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**(54) TURBULENCE GENERATOR OF A HEADBOX OF A FIBRE WEB MACHINE**

**TURBULENZERZEUGER EINES STOFFAUFLAUFS EINER FASERBAHNMASCHINE**

**GÉNÉRATEUR DE TURBULENCES D'UNE CAISSE DE TÊTE D'UNE MACHINE À TOILE DE FIBRES**

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(56) References cited:

**WO-A1-01/21886**

**WO-A1-01/21886**

**WO-A1-2008/105714**

**WO-A1-2008/105714**

**DE-A1- 19 830 872**

**DE-A1-102008 042 032**

**US-A- 4 539 075**

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**Description**

**[0001]** The invention relates to a turbulence generator according to the preamble of claim 1 for a headbox of a fiber web machine.

**[0002]** FI 110700 B discloses one example of a flow pipe, such as are used in the formation of a bank of pipes in the headbox of a fiber web machine. A flow pipe generally includes two consecutive flow sections, with surface areas of different sizes, in order to form a step. The material of a flow pipe is typically, for example, acid-proof steel, from which the desired turbulence generator can be assembled, for example, by welding. An other alternative for manufacturing a flow pipe is to make it by pressure shaping, for example at a pressure of 2000 - 4000 bar.

**[0003]** However, several drawbacks are associated with the manufacture of turbulence generators, for example, by assembling by welding flow pipes to each other. Firstly, welding is quite a labourious way to assemble a turbulence generator. In addition, the welding must typically be performed in a specific sequence, to avoid detrimental phenomena arising, for example, from thermal expansion. Secondly, it is difficult, if not completely impossible, to alter a turbulence generator that has been assembled by welding, once it has been made. Thirdly, there are problems relating to keeping a welded turbulence generator clean. Still in addition, the attachment of a possible turbulence sheet to a flow pipe also demands its own attachment arrangement, the creation of which increases the number of work stages relating to the manufacture of the flow pipe.

**[0004]** Another solution representing the prior art concerning turbulence generators is disclosed in patent application publication WO 2008/105714. In it, the turbulence generator is assembled from modular banks of pipes, which are connected to each other by means of connector elements formed in the banks of pipes. The weakness of this solution is in the large size of the module, so that, for example, the flow distribution cannot be altered on a small scale.

**[0005]** WO 01/21886 A1 shows a generic turbulence generator according to the preamble of claim 1 of a headbox of a fiber web machine, which includes a plurality of flow pipes having two ends, an inlet end and an outlet end, and between which ends there is a flow channel, wherein at least one groove and at least one protrusion is arranged in the external surface of each flow pipe in order to attach each flow pipe to adjacent flow pipes of the plurality of flow pipes.

**[0006]** A further turbulence generator of a head box assembly according to the prior art is shown in US 4 539 075 A, in which rod elements forming flow channels and having protrusions are locked to each other via separate fastening rods.

**Summary of the Invention**

**[0007]** It is the object of the present invention to further develop a turbulence generator according to the preamble of claim 1 of a headbox of a fiber web machine such that the installation size and the adaptability of the turbulence generator are improved.

**[0008]** The object of the present invention is achieved by a turbulence generator having the features of claim 1.

**[0009]** Further advantageous developments according to the present invention are defined in the dependent claims.

**[0010]** According to the present invention, a turbulence generator for a headbox of a fiber web machine is created, the assembly of which is easy and which can also easily be adapted.

**[0011]** According to the invention, at least one groove and at least one protrusion are arranged in the outer surface of the flow pipes, in order to attach each flow pipe to adjacent flow pipes, when the turbulence generator is assembled. By forming a counter-pair joint of at least one groove and one protrusion to the corresponding joint formations of adjacent flow pipes, the assembly of a turbulence generator from flow pipes is accelerated considerably and is, at the same time, also easy.

**[0012]** Preferably, the groove and protrusion of the flow pipe can form a shape-closure joint and thus also locking to the corresponding joint formations of the adjacent flow pipes. At the same time, the groove and protrusion can form a labyrinth seal for a turbulence generator structure, formed of flow pipes, and installed in a headbox. This will improve the robustness of the turbulence generator.

**[0013]** Preferably, shaping, which is arranged to form an attachment for a flow sheet with an upper and/or lower flow pipe, is integrated into the outlet end of the flow pipe. Thus, if desired, a flow sheet can be easily arranged in a turbulence generator, without special attachment arrangements.

**[0014]** Preferably, the shape-closure attachment of a flow pipe to adjacent flow pipes is arranged to permit the horizontal or vertical location of the flow pipe to be altered steplessly. The flow or number of rows in the turbulence generator can then be altered as desired more easily, compared to known, for example welded, turbulence generators.

**[0015]** Several other significant advantages are also gained with the aid of the invention. Through the invention, the flow pipes can also be changed afterwards, or updated for new hydraulics. Through the invention, it becomes possible, for example, to change the type of the turbulence generator from a sheet to a non-sheet and vice versa, by simply changing the flow pipes. In addition, the invention also permits the number of flow pipe rows to be reduced or increased, because the pipes can be detached.

**[0016]** The invention, which is not restricted to the embodiments presented in the following, is described in greater

detail with reference to the accompanying figures, in which

- Figure 1 shows one rough schematic diagram of the headbox of a fiber web machine,  
 Figure 2 shows one example of a flow pipe,  
 5 Figure 3 shows a bank of pipes assembled from flow pipes according to Figure 2,  
 Figures 4a - 4d show side views of some examples of ways of attaching flow pipes to each other,  
 Figures 5a - 5d show angled side views of the pipe banks of Figures 4a - 4d,  
 Figure 6 shows a way to arrange a turbulence sheet, applied to the flow pipe bank of the embodiment in Figure 4d,  
 10 Figures 7a and 7b show one way to arrange the flow pipe rows relative to each other, seen from different directions,  
 Figures 8a - 8c show example of turbulence generators assembled from flow pipes, seen from different directions, and  
 Figure 9 shows a variation of the embodiment shown in Figure 7a, in which there is a seal.

15 **[0017]** Figure 1 shows one example of the headbox 10 of a fiber web machine at a rough schematic level, as a cross-section seen from the side. The fiber suspension is led, in a manner that is, as such known, from the headbox's 10 inlet header 11 through a manifold tube bank 12 to a turbulence generator 14, which is formed of several flow pipes 17 set in a row formation and overlapping each other. From the turbulence generator 14, the fiber suspension proceeds to a slice channel 35 and from there onwards past a schematically-shown slice lip 34 to the forming wire (not shown). In addition, in the discharge opening 35 there can be sheets (not shown) following the turbulence generator 14. In the turbulence generator 14, the consistency profile of the fiber suspension evens out and any flocules that may have formed in the fiber suspension are dispersed. The flocules are dispersed by causing shear forces and turbulence in the flow. The turbulence is sufficient to keep the fibers separate and to disperse the flocules, without, however, disturbing the forming of the web on the wire.

25 **[0018]** Figure 2 shows an axial view of one example of a flow pipe 17, which is thus intended for the turbulence generator 14 of a headbox 10. The flow pipe 17 has two ends in the flow direction, i.e. an inlet end 13 and an outlet end 15. A flow channel 16, through which the flow led into the pipe from the inlet end 13 travels to the outlet end 15 and out of the flow pipe 17, is formed between the ends 13, 15. The flow channel 16 includes two consecutive flow sections, the inlet-end flow section 18 and the outlet-end flow section 19. The mutual flow cross-sectional surface-areas of the flow sections 18, 19 are of different sizes, thus forming the desired step 20 between them. The step 20 now forms its own area between the sections 18, 19. The internal cross-section of the inlet-end flow section 18 can be, for example, circular while the internal cross-section of the outlet-end flow section 19 can be, for example, square. Correspondingly, the external cross-section of the inlet-end flow section 18 is also circular while the external cross-section of the outlet-end flow section 19 is also square, more generally angular. The external cross-section of the outlet-end flow section 19 can also be a pentagon or a hexagon. In any event, its sides 21.1 - 21.4 have a planar external surface.

35 **[0019]** The flow pipe 17 can be manufactured in several different ways. One way is to manufacture it using a casting process. The flow pipe 17 can then be of a material that is, for example, a plastic. Polyethylene, or thermoplastic in general, can be given as an example of plastics. A thermoplastic flow pipe 17 can also be welded, if the operation in question is seen to be necessary, for example when assembling a turbulence generator 14 from pipes 17. A plastic flow pipe will resist water, chemicals, and washing agents. Various machining methods can also be used to manufacture a flow pipe from, for example, metals or composites. Yet another example of a possible manufacturing method is 3D printing, which also permits the economical manufacture of small batches. One significant advantage of moulding is that the flow pipe 17 is then manufactured mainly as a single-phase process. In addition, another advantage of the moulding process is the high degree of integration of the secondary operations relating to the operating environment of the flow pipe. The shaping of the flow chamber 16 of the flow pipe 17 can also be freely selected, within the limits of, for example, the injection-moulding technique.

