(19) Europäisches Patentamt
European Patent Office
Office européen des brevets

(11) EP 0 957 240 A1

(12) EUROPEAN PATENT APPLICATION

(43) Date of publication:
17.11.1999 Bulletin 1999/46

(51) Int Cl.[6]: **F01N 1/24**, B65B 1/16

(21) Application number: **99810404.6**

(22) Date of filing: **07.05.1999**

(84) Designated Contracting States:
AT BE CH CY DE DK ES FI FR GB GR IE IT LI LU MC NL PT SE
Designated Extension States:
AL LT LV MK RO SI

(30) Priority: **14.05.1998 NL 1009168**

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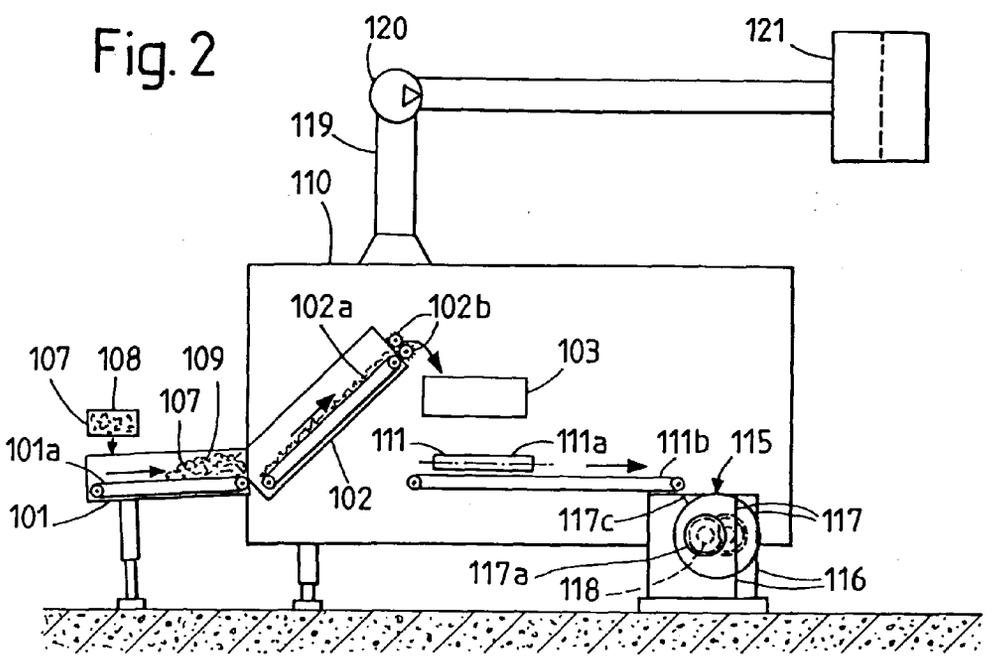
(54) Method and installation for introducing fibrous material into a housing, and housing produced in accordance with the method

(57) A method for introducing at least one fill of fibrous material (107) into a housing of a product, such as the housing of a silencer, comprises the provision of a fibrous material (107) in bulk composed of relatively short fibre pieces and the introduction of the or each fibrous material fill into the housing. The relatively short fibre pieces can be obtained by opening up fibrous material (107) from bulk. The or each fill can be determined by weighing opened up fibrous material (107) and afterwards be introduced into the housing (112) by a pushing element, such as a piston or conveyor screw (118). The method can comprise the provision of various types of fibrous material, as well as the introduction of said fibrous material (7, 107) to provide a fill composed of a mixture of the various types of fibrous material.

Fig. 2



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Description

[0001] The invention relates to a method for introducing fibrous material into a housing of a product, such as a housing of a silencer. Such silencers which are used in motor vehicles and accommodated in the exhaust system, comprise a housing in which at least one sound-damping fill has been accommodated. The or each sound-damping fill can consist of an amount of a fibrous material that has a suitable acoustic absorption capacity.

[0002] Various methods for introducing glass fibres into silencer housings are disclosed in US 4 774 985 A. Continuous glass fibre rovings are used as starting material for these known methods. The rovings are blown into the silencer housings and shall be bulked thereby. According to said US patent, a roving may be cut into pieces prior to bulking, but preferably it remains in continuous filament form throughout the process. The amount of fibrous material introduced into a housing may be controlled by timing the fill or by length measurements of the rovings by means of wheels. A similar method for blowing a continuos glass fibre filament into a silencer housing is disclosed in EP 91 413 B.

[0003] These known methods have various disadvantages. Firstly, long continuous rovings are relatively expensive. If such a roving break during the process, the latter may be disturbed or must even be interrupted. Since with this method only materials that can be produced in the form of long fibres can be used, various desirable materials cannot be considered. Basalt wool is one example of a material that for this reason cannot be used with this known method.

[0004] It is also not easy to guarantee uniform filling of the housing. If very long, continuous fibres are introduced, they can pile up without completely filling the housing. If a silencer housing contains a tube, the introduction of the fibrous material by means of a stream of air does also not guarantee that the fibrous material will completely encompass the tube. Furthermore it proves difficult to introduce an accurately adjusted quantity. It is pointed out hereto that a length measurement is only possible on a very long, continuous roving and is disturbed if the roving breaks. Because of these circumstances, the desired damping action cannot always be achieved.

