Spannens lösbar und direkt durch Reibungskontakt und Druckkraft mit dem Spannglied (5) verbunden ist, dadurch gekennzeichnet, daß ein Spannglied (5) verwendet wird, das gebildet ist aus einer Matrix auf Basis eines thermoplastischen oder eines duroplastischen Kunststoffes, wie Epoxyharz und/oder bis-Maleinsäureimid-Harz oder ungesättigtes Polyesterharz, enthaltend mehr als 5000, insbesondere mehr als 20 000 praktisch parallele Endlosfilamente, die gebildet sind aus einem Material gewählt aus der Gruppe der aromatischen Polyamide, wie Poly-p-phenylenterephthalamid, oder aus Kohlenstoff oder Glas oder lösungsgesponnenem Polyethylen, Polyvinylalkohol oder Polyacrylnitril.

2. Verfahren nach Anspruch 1, dadurch gekennzeichnet, daß ein Spannglied (5) verwendet wird, dessen Querschnitt zu seiner Längsrichtung praktisch rechteckig ist.

3. Verfahren nach Anspruch 2, dadurch gekennzeichnet, daß bei dem praktisch rechteckigen Querschnitt das Verhältnis der Dicke zur Breite kleiner als 1:2 ist und insbesondere im Bereich 1:8 bis 1:9 liegt.

4. Verfahren nach Anspruch 1, dadurch gekennzeichnet, daß ein Klammerkörper (3, 4, 22, 23, 28, 29, 30) verwendet wird, dessen Härtewert niedriger liegt, vorzugsweise um etwa 10 bis 50%, als derjenige des Spannngliedes (5), bestimmt in Übereinstimmung mit der Shore-D-Härtemessung.

Revendications

1. Un procédé de fabrication de béton précontraint dans lequel la précontrainte du béton est effectuée au moyen d'au moins un tirant ou élément de précontrainte (5) allongé qui est mis sous tension tout en étant soumis à une charge extérieure à la traction, cette charge extérieure à la traction étant retirée pour précontraindre ainsi la matrice de béton et étant exercée par mise sous tension de ce tirant (5) au moyen d'un dispositif d'ancrage, ce dispositif comprenant un corps de serrage (3, 4, 22, 23, 28, 29, 30) contenu dans un logement d'ancrage (1) de telle sorte que cette charge extérieure à la traction puisse être exercée suivant la direction longitudinale du tirant, le logement d'ancrage (1) ou un élément couplé à celui-ci et le corps de serrage (3, 4, 22, 23, 28, 29, 30) qui est sensiblement formé d'une matière synthétique étant pourvu de surfaces de contact coopérantes en position inclinée par rapport au tirant (5), en vue de transmettre la charge extérieure à la traction au tirant (5), lesquelles surfaces inclinées sont disposées à un angle aigu a avec la direction longitudinale du tirant (5) qui s'étend de l'intérieur (10) du dispositif à un autre point d'attache, ledit corps de serrage étant constitué de deux ou de plus de deux pièces (3, 4, 22, 23, 28, 29, 30) massives et formant un élément compact, en forme de bloc, dont les parties sont déjà solides avant l'insertion dans le logement d'ancrage (1), le corps de serrage (3, 4, 22, 23, 28, 29, 30) étant, pendant la tension couplé directement, mais étant détachable, au tirant (5) par un contact avec frottement et une force de pression, procédé caractérisé en ce que l'on utilise un tirant (5) formé par une matrice à base de matière synthétique thermoplastique ou thermodurcissable, telle que par exemple une résine époxy et/ou une résine de bismaléimide ou une résine de polyester insaturé contenant plus de 5000, notamment plus de 20 000, filaments continus pratiquement parallèles constitués d'une matière choisie dans le groupe des polyamides aromatiques, par exemple du polyparaphénylènetérephtalamide, du carbone ou du verre, ou du polyéthylène,

de l'alcool polyvinylique ou polyacrylonitrile filés à l'aide d'un solvant.

