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(54) **Methods and apparatus for introducing air-entrainable material into a channel or recess**

Methoden und Geräte zum Einführen von durch Luft angetriebenem Material in einem Kanal oder einer Aussparung

Procédés et appareils d'introduction d'un matériau entraînable par l'air dans un canal ou un évidement

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Description

[0001] This invention relates to methods and apparatus for introducing air-entrainable material such as, for example, insulating material, into an open recess or channel and to products so formed. In particular, but not exclusively, the invention relates to methods and apparatus for introducing insulating fibre material such as fibrous or foam material into an open frame element such as a timber frame.

[0002] Houses may be built using a timber frame construction method in which timber-framed panels are manufactured in a factory and then erected on site. As shown in Figure 1 of the accompanying drawings, a typical panel comprises a timber "studding" framework of elements typically 90 mm x 40 mm with a plywood sheathing board forming the external skin and plasterboard the internal skin. Alternative materials may sometimes be used, and a polythene vapour control layer may be included under the plasterboard. The vertical studding is normally placed at fixed modular distances, for example 600 mm, but as seen in Figure 1, design considerations often result in complex arrangements of the studs, e.g. where a door or window is included. The panels are normally insulated by pressing mineral fibre "quilt" or "batts" between the studding, prior to fixing the plasterboard.

[0003] Use of mineral fibre quilt or batts requires cutting the material to size and fitting in the recesses and this is time consuming and awkward and special precautions may need to be taken with the mineral fibre.

[0004] As an alternative to mineral fibre quilt, it is possible to use a loose-fill insulation of fibres such as mineral fibre or, preferably, cellulose fibre. In this method, the fibres are compressed into the space so as to give a stable fill which will resist settlement over time. Previous methods of insulating panels in this way have included drilling holes in the top or bottom stud of the panel, between each pair of vertical studs, and inserting a lance through the hole through which fibre is blown. The lance is fully inserted and then gradually withdrawn as filling proceeds. Alternatively holes may be drilled in either the plywood or plasterboard skins and then a nozzle can be inserted through the hole through which the fibre is blown.

[0005] There are many disadvantages involved with these methods. The panels are damaged, which is not easy to make good. It is difficult to provide an even fill without localised areas of high density and of low density (which may give rise to settlement of the fibre over time). The complexity of many panels can make the methods difficult or impossible to employ. Since the filling is being done "blind" through a single aperture into each recess, it is not possible to make a visual check to ensure that the filling is complete and uniform. US-A-2989790 discloses a method for filling wall cavities with insulating material. In this method the wall cavity is vertical and a mesh is temporarily attached between studs to define a cavity which is filled by lowering a filling head to the bottom of the cavity and then blowing material through the head whilst moving the head back and forth and up and down to tamp the discharged insulating material.

[0006] We have developed a system for introducing or packing insulating material into the recesses of a timber frame panel, which overcomes or mitigates at least some of the above disadvantages.

[0007] Accordingly, in one aspect of this invention, there is provided a method of introducing air-entrainable material into an open channel defined by a base and two spaced longitudinal side walls, the side walls terminating in respective generally co-planar surface regions defining the top of the channel, wherein said method includes applying to said channel a filling head dimensioned to span at least one of the width and length of the channel and to lie adjacent the top of the channel, said filling head having a cover plate associated therewith, thereby temporarily to cover said channel locally to define a local cavity, delivering into said cavity a blown mixture of air and air-entrainable material while substantially reducing or preventing leakage of the air-entrainable material, and effecting relative movement of said channel relative to said filling head, progressively to fill said channel.

[0008] The terms "upwards", "downwards", "transversely" etc. as used herein refer to the various items when the recess or channel extends generally horizontally, and the terms "leading" and "trailing" refer to the direction of relative movement of the filling head and the channel.

[0009] In one arrangement, where said filling head is disposed to span the width of the channel, said method may include effecting relative movement of said filling head longitudinally along said channel to fill said channel, or a plurality thereof.

[0010] Various filling movements are possible, depending on the shape and configuration of the recesses or channels and the size of the cover plate means. Thus, where a series of elongate channels of generally constant width are to be filled with fibre, the cover plate means and said point of delivery may be moved along each said channel to fill one channel or recess at a time, with the width of the cover plate means being sufficient to extend between opposite sides of said channel.

[0011] Alternatively, in a particularly preferred embodiment for filling a plurality of side by side longitudinal channels, a much larger cover plate may be used, long enough to span the entire length of at least one of the channels. Here the cover plate means and the point of delivery may be held stationary whilst the panel is moved beneath them in a single pass so that the channels move transversely in succession under the cover plate.

[0012] The step of substantially preventing or reducing leakage of insulating or other air-entrainable material from said recess or channel may be achieved in a variety of ways. As the cover plate means moves in a

given direction relative to a recess or channel, the insulating or other air-entrainable material at the trailing edge of the cover plate (in the sense of said movement direction) will already have been compressed by the delivery of material and this will prevent or reduce leakage from the trailing edge. However, at the leading edge of the cover plate means, where the bulk of the filling has yet to form, it is also necessary to prevent or reduce leakage. In one example, the leakage prevention means comprises an extended leading edge for the cover plate means which is selected with regard to the other operating parameters such as the air velocity, fibre size, filling depth, size and effective friction coefficient of the cover plate means etc, so that the accumulated friction applied both by the leading edge portion of the cover plate means and the opposing base and sides of the recess or channel is sufficient substantially to prevent or reduce leakage of material. The length of the leading edge portion of the plate required for any particular application may easily be determined by one skilled in the art using routine experimentation.

[0013] Alternatively, in one special case, where the filling head is moved longitudinally with respect to the channels or recesses, and it is known that the channels or recesses are of substantially the same width and that there are no obstructions or intermediate timbers above a pre-set height in the channel or recess, the cover plate means may be provided with a downwardly projecting wall for retaining insulating material within said recess or channel.

[0014] Preferably, a screeding plate is disposed aft of the filling head in the sense of the relative movement thereof relation to the channels and is moved or oscillated relative to the filling head, over the surface of a filled channel to smooth the surface thereof, and to agitate or disturb the air-entrainable material within said filling head.

[0015] The delivery pressure of the blown mixture may be monitored, and the speed of relative movement of the filling head relative to said channel controlled in accordance therewith.

[0016] Likewise, the delivery pressure of the blown mixture may be monitored and the pressure of the air inlet to the filling head controlled in accordance with the monitored delivery pressure to maintain it below a preset level.

[0017] Preferably the cover plate means and said point of delivery are incorporated in an applicator head means, which provides a filling chamber, for example of generally conical or trihedral shape which allows the insulating or other air-entrainable material to flow across the whole width of the channel or recess.

[0018] Preferably, the insulating or other air-entrainable material is agitated prior to or adjacent said delivery point.

[0019] In a further aspect of this invention there is provided a method of producing an insulated panel, which comprises providing a framework which is closed on one side of the frame by one orimore skin means to provide an open-topped framework panel, having a generally horizontal array of open channels separated by respective frame members, using a method as defined above to introduce insulating material into one or more of said channels, and then securing one or more skin elements to the other side of said framework to close said recesses and produce an insulated panel.

[0020] In yet another aspect of this invention, there is provided apparatus for use in a method of introducing air-entrainable material to an open channel as described above, said apparatus comprising a filling head having an inlet for receiving a mixture of air and air-entrainable material, a filling chamber of divergent form, and a cover plate extending transversely thereof, wherein the cover plate defines a continuous co-planar peripheral region adapted in use to engage material delivered through said filling head, and said cover plate is adapted in use to span at least one of the width and the length of the channel and to prevent or reduce leakage of air-entrainable material from said channel, the apparatus further including a workpiece support for supporting a panel comprising the channel below said filling head, and traverse means for moving said panel with respect to said filling head.

[0021] Preferably, said means for preventing or reducing comprises an extended portion of said cover plate means of length such that the friction accumulated between said extended portion and said material in use is sufficient to prevent or reduce leakage.

[0022] Alternatively, said means for preventing or reducing leakage may comprise a weir or blocking plate means projecting from said one surface of said cover plate means into said recess or channel in use.

[0023] Said discharge means preferably comprises a filling chamber, typically of conical or polyhedral form open to said one side of said cover plate means for receiving said mixture and discharging it across at least a substantial portion of the width of the recess or channel.

[0024] The filling head preferably comprises a trailing wall extending generally vertically and a leading wall inclined at an acute angle to said trailing wall. The leading wall may be inclined at an angle of between 45° and 65° to said leading wall, and more preferably at an angle of about 60° to said leading wall.

[0025] The filling head may comprise a plurality of feed inlets disposed along the length of the filling head with the feed inlets preferably being disposed in an upper wall or roof of said filling head.

[0026] The apparatus may further include means for agitating or disturbing said air-entrainable material within said filling chamber, said means for agitating comprising an agitating member movably mounted adjacent the trailing region of said filling chamber and projecting into said chamber, and drive means for moving said agitating member. The means for agitating may further include a screeding plate having a leading edge region which projects into said filling chamber and defines a lower

surface for screeding the surface of air-entrainable material in said panel.

