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(54) **AIR, ACOUSTIC AND/OR FIRE SEALING SLEEVE INSERT AND AIR, ACOUSTIC AND/OR FIRE SEALING DEVICE**

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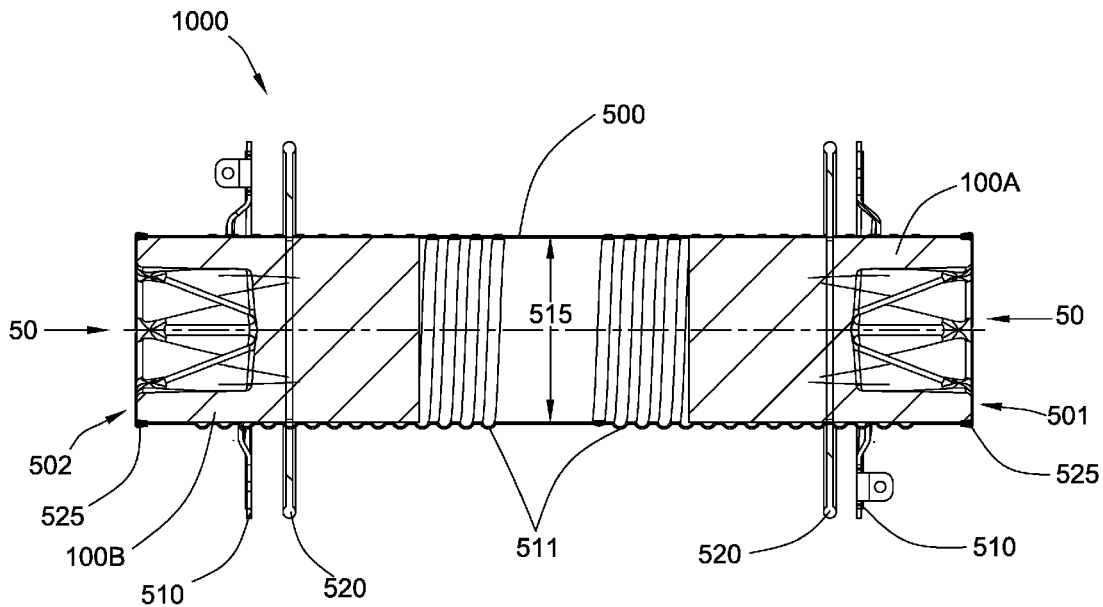
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(52) **U.S. Cl.**  
CPC ..... **F16L 5/10** (2013.01); **F16J 15/065** (2013.01)

(57) **ABSTRACT**

An air, acoustic and/or fire sealing sleeve insert, and an air, acoustic and/or fire sealing device including at least one insert, are disclosed.

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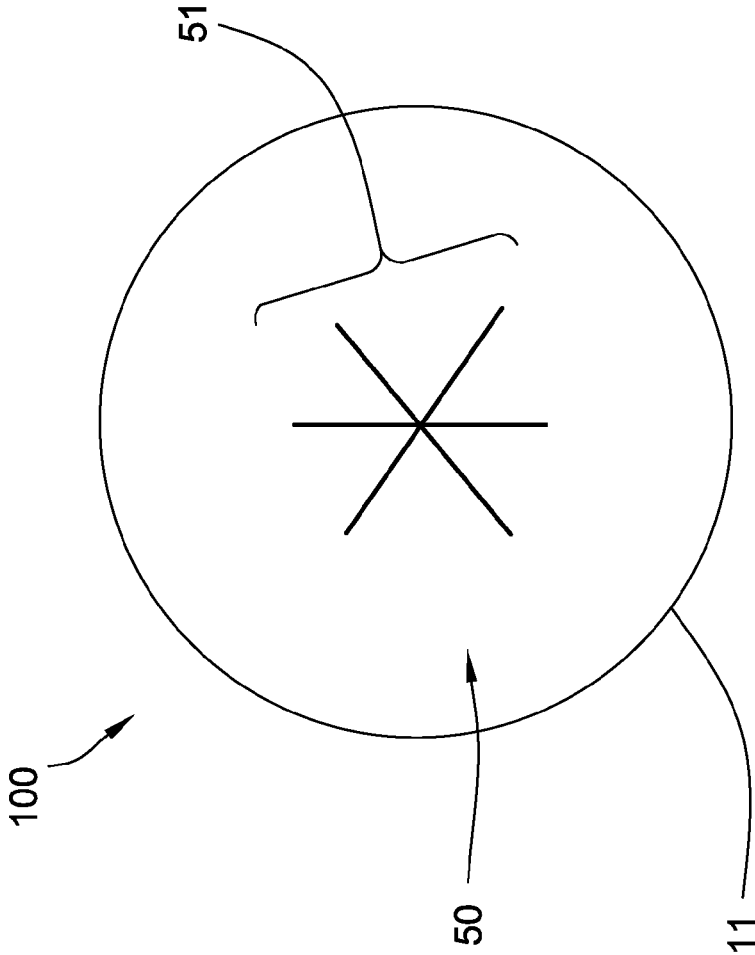


