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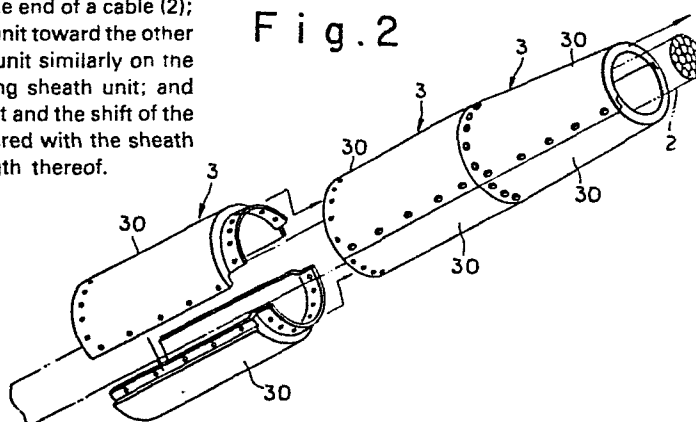
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54 **Method for covering cables with sheaths for corrosion protection and/or aesthetic reasons.**

57 A method for fitting a generally cylindrical corrosion protective and or aesthetic sheath on a cable, which method comprises: fitting a sheath unit (3) on one end of a cable (2); shifting the position of the fitted sheath unit toward the other end of the cable; fitting a fresh sheath unit similarly on the cable in continuation from the preceding sheath unit; and repeating the fitting of a fresh sheath unit and the shift of the preceding sheath until the cable is covered with the sheath units substantially over the entire length thereof.

Fig. 2



METHOD FOR COVERING CABLES WITH SHEATHS FOR
CORROSION PROTECTION AND/OR AESTHETIC REASONS

This invention relates to improvements in and relating to a method for fitting corrosion protective and/or aesthetic sheaths on tension members of suspension bridges, suspended roofs, cable stayed bridges and the like.

5 The circumferential surfaces of the tension members of this sort are usually covered with generally cylindrical sheaths for protection against corrosion. However, such corrosion protection sheaths are often found to be inconvenient since it becomes difficult to take up a
10 tension member on a reel for storage or for other purposes once a sheath is fitted on the tension member. Therefore, it has been the conventional procedure to thread a tension member through cylindrical sheaths which are provided on scaffolds which are erected at suitable intervals along
15 the tension member to be installed for protection against corrosion, or to fit sheaths on an installed cable by climbing on a scaffold which is provided along the entire length of the cable. Thus, the conventional protection sheaths invariably require a scaffold or
20 scaffolds for fitting them on a cable, and necessitate the building of scaffolds on a large scale for long cables, resulting in a high construction costs and an unduly long construction period.

25 The present invention aims to solve the above-mentioned problems or difficulties. It is a more specific object of the present invention to provide a method for covering tension members consisting of bundles of steel, wires, strands, wire ropes or high strength bars (hereinafter called "cables") with corrosion
30 protection and/or aesthetic sheaths in a simplified manner, which does not require provision of a scaffold for fitting the corrosion protective sheaths on cables and which can realize significant reductions of the cost and time of the cable installation.

According to the invention, there is provided a method for fitting a generally cylindrical corrosion protective and/or aesthetic sheath on a cable, said method comprising:

5 fitting a sheath unit (3) on one end of a cable (2);
 shifting the position of the fitted sheath unit
toward the other end of the cable;

 fitting a fresh sheath unit (3) similarly on the
cable in continuation from the preceding sheath unit; and
10 repeating fitting of a fresh sheath unit and shift
of preceding sheath until said cable is covered with said
sheath units substantially over the entire length thereof.

 In a preferred form of the invention, each corrosion
protective and/or aesthetic sheath unit consists of a pair
15 of split segments formed from a synthetic resin such as
polyethylene or a metal such as copper, aluminium,
stainless steel or the like, and is fitted on a cable
such that the split segments are located in staggered
positions along the axis of the cable.

20 The above and other objects, features and
advantages of the present invention will become apparent
from the following description, taken in conjunction with
the accompanying drawings. which show by way of example
preferred embodiments of the invention.

25 In the accompanying drawings:

 FIGURE 1 is a schematic front view of an embodiment
of the invention;

 FIGURE 2 is a schematic perspective view of split
sheath segments constituting a train of sheath units;

30 FIGURE 3 is a schematic perspective view of a
sheath of a different construction;

 FIGURE 4, 5(A), 5(B), 5(C), 6(A), and 6(B) are
schematic sectional view showing various means for
integrally connecting the sheath and cable together;

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FIGURES 7 and 8 are schematic sectional views showing the constructions at the terminal ends of a cable;

FIGURE 9 is a schematic perspective view showing
5 another embodiment of the invention;

FIGURE 10 is a schematic sectional view taken on line X-X of FIGURE 9;

FIGURE 11 is a schematic perspective view showing an example of the segment lifting means; and

10 FIGURE 12 is a schematic sectional view a completely sheathed cable.

Referring to the drawings and first to FIGURE 1, there is shown part of a cable stayed bridge 1 having a tension member 2, which consists of a bundle of steel
15 wires, strands, wire ropes or high strength bars (hereinafter called "a cable") tensioned between an upper end portion of a tower 10 and a beam 11 of the bridge. A cylindrical protective sheath unit 3 of a predetermined length is fitted on the circumference of a
20 lower end portion of the cable 2 immediately above the beam 11. The sheath unit 3 consists of a couple of split segments 30 of a synthetic resin like polyethylene or a metallic material such as copper, aluminum, stainless steel or the like (see FIGURE 3). After fitting the
25 split segments 30 on the cable 2, they are secured to each other by bolts, rivets, press-in fit or welding in such a manner as to hold the cable 2 from opposite sides.

The sheath unit 3 thus fitted on the cable 2 is
30 shifted upwards along the cable by a distance corresponding to its length by pulling a rope which is passed around a pulley 12 at the upper end of the tower 10, and then a fresh protective sheath unit 3 is fitted on the cable 2 in the same manner. The upper end of the lower or
35 succeeding sheath unit 3 is fitted into the lower end of

the preceding sheath unit 3, and the overlapped end portions of the two sheaths units 3 are fastened to each other by bolts or other suitable means. If desired, the connecting end portions of the preceding and succeeding sheath units may be secured to each other by butt welding. The two connected sheath units 3 are slid upwards by pulling the rope 13 again, and another fresh protective sheath unit 3 is fitted on the cable 2 and connected to the lower end of the second unit 3. In this manner fresh protective and/or aesthetic sheath units are connected one after another until the cable 2 is covered with the sheath 3 over the entire length thereof.

