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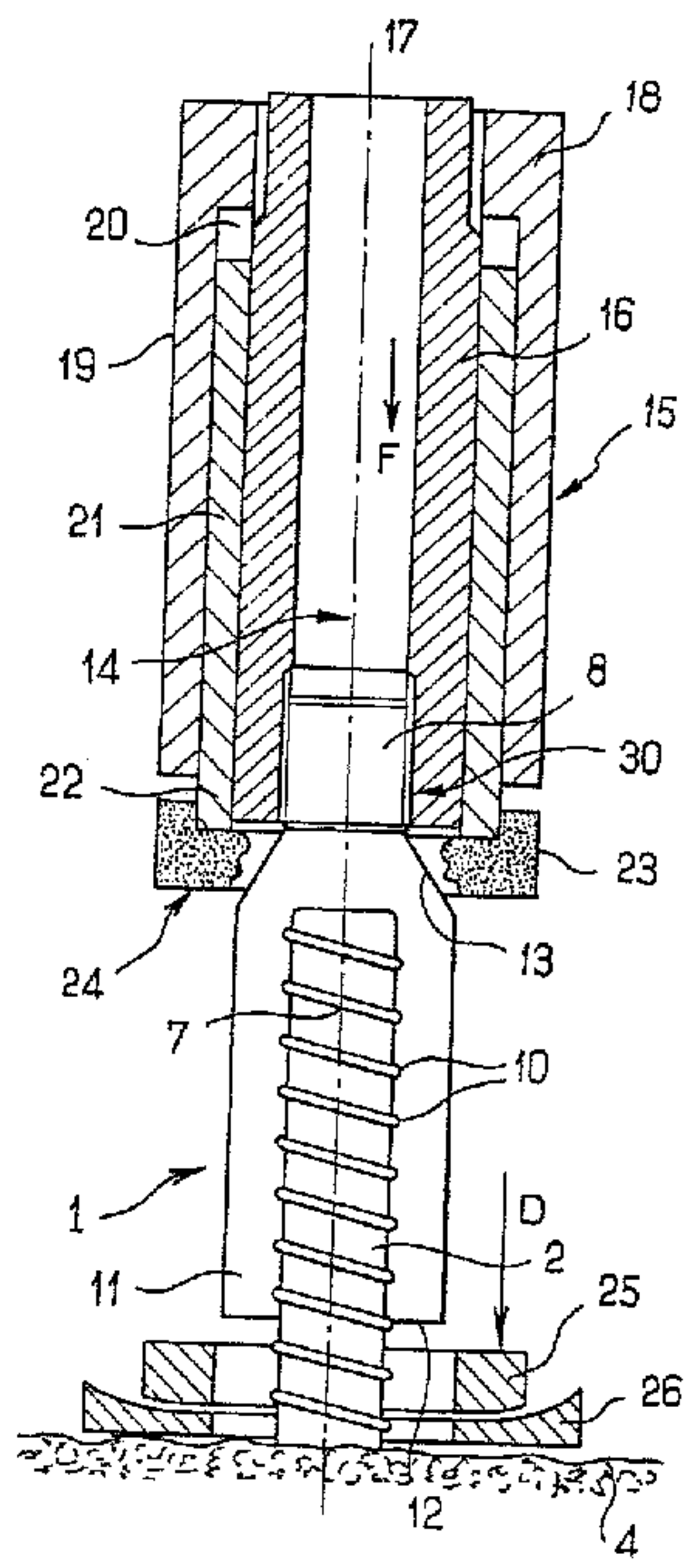
(54) **RACCORD MECANIQUE OPUR ARMATURES, DISPOSITIF SERVANT A METTRE CE RACCORD EN PLACE ET PROCEDE UTILISE POUR LE FIXER**

(54) **MECHANICAL CONNECTION FOR REINFORCING BARS, DEVICE FOR PLACING THIS MECHANICAL CONNECTION AND PROCESS FOR FIXING THE MECHANICAL CONNECTION FOR REINFORCING BARS**



(57) The invention relates to a mechanical connection for reinforcing bars, a device for placing this mechanical connection and a process for fixing the mechanical connection for reinforcing bars. According to the invention, the mechanical connection for reinforcing bars is characterised in that it comprises: - a bush (11) with a hollow cylindrical body into which the end of the bar not having a connecting element is introduced, - a thread (8) at the end of the bush (11), - the hollow body and the thread being coaxial so that two bars disposed end to end can be connected, - the outer material of the bush having been subjected to deformation by the formation of linear or helical indentations, - the material of the ribs (10) of the bar penetrating into the hollow body of the bush (11), in order to connect the bar and the bush. Used in building construction using concrete.

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ABSTRACT

The invention relates to a mechanical connection for reinforcing bars, a device for placing this mechanical connection and a process for fixing the mechanical connection for reinforcing bars.

According to the invention, the mechanical connection for reinforcing bars is characterised in that it comprises:

- a bush (11) with a hollow cylindrical body into which the end of the bar not having a connecting element is introduced,

- a thread (8) at the end of the bush (11),

- the hollow body and the thread being coaxial so that two bars disposed end to end can be connected,

- the outer material of the bush having been subjected to deformation by the formation of linear or helical indentations,

- the material of the ribs (10) of the bar penetrating into the hollow body of the bush (11),

in order to connect the bar and the bush.

