

[54] DUCTING

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[51] Int. Cl. **F16I 9/14**

[58] Field of Search..... 138/140, 141, 144,
138/149, DIG. 2

[56] **References Cited**

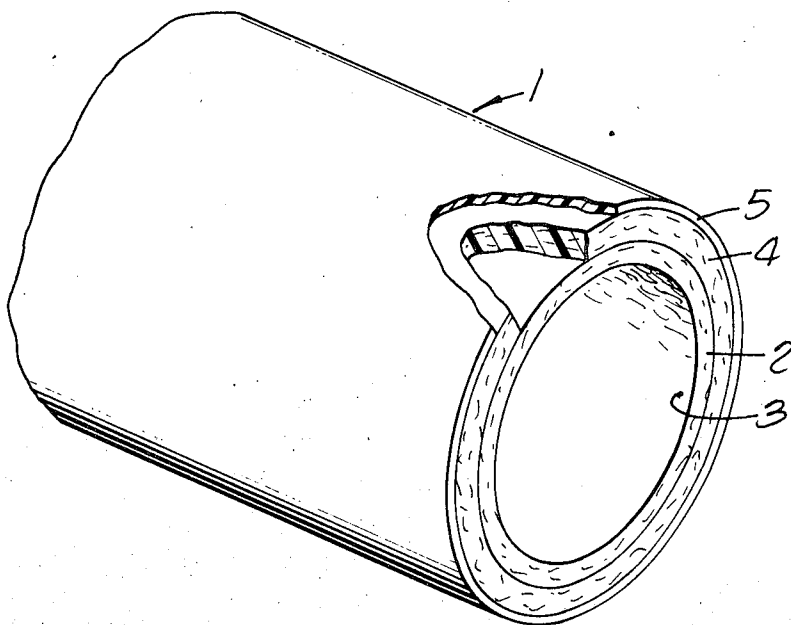
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[57] **ABSTRACT**

Ducting is disclosed having an inner composite of fine fibrous insulating material and a composite of textile fibrous material secured about the inner composite. A fluid-impermeable sleeve may be positioned about the composite of textile fibers.

5 Claims, 5 Drawing Figures



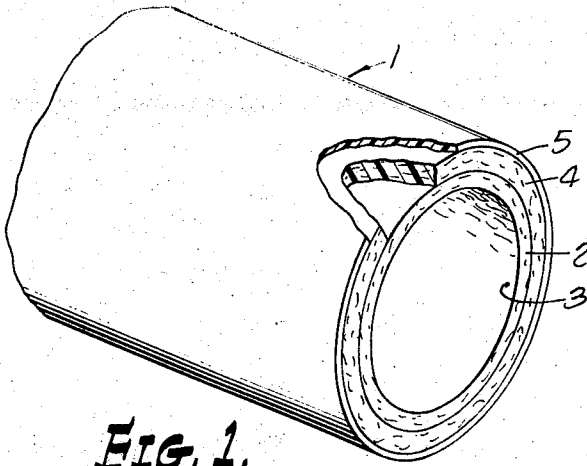


FIG. 1.

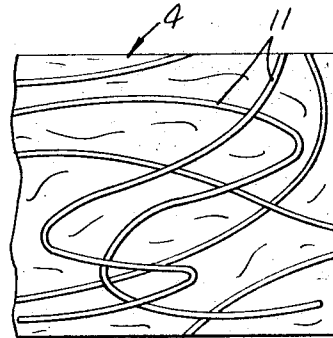


FIG. 3.

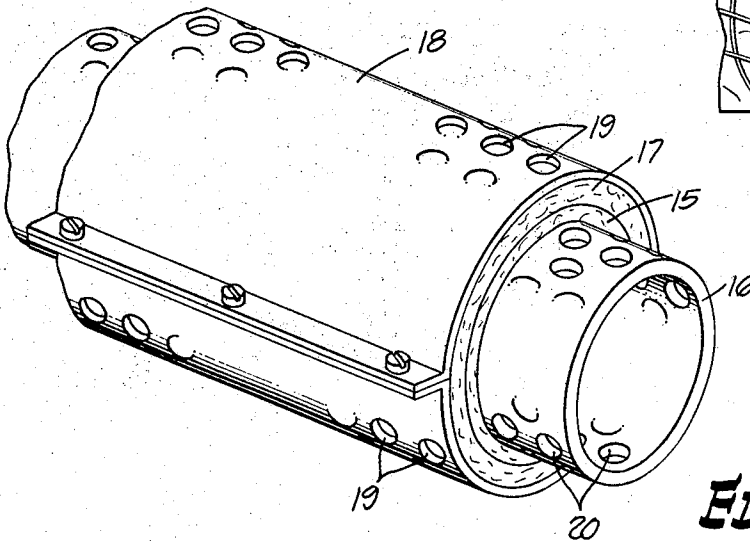


FIG. 2.

