April 27, 1954 K. J. SYLVEST 2,676,851

CONVEYING APPARATUS

Filed March 18, 1952

Fig. 1,

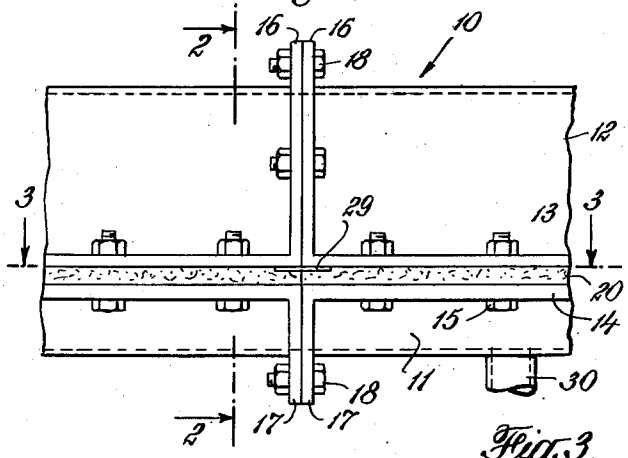


Fig. 2,

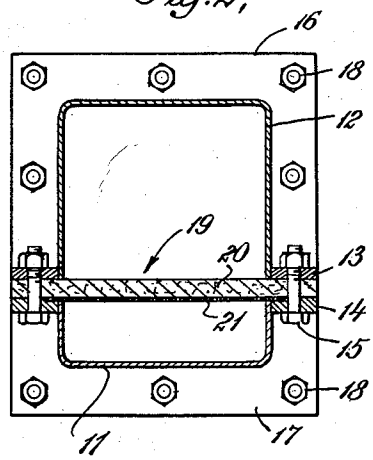


Fig. 3,

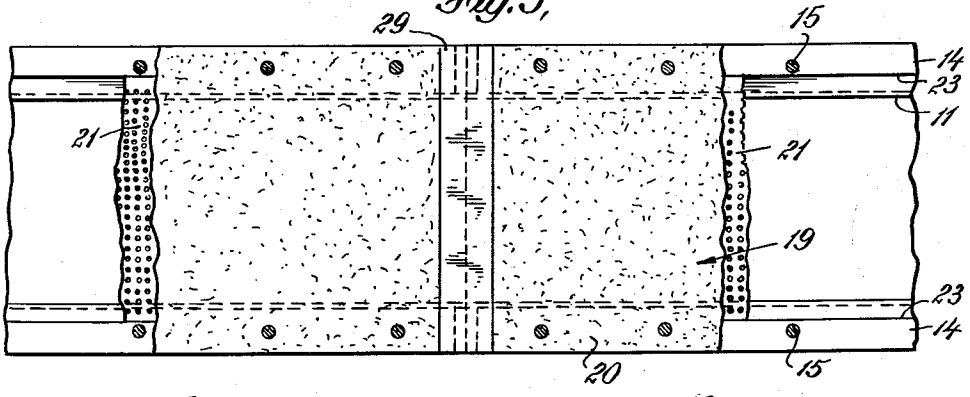


Fig. 5,



Fig. 4,

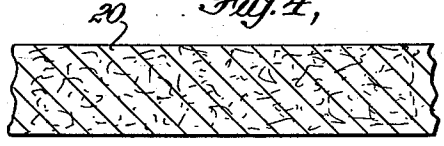


Fig. 6,

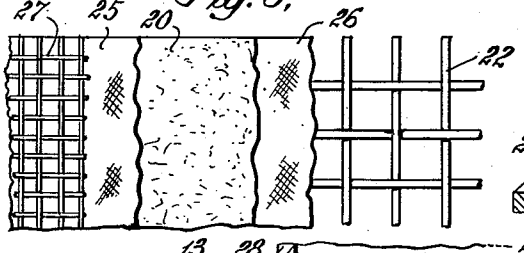


Fig. 7,

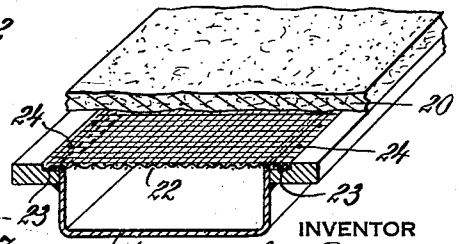
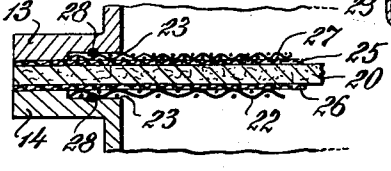


Fig. 8.