Used in building construction using concrete.

FIG. 2

The invention relates to a mechanical connection for reinforcing bars. It relates to a mechanical connection for reinforcing bars, a sleeve with a hollow body and a device for placing this mechanical connection. The invention also relates to a process for fixing the mechanical connection for reinforcing bars.

It is used inter alia in building construction using concrete, such as buildings in a town or harbour or road structures.

It is known in these fields to use mechanical connections to connect reinforcing bars in order to ensure the continuous transmission of tensile stress.

The mechanical connection according to the invention may be used on site in order to connect components having been subjected to industrial treatment in the workshop to other reinforcing bars available on site.

These bars used on site may have a rectilinear end or may be curved and the bar is provided in the known manner on its outer surface with ribs or ridges, the dimensions of which are relatively irregular, but are of course in proportion with the diameter of the bar. All of these elements are designed to give the connection a certain strength and, depending on the structure used, the bars may have a large diameter and large ribs or a small diameter and smaller ribs.

These ribs are generally disposed on the outer surface of the bar, e.g. in a helicoid, the pitch of which depends both on the diameter of the bar used and on the desired strength.

In some cases, it will sometimes be necessary to connect reinforcing bars embedded in a mass of old concrete to new reinforcing bars in order to extend or modify a structure.

In many cases, the reinforcing bars available on the existing site have not been designed with a mechanical connection such as a thread in order to facilitate connection or, on the other hand, have a thread which has been damaged by corrosion or sea water.

In many cases, the ends of bars embedded in concrete to be connected are not designed with a sufficient mechanical connection. The ends of untreated reinforcing bars are devoid of threading and it is therefore not possible to connect two reinforcing bars end to end in a simple manner.

Sometimes, the absence of threading on the end of a bar is due not to the construction of the bar, but to the fact that it is impossible to use this thread as it is corroded.

The absence of threading may also be the result of an accident on site, e.g. if a previously threaded bar were unfortunately to be sawn off.

Any mechanical treatment of the ends of the bars must be carried out in a specialised workshop. This operation creates a break in the reinforcement production line and entails considerable handling. This break of load is very expensive and often entails the transportation of hundreds of tonnes of steel from the site of the mechanical treatment to the works site and/or assembly point.

The aim of this invention is to integrate the mounting of the bush into the production circuit without having to treat the end of the bar prior to the assembly of the reinforcements.

It may also be necessary on site to connect a row of vertical bars to a concrete slab, such as a floor produced industrially in the workshop having a row of horizontal bars at the outlet of the concrete. These bars can be rectilinear or curved, but it is their ends to be connected on site to vertical reinforcing bars that constitute the vertical concrete elements.

There is sometimes also a high concentration of steel on site when the bars of the floor and the vertical bars are very close together and it is sometimes difficult to gain easy access thereto with large tools.

It is known nowadays to connect bars of this kind by means of a tubular sleeve crimped by a press. To this end, it is necessary to use bulky outer jaws as the system using an encompassing jaw operating by external pressure has to be powerful. This bulkiness is a disadvantage when the steel and reinforcing bar concentration is high as rapid intervention on site is no longer possible if the two bars are too close together.

The pressing elements and the environment of the tools are heavy and bulky and therefore sufficient space is required between the axes of the reinforcing bars for crimping, fifteen centimetres being required between the axes in practice.

The daily output of the operator on site is very modest and four to eight connections per hour must be reckoned on in the case of equipment of considerable weight, e.g. approximately one hundred and sixty kilograms.

It should also be noted that when the jaws are operated by external pressure in order to crimp the two bars end to end, it is not possible to check and test whether the operation has been effected correctly and it is therefore necessary to rely on the operator.

The devices and dies used are very heavy in order to allow for the reaction of the stress applied to the tools. The considerable force applied to the die means that a heavy and bulky outer frame must be used as the stress has to be transmitted to the frame. Pressures of up to two hundred tonnes are used and it is not easy to work rapidly and efficiently with complete reliability on all of the crimp connections.

The known devices crimping perpendicularly to the bars in successive passes act in a random manner as they do not know exactly how the bar will be urged into a hollow or into a rib. Sleeves of considerable length, of approximately 200 to 250 mm must therefore be used and it is impossible to ensure that all of the crimp connections are produced under good conditions. The crimping result thus depends on the pressure applied by the operator.

The known devices using perpendicular crimping with a movable jaw and a fixed die also result in almost obligatory offset of the two bars to be connected as the two bars are no longer aligned in view of the asymmetry and irregularity of the reinforcing bars used.

The aim of this invention is to propose a mechanical connection for reinforcing bars which mitigates the aforementioned disadvantages and allows for the connection of a reinforcing bar the end of which has no connecting means such as a thread. This absence of threading may be as a result of corrosion or quite simply as a result of the fact that no mechanical connection was provided at the time of construction. It may also be the case that this mechanical connection was cut off by accident on site.

Another aim of the mechanical connection for reinforcing bars according to the invention is to allow for rapid operation on site and therefore with lightweight, handy tools.

Another aim of the mechanical connection for reinforcing bars according to the invention is to make it possible to work with reinforcing bars in a high concentration, i.e. which are very close together, simply as a result of the small dimensions of the tool.

Another aim of the mechanical connection for reinforcing bars according to the invention is to allow for testing by applying stress, e.g. equal to 90 % of the elastic limit, thereto after connection.

