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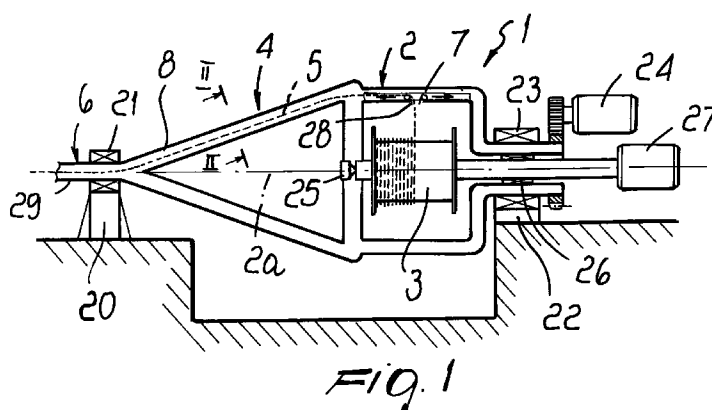
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(54) Machine for the single-twist stranding of cables composed of a plurality of wires, particularly for large-diameter cables

(57) A machine for the single-twist stranding of cables composed of a plurality of wires, particularly for large-diameter cables, comprising a winder frame (2) which is rotatably supported about its own axis (2a) and a winder reel (3) which is arranged inside the winder frame (2), the winder reel (3) being rotatably supported about its own axis, which substantially coincides with the axis (2a) of the winder frame (2). The winder frame (2) and the winder reel (3) can be rotatably actuated about their common axis (2a) independently of each

other. The winder frame (2) has at least one guide (4) forming a path for a cable (5) to be stranded which runs from a feed area (6) for feeding the cable to be stranded, located proximate to the axis (2a) of the winder frame (2), to a region (7) laterally spaced from the axis (2a) of the winder frame (2) and laterally facing the winder reel (3), the path being inclined with respect to the axis (2a) of the winder frame (2) at least along part of its extension starting from the feed area (6).



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Description

The present invention relates to a machine for the single-twist stranding of cables composed of a plurality of wires, particularly for large-diameter cables.

Conventional machines for stranding cables composed of a plurality of wires are substantially constituted by a rotating take-up unit or drum-twister composed of a frame which is rotatably rested or mounted in a cantilevered fashion about its own axis, which is generally arranged horizontally.

The rotating take-up unit internally supports a take-up reel which is arranged so that its axis is perpendicular to the rotation axis of the rotating take-up unit. The reel can be rotated about its own axis independently of the rotation of the rotating take-up unit. The cable to be stranded enters the rotating take-up unit through one of its axial ends, at the axis of the rotating take-up unit, and is gradually wound on the reel.

In practice, rotation of the rotating take-up unit about its own axis causes the stranding of the wire which is wound on the reel. In these machines, the stranding pitch is expressed by the ratio between the advancement rate of the cable to be stranded, which is a function of the rotation rate of the reel, and the rotation rate of the rotating take-up unit.

Machines are also known which perform a kind of stranding known as single-twist stranding and are constituted by a winder frame which is rotatably supported about its own generally horizontal axis and can be rotated about said axis. A winder reel is supported inside the winder frame so that it can rotate freely about its own axis, which coincides with the axis of the winder frame. Both the winder frame and the winder reel can be rotatably actuated about their common axis. The cable to be stranded is guided from a feed area, located at the axis of the winder frame, to a portion of said winder frame which laterally faces the reel. The cable to be stranded is guided by a pair of pulleys, around which the cable to be stranded partially winds. In these machines, the cable arriving from the spinner passes through a hollow shaft arranged at an axial end of the winder frame and then, by partially winding around the two guiding pulleys, it is directed onto the winder reel by means of an appropriate guide. The rotation rate of the winder frame determines the number of twists of the cable and therefore the machine productivity. This rotation rate can be as high as 1000 rpm in modern single-twist stranding machines, with respect to the 200 rpm obtainable with the previously described stranding machines, indeed because the stranding motion does not involve the rotation of the larger mass, which is constituted by the winder reel.

