(19) Europäisches Patentamt
European Patent Office
Office européen des brevets

(11) EP 1 154 441 A1

(12) EUROPEAN PATENT APPLICATION

(43) Date of publication:
14.11.2001 Bulletin 2001/46

(51) Int Cl.^{7}: **H01B 7/04**

(21) Application number: **00107167.9**

(22) Date of filing: **11.04.2000**

(84) Designated Contracting States:
AT BE CH CY DE DK ES FI FR GB GR IE IT LI LU MC NL PT SE
Designated Extension States:
AL LT LV MK RO SI

(71) Applicant: **W.L. GORE & ASSOCIATES GmbH**
85640 Putzbrunn (DE)

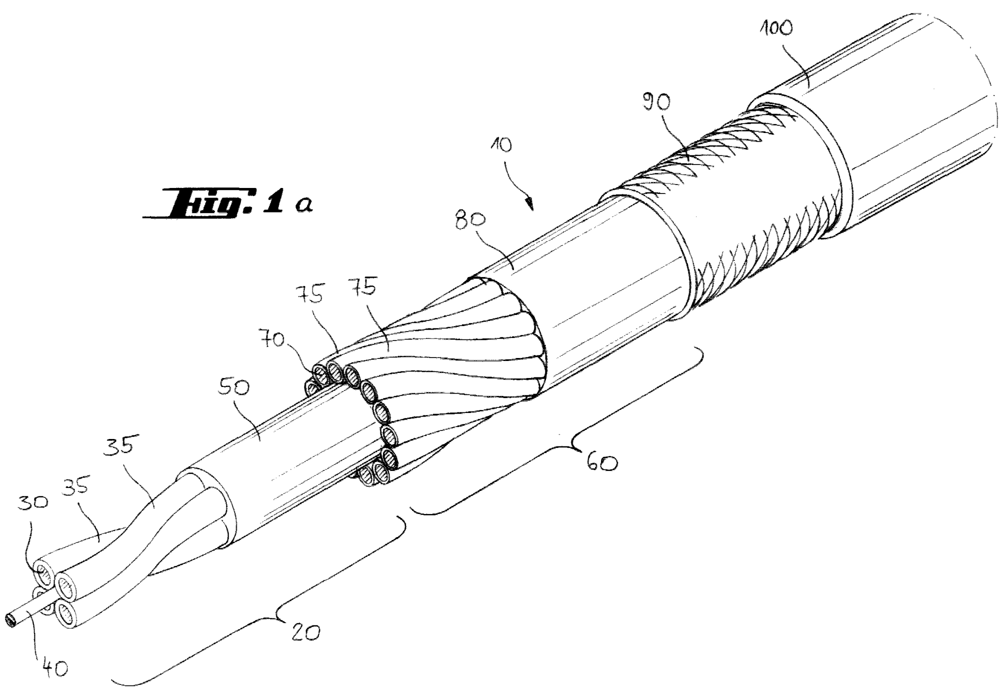
(72) Inventors:
- **Steff, Josef**
  91802 Meinheim (DE)
- **Braungart, Heinz**
  91187 Röttenbach (DE)

(74) Representative: **Harrison, Robert John**
W.L. Gore & Associates GmbH,
Hermann-Oberth-Strasse 22
85640 Putzbrunn (DE)

(54) **Cable**

(57) An electric cable (10) having a core (20) with at least one first conductor (30) is disclosed. The core (20) is completely surrounded by and embedded within a first stress-bearing matrix (50). At least one further layer (60) is disposed about the first stress-bearing matrix (50) and this further layer (60) has at least one further conductor (70) which is at least partially embedded within a second stress-bearing matrix (80). A jacket (100) is placed about the further layer (60) and furthermore a strength member (90) may be disposed between the further layer (60) and the jacket (100). The electric cable may find application in a pick-up system (200) such as a crane or a shelving system. The pick-up system (200) has one or more electromechanical motors (210) connected to a source (220) by the cable (10) of the invention.

Fig. 1 a



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Description

FIELD OF THE INVENTION

[0001] The invention relates to a cable and in particular a cable for use in pick-up systems such as storage shelving systems or cranes

PRIOR ART

[0002] Shelf storage systems 200 such as that shown diagrammatically in Fig. 3 are known in the art. The shelf storage system 200 has one or more arms 240 mounted onto a trolley 250. The trolley 250 moves the arms 240 around a warehouse to a desired position at which point the arms 240 extend into the shelving 205 to pick up a desired object by means of a holder 260. The movement of the trolley 250, the arms 240 and the holder 260 are controlled by electromechanical motors 210. Cables 10 are connected between the electromechanical motors 210 and a power and control source 220 which provide power and control signals along the cables 10. The cables 10 are wrapped about one or more cable drums 230 mounted on the trolley 250 which, as the trolley 250 and/or the arms 240 move, takes up or releases the cable 10 as required.

