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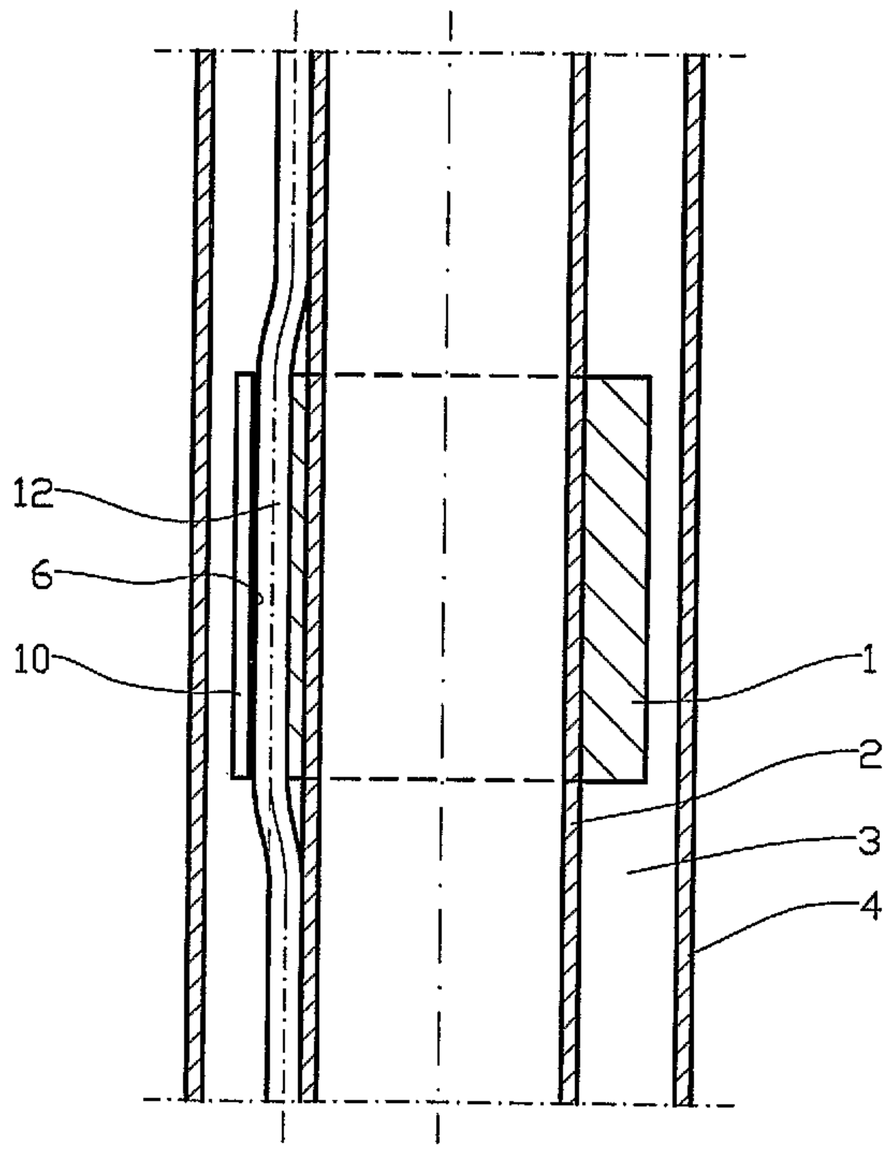
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(54) Title: A CABLE DUCT DEVICE IN A SWELLING PACKER



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A cable duct device in a swellable packer (1) of the kind in which the packer (1) is adapted to be able of sealing an annulus (3), and in which the swellable packer (1) is provided with at least one opening (6) therethrough adapted to constitute a duct for a cable (12).

