

Aug. 10, 1937.

R. D. LAMBERT

2,089,492

DUCT

Filed July 6, 1935

3 Sheets-Sheet 1

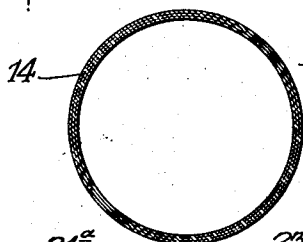
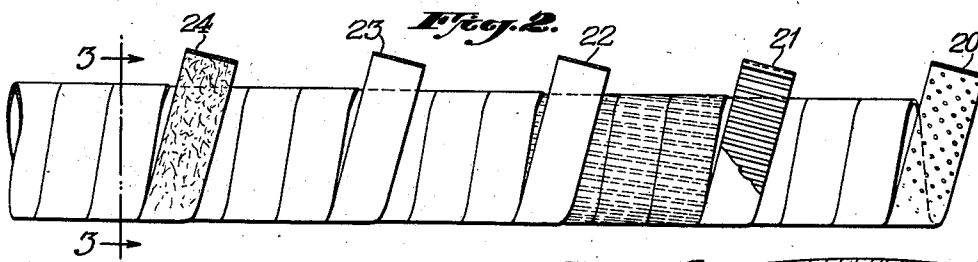
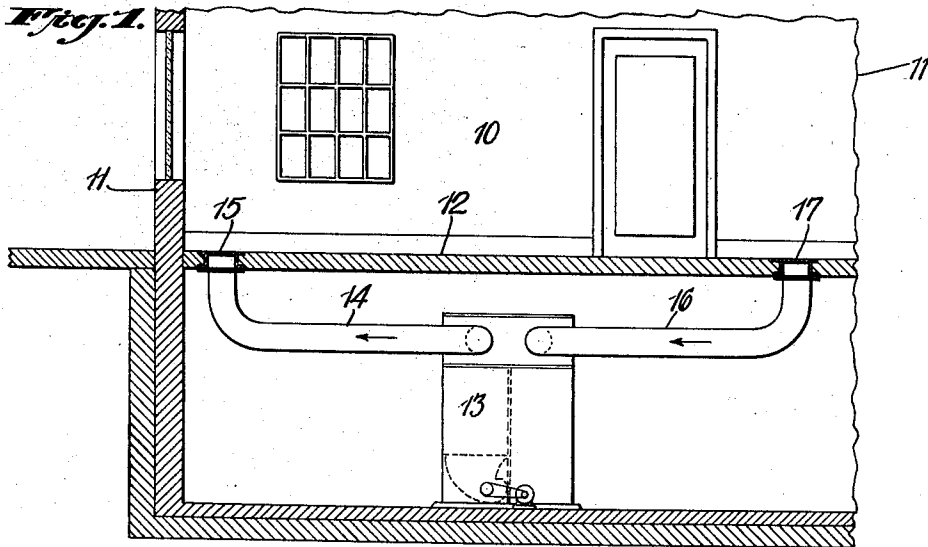


**Fig. 4.**

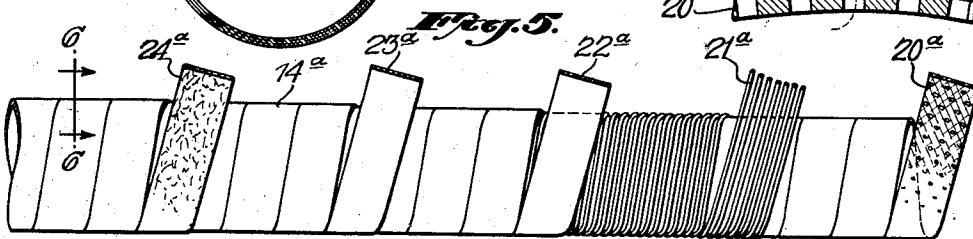
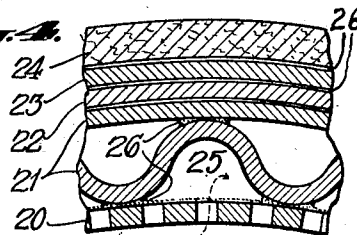
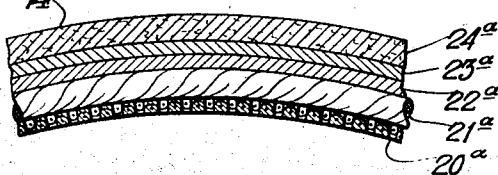