[0027] The apparatus may also include means responsive to the delivery pressure to the filling head to control the rate of movement of said traverse means in accordance therewith.

[0028] Where the apparatus is intended to allow filling of panels whose dimension in the direction parallel to the longitudinal axis of the filling head varies along the length of the panels, it may include a blanking means movably associated with the underside of said filling head, and biased into engagement with an edge of said panel, whereby the longitudinal dimension of the effective discharge aperture defined by the open end of the filling chamber is varied in accordance with the dimension of the panel.

[0029] The apparatus may include finishing means disposed aft of the filling head to finish the surface of the air-entrainable material in the panel; the finishing means may comprise at least one of a rotatable roller and a moving belt moving in the same sense as said panel.

[0030] The invention may be performed in various ways, and various embodiments thereof will now be described in detail, reference being made to the accompanying drawings, in which:-

Figure 1 is a side elevation of the skeletal framework studding of a typical conventional timber frame panel;

Figure 2 is an underneath plan view of the timber frame panel of Figure 1;

Figure 3 is a schematic top plan view of a first embodiment of filling head in accordance with a further aspect of this invention applied to fill an elongate recess;

Figure 4 is a sectional view through the first embodiment of filling head of this invention illustrated in Figure 3;

Figure 5 is a schematic view illustrating one possible path for filling a timber frame panel of the type shown in Figure 1;

Figure 6 is a transverse section view, on an enlarged scale, of the first embodiment of filling head;

Figure 7 is a section view through a second embodiment of filling head in accordance with the invention, intended for use with panels made up of a series of substantially unobstructed recesses of generally uniform width;

Figure 8 is a view from above of a third embodiment of an extended filling head for filling a timber frame panel in a single uni-directional sweep in a direction transverse to the longitudinal channels of this panel;

Figure 9 is a side view of the arrangement of Figure 8;

Figures 10 and 11 are schematic section and underneath plan views respectively of a first form of agitation mechanism for a filling head of this invention;

Figure 12 is a schematic underneath plan view of an embodiment of agitation mechanism for use with embodiments of extended filling head of the type shown in Figures 8 and 9;

Figure 13 is a schematic transverse section view through a fourth embodiment of an extended filling head for filling a timber frame panel in a single uni-directional sweep in a direction transverse to the longitudinal channels of the panel;

Figure 14 is a schematic plan view of the fourth embodiment of filling head;

Figure 15 is a detailed view of the leading edge of the screeding plate used in Figures 14 and 15;

Figure 16 is a schematic transverse section view of the fourth embodiment of this invention fitted with a finishing roller;

Figure 17 is a schematic transverse section view of the fourth embodiment of this invention fitted with a finishing belt;

Figure 18 is a plan view of a fifth embodiment of this invention fitted with a moveable blanking plate, and

Figures 19(a) to (d) are plan views showing the orientation of the blanking plate with respect to the filling head for a variety of different shapes of panel workpiece.

[0031] Referring initially to Figures 1 and 2, a typical conventional timber frame panel 10 is made up of vertical studding 12 connected at the lower end to a sole plate 14 and at the upper end to a top plate 16. Generally, the spacing between the vertical studding 12 is uniform except where there is an aperture 17 for a door or window. In addition, adjacent vertical studs 12 may be interconnected by a noggin 18. This timber studding framework is sandwiched between an outer plywood sheathing 20 and an inner plasterboard skin 22 to provide a timber frame panel. During production, the internal cavities of the timber frame panel are filled with insulating material either in the form of quilts or batts, or by blowing fibres.

[0032] In the embodiments to be described below, before the final inner (or outer) skin is applied, a travelling applicator head of special design traverses the surface of the panel to blow fibre continuously into a running chamber as the applicator head moves smoothly over the surface.

[0033] Referring now to Figure 3, in its simplest form, the applicator head 24 comprises a generally flat cover plate 26 which is wide enough to fill one channel between two timber studs (typically spaced at 600 mm). In order to fill the channel or recess between the two timber studs, the filling head is advanced in the direction of the arrow A whilst a mixture of air and fibre is blown through the filling chamber 28. As will be seen from Figures 3 and 4, the cover plate has an extended leading edge 30 which effectively closes the leading edge of the cavity into which the fibre is blown under pressure. Because

of the direction of movement, the fibre at the trailing edge is already packed to a stable state and therefore the trailing edge can be much shorter. The length of the leading edge is such that there is sufficient friction provided between the surfaces of the underlying sheathing panel 20 and the underside of the leading edge 30 to resist the blowing pressure which might otherwise force fibre out from below the plate 26, thus preventing a complete and well-compressed fill. We have found that this dimension is typically about 5-10 times the depth to be filled.

[0034] The filling chamber 28 may take many forms but in this example takes a hollow conical shape, as seen in figures 4 and 6. This shape effectively spreads the pressure evenly across the width of the channel to be filled, giving a correspondingly even density which cannot be obtained with the earlier drill and fill processes. Additionally, the chamber has the great advantage of allowing complex sections to be filled, where for example intermediate studs 121 are encountered as in the channel or recess identified at 32 on Figure 1. As seen in Figure 6, it can be seen that the chamber allows fibre to flow to each side of the intermediate stud 12^1 whereas, if there were no filling chamber and a simple access hole, the channel to one side of the intermediate stud would not be filled.

[0035] As seen in Figure 5, the filling head is traversed in serpentine fashion along adjacent recesses or channels and filling proceeds over the entire panel, irrespective of the position of additional timbers, whether they be at right angles or parallel to the direction of travel. Any areas designated as windows 17 or doors (i.e. sections not to be filled with insulation) can be fitted with temporary blanking plates over which the filling head 28 may traverse without obstruction, but without the ingress of fibre which continues to be held under pressure within the filling chamber 28.

[0036] Once the filling head 24 has traversed the entire panel, the fibre fill may be visually inspected for completeness of fill, density etc before the inner plasterboard skin 22 is applied to complete the panel.

[0037] Although in this example the panel is initially part-formed with the outer skin and the skeletal framework, it could of course be partly formed with the inner skin and the skeletal framework. It is of course preferred to keep the panel horizontal during the filling process although we do not exclude the possibility of the panel being oriented differently.

[0038] In the above embodiment, the head has a width slightly larger than the typical horizontal spacing of the timber studs 12, and traverses the recesses one by one moving generally longitudinally with respect to each recess.

[0039] Referring now to Figure 7, a second embodiment of filling head 24 is illustrated in which the leading edge of the cover plate is foreshortened and a cavity closing piece or weir 34 projects downwardly from the underside of the cover plate to retain fibre within the channel. This design is intended for the special case where it is known that channels will always be of similar width with no obstructions or intermediate timbers.

[0040] Referring now to the arrangement of Figures 8 and 9, there is shown an alternative fixed filling head 44 which spans the whole side of the timber frame panel and under which a panel sweeps in a single direction relative as shown by the arrow B, to enable the whole panel to be passed at a controlled speed under the head. This arrangement is particularly preferred for semi-automated production of timber frame panels because movement in a single direction only is required, and a wide variety of different designs of the panel can be filled. Here the head 44 includes a cover plate 26, and an elongate filling chamber 48 of generally trihedral cross section as seen more clearly in Figure 9. The filling chamber 48 is supplied with a mixture of air and fibres through the hoses 46. In this arrangement, the head 44 fills the panel one channel at a time but it fills across the channel rather than along its length. The chamber 48 can be of various designs but a trihedron as shown has been found to be effective in providing a good flow and even dispersion without resulting in blockages within the chamber.

[0041] Referring now to Figures 10 and 11, it is found that the above arrangements may be enhanced by using methods which help to "fluidise" the fibre within the filling chamber 28, thus improving the ability of the fibre to flow willingly and easily even into very small cavities. We have devised two methods which may be used either separately or in combination, namely mechanical agitation and air pulsing. In Figures 10 and 11, a mechanical agitator is disposed within the filling chamber 28 or 48 and comprises a blade 50 mounted on a vertical shaft which is rotated within the chamber further to disperse and fluidise the fibres in the airflow. A series of these devices could be used in the embodiment of Figures 8 and 9. Alternatively, the arrangement of Figures 8 and 9 may incorporate a mechanical agitator as shown in Figure 12. Here a horizontal elongate rod 52 is rotatably and axially moveable within the filling chamber 48. The agitator includes a series of paddles 54 at spaced intervals. In use the rod 52 is rotated and reciprocated back and forth to agitate fibre in the chamber.

[0042] The air pulsing may be achieved by suddenly and periodically cutting off the pressure exerted by the blowing machine on the chamber, or by applying a pulse of compressed air to the chamber to make use of the "reverse jet" principle. In the case of the arrangement of Figures 8 and 9, each filling point may be pulsed in turn in order to encourage the fibre to flow back and forth along the length of the chamber.