45 **[0020]** At least one groove 24 and at least one protrusion 25 are arranged in the external surface 21.1 - 21.4 of the outlet-end flow section 19 of the flow pipe 17. In the flow section 19, the groove 24 and the protrusion 25 are on its opposite external surfaces 21.3, 21.1; 21.2, 21.4. With the aid of their formations 24, 25, the flow pipe 17 can be attached to the adjacent flow pipes 17' surrounding it, and particularly to their corresponding attachment formations 24', 25' (for example, Figures 4a - 4d), when the turbulence generator 14 is, for example, assembled and installed in a headbox 10. Figures 3 shows a bank of pipes assembled from flow pipes 17, 17' according to Figure 2, which can form at least part of a turbulence generator 14. The adjacent flow pipe 17' can be located above or below, or to the right or left, relative to the flow pipe 17.

55 **[0021]** As already stated above, the groove 24 and the protrusion 25 can be located in the flow pipe 17 on the opposing external surfaces 21.1 - 21.4 of its outlet-end flow section 19. Thus, each external side surface of the flow section 19 has at least one connection formation, which is at least one groove 24, or at least one protrusion 25. Correspondingly, there is at least one protrusion 25 on the opposing external side surface of the flow section 19, relative to the external

side surface with the groove 24 in question, or at least one groove 24, which permits the flow pipes 17, 17' to be connected to each other in the horizontal and vertical directions. The external surface 21.1 - 21.4 of the flow pipe 17 is, at least in the outlet-end section 19, planar, in which case a tight connection is created between the flow pipe 17 and the adjacent flow pipe 17' of the turbulence generator 14, thus, for its part, permitting the flow pipes 17, 17' to be connected to each other by means of joint-shaping 24, 25, 24', 25'.

**[0022]** In the embodiment of Figure 2, the groove 24 is on the righthand side external surface 21.2 of the flow section 19 and, in addition, also on its lower external surface 21.3, if the flow pipe 17 is examined from the outlet end 15. Correspondingly, the protrusion 25 is on the upper external surface 21.1 and left-hand side external surface 21.4 of the flow section 19. In this way, the flow pipe 17 can be attached on all sides to the adjacent flow pipe 17'. Of course, if the flow pipe 17 will meet one of the edges of the turbulence generator 14, it will then be possible to manage with even only a single groove-protrusion pair on each pipe.

**[0023]** In the bank of pipes according to Figure 3, the flow pipes 17 are in stacked in rows. The adjacent pipes in the same row are attached to each other by groove-protrusion joints fitted to each other in the side surfaces 21.2, 21.4 of the outlet-end flow section 19. Correspondingly, the rows of pipes on top of each other in the vertical direction are attached to each other by groove-protrusion joints in the upper and lower surfaces 21.1, 21.3 of the outlet-end of the flow section 19. The totality is a tight pipe package, in which the pipes 17, 17' are securely attached to each other and which, on the other hand, can also be detached.

**[0024]** Figures 4a - 4d show some examples of ways to attach the flow pipes 17, 17' to each other and, more specifically in their inserts, some shapes of the grooves 24, 24' and protrusions 25, 25' arranged in the pipes 17, 17'. Generally, the grooves 24 and protrusions 25 of the flow pipe 17 can be arranged to form a form-locking joint with the corresponding joint forms 24', 25' in the adjacent flow pipes 17'. As can be seen from Figures 4a - 4d, the shape-locking joint can be created in several different ways.

**[0025]** In Figure 4a, the shape-closure joint is formed by a groove 24 and a protrusion 25, which are rounded in shape. In Figure 4b, the shape-closure joint is formed by a groove 24 and a protrusion 25, which are angular. In Figure 4c, the shape-closure joint is formed by two grooves 24 and two protrusions 25 fitted to the same external side of the pipe, which are now also angular in shape. In Figures 4a - 4c, the shape-closure joint is based on the interference fit between the groove 24 and the protrusion 25. The dimensions of the groove and the protrusion are then adapted relative to each other, in such a way that, when they are pressed against each other, the groove 24 compresses the protrusion 25. Generally, in Figures 4a - 4c, at least two grooves 24 and at least two protrusions 25 are arranged on the external surface 21.1 - 21.4 of the outlet-end of the flow section 19 of the flow pipe 17. The grooves 24 and protrusions 25 are on opposite external surfaces 21.1 - 21.4 of the outlet-end of the flow section 19.

**[0026]** In Figure 4d, the shape-closure joint is a dovetail joint. Now, on the two external surfaces 21.3, 21.1, which are opposite to each other, of the outlet-end flow section 19 of the flow pipe 17, there is arranged a groove 24 on one surface 21.3 and a protrusion 25 on the other surface 21.1. The groove 24 and the protrusion 25 are arranged to form a dovetail joint with the corresponding joint formations 24', 25' of the adjacent flow pipes 17'. In each embodiment, as well as the locking, the groove 24 and the protrusion 25 also form a labyrinth seal for the turbulence generator 14 formed by the flow pipes 17, 17' installed in the headbox 10. Yet other possible joint shapes are, for example, spherical, hemispherical, and angular. Generally, it is possible to refer to the connection of the flow pipes to the rest of the construction of the turbulence generator by means of shape-closure joints according to the "plug-and-play" principle.

**[0027]** Figures 5a - 5d show an axial view of the turbulence generator banks formed from the flow pipes 17, 17' of the Figures 4a - 4d. Irrespective of the type of attachment of the pipes 17, 17', a similar bank of pipes is obtained. In Figures 5a - 5c, the protrusions 25 are on upper surface of the pipes and the grooves 24 on the lower surface of the pipes 24. In Figure 5d, the situation is the opposite, i.e. the protrusions are on the lower surface and the grooves on the upper surface. The flow pipe can be rotated, which further increases its versatility.

**[0028]** Figures 4a - 4d also show that the stacked flow pipe rows can, connected to each other, form a location for a flow sheet 28. It can be seen more clearly from Figure 2 that, for this purpose, there can be at least one shaping 26 at the outlet end 15 of the flow pipe 17, which is arranged to form, together with an upper or lower flow pipe 17', an attachment 31 for a flow sheet 28. At the outlet end 15 of the flow pipe 17, there is a lip 26, at the front edge of which there is a protrusion.

**[0029]** Figure 6 shows an arrangement, in which the sheets 28 are installed at the end of the bank of pipes. The attachment rods 30 at the inlet-end edge of the sheet 28 are in slots 31 formed by the stacked flow pipes 17, 17', thus forming a shape-closure joint. The internal diameter of the slots 31 can then be, for example, 6 - 15 mm. In particular in pipes 17, 17' manufactured by moulding, there can be a high degree of integration, because the attachment shaping of the sheets 28 is achieved in the ends of the pipes 17, 17' already in the moulding process, so that there is no need for separate sheet grooves.

**[0030]** In addition, Figure 6 shows that the joints of the stacked flow pipes 17, 17' remain on the bottom of the slot 31 reserved for the lamella. This, for its part, also helps the turbulence generator 14 to remain clean.

**[0031]** It can also be seen from the insert of Figure 6, that the turbulence generator's tightness and the cleanliness of

its trailing edge can, if necessary, be ensured by reflow welding the seams of the outlet end. The welded joint 32 in question can be made simple by melting the seams, in which case additional material will not be required to close the seam. The intention of the welded joint is to remove the joint grooves and thus ensure, for example, the tightness and uniformity of the joint location. In other words, the welded joint nevertheless permits the pipes 17 to be also be easily

removed later with little effort, for example, in order to change them.

**[0032]** Figures 7a and 7b show one significant benefit that is made possible by the flow pipe 17. The shape-closure connection of a flow pipe 17 to an adjacent flow pipe 17' permits the location of the flow pipe 17 to be altered steplessly horizontally and vertically. This gives a degree of freedom for altering the flow of the turbulence generator 14. The shape-closure joint between the flow pipes 17, 17' limits the movement of the flow pipes relative to each other only in their longitudinal direction. In the cross direction of the headbox 10, the groove-protrusion joints of the flow pipes do not limit the movement of the flow pipes, instead the flow pipe rows can move relative to each other. In particular, if the flow pipes are manufactured, for example, from plastic, a force exceeding the static friction will be able to slide the rows of flow pipes relative to the pipe/groove. Plastic flexes and slides, but on the other hand, its static friction also ensures that the pipes will remain securely in place. In addition, pipes made from plastic withstand small static forces. Yet another significant difference of a flow pipe 17 made from plastic is that, for example, the local thermal expansion of small-tolerance flow pipes 17, 17' made from plastic will seal the trailing edge of the turbulence generator 14.

**[0033]** Figure 9 shows yet another embodiment of the invention, which is a modification of that shown in Figure 7a. In it, an O-ring seal 29 is added to the protrusion 25 and groove 24 arranged in the external surface of the flow pipes 17, 17'. There can be grooves 27 for the O-ring seal 29 in the protrusions 25 and grooves 24. There can advantageously be two O-ring grooves 27 in the external surface of the flow pipes 17, 17', in which case the O-rings 29 can be in a different groove 27 in every second pipe and the O-ring can thus go into the corresponding groove 27 in the adjacent pipe. Alternatively, there can be O-rings 29 in both grooves 27 in every second pipe, and none at all in the adjacent pipe. By means of this solution, the corner location of the pipes 17 too are sealed.