Another aim of the device for placing a mechanical connection according to the invention is to allow for the production of tested connections so that all of the connections produced are completely reliable from the point of view of the quality of the crimping of the bush to the end of the bar.

Another advantage of the mechanical connection for reinforcing bars according to the invention is the fact that, by checking the quality of the crimp connection, it is therefore possible to reduce considerably the length of the sleeve itself and of course to arrive at a very low cost price for the mechanical connections in a structure as the quantity of metal used is considerably reduced.

Another aim of this invention is to allow for rapid operation on site in order to connect an element produced industrially with projecting reinforcing bars to other reinforcing bars available on site.

E.g. all of the horizontal slabs can be prepared industrially at the same time and then connected to vertical bars all adjusted to the same height, e.g. by means of prior trimming of the ends of the bars.

Another advantage of the device according to the invention is that it is very handy and simple to use on site.

The device is provided with the possibility of testing the work just carried out in order to prove that the connection is functional, this of course being very advantageous as it was not hitherto possible to check the quality of the connection produced using crimping by means of jaws.

Another aim of the device according to the invention is to allow for a considerable increase in the quantity of connections produced, which can go up to four hundred a day instead of forty nowadays. The device can be installed in a stationary manner in order to industrialise the preparation of the bars.

According to this invention, the mechanical connection for reinforcing bars, used inter alia in the construction of concrete elements on site, intended to be fitted to a rectilinear or curved end, the bar having ribs on its outer surface, is characterised in that it comprises:

- a bush with a hollow cylindrical body into which the end of the bar not having a connecting element is introduced,

- a thread at the end of the bush,

- the hollow body and the thread being coaxial so that two bars disposed end to end can be connected,

- the outer material of the bush having been subjected to deformation by the formation of linear or helical indentations,

- the material of the ribs of the bar penetrating into the hollow body of the bush, in order to connect the bar and the bush.

The device for using the mechanical connection on a reinforcing bar, the end of which does not have a connecting element, intended to connect two bars end to end is characterised in that it comprises:

- a double-acting jack body,

- a tapped or threaded extension tube fitting on to the thread on the end of the bush and fixed to the body of the jack,

- a hollow piston of the jack being displaced between the body and the extension tube,

- a tool provided with balls or rings disposed at the end of the piston capable of being displaced vertically and/or in rotation in order to effect deformation of the outer material of the bush and to force the ribs of the reinforcing bar to penetrate into the interior of the bush in order to produce the connection and to crimp the bush to the end of the bar.

The process for fixing a mechanical connection for reinforcing bars, used inter alia on site, using the connection according to the invention, is characterised in that it consists in:

- covering the end of a reinforcing bar not having a connecting element by means of a bush,

- pressing the bush over the end of the bar by the vertical and/or circular displacement of a tool,

- selecting a material for the bush which is more malleable than the material of the bar so that the ribs of the bar penetrate into the interior of the hollow body of the bush,

- transmitting the stresses induced by the tool back to the bar.

This invention will be more readily understood from the following description given purely by way of a non-limiting example. It is accompanied by the attached drawings which form an integral part thereof and in which:

Figure 1 shows the mechanical connection for reinforcing bars according to the invention used on a vertical bar and on a curved horizontal bar;

Figure 2 is a view of the device according to the invention for effecting the mechanical connection of a reinforcing bar to a bar the end of which does not have a connecting element;

Figure 3 is a sectional view of the bush showing the shape obtained after deformation, and

Figure 4 shows a variant of the tool which, instead of being provided with offset rings as shown in Figure 2, is provided with balls.

Referring to Figure 1, it shows a mechanical connection for a reinforcing bar designated in general by the reference numeral (1). This reinforcing bar known to the person skilled in the art is used widely nowadays on site in order to reinforce constructions. The reinforcing bar (2) is to be connected to another reinforcing bar (3) disposed coaxially and end to end in relation to the bar (2). The connection (1) thus ensures the continuous transmission of the tensile stress between the bar (2) and the bar (3).

Figure 1 shows one single bar (3), but it could form part, e.g. of a horizontal floor (4) comprising a multitude of bars disposed in a substantially parallel manner. Each bar (3) can extend from the floor (4) in a rectilinear manner or, on the contrary, can have a curved end (5) as shown in Figure 1.

The mechanical connection for reinforcing bars according to the invention may also be used in other devices adapted to certain buildings with male/male or female/female sleeves.

The structure moreover comprises a vertical part into which a row of bars (2) disposed in parallel is integrated. The end (6) of the bar (3) therefore has to be connected to the end (7) of the bar (2). It should be noted that this end (7) of the reinforcing bar does not have a connecting element, i.e. it has no thread or tap as it would then be simple for the person skilled in the art to produce a mechanical connection.

It has been seen that the absence of threading may be due to the design or may be as a result of corrosion or unfortunate sawing on site.

Once the mechanical connection (1) according to the invention has been made integral with the end (7) of the bar by the process according to the invention, it may be connected to the bar (3), e.g. by screwing. The system used is of the "union" type (3 parts), where no bar can be turned.

