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(12) # EUROPEAN PATENT APPLICATION

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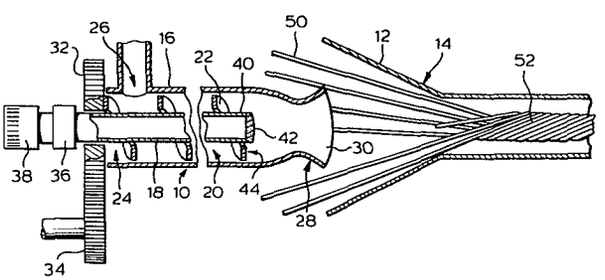
(54) **Powder ejection nozzle for strander.**

(57) A device for filling the interstices of a multi-stranded cable with powder, comprising an outer tubular housing (16, 72, 144) and a concentric inner tube (18, 74, 146) with an annular chamber therebetween for moving powder filler from an inlet (24) to the outlet end (28) of the deivce. Air is deliverable under pressure to the outlet end of the device to disperse the powder as a cloud.



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This invention relates to the production of multi-stranded electrical cables and more particularly to filling the interstices of such cables.

Multi-stranded electrical cables are filled with powder for water blockage. A powder filling for this purpose is described in United States Patent No. 4,002,819 issued January 11, 1977 to Northern Telecom Limited assignee of Leo V. Woytiuk. One method of filling the interstices of the cable is by passing the cable core through an electrostatic powder chamber as described in United States Patent No. 4,100,002 in the name of Leo V. Woytiuk assignor to Northern Telecom Limited. Such a method is relatively difficult to operate in order to obtain fine adjustments in the amount of powder filling placed within the interstices of the cable, i.e. to regulate accurately the percentage of voids filled by the powder.

It is an object of the present invention to provide an improved method and apparatus for powder filling a multi-stranded cable.

Essentially the invention consists of apparatus for filling the interstices of a multi-stranded cable with powder in which a plurality of strands are fed into a closing die having an outwardly flaring inlet end characterised in that it includes a powder distributor comprising: an outer tubular housing and inner tube concentric with the housing, the inner tube being spaced therefrom to form with the housing an annular chamber having an inlet for receiving powder and an outlet end; means to move powder along the chamber to the outlet end thereof; and means to deliver air under pressure to the outlet end of the chamber whereby powder moved along the chamber is dispersed as a cloud from the outlet end thereof.

Example embodiments of the invention are shown in the accompanying drawings in which:

Figure 1 is a side view in cross-section of an apparatus for powder filling a cable according to a first embodiment;

Figure 2 is a cross-sectional side view of part of apparatus forming a modification of the first embodiment;

Figure 3 is a cross-sectional side view of part of apparatus forming a second embodiment; and

Figure 4, 5 and 6 are cross-sectional side views respectively of parts of apparatus forming third, fourth and fifth embodiments.

In a first embodiment shown in Figure 1 of the drawings, apparatus for powder filling interstices of a multi-stranded cable comprises a powder distributor 10 locatable at the outwardly flaring inlet end 12 of a closing die 14. Distributor 10 comprises an outer tubular housing 16 and a concentric inner tube 18, the tube and the housing forming between them an annular chamber 20. Means to move powder along the chamber to an outlet end (44) of the chamber comprises a rotatable helical screw member 22 concentric with tube 18 and located in chamber 20. An inlet end 24 of chamber 20 has a powder feed aperture 26 opening laterally into the chamber. Outlet end 28 of housing 16, which in the operation of the device is located within inlet end 12 of closing die 14 extends beyond the inner tube and flares outwardly to form a bell mouth 30.

Adjacent inelt end 24 of distributor 10 lies a gear 32 coaxial with housing 16 and meshing with a drive gear 34. Helical screw 22 if fixed at one end to gear 32. In this embodiment gear 32 serves to close inlet end 24 of housing 16 and chamber 20. Inner tube 18 extends through gear 32 and connects with a compressor 36 driven by a direct current motor 38, the compressor and motor forming part of a pressurised air delivery means to deliver air along tube 18 to outlet end 44 of the chamber.