In this instance, instead of lifting by the rope 13, the connected sheath units 3 may be pushed up each time by a distance corresponding to their unit length, or alternatively the first sheath unit 3 may be fitted on the upper end of the cable 2 which is accessible from the top end portion of the tower 10, successively lowering the sheath units 3 along the cable 2 after fitting and connecting fresh sheath units 3 to the upper end of the preceding units 3. Further, it is to be understood that, instead of a pair of split segments 30, each sheath unit may be constituted by three or more segments which can be assembled into a cylindrical shape with a number of pieces in the longitudinal direction, if desired, for fitting the same on the cable 2 by elastic deformation. Furthermore, as shown particularly in Figure 3, a sheath 3a of a desired length can be formed by spirally wrapping a rolled covering strip 31 around the circumference at one end of a cable 2 and fastening the overlapped portions of the covering strips 31 by rivets or other suitable means.

After forming a sheath 3 of the necessary length at one end of the cable 2 in this manner, the sheath unit 3 is shifted toward the other end of the cable 2,

and a fresh sheath unit 3 is formed contiguously to the preceding unit 3. Consequently, there is no necessity for providing a scaffold or scaffolds as required by the conventional methods, and it becomes possible to reduce
5 the installation cost as well as the time of construction markedly.

In order to lessen the frictional resistance at the time of moving the joined sheath units toward the other end of the cable 2, it is desired to leave a
10 predetermined clearance (normally about a 2-60 mm gap) between the inner surfaces of each sheath unit 3 and the circumference of the cable 2. However, if such a clearance exists after installation, the sheath 3 may vibrate independently of the cable 2 due to the action of
15 winds or other external disturbances, so that there is a possibility of noise being produced or the sheath being damaged. These troubles can be precluded by integrating the sheath 3 and cable 2, for example by providing cushion material 20 such as sponge, sponge rubber, curled
20 stainless steel wire or a spring on the inner surface of the sheath 3 or on the circumferential surface of the cable 2 as shown in FIGURE 4. With this arrangement the protective and/or aesthetic sheath 3 can be moved with a small frictional resistance due to elastic deformation
25 of the cushion material 20, and, after installation, the sheath 3 and cable 2 are integrally joined to each other by the cushion material 20. Similar effects can be obtained by providing, instead of the cushion material 20, a age-hardening type tacky material such as silicone,
30 foamable urethane or the like. It is also possible to lay one or a plurality of inflatable tubes 21 along the cable 2 as shown in FIGURE 5 (A), inflating the tubes 21 by introducing a filler 22 thereinto as shown in FIGURES 5(B) and 5(C) until the tubes 21 completely

support the sheath 3 on cable 2 to connect them integrally to each other. Alternatively, the cable 2 may be temporarily held in a reduced diameter by compressing opposite end portions of the cable 2 with clamps 23 while the sheaths are fitted thereon as shown particularly in FIGURE 6 (A), and removing the clamps 23 afterwards so that the cable 2 may be integrally connected to the sheath 3 by restoration of its normal diameter as shown in FIGURE 6 (B).

As illustrated in FIGURE 7, the upper and lower ends of the cable 2 are fixed by sockets 14, and each end portions of the connected sheath unit is fitted on a pipe 15 of polyethylene, steel or the like which is retained in the socket 14, thereby preventing each end portion of the cable 2 being exposed to the weather and at the same time improving the corrosion resistance of each end portion of the cable 2 and its appearance. In order to improve the corrosion resistance of each end portion of the cable 2 still further, it is desirable to fill the pipes 15 with a filler material 16 of a synthetic resin, rubber or the like. Further, a water drain hole 17 may be provided at the lower end of the sheath 3 at a position opposing a slant surface of the filler material 16 to drain water which might enter the sheath 3 through its riveted joints.

Shown in FIGURE 8 is another embodiment in which each end of the sheath 3 is fitted in a trumpet sheath 18 which is provided on the anchorage attachment. In the case where there is a difference in linear thermal expansion coefficient between the cable 2 and sheath 3, it is desirable to provide a space S between the upper end of the sheath and socket 14 thereby to absorb the difference in the thermal expansions and contractions as shown in FIGURES 7 and 8, or to provide an extensible joint in an intermediate portion of the sheath 3. In the

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case of a very long cable 2, there are possibilities of a corrosion resistant layer of the cable 2 being damaged due to sliding movements of the cable 2 within the sheath caused by thermal expansion or contraction.

5 This can be suitably prevented by the provision of the above-mentioned cushioning material 20. Accordingly, it is preferred to provide the cushion material 20 between the circumferential surface of the cable 2 and the inner surface of the sheath 3 in the embodiments

10 shown in FIGURES 5(A), 5(B) and 5(C) and FIGURES 6(A) and 6(B). Where it is intended to bore apertures or tapped holes in the sheaths 3 and 3a of FIGURES 2 and 3 respectively on a construction site for receiving rivets or bolts which fasten the connecting

15 portions of the split sheath segments 30 or of the adjacent sheath units 3, it is desirable to provide projections on the inner surfaces of the sheaths 3 and 3a or to maintain a clearance of a predetermined gap between the sheaths 3 and 3a and the cable 2 by

20 interposition of a spacer or other suitable means to prevent the cable 2 from being damaged by a drill or tools.

Referring to FIGURE 9, there is shown a further embodiment to the invention, in which the opposing

25 semi-cylindrical segments of each sheath unit are connected in staggered positions along the length of the cable. More specifically, as illustrated in FIGURE 9, a segment 30 of a predetermined length and a segment 31 of a half length are fitted on the lower end of a

30 cable 2 from opposite sides thereof and connected to each other to form an initial end of a sheath. The long and short segments 30 and 31, which are aligned with each other at the upper ends but have their lower ends terminated at staggered positions in the longitudinal

35 direction, have the longitudinal meeting edges fastened

to each other by rivets 32 or other suitable fixing means such as bolts, screws, fit joints, slits or welding. In this instance, a bell-shaped split guide tube 33 is fitted on the cable 2 beforehand to connect thereto the alignment upper ends of the segments 30 and 31. In a manner similar to the foregoing embodiments, the connected sheath segments 30 and 31 are slid upward by pulling a rope 13, and a segment of the next sheath unit is fastened to the longitudinal edges of the lower half of the longer segment 3 contiguously to the lower end of the short segment 31. Namely, the segments 30 and 30' of each sheath units are connected to each other and to a segment of a preceding or succeeding sheath unit in longitudinally staggered positions by rivets 32 or other fastening means which secure the longitudinal meeting edges of the respective segments.

In this manner, the segments 30 and 30' of the succeeding sheath units are connected one after another at the lower end of the cable 2, while upwardly shifting the connected sheath units after connection of a single or a couple of fresh segments by a distance, corresponding to an increment in length of the connected sheath train. Since the segments 30 30' are connected to each other as well as to a staggered segment 30 and 30' of a longitudinally adjacent sheath unit, there is no necessity for fastening means for connecting the abutted ends of longitudinally adjacent sheath segments and therefore the connecting work can be simplified to a significant degree. In this case, in order to prevent invasion of water through the abutted ends of the adjacent sheath segments, it is desirable to fit around the abutted ends a hoop strap 35 with a backup material 36 such as silicon rubber, duplex adhesive tape or the like,

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fixing the hoop strap 35 in position by a caulking strip 37 or the like (FIGURE 9 and 10). The hoop strap 35 can be omitted in case the opposing end portions of the adjacent sheath segments are so shaped
5 as to be connected with each other by fitting engagement.