**Fig. 6.**



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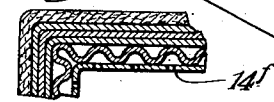
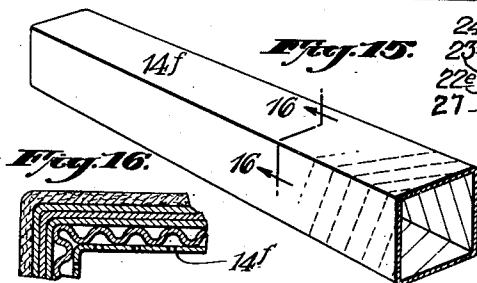
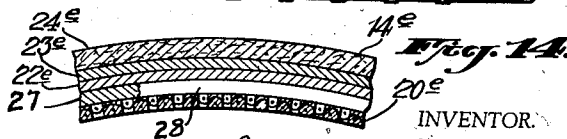
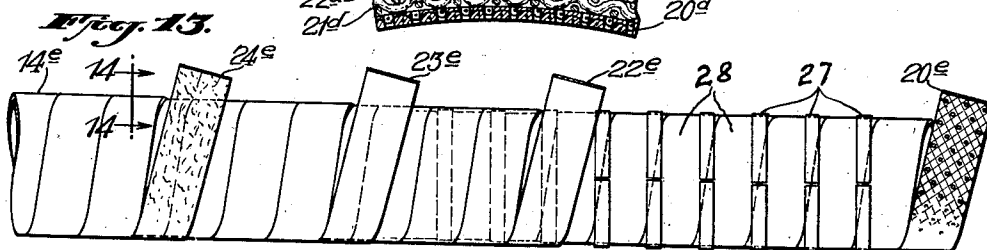
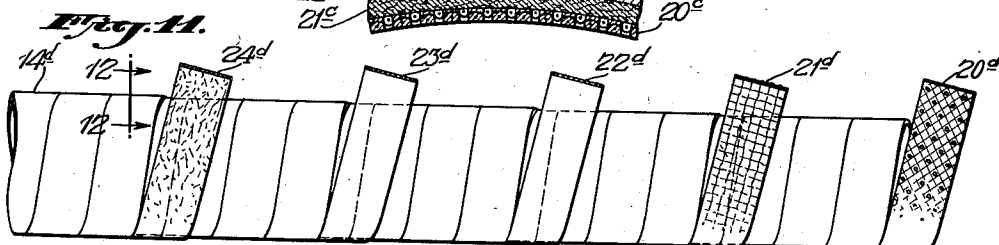
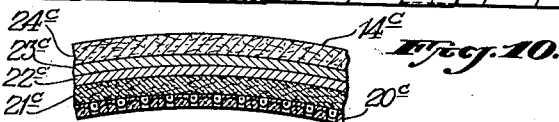
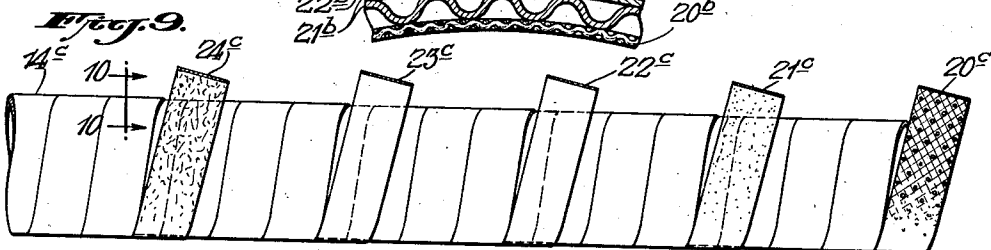
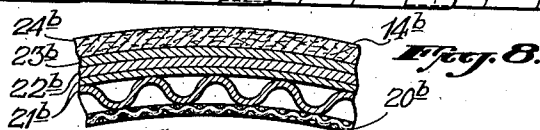
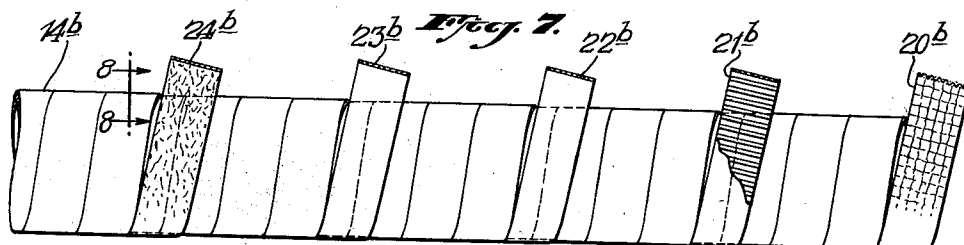
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DUCT