In these machines, the reel maintains only its take-up motion, which must still be linked to the stranding pitch by a relation which this time must take into account the fact that the real take-up rate is the relative rate of the reel with respect to the winder frame. If r is the reel winding radius on the reel, p is the stranding pitch, N_B is

the rotation rate of the winder frame, and N_A is the rotation rate of the reel, then follows:

$$N_B - N_A = N_B \frac{p}{2\pi r}$$

At each time unit, the number of wound turns must be equal to the produced length ($p \cdot N_B$) divided by the winding circumference.

Therefore:

$$N_A = N_B \left(1 - \frac{p}{2\pi r}\right)$$

is very high, and accordingly, since $\frac{p}{2\pi r}$ is usually equal to 1/10, in normal use N_A is equal to 9/10 N_B . Since the reel motion is symmetrical (rotation of a cylindrical body about its own axis of symmetry) and is not a revolving motion as in the case of the drum-twister rotating take-up unit, it is possible to achieve high winding speeds and therefore high productivities with these machines.

So far, however, use of single-twist stranding machines has been necessarily limited to the production of cables having a simple structure and a limited cross-section owing to the presence of the guiding pulleys, which force the cable to follow a bend and a complementary bend with tight radii of curvature.

Since the guiding pulleys must be supported on an arm of the winder frame which lies at right angles to the frame rotation axis, the length of the arm must be approximately equal to half the diameter of the winder reel, which is usually 2000 mm, and therefore the diameter of the guiding pulleys cannot exceed 500 mm. Since the diameter of the cable, for simple geometrical curvature reasons, cannot be more than 10 times the diameter of the pulleys around which it winds, there is a limit of $500/10 = 50$ mm for the maximum producible diameter which is much lower than the $2000/10 = 200$ mm which would be allowed by the winder reel.

A principal aim of the present invention is to solve the above drawbacks by providing a machine which is capable of performing single-twist stranding even of cables having a large diameter and a complex structure.

Within the scope of this aim, an object of the present invention is to provide a single-twist stranding machine providing high productivity.

Another object of the present invention is to provide a single-twist stranding machine which can in any case be used for the stranding of small-diameter cables.

This aim, these objects, and others which will become apparent hereinafter are achieved by a machine for the single-twist stranding of cables composed of a plurality of wires, particularly for large-diameter cables, comprising a winder frame which is rotatably supported about its own axis and a winder reel arranged inside the winder frame, said winder reel being rotatably supported independently about its own axis, which substantially coincides with the axis of said winder frame, means being provided for independently rotating said winder frame and said winder reel about said axis, characterized in that said winder frame is pro-

vided with at least one guide forming a path for a cable to be stranded which runs from a feed area for feeding the cable to be stranded, which is located proximate to the axis of the winder frame, to a region laterally spaced from said axis of the winder frame and laterally faces said winder reel, said path being inclined with respect to the axis of the winder frame at least along part of its extension starting from said feed area.

Further characteristics and advantages of the present invention will become apparent from the following detailed description of some preferred but not exclusive embodiments of the machine according to the invention, illustrated only by way of non-limitative example in the accompanying drawings, wherein:

figure 1 is a schematic axial sectional view of a first embodiment of the machine according to the present invention;

figure 2 is an enlarged-scale sectional view of figure 1, taken along the plane II-II;

figure 3 is a schematic view of a second embodiment of the machine according to the present invention;

figure 4 is a schematic sectional view of figure 3, taken along the plane IV-IV;

figure 5 is a schematic view of a third embodiment of the machine according to the present invention;

figure 6 is a schematic sectional view of figure 5, taken along the plane VI-VI;

figure 7 is a schematic view of a fourth embodiment of the machine according to the present invention;

figure 8 is a schematic sectional view of figure 7, taken along the plane VIII-VIII;

figure 9 is a schematic axial sectional view of a fifth embodiment of the machine according to the present invention;

figure 10 is a perspective view of the embodiment of figure 9;

figure 11 is a schematic axial sectional view of a sixth embodiment of the machine according to the present invention;

figure 12 is a perspective view of a seventh embodiment of the machine according to the present invention;

figure 13 is a schematic axial sectional view of an eighth embodiment of the machine according to the present invention.

