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(12) # EUROPEAN PATENT SPECIFICATION

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(54) **Packing automobile exhaust silencers.**

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Courier Press, Leamington Spa, England.

Description

This invention relates to the packing of automobile exhaust silencer casings.

Such silencer casings contain packing in order to assist in silencer exhaust gases from the vehicle engine by virtue of conversion of kinetic energy of the exhaust gases into mechanical displacements of the packing and thus heating thereof.

One of the materials used to pack such silencer casings is glass fibre fluffed up into a wool-like consistency. This material can be produced by chopping continuous strands of glass fibre.

In the past such silencer casings have been packed with such material manually and, to assist in this process, it has been proposed to apply a vacuum to one end of the silencer casing.

In order to adapt the process for automatic operation, glass fibre material in wool-like form has been fed into a hopper, from which it passes along ducts before being metered into individual quantities, each suitable for packing one silencer. However, the material has been prone to clog in the ducts and this has made the accurate metering of the material difficult, if the expense of weigh pans is to be avoided.

GB—A—1 279 472 discloses apparatus in which discrete lengths of glass fibre are fed into one end of an exhaust silencer casing whilst air is drawn therethrough by a suction pump connected to the other end.

EP—A—91 413 discloses apparatus in which a continuous strand of glass fibre is formed into a continuous "wool sausage" by means of a nozzle, this is then blown into one end of a silencer casing with the assistance of a suction fan connected to the other end of the silencer casing.

According to a first aspect of this invention there is provided a method of packing an automobile silencer casing comprising the steps: establishing an air flow into end of the silencer casing then out of the other end through a perforated tube passing therethough; and allowing discrete lengths of glass fibres to be carried into the silencer casing in the air flow, characterised in that the air flow is passed through a restricted passageway before entering the silencer casing and a strand consisting of a plurality of continuous glass fibres is chopped into discrete lengths upstream of the restricted passageway so that as the discrete lengths are formed they are carried by the air flow through the restricted passageway and individual fibres in each discrete length separate from each other in a region of turbulance created thereby to form a wool-like material.

It has been found that the individual fibres of each discrete length of strand can separate as they are being carried into the silencer in the air flow so that the packing fluffs up in the desired way in the silencer casing itself or as it is entering.

The strand, or roving, advantageously contains at least one hundred, preferably at least a thousand, individual continuous glass fibres whose diameter is advantageously less than 30 microns and preferably less than 15 microns. The fibres of the roving are preferably non-twisted.

Advantageously the roving is driven from two rollers in contact with each other; this makes it easy to meter accurate quantities of glass fibre into each silencer casing, since it is only necessary to leave the rollers running for a certain period of time in order to know exactly how much glass fibre has been fed into the silencer. A roller may also be provided for chopping the fibres, and they may be provided with the assistance of an air blast.

Preferably, the air flows through a restricted passageway with a diameter of less than one inch (2.54 cm), before it enters the casing: the fibre being fluffed up in the region of turbulence created thereby. The passageway may be formed by the narrow end of a tapering tubular member, the wide end of which receives the discrete lengths. The taper may be from 15° to 75° included angle.

The air flow may be produced by means of a vacuum applied to where the air flow leaves the silencer casing The vacuum applied to the silencer casing may be at least one inch of mercury (525N/m^2), preferably at least five inches of mercury (2624N/m^2), and advantageously between seven and a half and ten and a half inches of mercury (3936—6560N/m^2).

The air flow may be established by means of a jet of compressed air directed into the passageway. In the case of the tapering tubular member referred to, the jet preferably feeds into the passageway at an angle of 7.5° to 37.5° to the axis of the tubular member. The compressed air pressure should be at least 70 pounds per square inch (483kN/m^2).

According to a second aspect of this invention there is provided apparatus for packing an automobile exhaust silencer casing comprising: means for establishing an air flow into one end of the silencer casing and then out of other end through a perforated tube passing therethough; and means for supplying discrete lengths of glass fibre to be carried into the silencer casing in the air flow, characterised by means for positioning upstream of the silencer casing to chop a strand consisting of a plurality of continuous glass fibres into discrete lengths and by a restricted passageway through which the air flow passes before entering the silencer casing, the arrangement being such that, in use, as the discrete lengths are formed they are carried by the air flow through the restricted passageway so that individual fibres in each discrete length separate from each other in a region of turbulence created thereby to form a wool-like material.