INVENTOR
Karl Jens Sylvest
BY
Pennie Edmonds, Morton, Barrows & Taylor
ATTORNEYS

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CONVEYING APPARATUS

Karl Jens Sylvest, Copenhagen, Denmark, assignor to F. L. Smidth & Co., New York, N. Y., a corporation of New Jersey

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6 Claims. (Cl. 302—29)

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This invention relates to apparatus for conveying granular and pulverulent materials, which includes a trough or a tube or other duct having an air-permeable diaphragm supporting the material and means for maintaining air under pressure against the under surface of the diaphragm. The air passing through the diaphragm fluidizes the material and the material is then advanced along the trough, etc., by gravity or, if the diaphragm is within a closed space, may be propelled by air under pressure.

In conveying apparatus of the kind described, the trough or duct usually consists of upper and lower parts secured together with the side edges of the diaphragm gripped between them. The material frequently used is porous filter stone, which is quite brittle, and, when such stones are employed, it is necessary to set them in special frames or to employ resilient packing with them. The frames or packing are necessary in order to seal the side edges of the diaphragm and prevent leakage of air by-passing the diaphragm and the frames or packing also protect the diaphragm against being broken during its installation. Canvas has been used as the diaphragm material, but, if the diaphragm is made of only one or a few layers of canvas, a good seal requires the use of packing.

The present invention is directed to the provision of a novel diaphragm for use in conveying apparatus, which affords a number of advantages over those heretofore used for the purpose. The new diaphragm is sufficiently strong and rigid to carry the material being conveyed and, at the same time, is sufficiently resilient, so that it can withstand without injury the clamping pressure, which must be applied along its side edges by the upper and lower parts of the conveyor structure to prevent escape of air around those edges. The use of the new diaphragm thus does not require either special frames or resilient packing.

The essential element of the new diaphragm is a porous compressible body of unspun fibres lying at random to one another and bound together either by means of a binder or by being felted. The fibres may be of mineral, vegetable, or animal origin and the diaphragm may be made, for example, of plates of wood fibre, such as are commonly used for heat insulation. The plates may also be made of fibres of glass or mineral wool or asbestos held together by a binder, such as water glass or "sorell" cement, which is a mixture of magnesium chloride and magnesium oxides. Plates of the kinds mentioned may readily be made with the desired degree of porosity, which should be such that the pressure drop across such a plate is between 2" and 6" water gauge, when the amount of air passing through the plate varies from 3.5 to 7 cu. ft. of air per minute per square foot of area. The plates may be from 0.2" to 0.8" thick, but, if the plates are as thin as 0.2", it is advantageous to support them on perforated sheetmetal, so that they will properly carry the weight of the material being conveyed.

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Felt made of interlocked animal fibres is elastic enough to withstand clamping without injury and may be of the desired porosity. If the felt is sufficiently thick, it may be used alone, but it is preferably provided with a support of openwork or perforated metal. It is also preferable to protect one or both faces of the felt with a layer of canvas. A diaphragm comprising a sheet of felt may thus include a canvas layer covering the felt and protecting it against abrasion by the material being conveyed, a supporting network of metal, and a lower canvas layer between the under side of the felt and the network. The lower canvas layer not only protects the felt from damage by the netting but also makes it possible to use a felt of somewhat looser construction and greater porosity than would otherwise be suitable.