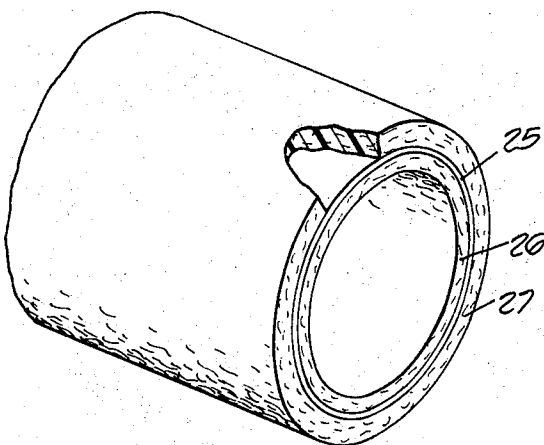


FIG. 5.

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DUCTING

BACKGROUND OF THE INVENTION

This invention relates to ducting of the type which is used to conduct air or other gaseous fluids, as for example in heating and ventilating systems.

In both residential and commercial construction, it is common practice to provide central heating and/or air conditioning in which air is heated or cooled as desired and circulated through a network of ducting to the different parts of the building to discharge the heated or cooled air. Such ducting is normally positioned within the ceilings, walls, attics, or between floors of multiple-story buildings.

The ducting which is to be used must be capable of transmitting the heated or cooled air without a substantial change in temperature. This requires that the ducting be insulated, which has been frequently accomplished by use of fiberglass insulation blankets, low density rock wool, etc. Another highly desirable characteristic of such ducting is that it be resilient, that is, capable of being deformed slightly, but resistant to crushing so as to permit installation in restricted areas such as in the floors, walls, or ceilings of a building without requiring modification of the structure of the building, and to withstand damage which can occur on the job site or during installation.

The type of ducting used in the past has most commonly been rigid in nature, usually fabricated of galvanized sheet metal, used in conjunction with a liner of fibrous insulating material to provide the necessary thermal and acoustical insulation. In recent years, however, flexible insulated ducting of the type disclosed in U.S. Pat. No. 3,216,459 has gained in popularity and in widespread usage. Such ducting represents a significant advancement in the art, but there is yet room for ducting which provides the necessary insulating characteristics and which is also capable of being manufactured relatively simply and inexpensively. By the same token, ducting should be resistant to damage and also provide good air flow (static friction) characteristics, since air flow is extremely important in that if ducting resists the flow of air to an objectionable degree, the size of the duct must be increased or the capacity of the air circulating blower must be increased to circulate a sufficient quantity of air to accomplish the desired heating or air-conditioning.

SUMMARY OF THE INVENTION AND DESCRIPTION OF PREFERRED EMBODIMENTS

The present invention provides ducting which has good air flow and insulating characteristics and is also resilient and capable of resisting damage. The ducting includes an inner composite of fine fibrous insulating material and a composite of textile fibrous material secured about the inner composite. A fluid-impermeable sleeve is positioned about the textile composite.

The invention will be better understood by referring to the annexed drawings in which:

FIG. 1 is a perspective view of the ducting partially cut away to illustrate the construction more clearly;

FIG. 2 and 3 are enlarged fragmentary views showing the inner and outer fibrous composites;

FIG. 4 illustrates steps of a preferred method of making the ducting; and

FIG. 5 is a perspective view illustrating a modified form of the invention.

Referring now to the annexed drawings, and more particularly to FIGS. 1-3, the ducting is designated generally by the numeral 1 and comprises an inner composite 2 of relatively fine fibrous insulating material which forms the interior surface 3 of the ducting. A second composite 4 of textile fibrous material is secured about composite 2. A fluid-impermeable sleeve 5 is positioned about composite 4 and in the preferred embodiment forms the outer surface of the ducting.

In FIG. 2, the inner composite can be seen more clearly and comprises fine fibrous material 10, relatively short in length, as for example, approximately 1 inch and shorter. Such fibers are about 7 microns or less in diameter, typically from about 3 to about 7 microns. In a preferred form, the composite comprises glass fibrous material known as "superfine" of the described diameter and length produced by a flame blown, flame attenuated or rotary process and bonded together during manufacture into an uncured fibrous blanket with a liquid phenolic resin binder. Such material is available commercially from various sources, including PPG Industries, under the designation, "Superfine", Johns Manville Corporation "Microlite", Owens Corning Fiberglas "Aerocor" and Certain-Teed St. Gobain "Ultrafine".