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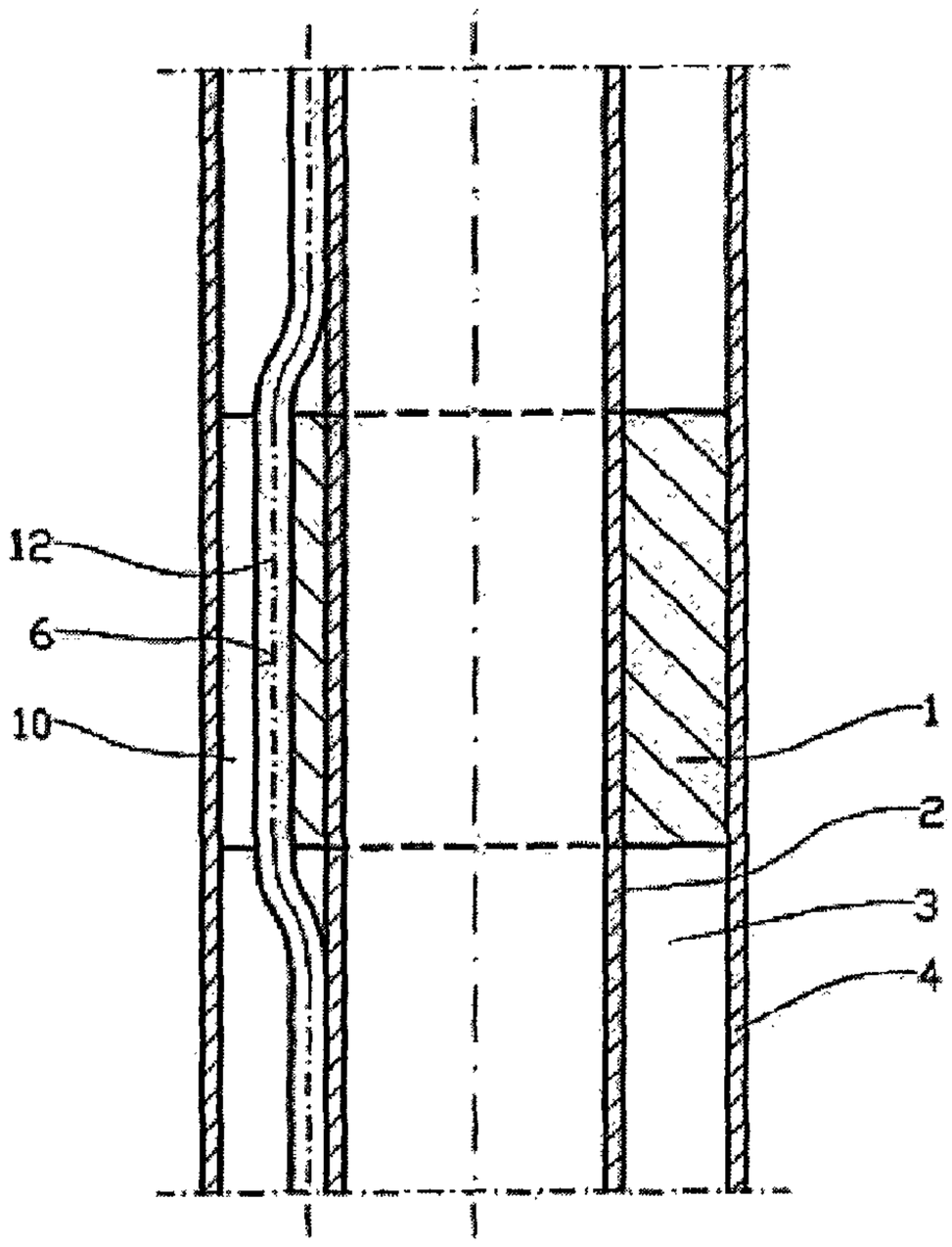
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(54) Title: A CABLE DUCT DEVICE IN A SWELLING PACKER

(57) Abstract: A cable duct device in a swellable packer (1) of the kind in which the packer (1) is adapted to be able of sealing an annulus (3), and in which the swellable packer (1) is provided with at least one opening (6) therethrough adapted to constitute a duct for a cable (12).



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A CABLE DUCT DEVICE IN A SWELLING PACKER

This invention relates to a cable duct in a swelling packer. More exactly it concerns a cable duct in a swelling packer adapted to seal an annulus between a production tubing and a casing, for example, or between a production tubing and the well formation in a well.

During the completion of a well, in particular a petroleum well, by which the well is prepared for production, a cable is usually arranged in the well parallel to production tubing. The cable is protectively arranged on the outside of the production tubing.

In this context a cable is intended to be any kind of cable or pipe, for example comprising electric lines, optical fibres, pipe lines for pressurized fluids or injection fluids, or combinations thereof. The cable may be adapted to conduct signals, supply of energy and chemicals between the surface and the well.

The term production tubing is used to illustrate the pipe enclosed by the packer. However, the packer is suitable to seal around any longitudinal body as well.

Due to technical conditions of the formation it may be necessary to provide one or more packers along the production tubing in its longitudinal extension to be able of sectioning the annulus encircling the production tubing.

According to the prior art, inflatable or mechanical expandable packers are used for this purpose. A mechanical expandable packer comprises a flexible material expanding against the casing or the walls of the formation when compressed in the axial direction of the well.

NO 20004509 discloses a swellable packer swelling in volume by the influence from the hydrocarbons of the well, whereby it is sealing against the casing or the walls of the formation.

According to prior art, it has been common to provide the packers with a cable extending through the packer and in which the cable at its end portions on the opposite sides of the packer is provided with connectors for the connection of the cable extending along the production tubing. It is obvious that the connectors of this kind may involve malfunctions, for example in the form of leakage of the pressurized fluids, bad electric contact or penetration of the formation fluids into the connectors. Thus, it is desirable to arrange whole lengths of the cable along the production tubing without having to join the cable at each packer.

