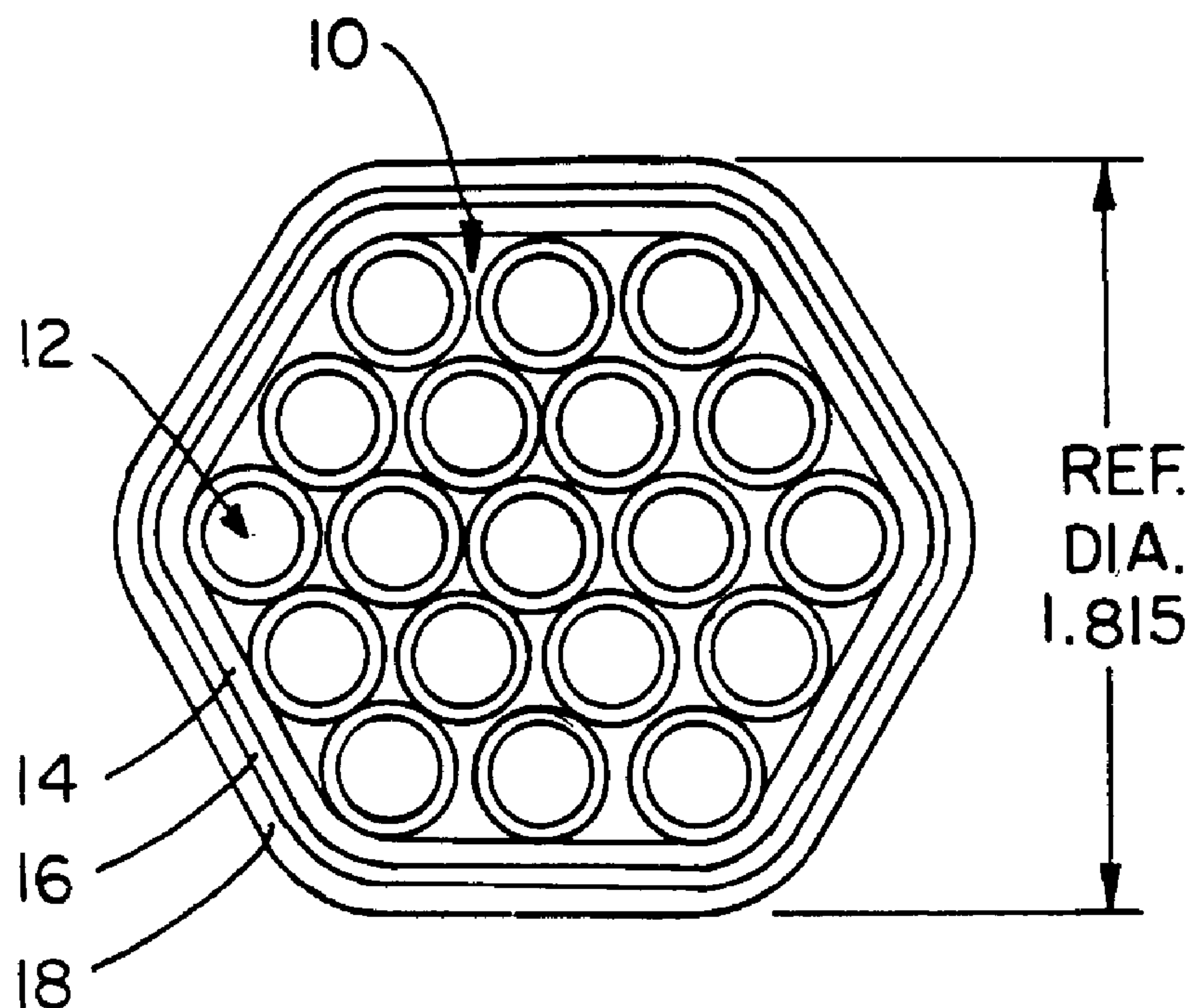




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(54) Titre : FAISCEAU DE TUBES ININFLAMMABLE POUR FIBRES OPTIQUES
(54) Title: FLAME-RETARDANT CABLE TUBING BUNDLE



(57) Abrégé/Abstract:

A flame-retardant optical fiber cable tubing (10) bundle which can be vertically mounted in the shaft of a building comprised of a plurality of tubes (10); a first thermoplastic layer (14) surrounding the tubes (10); and, a tape (16) wrapped spirally along the longitudinal axis of the first thermoplastic layer (14). A second thermoplastic layer (18) surrounds the tape. A method for complying with the UL 1666 fire test procedure for a cable tubing bundle intended for vertical installation includes the steps of liquefying a cross-sectional area of a thermoplastic layer (14) of the cable tubing bundle; forcing the flow of the liquified thermoplastic inwardly to the center of the cable tubing bundle; and, charring the liquified thermoplastic to form a cross-sectional area of solid material in the interior of the cable tubing bundle.