A free end 40 of inner tube 18 is closed by a cap 42 of porous material. Helical screw 22 terminates adjacent free end 40 of inner tube 18.

In the operation of the device of Figure 1, conductors, pairs or quads 50 are fed from a strander (not shown) into closing die 14 through its inlet 12 to form a stranded cable 52. Distributor 10 is located within the circle of conductors 50 as they enter closing die 14 and is aligned coaxially with the closing die. As conductors 50 are fed into closing die 14, powder is fed continuously through inlet 26 into chamber 20 and gear 32 is rotated by drive gear 34 which rotates helical screw 22 to carry the powder forward in the annular chamber towards outlet end 28 of housing 16. At the same time air under pressure is forced along inner tube 18 from compressor 36 and through porous cap 42. As the powder in chamber 20 is forced past the free end of inner tube 18 by helical screw 22 it is propelled forwardly by the air from inner tube 13 through mouth 30 of outer housing 16 into closing die 14. The shape of bell mouth 30 also disperses the powder laterally. As conductors 50 close to form stranded cable 52 the powder entering closing die 14 is carried by the conductors to fill the interstices in the cable. Preferably conductors 50 are coated with oil to which the powder adheres.

In a modification of the first embodiment as shown in Figure 2, apparatus which is otherwise as described for Figure 1 has inner tube 18 terminating in a lavel nozzle 60 for the air pressure supply.

In a second embodiment shown in Figure 3, apparatus is for use in powder filling a multi-stranded cable having a core. In this embodiment, a distributor 70 comprises an outer tubular housing 72 and a concentric inner tube 74 which extends beyond the housing at the outlet end of chamber 76 defined between the tube and housing.

Tube 74 defines within it a passage for a core of a cable. A rotatable helical screw member 78 concentric with tube 74 is located in chamber 76. Inner tube 74 is divided into an inner cylindrical portion 80 and an outer cylindrical portion 82 separated from the inner cylinderical portion to form longitudinal passageways 84 of an air delivery means radially outside the passage for the core. Adjacent its free end 86 closing passageways 84, outer tubular cylinder 82 has a circumferential porous cap 88 for directing air outwardly from the axis of the inner tube. Inner tube 74 projects beyond the end 90 of outer housing 72 and a screen 92 surround the cap 88 at the end of chamber 76.

The operation of the distributor of Figure 3 is similar to that of Figure 1 with conductors 50 fed into closing die 14 and with distributor 70 located within the circle of the conductors. As conductors 50 are fed into closing die 14 from a strander, a core 94 is simultaneously fed axially into the closing die through inner tube 74 of distributor 10, and the conductors are wrapped around the core to form a cable 96. At the same time powder is fed along chamber 76 by helical screw 78 and air under pressure is forced along passageways 84 of inter tube 74. The air from passageways 84 passes through porous cap 88 of outer tubular cylinder 82 and through screen 92 where it meets the powder leaving chamber 84. The air forms the powder into a cloud which is directed into inlet end 12 of closing die 14 where it is carried by conductors 50 to fill the interstices between the conductors as they are wrapped about core 94. Screen 92 assists in breaking up any agglomerations of the powder being moved by helical screw 76.

In a third embodiment shown in Figure 4, an inner tube 74 has longitudinal passageways 84 terminating in a cylindrical porous cap 100 located beyond the end of inner tube 74 which is coterminus with the end 101 outer housing 72. Porous cap 100 may be set in an extension 102

of inner tubular cylinder 80 of inner tube 74. Outer housing 72 terminates within a cylindrical flange 104 integral with the apex of an axially rotatable generally frusto-conical shroud 106, with a ring bearing seal 108 between the housing and the flange. Shroud 106 has a frusto-conical main body section 110 diverging to a circular flange 112 located close to the free, outward flaring edge 114 of inlet end 12 of closing die 14. Distributor 10, shroud 106 and inlet 12 of closing die 14 form a cloud chamber 107. A gap 116 between flange 112 and edge 114 is circumscribed by an annular suction means. This comprises a channel 118 extending around flange 112 and edge 114 with an outlet circuit 120 connectable to suction means not shown. Strands 50 pass through spaced apertures 122 in main body section 110 of shroud 106.