[0043] Referring now to Figure 13, in this embodiment the filling head 54 is similar to that shown in Figures 8 and 9 and is mounted above a workpiece table 56 having a drive roller 58 for driving an open-topped timber frame panel 59 to be filled. The filling head 54 has a vertical trailing wall 60, a leading wall 62 inclined in this

example at about 60° to the trailing wall 60 and a number of fibre feed inlets 64 in the roof 66. It is emphasised that the angles given here are by way of example, relating to one particular implementation, and that different angles may be used. The overall requirement is that the walls should be sufficiently divergent so that the compressed fibre in the filing head does not block and remains free to flow into the panel at all times when the space below is not yet fully filled. In the particular example of Figure 13, it has been much found that angles in excess of 62° may make the head too divergent and adversely alter fibre distribution, and that angles much below about 45° may increase the risk of the head becoming blocked with fibres.

[0044] Adjacent the lower edge of the trailing wall 60 is a screeding plate 68 which is moveably mounted by a cam arrangement 70 which is driven to oscillate the screeding plate 68 in the horizontal plane with the leading edge protruding into the filling head 54. This provides a number of important advantages. It serves to distribute and agitate the air/fibre mix within the filling chamber 54. The plate 68 has a serrated leading edge 72 which serves to cut through the mass of fibres with a bread knife effect. The lower surface of the screeding plate 68 applies a smoothing effect to the fibrous insulating material once it has been delivered into the panel 59. The screeding plate 68 also provides a sealing effect.

[0045] At the leading edge of the filling head is a cover plate 74 which, in conjunction with the fibrous material and the panel framework, retains fibre in the panel and provides a sealing action.

[0046] Referring now to Figures 16 and 17, there are shown two different optional finishing arrangements which may be beneficial depending on the nature of the fibres and the particular intended application. In Figure 16 a scrub roller 76 is driven contrary to the direction of movement of the panel as it is advanced under the filling head 54 to scrub the surface of the insulating material to level it, with suitable vacuum means (not shown) to remove surplus material. Alternatively the roller may be driven in the same sense as the panel to roll the surface.

[0047] In Figure 17, a moving conveyer belt arrangement 78 moves at the same speed as the panel to retain and smooth the surface of the insulating material.

[0048] Referring now to Figures 18 and 19, it is common to encounter wall panels in which the sides are not parallel, for example gable wall sections. In this case it is again possible to use blanking plates to 'square up' the panel, but an alternative is shown in these Figures where a blanking plate 80 fixed under the filling head 54, and in close contact with it, moves in and out as required to ensure that any section of the filling head not directly over the panel will be blanked off to prevent the escape of the insulation. In Figure 18, the movable plate 80 is kept in contact with the non-parallel edge by either springs 82 or pneumatic pressure or other means. The wheels 76 mounted to the plate follow the movement of the non-parallel edge exactly to ensure that the blanking plate is at all times correctly positioned.

[0049] Figures 19 (a) to (d) show how the position of the plate 74 changes with different shapes of panel to allow all types to be passed under the filling head without loss of insulation.

[0050] In addition, the pressure in the feed inlets 62 may be monitored for process control. For example, at commencement of filling of each empty panel section, the pressure drops and the traverse of the panel can be slowed or stopped until pressure increases, indicating that that section is full. Additionally or alternatively, when pressure reaches a pre-set level in any single hose, the air intake to that hose can be partially or wholly shut off in order to prevent excessive pressure in one area, or the pressure across all the filling points in the panel can be balanced continuously to provide a consistent fill.

Claims

1. A method of introducing air-entrainable material into an open channel defined by a base (20) and two spaced longitudinal side walls (12) the side walls (12) terminating in respective generally co-planar surface regions defining the top of the channel, **characterised in that** said method includes applying to said channel a filling head (24;44;54) dimensioned to span at least one of the width and length of the channel and to lie adjacent the top of the channel, said filling head (24) having a cover plate (26) associated therewith, thereby temporarily to cover said channel locally to define a local cavity, delivering into said cavity a blown mixture of air and air-entrainable material while substantially reducing or preventing leakage of the air-entrainable material, and effecting relative movement of said channel relative to said filling head (24), progressively to fill said channel.

2. A method according to Claim 1, wherein said filling head (24) is disposed to span the width of the channel, and is moved longitudinally with respect to said channel.

3. A method according to Claim 1, for introducing air-entrainable material into a plurality of longitudinal channels arranged side by side, wherein said filling head (44;54) is disposed to span the length of at least one of said channels and said plurality of channels is moved relative to said filling head (44;54) in a direction perpendicular to the length of the channels, to cause said channels to be filled with said air-entrainable material.

4. A method according to Claim 3, wherein said filling head (44;54) remains stationary whilst said plurality of channels is moved with respect thereto.

5. A method according to any of the preceding claims, wherein said filling head (24;44;54) includes an extended leading edge (26;74) in the sense of the movement of the filling head (24;44;54) relative to the channel, whereby the extended area of contact between the air-entrainable material in said channel and said extended leading edge (26) is sufficient to substantially reduce or prevent leakage in that direction.

6. A method according to any of Claims 1 to 3, for filling a recess of substantially constant width and depth, wherein the leading edge (26) of said filling head (24) includes a downwardly projecting retaining plate (34) which fits within said channel.

7. A method according to any of Claims 1 to 5, in which a screeding plate (68) is disposed aft of the filling head (54) in the sense of the relative movement thereof relation to the channel, and is moved or oscillated relative to the filling head (54) over the surface of a filled channel to smooth the surface thereof, and to agitate or disturb the air-entrainable material within said filling head (54).

8. A method according to any of the preceding claims, wherein the delivery pressure of the blown mixture is monitored, and the speed of relative movement of the filling head (24;44;54) relative to said channel is controlled in accordance therewith.

9. A method according to any of the preceding claims, wherein the delivery pressure of the blown mixture is monitored and the pressure of the air inlet to the filling head (24;44;54) is controlled in accordance with the monitored delivery pressure to maintain it below a preset level.

10. A method of producing an insulated panel which comprises providing an open topped framework panel, filling said panel with insulating material using a method according to any of the preceding claims, and applying a skin element to close the panel.

11. Apparatus for use in a method of introducing air-entrainable material to an open channel according to any of the preceding claims, said apparatus comprising a filling head (24;44;54) having an inlet for receiving a mixture of air and air-entrainable material, a filling chamber (28) of divergent form, and a cover plate (26) extending transversely thereof, **characterised in that** the cover plate (26) defines a continuous co-planar peripheral region adapted in use to engage the material delivered through said filling head and said cover plate (26) is adapted in use to span at least one of the width and the length of the channel and to prevent or reduce leakage of air-entrainable material from said channel, and **in that** said apparatus includes a workpiece support (56) for supporting a panel comprising the said channel below said filling head (64), and traverse means for moving said panel with respect to said filling head (64).

12. Apparatus according to Claim 11, wherein said filling chamber (28) has a generally conical inner profile.

13. Apparatus according to Claim 11 or Claim 12, wherein said filling head (24;44;54) is elongate, with said filling chamber (28) being polyhedral in transverse cross-section.

14. Apparatus according to any one of Claims 11 to 13, wherein said filling head (24) comprises a trailing wall (60) extending generally vertically and a leading wall (62) inclined at an acute angle to said trailing wall (60).

15. Apparatus according to Claim 14, wherein said leading wall (62) is inclined at an angle of between 45° and 65° to said leading wall (60).

16. Apparatus according to Claim 15, wherein said leading wall (62) is inclined at an angle of about 60° to said leading wall (60).

17. Apparatus according to any of Claims 11 to 16, wherein said filling head (24;44;54) comprises a plurality of feed inlets disposed along the length of the filling head.

18. Apparatus according to Claim 17, wherein the feed inlets (64) are disposed in an upper wall or roof of said filling head (54).

19. Apparatus according to any of Claims 11 to 18, further including means for agitating or disturbing said air entrainable material within said filling chamber (28), said means for agitating comprising an agitating member (68) movably mounted adjacent the trailing region of said filling chamber (64) and projecting into said chamber, and drive means (70) for moving said agitating member (68).

20. Apparatus according to Claim 19, wherein said means for agitating further includes a screeding plate (68) having a leading edge region (72) which projects into said filling chamber (64) and defines a lower surface for screeding the surface of air-entrainable material in said panel.

21. Apparatus according to any of Claims 11 to 20, further including means responsive to the delivery pressure to the filling head (64) to control the rate

of movement of said traverse means in accordance therewith.

22. Apparatus according to any of Claims 11 to 21, adapted to allow filling of panels whose dimension in the direction parallel to the longitudinal axis of the filling head varies along the length of the panels, which includes a blanking means (80) movably associated with the underside of said filling head (64), and biased into engagement with an edge of said panel, whereby the longitudinal dimension of the effective discharge aperture defined by the open end of the filling chamber is varied in accordance with the dimension of the panel.

23. Apparatus according to any of Claims 11 to 22, which includes finishing means (58) disposed aft of the filling head (54) to finish the surface of the air-entrainable material in the panel.

24. Apparatus according to Claim 23, wherein the finishing means comprises at least one of a rotatable roller and a moving belt moving in the same sense as said panel.