[0005] Blowing the fibrous material into a housing causes moreover an overpressure in the feed line and in the housing. This overpressure may blow dust particles and fibre pieces in the surroundings.

[0006] Similar problems may arise if a fibrous material is introduced into a housing of another product or device, such as a filter or the like.

[0007] The object of the invention is to provide a method for introducing a fibrous material into the housing of a silencer or possibly of another product and to avoid disadvantages of the known methods. More specifically, the method shall avoid the need of very long, continuous rovings.

[0008] This object is achieved by means of a method for introducing a fill of fibrous material into a housing, such as the housing of a silencer, comprising the steps:

- provision of a fibrous material in bulk comprising a plurality of fibre pieces, and
- introduction of at least one fill of the fibrous material into the housing.

[0009] The fibrous material used can be, for example, basalt wool, rock wool, glass wool or any other mineral wool or ceramic wool.

[0010] The fibrous material in bulk serving as starting material may be composed of a great number of relatively short fibre pieces. Such fibrous material is available at low costs and may possibly comprise waste fibres which came as result in other processes. The starting material is preferably opened up during the process before the fibrous material is introduced into the housing. The relatively short fibres can then be obtained by opening up fibrous material from bulk. The advantage is that the fibrous material supplied in bulk can be introduced directly into the production process, without any preparatory work being required.

[0011] To ensure the desired fill, and thus the desired damping effect, the method can also comprise the step involving metering of a quantity of fibrous material and the introduction of at least one fill or amount including the metered quantity of fibrous material into the housing.

[0012] Metering the fibrous material in the desired quantities can be carried out in various ways. According to a first possibility a quantity of fibrous material can be weighed, for example by means of a balance. Weighing gives the advantage that the means of the or each fibrous material fill introduced into the housing can be determined directly, precisely and independently of the number lengths, thickness and densities of the individual fibre pieces included in the fill.

[0013] According to a second possibility a quantity of fibrous material can be obtained by determining pressure differences if the fibrous material is transported and/or introduced by means of pneumatic transport generated by applying a pressure difference.

[0014] According to a third possibility a quantity of fibrous material can be obtained by means of optical detection in the gas stream required for the pneumatic transport.

[0015] The method can comprise the step involving introduction of the fibrous material by mechanical introduction means from an intermediate container belonging to mechanical introduction means and/or substantially containing this means into the housing of a product, such as the housing of a silencer. The mechanical transport can be effected by means of at least one pushing element, such as a piston which can be moved to and from in a tubular intermediate container or such as a conveyor screw.

[0016] When the fibrous material has been opened up and for instance also weighed, it may possibly be brought by pneumatic transport or by means of at least one conveyor belt to said mechanical means or possibly even be introduced into the housing by means of pneumatic transport, similarly as it is known per se from EP 91 413 B.

[0017] To optimise the acoustic absorption capacity, the method can also comprise the step involving the provision of various types of fibrous material and the subsequent introduction of the fibrous material to provide a fill composed of a mixture of the various types of fibrous material. The various types of a mixture may be chemically different and comprise, for example glass wool and basalt wool.

[0018] By virtue of the short fibres which are introduced in the housing, a homogenous degree of distribution of the various types of fibrous material can be obtained in a simple manner. If the fibrous material is brought to said mechanical means by pneumatic transport and/or even introduced into the housing by means of pneumatic transport, the gas stream provides for mixing of the fibrous material during this operation such that the production of locally deviating concentrations in the housing is prevented.

[0019] So as also to be able to guarantee the desired homogeneous distribution in the housing over a prolonged period, a fixing agent, such as a synthetic two-component or other resin, can be added to the fibrous material. The fixing agent can be introduced substantially simultaneously with the fibrous material into the housing and then connects the fibre pieces introduced into the housing fixedly to one another.

[0020] The method according to the invention can also comprise the step involving the use of suction to remove dust that is released during processing of the fibrous material.

[0021] As already mentioned, it is fibre pieces instead of very long continuous fibres that are used in the method. The length of said fibre pieces is preferably between 1 mm and 1 m.

[0022] In certain applications, such as, for example, silencers it is important to be able to control the density of the fibrous material. According to the invention the method to this end comprises control of the density of the fibrous material in the container by influencing the quantity by weight of fibrous material introduced.

[0023] The invention also concerns an installation for carrying out the method, the installation comprising the characteristics of claim 15.

[0024] The invention also concerns a housing of a product produced in accordance with the method and comprising the characteristics of claim 20.

[0025] The invention will be explained in more detail with reference to the accompanying drawings, in which

Fig. 1 is a schematic representation, partly in section, of an installation for introducing a fibrous material into a silencer housing,

Fig.2 is an analogous schematic representation of parts of another installation,

Fig.3 shows the installation according to Fig.2, partly in top view and partly in a horizontal section, and

Fig. 4 is a longitudinal section of portions of a silencer housing and of a mechanical introduction means including a conveyer screw for introducing fibrous material into the silencer housing.

