Office de la Propriété Intellectuelle du Canada
Un organisme d'Industrie Canada

Canadian Intellectual Property Office
An agency of Industry Canada

CA 2380885 A1 2003/10/05

(21) 2 380 885

(12) DEMANDE DE BREVET CANADIEN
CANADIAN PATENT APPLICATION

(13) A1

(22) Date de dépôt/Filing Date: 2002/04/05

(41) Mise à la disp. pub./Open to Public Insp.: 2003/10/05

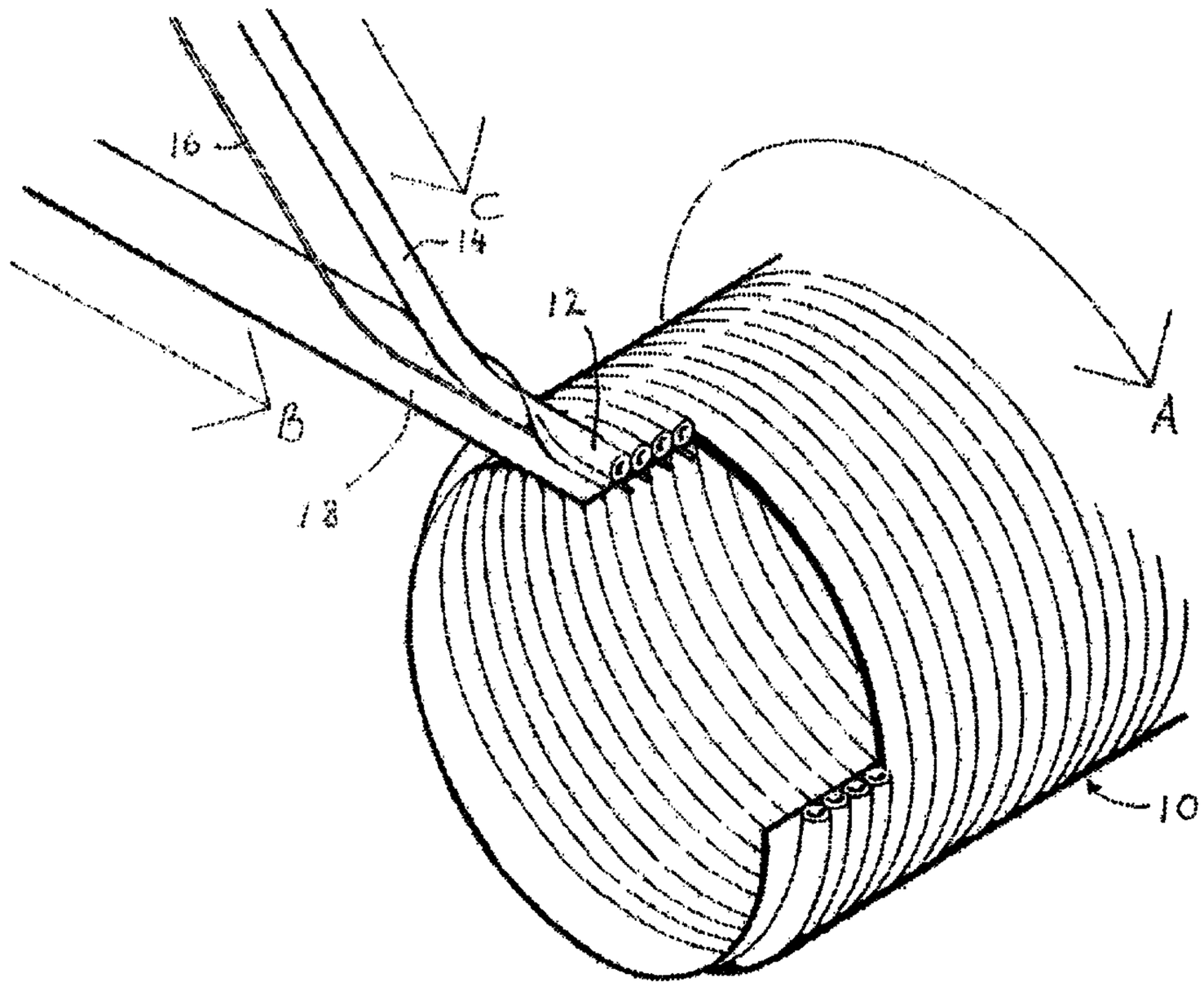
(51) Cl.Int.^{7}/Int.Cl.^{7} F24F 13/02

(71) Demandeur/Applicant:
TALANA INVESTMENTS LIMITED, VG

(72) Inventeur/Inventor:
DONNELLY, WILLIAM JAMES, AU

(74) Agent: OYEN WIGGS GREEN & MUTALA

(54) Titre : CONDUIT AMELIORE ET METHODE DE FABRICATION
(54) Title: AN IMPROVED DUCT AND METHOD OF CONSTRUCTION



(57) Abrégé/Abstract:
A flexible duct construction and method of manufacture is provided in which the duct is formed from a continuously wound elongate member comprising a core of insulating material, a reinforcing wire element and a casing comprising a strip of substrate material extending around the core and the reinforcing element. In the preferred method of manufacture, adhesive is applied to one side of the strip of substrate, the casing has a tail part extending from a generally circular part which encapsulates the core and the reinforcing element, and the elongate encapsulated insulating member is wound helically so that the circular part of one winding overlies and adheres to the tail part of the previous winding.

ABSTRACT OF THE DISCLOSURE

AN IMPROVED DUCT AND METHOD OF CONSTRUCTION

A flexible duct construction and method of manufacture is provided in which the duct is formed from a continuously wound elongate member comprising a core of insulating material, a reinforcing wire element and a casing comprising a strip of substrate material extending around the core and the reinforcing element . In the preferred method of manufacture, adhesive is applied to one side of the strip of substrate, the casing has a tail part extending from a generally circular part which encapsulates the core and the reinforcing element, and the elongate encapsulated insulating member is wound helically so that the circular part of one winding overlies and adheres to the tail part of the previous winding.

AN IMPROVED DUCT AND METHOD OF CONSTRUCTION

This invention relates to ducting and, more particularly, to an improved flexible duct construction of the kind suitable for use in ducted heating and air conditioning systems. The invention also relates to a method of and apparatus for manufacturing such a duct.

Many different forms of duct construction have been used in the past for heating and air conditioning duct construction, as well as in the construction of ducts for ventilation and air extraction systems.

Most previously proposed flexible duct constructions have a non-insulating core and require further processing to attach or contain an insulating medium such as fibreglass or a blanket of polyester fibre with a sheath of plastic or aluminium film being required to complete the duct.