Figure 1 is a partly sectional view of first embodiment of apparatus according to this invention;

Figure 2 a side view of a gun used in the apparatus of Figure 1 for feeding roving into the silencer casing;

Figure 3 is a front view of the gun shown in Figure 2;

Figure 4 is a plan view of the gun shown in Figure 2; and

Figure 5 is a schematic view of a second embodiment of apparatus according to this invention.

Referring to Figure 1, the first embodiment of apparatus for packing a silencer casing 1 comprises a vacuum producing apparatus 2, a sealing apparatus 3 and a gun 4.

The casing of the silencer is circular in section, and one end of it has been closed by an end piece 5, which supports a perforated tube 6 running along the length of the silencer casing 1. The end piece 5 supports a stub pipe 7 which connects to the rest of the exhaust assembly in use. A similar end piece bearing a stub pipe is welded to the other end of the silencer when it has been packed.

The vacuum producing apparatus has a rubber sealing member 8 which fits tightly around the stub pipe 7. The vacuum is produced by means of a centrifugal compressor (not shown) driven by a forty horse power (30 kW) motor (not shown). This apparatus produces a vacuum of around ten inches of mercury (5248N/m^2).

The sealing apparatus 3 likewise includes a sealing member 9 which seals against the open end of the casing and also blocks off the open end of the perforated tube 6, since this must not be filled with any packing material. The sealing member has a circular aperture 10 whose diameter is $\frac{3}{4}$ inch (1.9 cm).

Referring to Figure 2, the roving fed into the gun 4 consists of around two thousand monofilamentary continuous glass fibres, whose diameters lie between about six and twelve microns. The fibres in the roving are parallel to each other, that is, the roving is not twisted. The roving is fed from a spool (not shown) containing a length of about a couple of hundred meters of the roving.

The gun has an air-powered motor, contained in housing 11, to which rubber roller 12 is coaxially attached. The roving is driven by means of rubber roller 12 and steel roller 13 which is hard in contact with roller 12. The roving is cut into discrete lengths by means of a cutter 14 mounted diametrically through a further roller 15. Every half revolution of roller 15, the roving is severed at the point of contact with roller 12. The rollers are contained in a housing 16 having an inlet 17 and an outlet 18. The air exhaust from the air powered motor is fed into the housing 16 and, since the area of the outlet 18 is much greater than that of the inlet 17, the chopped lengths of roving are projected out of the gun with the aid of an air blast.

In operation of the method of the invention, a silencer casing 1 to be filled is fitted onto the vacuum producing apparatus 2 and a sealing apparatus is brought up to the open end of the silencer. The vacuum pump is started. The gun 4 is then run and left running for a pre-determined period of time. This pre-determined period corresponds to the desired weight of glass fibre it is desired to pack the particular silencer with, and this can be calculated simply from the weight per unit length of the roving and the velocity at which the roving is fed through the gun.

The chopped lengths of roving projected from the gun are all sucked through the aperture 10 in the sealing member 9 because of the vacuum applied at the other end of the silencer casing, and the silencer is gradually filled with glass fibre. It has been found that the fibres of each chopped length of roving separate either before they enter the silencer casing or while they are in the silencer casing (probably the separation mainly takes place within the silencer), and this results in the production of the desired wool-like form of the glass fibre in the silencer. The air flow within the silencer will of course be turbulent since it is being sucked through the perforated tube 6. The lengths of fibre do not pass into the tube 6 themselves.

Among the advantages of the invention are that it is possible to accurately meter the quantities of glass fibre with which each silencer is packed, and that the ducting required for handling the wool-like glass fibre is dispensed with.

Various modifications are of course possible, for example, tests have also been carried out with an accurate aperture 10 in the sealing member, the length of which is around four times its diameter. Although the roving "fluffled-up" in a satisfactory manner, it was nevertheless found that it "fluffed-up" better with the $\frac{3}{4}$ inch (1.9 cm) diameter aperture referred to earlier.