Referring to Figure 2, it shows the reinforcing bar (2) with its end (7) not having a connecting element, inter alia a thread. This reinforcing bar of appropriate diameter is provided on its outer surface with ribs (10) disposed, e.g. in a circular or helical manner. These ribs can be irregular, but facilitate support of the bars in the concrete in the known manner when they are subjected to high stresses. These ribs have different width and height dimensions adapted to the diameter of the bar.

In view of the method of construction, the diameter of the bar is not very regular and these ribs are not distributed in a very precise manner over the outer surface of the bar.

The mechanical connection for reinforcing bars according to the invention comprises a bush (11) with a hollow cylindrical body into which the end (7) of the bar is introduced via the orifice (12).

In one embodiment, the bush (11) has a cylindrical shape over a large part of its height, but also has a chamfered part (13). Above the chamfer (13), the end of the bush (11) has a thread (8) also shown in Figure 1.

The mechanical connections for reinforcing bars are therefore formed by the cylindrical bush (11) fitting on to the unthreaded end (7) of the bar (2) and comprising a thread (8). It should be noted that the bar (2) and the thread (8) are disposed coaxially along the axis (14) so that the bars (2 and 3) can be connected end to end.

It should be noted that the bars must be very well aligned and coaxial, as, if the edges are no longer aligned, this may result in offset stresses creating a moment having an adverse effect on the tension of the bars and on the "permanent elongation" tests or sliding test.

According to the invention, as a result of the axial crimping effected by the threaded rod and the tapping of the sleeve to be crimped and as a result of the annular shape of the tool, the process according to the invention results more reliably in centring of the two bars irrespective of the shape of the reinforcing bar.

The various elements of the mechanical connection are of course made of metal, but it may be advantageous to select a material for the bush (11) which is more malleable than the material constituting the reinforcing bar (2) so that the ribs (10) penetrate into the interior of the bush (11) when pressure is applied to the outer surface of this bush. This penetration may be effected, e.g. at the end (7) of the bar, thereby pressing the bush over the end of the bar. This can be achieved, e.g. by vertical and/or circular displacement of a tool designated in general by the reference numeral (15).

The material of the ribs of the reinforcing bar penetrates into the inner zone of the bush opposite the bar in order to connect the bar and the bush.

The device (15) for placing the mechanical connection (1) is shown in Figure 2.

This device is provided with a threaded extension tube (16) comprising at one of its ends a thread (17) and a tap (30) which is screwed on to the thread (8) of the connection (1).

The thread (17) of the extension tube is fixed in the end (18) of the body of the preferably double-acting hollow jack used. The body (19) of this jack defines together with the extension tube (16) a zone (20) in which a hollow piston (21) can be displaced. The end (22) of this piston is made integral with a tool (23) which may have different appropriate shapes, e.g. circular, provided with offset rings or with balls. In some cases, these devices may be adjustable in accordance with the diameter of the bar to be connected. The crimp connection may be adjusted by altering the number of balls and possibly creating a circular movement in order to effect crimping in a helical line.

In order to improve the surface contacts and to obtain a better connection, it may be advantageous to use a heating system allowing for an increase in temperature to 500 to 750°C for five to ten seconds. A high-frequency self-induction system is suitable to ensure the localised heating of components of small dimensions. Rapid heating and an increase in temperature can be achieved in a few seconds with small low-frequency lightweight equipment.

The cooling of the metal after connection has an important advantage as the thermal stress of the contraction accentuates crimping and therefore results in good adhesion and a completely integral connection between the bar and the sleeve.

The heating, inter alia by self-induction, results in much lower crimping forces and allows for the use of smaller tools.

It should therefore be noted that a bar diameter of 40 requires sixty tonnes of pressure with four balls and a bar diameter of 40 requires fifteen tonnes of heat pressure for a circular tool (23).

As a result of having controlled the connection in this manner by integrally connecting the bar and the coupler in a reliable manner, it is thus possible to considerably reduce the length of the coupler compared to the couplers used, e.g. with crimping perpendicular to the bars.

Figure 4 shows a detail of this tool (23) provided with balls. Balls produce deformations (27) on the outer part of the bush (11). Longitudinal and/or circular crimping is effected during the vertical descent of the tool, engaging with the outer surface of the bush, thereby resulting in controlled penetration and possible adjustment by means of the balls. This adjustment is obtained, e.g. by means of the screws shown in diagrammatic form at (28).

The crimping by means of balls can be helical if an inclined, semi-peripheral groove is formed on the exterior of the ring of the tool, a fixed point forcing it to rotate when pressure is applied, the tool being fixed to a thrust ball bearing, the angle of the groove being determined as a function of the pitch or pitches of the helix and in relation to the spacing of the bolts of the reinforcing bar.

The aim of this is to considerably increase the length of the indentation and to penetrate well into the hollow spaces in the reinforcing bar, while recreating the adhesive action of the reinforcing bar on the mechanical components.

The outer material of the bush undergoes deformation by the formation of linear or helical indentations.

When the piston descends in the direction of the arrow F, the end of the tool (23) is displaced vertically by a distance D. The base (24) of the tool (23) comes into contact with a pinned element (25). This element is itself placed on a pinned plate (26) with an interposed neoprene washer.

The tool (23) is first applied to the plane (13) and then over the entire outer periphery of the bush (11) by means of a considerable pressure imparted by the piston. It is by means of this pressure and the simultaneous deformation of the periphery of the bush, as shown in Figure 3, that the end (7) of the reinforcing bar is connected to the bush. The tool produces ridges (27) in a sufficient quantity on the outer part of the bush, preferably distributed regularly over the entire periphery. The number of ridges is of course a function of the diameter of the bar to be connected.