Patentansprüche

1. Verfahren zur Einführung von durch Luft mitnehmbarem Material in einen offenen Kanal, der von einem Boden (20) und zwei beabstandeten, länglichen Seitenwänden (12) gebildet wird, die in entsprechend koplanaren Oberflächenbereichen enden, welche die Oberseite des Kanals begrenzen, **dadurch gekennzeichnet, daß** der Kanal mit einem Füllkopf (24, 44, 54) versehen wird, der so bemessen ist, daß er wenigstens entweder die Breite oder die Länge des Kanals überbrückt und neben der Oberseite des Kanals liegt, daß der Füllkopf mit einer ihm zugeordneten Deckelplatte (26) versehen ist, um den Kanal örtlich zeitweilig zur Bildung eines lokalen Hohlraums abzudecken, in den ein Gemisch aus Luft und durch Luft mitriehmbare Material geblasen wird, während Leckage des durch Luft mitnehmbaren Materials erheblich reduziert oder ganz verhindert wird, und daß eine Relativbewegung des Kanals in Bezug auf den Füllkopf (24) bewirkt wird, um den Kanal in zunehmendem Maße zu füllen.

2. Verfahren nach Anspruch 1, **dadurch gekennzeichnet, daß** der Füllkopf (24) so angeordnet wird, daß er die Breite des Kanals überbrückt und in Längsrichtung in Bezug auf den Kanal bewegt wird.

3. Verfahren nach Anspruch 1, wobei das durch Luft mitnehmbare Material in mehrere in Längsrichtung Seite an Seite nebeneinander liegende Kanäle eingeführt wird, **dadurch gekennzeichnet, daß** der Füllkopf (44, 54) so angeordnet ist, daß er die Länge wenigstens eines dieser Kanäle überbrückt und daß mehrere Kanäle in Bezug auf den Füllkopf (44, 54) in einer Richtung lotrecht zur Länge der Kanäle bewegt werden, so daß diese Kanäle mit dem durch Luft mitnehmbare Material gefüllt werden.

4. Verfahren nach Anspruch 3, **dadurch gekennzeichnet, daß** der Füllkopf (44, 54) stationär bleibt, während die Kanäle in Bezug auf ihn bewegt werden.

5. Verfahren nach einem der vorhergehenden Ansprüche, **dadurch gekennzeichnet, daß** der Füllkopf (24, 44, 54) in seiner Bewegungsrichtung in Bezug auf den Kanal einen verlängerten Führungsrand (26, 74) aufweist, so daß der vergrößerte Berührungsbereich zwischen dem durch Luft mitnehmbaren Material im Kanal und dem verlängerten Führungsrand (26) ausreicht, um Lekkage in dieser Richtung erheblich zu verringern oder ganz zu vermeiden.

6. Verfahren nach einem der Ansprüche 1 bis 3 zur Füllung einer Aussparung von im wesentlichen konstanter Breite und Tiefe, **dadurch gekennzeichnet, daß** der Führungsrand (26) des Füllkopfes (24) eine sich abwärts erstrekkende Rückhalteplatte (34) aufweist, die in den Kanal hineinpaßt.

7. Verfahren nach einem der Ansprüche 1 bis 5, **dadurch gekennzeichnet, daß** hinter dem Füllkopf (54) in Richtung seiner Relativbewegung in Bezug auf den Kanal eine Abstreifplatte (68) angeordnet ist, die in Bezug auf den Füllkopf (54) über die Oberfläche des gefüllten Kanals zu deren Glättung bewegbar oder hin und her verschiebbar ist und um das durch Luft mitnehmbare Material innerhalb des Füllkopfes (54) aufzurühren oder in Bewegung zu setzen.

8. Verfahren nach einem der vorhergehenden Ansprüche, **dadurch gekennzeichnet, daß** der Lieferdruck des geblasenen Gemisches überwacht wird und daß die Geschwindigkeit der Relativbewegung des Füllkopfes (24, 44, 54) in Bezug auf den Kanal entsprechend gesteuert wird.

9. Verfahren nach einem der vorhergehenden Ansprüche, **dadurch gekennzeichnet, daß** der Lieferdruck des geblasenen Gemisches überwacht wird, und der Druck des Lufteintritts zum Füllkopf (24, 44, 54) entsprechend dem überwachten Lieferdruck gesteuert wird, um ihn unter einem vorgegebenen Niveau zu halten.

10. Verfahren zur Herstellung einer isolierten Tafel, **ge-**

kennzeichnet durch Schaffung einer oberflächig geöffneten Fachwerktafel, Füllen dieser Tafel mit Isoliermaterial unter Verwendung eines Verfahrens nach den vorhergehenden Ansprüchen und Anbringung eines hautförmigen Oberflächenelementes zum Verschließen der Tafel.

11. Gerät zur Verwendung bei einem Verfahren zur Einführung von durch Luft mitnehmbaren Material in einen offenen Kanal gemäß einem der vorhergehenden Ansprüche, wobei das Gerät einen Füllkopf (24, 44, 54) mit einem Einlaß zur Aufnahme eines Gemisches aus Luft und einem durch Luft mitnehmbaren Material aufweist, ferner eine differgierend geformte Füllkammer (28) und eine Deckelplatte (26), die sich über die Kammer erstreckt, **dadurch gekennzeichnet, daß** die Deckelplatte (26) eine durchgehende, koplanare Umfangszone bildet, die mit dem Material in Berührung treten kann, das durch den Füllkopf abgegeben wird, daß die Dekkelplatte (26) dazu dienen kann, wenigstens die Breite oder die Länge des Kanals zu überbrücken und Leckage des durch Luft mitgenommenen Materials aus dem Kanal zu verhindern oder zu reduzieren, daß das Gerät einen Werkstückträger (56) aufweist, der eine den genannten Kanal aufweisende Tafel unterhalb des Füllkopfes (64) abstützt, und daß eine verfahrbare Einrichtung vorhanden ist, um die Tafel in Bezug auf den Füllkopf (64) zu bewegen.

12. Gerät nach Anspruch 11, **dadurch gekennzeichnet, daß** die Füllkammer (28) ein im allgemeinen konisches Innenprofil aufweist.

13. Gerät nach Anspruch 11 oder 12, **dadurch gekennzeichnet, daß** der Füllkopf (24, 44, 54) langgestreckt ist und die Füllkammer (28) im Querschnitt vielflächig ist.

14. Gerät nach einem der Ansprüche 11 bis 13, **dadurch gekennzeichnet, daß** der Füllkopf (24) eine hintere Wand (60) aufweist, die sich im allgemeinen senkrecht erstreckt, sowie eine Vorderwand (62), die in einem spitzen Winkel zur hinteren Wand (60) geneigt ist.

15. Gerät nach Anspruch 14, **dadurch gekennzeichnet, daß** die Vorderwand (62) in einem Winkel zwischen 45° und 65° zur hinteren Wand (60) geneigt ist.

16. Gerät nach Anspruch 15, **dadurch gekennzeichnet, daß** die vordere Wand (62) in einem Winkel von etwa 60° zur hinteren Wand (60) geneigt ist.

17. Gerät nach einem der Ansprüche 1 bis 16, **dadurch gekennzeichnet, daß** der Füllkopf (24, 44, 54) mehrere Zufuhreinlässe aufweist, die entlang seiner Länge angeordnet sind.

18. Gerät nach Anspruch 17, **dadurch gekennzeichnet, daß** die Zufuhreinlässe (64) in einer oberen Wand oder dem Dach des Füllkopfes (54) angeordnet sind.

19. Gerät nach einem der Ansprüche 11 bis 18, mit einer Einrichtung zum Rühren oder heftigen Bewegen des durch Luft mitnehmbaren Materials innerhalb der Füllkammer (28), **dadurch gekennzeichnet, daß** die genannte Einrichtung einen beweglich neben dem hinteren Bereich der Füllkammer (64) gelagerten Rührkörper (68) aufweist, der sich in die Kammer hinein erstreckt sowie Antriebselemente (70) zur Bewegung des Rührkörpers (68).

20. Gerät nach Anspruch 19, **dadurch gekennzeichnet, daß** die Einrichtung zum Rühren des weiteren eine Abstreifplatte (68) aufweist, die einen vorderen Randbereich (72) bildet der sich in die Füllkammer (64) hinein erstreckt und eine untere Oberfläche begrenzt, die zum Abstreifen der Oberfläche des durch Luft mitnehmbaren Materials in der Tafel dient.

21. Gerät nach einem der Ansprüche 11 bis 20, **gekennzeichnet durch** eine Einrichtung, die auf den Ausgabedruck des Füllkopfes (64) anspricht, um die Bewegungsgeschwindigkeit der verfahrbaren Einrichtung entsprechend zu steuern.

22. Gerät nach einem der Ansprüche 11 bis 21, das Tafeln, deren Abmessung in Richtung parallel zur Längsachse des Füllkopfes variieren, entlang der Länge der Tafeln füllen kann, **gekennzeichnet durch** eine Blendenvorrichtung, die mit der Unterseite des Füllkopfes (64) beweglich ist und mit einem Rand der Tafel unter Druck in Eingriff bringbar ist, um **dadurch** die Längenabmessung der wirksamen Austragsöffnung, die **durch** das offene Ende der Füllkammer gebildet wird, entsprechend den Abmessungen der Tafel zu variieren.

23. Gerät nach einem der Ansprüche 11 bis 22, **gekennzeichnet durch** eine Abgleicheinrichtung (58), die hinter dem Füllkopf (54) angeordnet ist, um die Oberfläche des **durch** Luft mitnehmbaren Materials in der Tafel zu glätten.