With reference to figures 1 and 2, the machine according to the present invention, generally designated by the reference numeral 1, comprises a winder frame 2, which is rotatably supported about its own horizontally arranged axis 2a, and a winder reel 3, which is also rotatably supported about its own axis, which substantially coincides with the axis 2a, inside the winder frame 2.

The winder frame 2 is provided with at least one guide 4 forming a path for a cable 5 to be stranded which runs, starting from a feed area 6 located proximate to the axis 2a of the winder frame 2, up to a region 7 which is laterally spaced from the axis 2a and laterally faces the winder reel 3. The path is inclined with respect to the axis 2a of the winder frame at least along part of its extension starting from the feed area 6.

More particularly, as shown in figure 1, the guide 4 for the cable 5 to be stranded is formed by at least one arm 8 rigidly coupled to the winder frame 2.

As shown in particular in figures 3 and 4, instead of a single arm 8 it is possible to provide two arms 8a and 8b rigidly coupled to the winder frame 2 and angularly spaced with respect to each other about the axis 2a by an angle which is substantially equal to 180°. In practice, in this second embodiment, the arms 8a and 8b are practically coplanar with respect to the rotation axis 2a.

As shown in particular in figures 5 and 6, instead of two arms it is possible to provide three arms 8a, 8b, 8c rigidly coupled to the winder frame 2 and angularly spaced with respect to each other about the axis 2a at angles of substantially 120°.

As shown in figures 7 and 8, the path can also be formed by one or more passages 9a, 9b, 9c formed in a substantially conical portion 10 of the winder frame.

The arm or arms forming the path for the cable 5 to be stranded are provided with means for containing the outward expansion of the cable 5 produced by centrifugal force. These containment means can be constituted, as shown in particular in figures 3 to 8, by a shape which is concave towards the axis 2a of the arms or of the passages that form the path for the cable 5 to be stranded and/or by a plurality of pairs of rollers 11a and 11b having axes inclined with respect to each other and being freely supported about their respective axes by said arm or arms which form the path for the cable 5 to be stranded, as shown in figure 2. The pairs of rollers 11a and 11b are spaced from each other along the extension of the corresponding arm and form a cradle for the cable 5 for the resting of said cable 5 on the outside, i.e., on the opposite side with respect to the axis 2a.

Conveniently, it is possible to provide passage bushings 12, through which the cable 5 passes, between the pairs of rollers 11a and 11b.

As shown in particular in figure 2, the arm or arms 8, 8a, 8b, 8c have a hollow cross-section wherein the concave face is directed towards the axis 2a and has a symmetrical transverse cross-section so as to move in both directions to allow right-handed or left-handed stranding. The profile of the arms is cambered so as to produce limited aerodynamic drag in both directions. The cross-sections of the various arms are such that the moments of inertia of the winder frame 2, with respect to all the axes lying on a plane which is perpendicular to the axis 2a, are identical to each other.

The rollers 11a and 11b can have a cylindrical or diabolo-like shape and are located so that each pair arranged on the same plane at right angles to the axis of the wire 5 has a mutual distance and axes which are inclined with respect to each other so as to form a

curved element adapted for the predictable average diameter of the cable 5 to be produced (which must slide while resting thereon) and so that the entire set of rollers is arranged along the intended cable path.

The rollers 11a and 11b and/or the concave configuration of the arm have the purpose of preventing the wire from expanding outwards as a consequence of the centrifugal force during rotation of the winder frame 2.

The winder frame 2 is therefore constituted by a first portion which is conical or traces a conical shape in its rotary motion and wherein said at least one guide for the wire 5 is formed, and by a second portion, which is cylindrical or traces a cylindrical shape as a consequence of its rotation about the axis 2a and supports and contains the winder reel 3.