2. Un procédé selon la revendication 1, caractérisé en ce que l'on utilise un tirant (5) dont la section droite par rapport à sa direction longitudinale est sensiblement rectangulaire.

3. Un procédé selon la revendication 2, caractérisé en ce que le rapport de l'épaisseur à la largeur de cette coupe approximativement rectangulaire est inférieur à 1/2 et pratiquement compris entre 1/8 et 1/90.

4. Un procédé selon la revendication 1, caractérisé en ce que l'on utilise un corps de serrage (3, 4, 22, 23, 28, 29, 30) dont l'indice de dureté est inférieur, de préférence d'environ 10 à 50%, à celui du tirant (5), les mesures de dureté étant déterminées en conformité aux procédés de mesure de dureté Shore-D.

Fig. 1

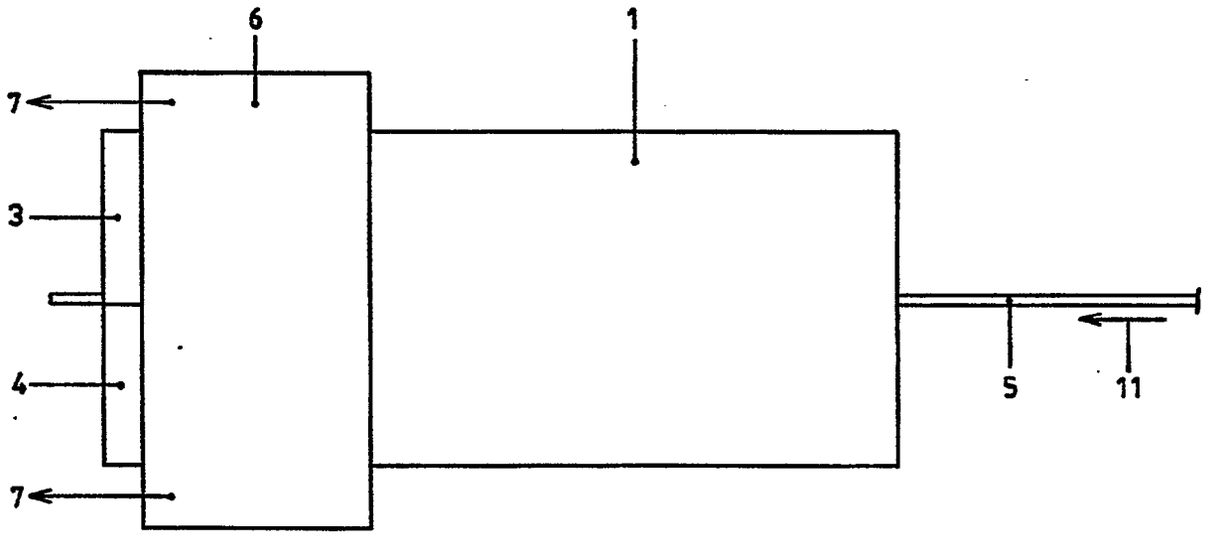


Fig. 2

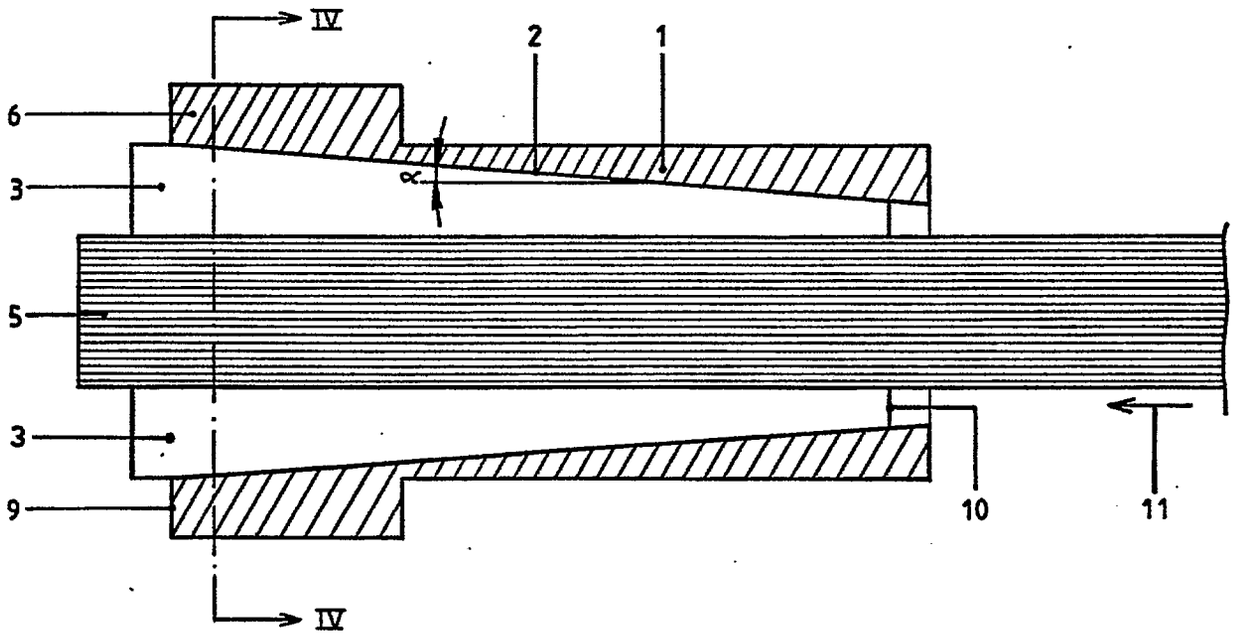


Fig. 3

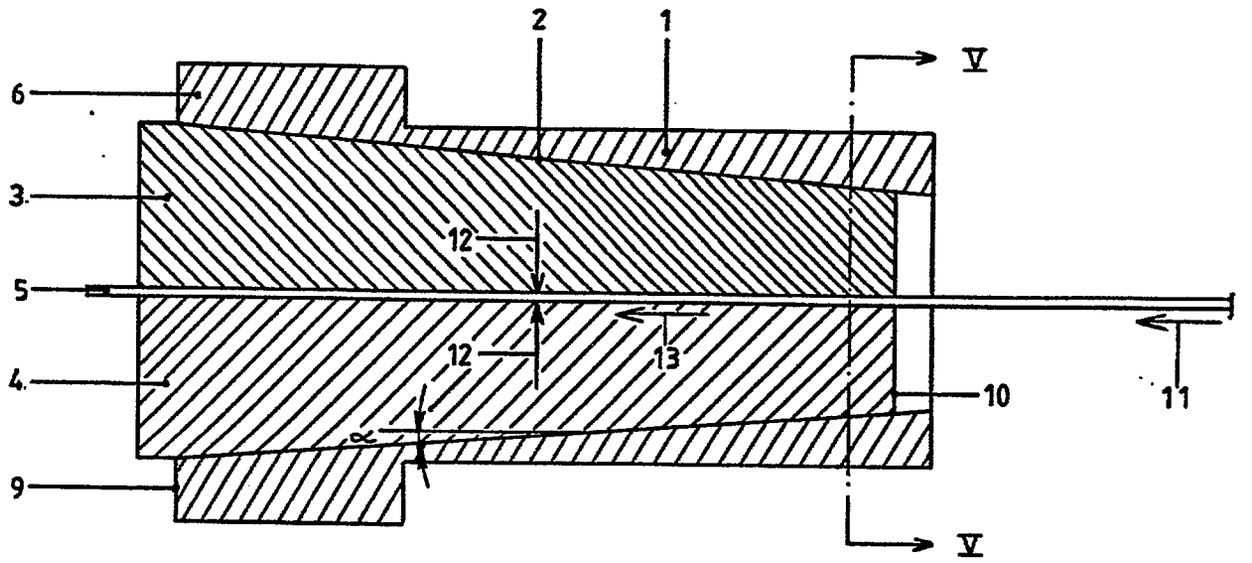


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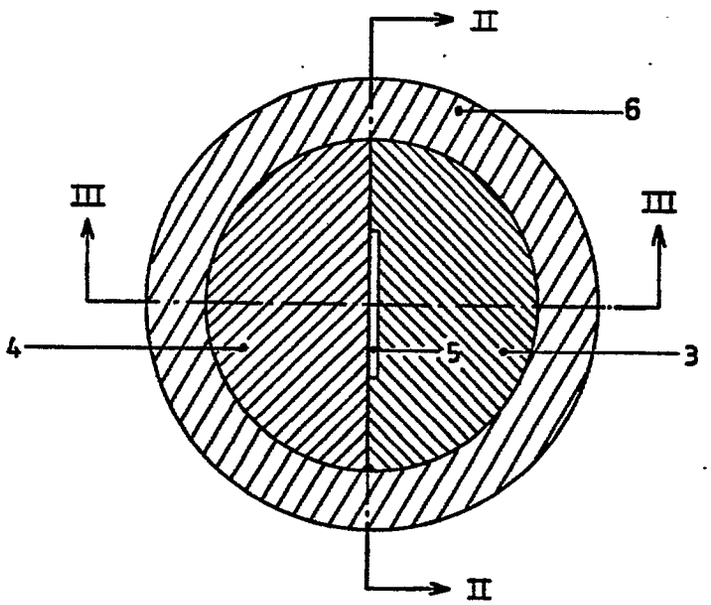
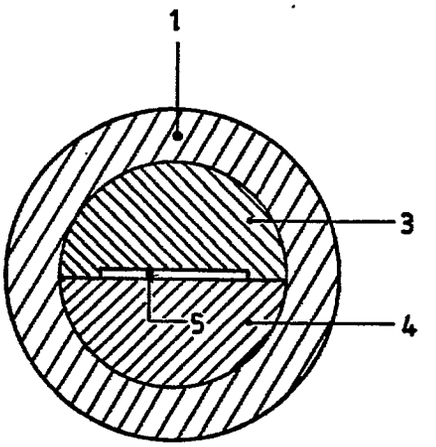