[0026] The installation shown in Fig. 1 comprises a feed 1 for supplying fibrous material 7 in bulk, for example in the form of bales 8. At station 2 said bales 8 are processed in such a way that the fibrous material is opened up. At station 3 the fibrous material opened up in this way is then weighed or possibly otherwise metered.

[0027] By means of the fan 19, a gas stream 4 is generated through the line 9, which is connected to the chamber 10 in which opening up and weighing of the fibrous material takes place. Under the influence of the gas stream the fibrous material passes into the intermediate container 6. A silencer housing 12 is positioned at the bottom end 11 of the intermediate container 6, which housing is held in place at the rim at said bottom end 11 of the intermediate container 6 by means which are not shown.

[0028] At its other end the silencer housing 12 bears against a plate 13, in which there is a hole to which the line 14 is connected, as a result of which the gas stream is guaranteed. Said gas stream can be intensified by means of fan 21.

[0029] A mechanical introduction means comprises the already mentioned intermediate container 6 and a piston 15. This piston 15 can be moved to and fro in the intermediate container by means of the driving mechanism 5, which is not shown in more detail. The quantity of fibrous material blown into the intermediate container 6 via line 9 is pushed down by the piston 15 towards and into the silencer housing, such that a certain density can be obtained in the silencer housing 12. The intermediate container 6 is shown in an axial section, as is the silencer (in part).

[0030] Suction is generated via line 14, by means of fan 21, in the housing 12, the intermediate container 6 and line section 9 in order to support the introduction of the fibrous material into the housing 12.

[0031] A line 16, in which suction is likewise generated by a fan 20 to remove dust that is released when the bulk fibrous material is opened up, is also connected to the chamber 12.

[0032] The dust can be filtered off at the filter 17.

[0033] A feed 18 is connected to the intermediate container 6 near the lower end thereof for adding a fixing agent to the fibrous material if desired.

[0034] The installation shown in the Figures 2 and 3 comprises a feed 101. The latter has a conveyor belt 101a arranged in a channel. The feed feeds a fibrous

material 107 used as starting material in bulk form to an opening up station or means 102. The latter comprises a conveyor belt 102a inclined upwards in the conveying direction and provided with a plurality of spikes. The opening up station or means 102 comprises moreover two rollers 102b arranged near the upper and delivery end of the conveyor belt 102a. The rollers 102b are also provided with spikes and rotated in opposite rotational directions by drive means (not shown).

[0035] The fibrous material 107 used as starting material comprises a great number of relatively short fibre pieces having equal or different lengths. The fibrous material 107 is brought for instance intermittently in form of bales 108 from a stock onto the conveyor belt 101a of the feed 101. The belt 101a transports fibrous material 107 intermittently on demand towards the conveyor belt 102a so that the fibrous material 107 forms a pile serving as intermediate fibrous material stock 109 at the transition of the two conveyor belts 101a and 102a, i.e. at the beginning and/or pick-up end of the conveyor belt 102a. The spikes of the conveyor belt 102a pull fibre pieces from the intermediate fibrous material stock 109 so that the fibrous material 107 fed in bulk is thereby opened up, loosened and conveyed at a more or less constant rate to the rollers 102b.

[0036] The rollers 102b transport the opened up fibrous material to a metering station or means, namely a weighing station or means 103. The latter includes a balance having a load carrier. The load carrier has for instance a receptacle having two parts which are configured similar to two clams of a crane and can be swivelled or tilted alternatively in a carrying position and in a delivering position. A conveyor and distributor 111 comprises a conveyor belt 111a disposed below said load carrier and two conveyor belts 111b. The two conveyor belts 111b are disposed below the two opposite ends of the conveyor belt 111a and have conveying directions which are substantially transversal to the two conveying directions of the conveyor belt 111a. The conveyor and distributor 111 comprises a drive means for driving the conveyor belt 111a selectively in one of two opposite directions indicated by a full and dashed arrow in Fig. 3 and for driving the belts 111b in the directions indicated by arrows.

[0037] There are also shown parts of a silencer housing 112 in Fig. 3 and partly in Fig. 4. The silencer housing 112 comprises a tubular wall 112a having two opposite ends with outwards flanged edges. The tubular wall 112a encompasses an interior space in cross-section. This interior space contains two partitions 112b which are spaced from one another and may or may not be perforated. The housing contains also two tubes 112c. Each tube 112c may or may not be at least partly perforated, extends from one of the ends of the tubular wall 112a to one of the partitions 112b, is affixed to the partition of concern and opens through the latter into the hollow space between the two partitions 112b. The two tubes 112c are eccentric with respect to the axis of the silencer housing, i.e. of the tubular wall 112a and arranged on opposite sides of this axis.