The winder frame 2 rests, at the feed area 6, on a support 20 through the interposition of a bearing 21 and, at the opposite axial end, on a support 22 by means of the interposition of a bearing 23.

As shown in particular in figure 1, the winder frame 2 can be rotated about the axis 2a for example by means of a gearmotor 24.

The reel 3 is rotatably supported about its own axis which, as mentioned, coincides with the axis 2a, by means of a complementary bearing 25 arranged inside the winder frame 2 and by means of a bearing 26 arranged inside or outside the winder frame 2. The reel 3, too, can be rotatably actuated about the axis 2a through an adapted gearmotor 27.

The cable 5 to be stranded is conveyed onto the lateral surface of the winder reel 3 by means of an adapted thread guide 28 applied to the winder frame 2.

The axial end of the winder frame 2 resting on the bearing 21 is constituted by a hollow shaft 29, through which the cable 5 to be stranded passes.

As shown in particular in figure 9, the cylindrical portion, or the portion tracing a cylinder during rotation of the winder frame 2 about the axis 2a, can support two disks 31 and 32 the axis whereof coincides with the axis 2a and which rest on supporting rollers 33 and 34, as also shown in figure 10.

As shown in figure 11, it is also possible to provide, inside the portion which is conical or traces a conical surface as a consequence of its rotation about the axis 2a, a shaft 44 rigidly coupled to the remaining part of the winder frame 2 and the axis whereof coincides with the axis 2a.

Also as illustrated in figure 11, the reel 3 can be supported by a shaft 35 the axis whereof coincides with the axis 2a and which is rotatably supported about the same axis by the winder frame 2 and can be extracted in order to allow insertion or removal of the reel 3. The shaft 35 also stiffens the structure of the winder frame in cooperation with the shaft 44.

As shown in figure 12, the winder frame 2 can also be supported by a large-diameter ball bearing 36 instead of being supported at its end on the support 20.

Advantageously, a controlled traction unit, generally designated by the reference numeral 37, can be pro-

vided in the portion of the winder frame 2 which is conical or forms a conical surface as a consequence of its rotation about the axis 2a; the traction unit 37 is constituted by at least one flywheel, two flywheels 38a and 38b in the illustrated case, with axes which are parallel to each other and perpendicular to the axis 2a. The controlled traction unit 37 is completed by a guiding roller 39, so as to form a path for the cable 5 to be stranded which can be likened to the path followed in conventional single-twist stranding machines. The controlled traction unit 37 can be used in stranding small-diameter cables which withstand bending around a smaller radius of curvature than that of the reel 3, so as to make the machine according to the invention adapted to be used also for cables having a reduced cross-section, thus achieving very high stranding speeds.

It should be noted that the surfaces against which the cable 5 rests along the path between the feed area 6 and the guide 28 can be coated with antifriction materials as an alternative to the system with rollers opposite to each other.

Operation of the machine according to the present invention is as follows.

The cable 5 arriving from the spinner is inserted through the hollow shaft 29 and conveyed along the path formed by the portion which is conical or traces a conical surface as a consequence of its rotation about the axis 2a, up to the guide 28, where through the cable 5 is conveyed onto the reel 3.

The rotation of the winder frame 2 and of the winder reel 3 about the axis 2a causes the stranding of the cable 5 and its winding on the reel 3.

It should be noted that the particular radiused shape of the path followed by the cable 5 from the feed area 6 to the guide 28, in the machine according to the present invention, achieves minimal bending of the cable, making the machine according to the invention particularly adapted for stranding large-diameter cables.

In practice it has been observed that the machine according to the present invention fully achieves the intended aim and objects, since it allows to perform single-twist stranding even of cables having a large diameter and a complex structure, achieving high productivity.

Although the machine according to the present invention has been conceived in particular for stranding large-diameter cables, it can nonetheless also be used for stranding small-diameter cables.

The machine thus conceived is susceptible of numerous modifications and variations, all of which are within the scope of the inventive concept; all the details may also be replaced with other technically equivalent elements.

In practice, the materials employed, as well as the dimensions, may be any according to requirements and to the state of the art.