FIG. 1

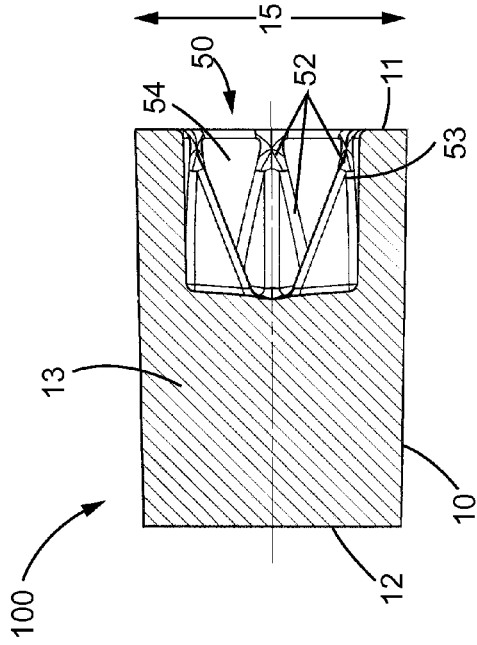


FIG. 2C

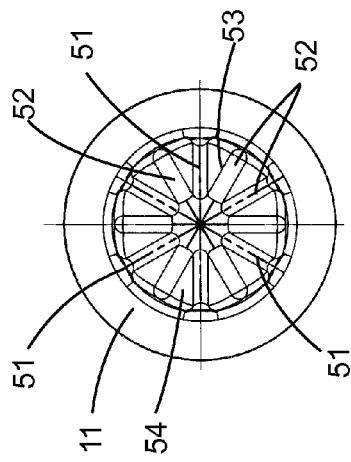


FIG. 2A

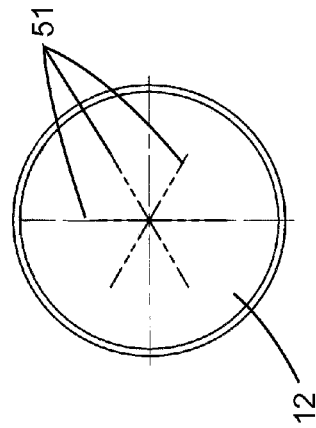


FIG. 2B

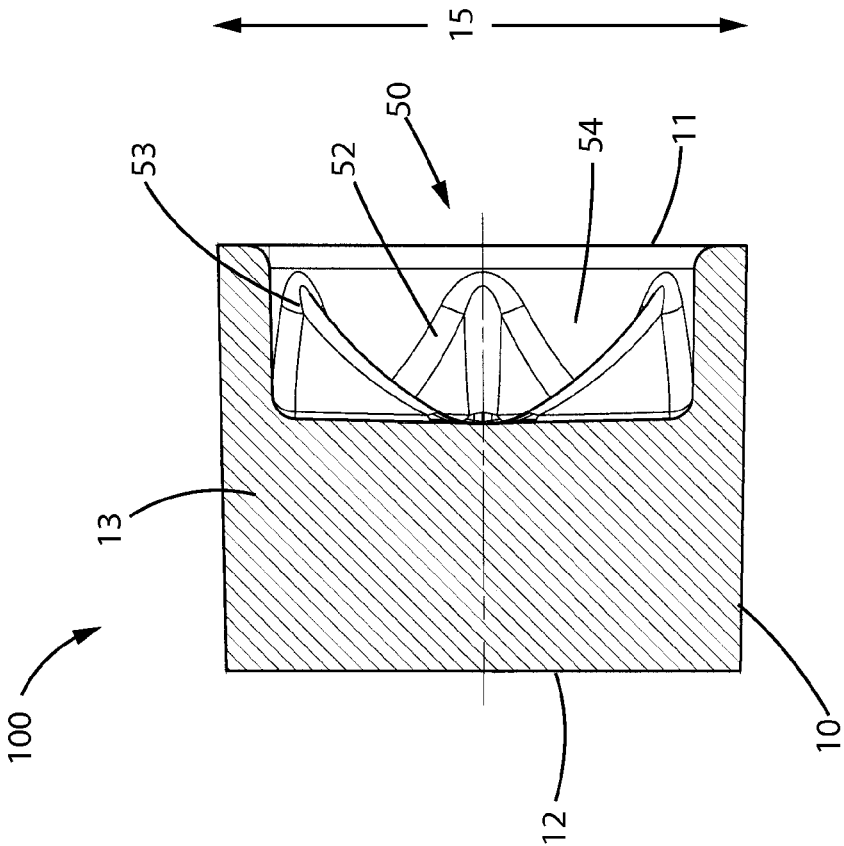


FIG. 2D

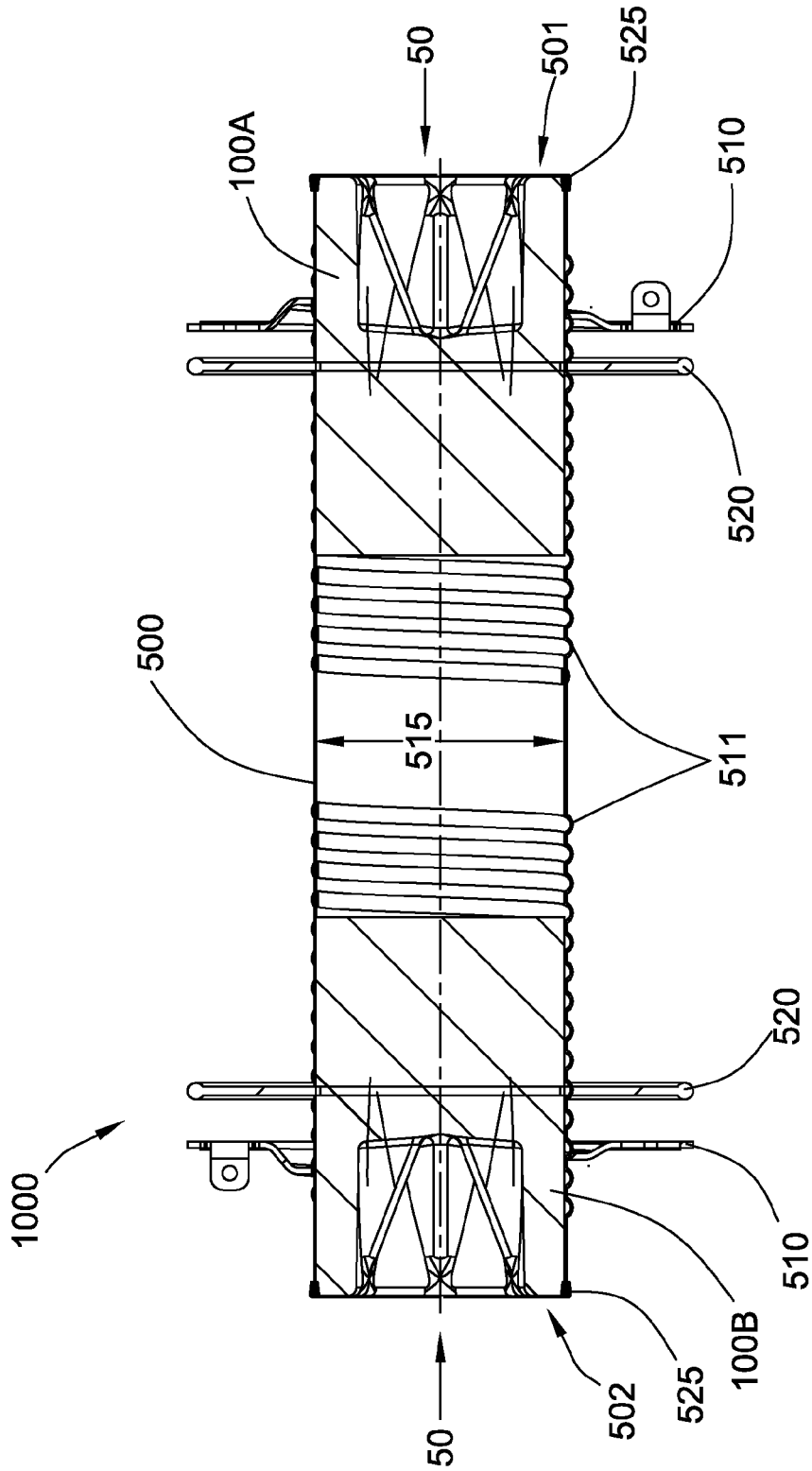


FIG. 3A

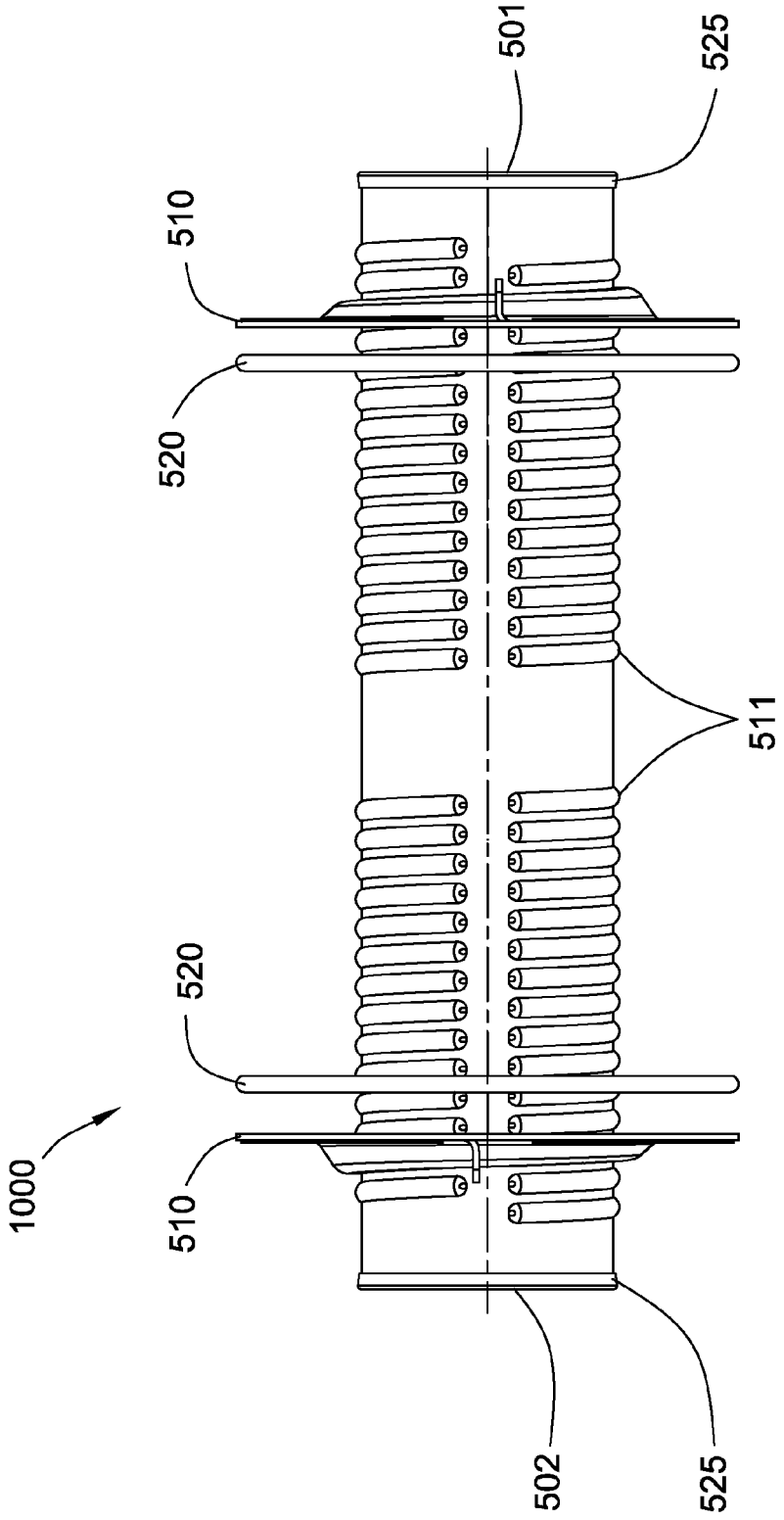


FIG. 3B



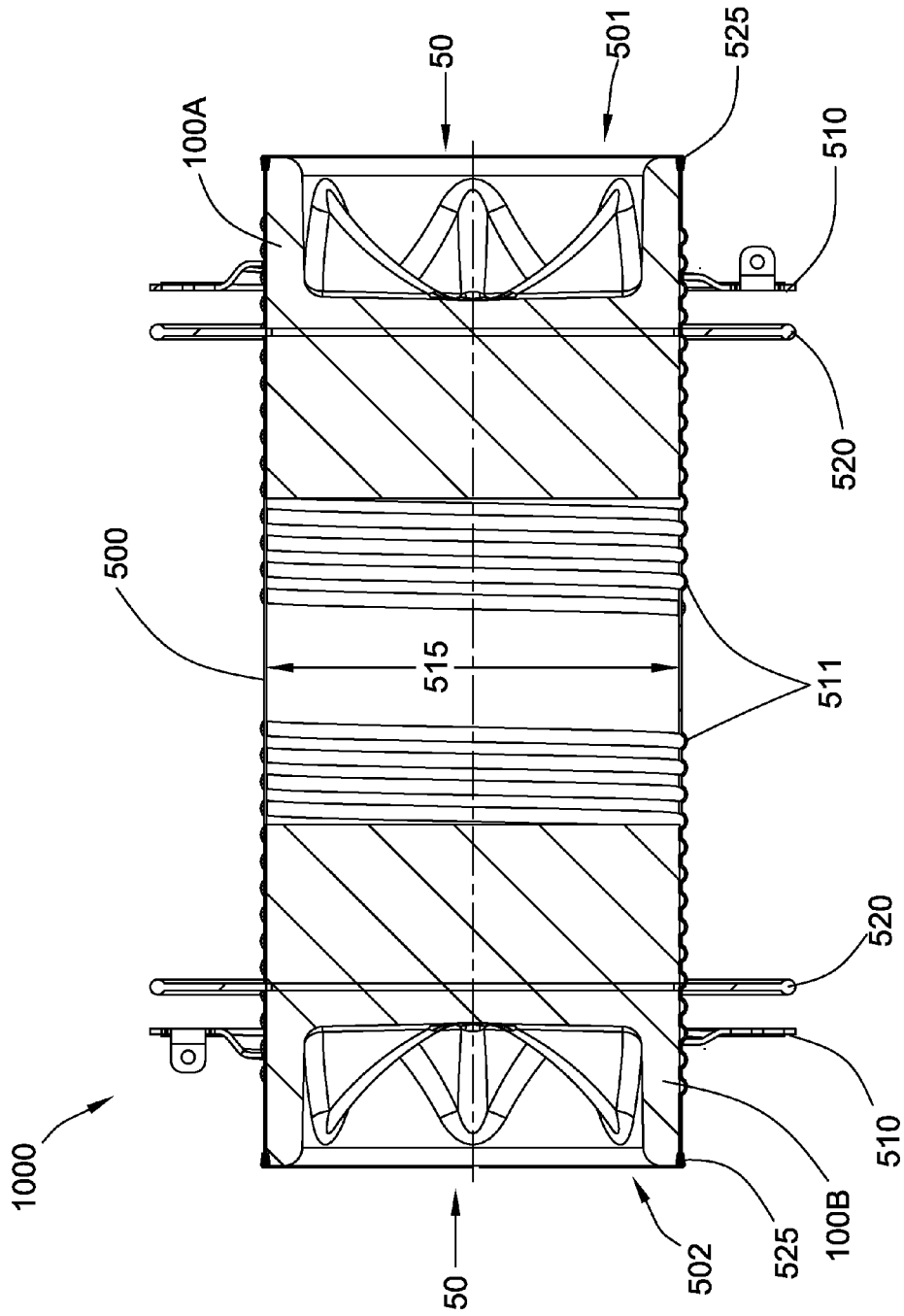


FIG. 4A



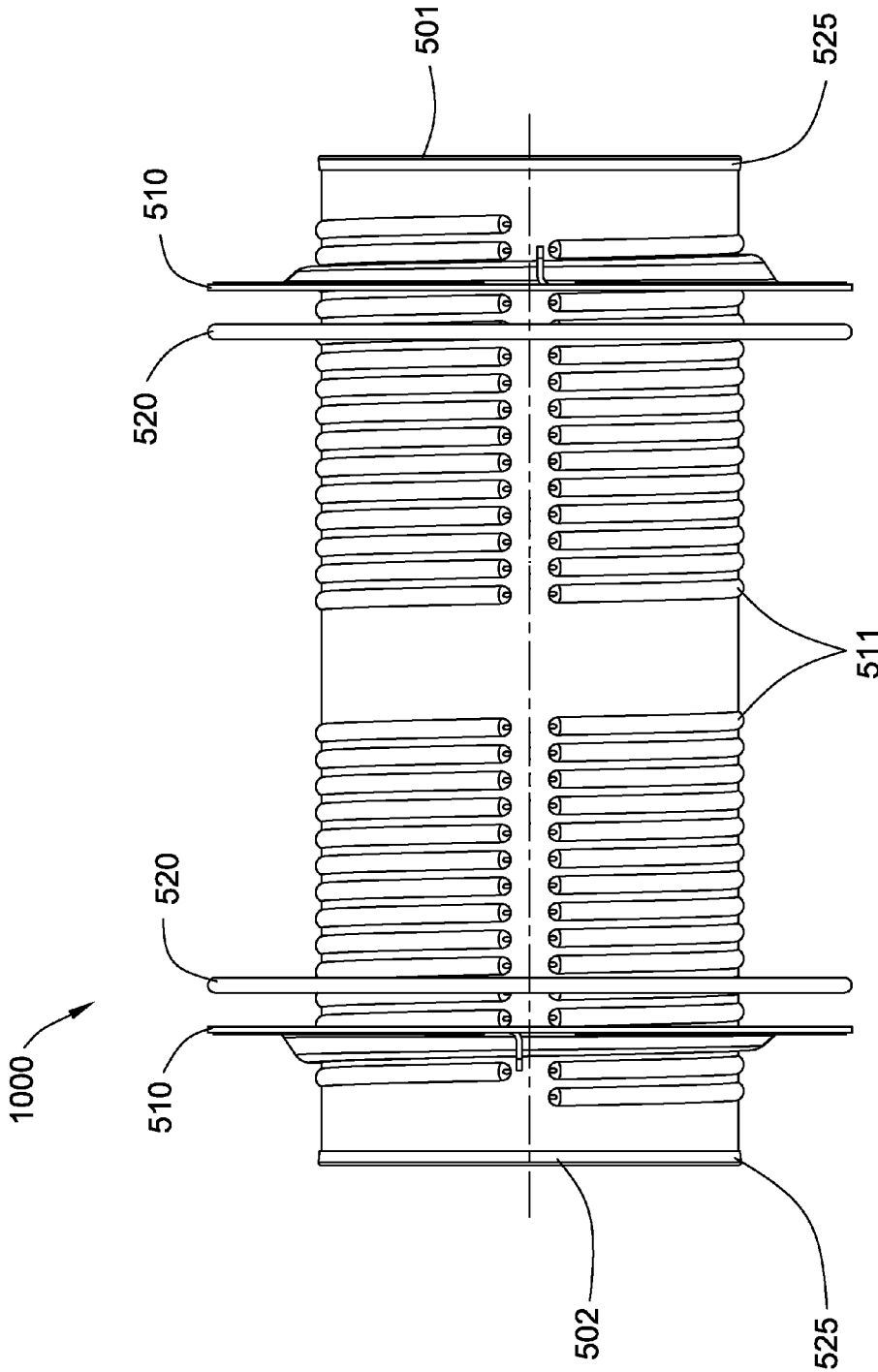


FIG. 4B

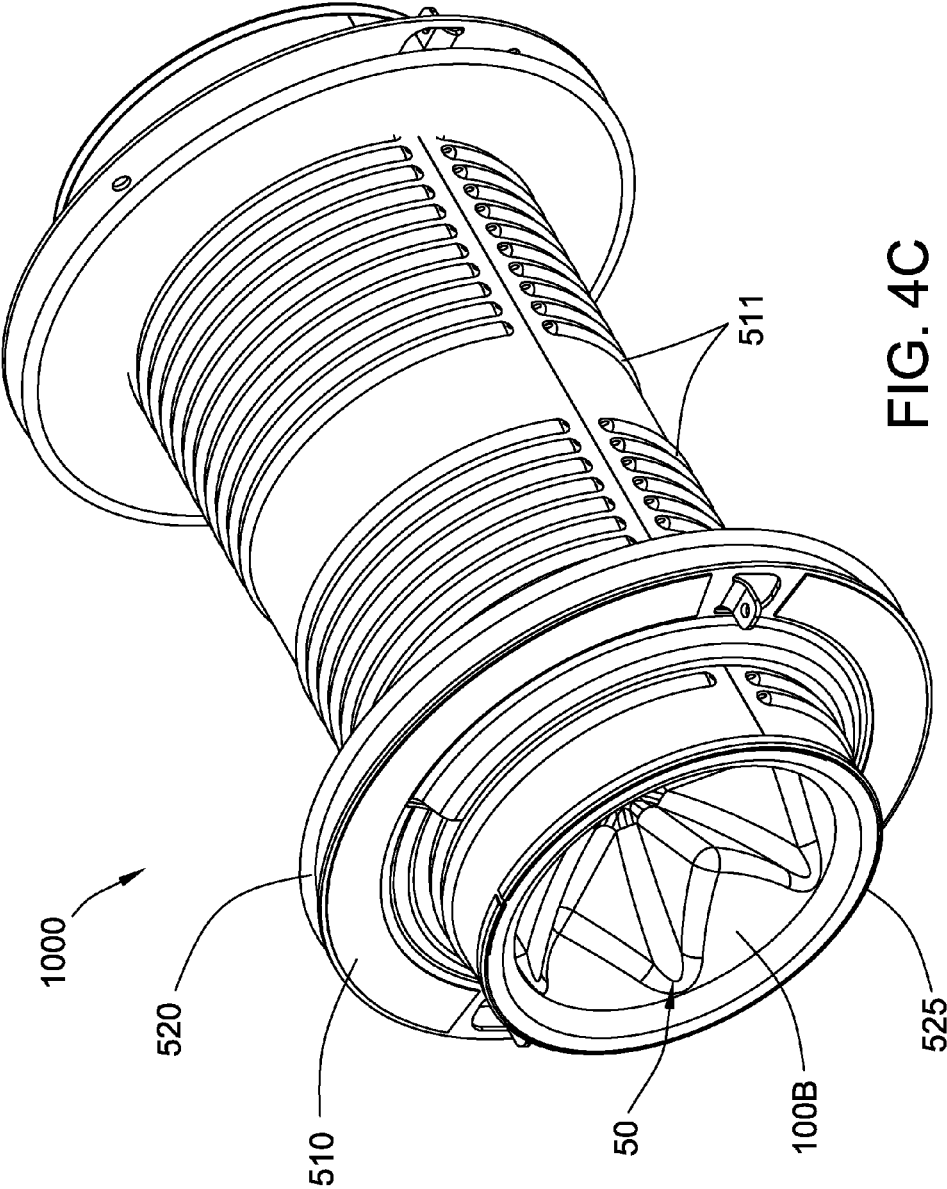


FIG. 4C

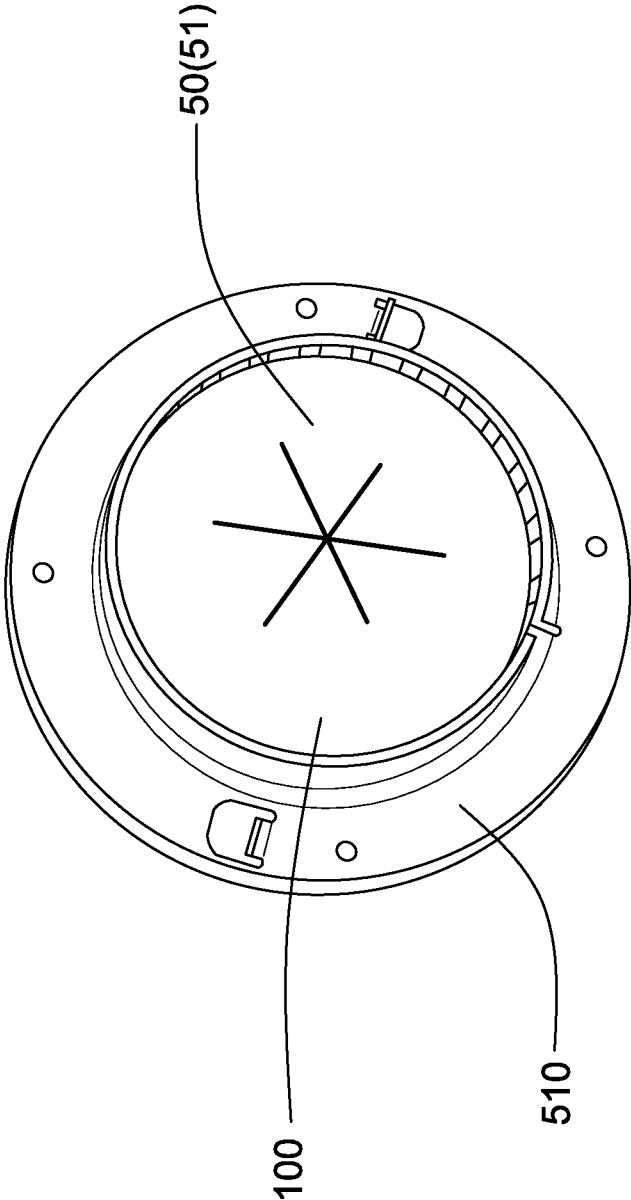


FIG. 5A

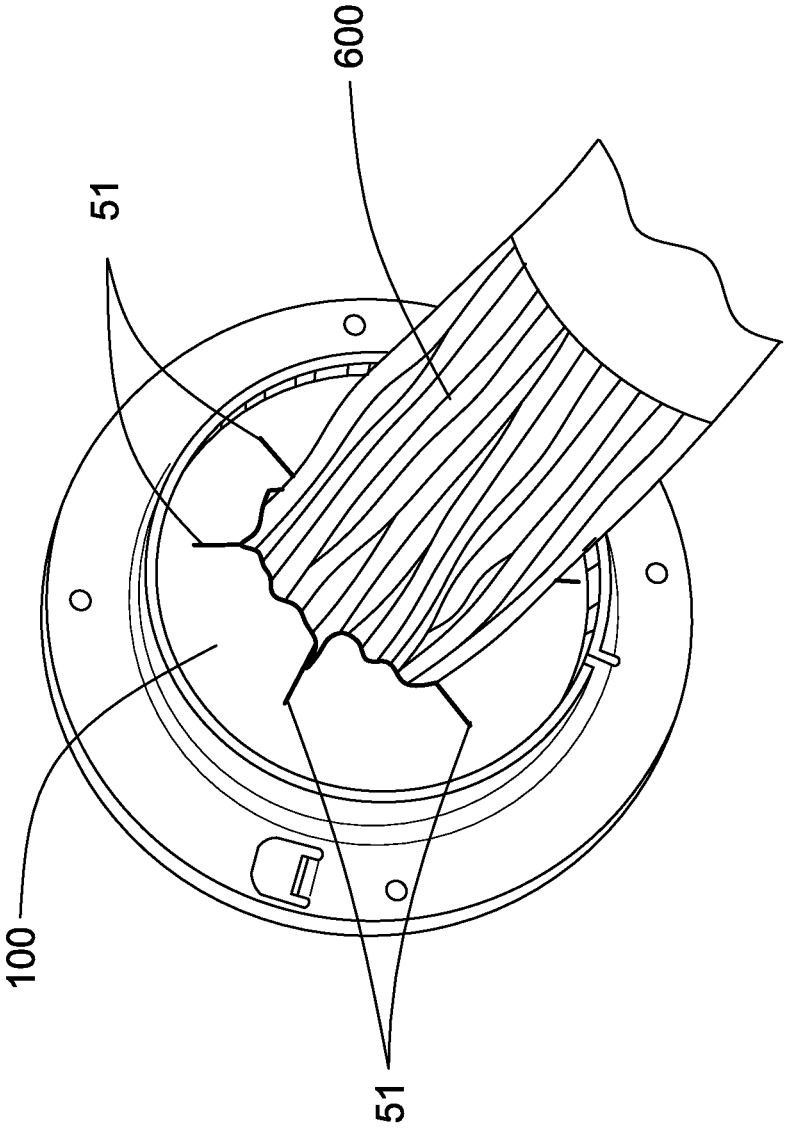


FIG. 5B

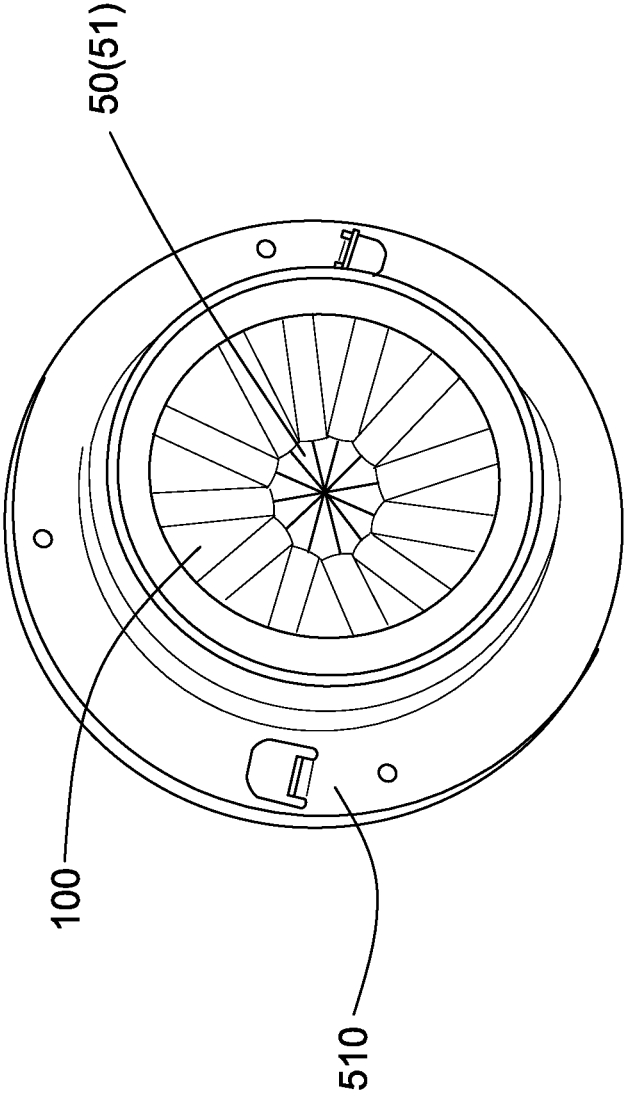


FIG. 6A

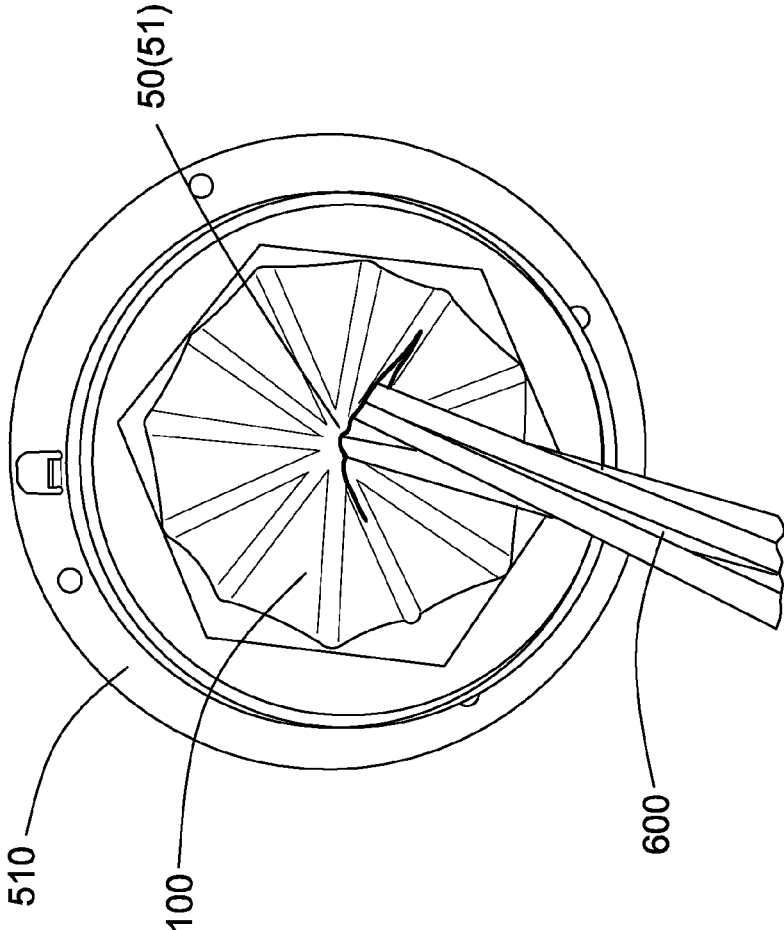


FIG. 6B

**AIR, ACOUSTIC AND/OR FIRE SEALING  
SLEEVE INSERT AND AIR, ACOUSTIC  
AND/OR FIRE SEALING DEVICE**

**BACKGROUND OF THE INVENTION**

**[0001]** Air, acoustic, and/or fire sealing devices, typically located in openings in walls, floors, and/or ceilings, and having pipes, fibers, and/or cables passing therethrough, generally prevent the spread of smoke throughout an area such as facility, thereby limiting damage to the area, and providing occupants more time to safely evacuate the area. Some devices also prevent the passage of sound, as the sound could frighten the occupants and therefore adversely impact the evacuation. If desired, the devices can be designed as fire stop devices, containing intumescent material that expands when exposed to extreme heat of the fire, sealing the openings to prevent the spread of flame and combustion through the openings.