**[0034]** Figures 8a - 8c show examples of the turbulence generator 14 of a fiber web machine, examined from different directions. The turbulence generator 14 includes several flow pipes 17. At least one groove and at least one protrusion, by which the flow pipe 17 is attached to the adjacent pipe 17, is arranged in the external surface of the outlet ends of the flow pipes 17. The pipes 17 are attached to one end 31 of a box structure 33 formed from plate-like elements. There are holes in the end plate 31, into which the pipes 17 fit tightly at the inlet end. Correspondingly, at the other end the pipe package can expand. Due to lateral thermal expansion, the pipes seal the plate 31 at the outlet end. At the outlet end 19 of the pipes 17, the flow pipes at the edges of the turbulence generator 14 can be tightened, for example, by means of a tensioned band (not shown) around the pipe package. If the box structure 33 extends right to the outlet end 15 of the pipes, there can be a metal plate at the upper and lower edge of the outlet end 31 of the box 33, in which there is a claw fitted to the locking shapes in the external sides of the pipes at the edges and thick plate pieces of the actual box structure, on top of the locking metal plate.

**[0035]** The turbulence generator 14 of the headbox according to the invention can be, for example, nine metres wide and have three rows. In that case, in one row there will be one hundred flow pipes over a distance of three meters and thus there will be more than one thousand flow pipes in the headbox in question. According to the invention, by means of the flow pipe, significant savings will be obtained in both labour and material costs and especially when assembling the headbox. At the same time, the mass of the turbulence generator 14 will be less than usual, particularly if the pipes are plastic. The flow pipes will also be of even quality and the level of turbulence will be uniform over the entire width of the slice opening.

**[0036]** It must be understood that the above description and the related figures are only intended to illustrate the present invention, i.e. the invention is thus in no way restricted to only the embodiments disclosed, but many different variations and adaptations of the invention, which fall within the scope of the invention as defined in the accompanying claims, are possible.

## Claims

1. Turbulence generator (14) of a headbox (10) of a fiber web machine, which includes a plurality of flow pipes (17, 17') wherein each flow pipe has two ends, an inlet end (13) and an outlet end (15), and between which ends (13, 15) there is a flow channel (16), wherein at least one groove (24) and at least one protrusion (25) is arranged in the external surface (21.1 - 21.4) of each flow pipe (17, 17') in order to attach each flow pipe (17, 17') to adjacent flow pipes (17, 17') of the plurality of flow pipes (17, 17'),  
**characterized in that**  
the at least one groove (24) and the at least one protrusion (25) of the flow pipe (17, 17') are formed in perpendicular direction to the axis of the flow pipe (17, 17') such that adjacent grooves (24) and protrusions (25) of the flow pipes (17, 17') are joined to each other to connect the adjacent flow pipes (17, 17') to each other by means of counter-

pair joint formations (24, 25, 24', 25').

2. Turbulence generator (14) according to claim 1, wherein the flow channel (16) has at least two flow sections, an inlet-end flow section (18) and an outlet-end flow section (19), wherein the outlet-end flow section (19) has an angular external cross-section and the at least one groove (24) and at least one protrusion (25) are arranged in the external surface (21.1 - 21.4) of the outlet-end flow section (19).
3. Turbulence generator (14) according to claim 2, **characterized in that** the at least one groove (24) and at least one protrusion (25) are arranged on opposite sides of the external surface (21.1 - 21.4) of the outlet-end flow section (19).
4. Turbulence generator (14) according to any of claims 1 - 3, **characterized in that** the groove (24) and protrusion (25) of the flow pipe (17, 17') are arranged to form a shape-locking connection to the corresponding counter-pair joint formation (24', 25') of the adjacent flow pipes (17, 17').
5. Turbulence generator (14) according to any of claims 1 - 4, **characterized in that** the groove (24) and protrusion (25) are arranged to form a labyrinth seal to the turbulence generator structure (14) formed by the flow pipes (17, 17').
6. Turbulence generator (14) according to any of claims 1 - 5, **characterized in that** on the two external surfaces (21.3, 21.1), which are opposite to each other, of the outlet end of the flow section (19) of the flow pipe (17, 17'), there is arranged a groove (24) on one surface (21.3) and a protrusion (25) on the other surface (21.1) and the groove (24) and protrusion (25) are arranged to form a dovetail joint with the corresponding counter-pair joint formations (24', 25') of the adjacent flow pipes (17, 17').
7. Turbulence generator (14) according to any of claims 1 - 6, **characterized in that** a shaping (26), which is arranged to form an attachment (31) for a flow sheet (28) with the flow pipes (17, 17') below and/or above, is arranged in the outlet end (15) of the flow pipe (17, 17').

#### Patentansprüche

1. Turbulenzerzeuger (14) eines Stoffauflaufs (10) einer Faserstoffbahnmaschine, der eine Vielzahl von Strömungsrohren (17, 17') aufweist, wobei jedes Strömungsrohr zwei Enden, ein Einlassende (13) und ein Auslassende (15), hat und es zwischen diesen Enden (13, 15) einen Strömungskanal (16) gibt, wobei zumindest eine Nut (24) und zumindest ein Vorsprung (25) in der Außenfläche (21.1 - 21.4) jedes Strömungsrohrs (17, 17') angeordnet sind, um jedes Strömungsrohr (17, 17') an benachbarte Strömungsrohre (17, 17') der Vielzahl von Strömungsrohren (17, 17') anzubringen,  
**dadurch gekennzeichnet, dass**  
die zumindest eine Nut (24) und der zumindest eine Vorsprung (25) des Strömungsrohrs (17, 17') in einer senkrechten Richtung zu der Achse des Strömungsrohrs (17, 17') derart ausgebildet sind, dass benachbarte Nuten (24) und Vorsprünge (25) der Strömungsrohre (17, 17') aneinander gefügt werden, um die benachbarten Strömungsrohre (17, 17') mittels gegenpaarigen Fügeausbildungen (24, 25, 24', 25') miteinander zu verbinden.
2. Turbulenzerzeuger (14) nach Anspruch 1, wobei der Strömungskanal (16) zumindest zwei Strömungsbereiche, einen einlassendseitigen Strömungsbereich (18) und einen auslassendseitigen Strömungsbereich (19), hat, wobei der auslassendseitige Strömungsbereich (19) einen eckigen Außenquerschnitt hat und die zumindest eine Nut (24) und der zumindest eine Vorsprung (25) in der Außenfläche (21.1 - 21.4) des auslassendseitigen Strömungsbereichs (19) angeordnet sind.
3. Turbulenzerzeuger (14) nach Anspruch 2, **dadurch gekennzeichnet, dass** die zumindest eine Nut (24) und der zumindest eine Vorsprung (25) an entgegengesetzten Seiten der Außenfläche (21.1 - 21.4) des auslassendseitigen Strömungsbereichs (19) angeordnet sind.
4. Turbulenzerzeuger (14) nach einem der Ansprüche 1 bis 3, **dadurch gekennzeichnet, dass** die Nut (24) und der Vorsprung (25) des Strömungsrohrs (17, 17') angeordnet sind, um eine formschlüssige Verbindung an der korrespondierenden gegenpaarigen Fügeausbildung (24', 25') der benachbarten Strömungsrohre (17, 17') auszubilden.
5. Turbulenzerzeuger (14) nach einem der Ansprüche 1 bis 4, **dadurch gekennzeichnet, dass** die Nut (24) und der Vorsprung (25) angeordnet sind, um eine Labyrinthdichtung an der Turbulenzerzeugerstruktur (14), die durch die

Strömungsrohre (17, 17') ausgebildet ist, auszubilden.

6. Turbulenzerzeuger (14) nach einem der Ansprüche 1 bis 5, **dadurch gekennzeichnet, dass** an den zwei einander entgegengesetzten Außenflächen (21.3, 21.1) des Auslassende des Strömungsbereichs (19) des Strömungsrohrs (17, 17') eine Nut (24) an einer Fläche (21.3) und ein Vorsprung (25) an der anderen Fläche (21.1) angeordnet sind und die Nut (24) und der Vorsprung (25) angeordnet sind, um eine Schwalbenschwanzverbindung mit den korrespondierenden gegenpaarigen Fügeausbildungen (24', 25') der benachbarten Strömungsrohre (17, 17') auszubilden.
7. Turbulenzerzeuger (14) nach einem der Ansprüche 1 bis 6, **dadurch gekennzeichnet, dass** eine Formgebung (26), die angeordnet ist, um eine Befestigung (31) für eine Strömungsplatte (28) mit den Strömungsrohren (17, 17') unterhalb und/oder oberhalb auszubilden, in dem Auslassende (15) des Strömungsrohrs (17, 17') angeordnet ist.