Where technical features mentioned in any claim are followed by reference signs, those reference signs have been included for the sole purpose of increasing

the intelligibility of the claims and accordingly, such reference signs do not have any limiting effect on the interpretation of each element identified by way of example by such reference signs.

Claims

1. A machine for the single-twist stranding of cables composed of a plurality of wires, particularly for large-diameter cables, comprising a winder frame rotatably supported about its own axis and a winder reel arranged inside said winder frame, said winder reel being rotatably supported independently about its own axis, which substantially coincides with the axis of said winder frame, means being provided for independently rotating said winder frame and said winder reel about said axis, characterized in that said winder frame is provided with at least one guide forming a path for a cable to be stranded which runs from a feed area for feeding the cable to be stranded, which is located proximate to the axis of the winder frame, to a region laterally spaced from said axis of the winder frame and laterally facing said winder reel, said path being inclined with respect to the axis of the winder frame at least along part of its extension starting from said feed area.

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2. A machine according to claim 1, characterized in that said guide is constituted by an arm rigidly coupled to said winder frame.

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3. A machine according to claim 1, characterized in that said guide is constituted by two arms rigidly coupled to said winder frame and angularly spaced from each other about the axis of said winder frame by an angle of substantially 180°.

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4. A machine according to claim 1, characterized in that said guide is formed by three arms rigidly coupled to said winder frame and angularly spaced from each other about the axis of said winder frame by an angle of substantially 120°.

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5. A machine according to claim 1, characterized in that said guide is formed by at least one passage provided in the structure of said winder frame.

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6. A machine according to claim 1, characterized in that the moments of inertia of the winder frame, with respect to all the axes lying on a plane at right angles to the rotation axis of the winder frame, are identical to each other.

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7. A machine according to claim 1, characterized in that said winder frame is supported at its axial ends so that it can rotate about its own axis, said feed area being constituted by a hollow shaft located at an axial end of said winder frame.

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8. A machine according to claim 1, characterized in that said winder frame has, starting from said feed area, a first portion, which is substantially conical or traces a conical surface as a consequence of its rotation about the axis of the winder frame and wherein said at least one guide is formed, and a second portion, which is substantially cylindrical or traces a cylindrical surface as a consequence of its rotation about the axis of the winder frame and supports said winder reel inside it.

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9. A machine according to claim 1, characterized in that said winder frame is rotatably supported about its own axis in an intermediate region of its axial extension as well.

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10. A machine according to claim 1, characterized in that said winder frame is internally provided with a coaxial shaft for supporting said winder reel, said shaft being removable for loading and unloading said winder reel.

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11. A machine according to claim 1, characterized in that said at least one guide comprises, along said path, means for containing the outward expansion of the cable.

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12. A machine according to claim 11, characterized in that said means for containing the outward expansion of the cable comprise a shape of said at least one arm which is concave towards the axis of said winder frame.

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13. A machine according to claim 11, characterized in that said means for containing the outward expansion of the cable comprise a row of pairs of cylindrical or alternated diabolo-shaped rotating rollers which are arranged so as to form a curved element, said pairs of rollers forming an outward resting cradle for said cable.

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14. A machine according to claim 11, characterized in that said means for containing the outward expansion of the cable comprise passage bushings crossed by the cable and alternated with said rollers.

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15. A machine according to claim 8, characterized in that a controlled traction unit is accommodated along said first portion of the winder frame and is composed of one or more flywheels rotatable about their respective axes, which are substantially perpendicular to the axis of the winder frame, and form an alternate path for the cable to be stranded.