24. Gerät nach Anspruch 23, **dadurch gekennzeichnet, daß** die Abgleicheinrichtung wenigstens eine drehbare Rolle und ein sich bewegendes Band aufweist, die sich in derselben Richtung bewegen wie die Tafel.

Revendications

1. Procédé d'introduction d'une matière entraînable par l'air dans un canal ouvert défini par une base (20) et deux parois latérales longitudinales espacées (12), les parois latérales (12) se terminant en régions de surfaces généralement co-planaires respectives définissant la partie supérieure du canal, **caractérisé par le fait que** ledit procédé comprend les étapes consistant à appliquer sur ledit canal une tête de remplissage (24 ; 44 ; 54) dimensionnée pour couvrir au moins l'une de la largeur et de la longueur du canal et pour s'étendre au voisinage de la partie supérieure du canal, ladite tête de remplissage (24) ayant une plaque de couverture (26) associée avec elle, permettant ainsi de recouvrir temporairement ledit canal localement afin de définir une cavité locale, à délivrer dans ladite cavité un mélange soufflé d'air et de matière entraînable par l'air tout en réduisant ou empêchant de façon substantielle une fuite de la matière entraînable par l'air, et à effectuer un mouvement relatif dudit canal par rapport à ladite tête de remplissage (24), pour remplir progressivement ledit canal.

2. Procédé selon la revendication 1, dans lequel ladite tête de remplissage (24) est disposée pour couvrir la largeur du canal, et est déplacée longitudinalement par rapport audit canal.

3. Procédé selon la revendication 1, pour introduire une matière entraînable par l'air dans une pluralité de canaux longitudinaux disposés côte à côte, dans lequel ladite tête de remplissage (44 ; 54) est disposée pour couvrir la longueur d'au moins l'un desdits canaux et ladite pluralité de canaux est déplacée par rapport à ladite tête de remplissage (44 ; 54) dans une direction perpendiculaire à la longueur des canaux, pour amener lesdits canaux à être remplis par ladite matière entraînable par l'air.

4. Procédé selon la revendication 3, dans lequel ladite tête de remplissage (44 ; 54) reste stationnaire alors que ladite pluralité de canaux est déplacée par rapport à celle-ci.

5. Procédé selon l'une quelconque des revendications précédentes, dans lequel ladite tête de remplissage (24 ; 44 ; 54) comprend une bordure avant étendue (26 ; 74) dans le sens du mouvement de la tête de remplissage (24 ; 44 ; 54) par rapport au canal, ce par quoi l'aire de contact étendue entre la matière entraînable par l'air dans ledit canal et ladite bordure avant étendue (26) est suffisante pour réduire ou empêcher de façon substantielle une fuite dans cette direction.

6. Procédé selon l'une quelconque des revendications 1 à 3, pour remplir une cavité de largeur et profondeur sensiblement constantes, dans lequel la bordure avant (26) de ladite tête de remplissage (24) comprend une plaque de retenue (34) se projetant vers le bas, laquelle s'adapte à l'intérieur dudit canal.

7. Procédé selon l'une quelconque des revendications 1 à 5, dans lequel une plaque égaliseuse (68) est disposée à l'arrière de la tête de remplissage (54) dans le sens du mouvement relatif de celle-ci par rapport au canal, et est déplacée ou amenée à osciller par rapport à la tête de remplissage (54) sur la surface d'un canal rempli pour lisser la surface de celui-ci, et pour agiter ou perturber la matière entraînable par l'air à l'intérieur de ladite tête de remplissage (54).

8. Procédé selon l'une quelconque des revendications précédentes, dans lequel la pression d'alimentation du mélange soufflé est surveillée, et la vitesse de mouvement relatif de la tête de remplissage (24 ; 44 ; 54) par rapport audit canal est contrôlée conformément à celle-ci.

9. Procédé selon l'une quelconque des revendications précédentes, dans lequel la pression d'alimentation du mélange soufflé est surveillée et la pression de l'entrée d'air dans la tête de remplissage (24 ; 44 ; 54) est contrôlée conformément à la pression d'alimentation surveillée pour la maintenir au-dessous d'un niveau pré-établi.

10. Procédé de fabrication d'un panneau isolé qui comprend les opérations consistant à prendre un panneau d'ossature à partie supérieure ouverte, à remplir ledit panneau par une matière isolante à l'aide d'un procédé tel que défini à l'une quelconque des revendications précédentes, et à appliquer un élément de peau pour fermer le panneau.

11. Appareil destiné à être utilisé dans un procédé d'introduction d'une matière entraînable par l'air dans un canal ouvert tel que défini à l'une quelconque des revendications précédentes, ledit appareil comprenant une tête de remplissage (24 ; 44 ; 54) ayant une entrée pour recevoir un mélange d'air et de matière entraînable par l'air, une chambre de remplissage (28) de forme divergente, et une plaque de couverture (26) s'étendant transversalement à celle-ci, **caractérisé par le fait que** la plaque de couverture (26) définit une région périphérique coplanaire continue, adaptée lors de l'utilisation pour engager la matière adressée à travers ladite tête de remplissage et ladite plaque de couverture (26) est adaptée lors de l'utilisation pour couvrir au moins l'une de la largeur et de la longueur du canal et pour empêcher ou réduire une fuite de ma-

tière entraînable par l'air à partir dudit canal, et **par le fait que** ledit appareil comprend un support de pièce à travailler (56) pour supporter un panneau comprenant ledit canal au-dessous de ladite tête de remplissage (61), et un moyen de déplacement pour déplacer ledit panneau par rapport à ladite tête de remplissage (64).

12. Appareil selon la revendication 11, dans lequel ladite chambre de remplissage (28) a un profil interne généralement conique.

13. Appareil selon la revendication 11 ou la revendication 12, dans lequel ladite tête de remplissage (24 ; 44 ; 54) est allongée, ladite chambre de remplissage (28) étant polyédrique en section transversale.

14. Appareil selon l'une quelconque des revendications 11 à 13, dans lequel ladite tête de remplissage (24) comprend une paroi arrière (60) s'étendant généralement verticalement et une paroi avant (62) inclinée à un angle aigu par rapport à ladite paroi arrière (60).

15. Appareil selon la revendication 14, dans lequel ladite paroi avant (62) est inclinée à un angle entre 45° et 65° par rapport à ladite paroi avant (60).

16. Appareil selon la revendication 15, dans lequel ladite paroi avant (62) est inclinée à un angle d'environ 60° par rapport à ladite paroi avant (60).

17. Appareil selon l'une quelconque des revendications 1 à 16, dans lequel ladite tête de remplissage (24 ; 44 ; 54) comprend une pluralité d'entrées d'alimentation disposées le long de la longueur de la tête de remplissage.

18. Appareil selon la revendication 17, dans lequel les entrées d'alimentation (64) sont disposées dans une paroi supérieure ou toit de ladite tête de remplissage (54).

19. Appareil selon l'une quelconque des revendications 11 à 18, comprenant en outre un moyen pour agiter ou perturber ladite matière entraînable par l'air à l'intérieur de ladite chambre de remplissage (28), ledit moyen d'agitation comprenant un élément d'agitation (68) monté de façon mobile au voisinage de la région arrière de ladite chambre de remplissage (64) et se projetant dans ladite chambre, et un moyen d'entraînement (70) pour déplacer ledit élément d'agitation (68).

20. Appareil selon la revendication 19, dans lequel ledit moyen d'agitation comprend en outre une plaque égaliseuse (68) ayant une région de bordure avant (72) qui se projette dans ladite chambre de remplissage (64) et définit une surface inférieure pour égaliser la surface de matière entraînable par l'air dans ledit panneau.

21. Appareil selon l'une quelconque des revendications 11 à 20, comprenant en outre un moyen sensible à la pression d'alimentation sur la tête de remplissage (64) pour commander la vitesse de mouvement dudit moyen de déplacement conformément à celle-ci.

22. Appareil selon l'une quelconque des revendications 11 à 21, adapté pour permettre un remplissage de panneaux dont la dimension dans la direction parallèle à l'axe longitudinal de la tête de remplissage varie le long de la longueur des panneaux, qui comprend un moyen obturateur (80) associé de façon mobile avec le côté inférieur de ladite tête de remplissage (64), et sollicité pour venir en engagement avec une bordure dudit panneau, ce par quoi l'on fait varier la dimension longitudinale de l'ouverture de décharge effective définie par l'extrémité ouverte de la chambre de remplissage conformément à la dimension du panneau.

23. Appareil selon l'une quelconque des revendications 11 à 22, qui comprend un moyen de finition (58) disposé à l'arrière de la tête de remplissage (54) pour finir la surface de la matière entraînable par l'air dans le panneau.

24. Appareil selon la revendication 23, dans lequel le moyen de finition comprend au moins l'un parmi un rouleau tournant et une courroie mobile se déplaçant dans le même sens que ledit panneau.

