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CA 2604769 A1 2008/03/29

(21) 2 604 769

(12) DEMANDE DE BREVET CANADIEN
CANADIAN PATENT APPLICATION

(13) A1

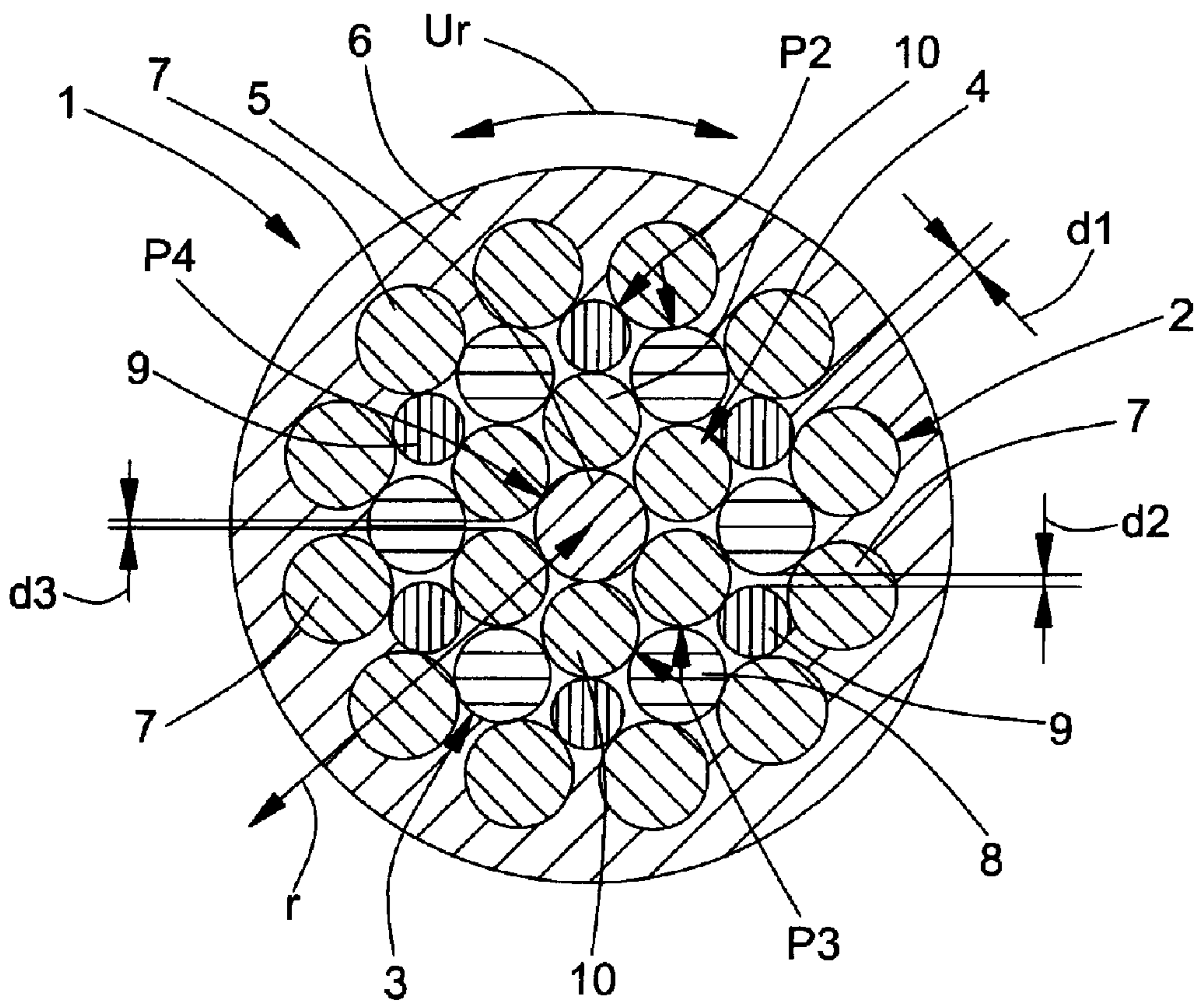
(22) Date de dépôt/Filing Date: 2007/09/27
(41) Mise à la disp. pub./Open to Public Insp.: 2008/03/29
(30) Priorité/Priority: 2006/09/29 (EP06 121572.9)

(51) Cl.Int./Int.Cl. *D07B 1/02* (2006.01), *B66B 7/06* (2006.01), *D07B 1/16* (2006.01), *D07B 5/06* (2006.01)

(71) Demandeur/Applicant:
INVENTIO AG, CH

(72) Inventeurs/Inventors:
DOLD, FLORIAN, CH;
BISSIG, ADOLF, CH;
D'APICE, ALESSANDRO, CH;
BACHMANN, HERBERT, CH;
WIRTH, MANFRED, CH;
NOSEDA, TOBIAS, CH;
LORENZ, ROLAND, CH; ...