Referring to Figure 5, the second form of apparatus differs from the first in that there is no vacuum required to draw the roving pieces into the silencer, rather they are drawn in carried in an air flow.

A silencer 20 to be filled is closed at the lower end as seen in the drawing by a closing plate 21 which has an aperture through which a perforated tube 22 of the silencer extends. The silencer is mounted on a platform 23 through which air can pass. The upper end of the silencer as seen in the drawing is connected to the apparatus, in particular to a closing plate 24 which carries a plug 25 for closing the end of the perforated tube 22.

The chopped strands of roving are fed into the silencer casing via a tube 26 and conical member 27, the tube 26 being sealed in an aperture in the closing plate 24.

A gun 28 supplies roving to the wide end of the conical member; the gun 28 is identical to the gun 4 of the first apparatus except that air does not assist in projecting the cut strands of roving from the gun, the cut strands being projected solely by the rotation of the rollers. The roving used is the same as in the first apparatus.

A narrow tube 29 opens into the tube 26, and compressed air is supplied to its other end.

It has been found that the compressed air fed along the tube 26 draws large quantities of air into the conical member 27, and through the tube 26 into the silencer casing. In the process, the cut strands of roving are carried in the air flow into

the silencer casing. The air flow leaves the silencer casing via the perforated tube and its open end passes through the closing plate 21. It has also been found that the cut strands are "fluffed-up" in the process, and that the casing is filled in a very satisfactory manner.

Examples of suitable dimensions and pressures are: tube 26, three inches (7.62 cm) long, one half inch (1.27 cm) diameter; conical member 27, semi-angle 30°, diameter at wide end, three inches (7.62 cm); tube 29, angle to axis of conical member, 35°, air pressure 100 pounds per square inch (690 kN/m²).

It is believed that the narrow diameter of the tube 26 is important in "fluffing-up" the cut strands of roving, since only with a narrow diameter is sufficient turbulence created in the tube to achieve this. It is believed that the narrow opening 10 in the first apparatus is also responsible for creating the necessary turbulence. The narrower the diameter, the smaller the compressed air pressure or vacuum needed to fluff-up the fibre, but if the diameter is too small, the restriction is prone to clogging.

Claims

1. A method of packing an automobile silencer casing (1;20) comprising the steps of: establishing an air flow into one end of the silencer (1;20) and then out of the other end through a perforated tube (6;22) passing therethrough; and allowing discrete lengths of glass fibres to be carried into the silencer casing (1;20) in the air flow, characterised in that the air flow is passed through a restricted passageway (10;26) before entering the silencer casing (1;20) and a strand consisting of a plurality of continuous glass fibres is chopped into discrete lengths upstream of the restricted passageway (10;26) so that as the discrete lengths are formed they are carried by the flow through the restricted passageway (10;26) and individual fibres in each discrete length separate from each other in a region of turbulence created thereby to form a wool-like material.

2. A method as claimed in claim 1, in which the strand consists of at least one hundred continuous glass fibres.

3. A method as claimed in claim 2, in which the strand consists of at least a thousand continuous glass fibres.

4. A method as claimed in any of claims 1 to 3, in which the diameters of the continuous glass fibres are less than thirty microns.

5. A method as claimed in claim 4, in which the diameters of the continuous glass fibres are less than fifteen microns.

6. A method as claimed in any preceding claim, in which the continuous glass fibres are not twisted in the strand.

7. A method as claimed in any preceding claim, in which the strand is fed between two rollers (12, 13) engaging one another, one (12) of which is driven.

8. A method as claimed in claim 7, in which the strand passes between a pair of roller (12, 15), one (15) of which has a cutter (14) mounted diametrically therethrough.

9. A method as claimed in claim 7 or 8, in which the discrete lengths are projected through the passageway (10;26) with the assistance of an air blast.

10. A method as claimed in any preceding claim, in which the diameter of the passageway (10;26) is less than one inch (2.54 cm).

