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(54) Coextrusion centrifugal fiberizing apparatus

(57) The subject of the invention is a coextrusion centrifugal fiberizing apparatus for the simultaneous production of synthetic and/or natural, homogeneous and/or mixed fibers from thermoplastic raw materials by centrifuging. The coextrusion centrifugal fiberizing apparatus according to the invention is suitable for the production of heat-insulating quilts of both homogeneous and/or mixed fiber structures primarily from recycled plastics.

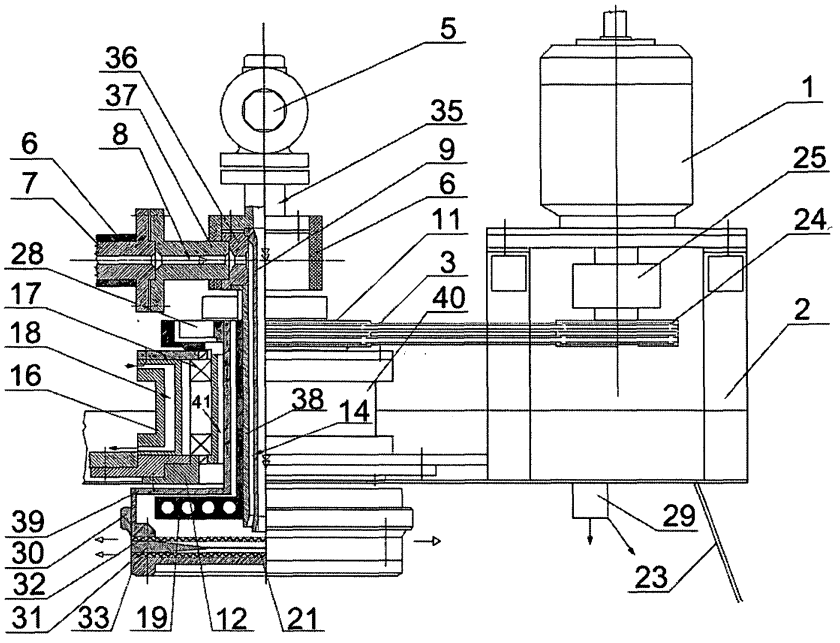

Figure 1

EP 2 071 063 A2

Description

[0001] The subject of the invention is a coextrusion centrifugal fiberizing apparatus for the simultaneous production of synthetic and/or natural, homogeneous and/or mixed fibers from thermoplastic raw materials. The coextrusion centrifugal fiberizing apparatus according to the invention is suitable for the production of heat-insulating quilts of both homogeneous and/or mixed fiber structures from recycled materials.

[0002] Patent No. DE9900016 entitled "Method and apparatus for the production of fibrous materials from thermoplastic plastics" discloses a horizontal-shaft centrifugal fiberizing apparatus. Size-reduced plastic is filled into the hopper of an extruder in the form of granules or chips. In the heated shell of the extruder a homogeneous polymer melt is formed. The melt is fed onto the rotating centrifugal disk of the apparatus by means of the extruder. The axis of rotation of the centrifugal disk is uniaxial with the axis of rotation of the pulley of the extruder apparatus. Due to the centrifugal force drops fly out through a fiber-forming orifice perpendicularly to the axis of rotation into an open air space, where the drops draw fibers. A flow of air in the direction of the shaft of the extruder facilitates the drawing of fibers from the polymer drops, and cools them as well. After fiber formation the fibrous product is removed from the fiber-forming head by a conveyor belt. The disadvantage of this technical solution is that due to the horizontal uniaxiality of the extruder and the fiber-forming head the collection and removal of the produced fibers is difficult, furthermore only one type of melt plastic can be fed onto the centrifugal disk of the fiberizing apparatus, the addition of ancillary materials or the simultaneous centrifugal fiberization of two plastic melts of different melting points cannot be performed. Patent application No. HU194787 entitled "Method and apparatus for the production of inorganic fibrous materials and method for the production of heat-insulating and fire-resistant products from such materials" discloses a technology and apparatus for the production of heat-insulating quilts by centrifugal fiberization. According to the solution the axis of rotation of the centrifugal fiber-forming head is vertical. Air and combustible gas are blown in a direction perpendicular or almost perpendicular to the direction of fiber formation. During the process a binding-material can be applied to the fibers, but it can be sprayed onto the fibers only after fiber formation. The bundle of fibers is subsequently hot-formed. According to this solution the centrifugal disk is equipped with a separate drive unit, and in the shaft of the centrifugal disk a system of bores is formed to allow the outflow of gas at the edge of the centrifugal disk. The apparatus is intended for the production of primarily silicate-containing fibers, for which a high-temperature technology is required. The disadvantage of the apparatus is that it is not suitable for the production of low-melting-point synthetic fibers, furthermore the centrifugal fiberization of only one type of primarily silicate-containing melt pre-mixed to homogeneous condition can be performed.