The operation of the device of Figure 4 is similar to that of Figure 3. Core 94 is fed through inner tube 74 of distributor 10 into closing die, powder is fed along chamber 76 by helical screw 78, and air under pressure is forced along passageways 84 of the inner tube. The pressurized air, forced through porous cap 100, disperses the powder emanating from chamber 76 into cloud chamber 107 where it is carried by conductors 50 to fill the interstices between the conductors as they are wrapped around core 94. As conductors 50 pass continuously into closing die 14 shroud 106 rotates about its conical axis and excess powder is drawn by suction through gap 116 into conduit 120 for recycling.

A fourth embodiment shown in Figure 5, a distributor 10 includes an inner tube 74 having inner and outer cylindrical portions 80 and 82 defining air passageways 84. These terminate in a porous cap 100 located at the end of the inner tube which is approximately coterminous with the end 101 of outer housing 72. A cylindrical ejection nozzle 130 is fixed at one end 132 to the free end 101 of outer housing 72 by a collar 132 of high voltage insulation material. A free end 134

of nozzle 130 flares outwardly. A ring 136 of high voltage insulation material is located concentrically within porous cap 100 and carries a cylindrical deflector guard 138 at its free end.

In the operation of the device of Figure 5, powder is electrostatically charged such as by passing it through an electrostatic chamber as described in U.S. Patent No. 4,100,002. The charged powder is then fed along chamber 76 of distributor 10 by screw 78 while pressurized air is forced through porous cap 100 to distribute the powder as a cloud through nozzle 130 onto conductors 50 passing into closing die 14 as in Figure 1, 3 or 4.

In a fifth embodiment in Figure 6, in a distributor 10 an annular passageway 140 for pressurized air is defined between outer and inner walls 142 and 144 of an outer housing. Between inner wall 144 of the housing and an inner tube 146, there is defined a chamber 148 in which helical screw 78 is located. Wall 144 terminates in a cylindrical porous section 150 which projects beyond the free end of inner tube 146. Outer housing 142 terminates in a contoured nozzle 152 which seals the end of annular passage 140.

The embodiment of Figure 6 operates by powder being pushed through annular chamber 148 and dispersed through nozzle 152 by pressurized air emanating from passageway 140 through porous section 150, nozzle 152 being located in inlet 12 of closing die 14 as in Figure 1, 3 or 4.

It will be appreciated that the present invention provides apparatus which improves the accuracy of controlling the amount of powder filler used in the continuous production of a multi-stranded cable, including such a cable having a core, and the proper dispersement of the powder among the strands. The amount of powder dispersed by the distributor is governed by the powder input into the inlet and the speed

of revolution of helical screw 22 or 78 (which also provides equal distribution circumferentially at the outlet end of chamber 20, 76 or 148). The pressurized air flow can be used to monitor the proper concentration of powder emanating from the device. Thus a decrease in the air flow would indicate that the concentration of powder is too high and conversely if the concentration of powder decreases the air flow will increase. By suitable feedback from DC motor 38 the feeding rate of powder can be controlled with a very short time lag.

The recovery of excess powder by the suction means shown in the embodiment of Figure 4 may be used in the other embodiments with suitable structural modifications. Similarly screen 92 shown in Figure 3, of suitable mesh size, may be used in other embodiments.

In addition to, or in substitution for, the use of electrostatic powder, as envisaged in the embodiment of Figure 5, strands 50 may be oil coated as a preferred method of powder filling by adherance of the powder to the strands.

Preferred embodiments use the porous cap (42, 88, 100 or 150) which inhibits blockage of the pressurized air tube (18) or passageways (84, 140) by the powder issuing from the distributor. Depending upon the configuration of the porous cap (42, 88, 100 or 150), or nozzle 60 of inner tube 18 where no cap is used as in Figure 2, the powder issues from distributor 10 both axially and radially as a cloud approaching uniform density.

The distributor may be rigid or it may be flexible as disclosed in United States Patent Application No. 876,874 filed February 13, 1978 in the name of J. H. Walling.