[0003] The most common cause of failure of the cables 10 in the above application is the so-called "corkscrew effect" which occurs because of the continuous flexing of the cables 10 as the taken up and released by the cable drum 230. The strain on individual conductors within the cable 10 causes them to move within the cable 10 and eventually destroy the cable 10 so that the cable 10 has to be replaced

[0004] One cable which is known in the art for such application is made by the IGUS company in Köln, Germany, and sold under the name CHAINFLEX ®. These have a plurality of conductors in the centre of the cable and a protective outer jacket is extruded about the conductors.

[0005] Other cables known in the art for use in such applications are made of steel and are consequently extremely heavy and bulky.

[0006] Similar problems are known to occur in cranes 300 as shown in Fig. 4 in which a grabber 330 is moved by means of electromechanical motors 310 attached to a power and control source 320 by means of a cable 10. Cranes 300 and shelf storage systems 200 together with similar applications are collectively known as pick-up systems.

SUMMARY OF THE INVENTION

[0007] The object of the invention is to provide an improved cable, in particular for use in a pick-up system.

[0008] It is furthermore an object of the invention to substantially eliminate the corkscrew effect in a cable.

[0009] These and other objects are solved by providing a cable comprising a core with at least one first conductor within the core. The core is completely surrounded by and embedded within a first stress-bearing matrix. At least one further layer is disposed about the first stress-bearing matrix and has at least one further conductor in the further layer which is completely surrounded by and embedded within a second stress-bearing matrix. Both the first and the further conductors are completely surrounded by a stress-bearing matrix and thus any longitudinal stress applied to the conductors is transmitted into the stress-bearing matrices. The stress-bearing matrices in the cable allow the distribution of stress throughout the cable and thus substantially reduce and even eliminate the corkscrew effect.

[0010] Preferably the core in the cable comprises at least two insulated first conductors disposed about a spacer and more preferably four insulated first conductors disposed equidistantly about the spacer. It is known that the use of four equidistantly disposed conductors minimises the electrical interference between one conductor and another. In another embodiment of the invention, the core comprises six first conductors .

[0011] The cable of the invention finds application in a pick-up system such as a crane or shelving system. The pick-up system has one or more electromechanical motors connected to a power source by the cable of the invention. In such inventions, the cable is wound on a cable drum and unwound from the cable drum. The winding and unwinding of the cable places enormous stress on the individual conductors within the cable. The presence of the stress-bearing matrices allows, however, the distribution of these stresses within the cable as explained above.

DESCRIPTION OF THE DRAWINGS

[0012]

Figs. 1a and 1b show a cable construction according to the invention.

Figs. 2a and 2b show a further cable construction according to the invention.

Fig. 3 shows a shelf storage system incorporating the cable of the invention.

Fig. 4 shows a crane incorporating the cable of the invention.

Figs. 5a and 5b show a test apparatus for the cable of the invention.

DETAILED DESCRIPTION OF THE INVENTION

[0013] Fig. 1a shows a perspective view of one example of a cable 10 constructed in accordance with this invention and Fig 1b shows a cross-sectional view of the same cable 10. The cable 10 comprises a core 20 which, in this example, has four first conductors 30 disposed equidistantly and helically wrapped about a spacer 40. The core 20 can have other constructions. For example, it might consist of a single first conductor 30 or six first conductors 30 as shown in Figs. 2a and 2b. The spacer 40 is made of a dielectric material such as polyamide, polyester, polytetrafluoroethylene or polyethylene.

[0014] A first dielectric material 50 is extruded about the core 20 using known extrusion techniques. The material used can be any extrudable dielectric material such as polyurethane polypropylene, polyester or polyrinycloride or thermoplastic rubber. The dielectric material 30 is extruded such that it completely surrounds the first conductors 30 - except where their outer circumferences touch each other - and bonds to the outer surface of the first conductors 30. The first conductors 30 are thus embedded within the first dielectric material 50. The first dielectric material 50 thus acts a stress-bearing matrix in which any load or stress placed on the first conductors 30 is transferred through the coupling of the first conductors 30 to the first dielectric material 50. Thus any stress placed on one of the first conductors 30 will be distributed throughout the cable 10.

[0015] Further conductors 70 are placed in a helical manner about the first dielectric material 50. A further dielectric material 80 is extruded over the further conductors 70 and the first dielectric material 50. The material used can be any extrudable dielectric material such as polyurethane or thermoplastic rubber. The further conductors 70 and the further dielectric material 80 collectively form a further layer 60. In a similar manner to the extrusion of the first dielectric material 50 about the core 20, the further dielectric material 80 is extruded such that it surrounds and bonds with upperhalves 72 of the outer surfaces of the further conductors 70 to the point 74 at which they touch each other. The further dielectric material 80 thus also acts as a stress bearing matrix to distribute loads or stresses within the cable 10 placed on the further conductors.

[0016] In a similar manner further layers of conductors and dielectric materials could be extruded about the further dielectric material if desired.