In U.S. Patent No. 5210947, there is described a flexible duct construction and method of manufacture in which a helically wound wire reinforcing element is embedded into the inner surface of a tubular casing of foam plastics. Such a duct construction has good insulating properties but can be expensive to manufacture requiring the electrically conductive wire to be heated to soften the internal wall of the foam casing to embed the wire in the foam casing.

It is therefore desirable to provide a fully insulated flexible duct construction which can be manufactured in a single continuous production process.

It is also desirable to provide an improved duct construction and method of manufacture which overcomes one or more of the disadvantages of known ducting constructions.

According to a broad aspect of the invention there is provided a flexible tubular duct comprising: a core of insulating material; a wire-like reinforcing element; and a casing covering the core and the wire-like reinforcing element. Preferably, the casing comprises at least one strip of material covering the core and reinforcing material.

According to another aspect of the invention there is provided a flexible tubular duct formed from a continuously wound elongate member, wherein the continuously wound elongate member comprises:

a core of insulating material;

a wire-like reinforcing element; and

a casing comprising at least one strip of material covering the insulating core and the reinforcing element.

According to a further aspect of the invention, there is provided an elongate member for forming a flexible tubular duct comprising: a core of insulating material, a wire-like reinforcing element, and a casing comprising at least one strip of material covering the core and the reinforcing material.

In one embodiment, the insulating core is of tubular form and may be formed from an extruded foam plastics material, such as polyurethane, polyethylene, ethylene vinyl acetate (EVA) or other similar materials.

In another embodiment, the core may be formed from a fibrous insulating material. The wire-like reinforcing element preferably comprises a springy-type metal wire which extends alongside and substantially parallel to the tubular insulating core within the casing of material.

The casing may be formed of a strip of substrate material which extends around the insulating core and reinforcing element. Preferably the strip of substrate extends completely around the insulating core and reinforcing element to encapsulate the core and reinforcing element. Alternatively, the core and reinforcing element may be sandwiched between strips of substrate forming the casing. The substrate may comprise a polymeric plastics material such as polyester, polypropylene, polyvinyl chloride (PVC) or polyethylene. Alternatively, the substrate may comprise a metallic foil, such as aluminium foil, or a laminated or partially laminated material, such as a metal/plastics laminate.

The casing may be secured to the insulating core and reinforcing element by an adhesive. Various types of adhesives may be used such as urethane or polyester-based adhesives, epoxy-based adhesives, contact adhesives or hot melt glues. The choice of adhesive may be varied to suit different substrate and/or core materials.