[0038] The installation comprises also a mechanical introduction means 115 for introducing fibrous material into the silencer housing 112. The mechanical introduction means 115 comprises two screw conveyors 116. Each screw conveyor has an intermediate container and/or screw conveyor housing 117. Each intermediate container or housing 117 is arranged near the delivery end of one of the conveyor belts 111b and comprises a substantially cylindrical, hollow housing part 111a. A flange 117b consisting of a flat plate is affixed to one of the ends of the cylindrical housing part 111a. Each intermediate container or screw conveyor housing 117 has an inlet 117c which is disposed below the delivery end of the associated conveyor belt 111b and for instance hopper-shaped. A conveyor screw 118 serving as pushing element is arranged for the most part within the housing part 117a. Each conveyor screw 118 has a shaft 118a. The shaft has a cylindrical main portion and a first end portion which is rotatably supported and connected to a driving device (not shown). An initially separate end member 118b is arranged at the second end of the shaft 118a and forms a conical shaft end portion 118c which is tapering towards the free end of the shaft. A radial collar 118d is disposed at the thicker end of the conical shaft end portion 118c and forms a shoulder with the latter. The outer diameter of the collar is at least approximately equal to the diameter of the adjacent cylindrical main portion of the shaft. A bearing means 118e disposed in hollow spaces of the shaft main portion 118b and end member connects the latter rotatably with the main portion of the shaft. The conveyor screw 118 comprises a helix 118f having a portion 118g which encompasses the cylindrical main portion of the shaft 118a, consists of a helical rib and is connected firmly and without intermediate space to the shaft. The helix end portion 118h encompassing the conically tapering shaft end portion 118c is spaced from the shaft. The mechanical introduction means 115 comprise furthermore a displacing means having at least one and preferably two pneumatic actuator(s) (not shown) for displacing the cylindrical housing part 117a and the conveyor screw 118 of at least one screw conveyor and preferably of both screw conveyors parallel to the axes of the conveyor screws and the silencer housing 112 shown in the Figures 3 and 4. The displacing means permits to vary the distance of the flanges 117b belonging to the two screw conveyor housings.

[0039] The silencer housing 112 shown in the Figures 3 and 4 comprises no end walls, yet. The two flanges 117b are pressed towards each other and towards the two ends of the tubular wall 112a of the silencer housing by means of said at least one pneumatic actuator so that the silencer housing is clamped between the two flanges. The free end of each conveyor screw projects into an end portion of the silencer housing 112. The axis of each housing part 117a and of the conveyor screw 118

arranged in this housing part is coincident with the axis of the associated tube 112c. The conical end portion 118c of each shaft 118a projects into one of the tubes 112c so that the shafts 118a and tubes 112c support each other. The free end of each tube 112c is opposed with little play or without play to an annular, radial, flat surface of the collar 118d of the associated conveyor screw. The end portion 118h of the helix 118f of each conveyor screw projects into an end portion of the silencer housing 112, encompasses an end portion of one of the tubes 112c and is separated by a free, intermediate space from the latter.

[0040] The opening up station or means 102, the weighing station or means 103, the conveyor and distributor 111 and at least the most part of the mechanical introduction means 115 are lodged in a chamber 110 which is at least approximately dust tight. The chamber may have for instance an opening for the fibrous material at the connection of the feed 101 with the opening up station or means 102. This opening may be partly closed by a curtain comprising a plurality of suspended, flexible strips. The mechanical introduction means 115 are arranged in such a way in the chamber 110 that no dust can escape from the mechanical introduction means into the surroundings and that a silencer housing 112 can anyway be easily inserted between the flanges 117b and thereafter again removed. The interior space of the chamber 110 is connected through at least one line 119 and at least one fan 120 and at least one dust filter 121 with the surroundings, i.e. the atmosphere.

[0041] The weighing and introducing of fibrous material into a silencer housing is now explained. If the carrier of the weighing station or means 103 is in the carrying position, the load carrier can receive and collect fibrous material. This material is continuously weighed. If the load carrier contains a quantity or amount of fibrous material having a predetermined mass or weight, the load carrier delivers this fibrous material to the conveyor and distributor 111 and namely dumps this fibrous material onto the conveyor belt 111a. This conveyor belt 111a transports the fibrous material depending on the selected direction to one of the two conveyor belts 111b. The respective conveyor belt 111b transports the weighed amount of fibrous material into the associated intermediate container or screw conveyor housing 117, which is configured and dimensioned for temporarily accommodating the complete, weighed amount of fibrous material. A further amount of fibrous material is meanwhile collected in or on the load carrier and weighed, thereafter dumped onto the conveyor belt 111a and transported to and into the other intermediate container and screw conveyor housing 117. Thereafter the two conveyor screws are rotated so that they push the two weighed amounts of fibrous material substantially simultaneously into the opposite end portions of the silencer hosing. Each weighed amount of fibrous material 107 forms then a fibrous material fill 125. The conveyor screws serving as pushing elements ensure thereby that the fibrous material fill 125 encompasses the tubes 112c all around the circumference of the tubes. As each helix 118f projects a little into the silencer housing, the fibrous material fill is in a small distance from the ends of the silencer housing immediately after the introduction of the fill. When the fills have been introduced, the housing parts 117a and the flanges 117b are moved away from one another and the shafts 118a are thereby pulled out from the tubes 112c so that the silencer housing provided with fibrous material can be removed from the screw conveyors. Thereafter the silencer housing is closed by affixing end walls (not shown) to the ends of the tubular wall 112a.

[0042] The mentioned distance between the fibrous material fills and the ends of the tubular wall 112a ensures that the fibrous material fills do not fall out from the tubular wall 112a when the latter is separated from the screw conveyors. When the silencer housing has been provided with said end walls, when the completed silencer has been mounted into an exhaust system of a car and if the latter is then used, there are produced vibrations. These vibrations act upon the fibrous material fills so that these fills expand and completely fill the hollow spaces between the tubular wall 112a and the tubes 112c and further limited by the partitions 112b and the not shown end walls.