During its vertical and/or circular displacement over the distance D, the tool presses the ridges over the outer periphery of the bush and, by means of pressure, also causes the penetration of the ribs (10) of the reinforcing bar at its end (7). This penetration is of course made possible by the selection of the material constituting the bush (11), which is more malleable than the material of the bar at (7).

In this manner, the bush can be connected to the end of the reinforcing bar and crimped. The material of the ribs of the bar at its end (7) are housed in the inner part of the bush in order to produce this connection.

Referring to Figure 2, it will be seen that the device (15) is operated by the piston (21) when oil is delivered under pressure. The bush (1) integral with the extension tube (16) is fixed to the body of the jack (8). This results in a reaction on the hollow piston which descends by the distance D and effects crimping. The patterns (10) on the outer surface of the bar penetrate into the material in the inner zone of the bush which is more malleable.

At the end of operation, the face (24) of the tool bears against the pinned element and testing is effected at the predetermined value, e.g. 99 % of the elastic limit of the reinforcing bar. This test is considered as good if no sliding recorded by a drop in oil pressure read off the manometer of the jack is observed during the tensile stress applied.

If crimping has not been effected under good conditions, the connection will come apart during the test and it is preferable for this to happen at this time to prevent subsequent problems on site. It either has to be redone or replaced.

It will be seen that the device for placing the mechanical connection described is very compact and acts vertically on the bar. It can therefore be used in a simple manner in zones where there is limited space available or where there is a high concentration of reinforcing bars.

It should be noted that the stresses induced by the tool (23) are transmitted back to the bush (1) and the bar (3). Use is made of the reaction of the component. The stress induced by the jack is transmitted back to the component. This stress contained in the component is not dispersed and it is not necessary to have a large press frame in order to dampen it. The stress dispersed by the jack is transmitted back and taken up wholly by the component. It is the inertia of the components that completely tolerates the stress of the jack, something which was not possible with the former devices as the component did not play this reactive role during crimping. The bush and the end of the bar play a reactive role during operation and it is possible to work in the open air without a lot of equipment and without a support.

The value of the distance D over which crimping is effected of course depends on the density of the ribs and the protuberances on the bar, and on the diameter of the bar and the mode of operation, i.e. cold, hot, longitudinal or helical.

This invention may also be used for products other than reinforcing bars, e.g. plain bars for crimping, the end preferably being "marked" in advance by a mechanical means or by the compression of an indentation.

For the final test, there is the pinned supporting device for bars projecting from the concrete, and for the test on plain bars, the system for locking to the bar is of the self-closing jaw type found in tractive machines.

THE EMBODIMENTS OF THE INVENTION IN WHICH AN EXCLUSIVE PROPERTY OR PRIVILEGE IS CLAIMED ARE DEFINED AS FOLLOWS:

1. A device for implementing a mechanical connection of a concrete reinforcing rod including ribs on its outer surface and an end without any connecting element, the mechanical connection, said device for connecting two reinforcing rods in an end to end manner, said device including a bushing with a cylindrical hollow body into which is inserted the end of the reinforcing rod, and an external thread at the end of the bushing, the hollow body and the external thread being coaxial, said device comprising:

a double-action jack body,

a threaded extension tube fitting on the external thread of the bushing and fixed to the jack body,

a hollow piston moving between the jack body and the extension tube,

a tool surrounding the bushing, an inner diameter of said tool being smaller than an outer diameter of the bushing prior to distortion arranged at the end of the piston, said tool capable of moving vertically in order to distort the outer diameter of the bushing and to cause the ribs of the concrete reinforcing rod to penetrate into the bushing to bring about the connection and to crimp the bushing onto the end of the reinforcing rod.

2. The device according to claim 1, further including a hinged member against which abuts a periphery of said tool in a final descending phase of the jack, in order to test the connection.

3. The device according to claim 1 or 2, wherein heat is applied by way of a high-frequency self-induction at the end of the reinforcing rod.

4. The device according to any one of claims 1 to 3, wherein said tool is a ball tool or a grain tool.

5. The device according to any one of claims 1 to 4, wherein said tool is also capable of rotational movement.

6. A process for securing a mechanical connection to a concrete reinforcing rod utilizing the device according to claim 1, in which the end of a concrete reinforcing rod without connecting member is recovered by means of a bushing and a material is chosen for the bushing which is more malleable than the material of the reinforcing rod, in order to cause the ribs of the reinforcing rod to penetrate into the hollow body of the bushing, the process comprising:

crushing the bushing on the end of the reinforcing rod through vertically moving said tool, surrounding the bushing, the inner diameter of said tool being smaller than the outer diameter of the bushing prior to said crushing,

maintaining the mechanical connection during the crimping through the external thread of the end of the bushing,

imparting onto the bushing the efforts induced by the tool.

7. The process according to claim 6, further comprising, after carrying out the connection, the step of testing the elastic limit of the concrete reinforcing rod.

8. The process according to claim 6 or 7, further comprising the steps of heating the end of the reinforcing rod at a temperature of 500 to 750°C for five to ten seconds, and cooling the end of the reinforcing rod to cause shrinkage to thus enhance crimping and improve contact surface and achieve a better connection.