According to yet another aspect of the invention there is provided a method of manufacturing a duct comprising the steps of:

providing an elongate core of insulating material;

providing a wire-like reinforcing element;

providing a strip of substrate material;

bending the strip of substrate material around the insulating core and reinforcing element to form an elongate encapsulated insulating member; and

winding the elongate encapsulated insulating member in a helical path to form a flexible tubular duct.

Preferably, the insulating core is of substantially circular cross-section and the strip of substrate material has a width greater than the circumference of the insulating core so that when the substrate is bent around the insulating core and reinforcing element, the substrate forms a casing which is generally P-shaped in cross-section, having a generally circular part and a tail part extending from the circular part. Preferably, the encapsulated insulating member is wound helically around a mandrel, in such a manner that the circular part of the casing of one winding overlies and preferably adheres to the tail part of the previous winding.

In a particularly preferred embodiment, the diameter of the insulating core is greater than the pitch of the helix developed in the winding process so that the sides of adjacent windings of the encapsulated member have greater areas of contact resulting in substantially straight sides of the wound insulating member.

When the elongate encapsulated insulating member is helically wound to form the duct, the outer part of the wound elongate member has a greater diameter than the inner part. The core of insulating material is usually manufactured from a foam plastics material having a natural elasticity that is able to accommodate the inner and outer diameter differential. However, the substrate material, such as a polymeric plastics substrate or metal plastics laminate, may not be able to accommodate the diameter differential without the substrate forming the radially outer part of the casing being stressed. In order to overcome this problem, heat and/or pressure may be applied to at least part of the substrate forming the radially outer part of the casing of the duct to induce stretching of said at least part of the substrate either before or during

the winding process resulting in substantially non-stressed radially outer and inner parts of the casing.

According to a still further aspect of the invention there is provided apparatus for manufacturing ducting comprising a rotatable mandrel, substrate supplying means for supplying a strip of substrate to the mandrel, adhesive applying means for applying an adhesive to a surface of the substrate, core feeding means for feeding an elongate core onto the strip of substrate, wire feeding means for feeding a wire onto the strip of substrate alongside and substantially parallel to the core, means for bending the strip of substrate around the core and the wire to form a casing surrounding the core and wire in an encapsulated insulating member, and means for rotating the mandrel to wind the encapsulated insulating member in a helical path around the mandrel to form a tubular duct.

Preferably, the apparatus includes means for guiding the encapsulated insulating member as it is wound helically around the mandrel whereby the pitch of the helical winding is less than the external diameter of the encapsulated insulating member.

The apparatus may also include means for applying heat and/or pressure to at least part of the substrate forming the radially outer part of the casing of the duct.

In order that the present invention may be more readily understood, a preferred embodiment will now be described, by way of example only, with reference to the accompanying drawings; in which:

Figure 1 is a perspective view of a duct construction in accordance with the invention;

Figure 2 is a enlarged view of part of the duct construction of Figure 1;

Figure 3 is an end view of an insulating core, a wire reinforcement and a strip for forming the duct construction of Figure 1;

Figure 4 is an end view similar to Figure 3 showing the strip partially bent around the core and wire reinforcement; and

Figure 5 is an end view of a generally P-shaped encapsulated insulating member formed from the core, wire reinforcement and strip of Figure 3.

As shown in Figures l and 2 a tubular duct 10 is formed by winding an elongate encapsulated insulating member 12 in a helical path. Preferably, the encapsulated insulating member is wound around a mandrel (not shown) which may be rotated in the direction shown by arrow A to facilitate the winding process.

Referring more particularly to Figures 2 to 5, the elongate encapsulated insulating member 12 comprises an elongate core 14 of foam insulating material, a reinforcing wire element 16 and a casing formed from a strip of substrate material 18 which is bent around the core 14 and the reinforcing wire element 16 to form the encapsulated insulating member 12.

As shown, the core 14 is of tubular cross-section and may be formed of an extruded insulating foam plastics material such as polyurethane foam. Alternatively, a shaped core section of fibreglass, fibrous polyester or other fibrous insulating material may be substituted for the tubular foam core. The reinforcing wire element 16 is preferably formed from a springy-type metal wire, such as spring steel, which provides strength and structural integrity to the finished duct. The substrate strip 18 may be formed of a polymerised plastic material such as polyester, polypropylene, PVC or polyethylene. In cases where building codes or regulations insist on external duct surfaces being of metallic material, the substrate strip l8 may be formed of a metallic foil such as aluminium foil, or may comprise a metallic/plastic laminate.