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DUCT

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*Fig. 17.*

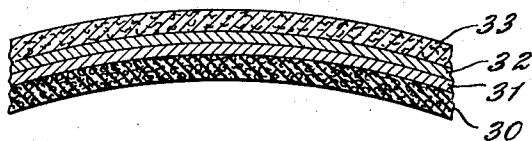


*Fig. 18.*

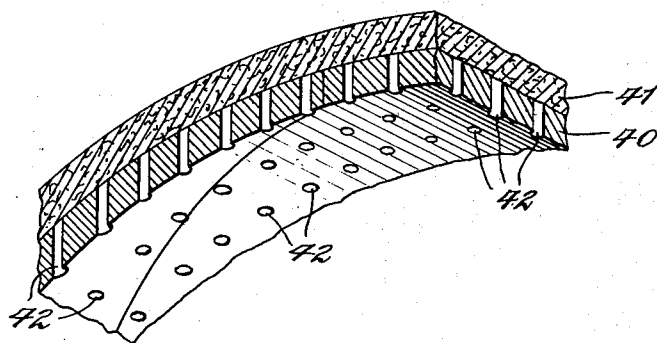
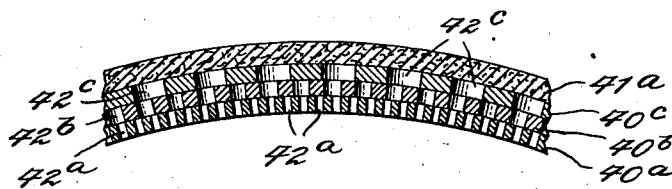


*Fig. 19.*



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## UNITED STATES PATENT OFFICE

2,089,492

## DUCT

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Application July 6, 1935, Serial No. 30,206

2 Claims. (Cl. 138—76)

My invention relates to apparatus for translating air and the like fluids, such, for example, as ventilating or air conditioning apparatus for buildings, houses, etc., and the invention has to do more particularly with improvements in the ducts used for conveying the air to and from different parts of the building.

In apparatus of this type, heretofore known to me, it is customary to convey air by either round, square or rectangular ducts formed of sheet metal, but such ducts are inadequate to meet the present day needs in that they are relatively difficult and expensive to install and because they transmit both the sounds of moving air and the mechanical sounds of the apparatus to the rooms of the building to which the ducts are connected.

An object of the present invention is to provide a relatively inexpensive duct which is strong and durable, which will effectively absorb sound waves, which may be readily cut into any desired length with ordinary carpenters' tools and which may be easily installed with a minimum of labor expense.

The invention consists in the novel construction and combination of parts, to be more fully described hereinafter, and the novelty of which will be particularly pointed out and distinctly claimed.