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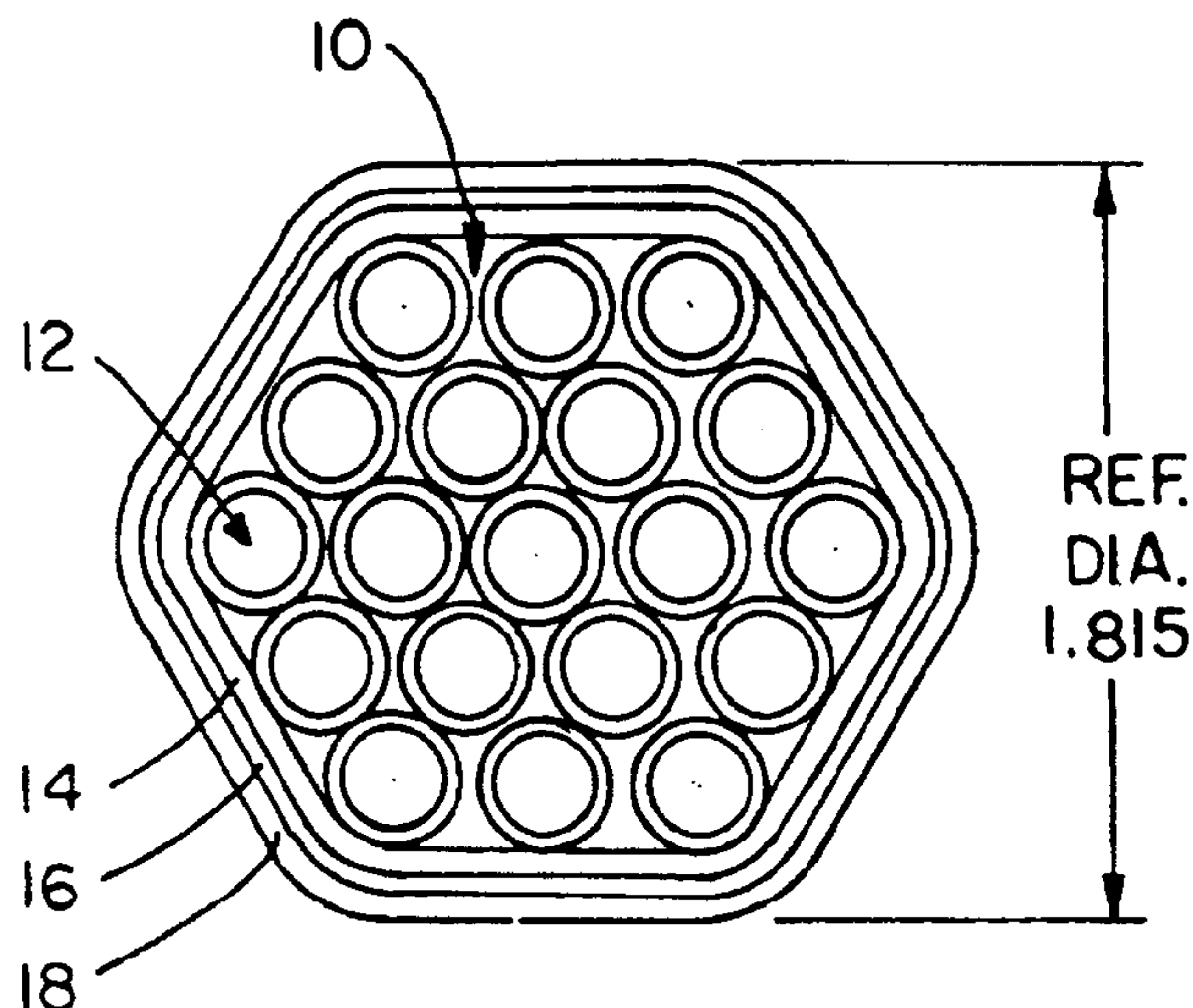
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(54) Title: FLAME-RETARDANT CABLE TUBING BUNDLE



(57) Abstract

A flame-retardant optical fiber cable tubing (10) bundle which can be vertically mounted in the shaft of a building comprised of a plurality of tubes (10); a first thermoplastic layer (14) surrounding the tubes (10); and, a tape (16) wrapped spirally along the longitudinal axis of the first thermoplastic layer (14). A second thermoplastic layer (18) surrounds the tape. A method for complying with the UL 1666 fire test procedure for a cable tubing bundle intended for vertical installation includes the steps of liquefying a cross-sectional area of a thermoplastic layer (14) of the cable tubing bundle; forcing the flow of the liquified thermoplastic inwardly to the center of the cable tubing bundle; and, charring the liquified thermoplastic to form a cross-sectional area of solid material in the interior of the cable tubing bundle.

FLAME-RETARDANT CABLE TUBING BUNDLEBackground of the InventionI. Field of the Invention

5 This invention pertains to the art of optical fiber cable tubing bundles and more particularly to cable tubing bundles intended for vertical installation.