## Revendications

1. Générateur de turbulences (14) d'une caisse de tête (10) d'une machine à toile de fibres comprenant une pluralité de tuyaux d'écoulement (17, 17'), dans lequel chaque tuyau d'écoulement a deux extrémités, une extrémité d'entrée (13) et une extrémité de sortie (15) et entre ces extrémités (13, 15) se situe un canal d'écoulement (16), dans lequel au moins un renforcement (24) et au moins une saillie (25) sont agencés dans la surface externe (21.1 - 21.4) de chaque tuyau d'écoulement (17, 17') afin d'attacher chaque tuyau d'écoulement (17, 17') aux tuyaux d'écoulement adjacents (17, 17') de la pluralité de tuyaux d'écoulement (17, 17'),  
**caractérisé en ce que**  
le au moins un renforcement (24) et la au moins une saillie (25) du tuyau d'écoulement (17, 17') sont formés suivant la direction perpendiculaire à l'axe du tuyau d'écoulement (17, 17') de sorte que des renforcements adjacents (24) et des saillies adjacentes (25) des tuyaux d'écoulement (17, 17') soient reliés les uns aux autres pour relier les tuyaux d'écoulement adjacents (17, 17') les uns aux autres au moyen de formations de jonctions par paire opposée (24, 25, 24', 25').
2. Générateur de turbulences (14) selon la revendication 1, dans lequel le canal d'écoulement (16) comprend au moins deux sections d'écoulement, une section d'écoulement d'extrémité d'entrée (18) et une section d'écoulement d'extrémité de sortie (19), dans lequel la section d'écoulement d'extrémité de sortie (19) a une coupe transversale externe angulaire et le au moins un renforcement (24) et la au moins une saillie (25) sont agencés dans la surface externe (21.1- 21.4) de la section d'écoulement d'extrémité de sortie (19).
3. Générateur de turbulences (14) selon la revendication 2, **caractérisé en ce que** le au moins un renforcement (24) et la au moins une saillie (25) sont agencés sur des faces opposées de la surface externe (21.1- 21.4) de la section d'écoulement d'extrémité de sortie (19).
4. Générateur de turbulences (14) selon l'une quelconque des revendications 1 à 3, **caractérisé en ce que** le renforcement (24) et la saillie (25) des tuyaux d'écoulement (17, 17') sont agencés pour former une connexion à verrouillage de forme à la formation de jonction par paire opposée correspondante (24', 25') des tuyaux d'écoulement adjacents (17, 17').
5. Générateur de turbulences (14) selon l'une quelconque des revendications 1 à 4, **caractérisé en ce que** le renforcement (24) et la saillie (25) sont agencés de façon à former un joint en labyrinthe à la structure du générateur de turbulences (14) formé par les tuyaux d'écoulement (17, 17').
6. Générateur de turbulences (14) selon l'une quelconque des revendications 1 à 5, **caractérisé en ce que** sur les deux surfaces externes (21.3- 21.1) qui sont opposées l'une par rapport à l'autre, de l'extrémité de sortie de la section d'écoulement (19) du tuyau d'écoulement (17, 17'), un renforcement (24) est agencé sur une surface (21.3) et une saillie (25) sur l'autre surface (21.1) et le renforcement (24) et la saillie (25) sont agencés de façon à former un joint en queue d'aronde avec la formation de jonction par paire opposée correspondante (24', 25') des tuyaux d'écoulement adjacents (17, 17').
7. Générateur de turbulences (14) selon l'une quelconque des revendications 1 à 6, **caractérisé en ce qu'une** forme (26), qui est agencée pour former une fixation (31) pour un panneau d'écoulement (28) avec les tuyaux d'écoulement (17, 17') au-dessous et/ ou au-dessus, est agencée dans l'extrémité de sortie (15) des tuyaux d'écoulement (17, 17').

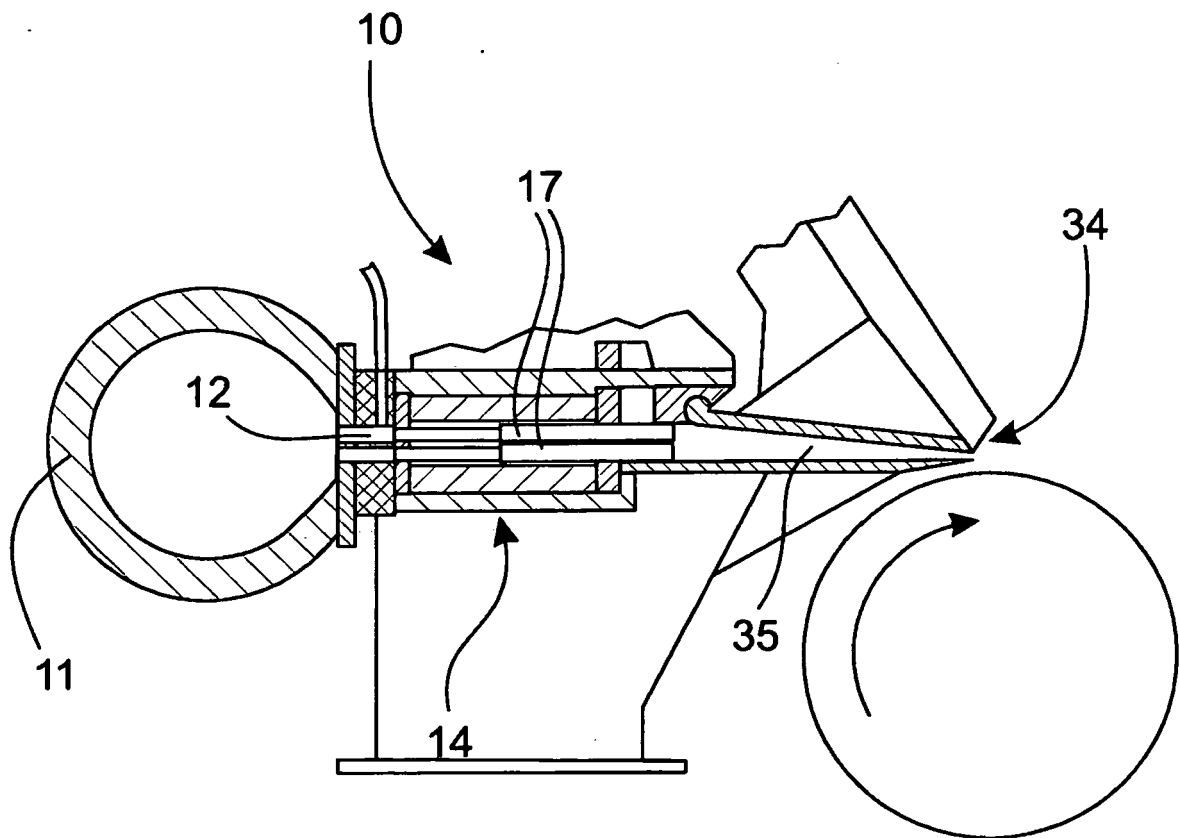
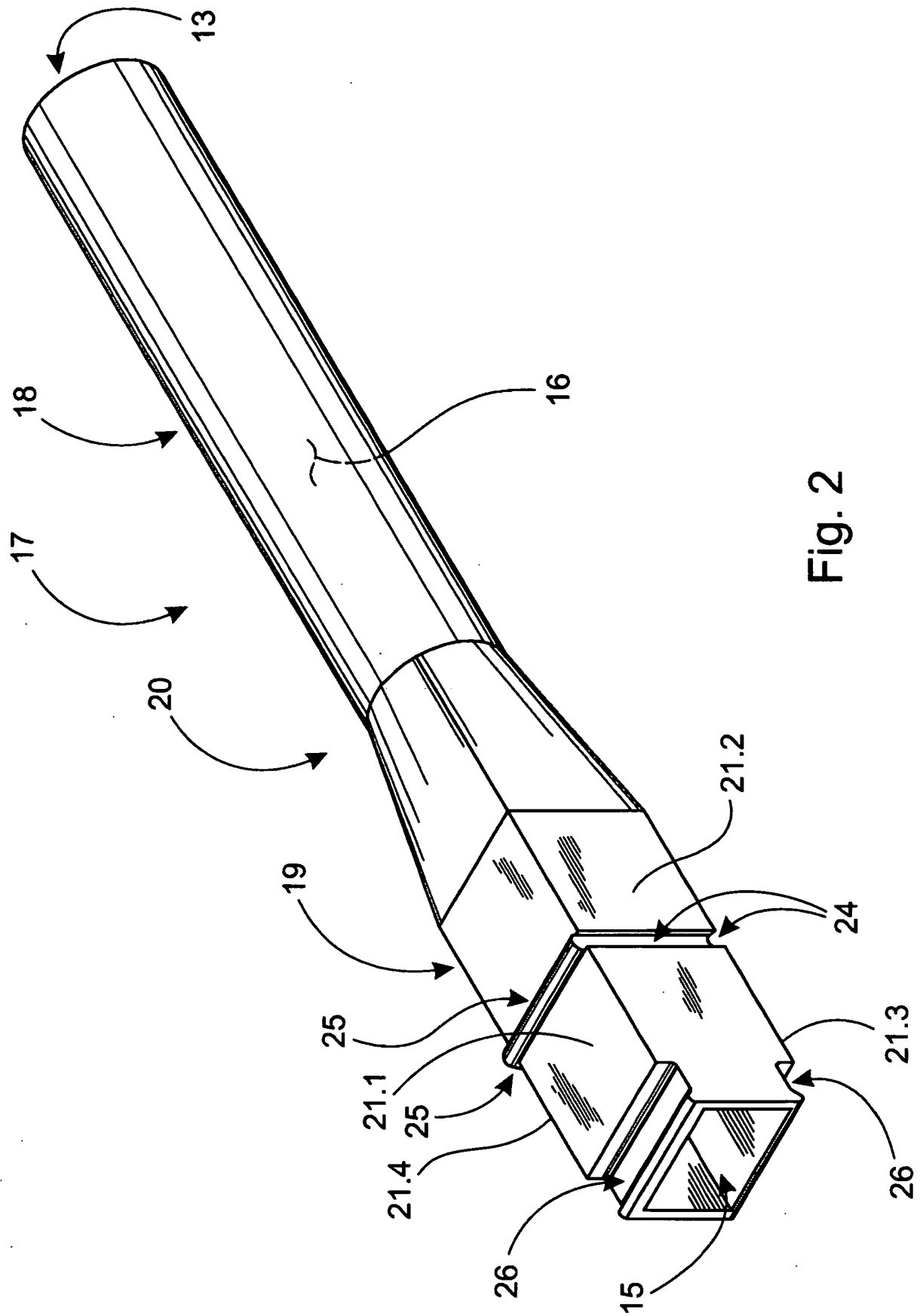