(54) Titre : CABLE EN FIBRE SYNTHETIQUE ET INSTALLATION D'ASCENSEUR AVEC CE CABLE EN FIBRE SYNTHETIQUE
(54) Title: SYNTHETIC FIBRE CABLE AND LIFT INSTALLATION WITH SUCH A SYNTHETIC FIBRE CABLE



(57) Abrégé/Abstract:
In this synthetic fibre cable (1) the strands of a strand layer are mutually spaced apart. With the mutual spacing (d1), the strands (7) of the outer strand layer (2) can move radially in the direction of the cable centre and exert a radial pressure on the strands (8, 9) of

(72) **Inventeurs(suite)/Inventors(continued)**: DE ANGELIS, CLAUDIO, DE

(74) **Agent**: RICHES, MCKENZIE & HERBERT LLP

(57) **Abrégé(suite)/Abstract(continued)**:
the first inner strand layer (3). The radial pressure is passed on from the strands (8, 9) of the first inner strand layer (3) to the strands (10) of the second inner strand layer (4). The radial pressure is passed on from the strands (10) of the second inner strand layer (4) to the core strand (5). The radial pressure increases inwardly from strand layer to strand layer. The soft cable sheathing (6) does not act as a support between the strands (7) in circumferential direction Ur,

Abstract:

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(Fig. 1)

Description:

Synthetic fibre cable and lift installation with such a synthetic fibre cable

The invention relates to a synthetic fibre cable consisting of strands, which are arranged stranded in at least one strand layer, according to the definition of the independent patent claim. In addition, it relates to a lift installation with such a synthetic fibre cable.

A synthetic fibre cable for a lift installation with strands stranded in multiple layers is known from the specification EP 1 004 700 A2, in which a coating of the strands is provided instead of an extruded, protective synthetic material sheathing. The strands of each strand layer are mutually supporting in circumferential direction. The strands of the outermost strand layer are treated with an impregnant which ensures reliable protection against environmental influences as well as an adequate abrasion resistance.

A support cable constructed from aramide fibres has become known from the specification US 4 202 164. Several aramide fibres form a thread and several threads form a strand. Several strands arranged around a core strand form the support cable, wherein the strands are completely embedded in an extruded thermoplastic. During manufacture of the strand, the cavities between the threads are filled with a lubricant.

Here the invention will create a remedy. The invention as characterised in claim 1 meets the object of creating a supporting and drive means in the form of a synthetic fibre cable with optimal transmission of the traction forces from strand layer to strand layer. The invention also relates to a lift installation with such supporting and drive means.

Advantageous developments of the invention are indicated in the dependent patent claims.

The advantages achieved by the invention are substantially to be seen in that the synthetic fibre cable functions correctly and the service life of the synthetic fibre cable is thereby extended. The synthetic fibre cable according to the invention is usually used as supporting and drive means, for example of a lift installation, wherein the supporting and drive means is guided over at least one drive pulley and over deflecting rollers and has to withstand bending in alternation. The safety of the lift installation is also improved by the synthetic fibre cable according to the invention.

When a supporting and drive means runs over a drive pulley of the lift drive, traction forces resulting from the weight difference between counter-weight and cage are applied in the supporting means longitudinal direction. These traction forces have to be introduced uniformly over the entire supporting means cross-section so as to achieve an optimum of service life and reliability of the supporting and drive means or the synthetic fibre cable.

The transmission of the traction force takes place by way of friction forces between drive pulley and cable sheathing. The introduction of the traction forces between sheathing and outer strands of the synthetic fibre cable is problem-free in itself, since the sheathing is fixedly connected with the outer strands. However, it is problematic to transfer the traction forces from the outer strands to the inner strands when the strand layers and their strands are displaceable relative to one another. The force transfer between outer strands and inner strands takes place by way of friction forces.

