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(54) **A device for reducing atmospheric pollution by exhaust gases from internal combustion engines.**

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Description

The present invention relates to a device for reducing atmospheric pollution by exhaust gases of internal combustion engines. More particularly, the present invention relates to a device for reducing atmospheric pollution by the exhaust gas as from diesel cycle engines both those installed on vehicles and those installed in static installations (for example generating plants).

As is known, internal combustion engine exhaust gases, particularly from diesel cycle engines utilising diesel oil as a fuel, contain numerous noxious substances such as, for example, unburnt hydrocarbons, particles, oxides of nitrogen and carbon etc.

There are many known systems and devices designed for reducing atmospheric pollution due to internal combustion engine exhaust gases. In general these are of the type comprising a hollow casing provided with an inlet for the exhaust gas to be purified and an outlet for the purified exhaust gas, and purifying means interposed between the said inlet and outlet.

By way of example it is known to use ceramic trap devices which retain the particles present in the exhaust gas and then burn them by means of suitable heating flames supplied by an appropriate burner. Such devices have not found wide application because of the excessively high cost.

It is also known from the US-A-4 175 107 a catalytic exhaust gas purifying device, wherein a purifying body is formed of a plurality of layers of metallic fibres housed between a pair of stainless tubular screens secured to two end discs, in turn housed in a cylindrical casing.

The object of the present invention is that of providing a device reducing atmospheric pollution by exhaust gases from internal combustion engines of Diesel cycle, able to effect a purification such as drastically to reduce the toxicity of such exhaust gases whilst being of a restricted production cost in comparison with known devices of the above specified type.

Said object is achieved by the pollution reducing device defined in the Claim 1.

For a better understanding of the present invention a preferred embodiment is described hereinafter purely by way of non-limitative example and with reference to the attached drawings, in which:

Figure 1 is a sectional side view of a device formed according to the present invention;

Figure 2 is a section, on an enlarged scale, taken on the line II-II of Figure 1;

Figure 3 is a view on an enlarged scale of a detail of Figure 1;

Figure 4 illustrates a detail of a production stage of a detail of the device in question; and

Figure 5 illustrates on an enlarged scale the structure of a detail of Figure 4.

With particular reference to Figure 1, a device for reducing atmospheric pollution by exhaust gases of internal combustion engines formed according to the principles of the present invention is generally indicated with the reference numeral 1.

The device 1 is of the type comprising a hollow casing 2 provided with an inlet 3 for the exhaust gases to be purified and an outlet 4 for the purified exhaust gases, and purifier means 5 interposed between the said inlet 3 and outlet 4.

In more detail, the casing 2 has a cylindrical structure with tubular side walls 7, an upper wall 8 and a lower wall 9. The upper wall 8 has an axial through-hole 11 and supports a conical diffuser 12 the purpose of which is to allow a progressive expansion of the exhaust gas to be purified coming from the inlet 3. The lower wall 9 has an offset through-hole 13 in which is fixed a tubular connector 14.

According to an aspect of the present invention the purifier means 5 are essentially constituted by mineral fibres 6 rendered active by means of a noble metal catalyst deposit thereon. Moreover, these are preferably constituted by quartz and/or silica fibres, whilst the noble metal catalyst is advantageously a platinum catalyst.

According to an essential aspect of the present invention the device 1 includes support means 15 for the mineral fibres 6, essentially constituted by a stocking of woven filiform material contacting these fibres 6 in such a way as to define, between the inlet 3 and the outlet 4, alternate layers of filiform material 15 and mineral fibres 6.

The stocking 15 of woven filiform material, a portion of which is illustrated in detail in Figure 5, is constituted by a plurality of free and elastically deformable meshes conveniently made by mechanical knitting of a stainless steel wire particularly adapted to resist high temperatures such as those of the exhaust gases of an internal combustion engine.