Fig. 1



**Fig. 2**

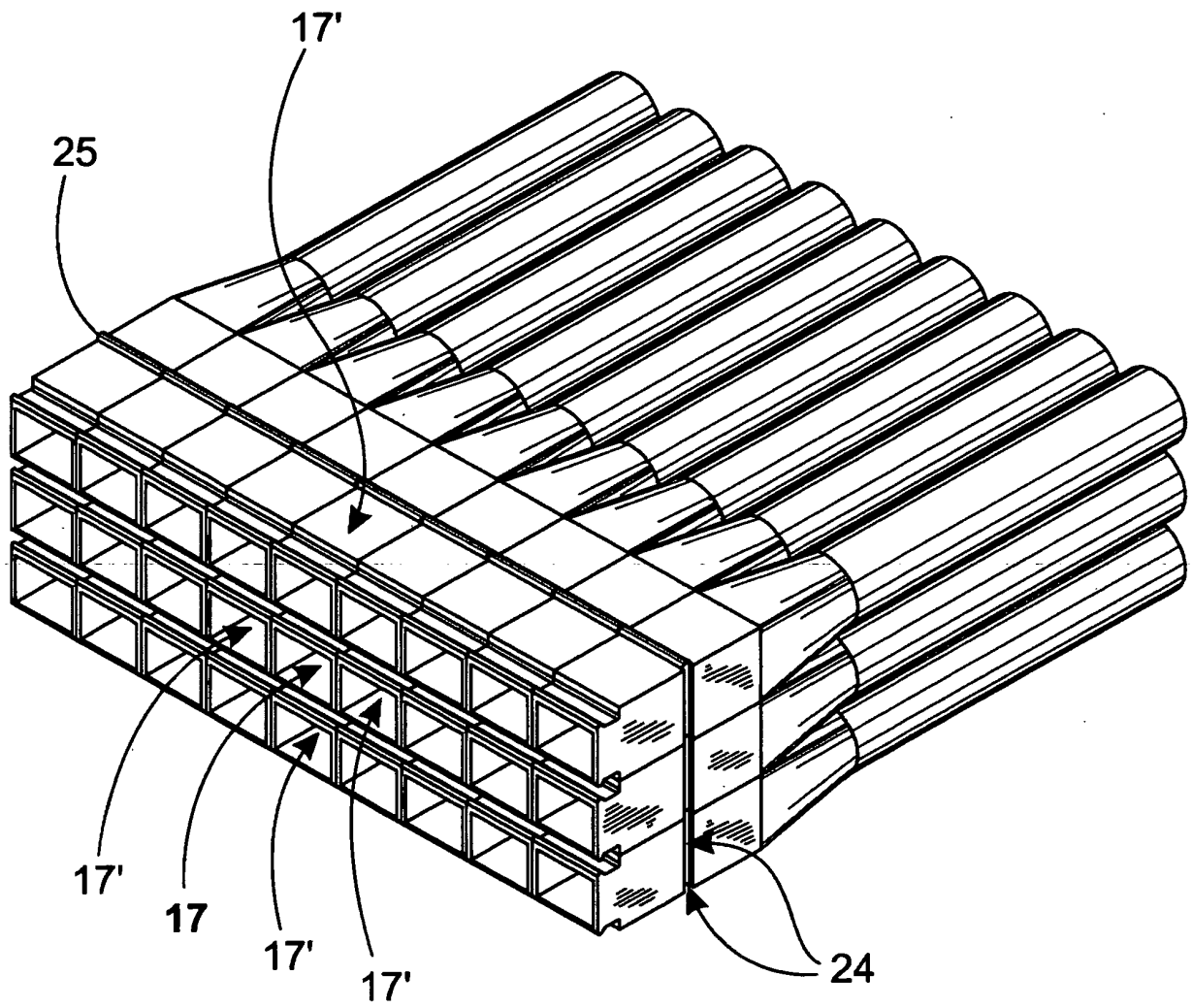
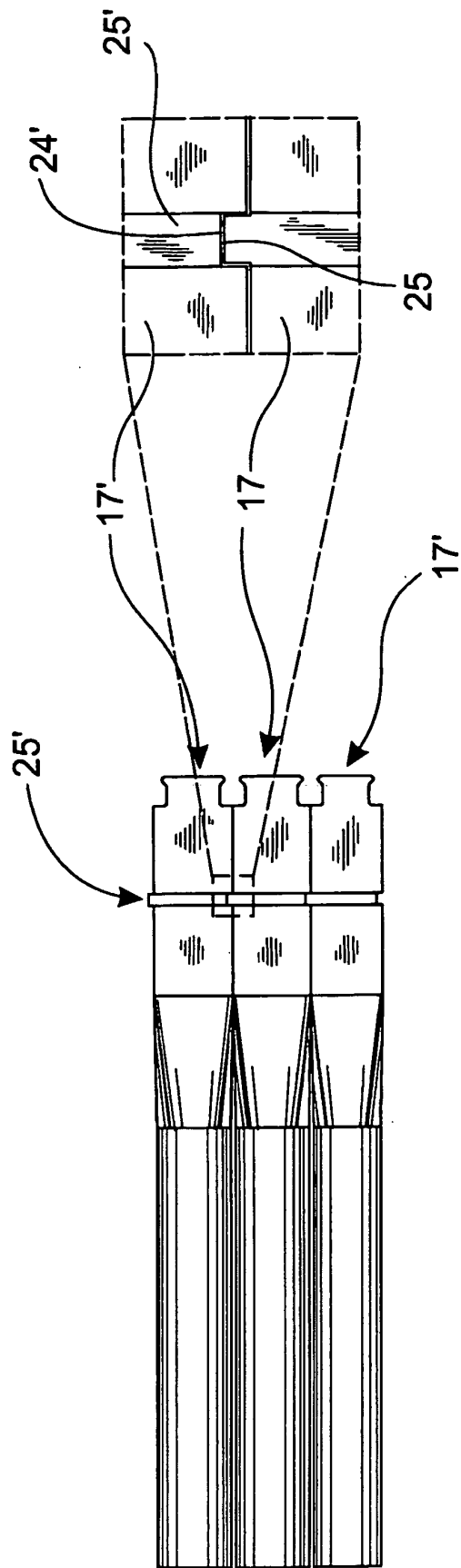
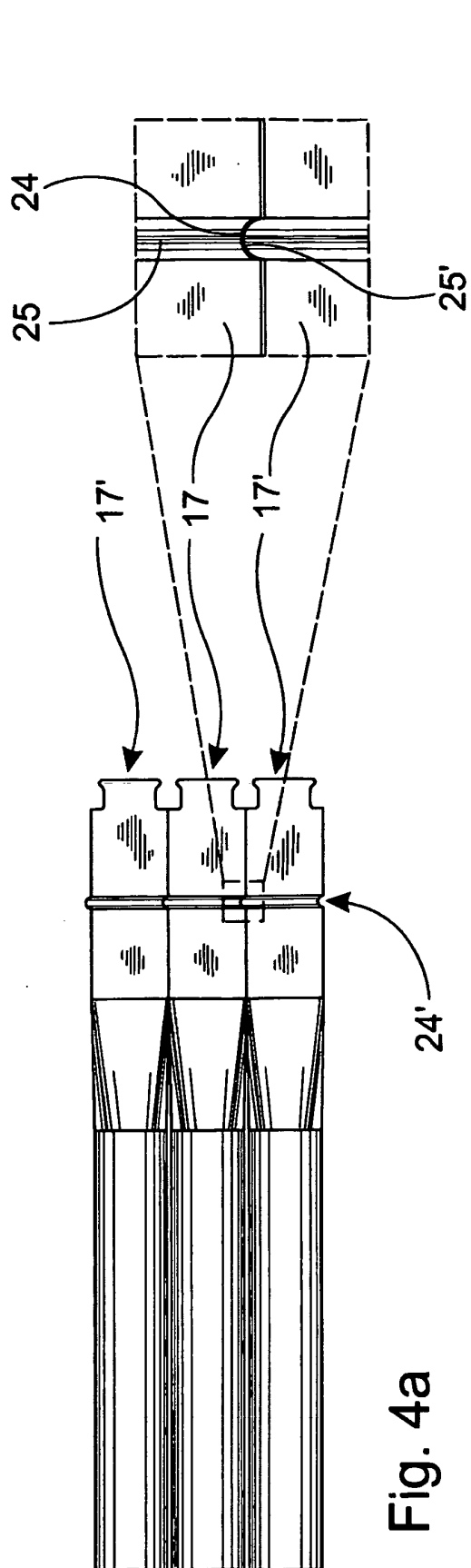