[0043] If the filled silencer housing has been separated from the screw conveyors, another silencer housing may be disposed between the screw conveyors and clamped. When the installation is operated, the fan 120 sucks air and dust out from the chamber 110. This dust is filtered off at the filter 121 so that no dust and no particles broken from fibre pieces get into the surroundings of the installation.

[0044] The feed 1 and the stations or means 2 and 3 of the installation shown in Fig. 1 and described only briefly may be configured similarly as the feed 101 and the stations or means 102, 103.

[0045] The installations shown in the Figures 1 to 4 are equipped with sensor means and control means (not shown) so that the described processes can be controlled, for example, to a large extent automatically. Both installations give also the advantage that the fibrous material can be brought from the feeds 1 or 101 into the silencer housings without any manual handling of the fibrous material. This permits to introduce the fibrous material into the silencer housings in efficient and economical manners and avoids injuries to the health of operators. The installations and introducing methods ensure also that the fibrous material encompasses the tube within the silencer housing completely.

[0046] As the fibrous material fills can be pushed into a certain distance form the open ends of the silencer housings by means of the conveyor screws of the second described installation, it is normally not necessary to add a fixing agent to the fibrous material. However, if a fixing agent is desired or necessary for one or the other reason, it may be introduced by the feed 18 of the in-

stallation shown in Fig. 1 or through the fibrous material inlets 117c of the screw conveyors 116 of the installation shown in the Figures 2 and 3. The screw conveyors could, however, be provided with separate inlets or feeds for the fixing agent.

[0047] The silencer housing 112 may for instance be replaced by a silencer housing having two tubes which are coaxial to the axis of the tubular wall 112a. Moreover, the silencer housing might contain only one tube coaxial to the axis of the tubular wall or no tube at all. The housing part 117a of at least one of the screw conveyors is preferably mounted in such a manner on a support that the axis of the housing part 117a and conveyor screw 118 can be transversally displaced. This permits to adjust the positions of the housing parts 117a and conveyor screws 118 to the mentioned, various types of silencer housings.

[0048] The installations, methods and silencer housings may furthermore be modified in various ways. It is possible in particular to combine features of different embodiments with one another. The fibrous material in bulk serving as starting material may, for example, be brought to the feed 2 or 102 in form of any kind of bulk pack, such as mats, and/or in form of a pile. The feeds could also be provided and/or connected with a silo or container or the like for accommodating an (intermediate) fibrous material stock in bulk. The annular piston having a coaxial hole may, for example, be replaced by a piston having an eccentric hole so that the piston can slide over and along an eccentric tube of a silencer. Moreover, there might be provided an installation having only one screw conveyor. If a silencer housing must be provided with two fibrous material fills, such as the silencer 112, then these fills may be introduced one after the other. A single screw conveyor may also be used if only one fibrous material fill shall be introduced.

[0049] The installations and methods according to the invention might possibly be used also for introducing fibrous material into housings of other products, e.g. of filters.

Claims

1. Method for introducing fibrous material (7, 107) into a housing (11, 12), such as the housing (11, 12) of a silencer, comprising the steps:

   - provision of a fibrous material (7, 107) in bulk, comprising a plurality of fibre pieces,
   - introduction of at least one fill (125) of the fibrous material (7, 107) into the housing (12, 112).

2. Method according to claim 1, wherein the fibre pieces for the at least one fill (125) of fibrous material (7, 107) are obtained by opening up an amount of the fibrous material (7, 107) in bulk.

3. Method according to claim 1 or 2, comprising the provision of various types of fibrous material (7, 107) and the introduction of said various types of fibrous material (7, 107) into the housing (12, 112) to provide said fill (125) composed of a mixture of the various types of fibrous material (7, 107).

4. Method according to any of the preceding claims, comprising the addition of a fixing agent, such as a resin, for instance a two component resin, to the fibrous material (7, 107) to connect the fibre pieces to one another.

5. Method according to claim 4, comprising introduction of the fixing agent substantially at the same time as introduction of the fibrous material (7, 107).

6. Method according to any of the preceding claims, wherein a quantity of fibrous material is metered for producing said at least one fill (125) of fibrous material (7, 107).

7. Method according to any of the preceding claims, wherein a quantity of fibrous material (7, 107) is weighed for determining said at least one fill (125) of fibrous material (7, 107).

8. Method according to any of the preceding claims, comprising the step involving the introduction of the fibrous material (7, 107) by mechanical transport by a mechanical introduction means (115) into the housing (12, 112), wherein the mechanical introduction means (115) preferably comprises at least one intermediate container (6, 117) and/or is substantially arranged in at least one intermediate container (6, 117),and wherein the fibrous material (7, 107) is preferably brought into the at least one intermediate container (6, 117) and then introduced into the housing (12, 112) by said mechanical transport.

9. Method according to claim 8, wherein the introduction of the fibrous material (7, 107) is effected by means of at least one pushing element of the mechanical introduction means (115).