Patent application No. HU212585 entitled "Method and apparatus for the formation of fibers from glass or other thermoplastic materials" also discloses a centrifugal fiberizing apparatus having a fiber-forming orifice. A pre-mixed thermoplastic material is delivered to the centrifugal disk through a central tube. The formed fibers are heated and drawn by a combustible gas flowing at a high speed. The angle of the nozzles and the drawing cone of the gas medium is directional and pre-set. The guiding and cooling of the fibers is ensured by a cold gas cushion. The disadvantage of the solution is that the formation of fibers of only one material quality is possible with the apparatus. The addition of ancillary materials to the raw material of the fibers is possible only in a preliminary mixing process prior to the operation of the apparatus. The simultaneous centrifugal fiberization of two different materials cannot be performed.

[0003] The object of the invention is to provide a coextrusion centrifugal fiberizing apparatus, eliminating the deficiencies of the known solutions, suitable for the formation of fibers from two thermoplastic materials of different qualities simultaneously in such a way that the fibers can be mixed already in the initial phase of production, during the simultaneous formation of fibers.

This object is achieved with the development of a centrifugal fiberizing apparatus, the main characteristic of which is that it has two orifices for the formation of fibers from two materials of different qualities, and in addition to a drop tube used for forwarding the raw material, it also comprises a circular gap for delivering the ancillary material.

The subject of the invention is a coextrusion centrifugal fiberizing apparatus for the production of synthetic homogeneous and/or mixed fibers from thermoplastic raw materials.

At least one extruder is connected to the centrifugal fiberizing unit of the apparatus according to the invention. The centrifugal fiberizing unit is held in the vertical axis by a frame equipped with an air control unit, which, in addition to controlling the air volume, ensures that the air flows in a direction perpendicular to the direction of projection. The main element located in the housing of the centrifugal fiberizing unit is a centrifugal head rotatable around its vertical axis, which is a hollow rotating body having a head. An insert piece and a centrifugal disk are mounted on the bottom of the centrifugal head in a releasable manner in such a way that an orifice is formed both between the insert piece and the centrifugal head, and between the insert piece and the centrifugal disk. The insert piece and the centrifugal disk rotate together with the centrifugal head. For forwarding the fiber material to the centrifugal head, a drop tube is installed in the centre of the axis of the centrifugal head, which is connected to the raw material extruder supplying the material required for the formation of the raw material fiber. A tube is mounted uniaxially on the drop tube. The gap between the drop tube and the tube is connected to an ancillary material

extruder, which fills the material required for the formation of the ancillary fiber into the gap and forwards it to the centrifugal head. The extruders are connected to the centrifugal fiberizing unit through a heated joining piece. The drop tube and the tube are non-rotating parts, they are not connected to the centrifugal disk.