In the accompanying drawings, to be taken as a part of this specification, I have fully and clearly illustrated a preferred embodiment of my invention, in which drawings—

Figure 1 is a vertical, sectional view taken through a building and showing my invention as used for conveying conditioned air to the rooms and for conveying return air from the rooms to an air conditioner;

Fig. 2 is an enlarged, elevational view of a portion of a laminated duct constructed in accordance with the present invention and showing the ends of the layers unwrapped to illustrate more clearly the details of construction of the duct;

Fig. 3 is a transverse section through the duct, the view being taken on the line 3—3 of Fig. 2.

Fig. 4 is a fragmentary, transverse, sectional view of the duct taken on a further enlarged scale and illustrating more clearly the structural details of the duct;

Fig. 5 is a view similar in character to Fig. 2 and illustrating a modified form of construction;

Fig. 6 is an enlarged, fragmentary, transverse, sectional view taken on the line 6—6 of Fig. 5;

Fig. 7 is a view similar in character to Fig. 2 and illustrating a further modified form of duct construction;

Fig. 8 is an enlarged, fragmentary, transverse,

sectional view taken on the line 8—8 of Fig. 7;

Fig. 9 is a view similar in character to Fig. 2 and illustrating a third modified form of duct;

Fig. 10 is an enlarged, fragmentary, transverse, sectional view taken on the line 10—10 of Fig. 9;

Fig. 11 is a view similar in character to Fig. 2 and illustrating a fourth modified form;

Fig. 12 is an enlarged, fragmentary, transverse, sectional view taken on the line 12—12 of Fig. 11;

Fig. 13 is a view similar in character to Fig. 2 and illustrates a fifth modified form of my improved duct;

Fig. 14 is an enlarged, fragmentary, sectional view on the line 14—14 of Fig. 13;

Fig. 15 is a perspective view illustrating a square or rectangular duct constructed in accordance with the present invention;

Fig. 16 is an enlarged, fragmentary, sectional view taken on the line 16—16 of Fig. 14;

Fig. 17 is an enlarged, fragmentary, sectional view of a duct illustrating a further modified form of construction;

Fig. 18 is an enlarged, fragmentary, sectional view of a duct illustrating a still further modified form of construction, and

Fig. 19 is an enlarged, fragmentary, sectional view illustrating another modification of my improved duct construction.

In accordance with one preferred embodiment of my invention I provide a duct which is composed of a plurality of layers of fibrous material and secure the layers together by a suitable adhesive. The interior portions of the duct or those portions which contact the moving air, are formed of materials suitable for absorbing or deadening sound waves which is an important feature in installations where the air is propelled by blowers, fans, or the like, or is subjected to humidifying sprays. In the absence of sound deadening, such mechanical noises as these and the noise of the air moving through the fan and restricted passages of the apparatus would be transmitted to the rooms by the duct and result in discomfort to the occupants. The intermediate portions of the duct may be formed of one or more layers of material which function as a strengthening or stiffening means for the duct. The outside portions of the duct may be made fire-proof or, if desired, all of the layers may be made of fire-proof material, or material treated with a fire-proofing agent. The outside layer may also function as a stiffening means.

As will presently appear, the three functions of sound deadening, strength and fire-proof are

preferably present in each modification shown in the drawings. However, these functions need not necessarily be performed by any one layer or group of layers of material, as a separate layer or layers may be provided for performing each function, or more than one function may be performed by the same layer or layers of material. In addition, one or all of the layers of material may be made of materials having the characteristic of repelling moisture.

Referring now in detail to the construction illustrated, the reference character 10 indicates a room of a dwelling house comprising walls 11 and a floor 12. Air at the proper humidity and temperature may be delivered to the room 10 from an air conditioner 13 by a duct 14, the air entering the room through a grille covered opening 15 in the floor 12. Return air is conducted from the room 10 to the conditioner 13 by a duct 16 which is similar in construction to the duct 14, the duct 16 being connected to the room by a second grille covered opening 17 in the floor 12. Thus far, I have described one application of my improved form of duct. Other applications will be apparent as the description proceeds.