**[0002]** However, there is a need for improvement of existing air, acoustic and/or fire sealing inserts and devices including the inserts. The present invention provides for ameliorating at least some of the disadvantages of the prior art. These and other advantages of the present invention will be apparent from the description as set forth below.

**BRIEF SUMMARY OF THE INVENTION**

**[0003]** An embodiment of the invention provides an air, acoustic and/or fire sealing sleeve insert comprising a body comprising molded foam material, the body having a first end and a second end and a bulk continuous with the first end and the second end; wherein at least the first end comprises a molded predetermined pattern.

**[0004]** In an embodiment, the molded predetermined pattern comprises a plurality of ribs and elevations. Alternatively, or additionally, in an embodiment, the molded predetermined pattern comprises a plurality of slits passing through the body in a direction longitudinal to the body.

**[0005]** In another embodiment, an air, acoustic and/or fire sealing device is provided, comprising (a) an embodiment of a first air, acoustic and/or fire sealing insert, wherein the body has an outer diameter, and the body is adapted to allow one or more fibers and/or cables to pass through the first and second ends and the bulk; and, (b) a hollow sleeve having an inner diameter, a first open end and a second open end, the ends being axially arranged; wherein the outer diameter of the first air, acoustic and/or fire sealing insert body is greater than, equal to, or less than, the inner diameter of the hollow sleeve; and, the first air, acoustic and/or fire sealing insert is arranged in the sleeve.

**[0006]** In a preferred embodiment, the air, acoustic and/or fire sealing device further comprises a second air, acoustic and/or fire sealing insert, arranged in the sleeve.

**BRIEF DESCRIPTION OF THE SEVERAL  
VIEWS OF THE DRAWING(S)**