Bearings are installed in the housing of the centrifugal fiberizing unit to ensure the rotatability of the centrifugal head. The construction of the bearing support allows high-temperature operation, as the bearings are surrounded from the outside by a water channel, and from the inside by an air passage for the cooling air flow. The centrifugal head is driven by a motor. During the operation of the coextrusion centrifugal fiberizing apparatus, when a disk-shaped insert piece is used for the purpose of producing two fibers of different qualities, the raw material extruder feeds plastic melt to the centrifugal head through an elbow piece and the drop tube. When the melt reaches the centrifugal disk, due to the centrifugal force it moves towards the circumference of the disk, then the melt drop leaves the centrifugal disk at a speed corresponding to that of the edge of the centrifugal disk and through the lower orifice gets into an air space bounded by the frame and a skirt plate, where fiber formation takes place by means of the cooling air. The ancillary material extruder forwards the melt required for the formation of the ancillary fiber to the centrifugal head and the insert piece through an ancillary material canal and the gap. The melt gets from the insert piece to the air space bounded by the skirt plate through the upper orifice. The cooling air flowing in a direction perpendicular to the direction of projection from a tube system installed in the frame diverts the fibers, and at the same time conditions and solidifies them. In this space the fibers are cooled, and the fibers coming from the lower and the upper orifices are mixed, and due to their own mass are deposited in layers under the centrifugal fiberizing unit, where they can be collected for further processing.

When a pitch-cone-shaped insert piece is used, the melts coming through the tube and the drop tube are already mixed on the centrifugal disk.

[0004] The centrifugal fiberizing apparatus according to the invention is shown in detail in the following figures, where

Figure 1: is a semi-sectional semi-view of the coextrusion centrifugal fiberizing apparatus with the drive

Figure 2: is a partial longitudinal sectional drawing of the centrifugal head with a disk-shaped insert piece

Figure 3: is a partial longitudinal sectional drawing of the centrifugal head with a cone-shaped insert piece

Figure 4: is a detail drawing of two gap-shaped orifices in the centrifugal head

Figure 5: is a detail drawing of two toothed-shaped orifices in the centrifugal head

[0005] Figure 1 shows a preferred embodiment of the coextrusion centrifugal fiberizing apparatus. As it is shown in Figure 1, the centrifugal fiberizing unit 40 is held in the vertical position by a frame 2. The feed tube of the raw material extruder is connected to the centrifugal fiberizing unit 40 through an elbow piece 5, and the feed tube of the ancillary material extruder through a joining piece 7, perpendicularly to the axis of rotation. The elbow piece 5 is connected to a suspender 36, which also accommodates an interface piece 37, to which the ancillary material extruder can be connected through the joining piece 7. The centrifugal fiberizing unit 40 comprises a centrifugal head 39. Inside the centrifugal head 39 a tube 38 is fitted with a heater head 19. An insert piece 31 and a centrifugal disk 33 are connected to the centrifugal head 39 on the bottom. An upper orifice 32 is formed between the centrifugal head 39 and the insert piece 31, and a lower orifice 21 between the insert piece 31 and the centrifugal disk 33. The centrifugal head 39 has a rim 30, by means of which the upper orifice 32 can be narrowed, as necessary. A drop tube 9 and the tube 38 mounted on it with a gap 14 are installed in the axis of the centrifugal head 39. The raw material extruder is in connection with the drop tube 9 through the elbow piece 5 and a neck piece 35. A bore in the suspender 36 is in direct connection with the gap 14. The drop tube 9 and the tube 38 are non-rotating parts, they are not connected to the centrifugal disk 33. The joining piece 7 and the suspender 36 are equipped with band heaters 6. The centrifugal head 39 is driven by means of a motor 1. A V-belt disk 24 is connected to the end of a clutch 25 mounted on the shaft of the motor 1. The V-belt 3 of the V-belt disk 24 is also connected to a bladed V-belt disk 11, which is mounted on the centrifugal head 39. The rotatability of the centrifugal head 39 is ensured by two bearings 17 installed in a bearing pad 16 forming a part of the housing 12 of the centrifugal fiberizing unit 40. The housing 12 is designed in such a way that the bearings 17 are cooled by cooling water flowing through a water channel 18. The bearing pad 16 connected to the centrifugal head 39 can also be cooled. Cooling is ensured by the bladed V-belt disk 11 - also operating as air compressing blades - by moving the cooling air in an air passage 41. The cooling air for fiber formation is supplied by a side nozzle 29 mounted in the frame 2, located under a skirt plate 23.