9. The process of any one of claims 6 to 8, wherein in said crushing step, said tool is also moved circularly.

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FIG_1

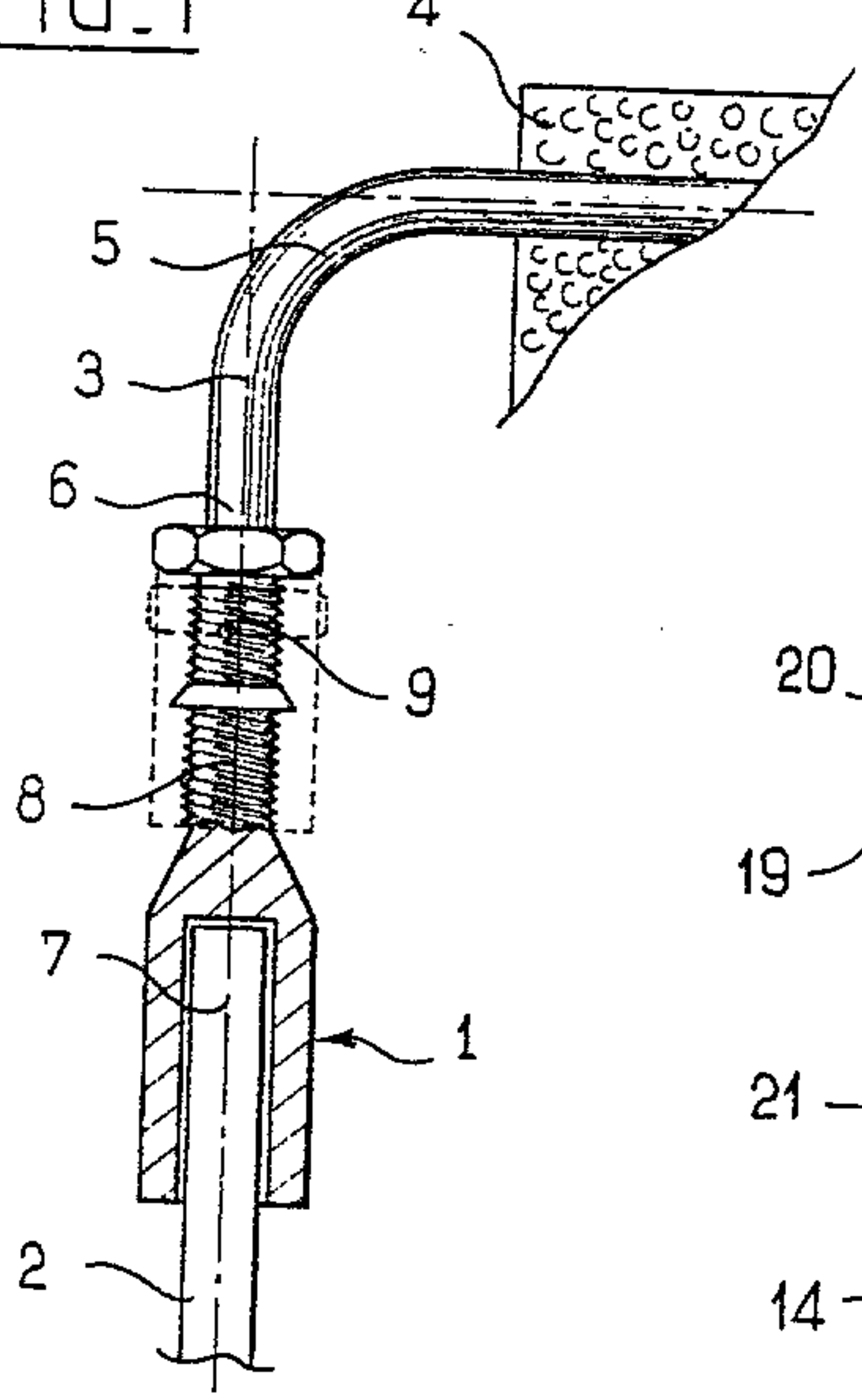

