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- (71) Applicant: **THE BOEING COMPANY** [US/US]; P.O. Box 3707, M/S 11-XT, Seattle, WA 98124-2207 (US).
- (72) Inventors: **CROSBY, Sean, D.**; 5 Dunston Trail, Glen Carbon, IL 62034 (US). **CANGE, Elizabeth, E.**; 516 Crown Passage Drive, St. Charles, MO 63303 (US).
- (74) Agent: **GALBRAITH, Ann, K.**; The Boeing Company, P.O. Box 3707, M/S 11-XT, Seattle, WA 98124-2207 (US).
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(54) Title: SILICONE TIE TAPE

(57) Abstract: A bundling tie includes a silicone rubber tape and at least one flat polyester string embedded therein. The silicone rubber tape may meet or be similar to Federal Specifications AA-59163 and the flat polyester string may meet or be similar to Federal Specifications AA-52081. The bundling tie is resistant to a wide range of temperature extremes, cracking, hardening, aging, and a variety of chemicals, solvents, fuels and oils. The bundling tie is easy to install/remove and is suitable for use in aerospace and other applications.

SILICONE TIE TAPE

BACKGROUND OF THE INVENTION

5 [0001] The present invention generally relates to bundling ties and, more particularly, to a silicone tie tape comprising a silicone rubber tape and a flat string, such as a polyester string.

[0002] Miles of wire in many products, from aircraft to support equipment, require bundling. Ties for bundling a plurality of wires, cables or similar objects
10 are known in the art. Bundling ties comprising a variety of forms and materials have been described in the prior art.

[0003] Wires and other elongated members have been bundled with string ties. Known string ties include cotton strings and plastic strings. Although a multitude of items may be bundled using these ties, string tie installation is
15 complicated and time consuming. Installation requires the tying of a complex knot. The knots produced by different personnel tend to vary and consistent knot tying is difficult to train. Additionally, older people and people with thick fingers may not have the dexterity required to efficiently tie the knots. Further, these knots protrude from the bundle surface and are not desirable in some
20 applications. For example, the protruding knots may snag when bundled wires are threaded through narrow tubular sheathing and bulkheads. Also, cutting tools used in string trimming can damage the bundled wires because the trimming occurs after string tie installation. Additionally, these bundling ties are difficult to use in tight spaces, such as in wing compartments.

25 [0004] Bundling ties that do not require a knot for installation are also known. U.S. Pat. No. 4,138,770 describes a tie comprising a rigid head and an integrally attached strap. The strap has a series of ratchet teeth on its inner surface. The ratchet teeth on the strap engage complimentary teeth within a slot through the head. Although these ties do not require a knot for installation, the head may
30 snag in some applications. For example, the head may get snagged on bulkheads during cable routing. Further, the rigid plastic heads have sharp

edges and can cut fingers during contact. Additionally, the straps must be trimmed. Strap trimming can result in the wires being damaged by cutting tools. Moreover, these ties can be installed too tightly and can damage the wiring. For this reason alone these ties have been disallowed for many applications. Also,
5 the plastic becomes brittle with time and tie failure results.

[0005] Bundling ties that do not have a protruding head have been described. U.S. Pat. No. 5,168,603 discloses a bundling tie comprising a VELCRO strap. Although these ties do not have a protruding knot or head, they are bulky and are not useful in some applications. The strap has loops on one
10 side and hooks on the other side. Tie fastening requires the hooks to engage the loops. These bundling ties are not useful in many applications because they can be easily unfastened. Additionally, material deterioration weakens these ties in some environments.

[0006] A variety of adhesive tapes have been used to bundle items. These
15 tapes comprise backing strips onto which adhesive has been applied. Backing strips comprising cloth and plastic film have been described. Although known adhesive tapes can be used to bundle items, they are not suitable for many applications. Environmental conditions often adversely affect the adhesives and the backing strips, resulting in bundling tie failure. Additionally, adhesive residue
20 remains on the surface of the bundled items after these tapes have been removed.

[0007] Tapes that can be removed without leaving a residue are known. Silicone rubber tapes are self-bonding and do not adhere to other surfaces. Unfortunately, these tapes do not have the strength needed for many bundling
25 tie applications.

[0008] Silicone rubber tapes have been reinforced with sinusoidal glass yarn. Although these tapes may be stronger than the unreinforced silicone rubber tapes, they are not useful in many bundling applications. Further, the glass
yarns can damage the surface of bundled wires in some applications.
30 Additionally, these tapes provide elongation between 15% and 25%. Although, this is less than the 300% elongation of unreinforced silicone rubber tape, these

tapes are inappropriate for many applications.

[0009] As can be seen, there is a need for bundling ties that are easy to install and that are useful in a variety of environments. Also, there is a need for a bundling tie that does not require the use of trimming tools after installation.

5 Further, there is a need for a bundling tie that does not require a knot and does not leave an adhesive residue when removed. Also needed are silicone rubber based tapes that do not stretch. Additionally, improved bundling ties for use in aerospace environments are needed.

10

SUMMARY OF THE INVENTION

[0010] In one aspect of the present invention, a bundling tie comprises: at least one silicone rubber tape; and at least one string in contact with the silicone rubber tape.

15 **[0011]** In another aspect of the present invention, a tie for bundling a plurality of wire members comprises: a poly(organosiloxane) based polymer sheet; and a polymer fiber embedded in the poly(organosiloxane) based polymer sheet.