In the method of the invention, the substrate strip 18 is fed from a roll of the strip in direction B to the mandrel, a layer of adhesive l7 is applied by an adhesive applicator to the surface on one side of the substrate strip 18, (the upper surface l9 as shown in Figure 3) and the insulating core 14 and the reinforcing wire 16 are fed in direction C from a feeding station and laid upon the upper surface of the substrate strip l8 with the wire 16 extending alongside and substantially parallel to the foam core 14.

The substrate 18 is caused to be bent around the insulating core 14 and the reinforcing wire 16 as the substrate 18, core 14 and wire 16 are wound helically around the mandrel, so that the substrate 18 encapsulates and adheres to the core 14 and the wire. The width of the substrate strip 18 is greater than the external diameter of the insulating core 14 which in turn is substantially greater than the diameter of the

reinforcing wire 16 so that in the encapsulated insulating member 12 the casing 20 formed from the strip 18 is generally P-shaped in cross-section having a generally circular part 22 which surrounds the core 14 and wire 16 and a trail 24 which extends substantially tangentially from the circular part. The end part 26 of the substrate strip 18 which is bent around the core 14 and wire adheres to the tail 24 of the generally P-shaped casing 20. As an alternative, the reinforcing wire 16 may be fed from a feeding station onto the strip as the substrate strip 18 is wrapped around the core 14 in the helical forming process.

As shown in Figure 2, when the encapsulated member is helically wound to form the tubular duct, the sides 28 of the generally circular parts 22 of adjacent windings of the encapsulated member are flattened so as to have a greater surface area in contact with one another. This is achieved by making the pitch of the helix of the winding process less than the diameter of the tubular core 14. Therefore as the encapsulated member is wound on the mandrel the sides of the tubular foam core 14 are compressed inwardly to enable the flattened sides 28 of adjacent windings to be formed. The greater area of contact between the sides 28 of adjacent windings provides the advantage of better insulation resulting from a larger thermal barrier. Also, when the duct is formed into a bend, a gap is much less likely to open up between adjacent windings than in a duct with a smaller area of contact between adjacent windings.

When the elongate encapsulated insulating member 12 is wound to form the duct, it will be noted that the radially outer part 30 of the casing of the wound elongate member has a greater diameter than the inner tail part 24, which could lead to the outer part 30 of the casing being stressed in the winding process. Preferably, heat and/or pressure is applied to the outer part 30 to induce stretching of the outer part 30 of the casing 12 so that the outer part is substantially non-stressed in the resultant wound duct 10. Various methods may be utilised to apply heat and/or pressure to the outer part 30 of the casing. In one preferred method, air or an inert gas is injected by an injector between the insulating core 14 and the radially outer part 30 of the substrate strip 18 as it is wrapped around the insulating core 14 (Figure 4) to create the required

pressure on the outer part 30 of the strip 18. The injected air or other gas may be heated to assist the substrate in reaching its natural softening point, allowing the outer part of the substrate to stretch to accommodate the difference in inner and outer diameters.

In an alternative method, at least the part of the substrate strip 18 forming the radially outer part 30 of the casing is heated and impressed with an appropriate stretch pattern to accommodate the difference in inner and outer diameters of the casing.

The present invention thus provides an improved flexible duct having properties of good thermal insulation, structural strength and integrity. The invention also provides a method of continuously manufacturing ducting in a single process which is relatively simple and economical to perform.

It will be appreciated that various modifications may be made to the preferred embodiment described above without departing from the scope and spirit of the present invention. For example, in some instances, it may be desirable to substitute a shaped core section of fibreglass, fibrous polyester or other fibrous insulating material for the tubular foam core. In one modification, fibrous insulating and/or reinforcing material, such as fibreglass, may be applied to the surface of the substrate before, during or after the application of the adhesive. In a further modification, a blanket of fibrous insulating and/or reinforcement material may be wrapped around a tubular foam core before it is encapsulated by the substrate. An advantage of incorporating fibrous material, such as fibreglass, in the duct construction is to increase the strength of the duct so that is can support more weight and is less likely to be punctured in a fire or hazard situation.

CLAIMS:

1. A flexible tubular duct comprising:

a core of insulating material,

a wire-like reinforcing element, and

a casing covering the core and the reinforcing element.

2. A duct according to claim 1 wherein the casing comprises at least one strip of material covering the core and reinforcing material.

3. A flexible tubular duct formed from a continuously wound elongate member, wherein the elongate member comprises:

a core of insulating material;

a wire-like reinforcing element; and

a casing comprising at least one strip of material covering the core and the reinforcing element.