FIG_2

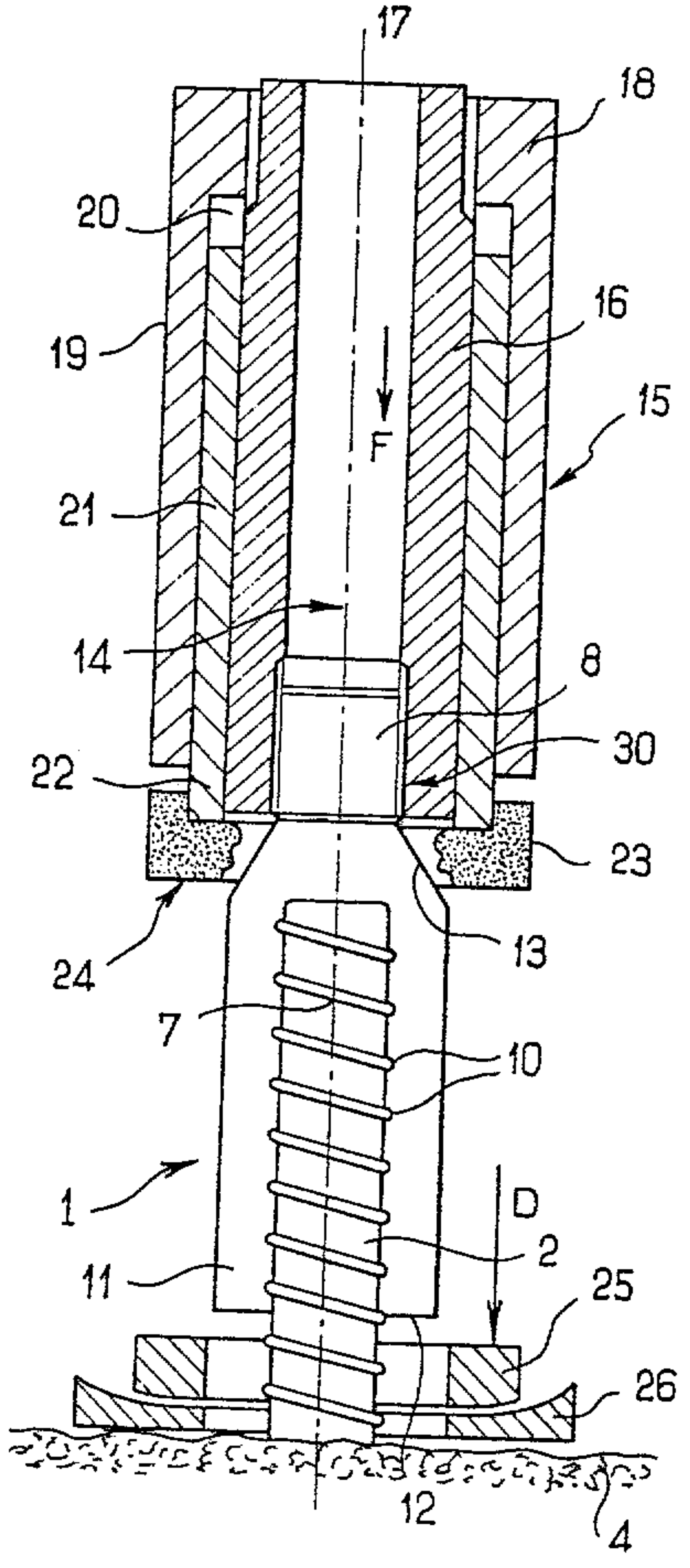

FIG_3

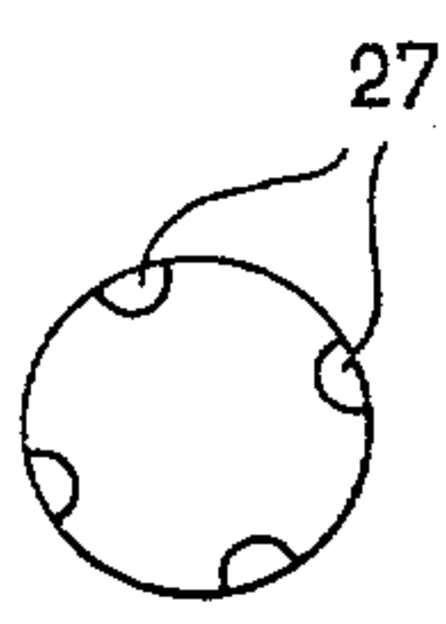

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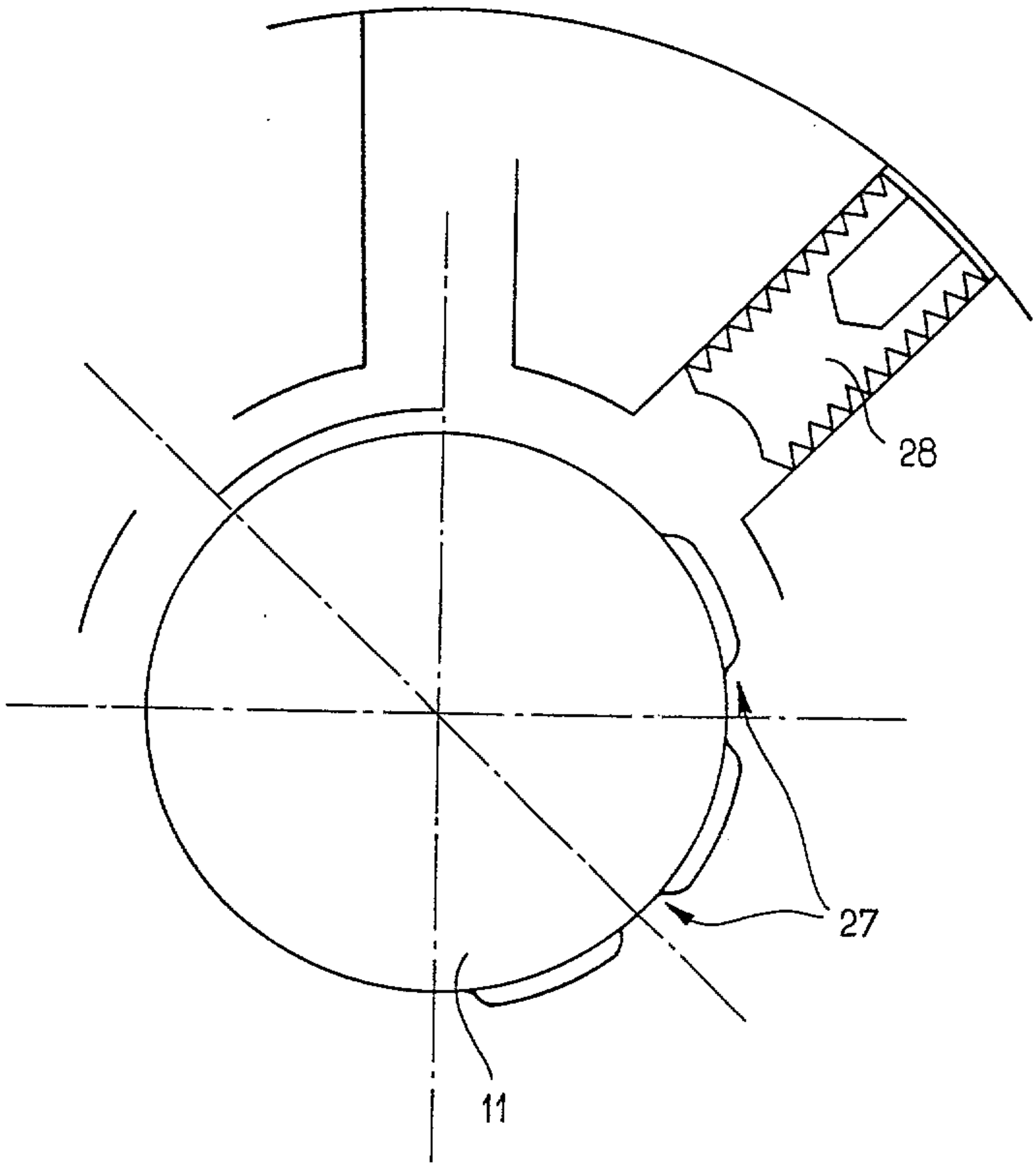
FIG_4