US 6173788 discloses a mechanical compressible packer provided with an outer longitudinal slot in which a cable may be arranged. When the packer is compressed and squeezed against the casing, the packer material is brought to squeeze sealingly around the cable. By being situated outside of the packer the cable is relatively poorly protected during the insertion of the production tubing into the well. Obviously, the cable is also subjected to relatively great loads during the mechanical compression. The use of mechanical compressible packers has proved to be unsuitable during the sealing against a well formation as the relative expansion of the packers are insufficient.

The object of the invention is to remedy the disadvantages of the prior art.

According to the invention the object is obtained by means of at least some of the features indicated in the description below.

A packer enclosing a production tubing and being formed from a swellable material is provided with a longitudinal opening therethrough. The opening is adapted to constitute a cable duct. Advantageously, the through-going opening is arranged relatively close to the tubing surface outside of the production tubing. The cross section of the through-going opening may exhibit any geometrical form such as circular or oval. In its longitudinal extension the opening may be straight or have another configuration, for example S-formed or helical.

If desirable the packer may be provided with a slit-protruding from the outer circumference of the packer and into the

through-going opening to facilitate placing of the cable in the through-going opening during the assembling work.

When the cable shall be arranged along the production tubing, it is unnecessary to join the cable at the packers. Thus, the cable extends protected in a manner known *per se* along the production tubing and continues in a protected manner within the through-going opening in the packer to the opposite end portion of the packer, from where it again extends protected along the production tubing.

After the production tubing is displaced into the well and the swellable material has obtained contact with the swell-activating material, the volume of the packer increases, whereby the packer expands and sealingly encloses the cable and seals against casing or the formation of the well.

A non-limiting example of a preferred embodiment is described hereinafter which is illustrated in the accompanying drawing, wherein:

Fig. 1 shows in section a packer having two cables arranged therein during insertion into a casing;

Fig. 2 shows a packer having one cable arranged therein after the material of the packer has swollen sufficiently so as the packer seals around the cable and against the casing;

Fig. 3 shows a section view along I-I in Fig. 1;

Fig. 4 shows a section view along II-II in Fig. 2; and

Fig. 5 shows a section view along IIa-IIa in Fig. 2.

In the drawings the reference numeral 1 denotes a packer manufactured from a swellable material, see below. The packer 1 encircles a production tubing 2 and is adapted to be able of sealing an annulus 3 between the production tubing 2 and the shell surface inside of a casing 4.

In its longitudinal extension the packer 1 is provided with an opening therethrough which is preferentially arranged relatively close to the shell surface outside of the production tubing 2.

Between the cylindrical surface 8 outside of the packer 1 and the through-going opening 6 there is provided a slit 10.

A cable 12 extends through the through-going opening 6.

When the cable 12 shall be arranged along the production tubing 2, see Fig. 3, the cable 12 extends along the shell outside of the production tubing 2, in which it is covered by a protection (not showed) according to prior art.

At the packer 1 the cable 12 extends into the through-going opening 6, in which the material of the packer 1 protects it. As the through-going opening 6 is situated close to production tubing 2, the cable 12 is relatively well protected also at the inlet and outlet of the through-going opening 6.

When the production tubing 2 along with packer 1 and cable 12 are situated in the well, the packer swells and seals the annulus 3 by contacting a swell-activating material which may

be of water or hydrocarbons, for example, depending on the material from which the plug is formed.

By swelling in hydrocarbons the packer 1 may be manufactured from a rubber or rubber-like material selected from the group comprising EPDM, styrene-butadiene rubber, natural rubber, ethylene-propylene monomer rubber, ethylene-vinyl acetate rubber, hydrogenated acrylonitrile-butadiene rubber, acrylonitrile-butadiene rubber, isoprene rubber, chloroprene rubber and polynorbornene.

When water shall be the swell-material, the packer 1 may be formed according to US 4137970 disclosing a swellable material casting in which the material manufactured from hydrogen dichromat being dissolved in water is mixed into a compound of glycerol and diethylene glycol. This compound is added a portion of polyacrylamide and then filled into a mould.

If desirable, the swellable material may be enclosed by a web-like material.

In an alternative embodiment the slit 10 may be situated between the through-going opening 6 and the production tubing 2.

In a further embodiment the packer 1 may be formed without the slit 10.

The packer 1 may be constituted by two or more segments together encircling the production tubing 2.

In Fig. 4 an embodiment is showed in which the opening 6 in its longitudinal extension is formed with a bend 14 to provide for a reduced longitudinal stiffness of the cable 12.

If desirable, at least one cable 12 may be arranged on the inside of the packer (1) in a recess in the shell surface outside of the production tubing 2.

WHAT IS CLAIMED IS:

1. A cable duct device, comprising:

a swellable packer adapted for sealing an annulus, the swellable packer including a seal material which swells and thereby increases in volume in response to contact with a swell-activating material;

at least one through-going opening positioned between an inner surface and an outer surface of the packer and adapted to constitute a duct for a cable or pipe; and

a slit extending between the through-going opening and the outer surface of the packer prior to actuation of the packer.