For lifting up the connected segments by the rope 13, there may be employed a cable grip 40 of a net-light-sock which is fitted around the segments 30 and 31 of the leading sheath unit, and has loops at its force end
10 connected to the rope 13 so that the grip 40 is tightened to lift the sheath segments 30 and 31 as the rope 13 is wound up by a winch 14.

In this manner, the connection of fresh sheath segments and the upward shift of the connected sheath segments are repeated alternately until the segments 30
15 and 31 at the leading end reaches the upper end of the cable 2, forming a continuous cylindrical sheath A over the entire length of the cable 2 as shown particularly in FIGURE 12. The lower ends of the opposing sheath
20 segments at the terminal end of the sheath A are compensated with each other by the use of a short segment 31 in the same manner as at the leading end of the sheath A, and the opposite ends of the sheath A are connected
25 respectively to connecting pipes 22 on sockets 21 through the trumpet sheath 33.

CLAIMS:

1. A method for fitting a generally cylindrical corrosion protective and/or aesthetic sheath on a cable, said method comprising:

fitting a sheath unit (3) on one end of a cable (2);
shifting the position of the fitted sheath unit toward the other end of the cable;

fitting a fresh sheath unit (3) similarly on the cable in continuation from the preceding sheath unit;
and

repeating fitting of a fresh sheath unit and shift of preceding sheath until said cable is covered with said sheath units substantially over the entire length thereof.

2. A method as set forth in claim 1, wherein said cable consists of a plurality of steel wires, strands, wire ropes or high strength bars, and said sheath unit consists of a pair of semi-cylindrical split segments (30) formed from a synthetic resin material including polyethylene or a metallic material including copper, aluminum or stainless steel.

3. A method as set forth in claim 1 or 2, wherein a clearance of a predetermined gap, normally in the range of 2-60mm, is provided between the inner surface of each sheath unit and the circumferential surface of said cable for the purpose of reducing frictional resistance at the time of shifting said sheath unit along said cable.

4. A method as set forth in claim 1 or 2, wherein said sheath unit is integrally connected to the circumference of said cable by a cushion material (20) including sponge, foamed rubber, curled stainless steel wire or a spring, provided on the inner surface of said sheath unit or on the circumferential surface of said cable.

5. A method as set forth in claim 1 or 2, wherein said sheath unit is integrally connected to the circumference of said cable by an age-hardening type tacky material, including silicone or foamable urethane, applied on the inner surface of said sheath unit or on the circumferential surface of said cable.

6. A method as set forth in claim 1 or 2, wherein at least one inflatable tube (21) is embedded between said sheath units and cable, and a filler material (22) is introduced into said inflatable tube after fitting said sheath units on said cable, thereby expanding said tube to support said sheath units on said cable for connecting same integrally with each other.

7. A method as set forth in claim 1, comprising:

forming each one of said sheath units from a plural number of split segments; and

fitting split segments of each sheath unit on said cable from opposite sides thereof in staggered positions in the longitudinal direction of said cable and fastening longitudinal meeting edges of said split segments to each other and to a segment of a preceding or succeeding sheath unit to form on said cable a cylindrical sheath consisting of a series of longitudinally connected sheath units having the opposite ends of the respective split segments abutted against split segments of an adjacent sheath unit in staggered positions.

8. A method as set forth in claim 7, wherein a hoop strap (35) is fitted on and around the abutted ends of said split segments of adjacent sheath units and fixed in position by a caulking strip (37) said hoop strap being held in tight contact with the circumferential surfaces of said split segments through a back-up material (36) applied on the inner surface of said hoop strap.

9. A method as set forth in claim 8, wherein said back-up material is silicone rubber.
10. A method as set forth in claim 8, wherein said back-up material is a duplex adhesive tape.
11. A method as set forth in claim 8, wherein said abutted ends of split segments of adjacent sheath units are connected by fitting engagement with each other.
12. A method as set forth in any preceding claim wherein said sheath units fitted on said cable are successively pulled upward by a rope (13) connected by an initial end of said sheath.
13. A method as set forth in any of claims 1 to 11, wherein said sheath units fitted on said cable are successively pushed up each time by a predetermined distance along said cable.
14. A method as set forth in any of claims 1 to 11, wherein said sheath units are fitted one after another on an upper end portion of said cable and successively moved toward the lower end of said cable.
15. A sheathed cable constructed by a method as set forth in any preceding claim.