In order to be able to transmit friction forces, a normal force and a coefficient of friction should have a defined level. The necessary normal force is applied by setting the radial pressing pressure of the outer strands on the inner strands. The coefficients of friction between the inner and outer strands are quite small particularly in the case of lubricated strands. Even with unlubricated strands, the coefficients of friction lie in a relatively low range of μ = 0.2 to 0.45. This region should not be fallen below, so that the shear forces can be permanently transmitted without lasting change of the cable structure. The coefficients of friction between the strands have to be relatively high for the transmission of traction. However, high coefficients of friction cause an increased wear of the strands. With coefficients of friction which are too low, individual strand layers can displace relative to one another. The coefficient of friction range of μ = 0.2 to 0.45 has proved ideal with respect to wear and traction transfer from numerous tests and can be achieved by means of dry lubricant (for example 'Teflon' powder).

The normal force necessary for transfer of traction force arises through the introduction of tension force into the outer strands, which constrict inwardly and exert a radial pressing pressure, also termed constriction pressure, on the inner strands. However, the outer strands can exert only a radial pressure inwardly when they can move radially in the direction of the cable centre. If the radial degree of freedom is blocked, no radial pressure can be exerted. Outer strands with a diameter which is too large form, together with the strands of the same layer, a form of arch and are not in a position of radially moving further inwardly. Accordingly, a spacing has to be given in circumferential direction particularly between the individual outer strands.

The supporting and drive means according to the invention in the form of a synthetic fibre cable consists of strands arranged stranded in at least one strand layer, wherein the strands of a strand layer are mutually spaced apart in circumferential direction without the strands being embedded.

The present invention is explained in more detail on the basis of the accompanying figures, in which:

Fig. 1 shows a synthetic fibre cable according to the invention,

Fig. 2 shows a supporting and drive means with more than one synthetic fibre cable and

Fig. 3 shows a lift installation with the synthetic fibre cable or supporting and drive means according to the invention.

Fig. 1 shows a synthetic fibre cable 1 according to the invention. The synthetic fibre cable 1 comprises several strand layers, an outer strand layer 2, a first inner strand layer 3, a second inner strand layer 4 and a core layer 5. A cable sheathing is denoted by 6. Construction and diameter of the strands 7 of the outer strand layer 2 are identical. The first inner strand layer consists of, in diameter, larger strands 8 and smaller strands 9. The larger strands 8 approximately correspond in diameter with the strands 10 of the second inner strand layer 4 and of the core strand 5. The strands 7 of the outer strand layer 2 are larger in diameter than the larger strands 8 of the first inner strand layer 3 and of the strands 10 of the second inner strand layer 5. The larger strands 8 of the inner strand layers 3, 4 are larger in diameter than the smaller strands 9 of the first inner strand layer 3. The larger strands 8 of the first strand layer 3 and the strands 10 of the second inner strand layer 4 are, in diameter, of approximately the same size as the core strand 5. The strands 10 of the second inner strand layer 4 are stranded around the core strand 5, the strands 8, 9 of the first inner strand layer 3 are stranded around the second strand layer 4 and the strands 7 of the outer strand layer 2 are stranded around the first inner strand layer 3.

A strand 5, 7, 8, 9, 10 consists of stranded threads, which in turn consist of unstranded or unidirectional synthetic fibres, wherein a thread consists of, for example, 1,000 synthetic fibres, also termed filaments. The stranding direction of the threads in the strands is provided so that the individual fibre is oriented in the tensile direction of the cable or in the cable longitudinal axis. Each thread is impregnated in a synthetic material bath. The synthetic material surrounding a thread or a strand is also termed matrix or matrix material. After stranding of the threads to form a strand the synthetic material of the threads is homogenised by means of a heat treatment. The strands then have a smooth strand surface and then consist of stranded threads completely embedded in the synthetic material.

The fibres are connected together by the matrix, but have no direct contact with one another. The matrix completely encloses or embeds the fibres and protects the fibres from abrasion and wear. Due to the cable mechanics, displacements occur between the individual fibres in the strands. These displacements are not translated by way of a relative movement by way of a relative movement between the filaments, but by a reversible stretching of the matrix.

The degree of filling of the strands describes the behaviour of the fibre component relative to the matrix. This degree of filling can be defined by way of the proportional area of the fibres to the total cross-section, as also by the weight proportion of the fibres to the total weight. The degree of filling in the currently employed aramide strands is between 35 to 80 area percent, or 35 to 80% of the strand cross-sectional area consists of fibres and the rest of matrix material.