[0012] In still another aspect of the present invention, a bundling tie comprises: a silicone rubber tape; and at least one flat polyester string in contact

20 with the silicone rubber tape.

[0013] In a further aspect of the present invention, an apparatus for bundling comprises: a silicone rubber tape, wherein the silicone rubber tape meets Federal Specifications AA-59163, wherein the silicone rubber tape is a colored silicone rubber tape, and wherein the silicone rubber tape has a width between

25 about 0.25 inches and about 4.0 inches; and a flat polyester string embedded in the silicone rubber tape, wherein the flat polyester string meets Federal Specifications AA-52081, and wherein the flat polyester string has a width between about 0.035 inches and about 0.375 inches.

[0014] In a further aspect of the present invention, a method for producing a

30 silicone tie tape comprises the steps of: providing at least one silicone rubber tape; and incorporating at least one polyester string into the silicone rubber tape,

wherein the polyester string extends longitudinally through the silicone rubber tape.

[0015] These and other features, aspects and advantages of the present invention will become better understood with reference to the following drawings,
5 description and claims.

BRIEF DESCRIPTION OF THE DRAWINGS

[0016] Figure 1 is a perspective view of a silicone tie tape in roll form,
10 according to one embodiment of the present invention;

[0017] Figure 2a is a perspective view of a silicone rubber tape in roll form, according to one embodiment of the present invention;

[0018] Figure 2b is a perspective view of a string in spool form, according to one embodiment of the present invention;

15 [0019] Figure 3a is a cross sectional diagram of a silicone tie tape, according to one embodiment of the present invention;

[0020] Figure 3b is a partial plane view of a silicone tie tape, according to one embodiment of the present invention;

[0021] Figure 4a is a cross sectional diagram of a silicone tie tape, according
20 to an embodiment of the present invention;

[0022] Figure 4b is a partial plane view of a silicone tie tape, according to an embodiment of the present invention;

[0023] Figure 5a is a cross sectional diagram of a silicone tie tape, according to an embodiment of the present invention;

25 [0024] Figure 5b is a partial plane view of a silicone tie tape, according to an embodiment of the present invention;

[0025] Figure 6a is a cross sectional diagram of a silicone tie tape, according to an embodiment of the present invention;

[0026] Figure 6b is a partial plane view of a silicone tie tape, according to an
30 embodiment of the present invention;

[0027] Figure 7 is a cross section of a plurality of wires secured by a silicone

tie tape, according to one embodiment of the present invention; and

[0028] Figure 8 is a diagram of a method for bundling a plurality of wires according to one embodiment of the present invention.

5

DETAILED DESCRIPTION OF THE INVENTION

[0029] The following detailed description is of the best currently contemplated modes of carrying out the invention. The description is not to be taken in a limiting sense, but is made merely for the purpose of illustrating the general principles of the invention, since the scope of the invention is best defined by the appended claims.

[0030] The present invention generally provides bundling ties and methods for producing the same. The silicone tie tapes of the present invention may be used, for example, for bundling wires and cables. The ties produced according to the present invention may find beneficial use in many industries including aerospace, automotive, electronics, and telecommunications. The present invention may be useful in household applications. The silicone tie tapes of the present invention may also find use as easy-to-remove sports ankle wraps. The present invention may be useful in cable installations in a variety of environments including space, underground and marine. These tie tapes may be useful in any application that requires bundling ties.

[0031] Unlike the prior art, the bundling ties of the present invention are easy to install, do not leave an adhesive residue when removed, and are useful in a variety of applications such as aerospace. Wire damage caused by trimming tools is eliminated because tie trimming after installment is not necessary. Unlike the prior art, the bundling ties of the present invention may be resistant to a wide range of temperature extremes, cracking, hardening, aging, and a variety of chemicals, solvents, fuels and oils. Further, unlike the silicone rubber tapes with embedded sinusoidal glass yarn, the present invention can provide bundling ties that do not stretch.

[0032] As seen in Figure 1, silicone tie tape 50 of the present invention can

comprise a silicone rubber tape 51 and a string 52 embedded in the silicone rubber tape 51, such that the string 52 extends longitudinally through the length of the silicone rubber tape 51. In this figure, the silicone tie tape 50 is in roll form suitable for dispensing.

5 **[0033]** The silicone rubber tape 51, as better seen in Figure 2a, is known in the art. Useful silicone rubber tapes may be available from Tommy Tape, Inc of Southington, CT; MOCAP Plastic Products of St. Louis, MO; Flexfab of Hastings, MI; and Freudenberg-NOK of Tillsonburg, Ont. Canada. The silicone rubber tapes 51 may be elastomeric self-bonding tapes. The silicone rubber tape 51
10 may be capable of self-fusing within 24 hours and may not leave a residue when removed from a wire bundle. They resist cracking and they may be useful at temperatures between about -65°F to about 500°F . Preferred silicone rubber tapes 51 may meet Federal Specifications AA-59163. Silicone rubber tapes 51 that meet these specifications have been approved for use in a variety of
15 environments. Silicone tie tapes 50 comprising AA-59163 type silicone rubber tape 51 may be preferred for use in those same environments. Available silicone rubber tapes 51 may have a minimum of 300% elongation and a tensile strength of about 70 psi.