By forming the inner composite from the described fibrous material, the ducting is provided with an interior surface which is relatively smooth to decrease the friction loss and provide good air flow characteristics, as well as excellent thermal and acoustical insulating properties. Although glass fiber materials of the described type are generally preferred, other types of fibrous insulating material may be used, including fire resistant silica fibers, carborundum fibers and synthetic fibers such as nylon which are capable of providing the described characteristics and are fire resistant.

In FIG. 3, the composite of textile fibers is shown most clearly. The composite is composed preferably of long, uniform diameter attenuated glass fibers 11 which are bonded together to thus provide a tough, resilient and damage resistant outer surface for the ducting. Such fibers are of a borosilica formula and are attenuated at a substantially uniform diameter of approximately 9 microns and cut to a uniform length of approximately 4 inches. The chopped fibers are laid in blanket form and bonded together with a dry powder phenolic resin. When the fibers are thus bonded together, the fibrous blanket has excellent tensile, compressive and tear strength and thus enables the production of ducting having the same characteristics.

The textile fibrous material is also commercially available from sources such as PPG Industries under the trade name "Textrafine", Johns Manville Corporation under the name "Microtex", Owens Corning Fiberglas "Aeroflex", and Certain-Teed St. Gobain "Ultralite". Although the textile fibers are also preferably glass fibers, other suitable fibrous insulating material may be used such as carborundum or other silica containing fibers and synthetic fibers, which possess the previously described physical characteristics.

In normal production, as shown in FIG. 1, composites 2 and 4 are of approximately equal wall thickness, as this provides ducting having the desired resiliency, structural strength, and thermal and acoustical insulating and air flow properties. However, depending upon the use to be made of the ducting, the wall thickness of the two composites may be varied and the inner com-

posite 2 may comprise only a single wrap of fine fibrous material while the other composite comprises several wraps of textile fibrous material. By the same token, the inner composite may comprise a plurality or wrappings of the fine fibrous material and the outer composite only a single wrapping of the textile fibrous material. In general, the relative thicknesses of the inner and outer composites will range from about 10 percent to about 90 percent of the total wall thickness, with the selection of the desired proportion of such composites depending upon the type of ducting desired, which in turn depends upon factors such as whether greater or lesser tensile and compressive strength or insulating properties are desired.

To illustrate the foregoing, if the ducting has an outside diameter of 10 inches, it will normally have a total wall thickness of 1 inch. In normal production, such as where the ducting is to be used in the typical heating or air-conditioning system, the 1 inch wall thickness will consist of $\frac{1}{2}$ inch of each of the inner and outer composites.

Referring now to FIG. 4, the ducting is manufactured by first wrapping the desired number of wrappings of fine fibrous material 15 about a hollow mandrel 16. The trailing end of the wrapping need only be positioned firmly against the underlying wrapping of fine fibrous material due to the phenolic resin used in manufacturing the fibrous material, which will cause the trailing end to adhere lightly to the adjacent wrapping. Thereafter, the textile fibrous material 17 is wrapped about the inner composite. Again, due to the phenolic resin contained in the fine fibrous material, it is unnecessary to use an adhesive to secure the lead end of the textile fibrous material to the inner composite. The textile material may be wrapped in the same direction as the fine fibrous material or, if desired, wrapped in the opposite direction. In either event, after the desired number of wrappings have been made, the tail end of the textile fibrous material need only be pressed against the underlying surface, as the binder used in manufacturing the textile material will cause the end to adhere thereto.

The mandrel with the two uncured composites positioned thereabout is then placed within mold 18, which compresses slightly the fibrous composites, as for example, from a total thickness of approximately 2 inches to a thickness of about 1 inch or less, depending upon the wall thickness desired in the ducting. Both the mold and mandrel are preferably formed of metals such as standard or stainless steel and are perforated as shown at 19 and 20, since curing is preferably carried out within a hot air furnace in which the air is circulated by blowers. Utilizing such a system, the ducting is cured at a temperature between approximately 500° and 800°F. for a time of from about 1 to about 5 minutes. The curing temperature and time, of course, will vary depending upon the type and size of ducting being manufactured, as the greater the quantity of glass fibers, the greater the curing time which is required. In the production of 10 inches outside diameter ducting, using a 9 inch perforated standard steel mandrel and mold as illustrated with a compressed composite total wall thickness of approximately 1 inch (the fine and textile fibers being of approximately equal thickness and of the previously described glass fibers), a total curing time of about 3.5 minutes is required when using a curing temperature of 700°F.