Fig. 1

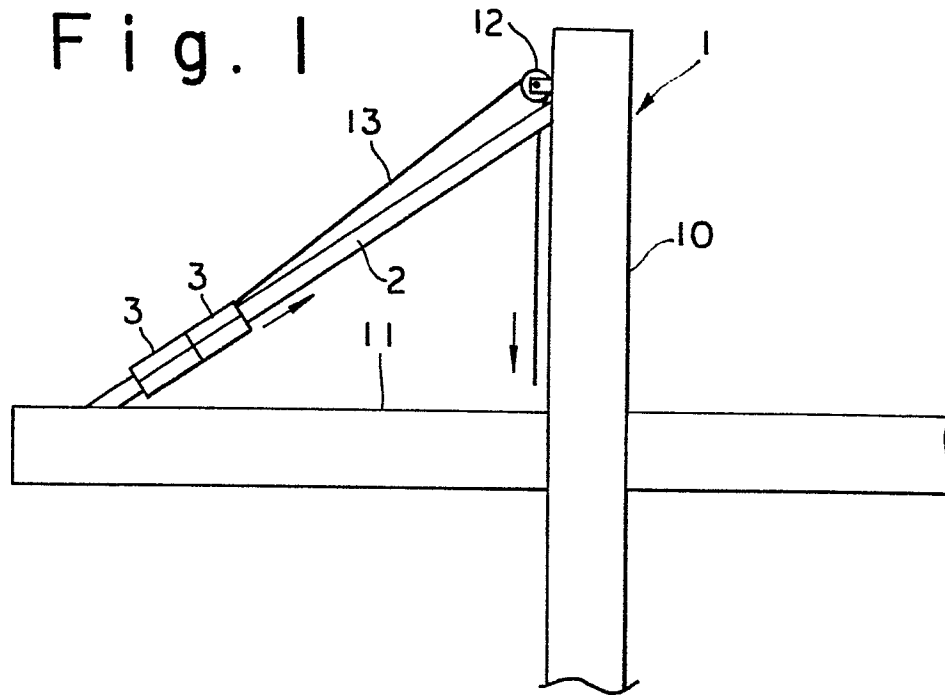


Fig. 2

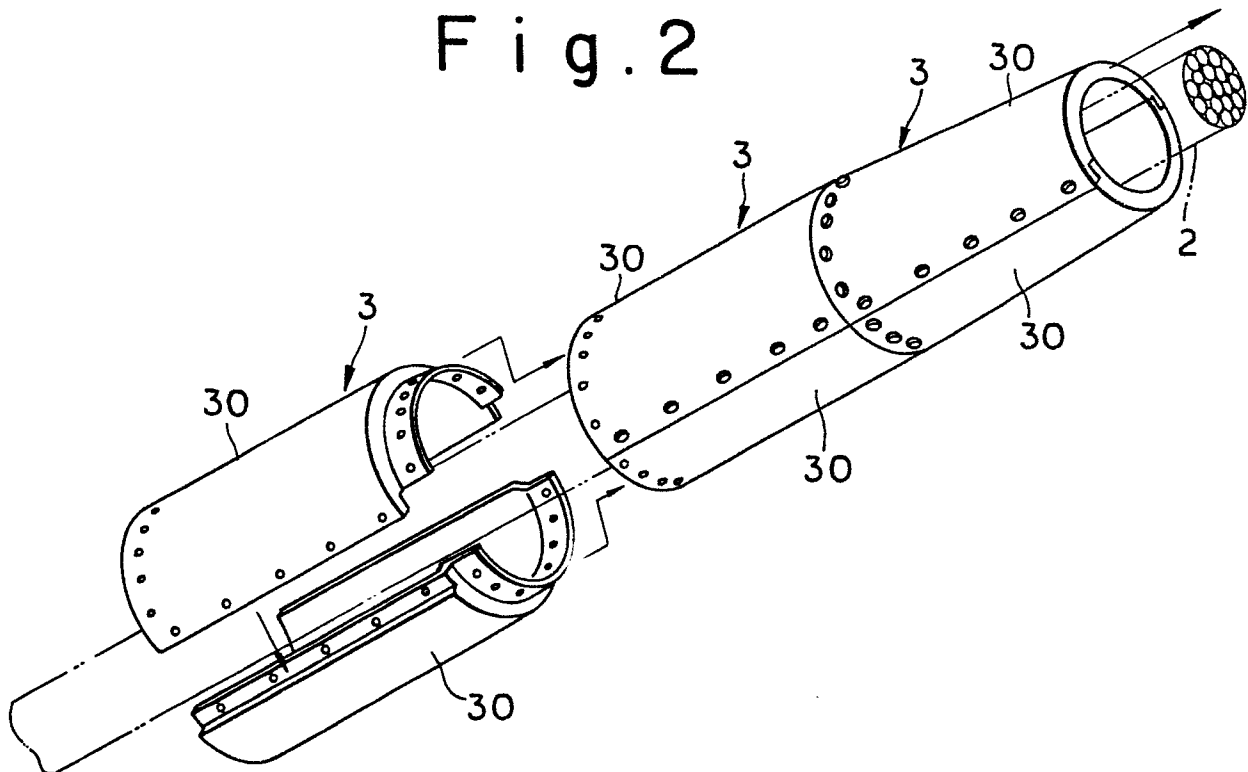


Fig. 3

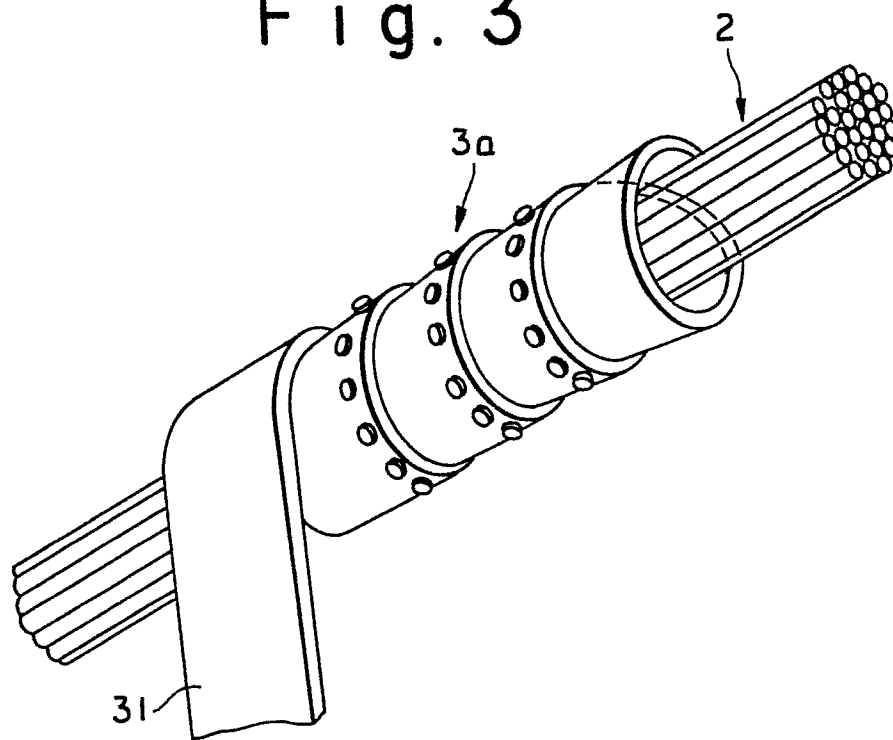


Fig. 4

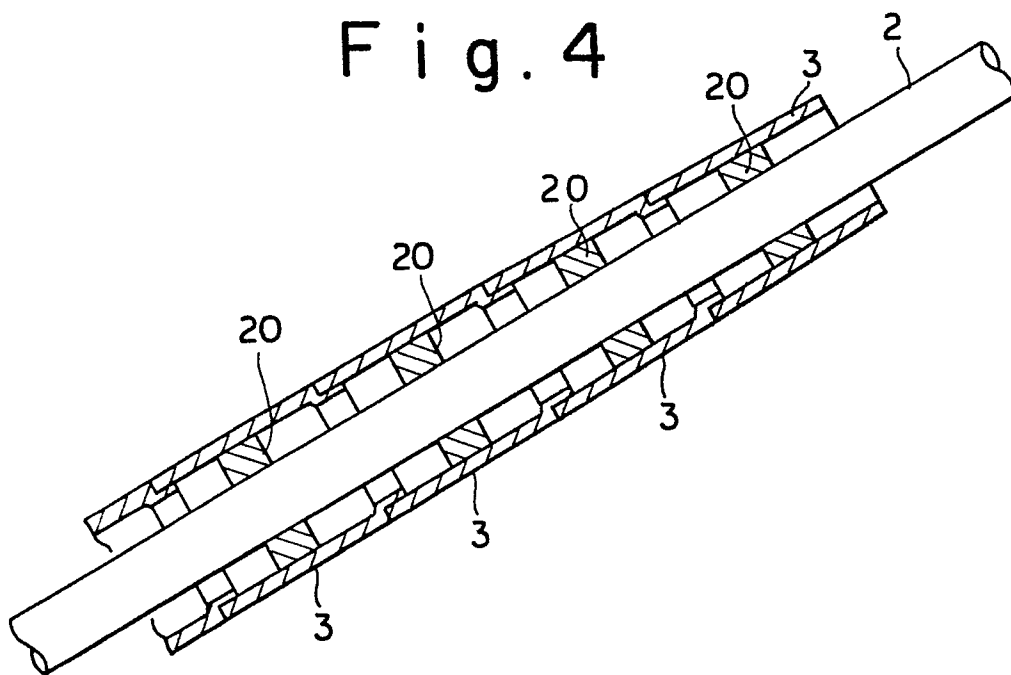


Fig. 5(A)