10. Method according to claim 9, wherein the at least one pushing element is a piston (15) which can be moved to and from in a tubular intermediate container (6), wherein the piston (15) has for instance a hole for introducing the fibrous material (17) into a space present between a wall of the housing (12) and a tube disposed within the latter.

11. Method according to claim 8 or 9, wherein the introduction of the fibrous material (107) is effected by means of at least one conveyor screw (118) of the mechanical introduction means (115).

12. Method according to claim 11, wherein the at least one conveyor screw (118) comprises a shaft (118a) and wherein a portion of this shaft (118a) is inserted into a tube (112c) disposed within a tubular wall (112a) of the housing (112) during the introduction of fibrous material (107) into the housing (112).

13. Method according to any of the preceding claims, comprising the use of suction to remove dust that is released during process of the fibrous material (7, 107).

14. Method according to any of the preceding claims, wherein the fibre length of the fibrous material (7, 107) in bulk is between 1 mm and 1 m.

15. Installation for carrying out the method according to any of the preceding claims, comprising a metering means for metering the fibrous material (7, 107) and a means for introducing the metered fibrous material (7, 107) into the housing (12, 112), characterised in that a means (2, 102) is provided for opening up a fibrous material (7, 107) in bulk.

16. Installation according to claim 15, characterised in that the metering means is a weighing means (3, 103) and that a mechanical introduction means (115) having at least one pushing element for pushing fibrous material (7, 107) into the housing (12, 112) is provided.

17. Installation according to claim 16, characterised in that the mechanical introduction means (115) comprises at least one intermediate container (6, 117) associated to the at least one pushing element, which intermediate container (6, 117) is configured for connecting a housing (12, 112), in which intermediate container (6, 117) a metered fill (125) of fibrous material (7, 107) can be accommodated and from which intermediate container (6, 117) said quantity can be transferred into the housing (12, 112) by the associated pushing element.

18. Installation according to claim 16 or 17, characterised in that the at least one pushing element is a piston (15) or a conveyor screw (118).

19. Installation according to any of the claims 15 to 18, characterised in that the means (2, 102) for opening up the fibrous material from bulk is located in a chamber (10, 110), which chamber is connected to a fan (20, 120) for removing dust.

20. Housing of a product produced in accordance with the method according to any of claims 1 to 14, characterised in that the housing is filled at least in part with a fibrous material (7, 107) composed of fibres pieces having a length of between 1 mm and 1 m.

21. Housing according to claim 20, characterised in that the product is configured as a silencer and wherein the fibrous material (7, 107) comprises for instance a mixture of various types of fibres.