The synthetic fibre cable 1 can be constructed from chemical fibres such as, for example, aramide fibres, Vectran fibres, polyethylene fibres, polyester fibres, etc. The synthetic fibre cable 1 can also consist of one or two or three or more than three strand layers.

Fig. 1 shows the synthetic fibre cable 1 according to the invention in which the strands of a strand layer are mutually spaced apart. The spacing between two strands 7 of the outer strand layer 2 is denoted by d1. The spacing between two strands 8, 9 of the first inner strand layer 3 is denoted by d2. The spacing between two strands 10 of the second inner layer 4 is denoted by d3. For example, d1 can lie in the range of 0.05 millimetres to 0.3 millimetres and d2 and d3 in the range of 0.01 millimetres to 0.08 millimetres. For preference d1 = 0.2 millimetres, d2 = 0.03 millimetres and d3 = 0.03 millimetres. The spacing between the individual strands is predetermined by the strand diameter, lay length and number of strands per strand layer.

With the mutual spacing apart of the strands of the strand layer, the strands of the strand layer can freely move in radial direction r in the direction of the cable centre. The strands of an outer strand layer exert a radial pressure on the strands of an inner strand layer. The strands 7 of the outer strand layer 2 exert a radial pressure on the strands 8, 9 of the first inner strand layer 3, as is symbolised by the arrows P2. The radial pressure is passed on from the strands 8, 9 of the first inner strand layer 3 to the strands 10 of the second inner strand layer 4, as is symbolised by the arrows P3. The radial pressure is passed on from the strands 10 of the second inner strand layer 4 to the core layer 5, as is symbolised by the arrow P4. The radial pressure increases inwardly from strand layer to strand layer.

Each strand 7 of the outer strand layer 2 is supported on two strands 8, 9 of the first inner strand layer 3. Each smaller strand 9 of the first inner strand layer 3 is supported on a strand 10 of the second inner strand layer 4. Each larger strand 8 of the first inner strand layer 3 is supported on the same strand 10 as the smaller strand 9 and on a further strand 10 of the second inner strand layer 4.

The diametral ranges or optimal diameters of the individual strands can, for example in the case of a lay length of 80 millimetres, be selected as follows: strand 5: diameter range 1.55 millimetres to 1.85 millimetres, diameter 1.66 millimetres; strand 7: diameter range 1.85 millimetres to 2.15 millimetres, diameter 1.97 millimetres; strand 8: diameter range 1.55 millimetres to 1.85 millimetres, diameter 1.66 millimetres; strand 9: diameter range 1.15 millimetres to 1.45 millimetres, diameter 1.28 millimetres; strand 10: diameter range 1.45 millimetres to 1.75 millimetres, diameter 1.58 millimetres.

The cable sheathing 6, which is very much softer by comparison with the strands 7, reaches approximately to the first inner strand layer 3 and does not have any influence on the mutual support of the strands 7. The soft cable sheathing 6 does not act in circumferential direction Ur as a support between the strands 7. The strands 7 of the outer strand layer 3 are in a position of moving radially inwardly. The sheathing material can, for example, lie in the Shore hardness range 75A to 95A and the matrix material of the strands can, for example, lie in the Shore hardness range of 50D to 75D.

The synthetic fibre cable 1 can also manage without the cable sheathing 6, but the cable construction has to be slightly changed in that the outer strand layer 2 stranded oppositely (in counter lay) relative to the inner strand layers 3, 4.

If the strands 7, 8, 9, 10 of the respective strand layer were to hit against one another as seen in circumferential direction Ur, the traction forces could not be transmitted from the strands 7 of the outermost strand layer 2 to the strands 8, 9 of the first inner strand layer 3 and not from this to the strands 10 of the second inner strand layer 4 and further to the core strand 5.

Fig. 2 shows a supporting and drive means for a lift with two load-bearing synthetic fibre cables 1, which are encased by a common, integral sheathing 12, according to Fig. 1 and which form a double cable 11. The double cable 11 can, between the synthetic fibre cables 1, be constructed together with the sheathing 12 as a flat cable or can have a narrowing 13 between the synthetic fibre cables 1. In the case of the variant with the narrowing 13 the common engagement surface of the double cable 11 with the drive pulley is formed, as seen in cross-section, by approximately a semicircle of the synthetic fibre cable 1 and half the narrowing 13. The drive pulley surface is approximately complementary to the profile of the double cable 11. In addition, more than two synthetic fibre cables 1 can be encased by a common sheathing and form a multiple cable with and without narrowing between the synthetic fibre cables 1.