Fig. 3



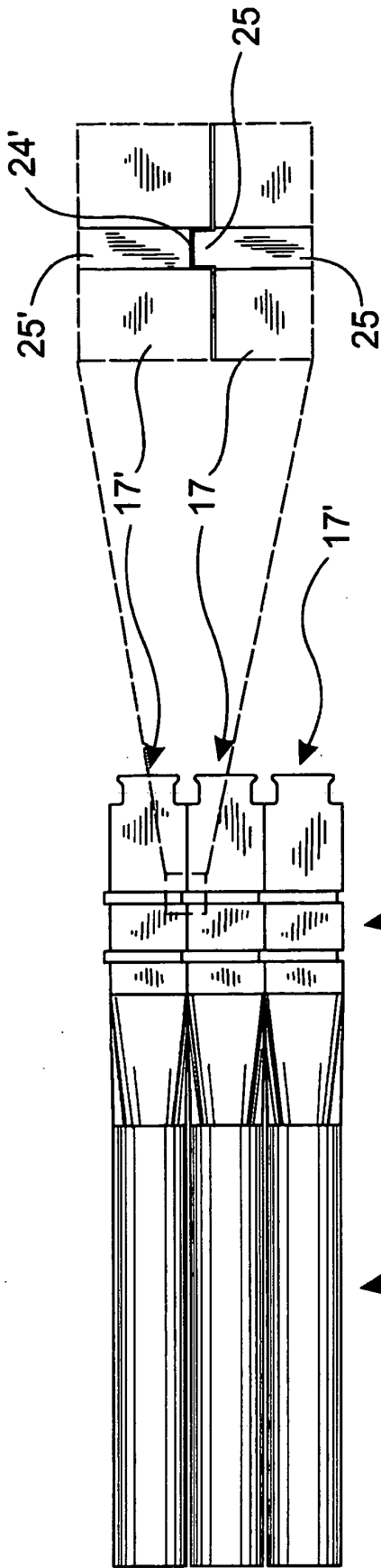


Fig. 4c

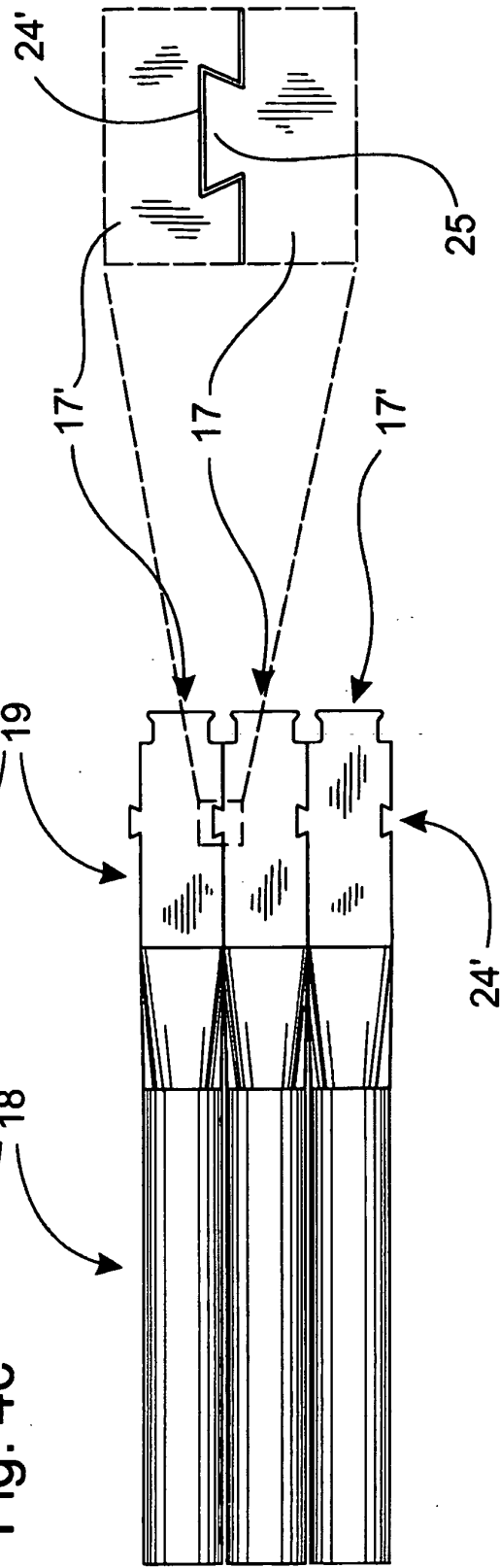


Fig. 4d

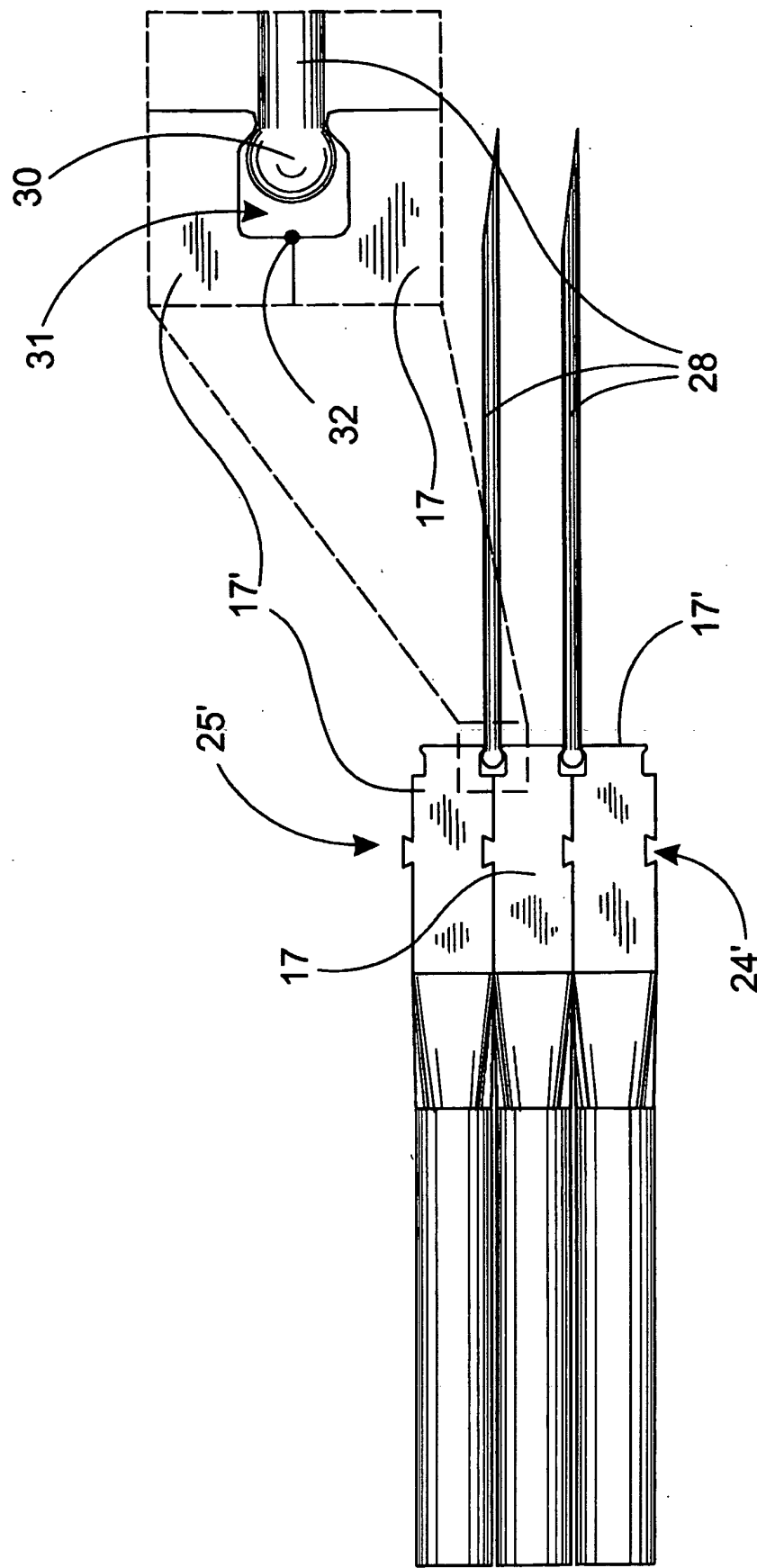


Fig. 6

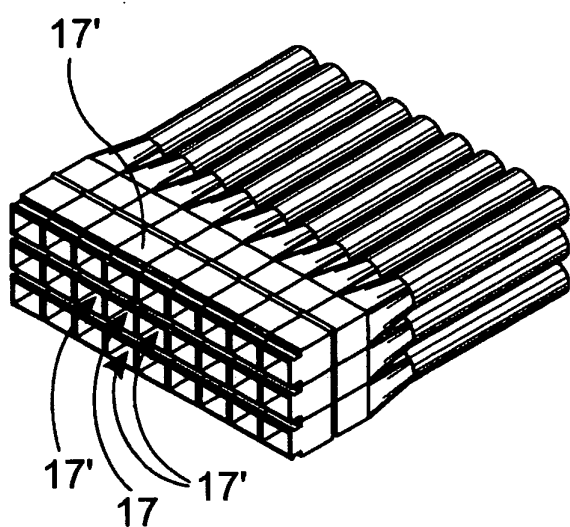


Fig. 5a