[0034] Silicone rubber tapes 51, as is known in the art, may comprise
20 vulcanizable poly(organosiloxane) gum, processing aids, catalysts, pigments, stabilizers, and fillers. The poly(organosiloxanes) gums may be viscous masses or gummy elastic solids depending on the state of condensation, the condensing agent employed, and the composition of the poly(organosiloxane) used. A poly(organosiloxane) commonly used in silicone rubber tape manufacturing may
25 be poly(dimethylsiloxane). The poly(organosiloxane) gums may be obtained by the condensation of a liquid poly(organosiloxane) with a condensing agent such as ferric chloride hexahydrate, phenyl phosphoryl chloride, sodium hydroxide, and potassium hydroxide. Silicone rubber tapes 51 may be formed by any known method, such as polymer extrusion. The silicone rubber tapes 51, as is
30 known in the art, may be colored by incorporating a dye prior to the polymer extrusion process. The use of colored silicone rubber tapes may assist in the

identification of different wire bundles. A variety of colored tapes and a color-coding system may be used to distinguish the different wire bundles from one another.

[0035] The dimensions of the silicone rubber tape 51 may vary depending on
5 desired application. Useful silicone rubber tapes 51 may be between about 0.25
inches and about 4.0 inches in width. The wider silicone rubber tapes 51 may be
useful for silicone tie tapes 50 that incorporate two or more strings 52. The wider
silicone rubber tapes 51 may be useful for applications such as sports ankle
wraps. A preferred width for wire bundling applications may be between about
10 0.375 inches and about 1.0 inch. In applications where the number of wires to
be bundled is small, for example three wires, or when the wire diameter is small,
for example twenty-gauge wire, the narrower silicone rubber tapes 51 may be
preferred. In applications where the number of wires to be bundled is larger, for
example thirty wires, or when the wire diameter is larger, for example four-gauge
15 wire, the wider silicone rubber tapes 51 may be preferred. The thickness of a
useful silicone rubber tape 51 may be between about 5 mil and about 40 mil.
The thicker silicone rubber tapes 51 may be useful when the silicone tie tape 50
incorporates thicker strings 52. For wire bundling applications, the thickness of a
preferred silicone rubber tape 51 may be between about 10 mil and about 20 mil.

[0036] The string 52, as better seen in Figure 2b, is known in the art. Strings
20 52 of the present invention may include multifilament strings, fibers, flat tapes,
and monofilament strings. The strings 52 may be flat tape shaped strings. The
strings 52 may be comprised of materials including polyester, nylon, and elastic.
Any material that can be produced in a flat or small diameter string may be
25 useful. The composition of a useful string 52 may depend on the desired
application. For example, useful strings 52 for aerospace applications may
include flat polyester strings available from Breyden Product, Inc. of Hesperia,
CA. Useful strings 52 may include the polyester monofilament strings described
in U.S. Pat. No. 6,399,197, which is herein incorporated by reference. Preferred
30 strings 52 may be polyester strings that meet Federal Specifications AA-52081.
Polyester strings 52 that meet these specifications have been approved for use

in a variety of environments. Silicone tie tapes 50 comprising AA-52081 type polyester strings may be preferred for use in those same environments. Polyester string meeting AA-52081 specifications may be available from Western Filament, Inc of Grand Junction, CO. In applications where a stiffer silicone tie tape 50 is desired, the string 52 may be a flat nylon string. In applications where a stretchy silicone tie tape 50 is desired, the string 52 may be a flat elastic string. For example, in applications where bundled wires are to be routed around corners, a silicone tie tape 50 comprising an elastic string may be useful. Strings 52 comprising polyester may also be useful for these applications. This may be because the silicone tie tape 50 may not adhere to the wire bundle and may allow axial movement of the wires during routing.

[0037] The dimensions of the string 52 may vary depending on the desired application, the dimensions of the silicone rubber tape 51, and the composition of the string 52. For example, when the silicone rubber tape 51 is about 20 mil thick and about 0.5 inches wide, a useful flat polyester string may be 0.0625 inches wide. Useful strings 52 may be between about 0.035 inches and about 0.375 inches in width. The strength of the silicone tie tape 50 may be a function of the strength of the string 52. The wider strings 52 may be stronger than the narrower strings 52. Varying the width of the string 52 may vary the strength of the silicone tie tape 50. For wire bundling applications, a preferred width of a string 52 may be between about 0.07 inches and about 0.10 inches. The thickness of a useful string 52 may be between about 0.005 inches and about 0.025 inches. The thicker strings 52 may be stronger than the thinner strings 52. Varying the thickness of the string 52 may vary the strength of the silicone tie tape 50. The thickness of a preferred string 52 for wire bundling applications may be between about 0.01 inches and about 0.02 inches.

[0038] The string 52 may be embedded in the silicone rubber tape 51, as shown in Figures 3a and 3b. Methods for embedding a fiber, such as a string 52, in a polymer, such as a silicone rubber tape 51, are known in the art. These methods may comprise embedding the fiber during polymer extrusion. The string 52 may be about parallel to the sides of the silicone rubber tape 51. The

string 52 may extend longitudinally through the length of the silicone rubber tape 51, as shown in Figure 3b.