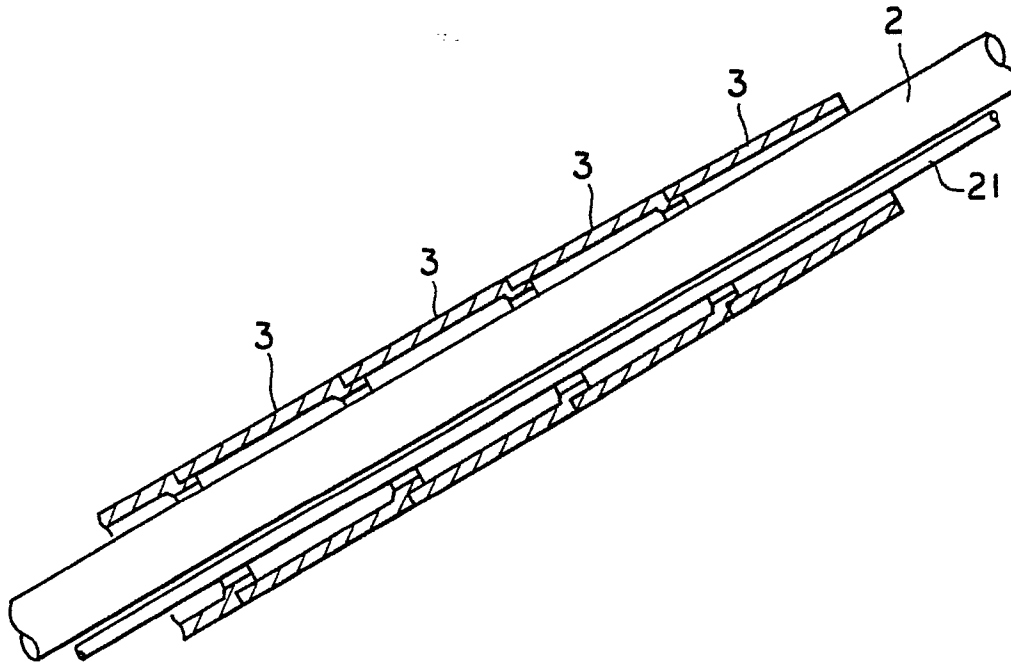


Fig. 5(B)

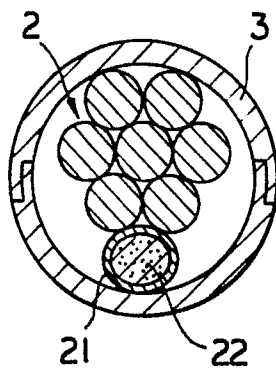


Fig. 5(C)

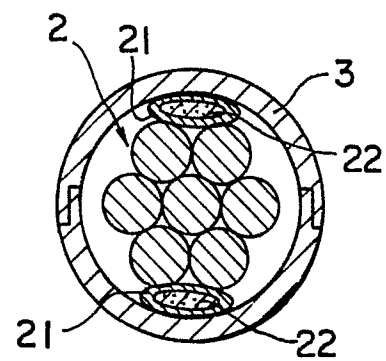


Fig. 6(A)

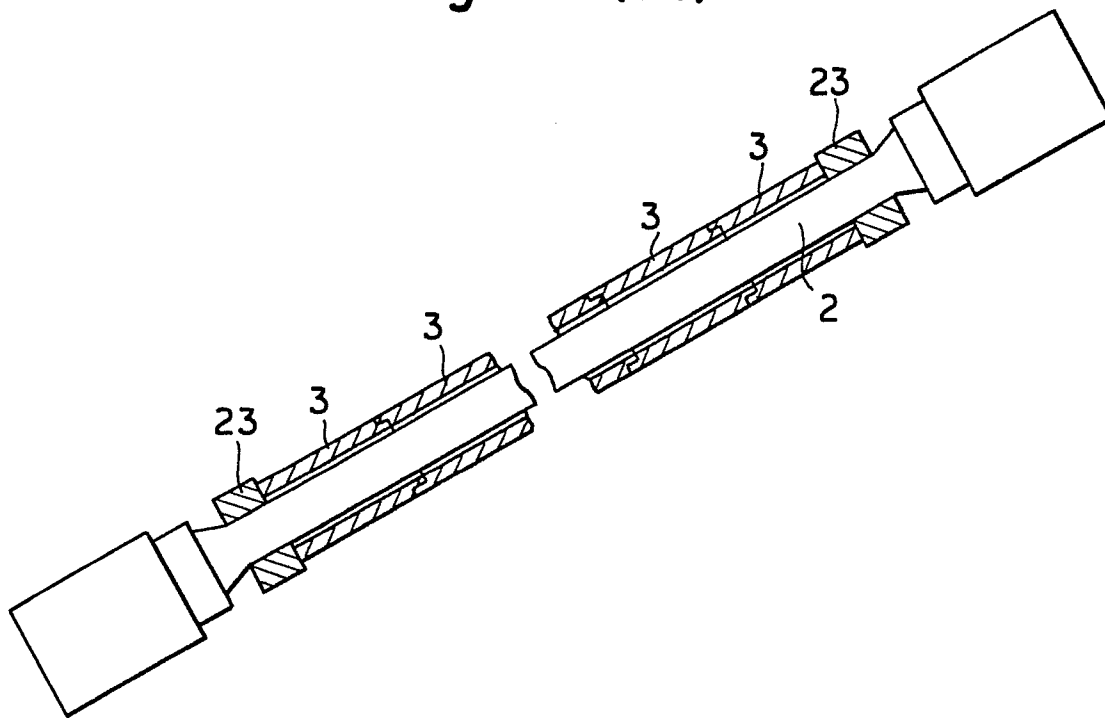


Fig. 6(B)