[0017] A braid 90 is placed about the outermost dielectric material, in the example of Fig. 1 about the further dielectric material 80. The braid 90 can be made in accordance with known techniques to act as a strain relief.

[0018] A jacket 100 is placed about the shield 90. The jacket 100 can be made in accordance with known techniques such as extrusion or tape wrapping of polymer materials such as polyurethane, polyethylene, polyester, perfluoralkoxy, fluoroethylene-propylene, polypropylene, polymethylpentene, full density polytetrafluoroethylene or expanded polytetrafluoroethylene.

[0019] The first conductors 30 and the further conductors 70 are made of a conducting material. Suitable conducting materials include copper, nickel-plated copper, tin-plated copper, silver-plated copper, tin-plated alloys, silver-plated alloys or copper alloys. A first insulation layer 35 can be placed about the first conductor 20 and a further insulation layer 75 can be placed about the further conductor 70. The first insulation layer 35 and/or the further insulation layer 75 are made of a polymer material which bonds to the first dielectric material 50 or the further dielectric material 80 respectively. Examples of suitable materials include polytetrafluorethylene, polyester or polyurethane which are extruded or wrapped about the conductor. Preferably the material is a hard material such as hard polyester and serves to additionally protect the first conductors 40 or further conductors 70.

[0020] As mentioned in the introduction, the cable 10 according to the invention can be used in a shelf storage system, such as that depicted in Fig. 3. Such systems are made, for example, LTW Lagertechnik Wohlfurth in Austria or TGW Transportgerate Wels in Austria. The cable drums 230 are made by Westfalia in Bergholzhausen, Germany, Alfo in Germany or Hartmann und König in Graben-Neudorff, Germany. In such cable drums 230 the cable 10 after extension is pulled back either by a spring or mechanical means and therefore undergoes a large amount of stress.

[0021] The cable 10 can also be used in the crane shown in Fig. 4 which is made, for example, by Liebherr in Ehingen, Germany, or Nenzing, Austria.

Example

[0022] A cable 10 was made according to the design shown in Fig. 1. The spacer 40 was made of polyamid and had an outside diameter of 1.0 mm. Each other first conductors 30 was made of ? wire of diameter and coated with a hard polyester material wrapped about the first conductor 30 to form the first insulation layer 35. The first conductors 30 had a nominal outside diameter of 1.8 mm. Four first conductors 30 were helically wrapped equidistantly about the spacer 40 with a lay length of 55.0 mm. Polyurethane was extruded about the four first conductors 30 to form the first dielectric material 50 to give an outside diameter of maximum 5.4 mm.

[0023] Fourteen further conductors 70 were helically wrapped about the first dielectric material 50 with a lay length of 89 mm. The fourteen further conductors were identical in construction with the first conductors 30. Polyurethane was extruded about the fourteen further conductors 70 to form the further dielectric material 80 to give an outside diameter of maximum 9.1 mm.

[0024] The braid 90 was formed of Kevlar thread with 24 ends and had a braiding angle of 20°. The jacket 100 was formed of extruded polyurethane.

Test Method

[0025] The flex life of the cable 10 can be tested by using a drum test apparatus 400 as shown in Figs. 5a and 5b. The drum test apparatus comprises a cable drum 410 about which is wrapped a cable 10 to be tested. A first end 430 of the cable 10 is attached to the cable drum 410. A second end 420 of the cable 10 is extended out 15m as shown in Fig. 5a. The cable 10 is subsequently wrapped about the drum 400 before extending a further 15m over rollers 440 in the opposite direction as shown in Fig. 5b. The number of complete movement cycles (one complete cycle of the second end 420 from one side to the other side) is then counted. The cable 10 of the example was tested to over 100 000 cycles.

Claims

1. Cable (10) comprising:

a core (20) having at least one first conductor (30), the core (20) being completely surrounded by and embedded within a first stress-bearing matrix (50); and
at least one further layer (60) disposed about the first stress-bearing matrix (50) and having at least one further conductor (70) being at least partially embedded within a second stress-bearing matrix (80).

2. Cable (10) according to claim 1 wherein the core (20) comprises at least two first conductors (30) disposed about a spacer (40).

3. Cable (10) according to claim 2 wherein a first insulation layer (35) is disposed about the at least two first conductors (30)

4. Cable (10) according to claim 2 wherein the core (20) comprises four first conductors (30) disposed equidistantly about the core (20).

5. Cable (10) according to claim 1 wherein the core (20) comprises six first conductors (30).

6. Cable (10) according to claim 1 wherein a further insulation layer (75) is disposed about the at least one further conductor (70)

7. Cable (10) according to claim 1 further comprising a jacket (100) disposed about the further layer (60).

8. Cable (10) according to claim 7 further comprising a strength member (90) disposed between the further layer (60) and the jacket (100).