**[0007]** FIG. 1 is a top view of an air, acoustic and/or fire sealing sleeve insert comprising a predetermined pattern of a plurality of slits according to an embodiment of the present invention.

**[0008]** FIG. 2A is a top view, FIG. 2B is a bottom view, and FIG. 2C is a cross-sectional view, of an air, acoustic and/or fire sealing sleeve insert comprising a predetermined pattern of a plurality of ribs, elevations, and slits, according

to another embodiment of the present invention. FIG. 2D is a cross-sectional view, of an air, acoustic and/or fire sealing sleeve insert comprising a predetermined pattern of a plurality of ribs, elevations, and slits, according to another embodiment of the present invention.

**[0009]** FIG. 3A is a cross-sectional view, FIG. 3B is a side view, and FIG. 3C is a perspective view, of an embodiment of an air, acoustic and/or fire sealing device comprising first and second air, acoustic and/or fire sealing sleeve inserts according to FIGS. 2A-2C, wherein the sleeve inserts are arranged in the hollow sleeve of the device, and FIG. 3A shows the molded predetermined pattern of the air, acoustic and/or fire sealing inserts facing outwardly from the open ends of the sleeve.

**[0010]** FIG. 4A is a cross-sectional view, FIG. 4B is a side view, and FIG. 4C is a perspective view, of an embodiment of an air, acoustic and/or fire sealing device comprising first and second air, acoustic and/or fire sealing sleeve inserts according to FIG. 2D, wherein the sleeve inserts are arranged in the hollow sleeve of the device, and FIG. 4A shows the molded predetermined pattern of the air, acoustic and/or fire sealing inserts facing outwardly from the open ends of the sleeve.