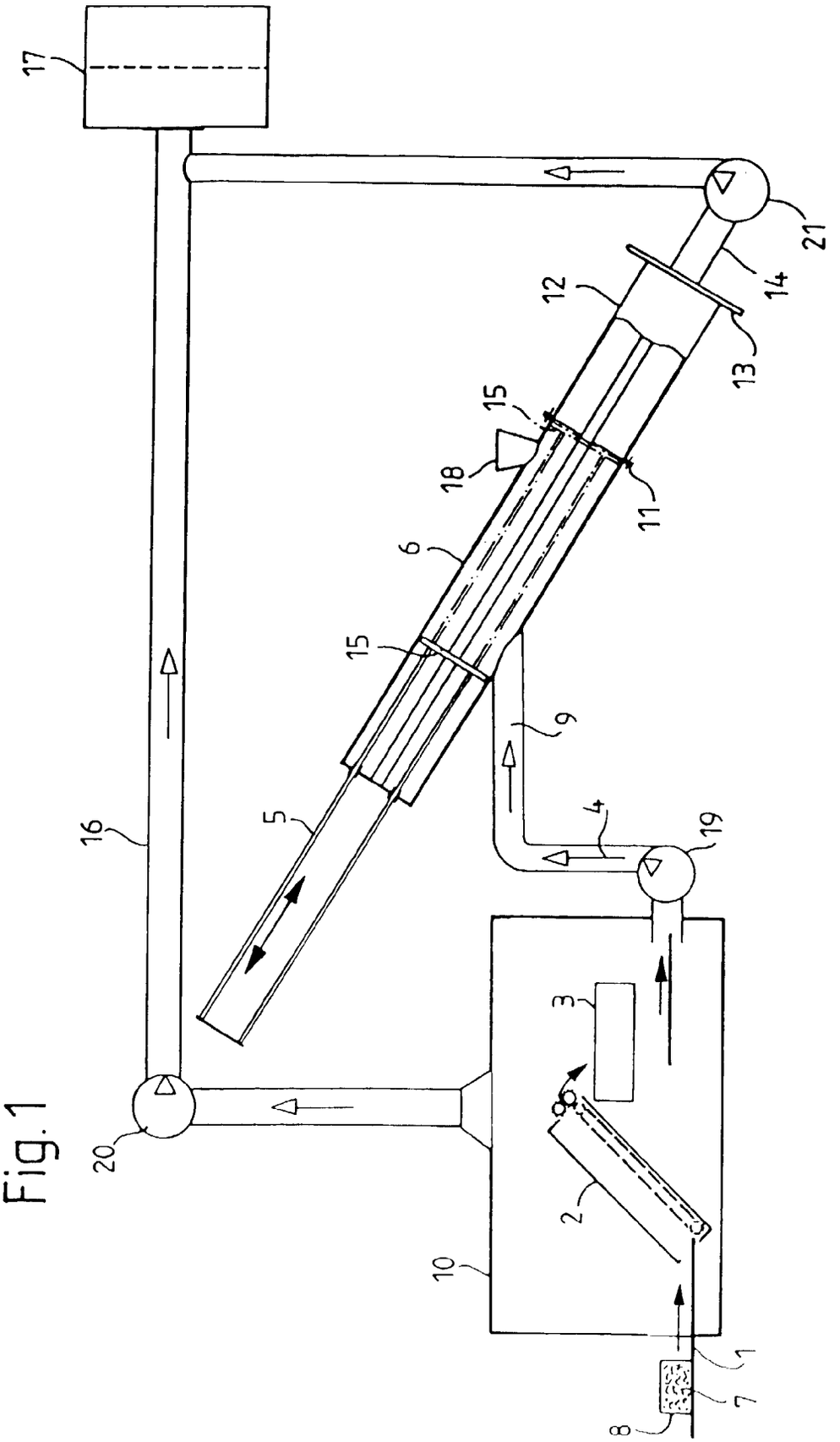

Fig. 1

Fig. 2

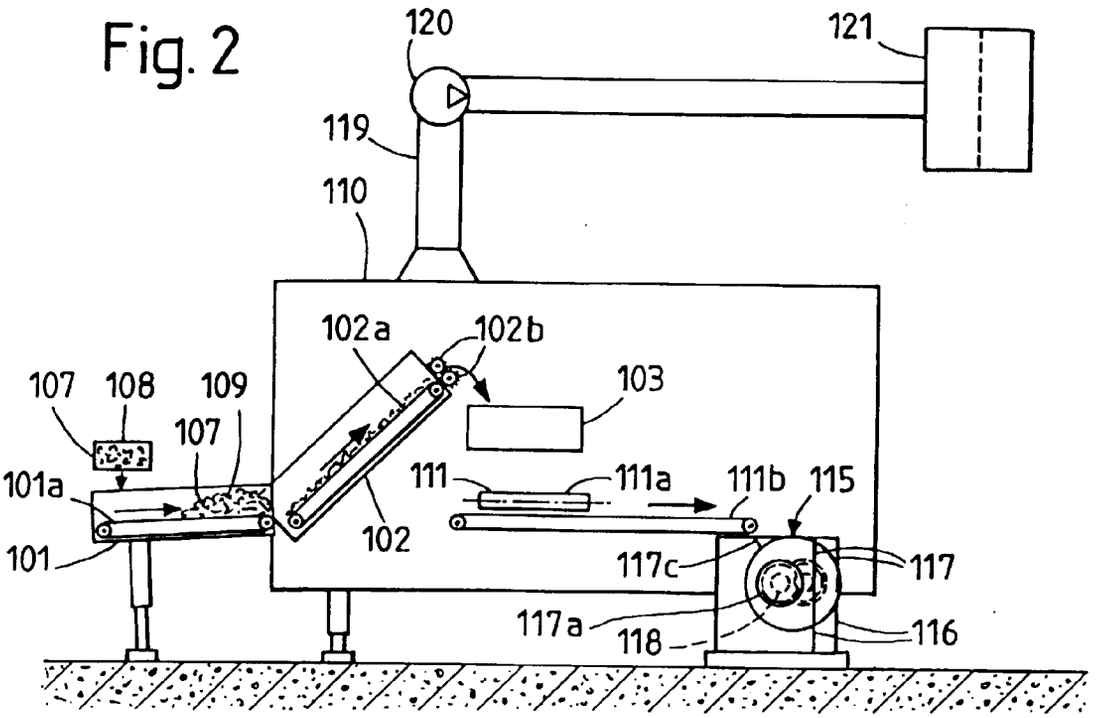
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Fig. 3