[0039] The string 52 may be positioned between two silicone rubber tapes 51, as shown in Figures 4a and 4b. Methods for positioning a fiber, such as a string 52, between two polymer sheets, such as silicone rubber tapes 51, are known in the art. These methods may comprise placing the fiber in contact with a surface of a first polymer sheet; and placing a second polymer in contact with both the first polymer sheet and the fiber. The addition of an adhesive to secure the string 52 between the two silicone rubber tapes 51 may be unnecessary because silicone rubber tape 51 adheres to itself and the silicone rubber tape 51 may be wider than the string 52. The two silicone rubber tapes 51 may provide sufficient pressure to hold the string 52 in place.

[0040] The string 52 may be adhered to a surface of the silicone rubber tape 51, as shown in Figures 5a and 5b. Methods for adhering a fiber, such as a string 52, to a polymer sheet, such as a silicone rubber tape 51, are known in the art. These methods may comprise applying an adhesive to a surface of the polymer sheet; and positioning the fiber on the adhesive. An adhesive 54 may be in contact with a surface 55 of a silicone rubber tape 51, and a string 52 may be in contact with the adhesive 54, as shown in Figure 5a. The composition of a useful adhesive 54 may depend on the composition of the fiber and the composition of the polymer sheet, as is known in the art. Useful adhesives 54 may include the silicone rubber adhesives described in U.S. Pat. No. 4,918,126, which is herein incorporated by reference.

[0041] The silicone tie tape 50 may comprise more than one string 52. As shown in Figures 6a and 6b, two strings 52 may be incorporated into one silicone tie tape 50. As another example, four strings 52 may be incorporated into a two-inch wide silicone rubber tape 51. The strings 52 may be embedded in a silicone rubber tape 51 during polymer extrusion processes. The strings 52 may be placed between two silicone rubber tapes 51. The strings 52 may be adhered to a surface 55 of a silicone rubber tape 51. Silicone tie tapes 50 comprising more than one string 52 may be wider than silicone tie tapes 50

comprising one string 52. Silicone tie tapes 50 may comprise more than two strings 52.

[0042] The dimensions of the silicone tie tapes 50 may vary depending on desired application. Useful silicone tie tapes 50 may be between about 0.25
5 inches and about 4.0 inches in width. A preferred width for wire bundling applications may be between about 0.375 inches and about 1.0 inch. The thickness of a useful silicone tie tape 50 may be between about 5 mil and about 40 mil. The thickness of a preferred silicone tie tape 50 for wire bundling applications may be between about 10 mil and about 20 mil.

10 **[0043]** The silicone tie tapes 50 of the present invention may be useful for bundling wires and other elongated members. The silicone tie tapes 50 may be self-bonding. A method for wire bundling may comprise wrapping a length of the silicone tie tape 50 around a plurality of wires 53, such that one end of the tie tape 50 overlaps the other end of the silicone tie tape 50, as shown in Figure 7.
15 The silicone tie tape 50 may have a front surface 56a and a back surface 56b. In this method, the front surface 56a of one end of the silicone tie tape 50 may be in contact with the back surface 56b of the other end. Another method for wire bundling is depicted in Figure 8. In this method, the two ends of the silicone tie tape 50 may be urged together, such that the silicone tie tape 50 surrounds a
20 plurality of wires 53 and such that the back surface 56b of one end of the silicone tie tape 50 is in contact with the back surface 56b of the other end, producing a flap 57. The flap 57 may then be positioned in contact with the front surface 56a of the silicone tie tape 50. Because the flap 57 may adhere to the silicone tie tape 50, tie trimming may not be necessary.

25 **[0044]** The silicone tie tape 50 may be suitable for use as a bundling tie because the string 52 may prevent the silicone rubber tape 51 from elongating. The silicone tie tape 50 may have the strength desired for bundling applications.

[0045] The silicone tie tape 50 may be dispensed in roll form. A roll of silicone tie tape 50 may include a release backing, or backing paper, to prevent
30 the silicone tie tape 50 from bonding to itself. Release backings are known in the art and commonly provided with double-sided adhesive tapes and

unreinforced silicone rubber tapes.

[0046] The silicone tie tape 50 may be used in known tape dispensers. A useful tape dispenser may be the tape dispenser described in U.S. Pat. No. 5,472,560, which is herein incorporated by reference. The disclosed dispenser
5 may take up the backing paper. The use of this dispenser may reduce foreign object disposal (FOD) because the backing papers may be contained within the dispenser.

[0047] As can be appreciated by those skilled in the art, the present invention provides a bundling tie tape suitable for aerospace applications. Also
10 provided is a bundling tie that may not become snagged and may be easy to install. A tie is provided that may not cause damage to the surface of the bundled items. Further, a bundling tie is provided that can be removed without leaving a residue on the bundled items.

[0048] It should be understood, of course, that the foregoing relates to
15 preferred embodiments of the invention and that modifications may be made without departing from the spirit and scope of the invention as set forth in the following claims.

WE CLAIM:

1. A bundling tie comprising:
at least one silicone rubber tape; and
at least one string in contact with said silicone rubber tape.
2. The bundling tie of claim 1, wherein said string comprises a polyester.
3. The bundling tie of claim 1, wherein said string comprises a monofilament.
4. The bundling tie of claim 1, wherein said silicone rubber tape has a width between about 0.25 inches and about 4.0 inches.
5. The bundling tie of claim 1, wherein said string has a width between about 0.035 inches and about 0.375 inches.
6. The bundling tie of claim 1, wherein one said string is in contact with each of two said silicone rubber tapes.
7. The bundling tie of claim 1, wherein each of two said strings are in contact with one said silicone rubber tape.
8. The bundling tie of claim 1, wherein said silicone rubber tape is colored silicone rubber tape.
9. The bundling tie of claim 1, wherein said string comprises a nylon.
10. The bundling tie of claim 1, wherein said string is embedded within said silicone rubber tape.