1. Apparatus for filling the interstices of a multi-stranded cable with powder in which a plurality of strands are fed into a closing die having an outwardly flaring inlet end characterized in that it includes a powder distributor (10, 70) comprising:

an outer tubular housing (16, 72, 144);

an inner tube (18, 74, 146) concentric with the housing and spaced therefrom to form with the housing an annular chamber (20, 76, 148) having an inlet (26) for receiving powder and an outlet end (44);

means (22, 32, 34, 78) to move powder along the chamber to the outlet end; and

means (36, 38, 84, 140) to deliver air under pressure to the outlet end of the chamber whereby powder moved along the chamber is dispersed as a cloud from the outlet end thereof;

the powder distributor being locatable with the outlet end of the chamber disposed to direct the cloud of powder into the inlet wall (12) of the closing die (14).

2. Apparatus according to claim 1 characterized in that the inner tube (18, 74) surrounds a passageway (84, 140) of the air delivery means for delivering air under pressure to the outlet end of the chamber.

3. Apparatus according to claim 2 characterized in that it includes a porous cap (42, 88, 100) at the outlet end of the passageway for flow of pressurized air therethrough.

4. Apparatus according to claim 2 characterized in that at the outlet end of the chamber, the housing extends beyond the inner tube and forms a nozzle (28, 130, 152).

5. Apparatus according to claim 2 characterized in that at the outlet end of the chamber, the housing 16 extends beyond the inner tube and the inner tube and housing each provide a nozzle (28, 60) at the outlet end of the chamber.

6. Apparatus according to claim 1 characterized in that the inner tube (74) defines a passage for a core on which the strands are wound to form a cable.

7. Apparatus according to claim 6 characterized in that the inner tube has radially inner and outer portions (80, 82) which define a passageway (84) of the air delivery means, the passageway being radially outside the passage for the core, and the passageway terminates in a porous cap (42, 88, 100) for flow of pressurised air therethrough.

8. Apparatus according to claim 7 characterised in that at the outlet end of the chamber, the inner tube (74) extends beyond the housing (72), and the porous cap (88) is annular and circumscribes the inner portion (80) of the inner tube whereby the pressurised air passes therethrough laterally outwardly with respect to the axis of the inner tube.

9. Apparatus according to claim 8 characterised in that it includes a screen (92) at the outlet end of the chamber for flow therethrough of the powder, the screen being disposed radially outwards of the porous cap.

10. Apparatus according to claim 7 characterized in that the housing (10) carries a cylindrical ejection nozzle (130) fixed thereto by a collar (132) of high voltage insulation material, and a ring (136) of high voltage material is fixed concentrically within the porous cap (100) to separate the cap from the passage for the core.

11. Apparatus according to claim 6 characterized in that the outer housing (142) has radially inner and outer walls (142, 144) which define a passageway (140) of the air delivery means, and at the outlet end of the chamber, the housing extends beyond the inner tube (146) and the passageway (140) terminates in an annular porous cap (150) which is disposed radially inwards of the passageway to direct pressurized air from the passageway laterally inwardly with respect to the axis of the outer tube.

12. Apparatus according to claim 1 characterized in that the powder distributor is axially aligned with the closing die, and an axially rotatable generally frusto-conical shroud (106) interconnects the outer housing and the inlet end of the closing die, the shroud having a plurality of spaced apertures (122) for passage of strands therethrough into the closing die to form the cable.

13. Apparatus according to claim 12 characterized in that the shroud is freely rotatable.

14. Apparatus according to claim 12 characterized in that the shroud has a cylindrical flange (104) at an apex thereof, the flange interengaging the housing through a bearing seal (108), and a circular rim flange (112) located adjacent the inlet end of the closing die with a gap therebetween, and annular suction means (118, 120) circumscribes the gap.