9. Pick-Up System (200) having one or more electromechanical motors (210) connected to a source (220) by a cable (10), the cable (10) being wound on a cable drum (230), wherein
the cable (10) comprises:

a core (20) having at least one first conductor (30), the core (20) being completely surrounded by and embedded within a first stress-bearing matrix (50); and
at least one further layer (60) disposed about the first stress-bearing matrix (50) and having at least one further conductor (70) being at least partially embedded within a second stress-bearing matrix (80).

10. Pick-Up System (200) according to claim 9 wherein the core (20) comprises at least two first conductors (30) disposed about a spacer (40).

11. Pick-Up System (200) according to claim 10 wherein a first insulation layer (35) is disposed about the at least two first conductors (30)

12. Pick-Up System (200) according to claim 10 wherein the core (20) comprises four first conductors (30) disposed equidistantly about the core (20).

13. Pick-Up System (200) according to claim 9 wherein the core (20) comprises six first conductors (30).

14. Pick-Up System (200) according to claim 9 wherein a further insulation layer (75) is disposed about the at least one further conductors (70)

15. Pick-Up System (200) according to claim 9 further comprising a jacket (100) disposed about the further layer (60).

16. Pick-Up System (200) according to claim 15 further comprising a braid (90) disposed between the further layer (60) and the jacket (100).

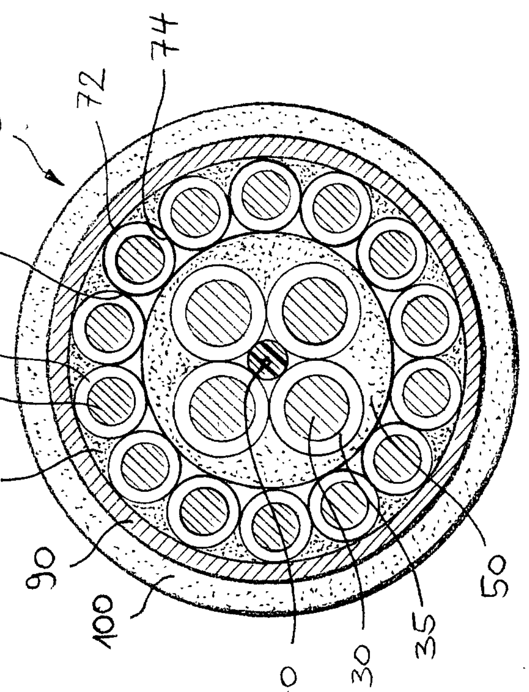
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Fig. 1 b

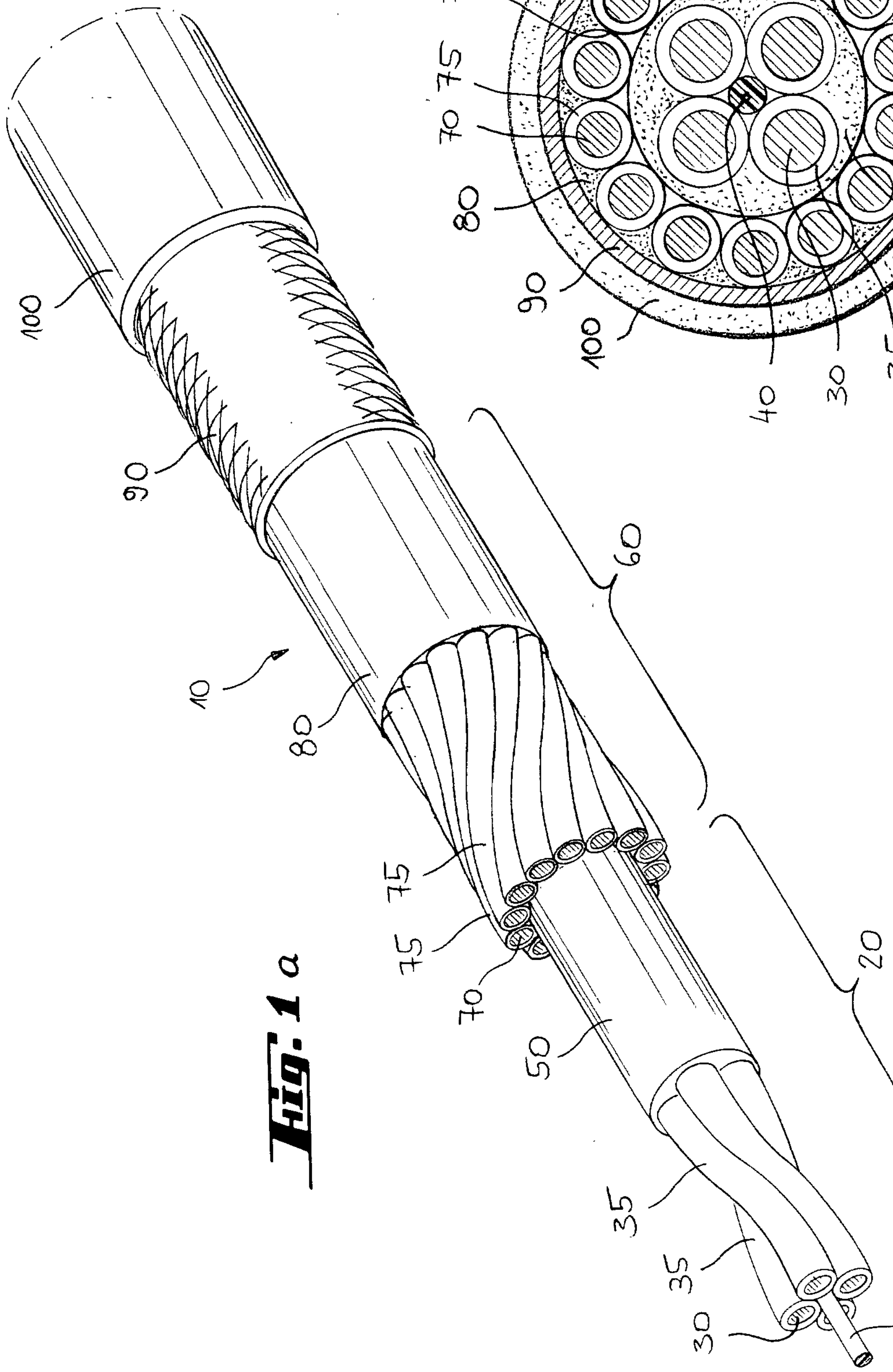
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Fig. 1 a