**[0011]** FIG. 5A shows an end view of an air, acoustic and/or fire sealing device including the insert shown in FIG. 1 and a flange, and FIG. 5B shows pipes, cables and/or fibers passing through the air, acoustic and/or fire sealing insert.

**[0012]** FIG. 6A shows an end view of an air, acoustic and/or fire sealing device including the insert shown in FIGS. 2A-2D and a flange, and FIG. 6B show pipes, cables and/or fibers passing through the air, acoustic and/or fire sealing insert.

**DETAILED DESCRIPTION OF THE  
INVENTION**

**[0013]** In accordance with an embodiment of the present invention, an air, acoustic and/or fire sealing sleeve insert comprising a body comprising molded foam material, the body having a first end and a second end and a bulk continuous with the first end and the second end; wherein at least the first end comprises a molded predetermined pattern.

**[0014]** In an embodiment, the molded predetermined pattern comprises a plurality of ribs and elevations. Alternatively, or additionally, in an embodiment, the molded predetermined pattern comprises a plurality of slits passing through the body in a direction longitudinal to the body.

**[0015]** The air, acoustic and/or fire sealing sleeve insert can have any desired shape, in one embodiment, comprising a generally cylindrical body, wherein the bulk has a generally cylindrical shape.

**[0016]** In one preferred embodiment, the molded foam material comprises polyurethane. In some embodiments, the molded foam material comprises an intumescent material.