11. A tie for bundling a plurality of wire members comprising:
a poly(organosiloxane) based polymer sheet; and
a polymer fiber embedded in said poly(organosiloxane) based polymer sheet.
12. The tie of claim 11, wherein said poly(organosiloxane) based polymer sheet comprises a poly(dimethylsiloxane) based polymer sheet.
13. The tie of claim 11, wherein said poly(organosiloxane) based polymer sheet has a width between about 0.375 inches and about 1.0 inch.
14. The tie of claim 11, wherein said polymer fiber comprises a flat polyester tape.
15. The tie of claim 11, wherein said tie is a colored tie.
16. The tie of claim 11, wherein said tie has thickness between about 5 mil and about 40 mil.
17. The tie of claim 11, wherein said polymer fiber has a width between about 0.07 inches and about 0.10 inches.
18. A bundling tie comprising:
a silicone rubber tape; and
at least one flat polyester string in contact with said silicone rubber tape.
19. The bundling tie of claim 18, wherein said silicone rubber tape is a silicone rubber tape meeting Federal Specifications AA-59163.
20. The bundling tie of claim 18, wherein said flat polyester string is a

flat polyester string meeting Federal Specifications AA-52081.

21. The bundling tie of claim 18, wherein said silicone rubber tape is a silicone rubber tape meeting Federal Specifications AA-59163, and wherein said flat polyester string is a flat polyester string meeting Federal Specifications AA-52081.

22. The bundling tie of claim 18, comprising at least two said flat polyester strings.

23. The bundling tie of claim 18, wherein said bundling tie is a colored bundling tie.

24. An apparatus for bundling comprising:
a silicone rubber tape, wherein said silicone rubber tape meets Federal Specifications AA-59163, wherein said silicone rubber tape is a colored silicone rubber tape, and wherein said silicone rubber tape has a width between about 0.25 inches and about 4.0 inches; and
a flat polyester string embedded in said silicone rubber tape, wherein said flat polyester string meets Federal Specifications AA-52081, and wherein said flat polyester string has a width between about 0.035 inches and about 0.375 inches.

25. A method for producing a silicone tie tape comprising the steps of:
providing at least one silicone rubber tape; and
incorporating at least one polyester string into said silicone rubber tape, wherein said polyester string extends longitudinally through said silicone rubber tape.

26. The method of claim 25, wherein said step of incorporating comprises extrusion processing.

27. The method of claim 25, wherein said step of incorporating comprises positioning said polyester string between two said silicone rubber tapes and self-bonding said two silicone rubber tapes.

28. The method of claim 25, wherein said step of incorporating comprises applying an adhesive to a surface of said silicone rubber tape, and positioning said polyester string in contact with said adhesive.

29. A method for bundling a plurality of wires comprising the steps of:
providing a silicone tie tape in contact with said wires, said silicone tie tape has a front surface and a back surface;
wrapping said silicone tie tape around said wires;
securing said silicone tie tape, such that a wire bundle is produced.

30. The method of claim 29, wherein said securing comprises positioning said front surface of said silicone tie tape in contact with said back surface of said silicone tie tape.

31. The method of claim 29, wherein said securing comprises positioning a portion of said back surface of said silicone tie tape in contact with a second portion of said back surface of said silicone tie tape.

32. The method of claim 29, wherein said securing comprises positioning said back surface of one end of said silicone tie tape in contact with said back surface of a second end of said silicone tie tape, whereby a flap is produced, and positioning said flap in contact with said front surface of said silicone tie tape.

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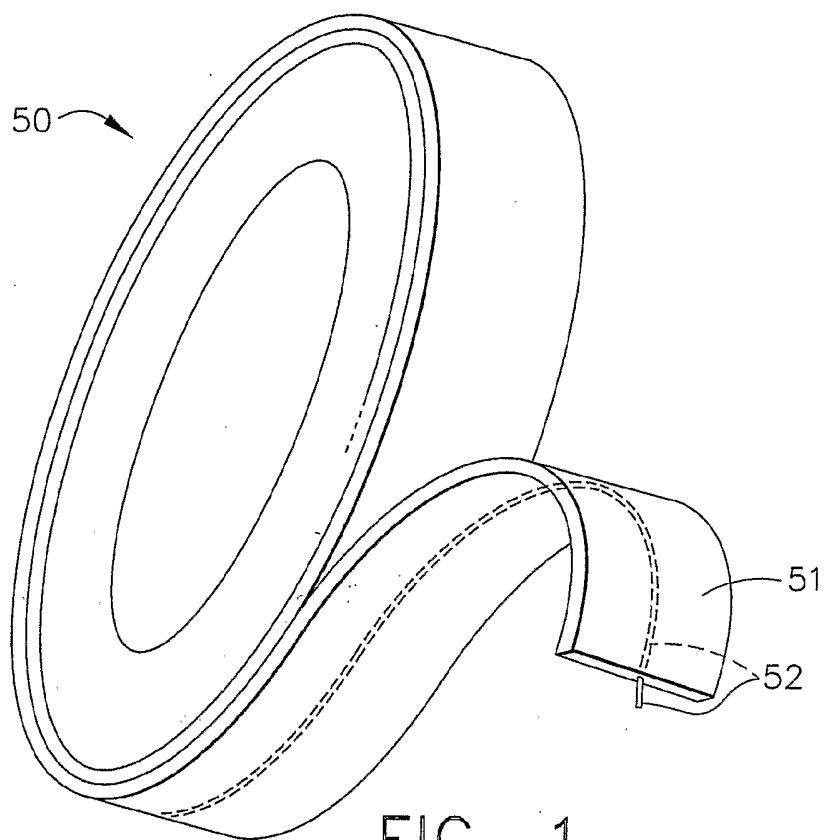