4. An elongate member for forming a flexible tubular duct comprising: a core of insulating material, a wire-like reinforcing element, and a casing comprising at least one strip of material covering the core and the reinforcing element.

5. A duct or element member according to any one of claims 2 to 4 wherein the casing is formed from a strip of substrate material which extends around the core and reinforcing element.

6. A duct or elongate member according to claim 5 wherein the strip of substrate extends completely around the core and reinforcing material to encapsulate the core and reinforcing material.

7. A duct or elongate member according to any one of claims 2 to 4 wherein the core and reinforcing element are sandwiched between strips of substrate forming the casing.

8. A duct or element member according to any one of claims 5 to 7 wherein the substrate comprises a polymeric plastics material.

9. A duct or elongate member according to claim 8 wherein the polymeric plastics material comprises any one of the following: polyester, polypropylene, polyvinyl chloride (PVC) or polyethylene.

10. A duct or elongate member according to any one of claims 5 to 7 wherein the substrate comprises a metallic foil.

11. A duct or element member according to any one of claims 5 to 7 wherein the substrate comprises a laminated or partially laminated material.

12. A duct or elongate member according to claim 11 wherein the substrate comprises a metal/plastics laminate.

13. A duct or elongate member according to any one of the preceding claims wherein the insulating core is of tubular form.

14. A duct or elongate member according to any one of the preceding claims wherein the insulating core is formed from an extruded foam plastics material.

15. A duct or elongate member according to claim 14 wherein the core is formed from any one of the following: polyurethane, polyethylene or ethylene vinyl acetate.

16. A duct or elongate member according to any one of claims 1 to 12 wherein the insulating core is formed from fibreglass, fibrous polyester or other fibrous insulating material.

17. A duct or elongate member according to any one of the preceding claims wherein the reinforcing element is formed from metal wire.

18. A duct or elongate member according to any one of the preceding claims wherein the reinforcing element extends alongside and substantially parallel to the insulating core.

19. A duct or elongate member according to any one of the preceding claims wherein the casing is secured to the insulating core and reinforcing element by an adhesive.

20. An elongate member according to any one of claims 4 to 19 wherein the insulating core is of substantially circular cross-section and the strip has a width greater than the circumference of the insulating core, the strip being bent around the insulating core and the reinforcing element to form a casing which is generally P-

shaped in cross-section having a generally circular part and a tail part extending from the generally circular part.

21. A duct formed from an elongate member according to claim 20 wherein the elongate member is helically wound in such a manner that the circular part of the casing of one winding overlies the tail part of the previous winding.

22. A duct according to any one of the preceding claims further including fibrous insulating and/or reinforcing material.

23. A method of manufacturing a flexible tubular duct comprising:

providing an elongate core of insulating material;

providing a wire-like reinforcing element;

providing a strip of substrate material;

bending the strip of substrate material around the insulating core and reinforcing element to form an elongate encapsulated insulating member; and

winding the elongate encapsulated insulating member in a helical path to form the flexible tubular duct.

24. A method according to claim 23 wherein the insulating core is of substantially circular cross-section and the strip of substrate material has a width greater than the circumference of the insulating core so that when the substrate is bent around the insulating core and reinforcing element, the substrate forms a casing which is generally P-shaped in cross-section having a generally circular part and a tail part extending from the generally circular part.

25. A method according to claim 24 wherein the encapsulated insulating member is wound in such a manner that the generally circular part of the casing of one winding overlies the tail part of the previous winding.

26. A method according to claim 25 wherein the generally circular part of one winding is bonded to the tail part of the previous winding by an adhesive.

27. A method according to any one of claims 23 to 26 wherein the bending and winding steps are performed substantially simultaneously.

28. A method according to any one of claims 23 to 27 wherein the encapsulated insulating member is wound on a mandrel.

29. A method according to any one of the claims 23 to 28 wherein the strip of substrate material is bonded to the insulating core.

30. A method according to claim 29 wherein the strip of substrate material is bonded to the insulating core by an adhesive.

31. A method according to any one of claims 23 to 30 wherein the diameter of the insulating core is greater than the pitch of the helix in the winding process so that the sides of adjacent windings of the encapsulated member have greater areas of contact resulting in substantially flat sides of the wound insulating member.

32. A method according to any one of claims 23 to 31 wherein heat and/or pressure is applied to at least part of the substrate material forming the radially outer part of the casing of the duct.

33. A method according to claim 32 wherein air or another gas is injected between the insulating core and the substrate material forming the radially outer part of the casing of the duct to apply pressure and induce stretching of the radially outer part of the casing.