**[0017]** In another embodiment, an air, acoustic and/or fire sealing device is provided, comprising (a) an embodiment of a first air, acoustic and/or fire sealing insert, wherein the body has an outer diameter, and the body is adapted to allow one or more fibers and/or cables to pass through the first and second ends and the bulk; and, (b) a hollow sleeve having an inner diameter, a first open end and a second open end, the ends being axially arranged; wherein the outer diameter of the first air, acoustic and/or fire sealing insert body is greater

than, equal to, or less than, the inner diameter of the hollow sleeve; and, the first air, acoustic and/or fire sealing insert is arranged in the sleeve.

**[0018]** Typically, the first air, acoustic and/or fire sealing insert is arranged in the first open end of the sleeve. In one embodiment of the air, acoustic and/or fire sealing device, the molded predetermined pattern of the first air, acoustic and/or fire sealing insert faces outwardly from the first open end of the sleeve. In another embodiment, the molded predetermined pattern of the first air, acoustic and/or fire sealing insert faces inwardly from the first open end of the sleeve.

**[0019]** In a preferred embodiment of the air, acoustic and/or fire sealing device, it further comprises a second air, acoustic and/or fire sealing insert, arranged in the sleeve, typically, wherein the second air, acoustic and/or fire sealing insert is arranged in the second open end of the sleeve. In one embodiment, the molded predetermined pattern of the second air, acoustic and/or fire sealing insert faces outwardly from the second open end of the sleeve, in another embodiment, the molded predetermined pattern of the second air, acoustic and/or fire sealing insert faces inwardly from the second open end of the sleeve.