A lift installation denoted by 100 and consisting of a lift cage 103 and a counterweight 104 movable in a lift shaft 102 is illustrated in Fig. 3. The lift cage 103 with floor 121 and ceiling 140 is guided by means of a first guide rail 105 and by means of a second guide rail 106. The counterweight 104 is guided by means of a third guide rail 107 and by means of a fourth guide rail (not illustrated). The guide rails are supported in a shaft pit 108, wherein the vertical forces are conducted into the shaft pit 108. The guide rails 105, 106, 107 are connected by brackets (not illustrated) with the shaft wall. Arranged in the shaft pit 108 are buffers 109 on which buffer plates 110 of the lift cage 103, or the counterweight 104, can set down.

The synthetic fibre cable 1 or double cable 11 according to the invention can be provided as supporting and drive means with a 2:1 belt guidance. If a mechanical linear drive 112, which is arranged at the second guide rail 106, for example in the shaft head 102.1, advances the synthetic fibre cable 1 or double cable 11 by means of a drive wheel 113 by one unit, the lift cage 103 of the counterweight 104 moves by half a unit. The transmission of the traction force takes place, as explained further above, by way of friction forces between drive wheel and cable sheathing. One end of the synthetic fibre cable 1 or double cable 11 is arranged at a first cable fixing point.114 and the second end of the synthetic fibre cable 1 or the double cable 11 is arranged at a second cable fixing point 115. The synthetic fibre cable 1 or double cable 11 is guided over a first deflecting roller 116, a profiled roller 117, a second deflecting roller 118, a third deflecting roller 119, the drive wheel 113 and a fourth deflecting roller 120. The third deflecting roller 119 arranged at the second guide rail 106 has a brake for normal operation. Diverting rollers 122 of the linear drive 112 increase the angle of looping of the synthetic fibre cable 1 or double cable 11 at the drive wheel 113. The motor or motors for the drive wheel 113 is or are not illustrated. The fourth deflecting roller 120 is arranged in the counterweight 104 and is comparable in construction with the first deflecting roller 116 or with the second deflecting roller 118.

The synthetic fibre cable 1 or the support and drive means 11 can also be used for other known lift drives.

Patent Claims:

1. Synthetic fibre cable consisting of strands arranged to be stranded in at least one strand layer, characterised in that the strands of a strand layer are mutually spaced apart in circumferential direction, wherein the strands of an outer strand layer can freely move in radial direction in the direction of the cable centre and exert a radial pressure on the strands of an inner strand layer and the radial pressure increases in inner direction from strand layer to strand layer.

2. Synthetic fibre cable according to claim 1, characterised in that an outer strand layer with strands arranged to be stranded, a first inner strand layer with strands arranged to be stranded, a second inner strand layer with strands arranged to be stranded and a core strand are provided.

3. Synthetic fibre cable according to one of claims 1 and 2, characterised in that the mutual spacing of the strands of a strand layer in circumferential direction is predetermined by the strand diameter, the lay length and the number of strands per strand layer.

4. Synthetic fibre cable according to claim 3, characterised in that the mutual spacing of the strands of the outer strand layer lies in the region of 0.05 millimetres to 0.3 millimetres, that the mutual spacing of the strands of the first inner strand layer lies in the region of 0.01 millimetres to 0.08 millimetres and that the mutual spacing of the strands of the second inner strand layer lies in the region of 0.01 millimetres to 0.08 millimetres.

5. Synthetic fibre cable according to any one of the preceding claims, characterised in that the strands of the outer strand layer lie in the diameter range of 1.85 millimetres to 2.15 millimetres, that the strands of the first inner strand layer lie in the diameter range of 1.55 millimetres to 1.85 millimetres or in the diameter range of 1.15 millimetres to 1.45 millimetres, that the strands of the second inner strand layer lie in the diameter range of 1.45 millimetres to 1.75 millimetres and that the core strand lies in the diameter range of 1.55 millimetres to 1.85 millimetres.

6. Synthetic fibre cable according to claim 5, characterised in that the smaller strand of the first inner strand layer is supported on the strand and the strand of the second strand is supported on a strand and the remaining strands are respectively supported on

two strands.