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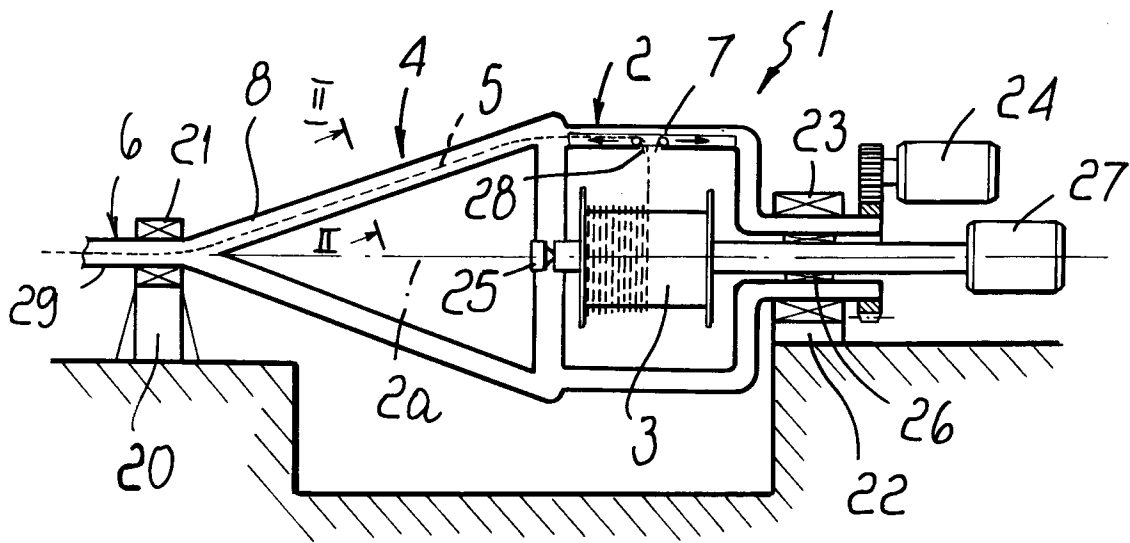


Fig. 1

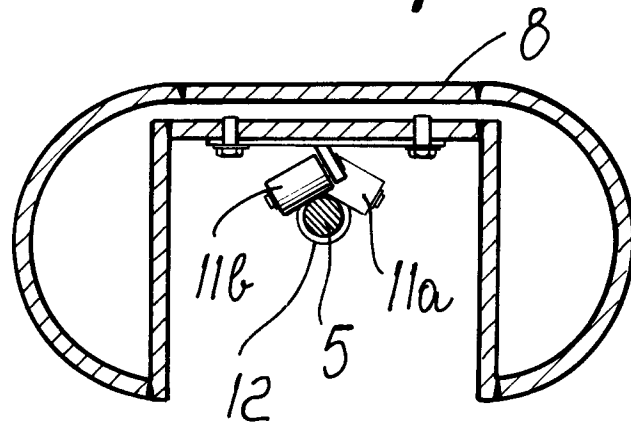


Fig. 2

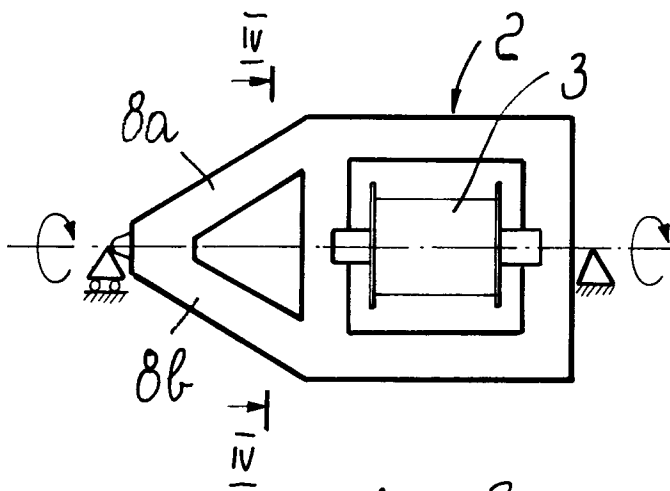


Fig. 3

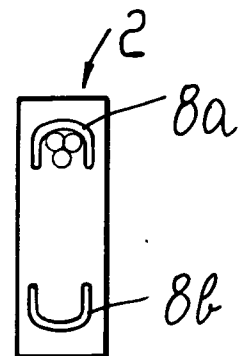


Fig. 4