**[0020]** Advantageously, one or more of any of the following are provided: (a) the foam material allows for any diameter pipe, cable and/or fiber and/or multiple pipe, cable and/or fiber bundle to be inserted and sealed as the foam expands or contracts around the cable(s), fiber(s), and/or pipe(s); (b) it is easy to penetrate the insert from either end; (c) high cable load is possible; (d) efficient air, acoustic and/or fire and tightness/blocking, as no visible openings around pipe(s), cable(s) and/or fiber(s); (e) long pipe(s), cable(s) and/or fiber(s) can be passed through without impacting the foam surface; (f) one step application, no opening is necessary, as the pipe(s), cable(s) and/or fiber(s) can easily slide through the foam (though, if desired, the inserts can have one or more slits); and (g) cost-effective production and assembly. If desired, e.g., wherein the insert comprises an intumescent material, the inserts and devices can be used in firestop applications. Alternatively, or additionally, inserts and/or devices can be retrofit into existing devices and applications.

**[0021]** Each of the components of the invention will now be described in more detail below, wherein like components have like reference numbers.

**[0022]** FIGS. 1 and 2A-2D show embodiments of air, acoustic and/or fire sealing sleeve inserts **100**, comprising a body **10** comprising molded foam material, the body having a first end **11** and a second end **12** and a bulk **13** continuous with the first end and the second end; wherein at least the first end comprises a molded predetermined pattern **50**. As shown in FIGS. 2C and 2D, the inserts have an outer diameter **15**. The inserts comprise air-sealing (e.g., smoke-sealing) material, preferably also providing for sound-sealing, and in some embodiments, fire-sealing. As used herein “sealing” air, sound, and/or fire includes “blocking,” air, sound, and/or fire, and “air” includes airflow, and airborne particles (including, for example, smoke, airborne pathogens, and odors).

**[0023]** In the embodiment shown in FIG. 1, the predetermined pattern **50** includes a plurality of slits **51**. While not shown in the top view of FIG. 1, the slits pass through the body in a direction longitudinal to the body.

**[0024]** In the embodiment shown in FIGS. 2A-2D, the predetermined pattern **50** includes a plurality of ribs **52** and elevations **53** (and valleys **54**), as well as a plurality of slits **51** (wherein the slits pass through the body in a direction longitudinal to the body).

**[0025]** The number of ribs and elevations, and the depth of the elevations, can be selected to ensure sufficient closure of the foam material around the pipe(s), cable(s) and/or fiber(s), e.g., to reduce or avoid gaps. Additionally, or alternatively, the length of the insert can be selected to provide, for example, desired air tightness and/or desired acoustic properties.

**[0026]** While the embodiments illustrated in FIGS. 1 and 2A-2D show the insert **100** comprising a generally cylindrical body, wherein the bulk has a generally cylindrical shape, other shapes are possible, e.g., wherein neither the sleeve, nor the sleeve insert, has a cylindrical form.

**[0027]** FIGS. 3A-3C and 4A-4C, show embodiments of air, acoustic and/or fire sealing devices **1000**, each comprising a hollow sleeve **500** with a first open end **501**, and a second open end **502** (the sleeve having an inner diameter **515**), wherein the devices include first and second air, acoustic and/or fire sealing inserts (**100A**, **100B**), arranged in the open ends of the sleeve, wherein the molded predetermined pattern of each insert faces outwardly from the open ends of the sleeve. However, in another embodiment, the device has a single insert, arranged in a location other than an open end. Alternatively, or additionally, the molded predetermined pattern the insert(s) can face inwardly from the open end(s) of the sleeve.

**[0028]** The sleeve **500** can be made of any suitable material, such as metal or plastic. Metal is preferred for applications wherein fire resistance is desired. The sleeve can be a one-piece continuous sleeve, e.g., as illustrated. Alternatively, however, the sleeve can comprise a multi-piece and/or slit sleeve, e.g., wherein the walls of the sleeve are joined together before installation.

**[0029]** The illustrated embodiments of the devices also include flanges **510** (also shown in FIGS. 5A, 5B, 6A, and 6B), e.g., for ease of installing or embedding the device into a constructional component (e.g., a concrete wall). If desired, and as shown, the flange(s) can include openings (and brackets with openings) for passing fastening elements such as nails, screws and/or bolts therethrough. If desired, and as shown in Figure 3B, 3C, 4B, and 4C, the sleeve **500** can include threads **511** so that the flanges can be threadably engaged with the sleeves (e.g., for ease in adjustment so that the device can be used with constructional components of different thicknesses).

**[0030]** Preferably, the device also includes gaskets **520**. The use of an air, acoustic and/or fire-tight gasket can be desirable in providing extra sealing by sealing the wall penetration behind the flange.

**[0031]** In some embodiments, the device includes an edge bushing **525**. The use of an edge bushing can be desirable in providing extra protection to the pipe(s), cable(s) and/or fiber(s) when pulled through the insert/device.

**[0032]** As shown in FIGS. 5A and 5B, as well as 6A and 6B, the foam material allows for any diameter multiple pipe, cable and/or fiber bundle **600** (and/or individual pipe, cable and/or fiber) or to be inserted and sealed as the foam expands or contracts around the pipe(s), cable(s) and/or fiber(s).



**[0033]** As noted above, the embodiments illustrated in FIGS. 1 and 2A-2D show the insert comprising a generally cylindrical body, wherein the bulk has a generally cylindrical shape.

**[0034]** A variety of foam materials are suitable. The foam material can be an open-cell foam material with very low air permeability, an almost closed-cell foam material with extreme low air permeability, and a closed-cell foam material; the foam material may also be impregnated to enhance the sealing properties; to provide sufficient tightness against air, acoustic and/or fire at least the outer surface of the foam insert should have closed pores.

**[0035]** Suitable materials include, for example, cellular rubber (e.g., closed-cell cellular rubber), foam materials such as polyethylene and polyurethane foam or natural or synthetic rubber, such as styrene butadiene rubber (SBR), ethylene propylene diene monomer rubber (EPDM), or polychloroprene rubber.

**[0036]** Other materials and processes suitable for producing the air, acoustic and/or fire sealing insert are disclosed in, for example, U.S. Patent Application Publication Number U.S. 2013/0161030. For example, the production of the molded foam body can be by mold foaming, such as reaction injection molding (RIM), according to DE 3917518, e.g., using Fomox® fire prevention foam or the material HILTI CP 65GN forming the insulation layer. Material which may be used for the purposes according to the invention are known from EP 0061024 A1, EP 0051106 A1, EP 0043952 A1, EP 0158165 A1, EP 0116846 A1, and US Pat. No. 3,396,129 A, as well as EP 1347549 A1. Preferably, the molded body comprises a polyurethane foam capable of intumescence, such as known from EP 0061024 A1, DE 3025309 A1, DE 3041731 A1, DE 3302416A, and DE 3411327A1.

**[0037]** In an embodiment, the insert is produced to have a slightly greater outer diameter than the inner diameter of the sleeve, such that the insert remains in place while the pipe(s)/fiber(s)/cable(s) are being passed therethrough. However, in other embodiments, the insert can have an outer diameter equal to, or less than, the inner diameter of the sleeve. For example, the sleeve can provide for air and/or acoustic sealing and have an outer diameter equal to, or less than, the inner diameter of the sleeve, and a separate intumescent material can be included (e.g., as a strip), such that the foam material is compressed with the sleeve and insert are inserted into the sleeve.

**[0038]** The insert can be produced as is known in the art, e.g., reaction injection molded into a form or template, and molded.