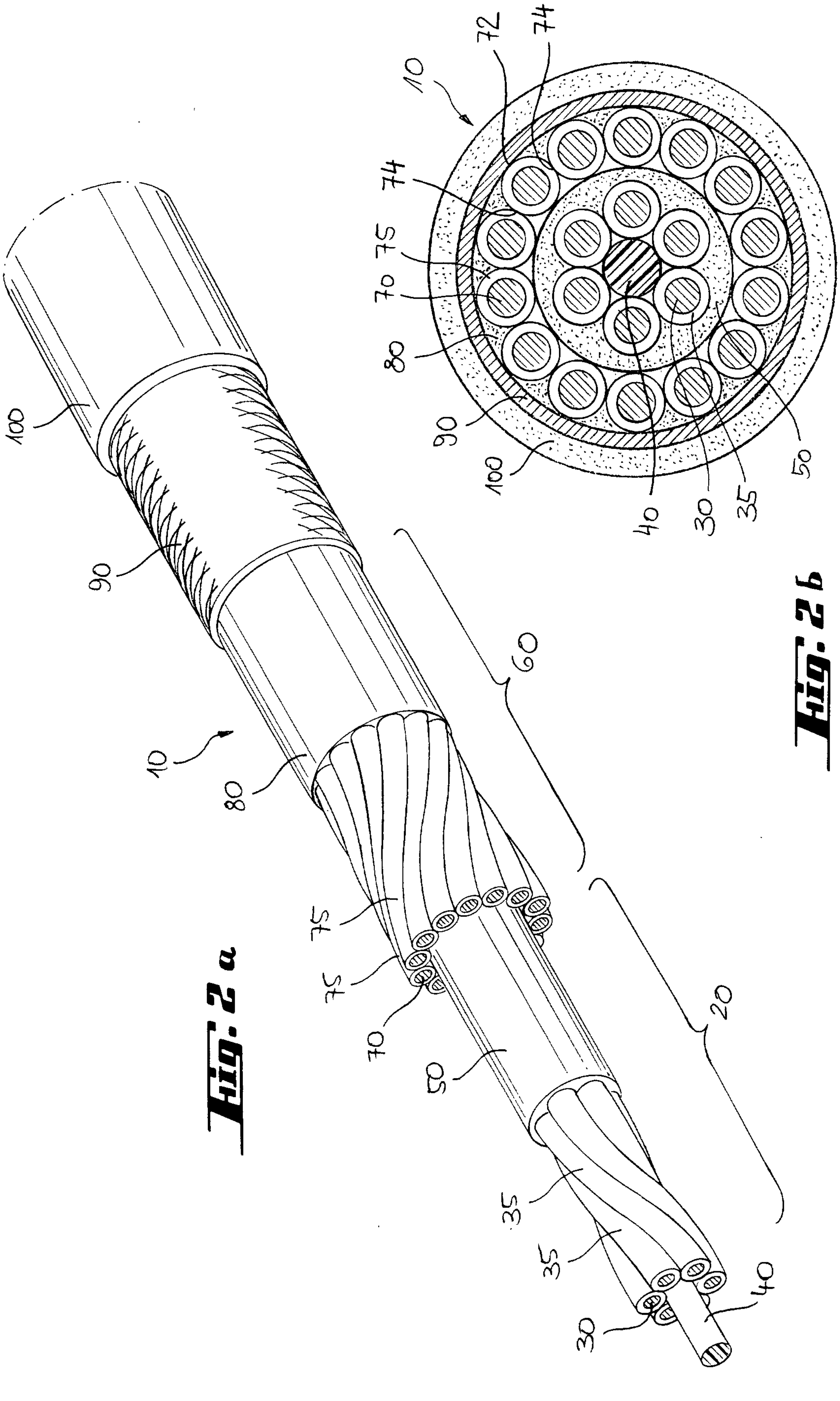
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Fig. 2a