The upper surface of any of the fibrous diaphragms described may be advantageously provided with a covering of openwork or perforated metal. Such a metal sheet checks the movement of the layer of material being conveyed, which lies closest to the diaphragm, and thus reduces abrasion of the upper surface of the diaphragm by the material. The metal sheet clamped at its edges between the upper and lower parts of the conveyor structure also resists any tendency of the diaphragm to arch upward by reason of the pressure differential across the diaphragm and thus tends to maintain an even air distribution.

An example of a diaphragm with a support and a cover may consist of the following layers from top to bottom:

1. Netting made of 1 mm. wire with a mesh of 3–4 mm.
2. Sheet of 12 oz. canvas.
3. Sheet of felt 7 mm. thick.
4. Sheet of 12 oz. canvas.
5. Netting made of 2 mm. wire with a 10 mm. mesh.

When such a diaphragm is used for the conveyance of Portland cement in a trough inclined at 4° to the horizontal, a suitable flow of air is 5.25

to 7 cu. ft. of air per min. per sq. ft. of diaphragm surface and this is accompanied by a pressure drop of 8''–10'' water gauge across the diaphragm.

For a better understanding of the invention reference may be had to the accompanying drawing in which

Fig. 1 is a view in side elevation of a portion of a conveying apparatus embodying the invention;

Figs. 2 and 3 are sectional views on the lines 2—2 and 3—3, respectively, of Fig. 1;

Fig. 4 is a vertical sectional view through the fibrous element of the new diaphragm;

Fig. 5 is a vertical sectional view through a form of the diaphragm including woven and metallic sheets.

Fig. 6 is a plan view, with parts broken away, of the diaphragm shown in Fig. 5;

Fig. 7 is a perspective view showing the manner of mounting the lower metallic member of the diaphragm; and

Fig. 8 is a fragmentary sectional view showing the manner of mounting the diaphragm shown in Fig. 5.

The apparatus shown in Fig. 1 comprises a duct 10 made up of a trough 11 and a cover 12 of inverted trough shape, which are provided, respectively, with lateral flanges 13, 14 secured together by bolts 15. The trough and cover are made up of sections provided, respectively, with end flanges 16, 17 connected together by bolts 18, and the duct consists of the required number of trough and cover sections to produce a duct of the desired length.

The duct 10 is divided into two parts by a diaphragm 19, which extends across the duct and has its edges clamped between flanges 13 and 14, the bolts 15 passing through openings in the diaphragm. The diaphragm comprises a porous compressible layer 20 of unspun fibres lying in random distribution and bound to one another and the layer may be a plate of wood fibres, such as is commonly employed for heat insulation, or it may be made up of fibres of glass or mineral wool or asbestos bound by a suitable binder. As an alternative, the layer may be made of fibres of animal origin bound together by felting.

The diaphragm may consist only of the fibrous layer 20, in which event, the layer must be of substantial thickness in order to support the weight of the material being carried. It is preferable to use a somewhat thinner layer and to give it rigidity and strength by employing with it an openwork metal sheet 21. The sheet may have a multiplicity of fine perforations or, if preferred, it may be a woven wire screen 22. When the supporting metal sheet is employed, its width is less than the overall width of flanges 14 of trough 11 and the upper surfaces of the flanges are preferably countersunk, as indicated as 23, to receive the edges of the sheet. The edges of the sheet lying on the flanges are then secured in place by spot-welding, as shown at 24. With this arrangement, the compressible layer 20 makes contact with the faces of the flanges beyond the edges of the metallic sheet.

In some cases, it may be desirable to provide the diaphragm with protective facings 25, 26 of woven fabric. Such a facing may be applied to either surface of the fibrous layer 19 and the fabric sheets serve different purposes as follows: The upper sheet 25, with which the material being conveyed comes into contact, protects the fibrous layer from abrasion by the material. The lower fabric sheet 26 protects the fibrous layer against damage by the metal sheet 22, when the latter is used, and also assists in controlling the rate of flow of air through the diaphragm, so that the fibrous body 20 may be of somewhat greater porosity than would otherwise be desirable.