The mold may be positioned within the oven in numerous ways, as for example, suspended from the ceiling of the oven, stacked on the floor, positioned on tables, etc. A continuous operation may also be used in which the mold is positioned upon a conveyor and passed through the oven at a speed such that the mold would be exposed to the circulating hot air for a time sufficient to effect curing.

In many instances, it may be desirable to apply a light coating of a parting compound, such as caruba wax or other such material to the exterior surface of the mandrel and to the interior surface of the mold cavity to prevent sticking of the fibrous material and thus facilitate the subsequent removal of the ducting from the mold and mandrel.

During curing, the two fibrous composites are bonded together by the phenolic resin in the composites as a result of the manner in which they are manufactured. When the temperature is increased sufficiently, the resins react and bonding thus occurs at the interface between the two composites to secure the same together and form a unitary fibrous cylinder.

After curing, the ducting is removed from the mold and mandrel and thereafter the outer covering is placed thereon. To achieve this, in one preferred method, the fibrous cylinder is placed within a metal cylinder. One end of the metal cylinder is then inserted into a plastic sock which is wound on a roll. Air is then injected into the interior of the metal cylinder and sock, which expands the sock sufficiently that the fibrous cylinder can be readily pushed through the metal cylinder and inserted into the sock. The air is then turned off, and the ends of the sock are trimmed to fit the fibrous cylinder.

Several materials can be used as the fluid-impervious sleeve, including various thin (approximately 3.0 to 3.5 mils), flexible substantially non-expandable plastic tubing such as polyvinylchloride or polyvinylidene chloride. Examples of such sleeves include those commercially available from Goodyear Tire and Rubber Company under the designation "TI43" and "AV1059", and from Clipay Corporation under the designation "2069".

In FIG. 5, a modified form of the ducting is shown in which a layer of thin aluminum or other metallic foil 25 is positioned between the inner and outer composites 26 and 27 of fine and textile fibrous material. The foil thus serves as a vapor barrier and enables gaseous fluids to be transmitted through the ducting. The foil normally will be wrapped about the inner composite and adhered thereto sufficiently by the phenolic resin of the composite to permit the textile material to be wrapped thereabout. If desired, a light coating of a phenolic or other such resin may be applied to facilitate bonding of the foil to the composites.

In some instances, the ducting may be also used as a duct liner in which case it is not necessary to include either the metal foil or the plastic sleeve.

It will be appreciated from the foregoing that by combining the two types of fibrous composites into a homogeneous construction, ducting has been provided which is resilient and yet has excellent compressive, tear and tensile strength to resist crushing or other damage which may result from improper handling or installation. The ducting also possesses the necessary characteristics of acceptable thermal and acoustical insulating and air flow qualities.

I claim:

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1. Ducting for the conducting of air, comprising a unitary fibrous cylinder of an inner composite of bonded fine fibrous material of relatively short fibers from three to about seven microns in diameter and a composite of textile fibrous material of long, substantially uniform diameter chopped fibers bonded about said inner composite, and a fluid-impermeable flexible sleeve positioned about said fibrous cylinder, said inner composite providing thermal and acoustical insulation properties to said ducting and a comparatively smooth interior surface to facilitate air flow through said ducting, and said composite of textile fibrous material providing a tough, resilient damage resistant surface.

2. The ducting of claim 1 in which and said textile fiber composite comprises chopped fibers of up to approximately four inches in length.

3. The ducting of claim 2 in which said inner and textile composites are of approximately equal wall thickness.

4. The ducting of claim 2 in which the thickness of

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said inner composite and said composite of textile fibrous insulating material are within the range of from about 10 to about 90 percent of the total wall thickness of said ducting.

5. Ducting for the conducting of air, comprising a unitary fibrous cylinder of an inner composite of bonded fine fibrous material of relatively short fibres of up to about seven microns in diameter, a layer of metal foil positioned about said inner composite and adhered thereto, and a composite of textile fibrous material of relatively long, substantially uniform diameter chopped fibres bonded about said layer of metal foil and said inner composite, said inner composite providing thermal and acoustical insulation for said ducting and a comparatively smooth interior surface to facilitate air flow through said ducting, and said composite of textile fibrous material providing a tough, resilient damage resistant surface for said ducting.

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