II. Description of the Related Art

10 Presently, cable tubing bundles intended for installation in the vertical shafts of buildings must meet the standard for safety imposed by Underwriters Laboratories, Inc. for flame propagation height of electrical and optical-fiber cables installed vertically in shafts. UL 1666 describes the Underwriters
15 Laboratories, Inc.'s standard test method for determining values of flame propagation height for electrical and optical-fiber cables installed vertically in shafts. To be acceptable, the flame propagation height for a vertically installed cable cannot equal or exceed 12
20 feet, 0 inches. The purpose of the test is to insure that vertically installed cables comply with ANSI/NFPA 70-1987: section 725-38(b)(2), exception to section 760-28(c)(2), section 770-6(b), section 800-3(b)(2), and section 820-15(b) of the National Electric Code.

25 The test apparatus consists of a test chamber; burner apparatus; and, temperature and flow measurement instrumentation. Two samples of cable construction of multiple seventeen and one half ($17\frac{1}{2}$) feet lengths are tested. A test flame is applied to one end of the cable
30 construction for thirty (30) minutes. After thirty (30) minutes, the test flame is extinguished and the maximum height of continuous cable damage is measured and

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recorded. Damage is recorded as having occurred when the combustible material comprising the cable is softened (“melt”), partially consumed (“char”), or completely consumed (“ash”).

5

Optical fiber cable tubing bundles designed to meet or exceed the UL 1666 standard set for determining flame propagation height of cables mounted vertically in shafts, have relied on the thermoplastic material used to off gas when heated or burned creating a smothering effect, stopping flame propagation.

10

BRIEF SUMMARY OF THE INVENTION

The present invention provides optical fiber cable tubing bundles with an advantage that usually is accomplished through the use of specific materials selected for their ability to reduce flame propagation and smoke generation. These materials do provide acceptable test results but are more expensive. Optical fiber cable tubing bundles using the proposed invention can provide tubing bundles that will pass UL 1666 test and not be limited to the use of more costly materials as the only approach to passing the required test.

20 According to one aspect of the invention, there is provided a flame-retardant optical fiber cable tubing bundle. A flame-retardant optical fiber cable tubing bundle having the features of the present invention is inclusive of a plurality of tubes; a first thermoplastic layer surrounding the tubes; and a tape wrapped spirally along the longitudinal axis of the first thermoplastic layer. The first thermoplastic layer is flame-retardant. The first thermoplastic layer may be manufactured from a material having intumescent and charring capabilities. The tape may comprise glass fibers. The tubes, ranging, for example, in number from two (2) to nineteen (19), may be made up of a flame-retardant polyethylene compound in the preferred embodiment. The tubing bundle further comprises a second thermoplastic layer surrounding the tape.

30

In accordance with another aspect of the invention, there is provided an optical fiber cable tubing bundle which meets the UL 1666 standard for safety. The optical fiber cable

tubing bundle, which can be installed vertically in the shafts of a building, includes a plurality of tubes; a first thermoplastic layer surrounding the tubes; and, means for forcing the flow of the first thermoplastic layer inwardly to the center of the optical fiber cable tubing bundle during implementation of the UL 1666 test procedure for flame propagation height of electrical and optical-fiber cables. The number of tubes making up the bundle may be from two (2) to nineteen (19). The tubes may consist of a flame-retardant polyethylene compound. The first thermoplastic layer includes a flame-retardant material having both intumescent and charring capabilities.

10 The means for forcing the flow inwardly may be a glass fiber tape wrapped spirally along the longitudinal axis of the first thermoplastic layer. A second flame-retardant thermoplastic layer also comprises the tubing bundle. The second thermoplastic layer surrounds the means for forcing the flow inwardly.

15 In accordance with still another aspect of the invention, a method for insuring compliance with the UL 1666 fire test procedure for a vertically mounted cable tubing bundle is disclosed. A cross-sectional area of a solid thermoplastic layer comprising the optical fiber cable tubing bundle is liquified by means of a fire source located at one end of the vertically mounted cable tubing bundle. The flow of the liquified thermoplastic is forced
20 inwardly to the center of the optical fiber cable tubing bundle. The liquified thermoplastic is subsequently charred to form a cross-sectional area of solid material in the interior of the optical fiber cable tubing bundle. The cross-sectional area of charred material acts as a fire stop to prevent vertical flow of additional liquified thermoplastic materials resulting from continuous application of the fire source.

25

In accordance with the present invention there is provided a method wherein the step of forcing the flow of the liquified thermoplastic inwardly may include spirally wrapping a tape along the longitudinal axis of the thermoplastic layer comprising the optical fiber cable tubing bundle.

30

The flow of the liquified thermoplastic may be forced inwardly by means of a fiberglass

tape wrapped spirally along the longitudinal axis of the thermoplastic layer. Charring of the liquified thermoplastic may be effected by continuous application of the fire source to the end of the optical fiber cable tubing bundle.

- 5 One advantage of the present invention is that a flame-retardant optical fiber cable tubing bundle having a simple design can be manufactured.