34. A method according to claim 33 wherein the air or other gas injected is heated.

35. A method according to claim 32 wherein the substrate material forming at least the radially outer part of the casing is heated and impressed with a stretch profile.

36. Apparatus for manufacturing ducting comprising a rotatable mandrel, substrate supplying means for supplying a strip of substrate to the mandrel, adhesive applying means for applying an adhesive to a surface of the substrate, core feeding means for feeding an elongate core onto the strip of substrate, wire feeding means for feeding a wire onto the strip of substrate, wire feeding means for feeding a wire onto the strip of substrate alongside and substantially parallel to the core, means for bending the strip of substrate around the core and the wire to form a casing surrounding the core and wire in an encapsulated insulating member, and means for rotating the mandrel to wind the encapsulated insulating member in a helical path around the mandrel to form a tubular duct.

37. Apparatus according to claim 36 wherein the apparatus includes means for guiding the encapsulated insulating member as it is wound helically around the

mandrel whereby the pitch of the helical winding is less than the external diamter of the encapsulated insulating member.

38. Apparatus according to claim 36 or claim 37 further comprising means for applying heat to at least part of the substrate forming the radially outer part of the casing of the duct.

39. Apparatus according to any one of claims 36 to 38 further comprising means for applying pressure to at least part of the substrate forming the radially outer part of the casing of the duct.

40. A method of manufacturing a flexible tubular duct substantially as described herein.

41. A flexible tubular duct formed by the method of any one of claims 24 to 35 or claim 40.

42 A flexible tubular duct substantially as hereinbefore described with reference to the accompanying drawings.

43. An elongate member for forming a flexible tubular duct substantially as hereinbefore described with reference to Figure 5 of the accompanying drawings.