2. The device according to claim 1, wherein the through-going opening encloses the cable both prior to and after swelling has occurred in the swellable packer.

3. The device according to claim 1, wherein the through-going opening has a variable longitudinal extension.

4. The device according to claim 1, wherein the through-going opening has a variable cross-section.

5. A cable duct device, comprising:

a packer adapted for sealing an annulus, the packer including a material which swells and thereby increases in volume to seal off the annulus;

at least one through-going opening positioned between an inner surface and an outer surface of the packer and adapted to constitute a duct for a cable or pipe; and

a slit extending between the through-going opening and the outer surface of the packer prior to actuation of the packer.

6. The device of claim 5, wherein the packer seals about a cable positioned in the through-going opening when the packer is actuated.

7. The device of claim 5, wherein the packer extends lengthwise in a longitudinal direction, wherein the through-going opening extends longitudinally through the packer, and wherein a cable extends longitudinally through the through-going opening.

8. The device of claim 5, wherein a cable is inserted through the slit and positioned in the through-going opening.

9. A method of extending a cable longitudinally through a packer, the method comprising the steps of:

providing a swellable packer including a seal material having an opening extending longitudinally through the seal material and positioned between an inner surface and an outer surface of the packer, and a longitudinal slit extending between the opening and the outer surface of the packer prior to actuation of the packer;

inserting the cable into the opening through the slit; and

then swelling the seal material by contacting the seal material with a swell-activating material, thereby causing the seal material to seal about the cable in the opening.

10. The method of claim 9, wherein the swell-activating material comprises water.

11. The method of claim 9, wherein the swell-activating material comprises hydrocarbons.

12. The device of claim 5, wherein the packer comprises a swellable packer including a seal material which swells and thereby increases in volume in response to contact with a swell-activating material.