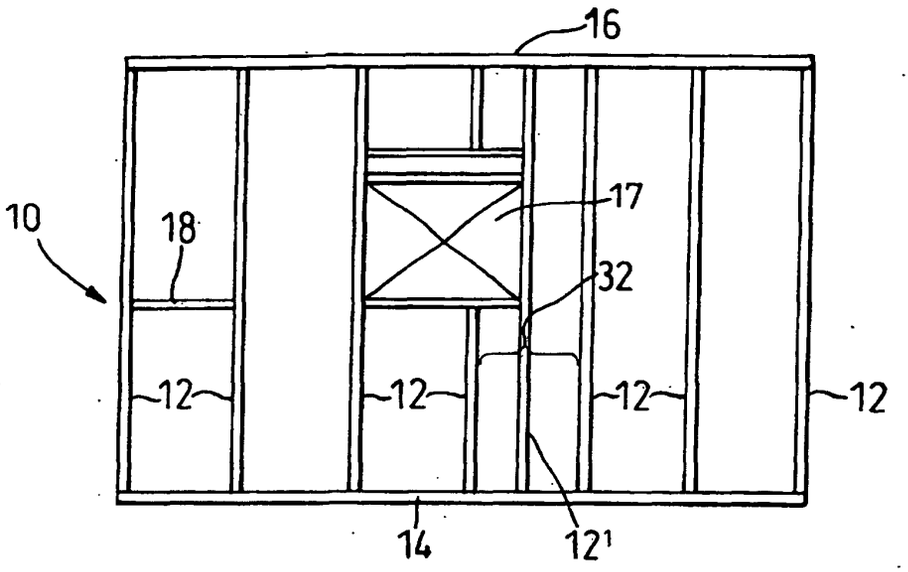


Fig. 1

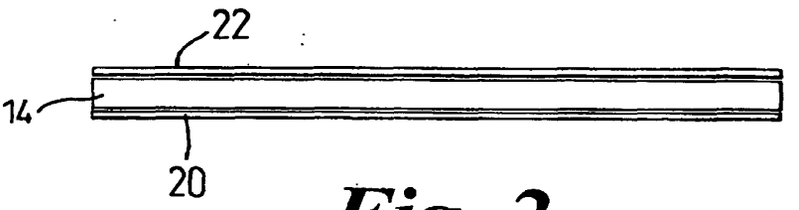


Fig. 2

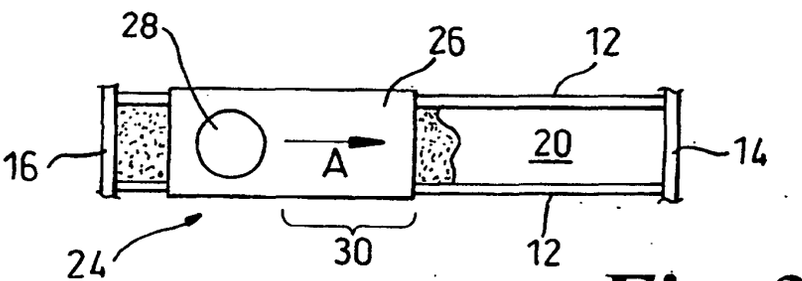


Fig. 3

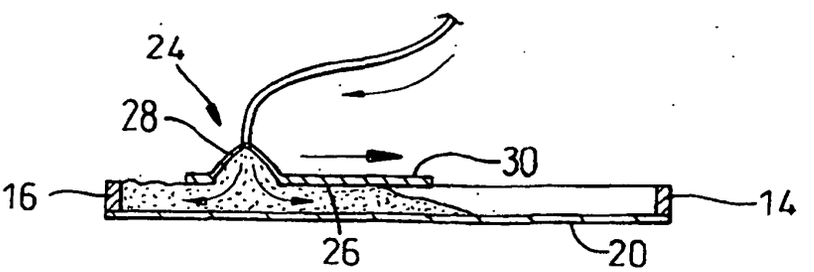


Fig. 4

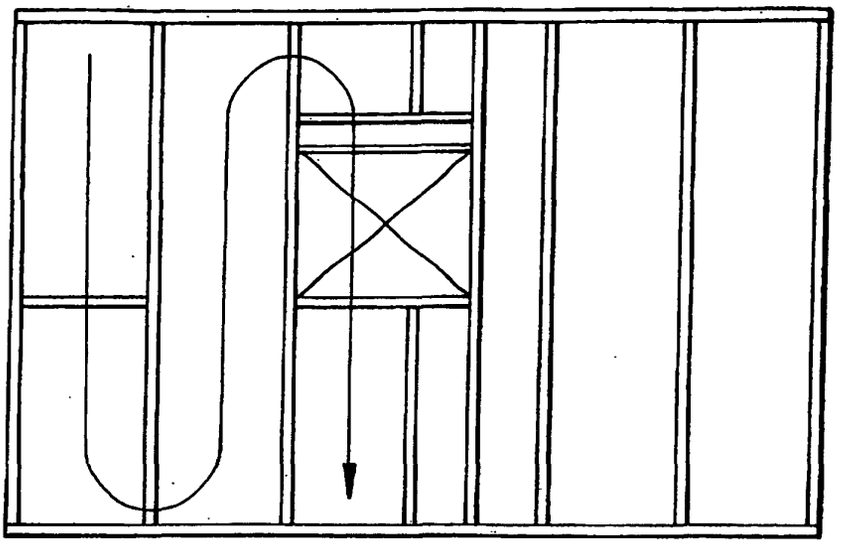


Fig. 5

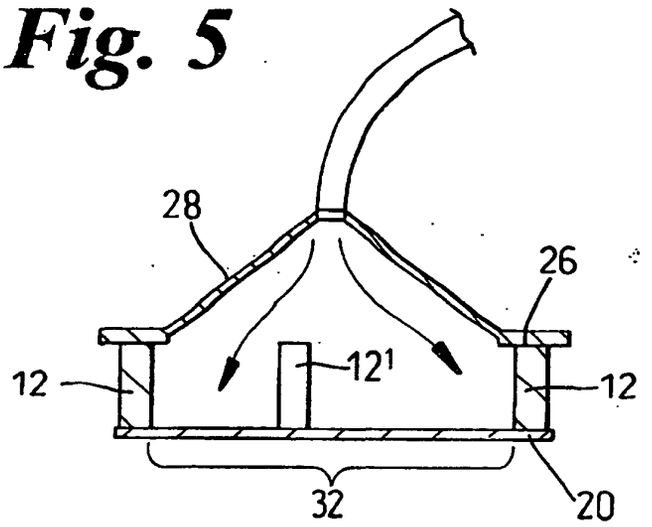


Fig. 6

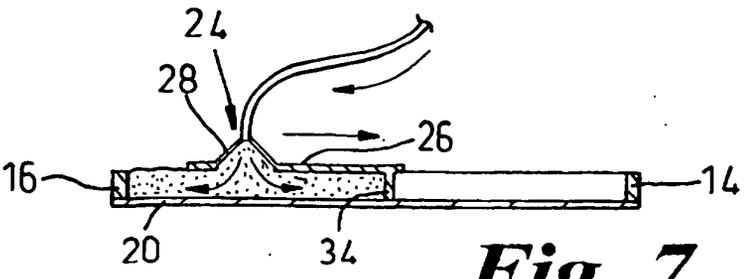


Fig. 7

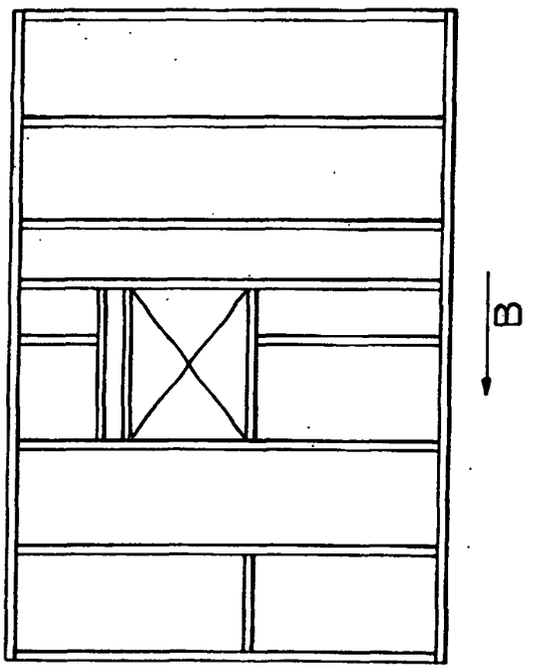
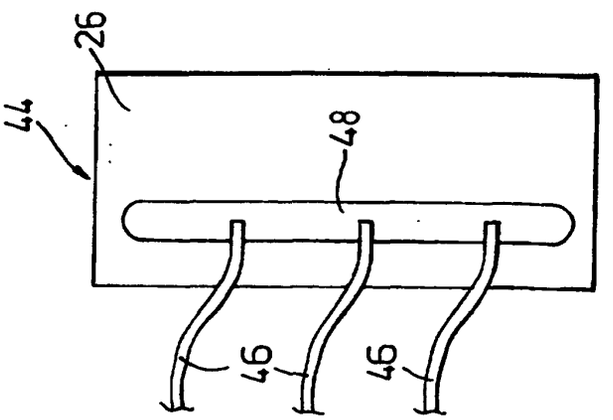