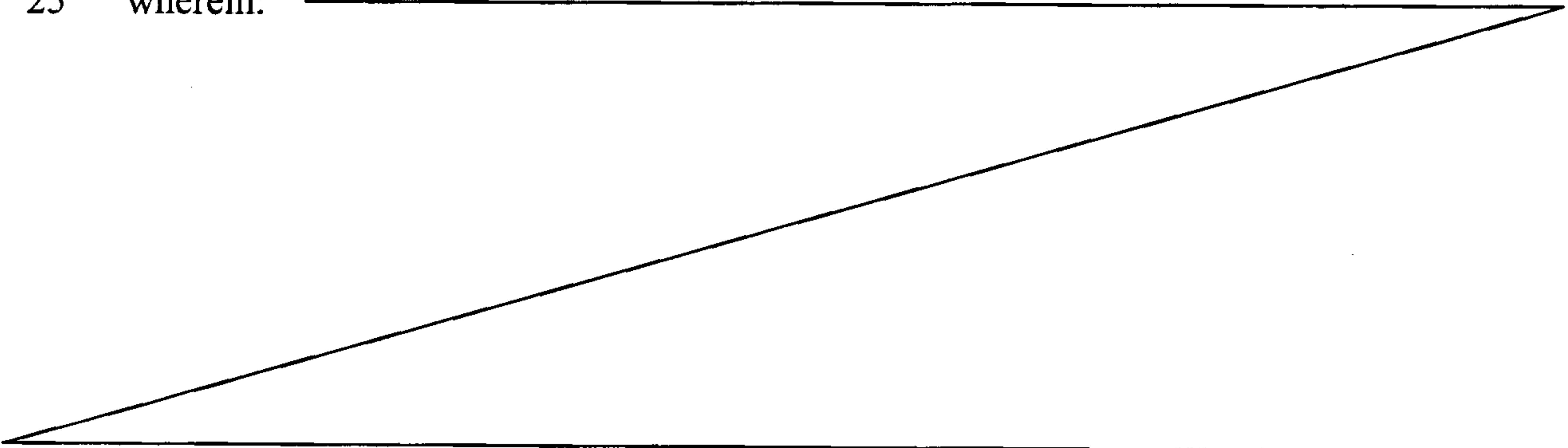
Another advantage of the present invention is that an optical fiber cable tubing bundle meeting the requirements of the UL 1666 standard for safety can be manufactured using
10 materials that are inexpensive.

Still a further advantage of the present invention is that a method of insuring a flame propagation height of less than twelve (12) feet for a vertically mounted optical fiber cable tubing bundle is disclosed. Thus, compliance with fire test method UL 1666 is
15 satisfied.

Still other benefits and advantages of the invention will become apparent to those skilled in the art upon a reading and understanding of the following detailed specification.

20 BRIEF DESCRIPTION OF THE DRAWINGS

The invention may take physical form in certain parts and arrangements of parts, preferred and alternate embodiments of which will be described in detail in this specification and illustrated in the accompanying drawings which form a part hereof, and
25 wherein: _____



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FIGURE 1 is a cross-sectional view of an optical fiber cable tubing bundle of the present invention; and,

FIGURES 2A-2C are cross-sectional views of the optical fiber cable tubing bundle of FIGURE 1, showing the charring conditions taking place in the interior of the bundle during fire test method UL 1666.

Detailed Description of Preferred
and Alternate Embodiments

Referring now to the drawings, wherein the showings are for purposes of illustrating preferred and alternate embodiments of the invention only and not for purposes of limiting same, as shown in FIGURE 1, an optical fiber cable tubing bundle of the present invention comprises a plurality of tubes 10. The plurality of tubes 10 are surrounded by a first thermoplastic layer 14 that is a nominal thickness of .062 inches 14. The first thermoplastic layer 14 is surrounded by a fiberglass tape barrier 16 that has a nominal thickness of .030 inches. Tape 16 is wrapped spirally along the longitudinal axis of the first thermoplastic layer 14. A second thermoplastic layer 18 has a nominal thickness of .062 inches and surrounds the tape 16.

The plurality of tubes 10 range in number from 2 through 19. The tubes 10 have an outer diameter of $.315 \pm .003$ inches and an inner diameter of $.236 \pm .003$ inches. The plurality of tubes 10 are composed of a flame-retardant polyethylene compound having a unique blend of linear low density polyethylene (LLDPE) and ethylene vinyl-acetate (EVA) resins containing hydrated alumina, antimony oxide and chlorinated paraffin. The compound has an excellent balance of flame retardancy and physical properties which account for its excellent

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processing characteristics. The nominal tube wall thickness corresponding to each tube 10 is equal to .040 inches.

Optical fiber cables (multiple fibers) 12 or other types of signalling devices may be present within each hollow tube 10.

The first thermoplastic layer 14 longitudinally surrounds the tube 10. In the preferred embodiment, the first thermoplastic layer 14 is a black flame-retardant polyvinyl chloride jacket having a nominal thickness of .062 inches. More particularly, the bundle inner jacket thickness of the first thermoplastic layer 14 is .062 ± .010 inches. Additionally, the bundle outer jacket thickness of the first thermoplastic layer 14 is also .062 ± .010 inches.

The tape 16, wrapped spirally along the longitudinal axis of the first thermoplastic layer 14, is preferably composed of fiberglass (nominal thickness .030 inches).