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Fig. 2b

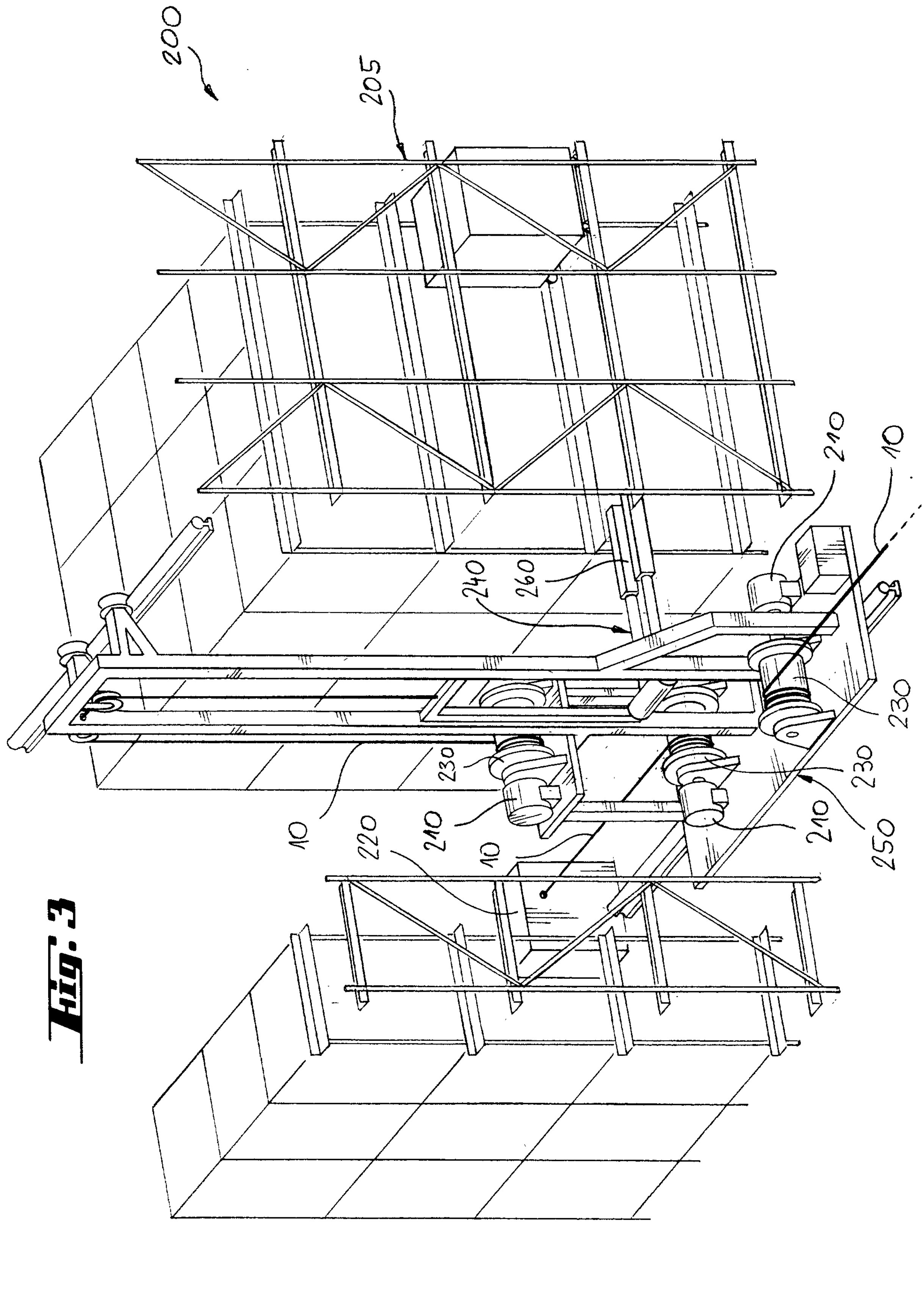

Fig. 3

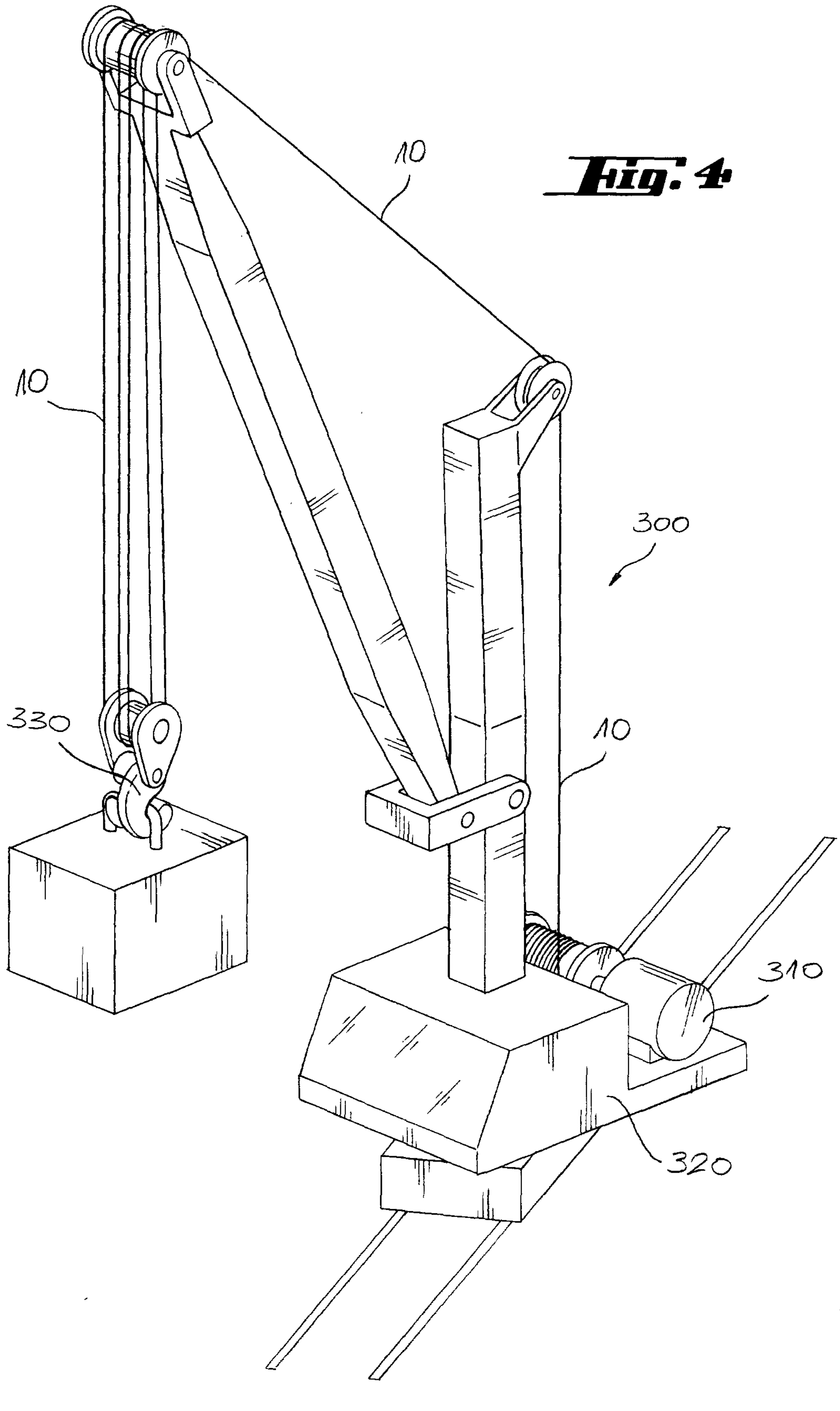

Fig. 4

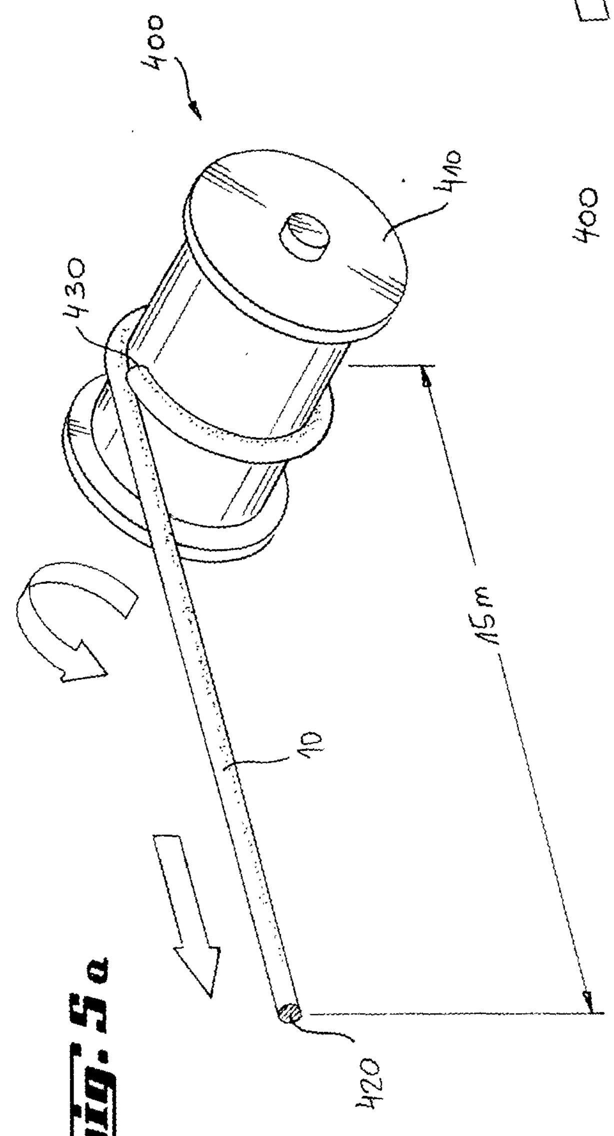

Fig. 5a

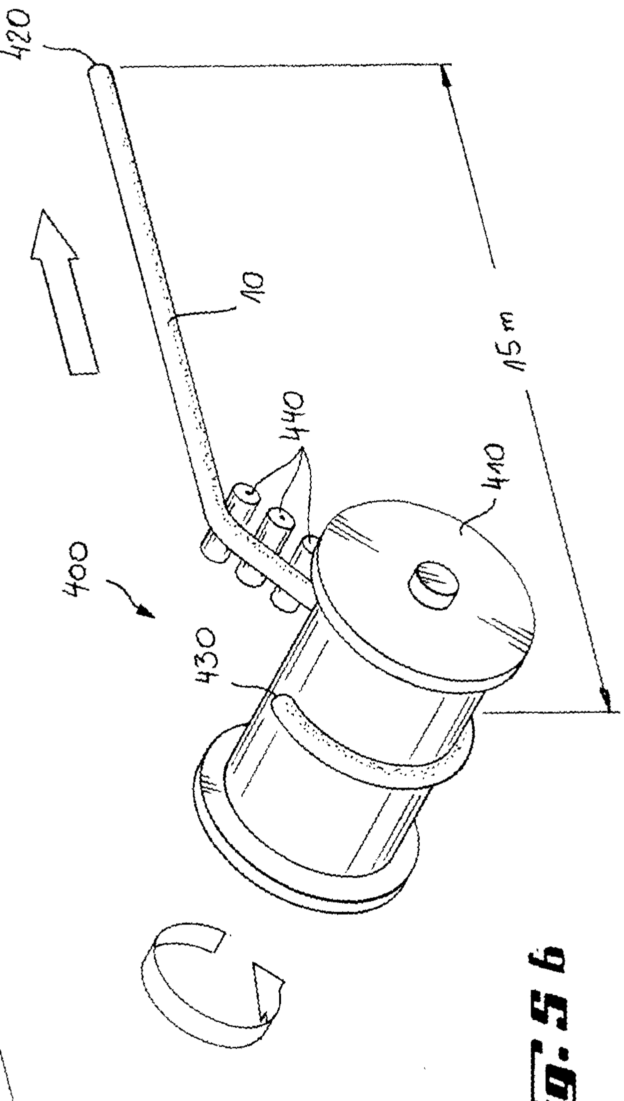

Fig. 5b

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EUROPEAN SEARCH REPORT

Application Number
EP 00 10 7167

DOCUMENTS CONSIDERED TO BE RELEVANT

Category	Citation of document with indication, where appropriate, of relevant passages	Relevant to claim	CLASSIFICATION OF THE APPLICATION (Int.Cl.7)