Fig. 5



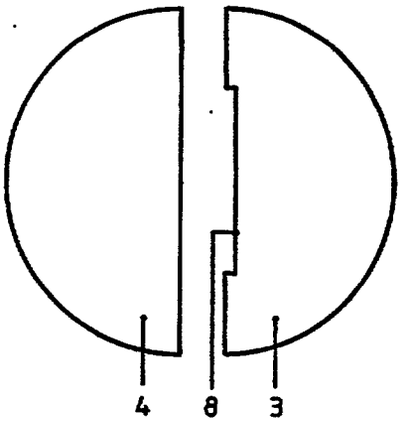


Fig.9

Fig.10

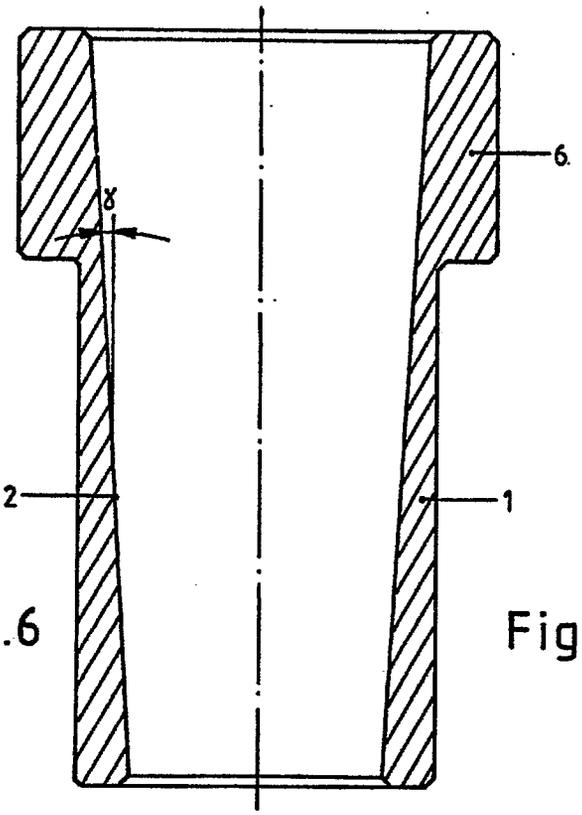


Fig.6

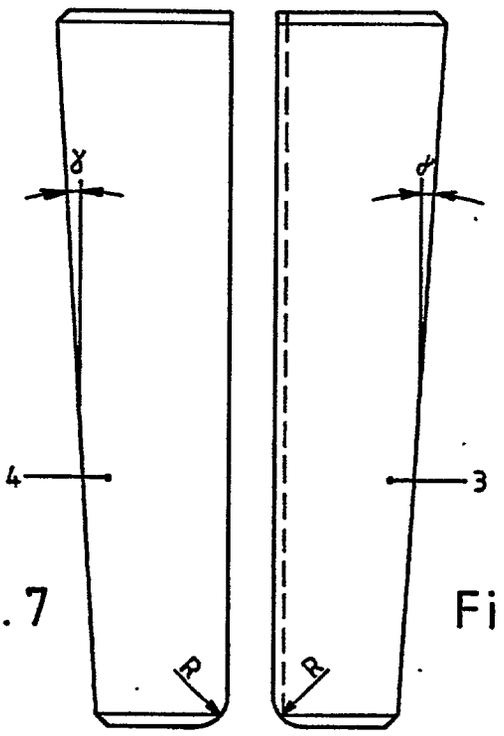


Fig. 7

Fig. 8

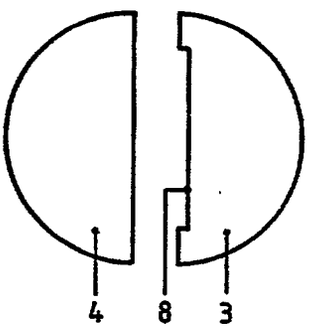