As stated previously, the ducts 14 and 17 may be formed in a variety of ways. In the modification shown in Figs. 2, 3, and 4, I have shown the duct 14 as comprising an interior or inner layer 20 of perforated asphaltum paper, a second layer 21 of corrugated paper board, two layers 22 and 23 of ordinary cardboard, and an exterior layer 24 of sheet asbestos, for example, in paper or woven form. Asphaltum paper is provided because it is a moisture repelling material, and the perforations are provided in the material so that sound waves will permeate the walls of the duct. If desired, the asphaltum paper may also be wrinkled to aid in its sound deadening and absorbing qualities. The corrugations in the paper layer 21 provide open spaces 25 for deadening and absorbing sound waves passing through the perforations of the interior layer 20. The cardboard layers 22 and 23 are for the purpose of stiffening and strengthening the duct, and the exterior layer 24 of asbestos or its equivalent is for the purpose of rendering the duct fire-proof.

The ducts 14 and 17 may be made in a variety of ways without departing from certain of the broader aspects of my invention. In Figs. 2, 3, and 4, I have illustrated a cylindrical duct formed of spirally wound layers of material. The interior layer 20 may be spirally wound on a mandrel with the edges of adjacent convolutions abutting one another. The next layer 21 may be spirally wound on the interior layer and in such a manner that the meeting edges of each convolution also adjoin one another and are spaced longitudinally of the duct from the meeting edges of the convolutions of the interior layer 20. Each remaining layer may be spirally wound on the previously wound layer in a similar manner.

Each layer may be secured to the previously wound layer by a suitable adhesive, which is preferably fire-proof; for example, by a solution of sodium silicate or water glass, thus rendering the duct more fire-proof, and incidentally contributing to its strength and rigidity. The sodium silicate is indicated at 26 in Fig. 4. If desired, all of the materials may be treated as by coating or impregnation with a fire-proofing agent, such, for example, as the sodium silicate solution. In such a case, the exterior layer of asbestos may be omitted, if desired.

In Figs. 5 and 6 I have shown a duct 14<sup>a</sup>

formed in a similar manner and with materials performing similar functions as the duct and materials shown in Figs. 2, 3, and 4. In Figs. 5 and 6 the interior layer 20<sup>a</sup> is formed of a perforated, closely woven fabric similar to oil cloth, known commercially as kribble cloth, the perforations performing the same sound absorbing function as the layer 20, previously described. The layer 21<sup>a</sup> may be formed of spirally wound cord or rope of fibrous material such as hemp or cotton and the convolutions thereof are spaced apart for the purpose of more effectively absorbing or deadening the sound waves passing through the layer 20<sup>a</sup>. The rope or cord may be several separate and parallel strands arranged in groups and the groups spirally wound as a unit on the layer 20<sup>a</sup>, as shown, or the rope may be a single strand continuously wound to provide the spaced convolutions. The layers 22<sup>a</sup>, 23<sup>a</sup>, and 24<sup>a</sup> are formed of cardboard and asbestos, as in the case of Figs. 2, 3, and 4. The several layers may be secured together by a fire-proof adhesive and may be impregnated or coated with a fire-proofing agent as explained in connection with the previously described embodiment.

In Figs. 7 and 8 I have illustrated a still different selection of materials for the several layers forming the duct. The duct 14<sup>b</sup> is provided with an interior layer 20<sup>b</sup> of loosely woven cloth so that the sound waves will permeate the same. The layer 21<sup>b</sup> is formed of corrugated paper, the layers 22<sup>b</sup> and 23<sup>b</sup> of cardboard and the layer 24<sup>b</sup> of asbestos.

In Figs. 9 and 10 the interior layer 20<sup>c</sup> is formed of perforated woven fabric such as oil-cloth or kribble cloth. The layer 21<sup>c</sup> is formed of a coarse fibrous material, such as acoustic felt which provides open spaces for the absorption of sound. The layers 22<sup>c</sup> and 23<sup>c</sup> are formed of cardboard and the layer 24<sup>c</sup> of asbestos.