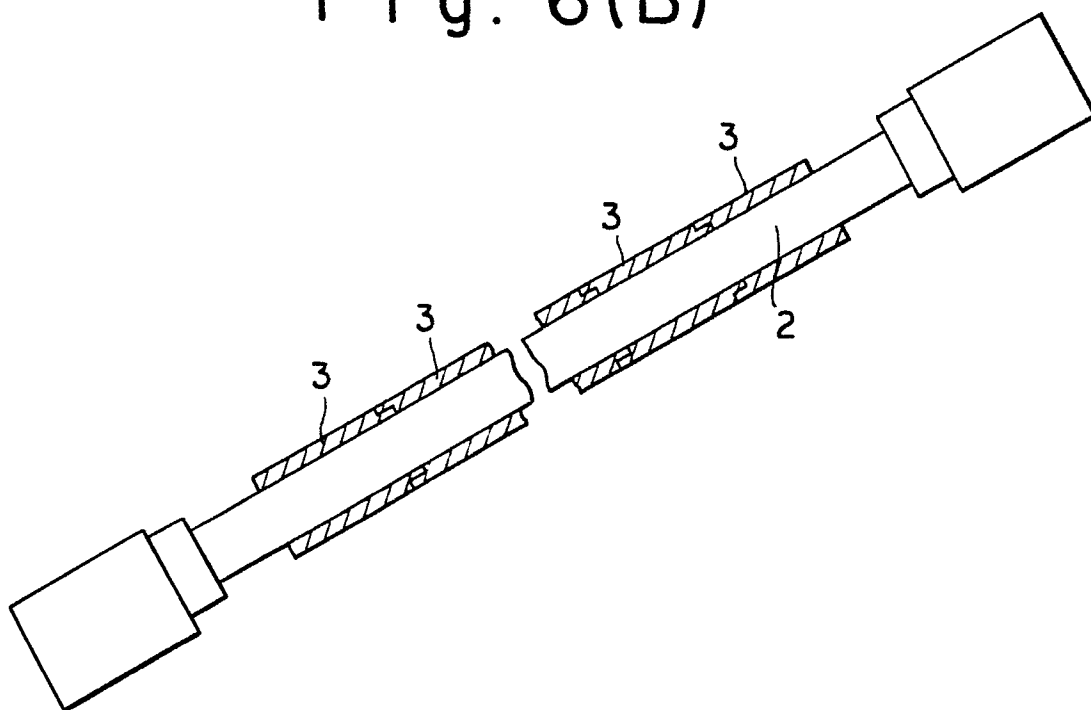


Fig. 7

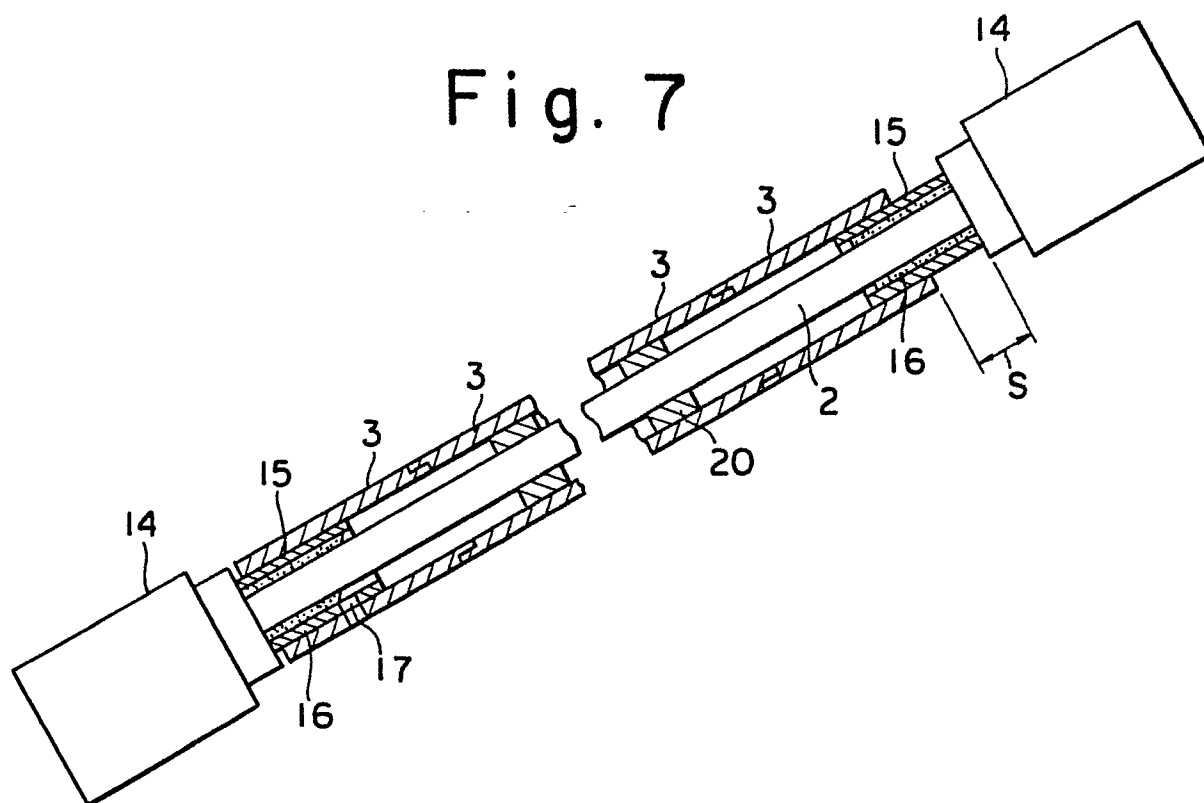
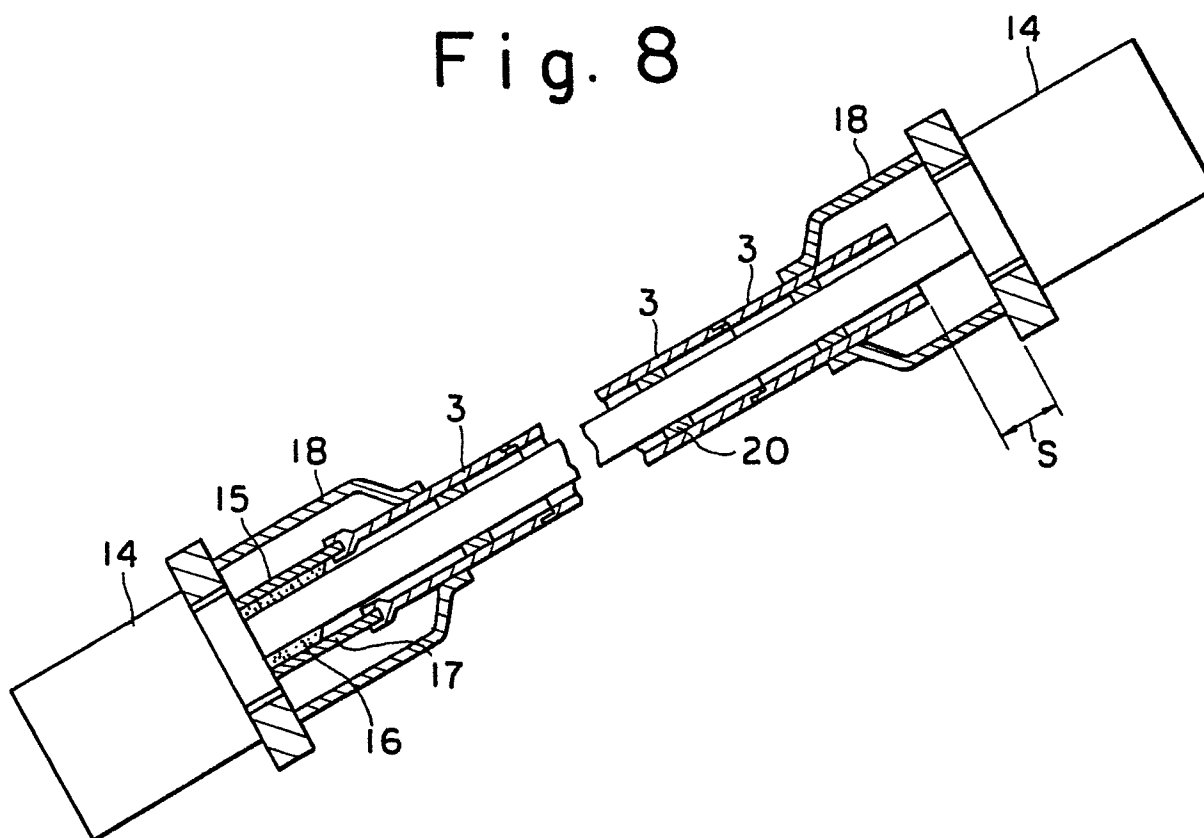