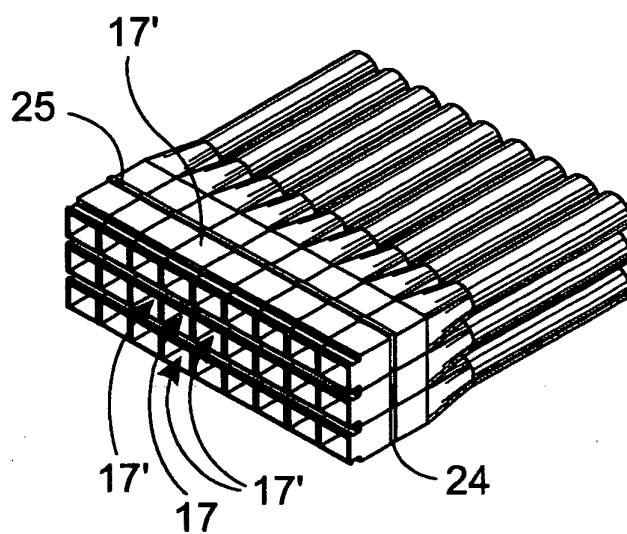


Fig. 5b

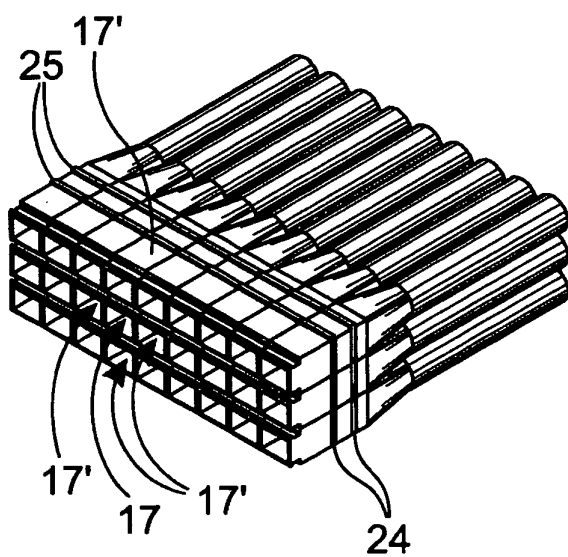


Fig. 5c

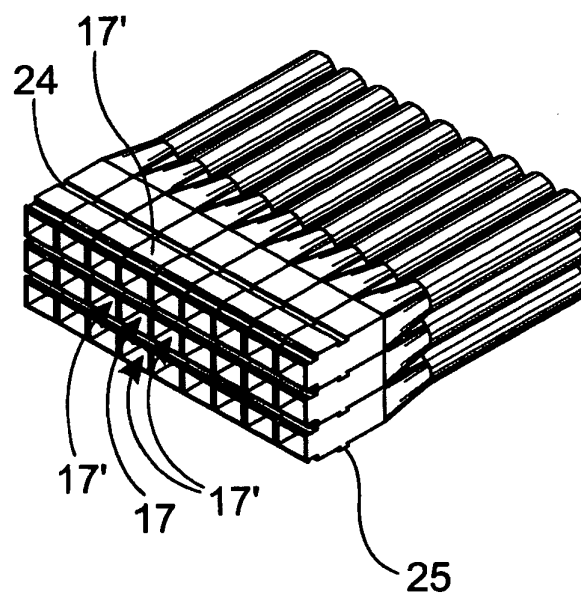
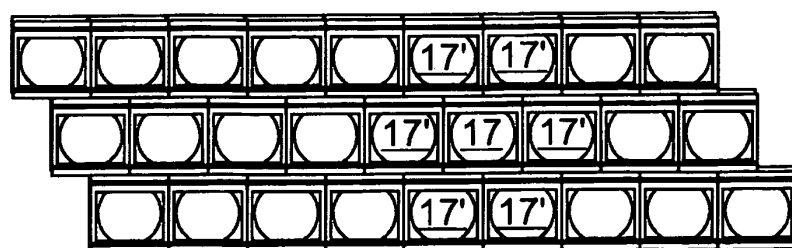
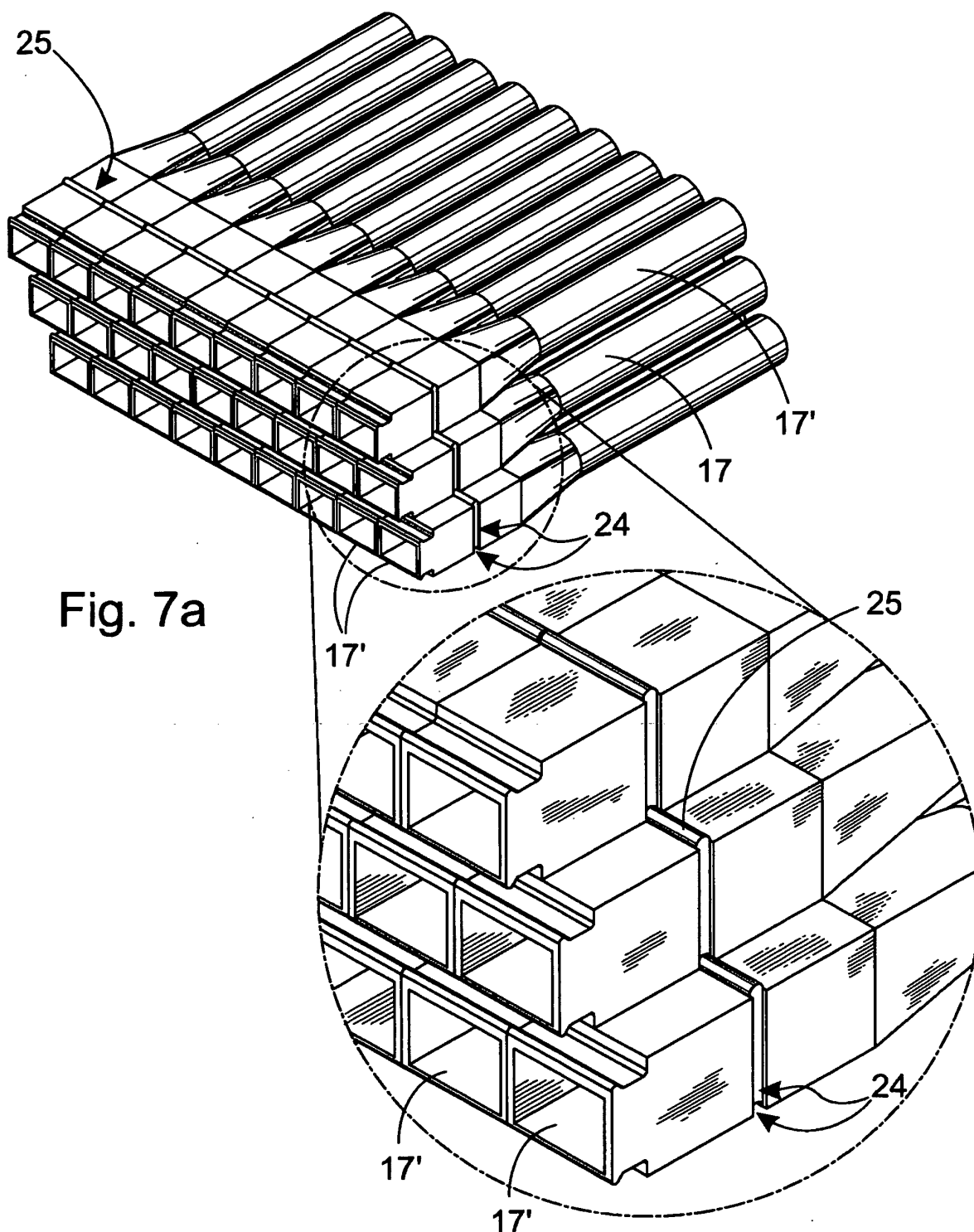