Fig.11

Fig.12

Fig. 13

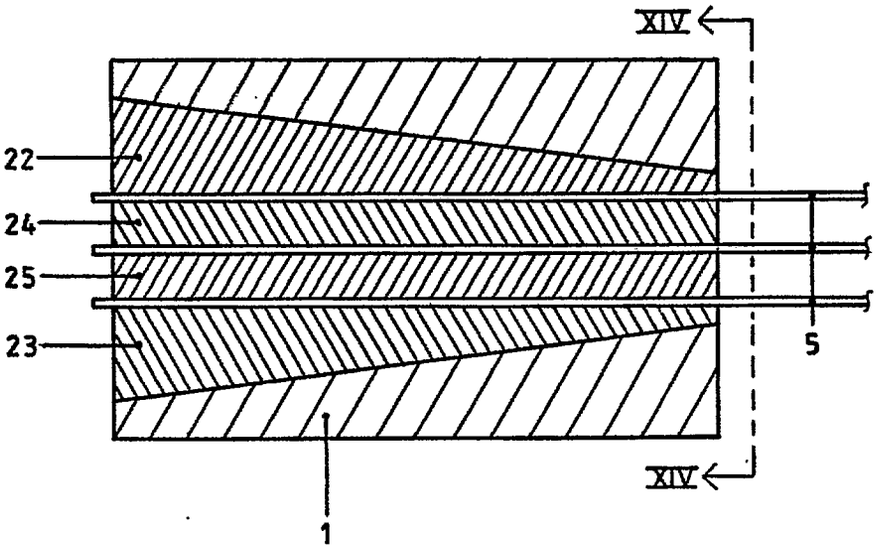


Fig. 14

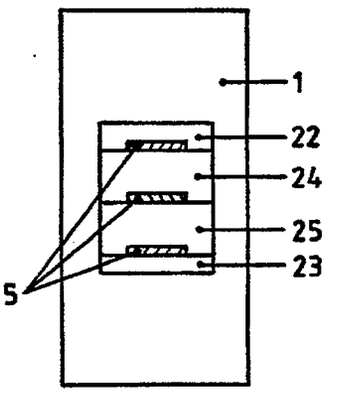


Fig. 15

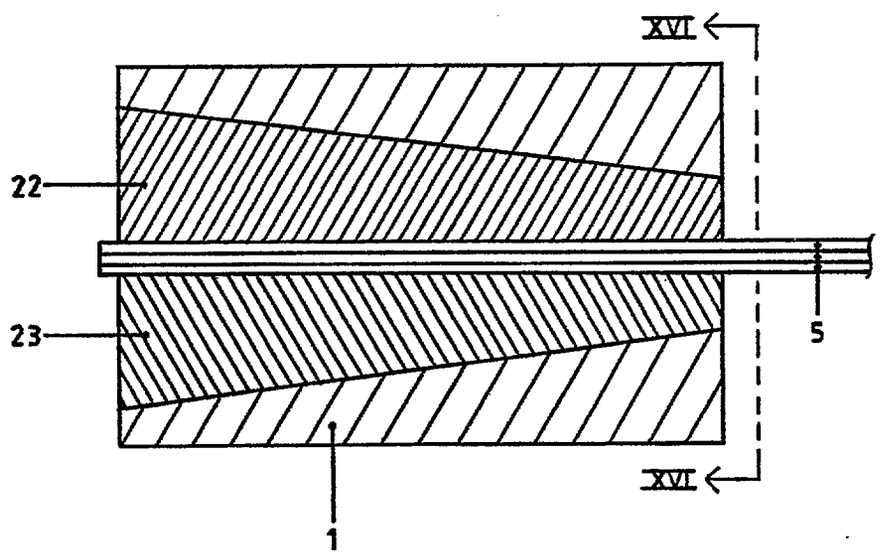


Fig. 16

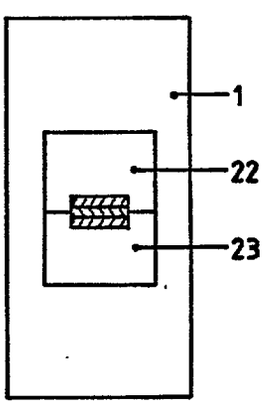