7. Synthetic fibre cable according to any one of the preceding claims, characterised in that the coefficients of friction (μ) between the strands lie in the region of = 0.2 to 0.45.

8. Synthetic fibre cable according to any one of the preceding claims, characterised in that the outer strand layer is encased by a cable sheathing and the cable sheathing reaches approximately to the first inner strand layer.

9. Synthetic fibre cable according to claim 8, characterised in that the sheathing material lies in the Shore hardness range of 75A to 95A and the matrix material of the strands lies in the Shore hardness range of 50D to 75D.

10. Supporting and drive means for a lift with at least two synthetic fibre cables according to any one of the preceding claims, which are encased by a common integral sheathing.

11. Supporting and drive means according to claim 10, characterised in that the sheathing has a narrowing between two synthetic fibre cables.

12. Lift installation with a synthetic fibre cable according to one of claims 1 to 9 or with a supporting and drive means according to one of claims 10 and 11.

13. Lift installation according to claim 12, characterised in that the synthetic fibre cable or the supporting and drive means is guided over a drive wheel and moves a lift cage and a counterweight.

14. Method of producing a synthetic fibre cable according to any one of claims 1 to 9, characterised in that threads are produced from synthetic fibres, wherein the threads are impregnated in a synthetic material bath and several stranded threads form a strand, which after stranding of the threads is homogenised by means of a heat treatment, wherein the strand surface is smoothed and the stranded threads are completely embedded in the synthetic material.