Fig. 8



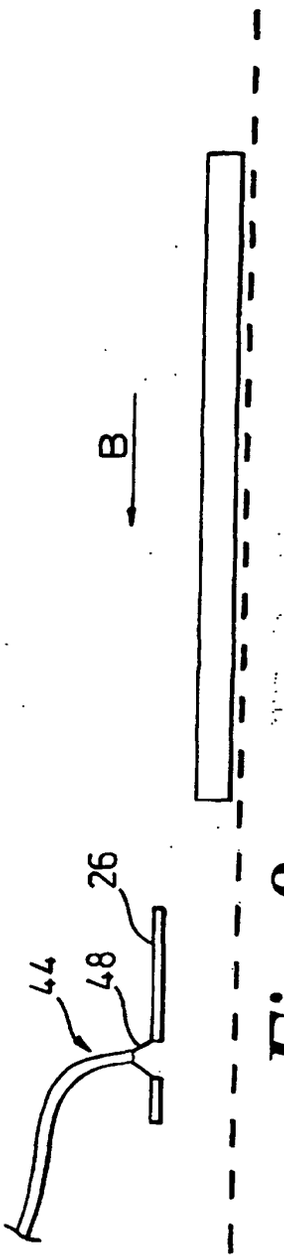


Fig. 9

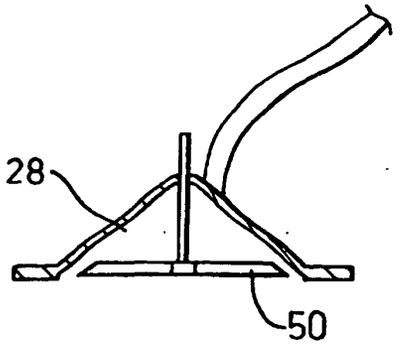


Fig. 10

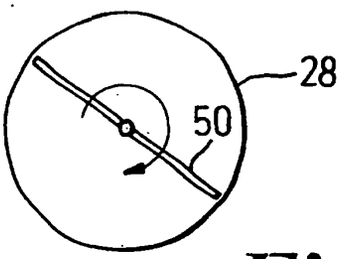


Fig. 11

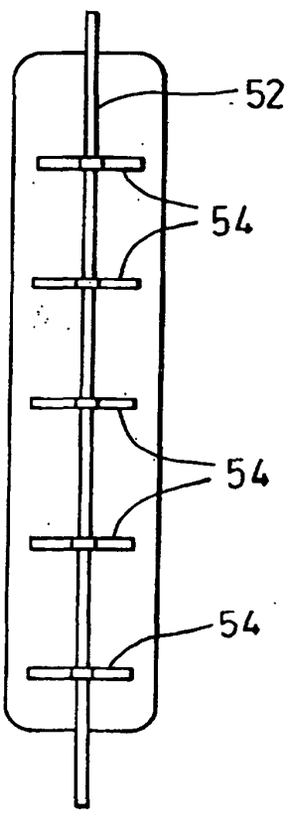


Fig. 12

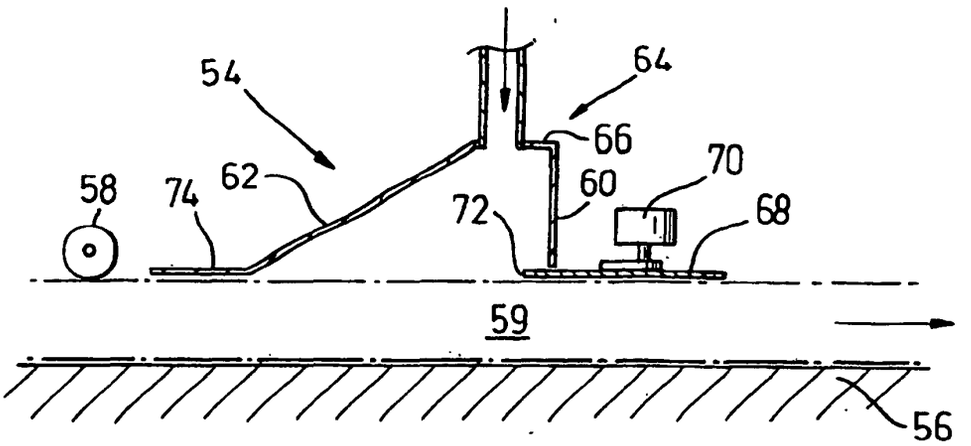


Fig. 13

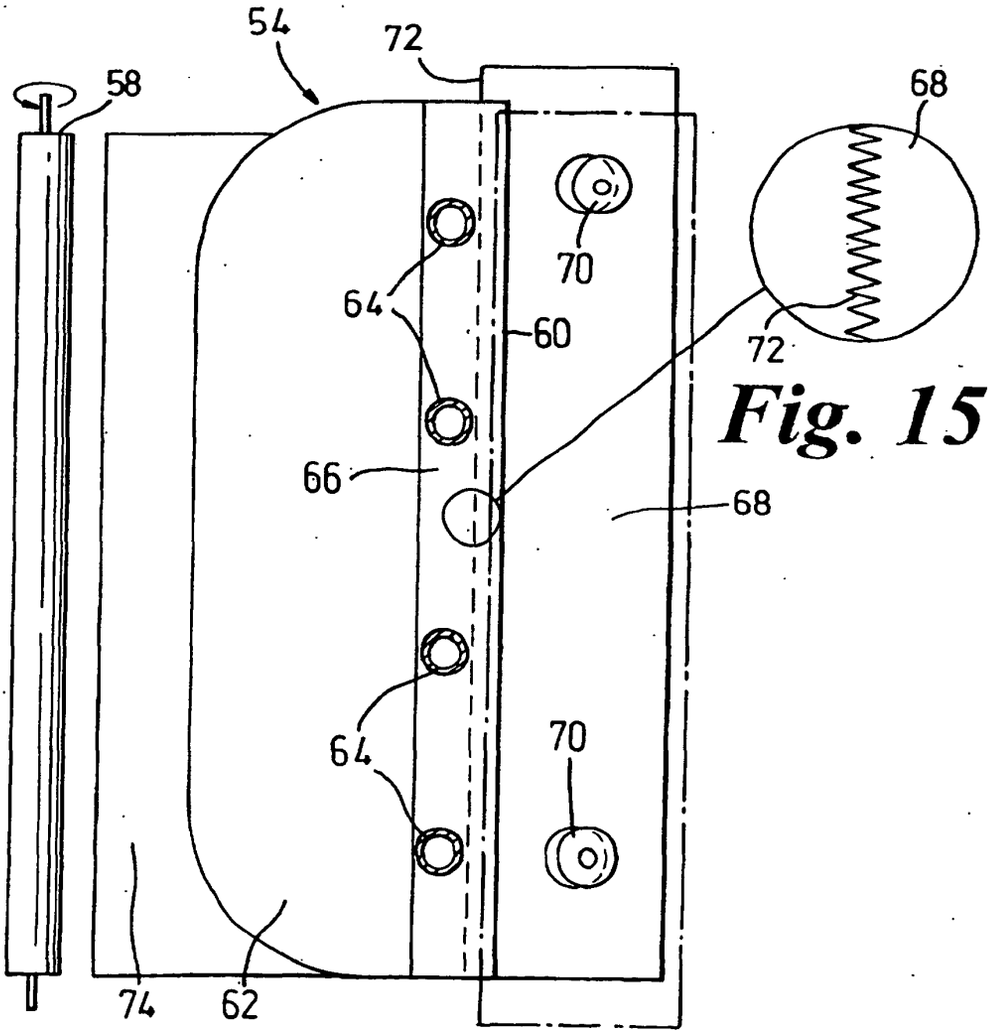


Fig. 15

Fig. 14

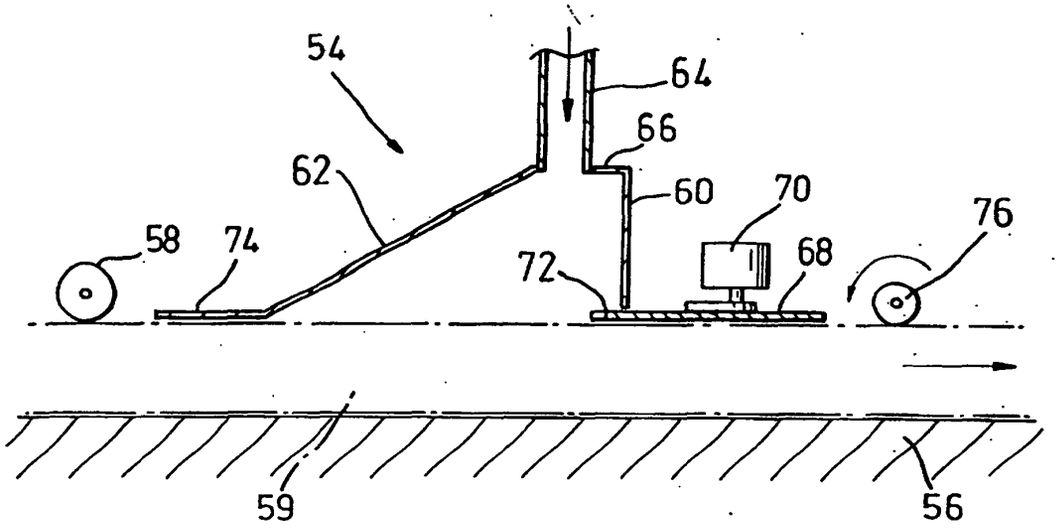