11. A method as claimed in claim 10, in which the passageway (26) is formed by the narrow end of a tapering tube (27), the wide end of which receives the discrete lenths.

12. A method as claimed in any preceding claim in which the air flow is established by means of a vacuum applied where the air flow leaves the silencer casing (1;20).

13. A method as claimed in any one of claims 1 to 11, in which the air flow is established by means of a jet of compressed air directed into the passageway (10;26).

14. A method as claimed in claims 11 and 13, in which the jet is inclined with respect to the axis of the tapering tube (27).

15. Apparatus for packing an automobile exhaust silencer casing (1;20) according to the method of claim 1 comprising: means (2;29) for establishing an air flow into one end of the silencer casing (1;20) and then out of the other end through a perforated tube (6;22) passing therethrough; and means (4) for supplying discrete lengths of glass fibre to be carried into the silencer casing (1;20) in the air flow, characterised by means (4) for positioning upstream of the silencer casing (1;20) to chop a strand consisting of a plurality of continuous glass fibres into discrete lengths and by a restricted passageway (10;26) through which the air flow passes before entering the silencer casing (1;20), the arrangement being such that, in use, as the discrete lengths are formed they are carried by the air flow through the restricted passageway (10;26) so that individual fibres in each discrete length separate from each other in a region of turbulence created thereby to form a wool-like material.

Patentansprüche

1. Verfahren zum Füllen eines Kraftfahrzeug-Auspuffschalldämpfergehäuses (1; 20), das folgende Schritte umfaßt: Erzeugen einer Luftströmung in ein Ende des Auspuffschalldämpfergehäuses (1; 20) hinein und danach am anderen Ende heraus durch ein perforiertes Rohr (6; 22), das durch das Auspuffschalldämpfergehäuse hindurchführt; und Eintragenlassen von getrennten Abschnitten von Glasfasern in das Auspuffschalldämpfergehäuse (1; 20) in der Luftströmung, dadurch gekennzeichnet, daß die Luftströmung durch einen verengten Durchlaß (10; 26) durchgeleitet wird, bevor sie in das Auspuffschalldämpfergehäuse (1; 20) eintritt und ein Strang, bestehend aus einer Mehrzahl von fortlaufenden Glas-

fasern, stromaufwärts von dem verengten Durchlaß (10; 26) in getrennte Aschnitte zerhackt wird, so daß, wenn die getrennten Abschnitte hergestellt sing, diese von der Luftströmung durch den verengten Durchlaß (10; 26) eingetragen werden und einzelne Fasern jedes getrennten Abschnitts sich in einer erzeugten Turbulenzzone voneinander trennen und dadurch ein wollartiges Material bilden.

2. Verfahren nach Anspruch 1, dadurch gekennzeichnet, daß der Strang aus wenigstens 100 fortlaufenden Glasfasern besteht.

3. Verfahren nach Anspruch 2, dadurch gekennzeichnet, daß der Strang wenigstens aus 1000 fortlaufenden Glasfasern besteht.

4. Verfahren nach einem der Ansprüche 1 bis 3, dadurch gekennzeichnet, daß die Durchmesser der fortlaufenden Glasfasern weniger als 30 µm betragen.

5. Verfahren nach Anspruch 4, dadurch gekennzeichnet, daß die Durchmesser der fortlaufenden Glasfasern weniger als 15 µm betragen.

6. Verfahren nach einem der vorausgehenden Ansprüche, dadurch gekennzeichnet, daß die fortlaufenden Glasfasern in dem Strang nicht verdrillt sind.

7. Verfahren nach einem der vorausgehenden Ansprüche, dadurch gekennzeichnet, daß der Strang zwischen zwei aneinander angreifende Walzen (12, 13), von denen eine (12) angetrieben wird, geführt wird.

8. Verfahren nach Anspruch 7, dadurch gekennzeichnet, daß der Strang zwischen einem Paar von Walzen (12, 15), von denen eine (15) eine diese diametral durchsetzend montierte Schneidvorrichtung (14) aufweist, hindurchgeführt wird.