As it is shown in Figure 2, the insert piece 31 and the centrifugal disk 33 are connected to the centrifugal head 39 by bolted connection in such a way that a lower orifice 21 and an upper orifice 32 are formed between the elements. According to a preferred embodiment the insert piece 31 is disk-shaped. In this case the drop tube 9 extends beyond the insert piece 31. The fitting gap 43 between the insert piece 31 and the drop tube 9 is so small that the melt coming from the ancillary material extruder through the gap 14 cannot get through it. The centrifugal fiberization of the ancillary material takes place at the upper orifice 32.

Figure 3 shows another preferred embodiment of the in-

sert piece 31, where the insert piece 31 is pitch-cone-shaped. In this case the drop tube 9 again extends beyond the insert piece 31, but the fitting gap 43 between the insert piece 31 and the drop tube 9 is so big that the melt coming from the ancillary material extruder through the gap 14 gets directly onto the centrifugal disk 33, and there it can mix with the raw material melt. Then the centrifugal fiberization of the ancillary material and the raw material takes place at the lower orifice 21. In case of intensive extrusion the centrifugal fiberization of the mixed melt takes place both at the lower orifice 21 and the upper orifice 32.

Figure 4. shows a preferred embodiment of the lower orifice 21 and the upper orifice 32, according to which the centrifugal head 39 and the centrifugal disk 33 are fitted together by means of the insert piece 31 in such a way that the lower orifice 21 and the upper orifice 32 are bounded by parallel plane surfaces.

Figure 5 shows another preferred embodiment of the lower orifice 21 and the upper orifice 32, where the lower orifice 21 and the upper orifice 32 are toothed-shaped.

[0006] During the operation of the coextrusion centrifugal fiberizing apparatus the raw material extruder feeds plastic melt to the centrifugal head 39 through the elbow piece 5 and the neck piece 35. The flow direction of the raw material is indicated by a double arrow (in Figure 1). The melt passes through the drop tube 9, then upon reaching the centrifugal disk 33, due to the centrifugal force it moves towards the circumference thereof, and leaves it through the lower orifice 21 or the upper orifice 32. The ancillary material is extruded in through an ancillary material canal 8 in the joining piece 7. The ancillary material melt gets onto the centrifugal disk 33 through the gap 14. The melts of different material quality coming through the drop tube 9 and the gap 14, respectively, can mix on the centrifugal disk 33. The heater head 19 installed in the centrifugal head 39, which also ensures the preheating of the centrifugal head 39, maintains the temperature of the melt. The neck piece 35, the joining piece 7, and the elbow piece 5 have their own electric band heater 6 for the purpose of maintaining the temperature of the melt.

When the insert piece 31 is cone-shaped, the pitch-cone of the insert piece 31 distributes the mixed bulk thermoplastic material towards the lower orifice 21 and the upper orifice 32 as a function of the feed quantity. Then the centrifugal fiberization of the ancillary material and raw material melts takes place together, that is the composition of the fibers flying out through the lower orifice 21 and the upper orifice 32 is the same. When the insert piece 31 is disk-shaped, then the centrifugal fiberization of the ancillary material melt takes place at the upper orifice 32, and the centrifugal fiberization of the raw material melt takes place at the lower orifice 21. Fiber formation by means of the centrifugal force and the mixing of the fibers take place outside the centrifugal head 39, in the air space below the skirt plate 23. Fiber formation takes place in such a way that the melt, due to the increasing centrifugal force moves towards the circumference of the centrifugal disk 33 and leaves it at a speed corresponding to that of the edge of the centrifugal disk 33, drawing fibers. The fibers are diverted and drawn by the cooling air coming from the side nozzle 29 in a direction perpendicular to the direction of projection. During this the flying fibers are cooled and mixed, and due to their own mass are deposited in layers, then further processing can take place.

The centrifugal head 39 is driven by the motor 1. The motor 1 drives the bladed V-belt disk 11 and through that the centrifugal head 39 by means of the V-belt 3. The centrifugal head 39 rotates on the bearings 17 installed in the bearing pad 16. The housing 12 of the centrifugal fiberizing unit 40 ensures the fixing of the rotating parts and the bearing pad 16, and also houses the internal parts of the centrifugal head 39. The bearings 17 have a dual cooling system to ensure their safe operation. The bearings 17 in the bearing pad 16 are surrounded from the outside by the water channel 18, and from the inside by the air passage 41. Cooling water flows in the water channel 18. Inside the bearing pad 16 the cooling of the inner rings of the bearings 17 is ensured by cooling air supplied by means of the bladed V-belt disk 11 equipped with blades 28.