In Figs. 11 and 12 the interior layer 20<sup>d</sup> is formed of perforated oil-cloth or kribble cloth, the layer 21<sup>d</sup> is formed of heavy, coarsely woven, fibrous cloth, such as jute fiber, burlap, or the like, such a cloth providing the open spaces for absorbing the sound. The layers 22<sup>d</sup> and 23<sup>d</sup> are formed of cardboard and the layer 24<sup>d</sup> of asbestos.

In Figs. 13 and 14, the layers 20<sup>e</sup>, 22<sup>e</sup> and 24<sup>e</sup> are formed of the same materials as the corresponding layers in Figs. 5, 7, 9, and 11, but the open spaces for the absorption of sound behind the layer 20<sup>e</sup> are provided by bands 27 of paper or other suitable material spaced longitudinally of the duct as shown, to form spaces 28 between the bands and the layers 20<sup>e</sup> and 22<sup>e</sup>.

In Figs. 15 and 16 I have illustrated a duct 14<sup>f</sup> which is rectangular in cross-section and is formed of the same layers of material as Figs. 2, 3 and 4. The rectangular duct may be formed in any suitable manner; for example, the layers may be spirally wound on a rectangular mandrel.

In Fig. 17 I have illustrated a portion of a laminated duct, wherein instead of having two interior layers to deaden the sound, as is the case in the previously described modifications, only one layer is provided for this purpose. The interior layer 30 of the duct is formed of sponge rubber or a like material having interstices therethrough which receive and absorb the sound waves. The layers 31 and 32 are formed of cardboard and the layer 33 is formed of asbestos or other suitable fire-resisting material.

In Fig. 18 I have illustrated a duct having

only two layers 40 and 41. The layer 40 is on the inside of the duct and is formed of fiber board perforated as indicated at 42 for receiving and absorbing the sound waves. The fiber board performs the dual function of strength and sound absorbing. The layer 41 is formed of asbestos.

In Fig. 19 I have illustrated three layers of fiber board 40<sup>a</sup>, 40<sup>b</sup> and 40<sup>c</sup>, which are perforated as indicated at 42<sup>a</sup>, 42<sup>b</sup> and 42<sup>c</sup> respectively. As shown, the perforations 42<sup>a</sup> are relatively small and are arranged relatively close together. The perforations 42<sup>b</sup> are larger than perforations 42<sup>a</sup> and spaced farther apart, and the perforations 42<sup>c</sup> are still larger and spaced still farther apart. This construction provides extremely effective sound deadening, as the perforations of the several layers overlap and communicate with one another and thereby provide spaces, which increase in size toward the outside of the duct, for receiving and absorbing the sound waves. The layer 41<sup>a</sup> is formed of suitable fire-proof material.

From the above it will be readily seen that I have provided a duct which is unusually strong and durable, is fire-proof, and one which will effectively absorb sound, thus providing a duct which meets the requirements of air conditioning and ventilating apparatus. The duct is formed of material which can be readily cut and joined by the conventional carpenters' tools or their equivalents.

What I claim and desire to secure by Letters Patent of the United States is:—

1. An elongated laminated tubular duct for conducting air and like fluids and formed of a plurality of superimposed layers of fibrous material; said duct comprising an inner or first layer of fibrous material having a multitude of small openings therethrough for the passage of sound waves from the inside of the duct; a second layer covering and directly secured to the exterior surface of the inner layer and formed of a fibrous material having relatively large air spaces communicating with the relatively small openings through the inner layer for the purpose of receiving and deadening the sound waves transmitted through the relatively small openings, and a third layer of relatively stiff fibrous material covering and engaging the second layer.

2. An elongated laminated tubular duct for conducting air and like fluids and formed of a plurality of superimposed layers of fibrous material; said duct comprising an inner or first layer of perforated paper, a second layer of corrugated paper covering and directly secured to the inner layer and so arranged that sound waves passing from the interior space of the duct through the perforations of the inner layer will enter the relatively large spaces between corrugations in the second layer and be deadened thereby, and a third layer of relatively stiff fibrous material engaging and covering the second layer.

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