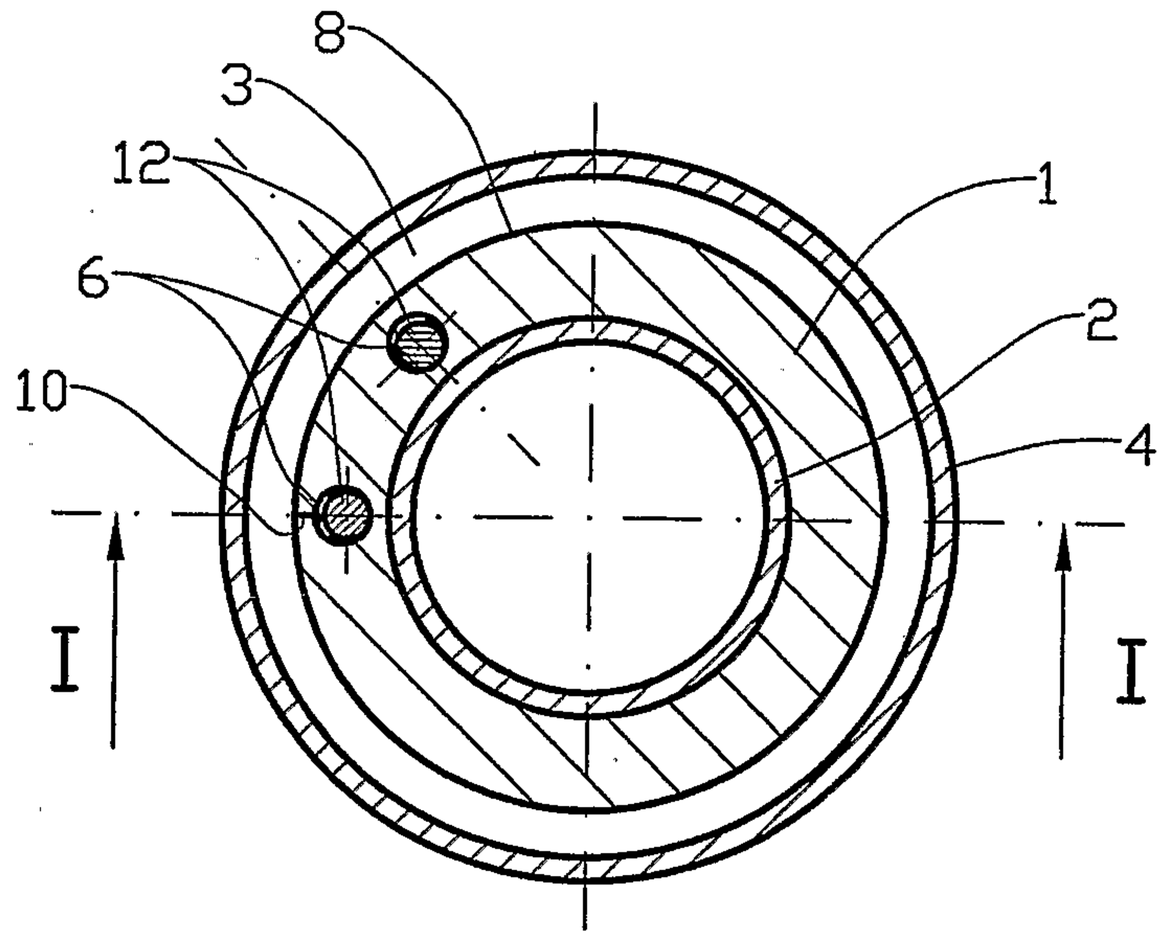


Fig. 1