[0007] The coextrusion centrifugal fiberizing apparatus according to the invention can be used preferably for the production of mixed-fiber quilt products made of thermoplastic materials, primarily polymers, with ancillary materials. The apparatus can be used well for the simultaneous centrifugal fiberization of for example polyethylene terephthalate and polyethylene terephthalate materials with ancillary materials, modified by flame-retardant chemical additives, and for the mixing of the fibers during drawing. From the bundle of fibers produced in this manner heat-insulating quilts or boards can be produced for the construction industry. The apparatus is also suitable for the production of heat-insulating products for the construction industry from waste PET bottles for use in high-temperature applications.

List of references

[0008]

1	motor
2	frame
3	V-belt
5	elbow piece
6	band heater
7	joining piece
8	ancillary material canal
9	drop tube
11	bladed V-belt
12	housing
14	gap
16	bearing pad
17	bearing

18 water channel
19 heater head
21 lower orifice
23 skirt plate
24 V-belt disk
25 clutch
28 blade
29 side nozzle
30 rim
31 insert piece
32 upper orifice
33 centrifugal disk
35 neck piece
36 suspender
37 interface piece
38 tube
39 centrifugal head
40 centrifugal fiberizing unit
41 air passage
43 fitting gap

Claims

1. A coextrusion centrifugal fiberizing apparatus for the production of synthetic homogeneous and/or mixed fibers from thermoplastic raw materials by centrifuging, to the centrifugal fiberizing unit (40) of which at least one extruder is connected, the centrifugal fiberizing unit (40) comprises a centrifugal head (39) equipped with heating, rotatable around its vertical axis, a centrifugal disk (33) connected to the centrifugal head (39) in a releasable manner, an orifice suitable for fiber formation, and a drop tube (9) installed in the centre of the axis of the centrifugal head (39) for delivering the material of the raw material fiber to the centrifugal disk (33); it is also equipped with a side nozzle (29) for supplying cooling air, as well as a motor (1) suitable for driving the centrifugal head (39), wherein it has a gap (14) bounded by the drop tube (9) and a tube (38) mounted uniaxially on the drop tube (9) in the axis of the centrifugal fiberizing unit (40) for delivering the ancillary fiber material to the centrifugal disk (33), and a lower orifice (21) and an upper orifice (32) formed by means of an insert piece (31) installed between the centrifugal head (39) and the centrifugal disk (33) for the formation of fibers of different properties, as necessary.

2. The coextrusion centrifugal fiberizing apparatus according to claim 1, wherein the insert piece (31) is disk-shaped.

3. The coextrusion centrifugal fiberizing apparatus according to claim 1, wherein the insert piece (31) is pitch-cone-shaped.

4. The coextrusion centrifugal fiberizing apparatus according to any of claims 1 to 3, wherein it has a rim (30) part on the centrifugal head (39), mounted in a movable manner.

5. The coextrusion centrifugal fiberizing apparatus according to any of claims 1 to 4, wherein the lower orifice (21) and the upper orifice (32) are toothed-shaped.

6. The coextrusion centrifugal fiberizing apparatus according to any of claims 1 to 5, wherein a cooling water channel (18) is formed in the bearing pad (16).

7. The coextrusion centrifugal fiberizing apparatus according to any of claims 1 to 6, wherein an air passage (41) is formed in the bearing pad (16) for the cold air delivered by the blades (28) of a bladed V-belt disk (11).