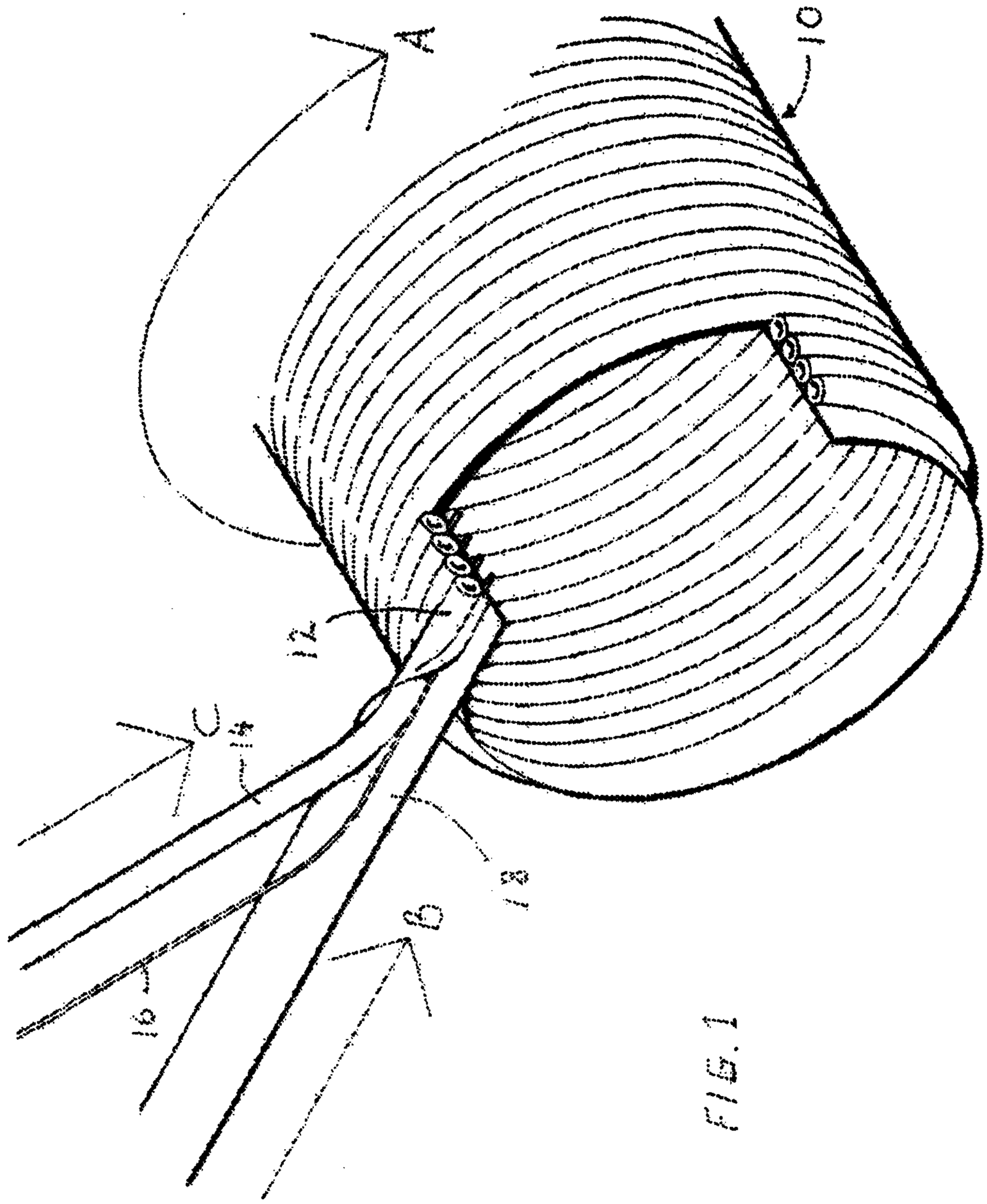


FIG. 1

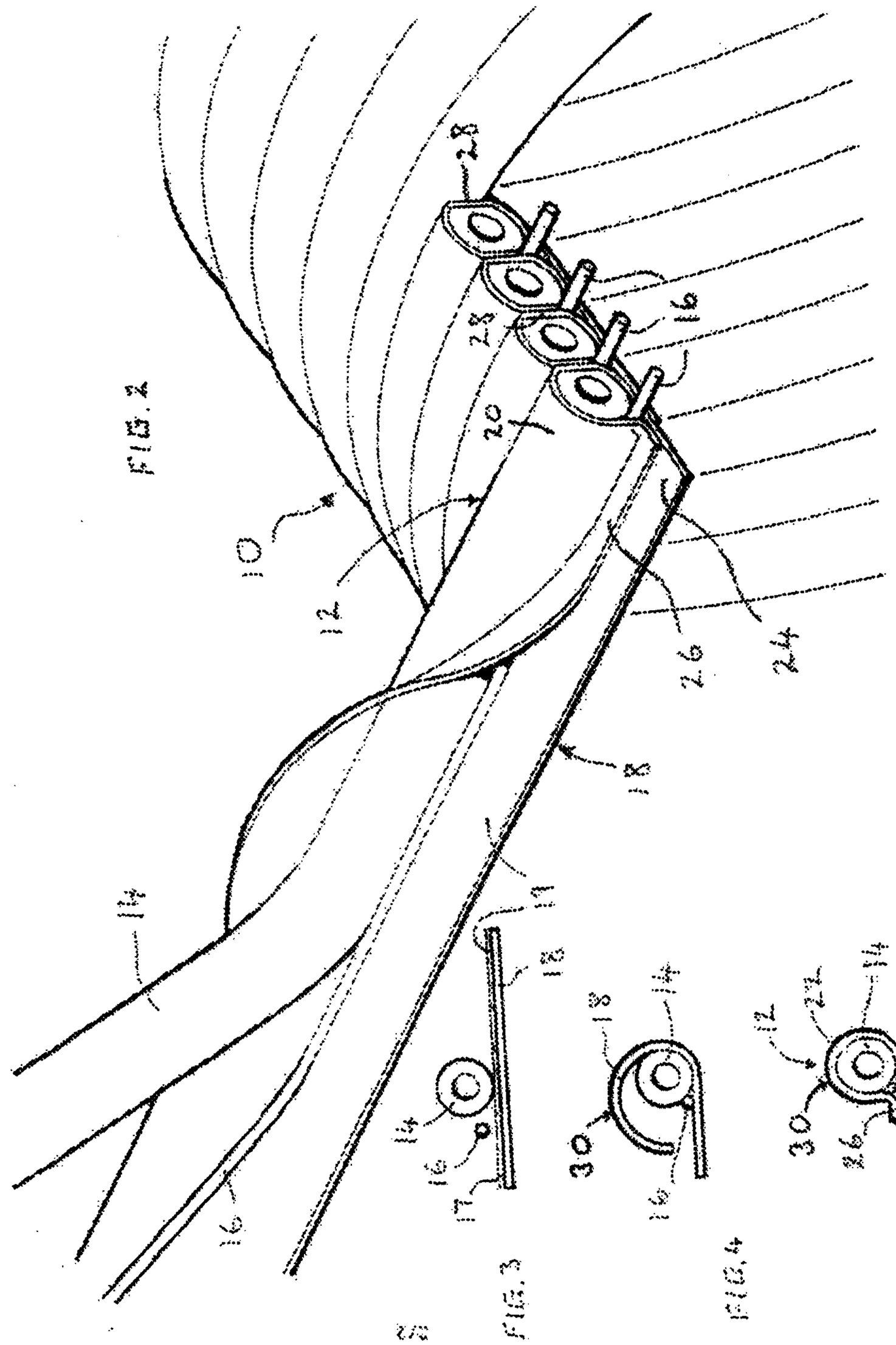