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Fig. 16

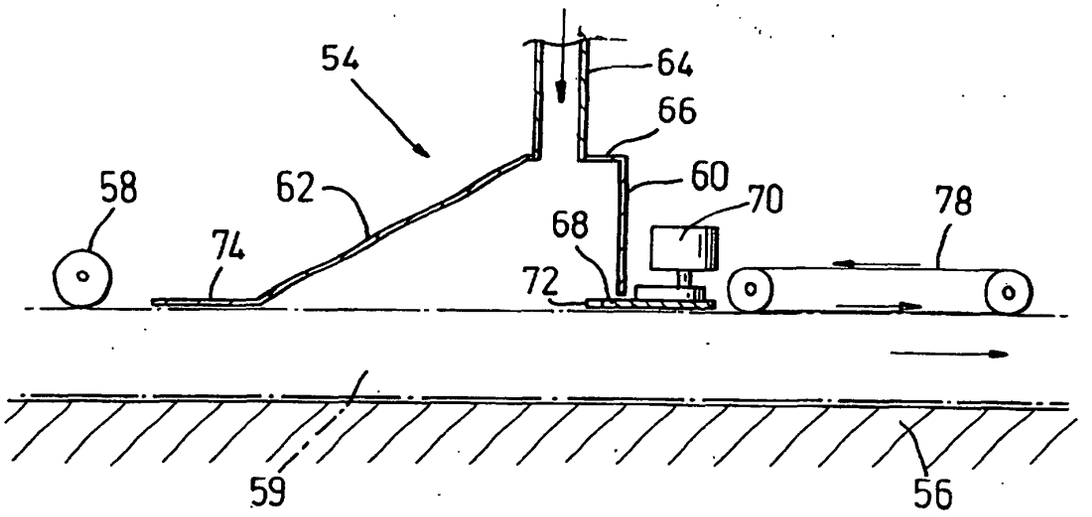
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Fig. 17

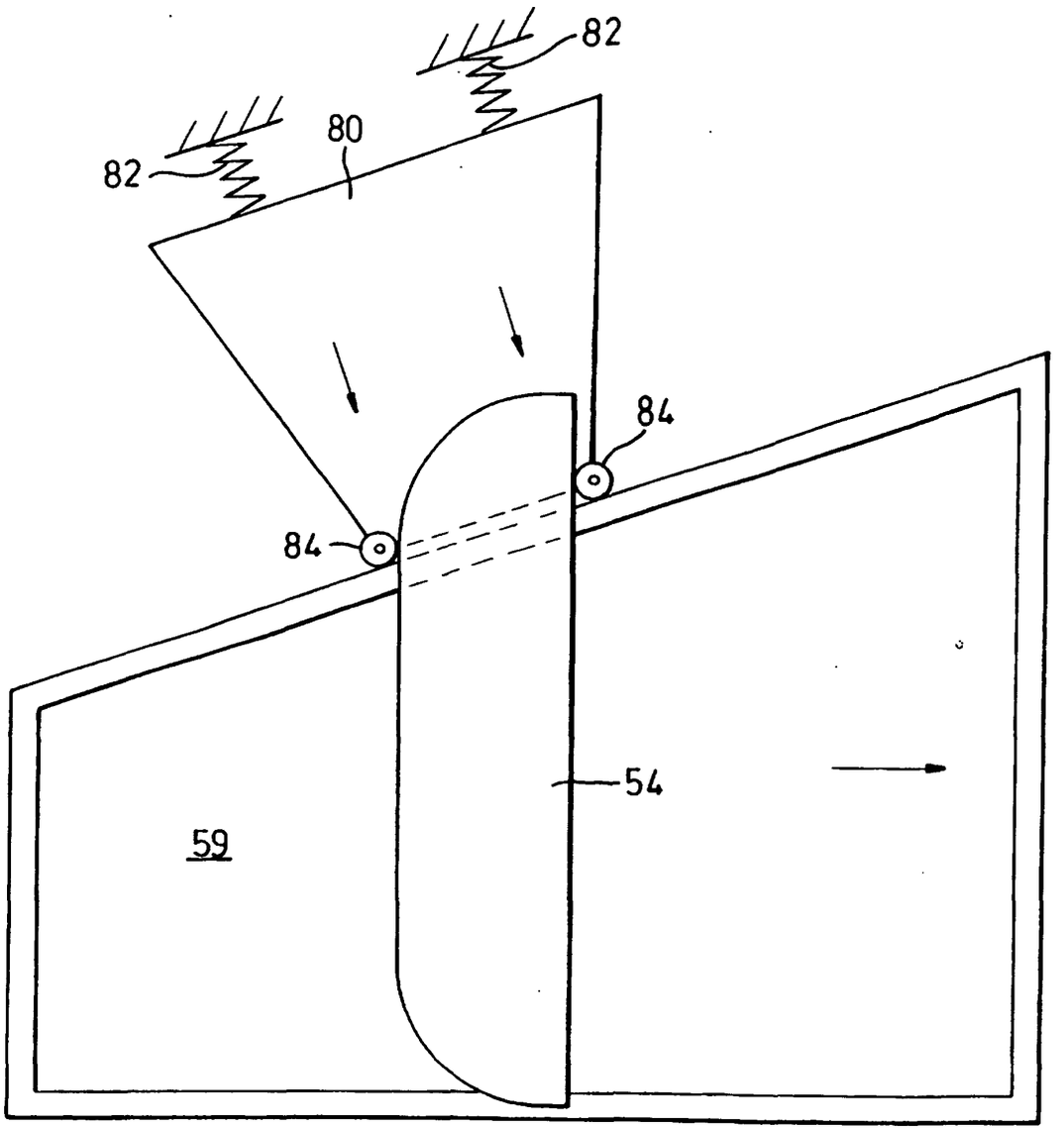

Fig. 18

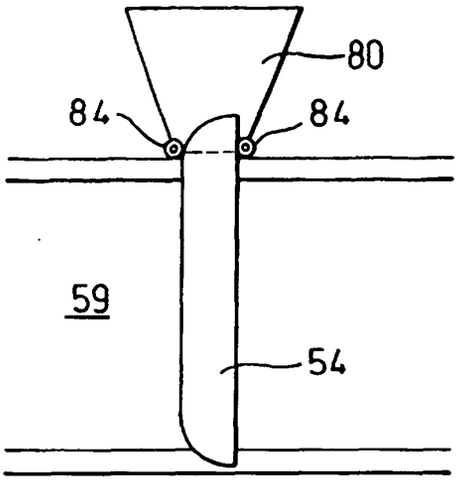

Fig. 19(a)

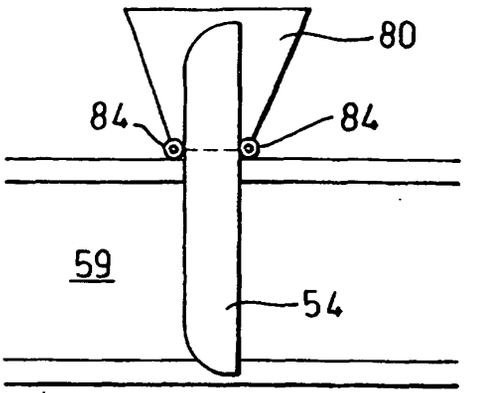

Fig. 19(b)

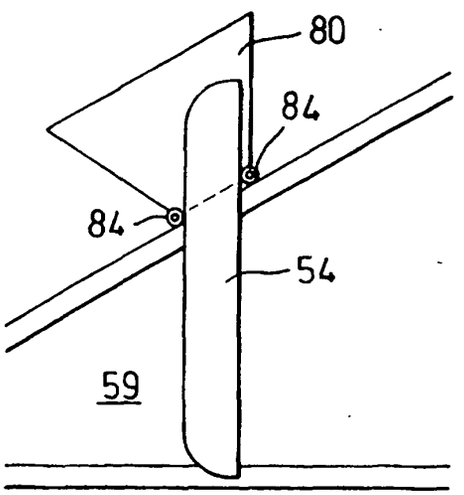

Fig. 19(c)

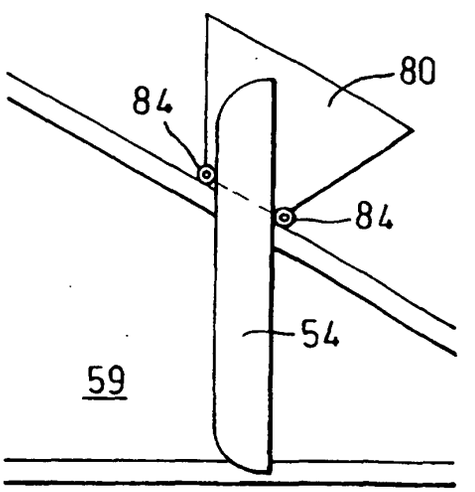

Fig. 19(d)