9. Verfahren nach Anspruch 7 oder 8, dadurch gekennzeichnet, daß die getrennten Abschnitte mit Hilfe eines Luftstroms durch den Durchlaß (10; 26) geblasen werden.

10. Verfahren nach einem der vorausgehenden Ansprüche, dadurch gekennzeichnet, daß der Durchmesser des Durchlasses (10; 26) kleiner als ein Inch (2, 54 cm) ist.

11. Verfahren nach Anspruch 10, dadurch gekennzeichnet, daß der Durchlaß (26) durch das enge Ende einer sich verjüngenden Röhre (27) gebildet wird, deren weites Ende die getrennten Abschnitte aufnimmt.

12. Verfahren nach einem der vorausgehenden Ansprüche, dadurch gekennzeichnet, daß die Luftströmung durch ein Vakuum erzeugt wird, das an einer Stelle angelegt wird, wo die Luftströmung das Auspuffschalldämpferhäuse (1; 20) verläßt.

13. Verfahren nach einem der Ansprüche 1 bis 11, dadurch gekennzeichnet, daß die Luftströmung durch einen Strahl komprimierter Luft erzeugt wird, der in den Durchlaß (10; 26) gerichtet wird.

14. Verfahren nach Anspruch 11 und 13, dadurch gekennzeichnet, daß der Luftstrahl in bezug auf die Längsachse der sich verjüngenden Röhre (27) geneigt ist.

15. Vorrichtung zum Füllen eines Kraftfahrzeug-Auspuffschalldämpfergehäuses (1; 20) gemäß dem Verfahren nach Anspruch 1, bestehend aus: Einer Einrichtung (2; 29) zur Erzeugung einer Luftströmung in ein Ende des Auspuffschalldämpfergehäuses (1; 20) hinein und danach am anderen Ende heraus durch ein perforiertes Rohr (6; 22), das durch das Auspuffschalldämpfergehäuse hindurchführt; und einer Einrichtung (4) zum Zuführen von getrennten Abschnitten von Glasfaser, die in der Luftstromung in das Auspuffschalldämpfergehaüse (1; 20) einzutragen sind, gekennzeichnet durch eine Einrichtung (4) zum Positionieren stromaufwärts von dem Auspuffschalldämpfergehäuse (1; 20), um einen Strang, bestehend aus einer Mehrzahl von fortlaufenden Glasfasern, in getrennte Abschnitte zu zerhacken, sowie durch einen verengten Durchlaß (10; 26), durch den die Lufströmung hindurchströmt, bevor sie in das Auspuffschalldämpfergehäuse (1; 20) eintritt, wobei die Anordnung derart ausgelegt ist, daß im Betrieb, wenn die getrennten Abschnitte gebildet sind, diese durch die Luftströmung durch den verengten Durchlaß (10; 26) getragen werden, so daß einzelne Fasern in jedem getrennten Abschnitt sich in einem erzeugten Tubulenzbereich voneinander trennen und dadurch ein wollähnliches Material bilden.

Revendications

1. Méthode de garnissage d'un carter de silencieux d'automobile (1; 20) comprenant les étapes suivantes: un écoulement d'air est établi entrant par une extrémité du carter de silencieux (1; 20) puis sortant par l'autre extrémité par l'intermédiaire d'un tube perforé (6; 22) traversant et des longueurs discrètes de fibres de verre sont admises et transportées dans le carter de silencieux (1; 20) par l'écoulement d'air, caractérisée en ce que l'écoulement d'air passe à travers un passage restreint (10; 26) avant d'entrer dans le carter de silencieux (1; 20) et un fil consistant en un certain nombre de fibres de verre continues est coupé en longueurs discrètes en amont du passage restreint (10; 26) de telle sorte que, lorsque les longueurs discrètes sont formées, elles sont portées par l'écoulement d'air à travers le passage restreint (10; 26) et les fibres individuelles dans chaque longueur discrète se séparent les unes des autres dans une région de turbulence créée, pour ainsi former un matériau d'aspect laineux.

2. Méthode suivant la revendication 1, caractérisée en ce que le fil consiste en au moins une centaine de fibres de verre continues.