The second thermoplastic layer 18 is also a black flame-retardant polyvinyl chloride jacket having a nominal thickness of .062 inches. The second thermoplastic layer 18 completely surrounds the tape 16.

As shown in Figure 1, the reference diameter of the bundle (i.e. the distance across the flats) is approximately 1.875 inches for the nineteen (19) tube bundle shown.

A process according to the present invention for insuring compliance with the UL 1666 fire test procedure for an optical fiber cable tubing bundle intended for vertical installation comprises the steps of liquefying a cross-sectional area of a thermoplastic layer 14 comprising the optical fiber cable tubing bundle; forcing the flow of the liquified thermoplastic inwardly to the center of the optical fiber cable tubing

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bundle; and, charring the liquified thermoplastic to form a cross-sectional area of solid material in the interior of the cable tubing bundle. The solid cross-sectional area of charred material acts as a fire stop, thus
5 preventing vertical flow of the liquified thermoplastic down voids in the interior of the optical fiber cable tubing bundle.

In the step wherein the cross-sectional area of the thermoplastic layer comprising the vertically
10 mounted optical fiber cable tubing bundle is liquified, a fire source is applied to one end of a vertically mounted cable tubing bundle. The fire source is a test flame producing approximately 527,500 Btu (thermochemical) per hour (154.5 KW). The fire source is applied to one end
15 of the vertically mounted optical fiber cable tubing bundle for thirty (30) minutes, unless the non-metallic cable parts are completely consumed in a lesser amount of time. Upon application of the fire source, a cross-sectional area of the first thermoplastic layer 14
20 adjacent to the fire source liquifies.

In the step wherein the flow of the liquified layer is forced inwardly to the center of the optical fiber cable tubing bundle, the tape 16, wrapped spirally along the longitudinal axis of the first thermoplastic
25 layer 14, restricts outward movement of the flow, thereby forcing movement inwardly to the center of the bundle.

With reference to FIGURES 2A-2C, the liquified thermoplastic moves inwardly to fill the voids present in the interior of the optical fiber cable tubing bundle.
30 The step of charring the liquified thermoplastic is effected by continuous application of the fire source. Over the applicable time period, a cross-sectional area of solid charred material is generated within the interior of the optical fiber cable tubing bundle. The
35 cross-sectional area of solid charred material prevents

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vertical flow of liquified thermoplastic down the interior of the optical fiber cable tubing bundle. These FIGURES do not suggest, however, that 100% charring must be effected to insure the workability of the present invention.

The invention has been described with reference to preferred and alternate embodiments. Obviously, modifications and alterations will occur to others upon the reading and understanding of this specification. It is intended to include all such modifications and alterations insofar as they come within the scope of the appended claims or the equivalents thereof.

CLAIMS

1. A flame-retardant cable tubing bundle, which comprises:
 - 5 (a) a plurality of hollow tubes configured to receive a multiple fiber cable;
 - (b) a first thermoplastic layer surrounding the plurality of tubes, said first thermoplastic layer comprised of a material having intumescent and charring capabilities; and,
 - 10 (c) a tape wrapped around the first thermoplastic layer and spirally along the longitudinal axis of the first thermoplastic layer.
2. The tubing bundle of claim 1, wherein the number of tubes ranges from 2-19.
- 15 3. The tubing bundle of claim 1, wherein the tubes are comprised of a flame-retardant polyethylene compound.
4. The tubing bundle of claim 1, wherein the tape is comprised of glass fibers.
- 20 5. The tubing bundle of claim 1, further comprising a second thermoplastic layer surrounding the tape.
6. The tubing bundle of claim 5, wherein the second thermoplastic material is flame-retardant.
- 25 7. A flame-retardant cable tubing bundle, which comprises:
 - (a) a plurality of hollow tubes configured to receive a multiple fiber cable;
 - 30 (b) a first thermoplastic layer surrounding the plurality of tubes, said first thermoplastic layer comprised of a material having intumescent and charring capabilities;

(c) means for forcing the first thermoplastic layer inwardly to the center of the optical fiber cable tubing bundle when a fire source is applied to an end of the tubing bundle.

5 8. The tubing bundle of claim 7, wherein the number of tubes ranges from 2-19.

9. The tubing bundle of claim 7, wherein the tubes are comprised of a flame-retardant polyethylene compound.

10 10. The tubing bundle of claim 7, wherein the means for forcing the flow of the first thermoplastic layer inwardly is comprised of a tape wrapped spirally along the longitudinal axis of the first thermoplastic layer.