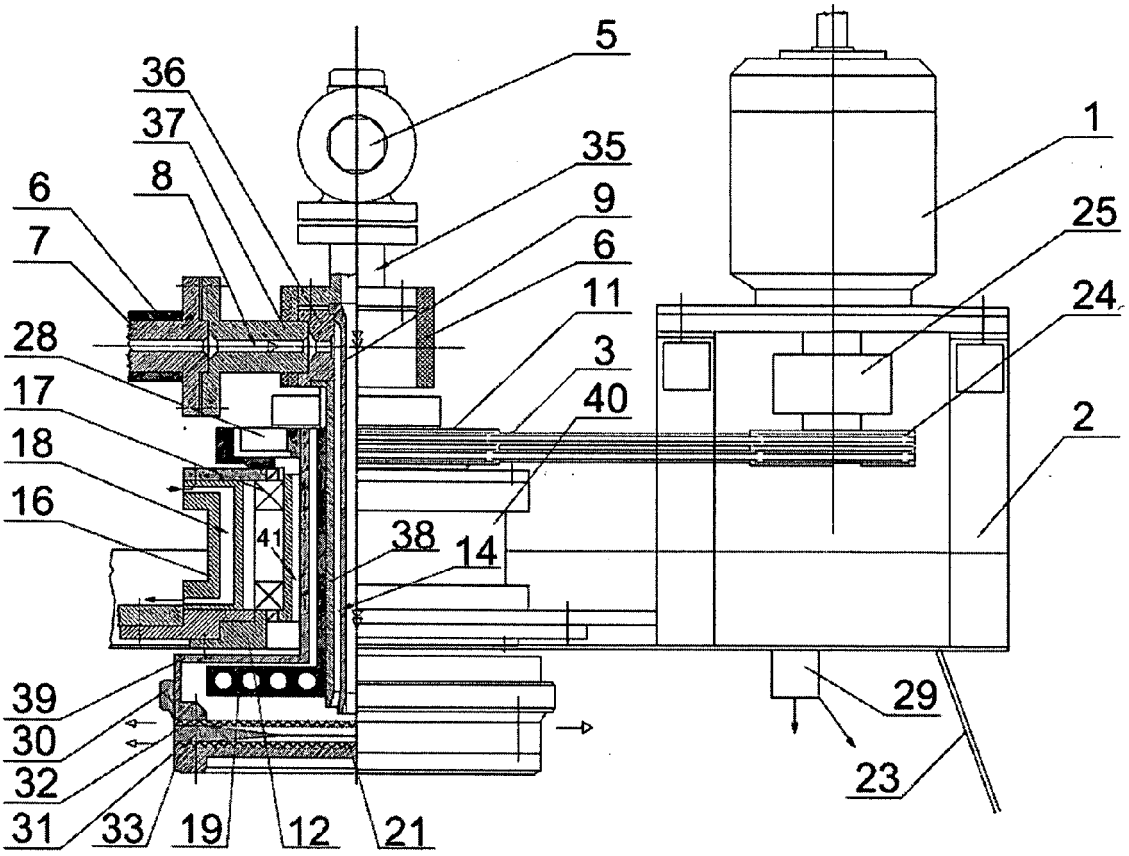

Figure 1

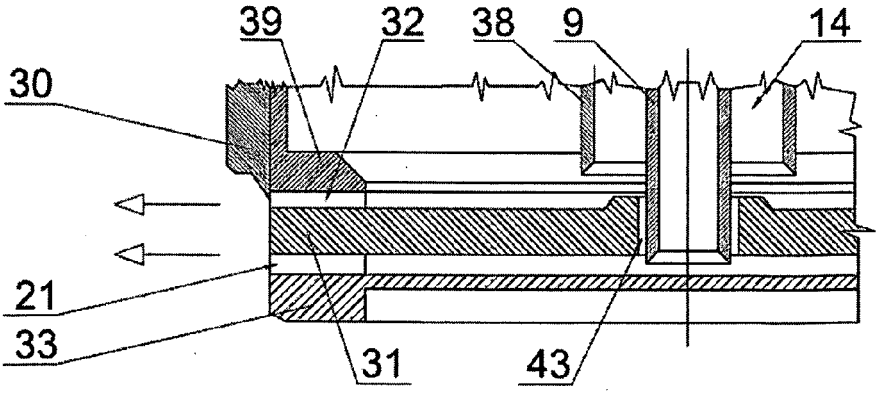

Figure 2

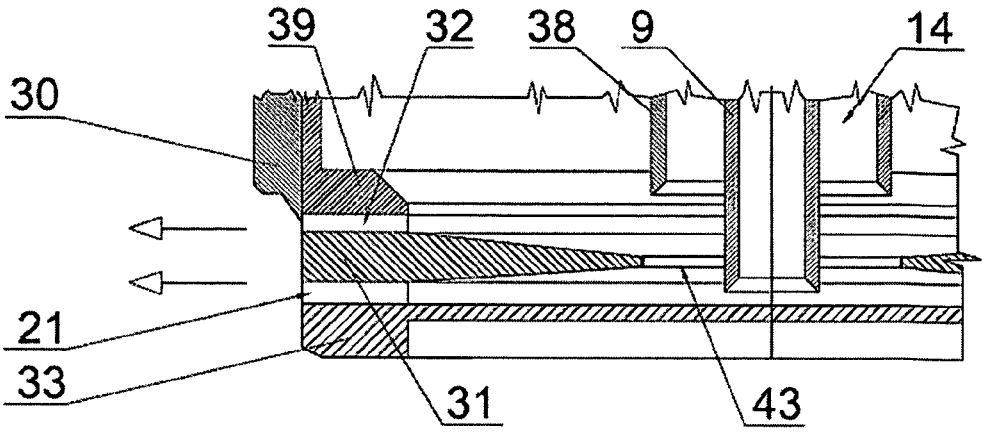

Figure 3