3. Méthode suivant la revendication 2, caractérisée en ce que le fil consiste en au moins un millier de fibres de verre continues.

4. Méthode suivant l'une quelconque des revendications 1 à 3, caractérisée en ce que les diamètres des fibres de verre continues sont inférieures à 30 microns.

5. Méthode suivant la revendication 4, caractérisée en ce que les diamètres des fibres de verre continues sont inférieures à 15 microns.

6. Méthode suivant l'une quelconque des re-

vendications précédentes, caractérisée en ce que les fibres de verre continues ne sont pas torsadées dans le fil.

7. Méthode suivant l'une quelconque des revendications précédentes, caractérisée en ce que le fil est alimenté entre deux rouleaux (12, 13) en prise l'une avec l'autre, l'un d'eux (12) étant entraîne.

8. Méthode suivant la revendication 7, caractérisée en ce que le fil passe entre une paire de rouleaux (12, 13) dont l'un (15) possède une lame (14) montée diamétralement au travers de celui-ci.

9. Méthode suivant la revendication 7 ou 8, caractérisée en ce que les longueurs discrètes sont projetées à travers le passage (10; 26) à l'aide d'un souffle d'air.

10. Méthode suivant l'une quelconque des revendications précédentes, caractérisée en ce que le diamètre du passage (10; 26) est inférieur à 1 pouce (2,54 cm).

11. Méthode suivant la revendication 10, caractérisée en ce que le passage (26) est formé par l'extrémité étroite d'un tube effilé (27), dont l'extrémité large reçoit les longueurs discrètes.

12. Méthode suivant l'une quelconque des revendications précédentes, caractérisée en ce que l'écoulement d'air est établi au moyen du vide appliqué à l'endroit où l'écoulement d'air quitte le carter de silencieux (1; 20).

13. Méthode suivant l'une quelconque des revendications 1 à 11, caractérisée en ce que l'écoulement d'air est établi au moyen d'un souffle d'air comprimé dirigé dans le passage (10; 26).

14. Méthode suivant les revendications 11 et 13, caractérisée en ce que le souffle est incliné par rapport à l'axe du tube effilé (27).

15. Appareil pour garnir un carter de silencieux d'échappement automobile (1; 20) suivant la méthode de la revendication 1 comprenant des moyens (2; 29) pour établir un écoulement d'air entrant par une extrémité du carter de silencieux (1; 20) puis sortant par l'autre extrémité à travers un tube perforé (6; 22) traversant; et des moyens (4) pour fournir des longueurs discrètes de fibre de verre devant être portées dans le carter de silencieux (1; 20) par l'écoulement d'air, caractérisé par des moyens (4) pour se positionner en amont du carter de silencieux (1; 20) afin de couper un fil consistant en un certain nombre de fibres de verre continues pour obtenir des longueurs discrètes, et par un passage restreint (10; 26) au travers duquel l'écoulement d'air passe avant d'entrer dans le carter de silencieux (1; 20), l'agencement étant tel que, en utilisation, lorsque les longueurs discrètes sont formées, elles sont portées par l'écoulement d'air à travers le passage restreint (10; 26) de telle sorte que les fibres individuelles dans chaque longueur discrète se séparent les unes des autres dans une région de turbulence créée pour ainsi former un matériau d'apparence laineuse.