Fig. 8



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Fig. 9

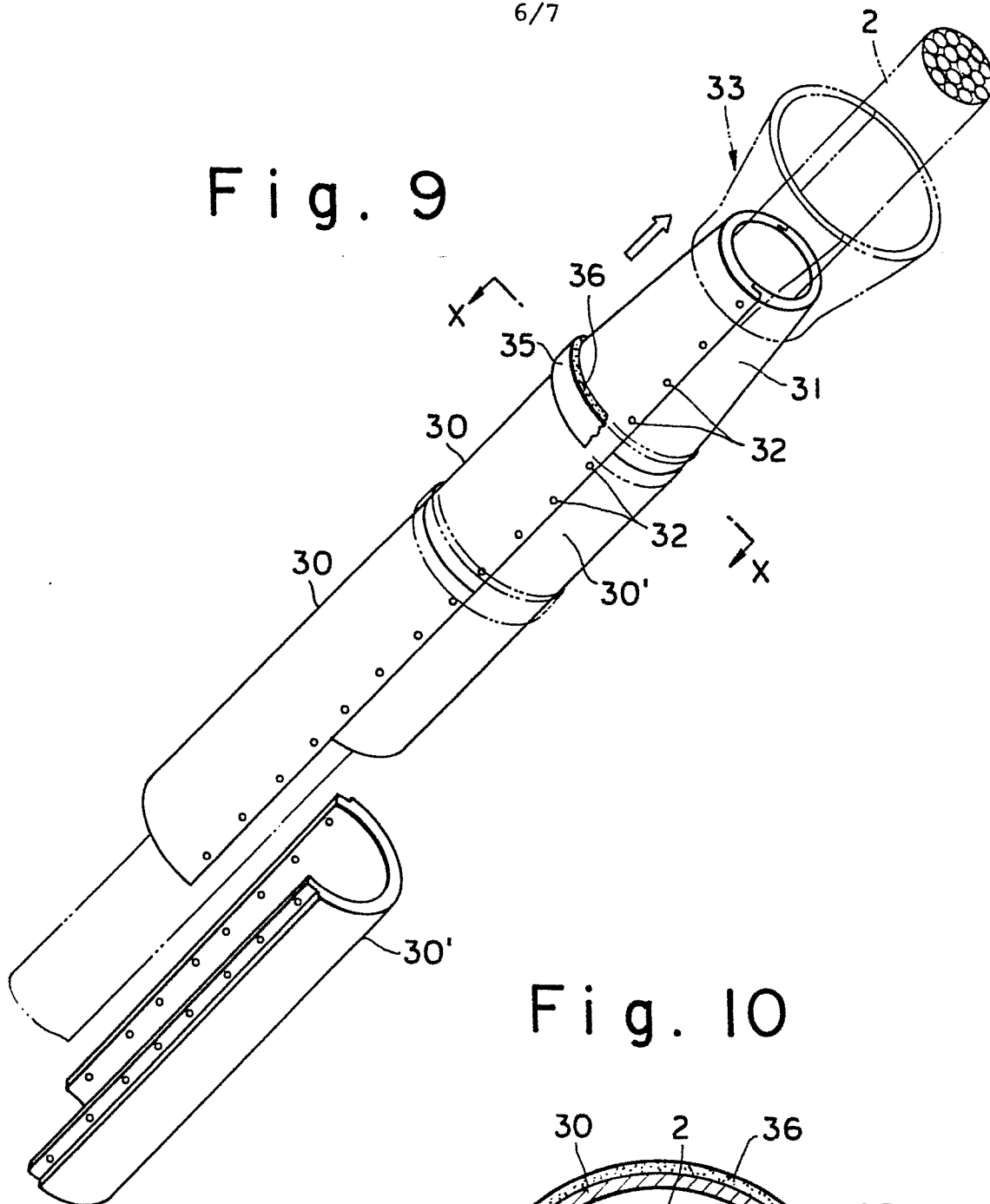


Fig. 10

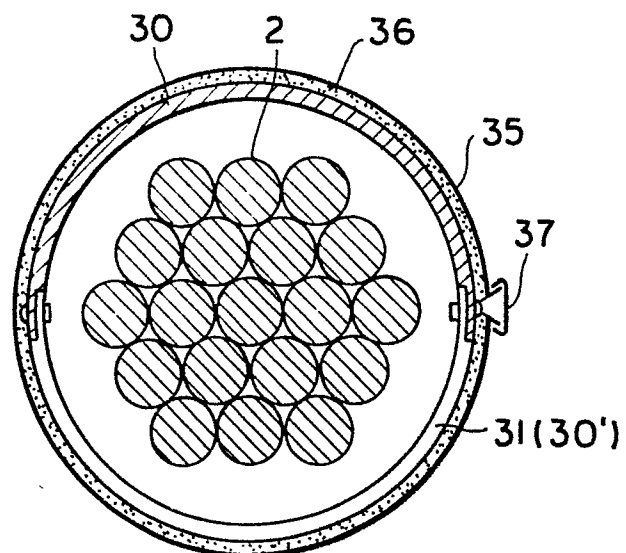


Fig. 11

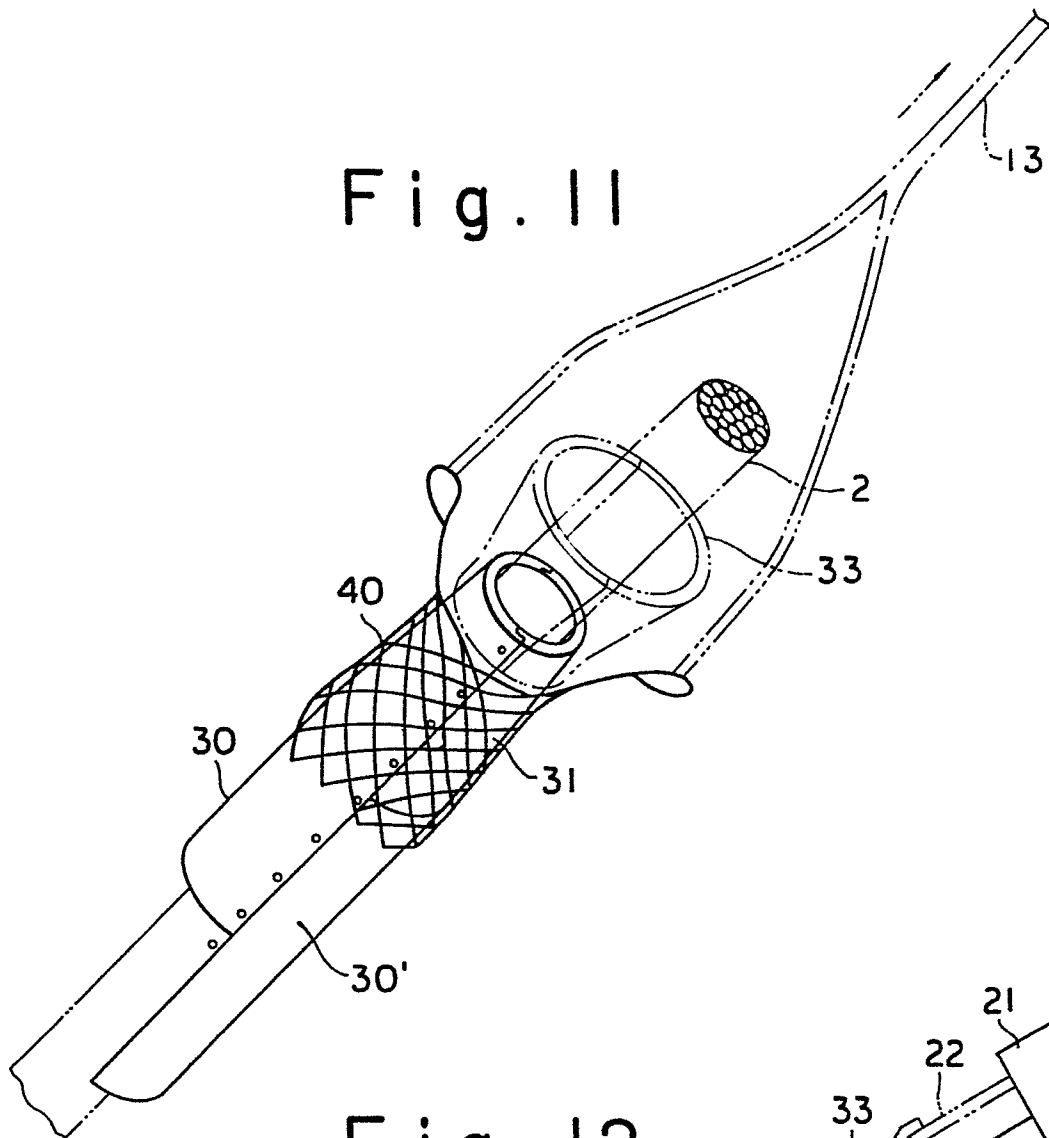
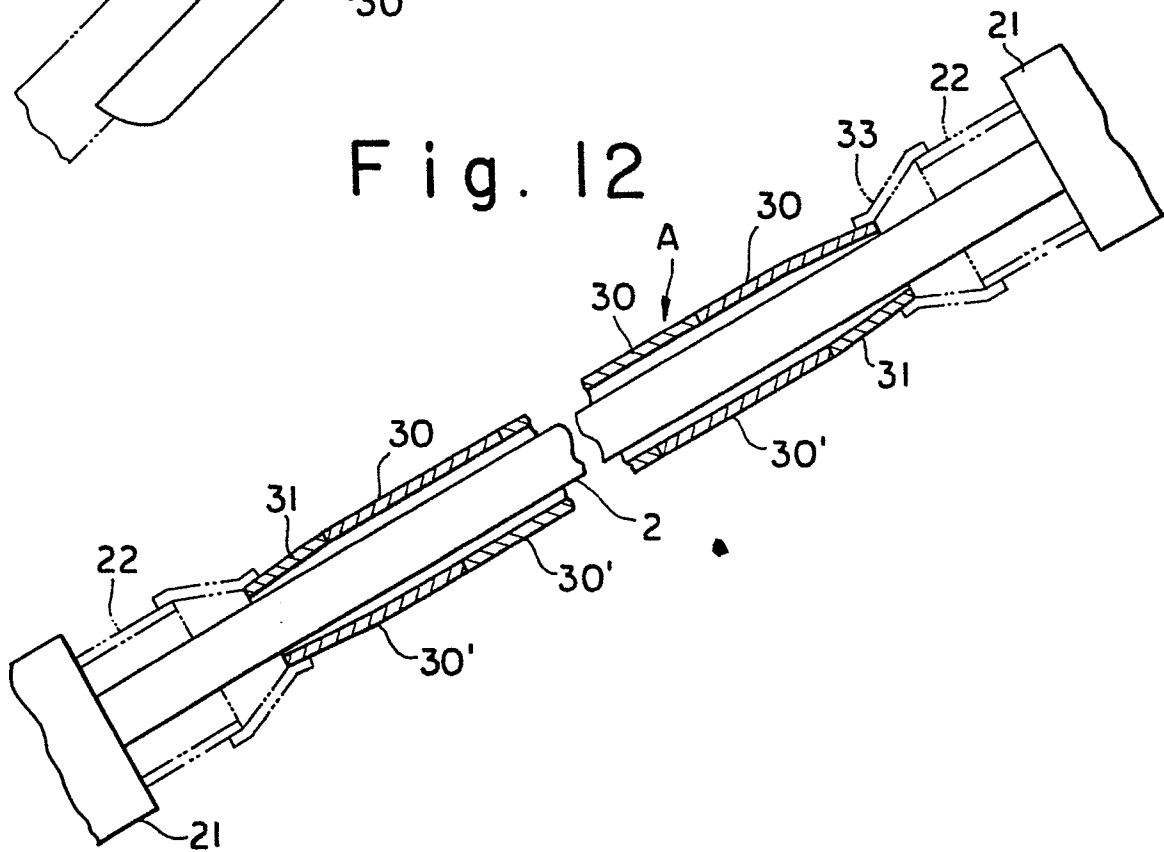


Fig. 12





European Patent
Office

EUROPEAN SEARCH REPORT

0169276

Application number

EP 84 30 4934

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. 4)
A	DE-B-1 290 456 (KRUPP) * Whole document *	1	E 01 D 11/00 D 07 B 1/16
A	GB-A- 517 620 (HAMILTON) * Whole document *	1	
A	DE-C- 890 355 (SEEGER) * Whole document *	1,2	
			TECHNICAL FIELDS SEARCHED (Int. Cl. 4)
			E 01 D
The present search report has been drawn up for all claims			
Place of search THE HAGUE		Date of completion of the search 04-03-1985	Examiner DIJKSTRA G.
CATEGORY OF CITED DOCUMENTS			
X : particularly relevant if taken alone Y : particularly relevant if combined with another document of the same category A : technological background O : non-written disclosure P : intermediate document		T : theory or principle underlying the invention E : earlier patent document, but published on, or after the filing date D : document cited in the application L : document cited for other reasons & : member of the same patent family, corresponding document	