FIG. 1

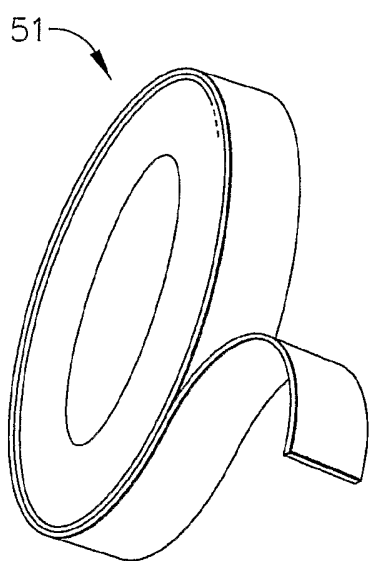


FIG. 2a

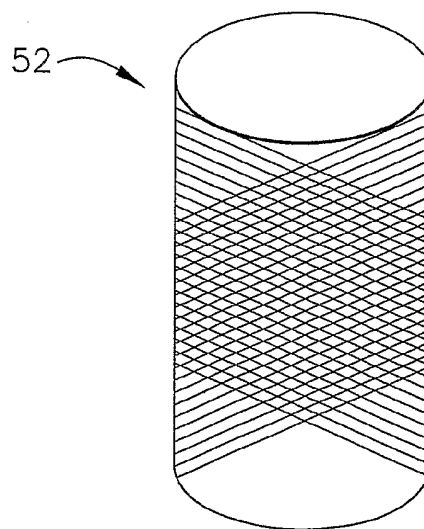
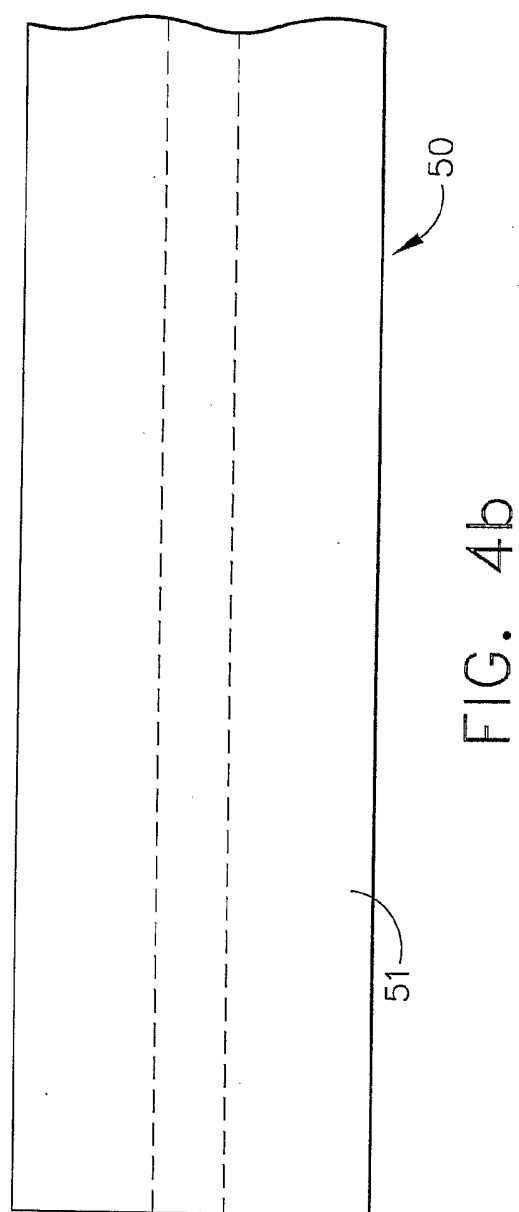
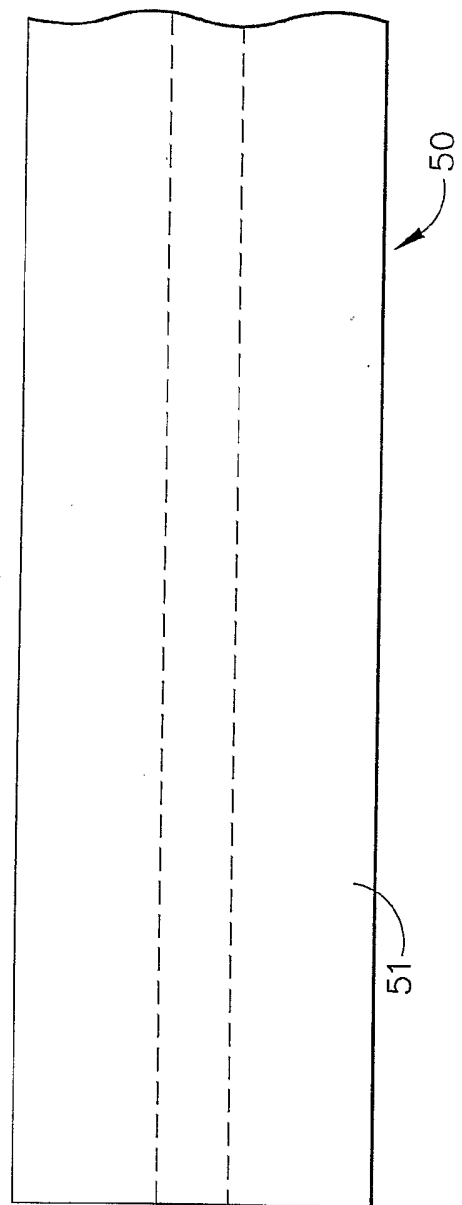