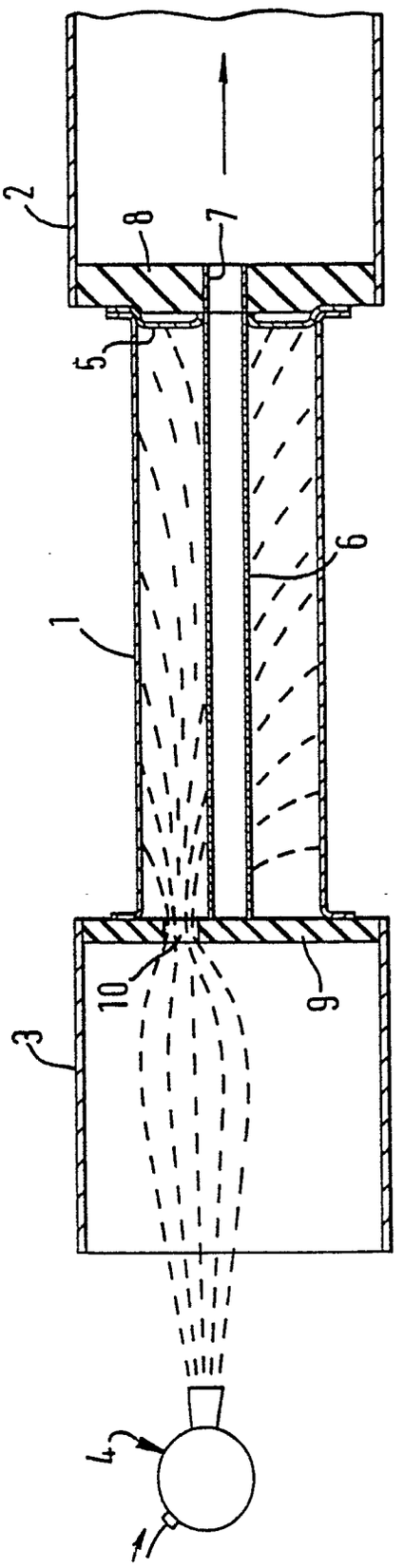

FIG.1

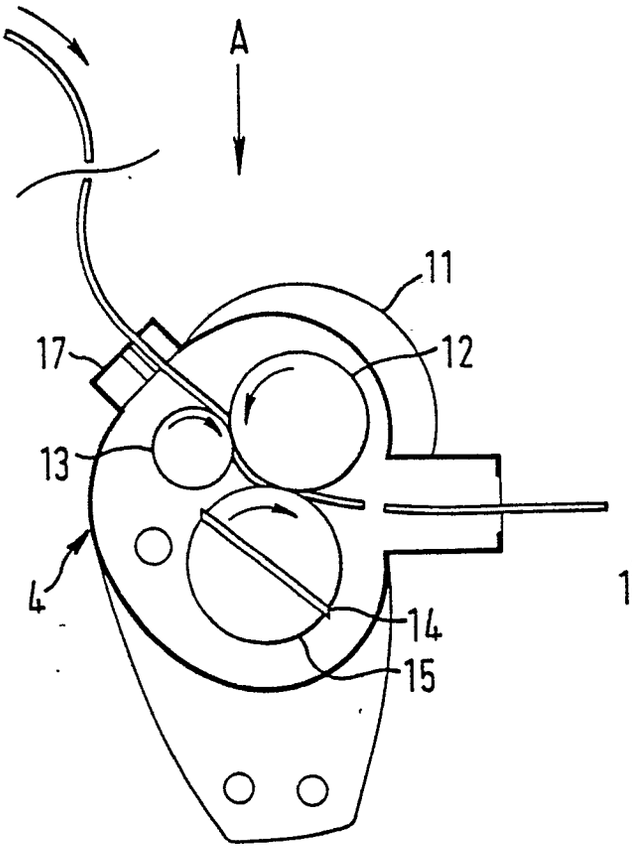

FIG. 2

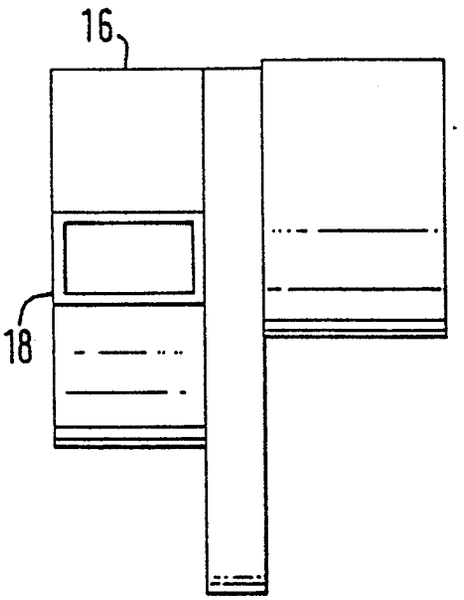