**[0039]** The molded body can comprise a foaming binder, which at least comprises an ash-forming and perhaps intumescent material mixture. Here, this binder serves as a compound-forming carrier for the ash-forming and perhaps intumescent material mixture. Preferably the material mixture is distributed homogeneously in the binder. The compound-forming carrier is preferably selected from a group comprising polyurethane, phenol-resins, polystyrene, polyolefin, such as polyethylene and/or polybutylene, melamine resin, melamine resin-foam, synthetic or natural rubber, cellulose, elastomers, and mixtures therefrom, with polyurethane being preferred.

**[0040]** The ash-forming and perhaps intumescent material mixture may comprise the fire prevention additives commonly used and known to one trained in the art, which in

case of fire, thus under the impact of heat, foam and thus form a froth hindering the fire from spreading, such as an intumescent material based on an acid former, a compound yielding carbon, and a gas former. Preferably the intumescent material comprises a salt or an ester of an inorganic, non-volatile acid as the acid former, selected from sulfuric acid, phosphoric acid, and boric acid, a polyhydroxy-compound as the compound yielding carbon, and/or a thermoplastic or duroplastic polymer resin binder, and as a gas former a chloroparaffin, melamine, a melamine compound, particularly melamine cyanurate, melamine phosphate, melamine polyphosphate, tri(hydroxyl ethyl)-cyanurate, cyanamide, dicyanamide, dicyanadamide, biguanidine, and/or a guanidine salt, particularly guanidine phosphate or guanidine sulfate.

**[0041]** The compound-forming carrier may further comprise an inorganic compound as an ablative additive, which comprises water, e.g., water of crystallization, tightly bonded and not evaporating at temperatures up to 100° C., however releases it in case of fire at 120° C. and thus is able to cool temperature-guiding parts, preferably an inorganic hydroxide or hydrate, particularly aluminum hydroxide, aluminum oxide hydrate, or partially hydrated aluminum hydroxides releasing water preferably at fire temperature and/or when subjected to flames. However, other inorganic hydroxides or hydrates releasing water when subjected to flames may also be used, such as described in EP 0 274 068 A2.

**[0042]** Such compounds, which may be used as mixtures of material in the fire prevention insert according to one or more embodiments of the invention, are known to one trained in the art and disclosed, for example, in the following publications, which are hereby included by reference: DE 30 25 309 A1, DE 30 41 731 A1, DE 33 02 416 A1, DE 34 11 327 A1, EP 0 043 952 B1, EP 0 051 106 B1, EP 0 061 024 B1, EP 0 116 846 B1, EP 0 158 165 B1, EP 0 274 068 A2, EP 1 347 549 A1, EP 1 641 895 B1, and DE 196 53 503 A1.

**[0043]** All references, including publications, patent applications, and patents, cited herein are hereby incorporated by reference to the same extent as if each reference were individually and specifically indicated to be incorporated by reference and were set forth in its entirety herein.

**[0044]** The use of the terms “a” and “an” and “the” and “at least one” and similar referents in the context of describing the invention (especially in the context of the following claims) are to be construed to cover both the singular and the plural, unless otherwise indicated herein or clearly contradicted by context. The use of the term “at least one” followed by a list of one or more items (for example, “at least one of A and B”) is to be construed to mean one item selected from the listed items (A or B) or any combination of two or more of the listed items (A and B), unless otherwise indicated herein or clearly contradicted by context. The terms “comprising,” “having,” “including,” and “containing” are to be construed as open-ended terms (i.e., meaning “including, but not limited to,”) unless otherwise noted. Recitation of ranges of values herein are merely intended to serve as a shorthand method of referring individually to each separate value falling within the range, unless otherwise indicated herein, and each separate value is incorporated into the specification as if it were individually recited herein. All methods described herein can be performed in any suitable order unless otherwise indicated

herein or otherwise clearly contradicted by context. The use of any and all examples, or exemplary language (e.g., “such as”) provided herein, is intended merely to better illuminate the invention and does not pose a limitation on the scope of the invention unless otherwise claimed. No language in the specification should be construed as indicating any non-claimed element as essential to the practice of the invention. [0045] Preferred embodiments of this invention are described herein, including the best mode known to the inventors for carrying out the invention. Variations of those preferred embodiments may become apparent to those of ordinary skill in the art upon reading the foregoing description. The inventors expect skilled artisans to employ such variations as appropriate, and the inventors intend for the invention to be practiced otherwise than as specifically described herein. Accordingly, this invention includes all modifications and equivalents of the subject matter recited in the claims appended hereto as permitted by applicable law. Moreover, any combination of the above-described elements in all possible variations thereof is encompassed by the invention unless otherwise indicated herein or otherwise clearly contradicted by context.

1. An air, acoustic and/or fire sealing sleeve insert comprising:

a body comprising molded foam material, the body having a first end and a second end and a bulk continuous with the first end and the second end; wherein at least the first end comprises a molded predetermined pattern.

2. The sleeve insert of claim 1, wherein the molded predetermined pattern comprises a plurality of ribs and elevations.

3. The sleeve insert of claim 1, wherein the molded predetermined pattern comprises a plurality of slits passing through the body in a direction longitudinal to the body.

4. The sleeve insert of claim 1, comprising a generally cylindrical body, wherein the bulk has a generally cylindrical shape.

5. The sleeve insert of claim 1, wherein the molded foam material comprises polyurethane.

6. The sleeve insert of claim 1, wherein the molded foam material comprises an intumescent material.

7. An air, acoustic and/or fire sealing device comprising:

(a) the first air, acoustic and/or fire sealing insert of claim 1, wherein the body has an outer diameter, and the body is adapted to allow one or more pipes, fibers and/or cables to pass through the first and second ends and the bulk; and,

(b) a hollow sleeve having an inner diameter, a first open end and a second open end, the ends being axially arranged;

wherein the first air, acoustic and/or fire sealing insert is arranged in the sleeve.

8. The device of claim 7, wherein the first air, acoustic and/or fire sealing insert is arranged in the first open end of the sleeve.

9. The device of claim 7, wherein the molded predetermined pattern of the first air, acoustic and/or fire sealing insert faces outwardly from the first open end of the sleeve.

10. The device of claim 7, wherein the molded predetermined pattern of the first air, acoustic and/or fire sealing insert faces inwardly from the first open end of the sleeve.

11. The device of claim 7, wherein the outer diameter of the first air, acoustic and/or fire sealing insert body is greater than the inner diameter of the hollow sleeve.

12. The device of claim 7, wherein the outer diameter of the first air, acoustic and/or fire sealing insert body is less than or equal to the inner diameter of the hollow sleeve.

13. The device of claim 7, further comprising a second air, acoustic and/or fire sealing insert, arranged in the sleeve.

14. The device of claim 13, wherein the second air, acoustic and/or fire sealing insert is arranged in the second open end of the sleeve.

15. The device of claim 13, wherein the molded predetermined pattern of the second air, acoustic and/or fire sealing insert faces outwardly from the second open end of the sleeve.

16. The device of claim 13, wherein the molded predetermined pattern of the second air, acoustic and/or fire sealing insert faces inwardly from the second open end of the sleeve.

17. The device of claim 13, wherein the outer diameter of the first air, acoustic and/or fire sealing insert body is greater than the inner diameter of the hollow sleeve.

18. The device of claim 13, wherein the outer diameter of the first air, acoustic and/or fire sealing insert body is less than or equal to the inner diameter of the hollow sleeve.

19. The sleeve insert of claim 2, wherein the molded foam material comprises polyurethane.

20. The sleeve insert of claim 5, wherein the molded foam material comprises an intumescent material.

\* \* \* \* \*