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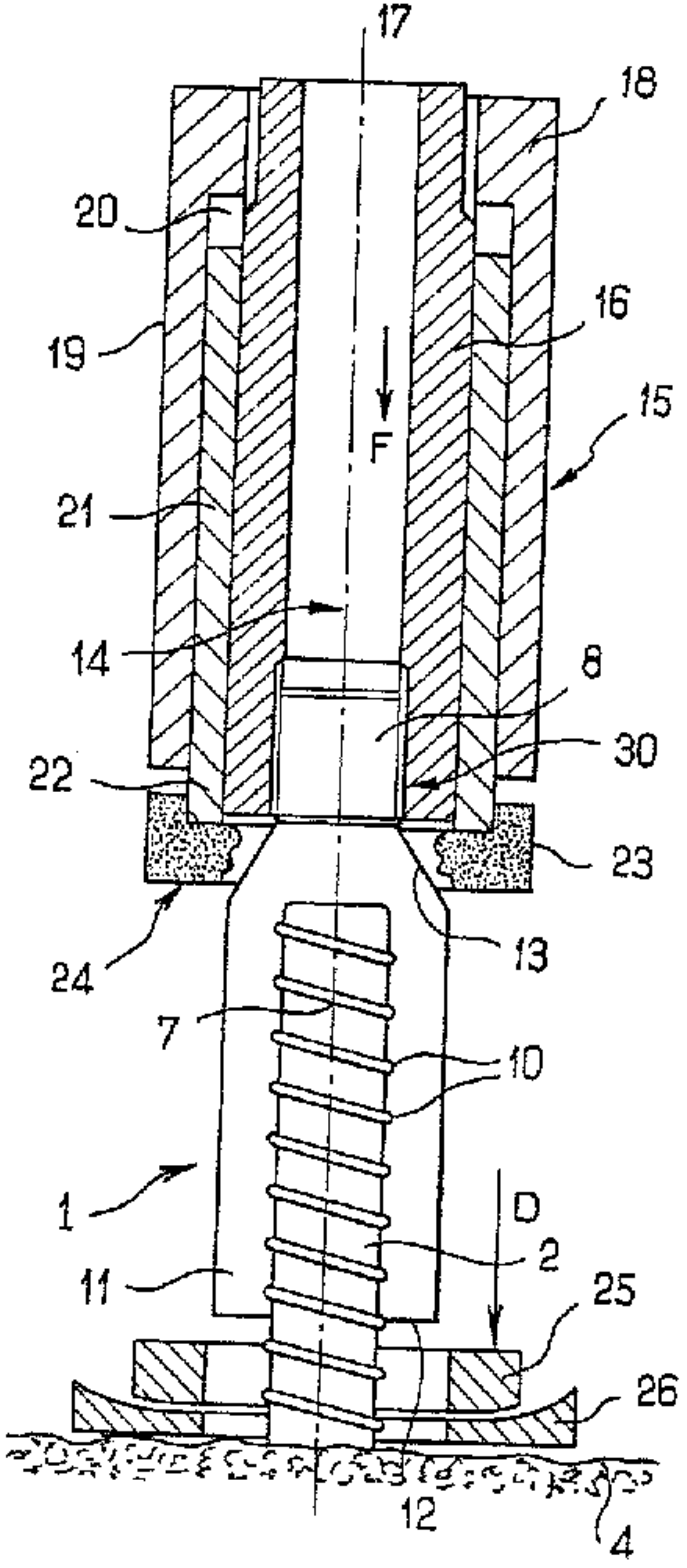

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