It is also desirable in some instances to construct the diaphragm with an upper openwork metal sheet, such as the screen 27. When such a screen is employed, it is of less width than the overall width of the flanges 13 on the upper member of the duct, and the flanges 13 are countersunk to receive the edges of the sheet 27. The edges of the sheet are then held in position by spot-welding, as indicated at 28. The sheet 27 resists the tendency of the diaphragm to bulge upwardly by reason of the differential pressure on its opposite faces and also tends to insure a uniform distribution of air. The metal sheet also checks the movement of the layer of material nearest the diaphragm and thus reduces the abrasive action of the material.

The diaphragm is made up in sections and, at the places where the ends of adjacent fibrous layers 20 meet, the edges may be covered by an impermeable metal strip 29, which extends across the duct and is clamped at its ends by the flanges 13, 14. The strip should be relatively narrow, so that the material will not be retarded in flowing over it. When the porous body 20 is made of felt, adjacent lengths of the felt may be secured together by scarfed or butt joints, the latter being glued. Joints in the fabric sheets can be made by slight overlapping and the metal sheets may be either butted or slightly overlapped.

In the operation of the apparatus, air is supplied to the interior of the trough 11 through inlets 30 spaced along the trough 11 and the air passes upward through the diaphragm and is diffused through the material lying thereon to render the material fluent. The duct is inclined so that, when the material is fluidized, it flows through the duct by gravity. The duct need not have a cover 12, but, if the cover is omitted, elements similar to flanges 13 are provided, so that the edges of the diaphragm can be clamped. The duct may be of any desired cross-section and may be straight or curved.

All forms of the diaphragm described include the porous compressible layer 20, which can be clamped directly between flanges 13, 14 of the members of the duct without the use of special frames or resilient packings. The clamping of the layer so compresses the clamped portions thereof as to seal them, with the result that air cannot escape through the edges of the diaphragm, but must flow upwardly into the material lying thereon. Because of the compressibility of the diaphragm structure, it is not subject to breakage when being installed and, when used in an uncovered trough, there is no likelihood of its being injured by a foreign object dropping into the trough.

I claim:

1. In conveying apparatus having a trough with spaced flat top surfaces and means supplying air under pressure to the interior of the trough, a diaphragm resting on said surfaces to close the top of the trough and comprising a porous yielding layer of unspun fibers bound together in random distribution within the layer and a sheet of porous woven textile fabric covering and in direct contact with one face of the layer.

2. In conveying apparatus having a trough with spaced flat top surfaces and means supply-

ing air under pressure to the interior of the trough, a diaphragm resting on said surfaces to close the top of the trough and comprising a yielding porous layer of compressible unspun fibers bound together in random distribution within the layer, a sheet of woven textile fabric covering and in direct contact with a face of the layer and an openwork metal sheet covering and in contact with the outer face of the sheet.

3. In conveying apparatus having a trough with spaced flat top surfaces and means supplying air under pressure to the interior of the trough, a diaphragm resting on said surfaces to close the top of the trough and comprising a layer of felt and a sheet of canvas covering and in direct contact with one face of the layer.

4. In conveying apparatus having a trough with spaced flat top surfaces and means supplying air under pressure to the interior of the trough, a diaphragm resting on said surfaces to close the top of the trough and comprising a layer of felt and sheets of canvas covering and in direct contact with the opposite faces of the layer.

5. In conveying apparatus having a trough with spaced flat top surfaces and means supplying air under pressure to the interior of the trough, a diaphragm resting on said surfaces to close the top of the trough and comprising a layer of felt, a sheet of canvas covering and in direct contact with one surface of the felt and an openwork metal sheet covering and in direct contact with the outer surface of the canvas.

6. In conveying apparatus having a trough with spaced flat top surfaces and means supplying air under pressure to the interior of the trough, a diaphragm resting on said surfaces to close the top of the trough and comprising a porous yielding layer of unspun fibers bound together in random distribution within the layer and a sheet of porous woven textile fabric covering and in direct contact with one face of the layer, said diaphragm having a gas-permeability such that the pressure drop thereacross is between two inches and six inches water gauge when the amount of air passing through the plate varies from 3.5 to 7 cu. ft. of air per minute per square foot of area.

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