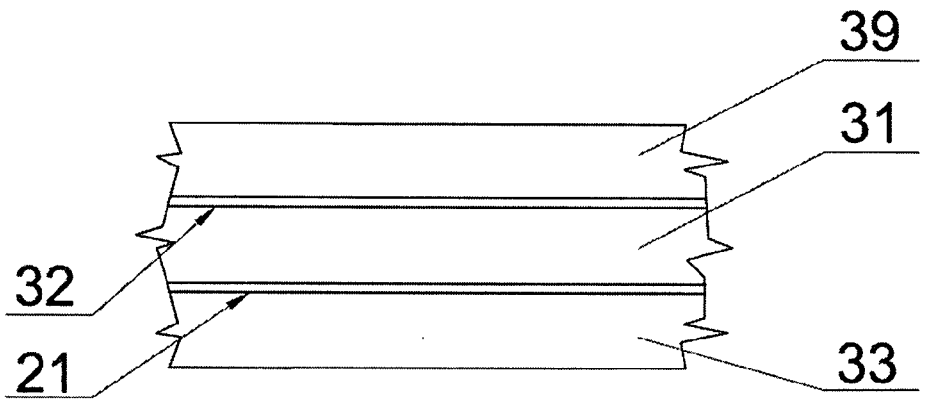

Figure 4

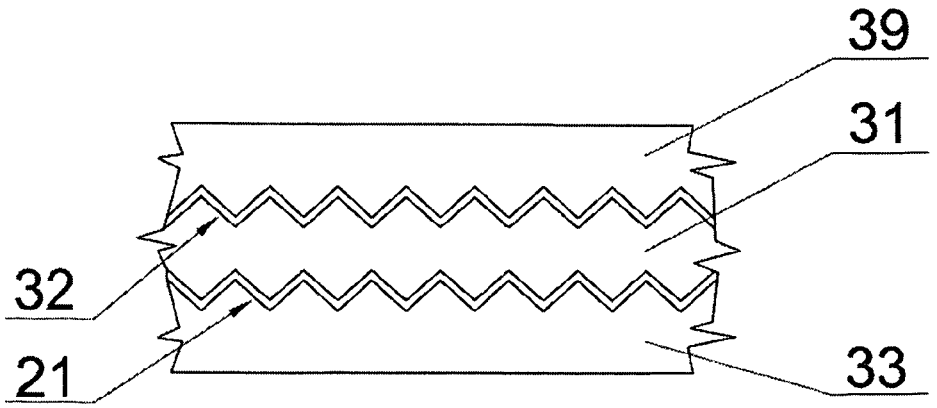

Figure 5

REFERENCES CITED IN THE DESCRIPTION

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