Fig. 5d



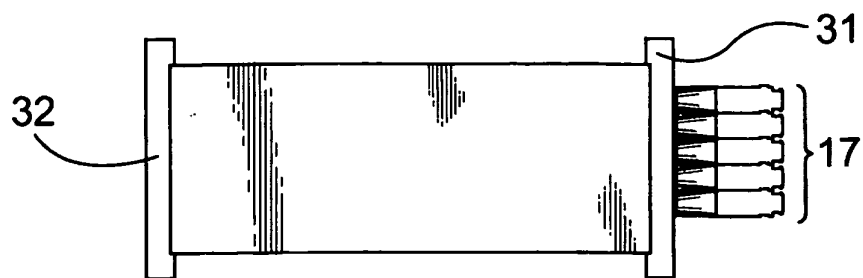


Fig. 8a

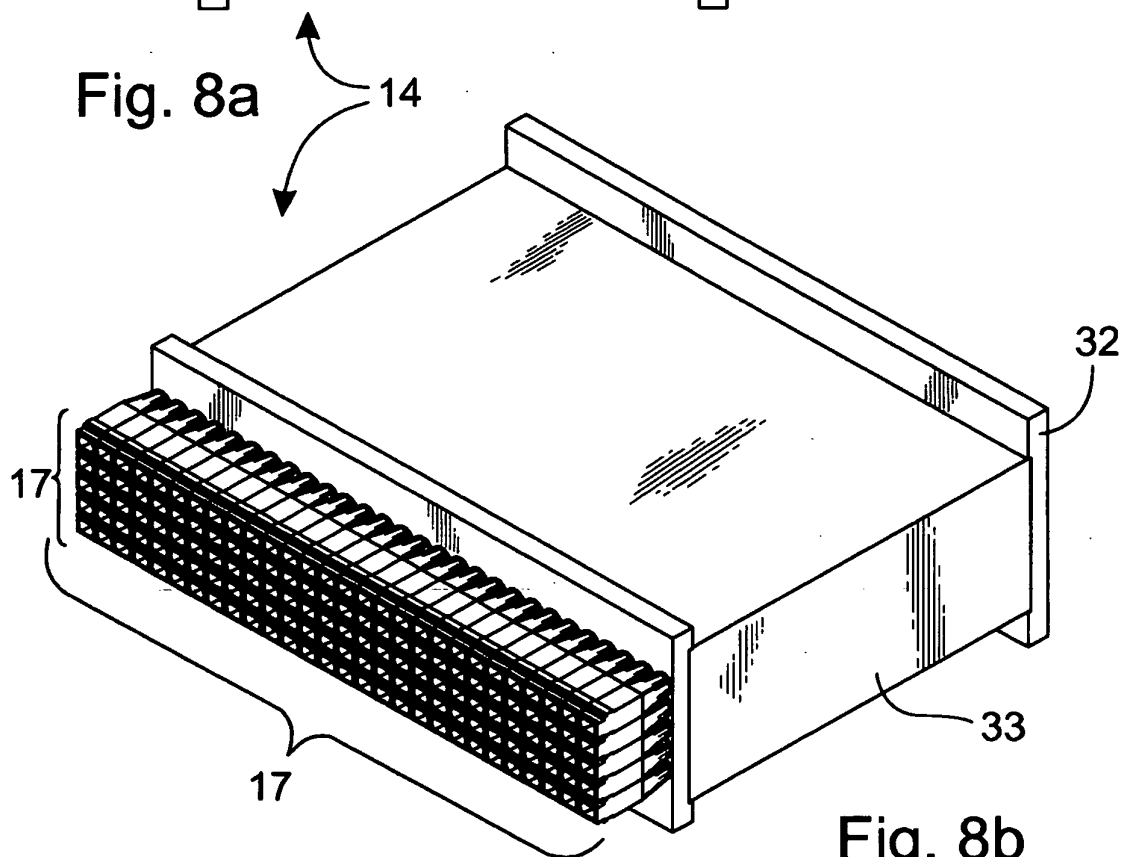


Fig. 8b

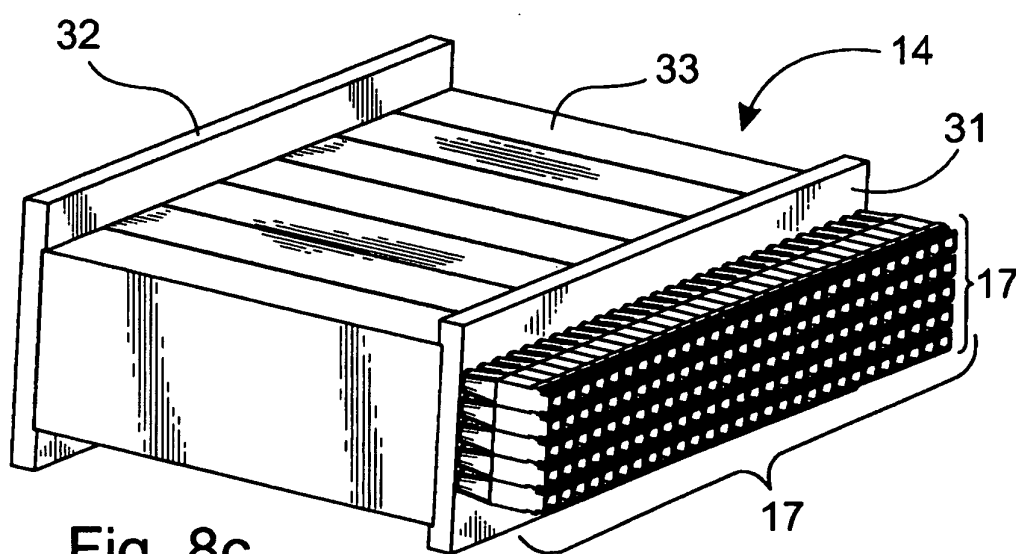
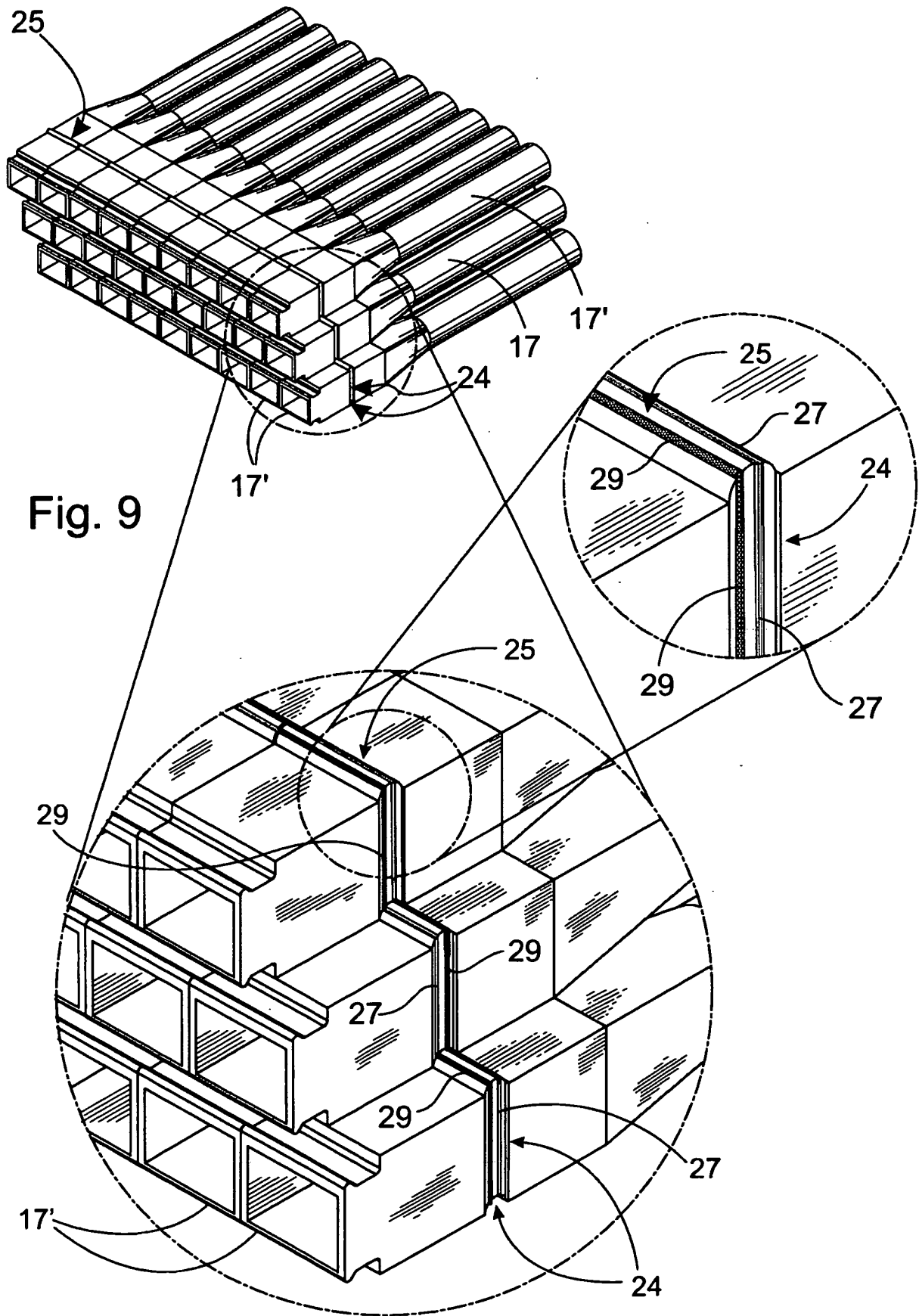


Fig. 8c



**REFERENCES CITED IN THE DESCRIPTION**

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**Patent documents cited in the description**

- FI 110700 B [0002]
- WO 2008105714 A [0004]
- WO 0121886 A1 [0005]
- US 4539075 A [0006]