11. The tubing bundle of claim 10, wherein the tape is comprised of glass fibers.

15

12. The tubing bundle of claim 7, further comprising a second thermoplastic layer surrounding the tape.

13. The tubing bundle of claim 12, wherein the second thermoplastic material is
20 flame-retardant.

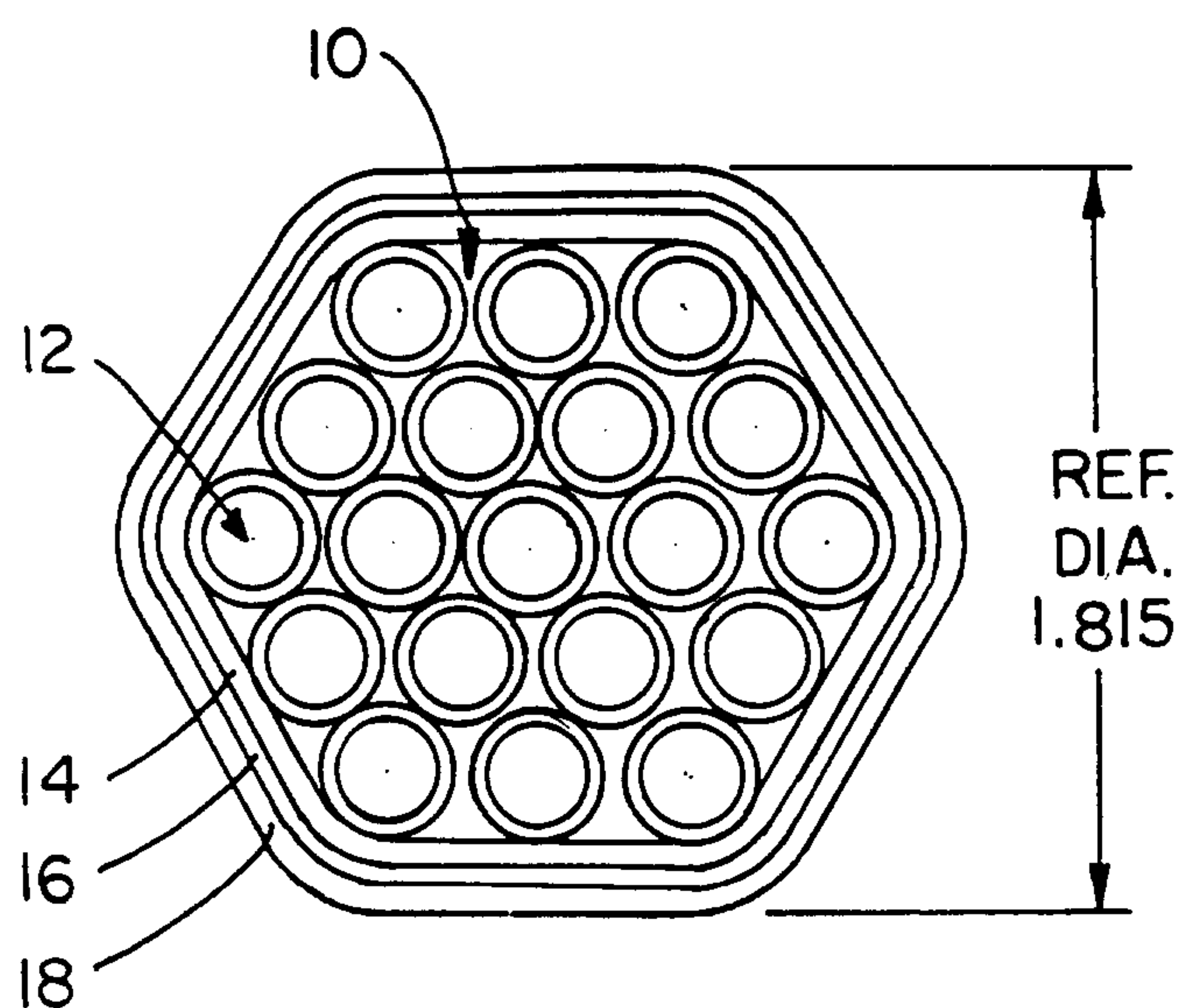