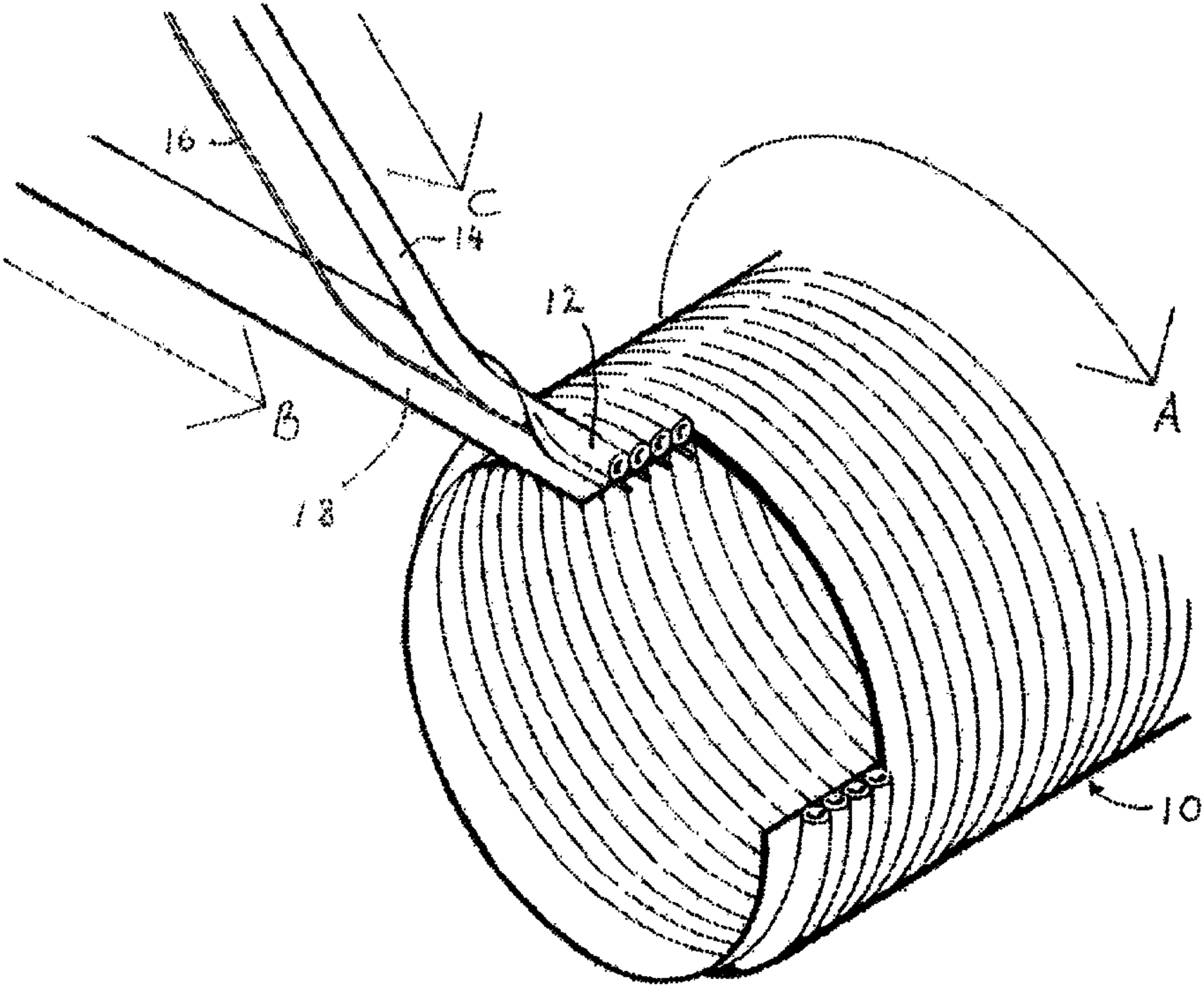


FIG. 1

FIG. 3

FIG. 4

FIG. 5


16
C
14
12
A
B
18
10