Fig. 17

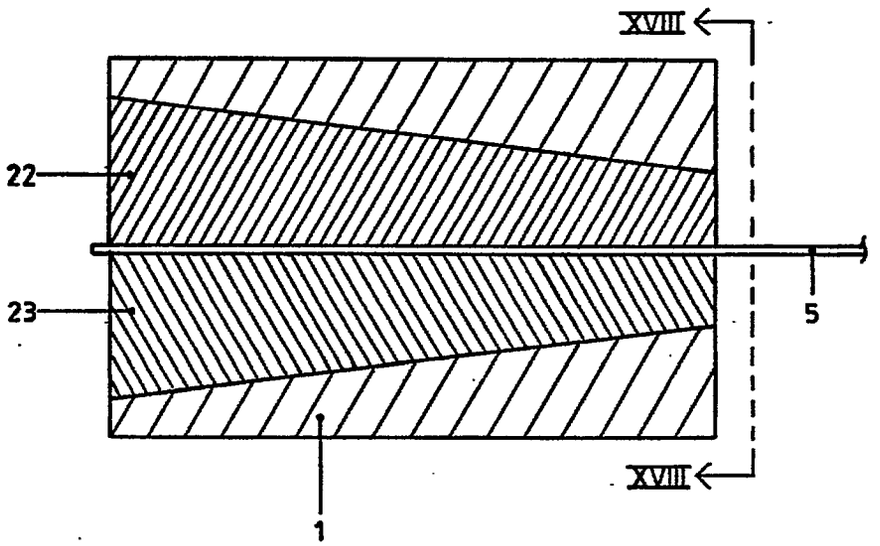


Fig. 18

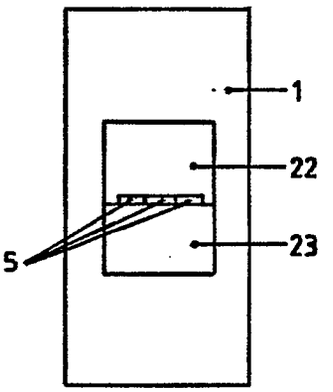


Fig. 19

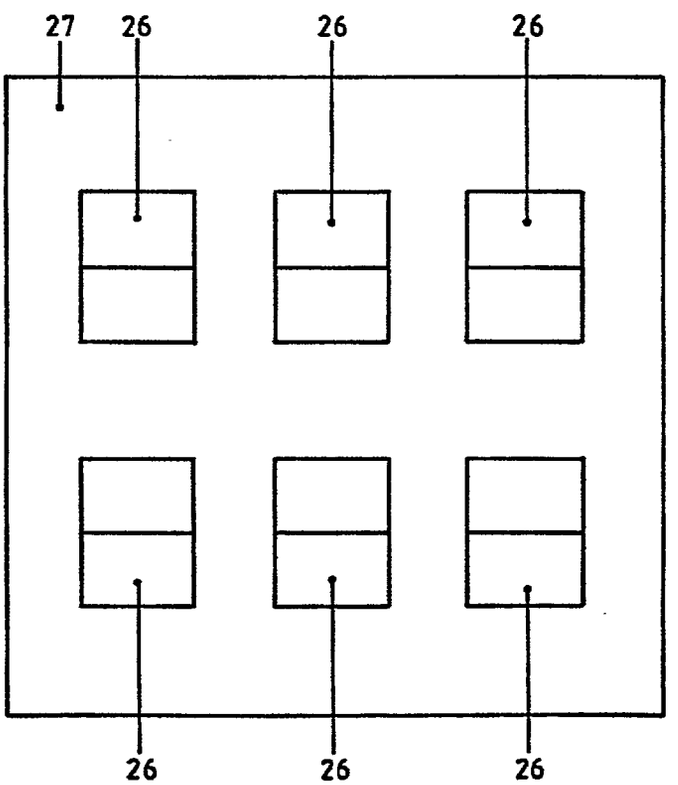


Fig. 20

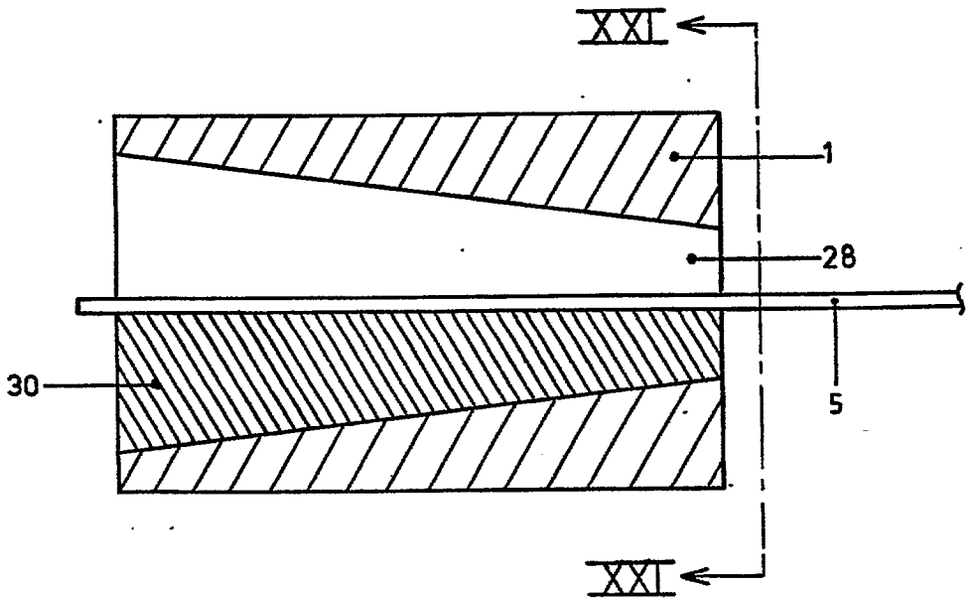


Fig. 21