FIG. 2b



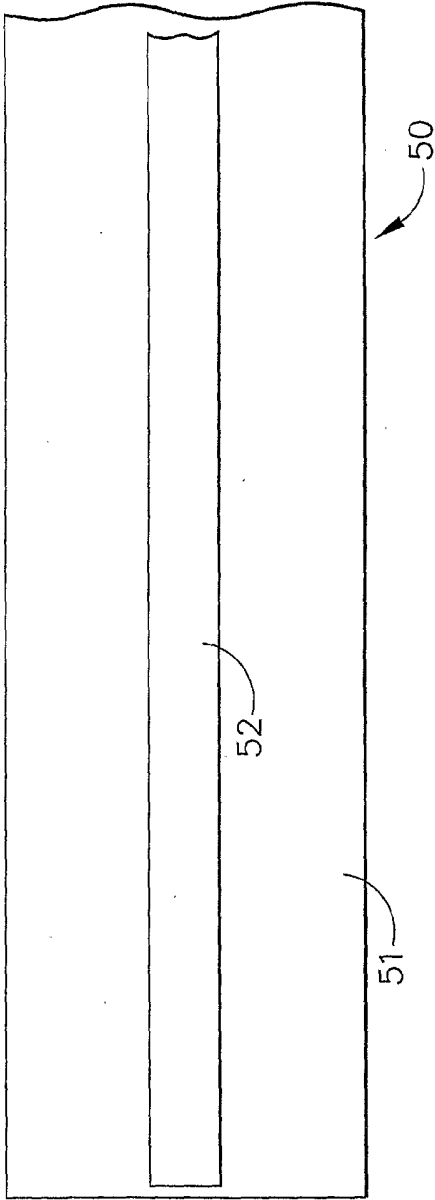


FIG. 5b

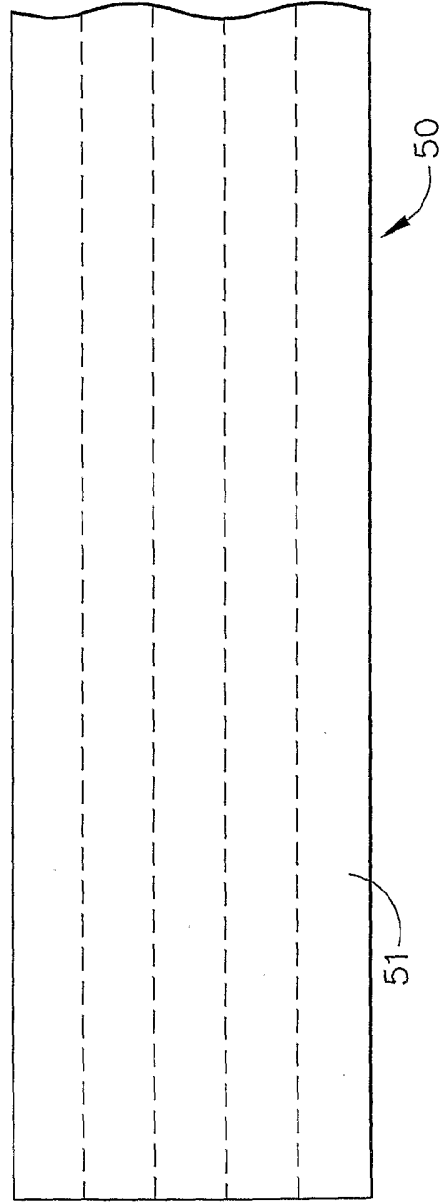


FIG. 6b

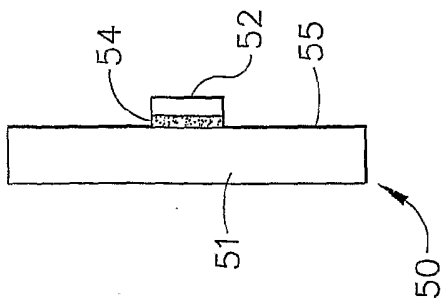


FIG. 5a

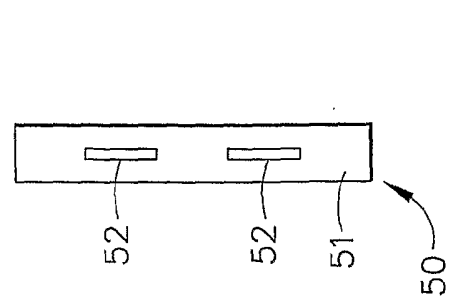


FIG. 6a

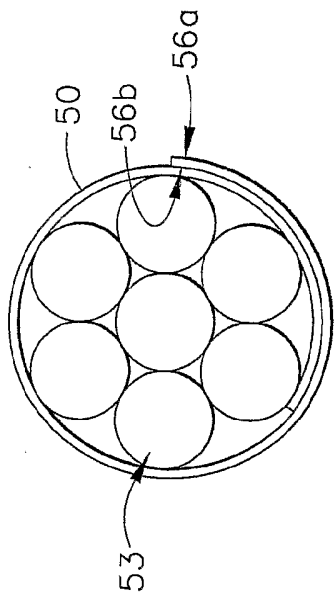


FIG. 7

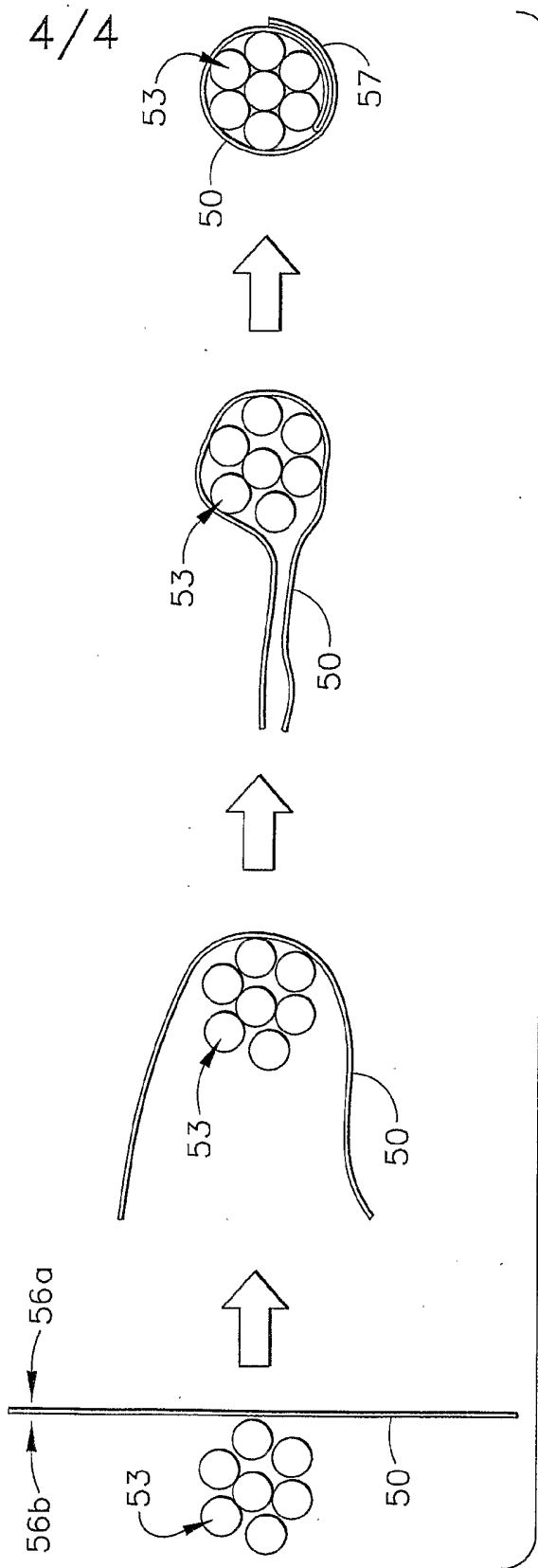


FIG. 8

INTERNATIONAL SEARCH REPORT

International Application No
PCT/US 03/36076

A. CLASSIFICATION OF SUBJECT MATTER
IPC 7 B65D63/10

According to International Patent Classification (IPC) or to both national classification and IPC

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)
IPC 7 B65D A44B

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

Electronic data base consulted during the international search (name of data base and, where practical, search terms used)

EPO-Internal, WPI Data, PAJ

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category °	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X	EP 0 828 328 A (BEIERSDORF AG) 11 March 1998 (1998-03-11) claims 1,7-9	1-4,9, 10,15-18
X	FR 1 472 519 A (STAUFFER CHEMICAL CO) 10 March 1967 (1967-03-10) figures 2-5 page 3, paragraph 2 page 3, paragraph 3-4	1,10,11, 25-28
A	US 5 168 603 A (REED BRIAN E) 8 December 1992 (1992-12-08) cited in the application the whole document	1-32
A	US 4 138 770 A (GLODE JR JOHN B ET AL) 13 February 1979 (1979-02-13) cited in the application the whole document	1-32

Further documents are listed in the continuation of box C.

Patent family members are listed in annex.

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Date of the actual completion of the international search

5 April 2004

Date of mailing of the international search report

15/04/2004

Name and mailing address of the ISA

European Patent Office, P.B. 5818 Patentlaan 2
NL - 2280 HV Rijswijk
Tel. (+31-70) 340-2040, Tx. 31 651 epo nl,
Fax: (+31-70) 340-3016

Authorized officer

Marquis, D

INTERNATIONAL SEARCH REPORT

Information on patent family members

International Application No

PCT/US 03/36076

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