FIG. 3

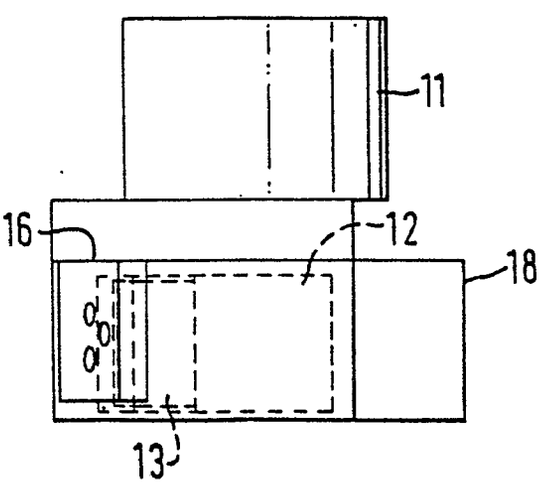

FIG. 4

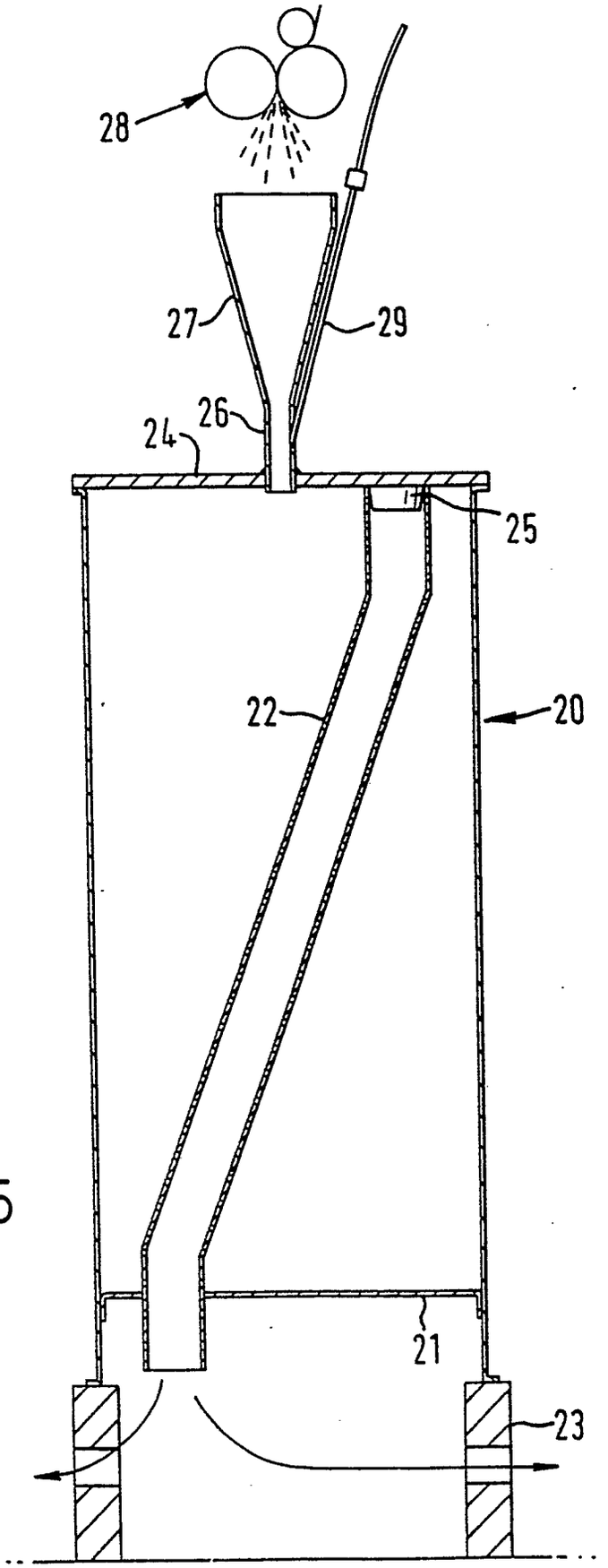

FIG.5