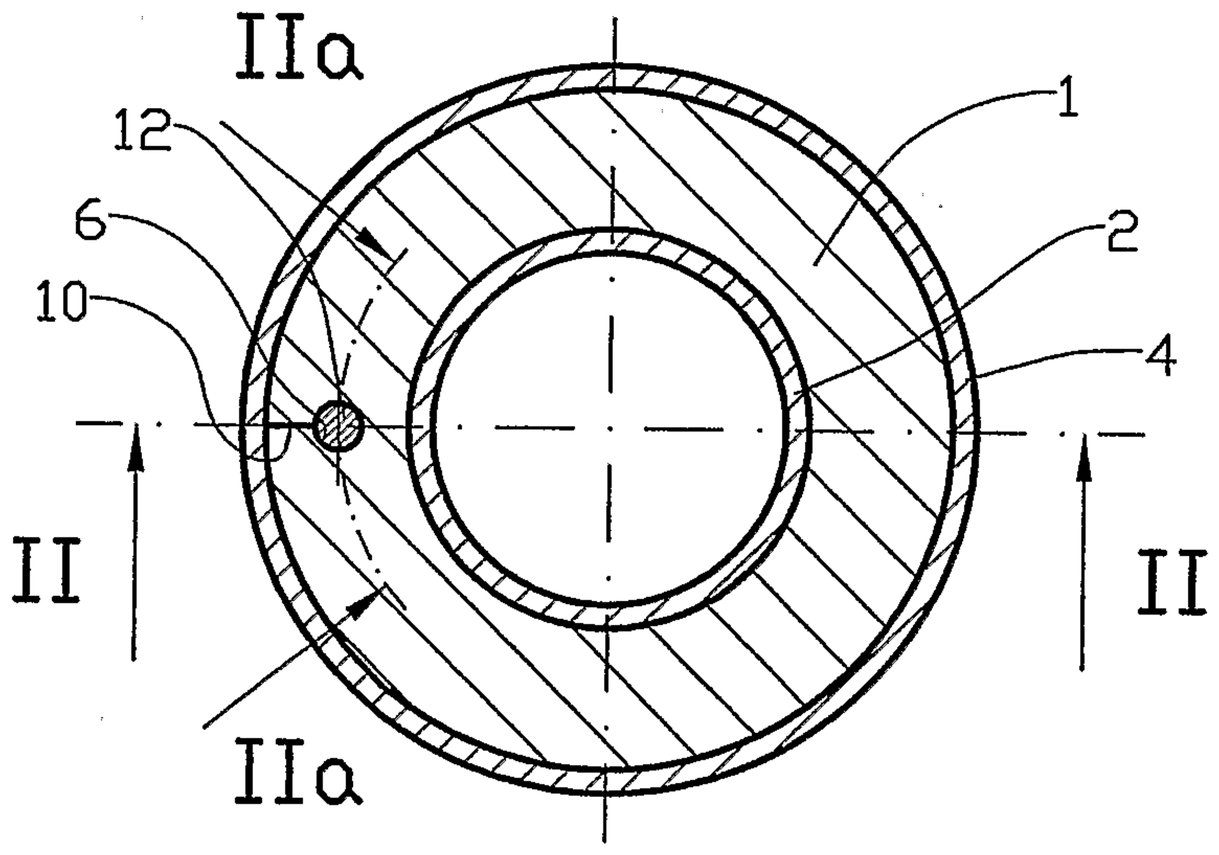
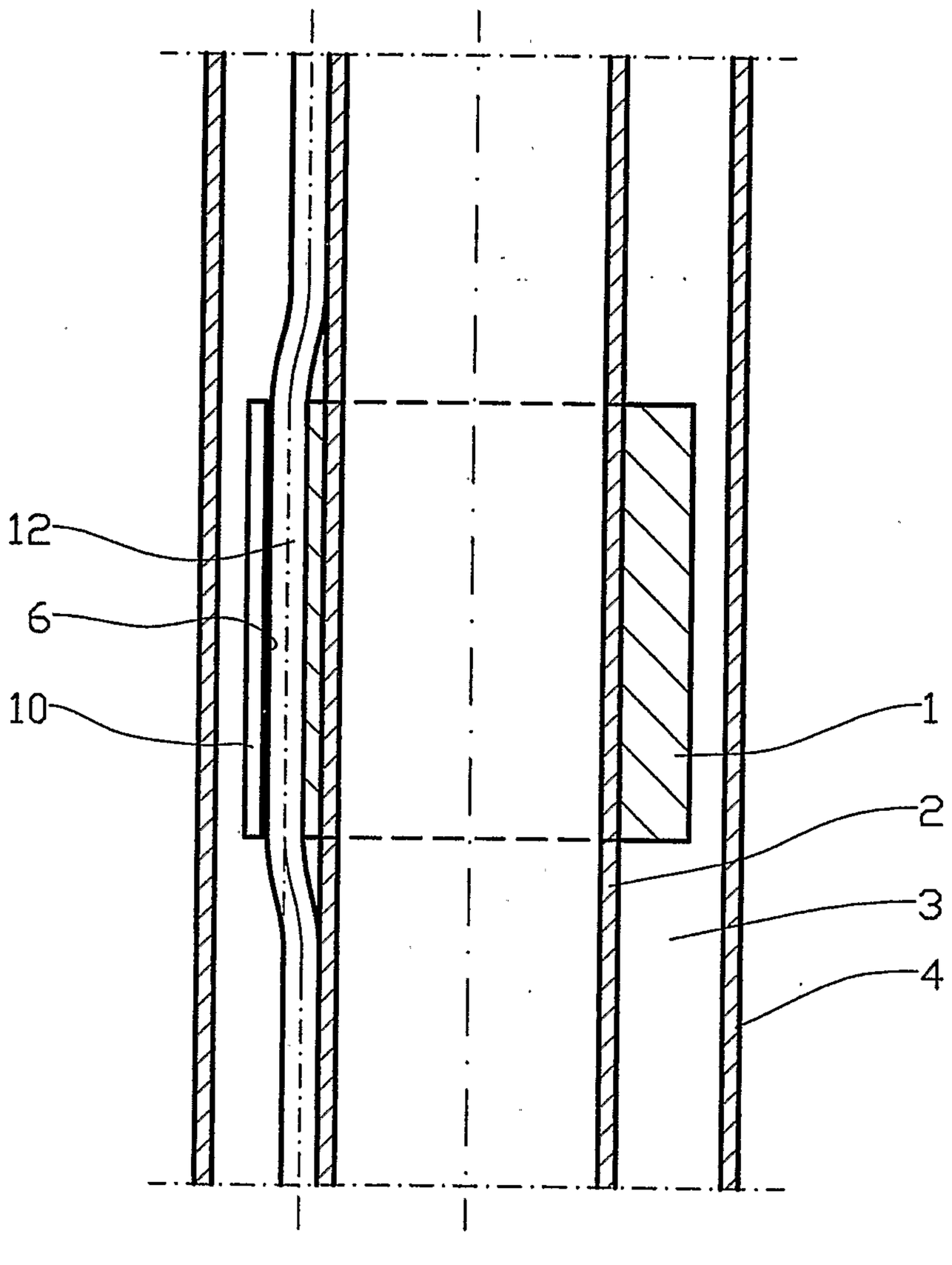