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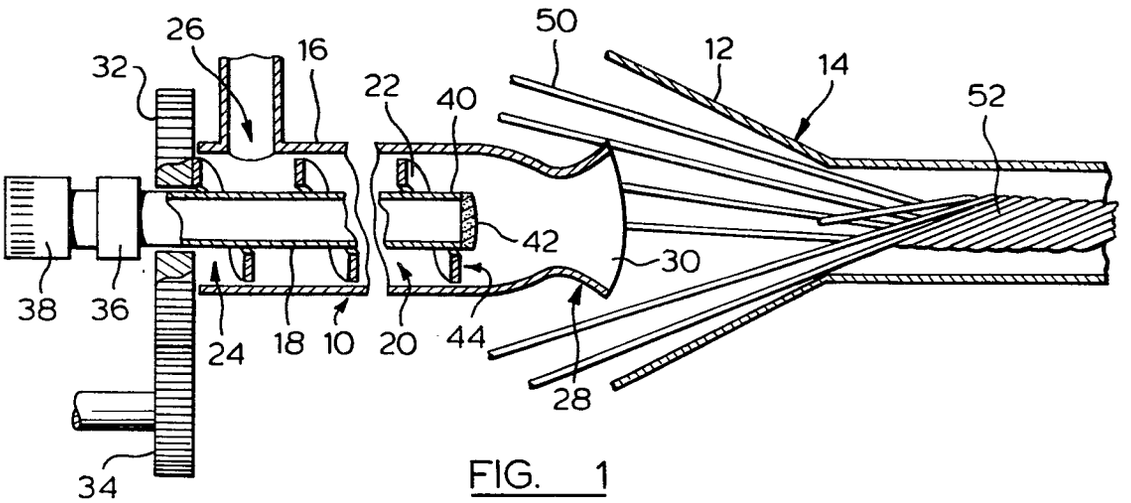