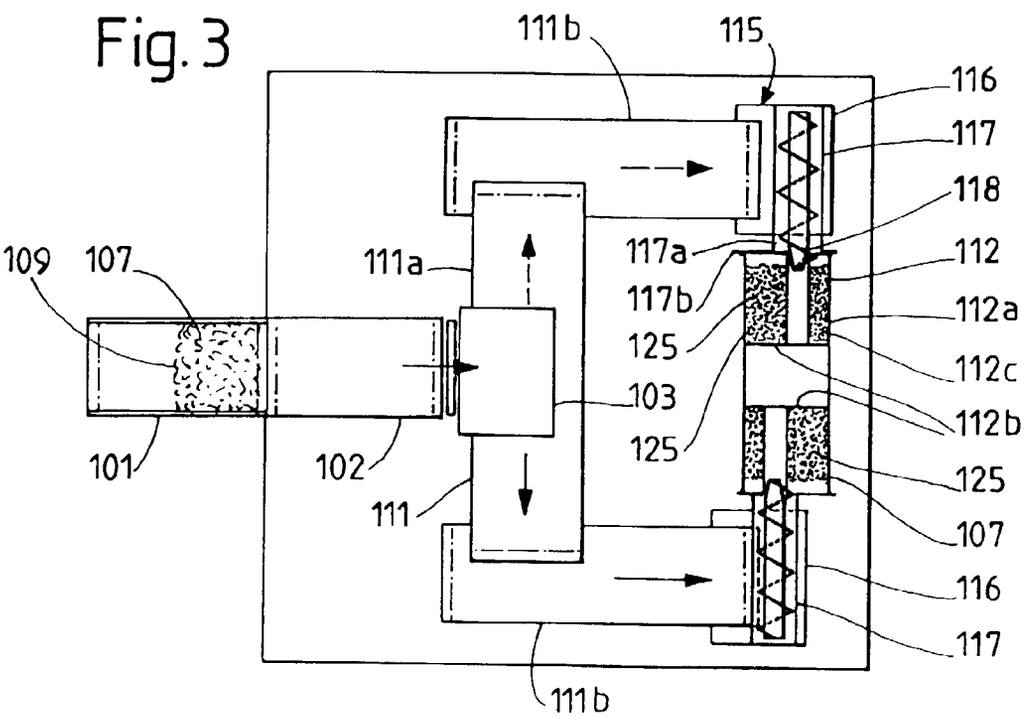
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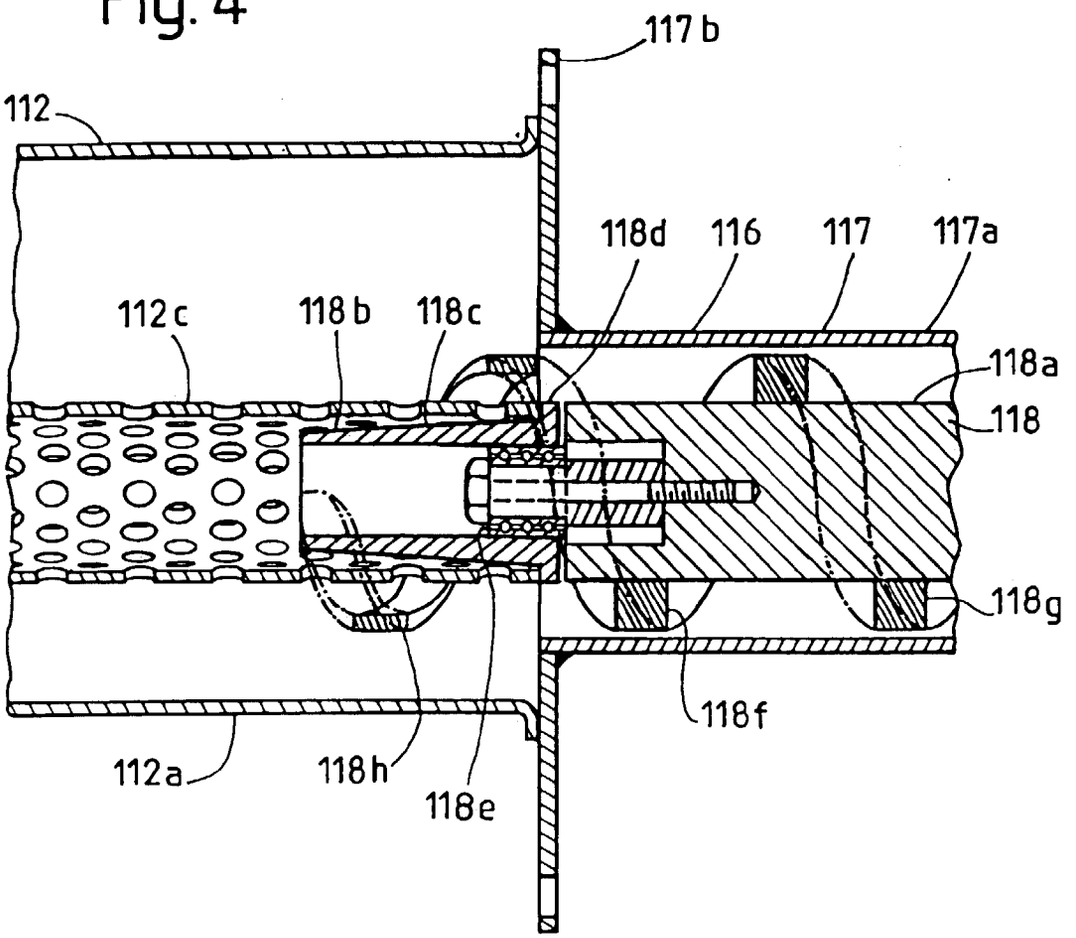
Fig. 4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European Patent Office

EUROPEAN SEARCH REPORT

Application Number
EP 99 81 0404

DOCUMENTS CONSIDERED TO BE RELEVANT

Category	Citation of document with indication, where appropriate, of relevant passages	Relevant to claim	CLASSIFICATION OF THE APPLICATION (Int.Cl.6)
D,A	US 4 774 985 A (BROADBELT KEITH ET AL) 4 October 1988 (1988-10-04) * column 1, line 13 - line 49 * * column 3, line 39 - line 49 * * column 5, line 20 - line 29 * * column 10, line 5 - column 24; figures *	1,2,4,8, 9,15,20, 21	F01N1/24 B65B1/16
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