FIG. 1

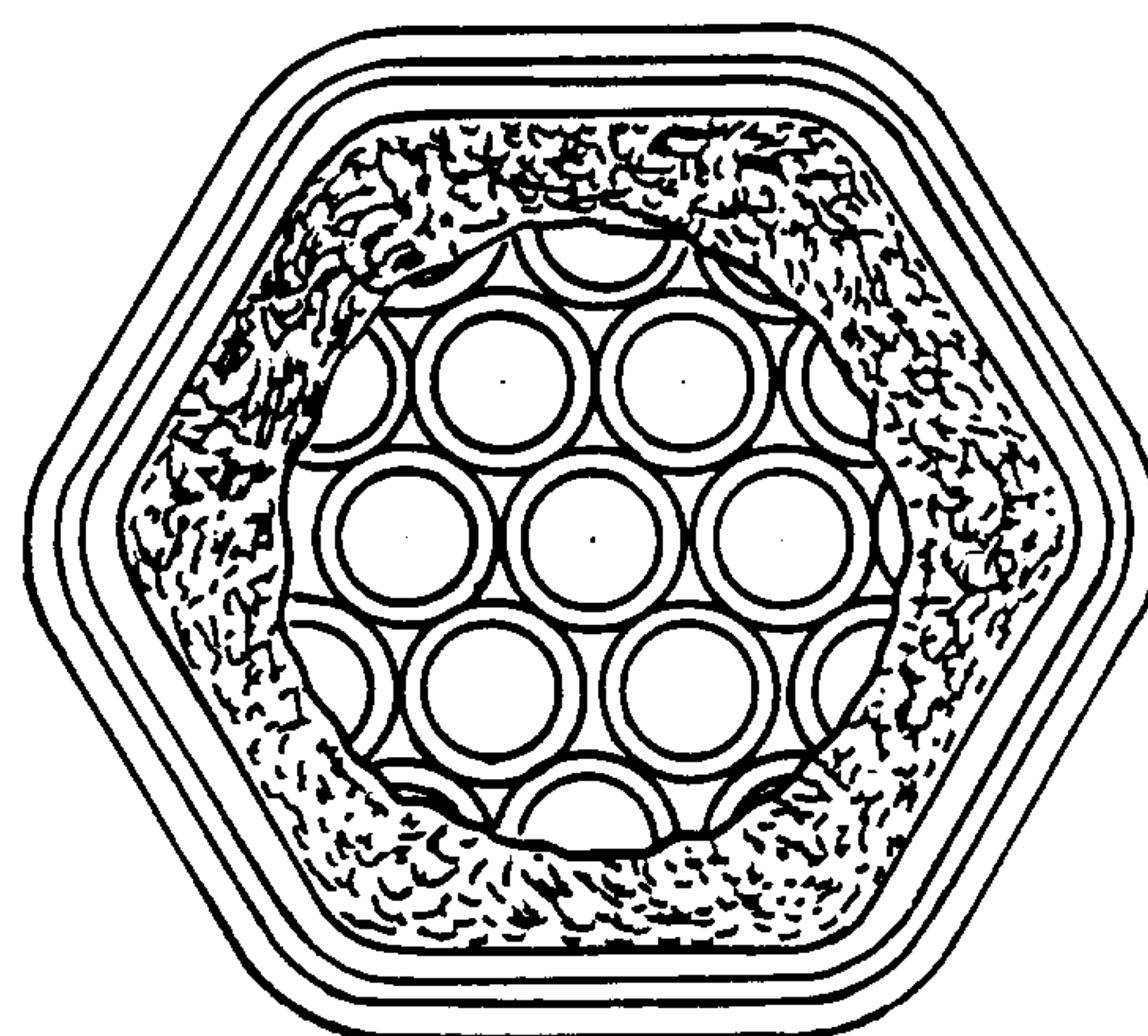


FIG. 2A

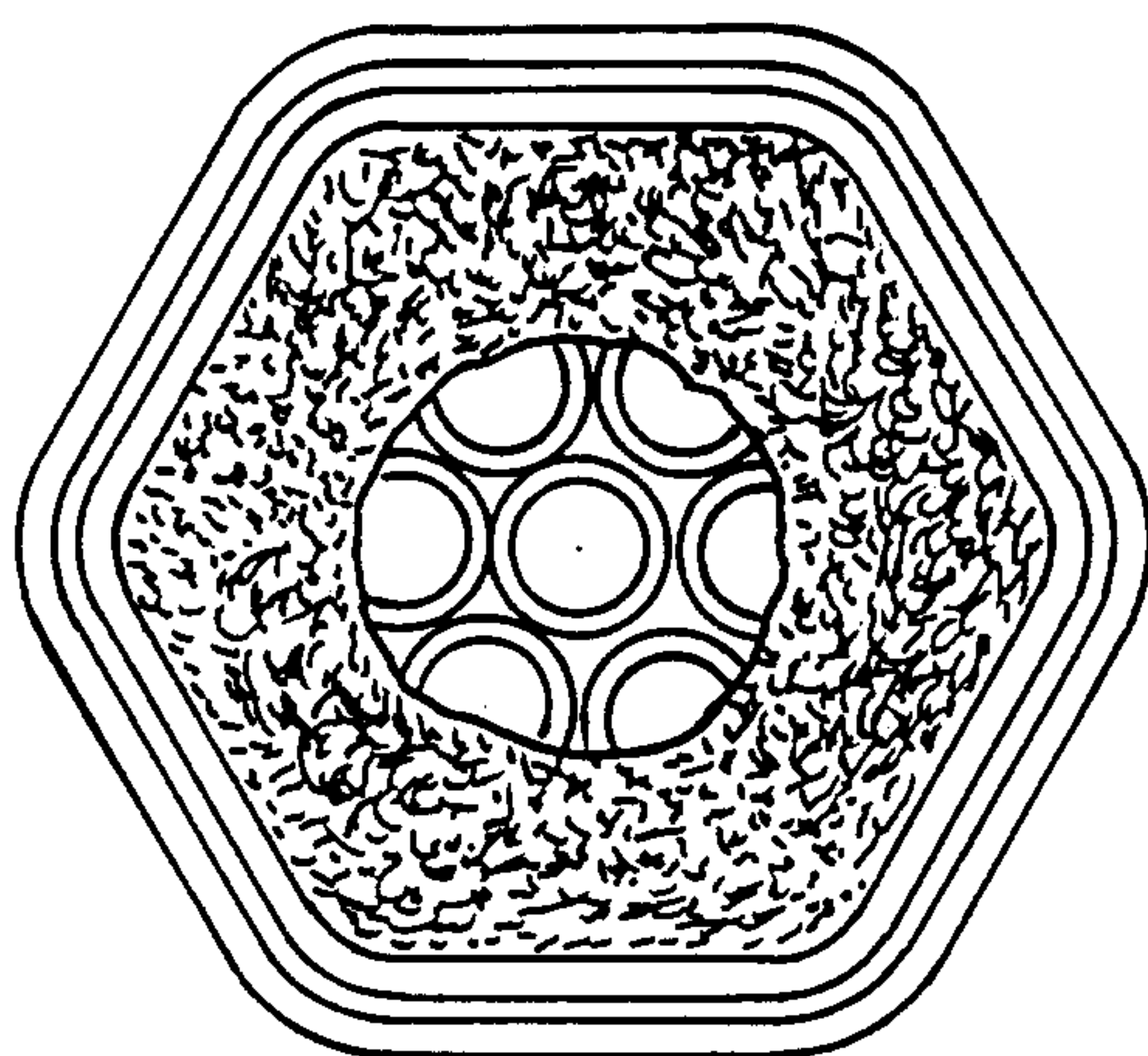


FIG. 2B

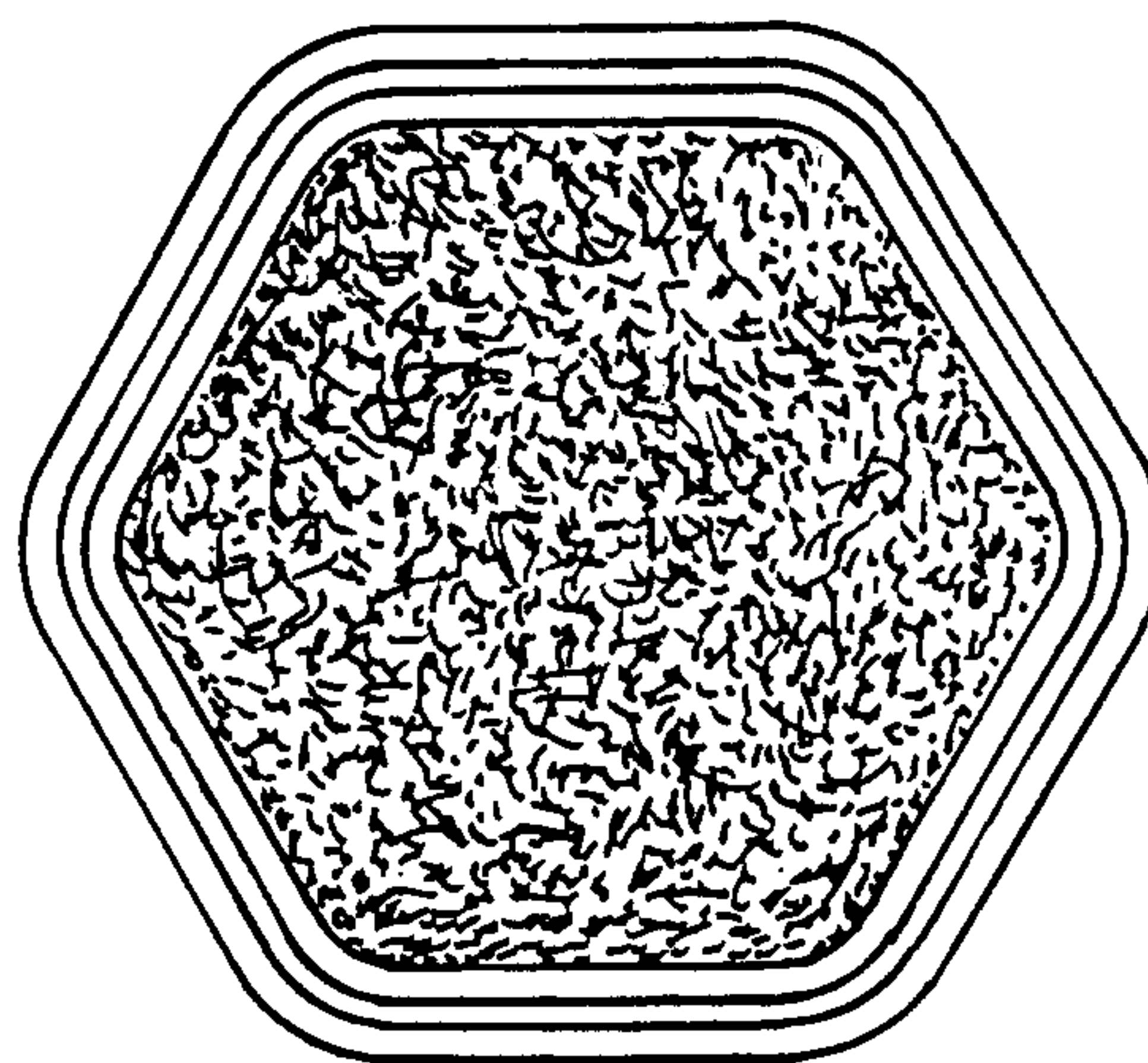


FIG. 2C