FIG. 1

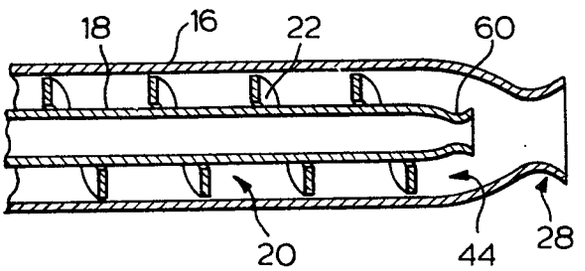

FIG. 2

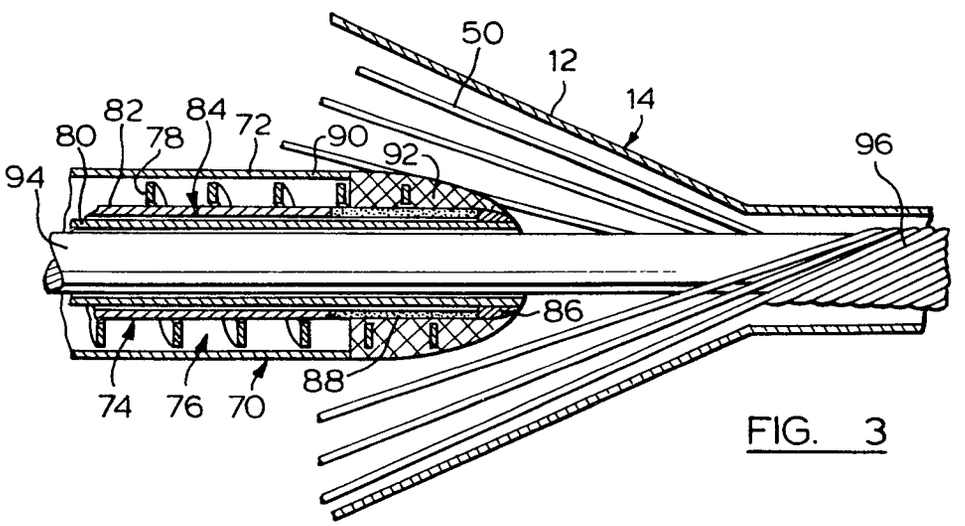

FIG. 3

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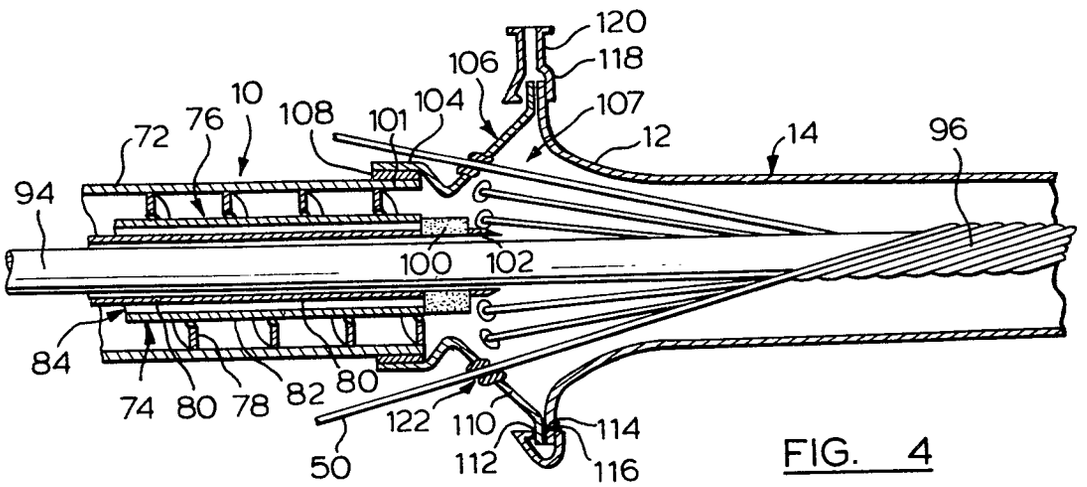

FIG. 4

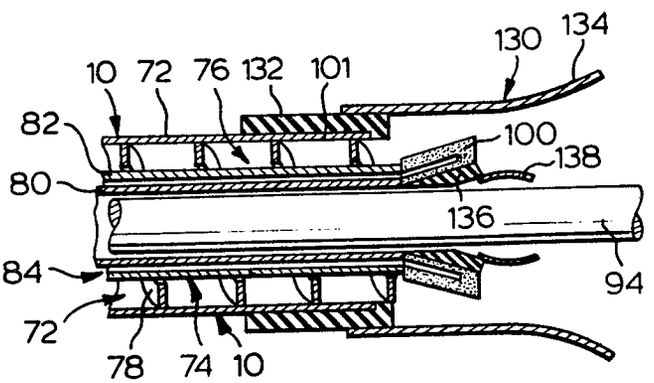

FIG. 5

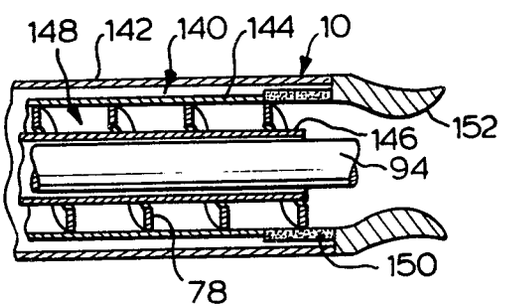

FIG. 6

European Patent Office

EUROPEAN SEARCH REPORT

Application number
0027831
EP 79 10 4212

DOCUMENTS CONSIDERED TO BE RELEVANT

Category	Citation of document with indication, where appropriate, of relevant passages	Relevant to claim
	EP - A - 0 003 672 (NORTHERN TELECOM) * Page 3, line 6 - page 5, line 3; figure 1 *	1,4
	EP - A - 0 003 673 (NORTHERN TELECOM) * Page 2, line 25 - page 4, line 20; figure 1 *	1,6
	DE - A - 2 712 820 (NORTHERN TELECOM) * Page 8, last paragraph - page 10, paragraph 2; figures 1,2 *	1
	US - A - 2 316 814 (SCHEMM) * Page 1, column 1, line 48 - page 2, column 1, line 26; figure 1 *	3

CLASSIFICATION OF THE APPLICATION (Int. Cl. 3)

H 01 B 13/22

TECHNICAL FIELDS SEARCHED (Int.Cl. 3)

H 01 B 13/22
7/28
13/30

CATEGORY OF CITED DOCUMENTS

X: particularly relevant
A: technological background
O: non-written disclosure
P: intermediate document
T: theory or principle underlying the invention
E: conflicting application
D: document cited in the application
L: citation for other reasons

&: member of the same patent family, corresponding document

X The present search report has been drawn up for all claims

Place of search	Date of completion of the search	Examiner
The Hague	25-06-1980	DEMOLDER

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