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FIG. 1

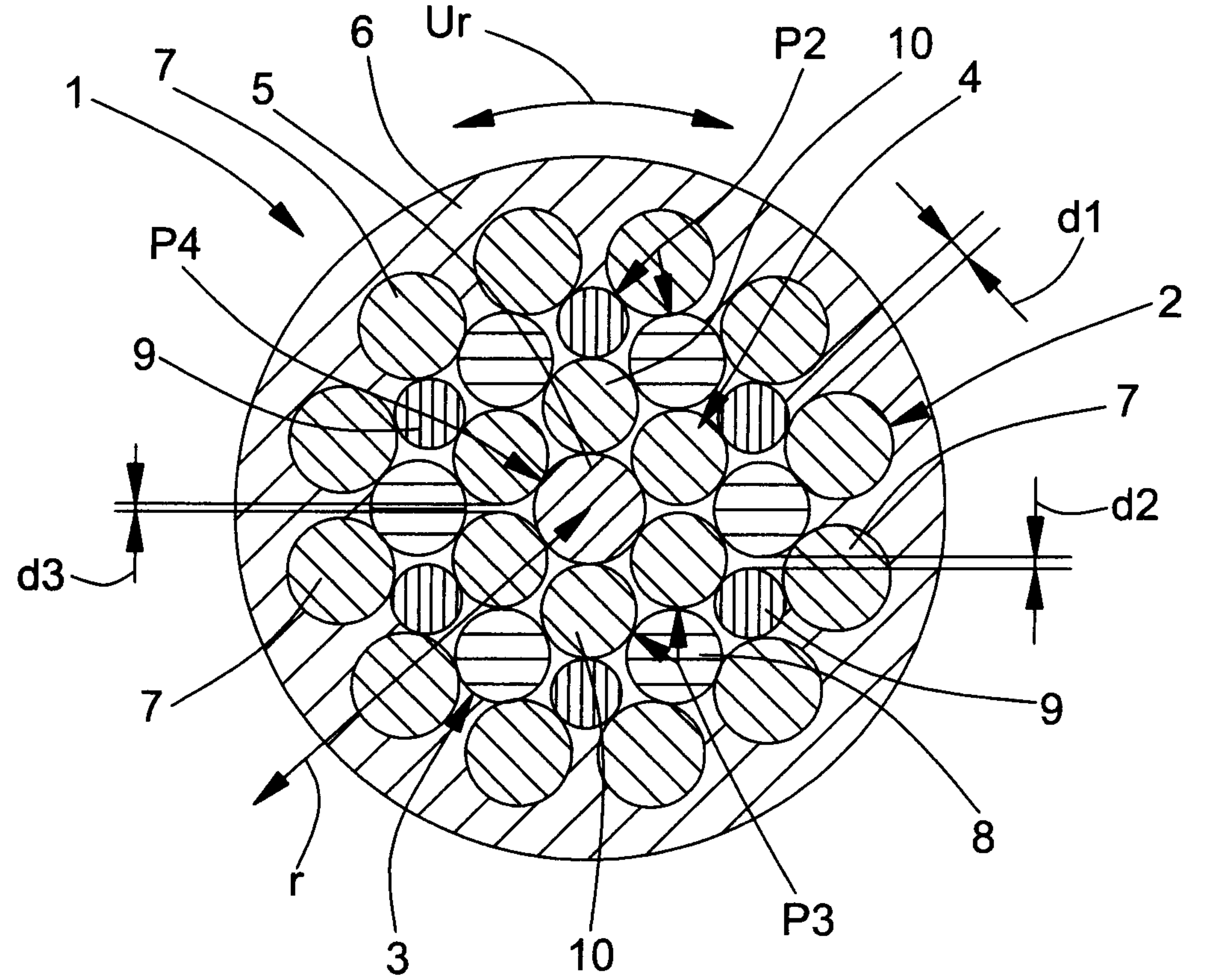
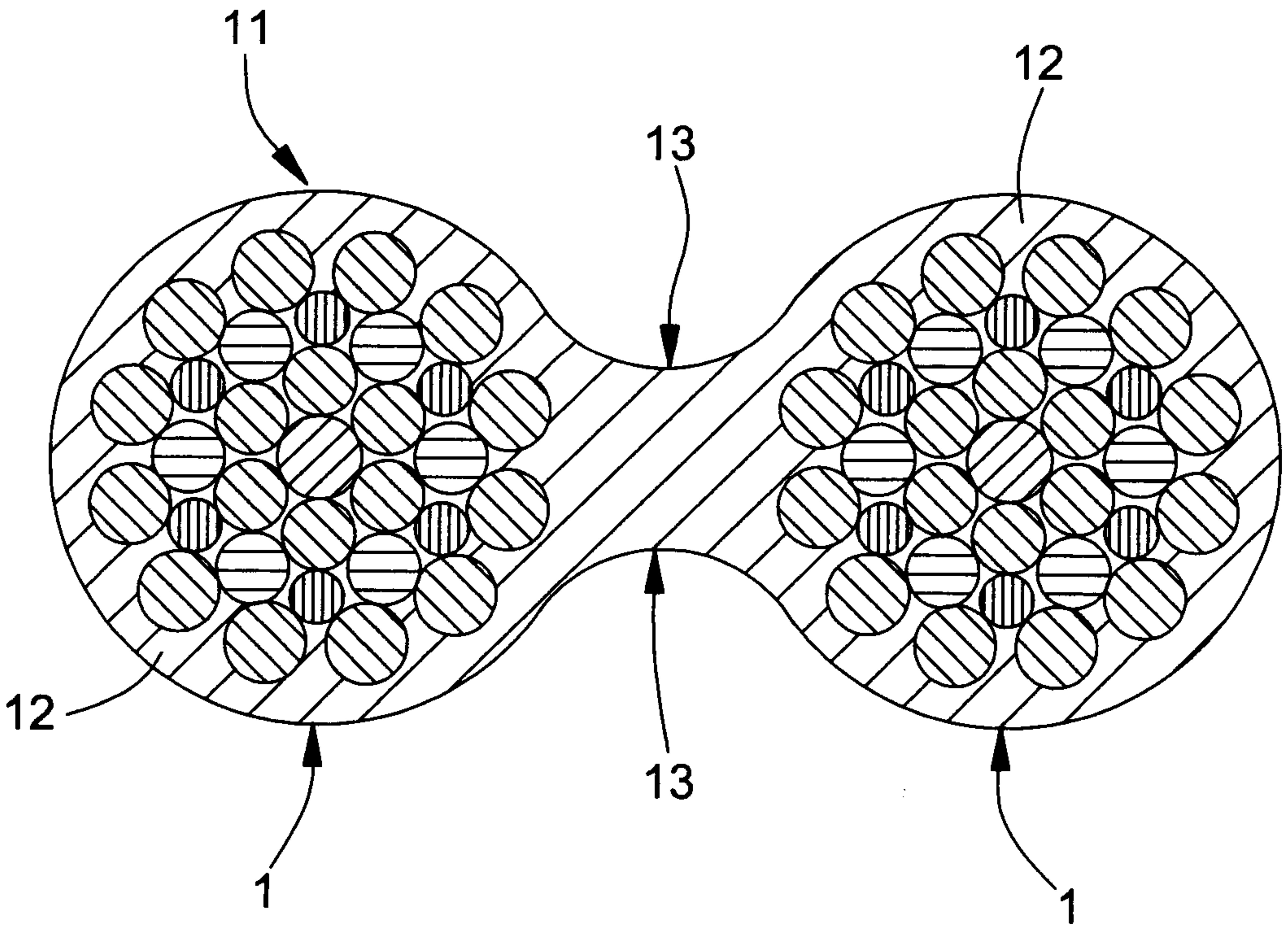
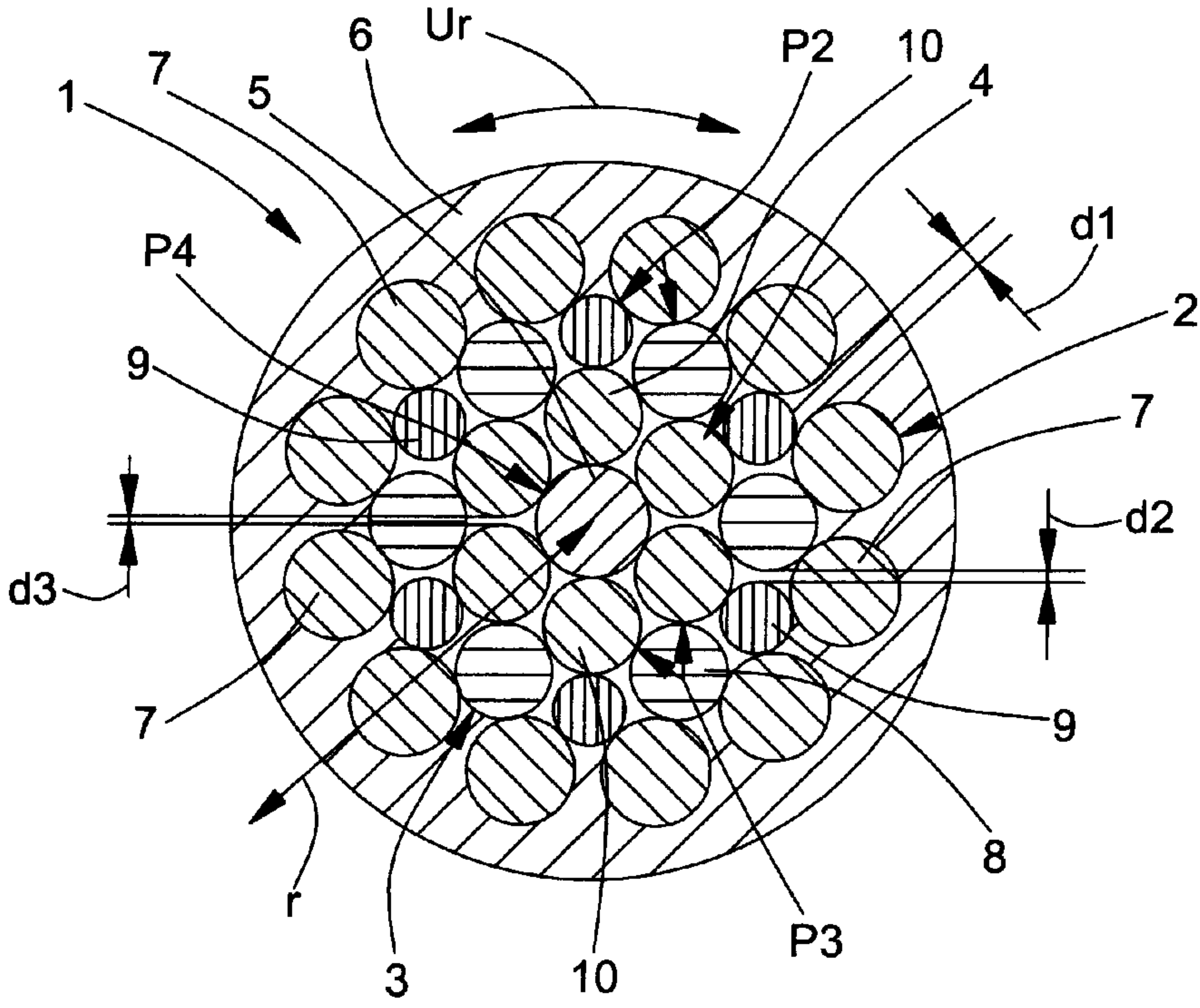


FIG. 2





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P2
10
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P4
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d2
d3
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P3
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