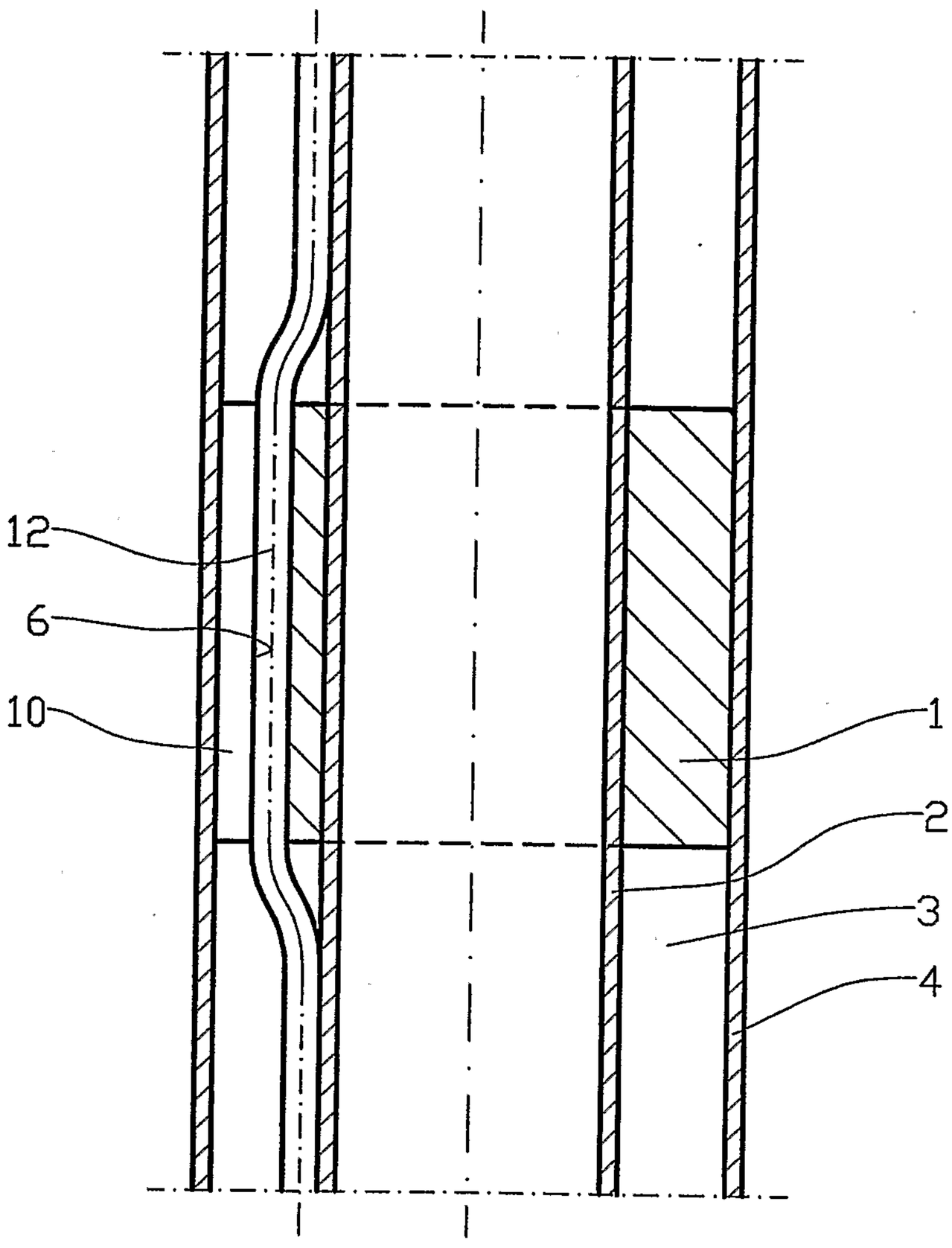