X A	US 4 486 623 A (PLOPPA JUERGEN) 4 December 1984 (1984-12-04) * column 2, line 6 - line 19 * * column 2, line 61 - column 3, line 68; figures 1,2 *	1,2,7 3,4,6	H01B7/04
A	DE 11 13 966 B (SPECHT) 21 September 1961 (1961-09-21) * column 1, line 26 - column 2, line 1; figure 1 *	1,3,6,7	
A	DE 32 24 597 A (SIEMENS AG) 29 December 1983 (1983-12-29) * page 7, line 5 - line 9; figure 7 *	1,9	

TECHNICAL FIELDS SEARCHED (Int.Cl.7)

H01B

The present search report has been drawn up for all claims

Place of search	Date of completion of the search	Examiner
THE HAGUE	1 September 2000	Demolder, J

CATEGORY OF CITED DOCUMENTS

X : particularly relevant if taken alone
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ANNEX TO THE EUROPEAN SEARCH REPORT ON EUROPEAN PATENT APPLICATION NO. EP 00 10 7167

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01-09-2000

Patent document cited in search report	Publication date	Patent family member(s)	Publication date
US 4486623 A	04-12-1984	DE 3150031 A	23-06-1983
		CH 656970 A	31-07-1986
		GB 2112200 A,B	13-07-1983
		IT 1157346 B	11-02-1987
		JP 58111207 A	02-07-1983
DE 1113966 B		NONE	
DE 3224597 A	29-12-1983	NONE	

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For more details about this annex : see Official Journal of the European Patent Office, No. 12/82