Fig. 2



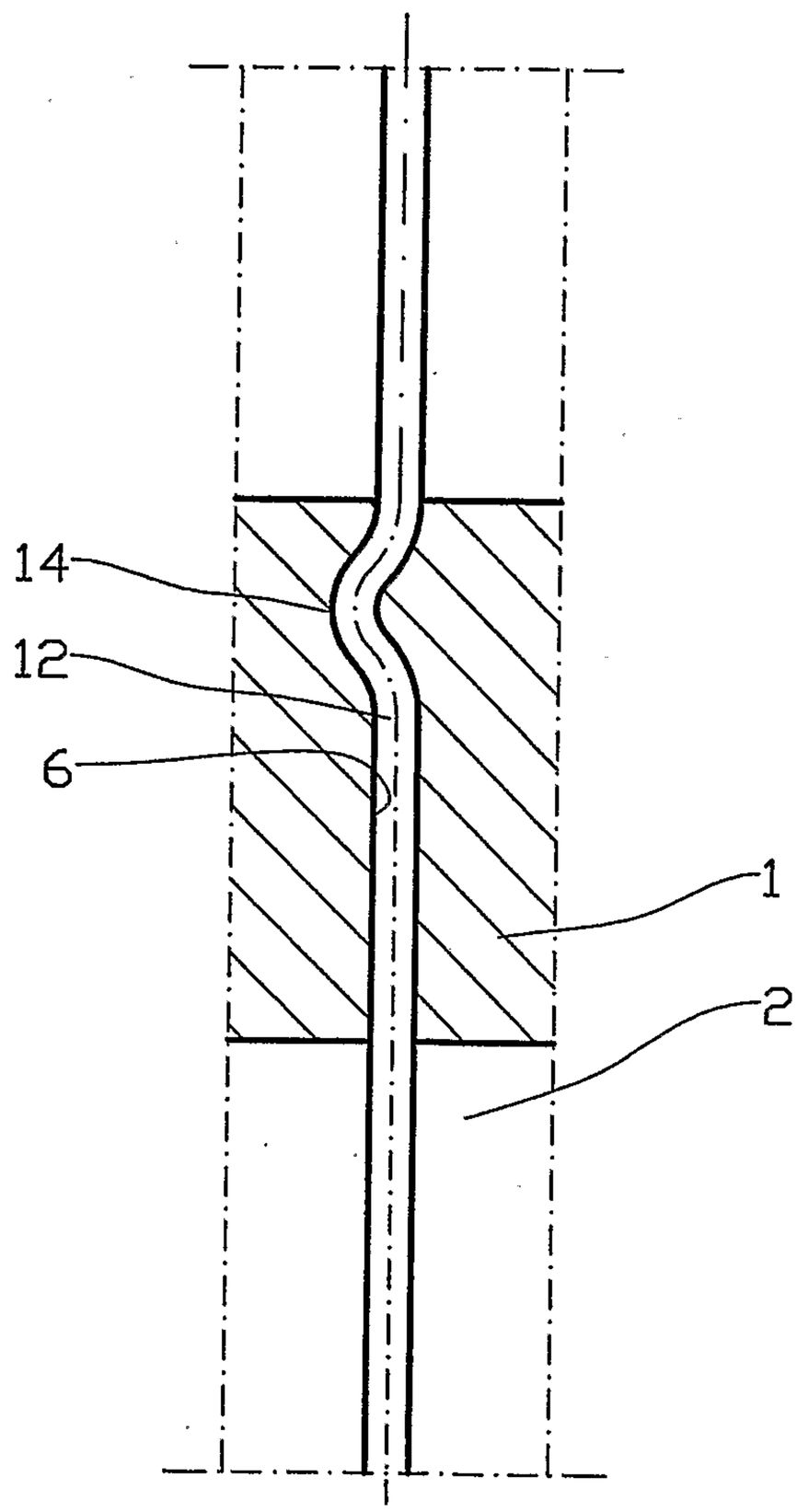
I-I

Fig. 3



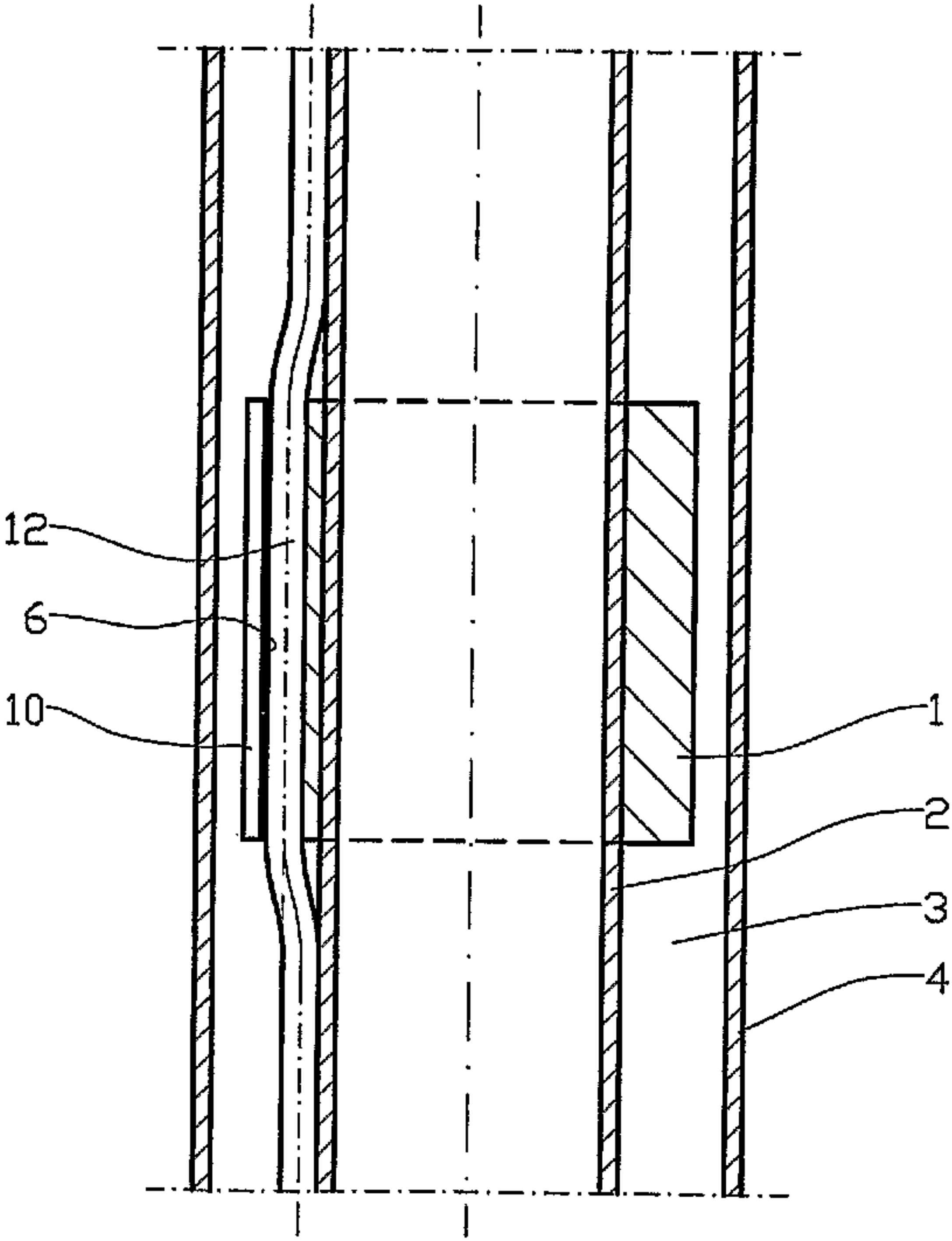
II–II

Fig. 4



IIa-IIa

Fig. 5



I–I