It is observed that the mineral fibres 6 and the stocking 15 of woven filiform material are wound in a coil (as illustrated in Figure 4) in such a way as to define a tubular mattress 17 which is interposed between two tubular metal meshes, respectively an inner mesh 18 and an outer mesh 19. Preferably, these meshes 18, 19 are obtained as expanded metal meshes of stainless steel sheet of a type adapted to resist high temperature as specified above.

The mineral fibres 6, the stocking 15 and the rigid meshes 18, 19 together define a cartridge 20 which is installed in axial position within the casing 2 and is dimensioned in such a way that the diameter of the inner mesh 18 is substantially coincident with the diameter of the through-hole 11 in the upper wall 8 of the casing 2.

The upper portion of the cartridge 20 is positioned, in use, between inner and outer centring collars 21, 22 extending from the inner side of the upper

wall 8 of the casing 2 through the through-hole 11 mentioned above.

The lower portion of the cartridge 20 is housed within an annular bowl 24 substantially constituted by a flat ring 25 and two collars 26, 27 extending perpendicularly from this latter and entirely identical to the collars 21, 22 described above.

For the purpose of allowing, in use, an expansion of the cartridge within the casing 2 without creating mechanical stresses between these two components, the cartridge 20 is retained in the working position by means of a disc 30 resting on the lower surface of the annular bowl 24 and mechanically connected to a crosspiece 31 supported by the collar 21 by means of an axial tie rod 32 a threaded leg 33 of which retains the disc 30 by means of a nut 34. The material constituting the tie rod 32 is of the same type as that constituting the rigid meshes 18, 19 of the cartridge 20, in such a way as to present a substantially identical thermal expansion to that of the meshes 18, 19 themselves.

The disc 30 is provided with a set of three radial tongues 35 angularly equidistant from one another and extending towards the inner surface of the lateral wall 7 of the casing 2 (Figures 2 and 3). The tongues 35 are bent with respect to the plane of the disc 30 in such a way as to form with this latter an angle of substantially 45° and present a circular outline such that these do not dig in to the wall 7 during longitudinal excursions of the cartridge 20 by the effect of the increase in the working temperature.

For the purpose of distributing exhaust gases uniformly over the entire inner surfaces of the cartridge 20 the device 1 is provided with a pair of flow deflectors 37, 38 substantially constituted by tubular elements of conical profile of different diameters fixed coaxially to the crosspiece 31.

According to a further characteristic of the present invention the disc 30 is provided with a through-hole 40 of suitable dimensions, which puts the inlet 3 in direct communication with the outlet 4 of the casing 2.

The device 1 operates in general in a manner similar to known devices of this type in the sense that the exhaust gases gain access to the interior of the casing 2 through the inlet 3 and subsequently flow to the outlet 4 after having traversed the cartridge 2 and having been purified by means of the purifier 5 contained in it.

By examining in detail the structure of the device 1 numerous characteristics are noted which render this device signficantly effective.

In particular, the use of the stocking 15 of woven wire-like material certainly performs two important functions:

a principle function consisting in supporting the mineral fibres 6 correctly for the purpose of maintaining them always distributed in a uniform manner within the interior of the cartridge 20 and therefore making the purifying effect homogeneous in time;

a secondary, but equally important function, consisting in creating, between the inlet 3 and the outlet 4, an alternating set of layers of mineral fibres and wire material, this latter causing a certain separation between adjacent layers of mineral fibres and therefore a good distribution of the flow of gas between the mineral fibres themselves, and, ultimately, an optimum purifying effect.

The system for fixing the cartridge 20 to the casing 2 by means of the tie rod 32 (having a coefficient of thermal expansion similar to that of the rigid meshes 18, 19) allows, simultaneously, the fixing of the cartridge 20 to the casing 2 and the free expansion of the meshes 18, 19 without casuing rupture of these meshes by exceeding the yield points of the respective metal materials.

The presence of the hole 40 in the disc 30 has substantially no effect in normal operating conditions of the device 1, that is to say in the case in which the combustion residues are consumed by part of the purifier means 5 in such a way as to cause no accumulation of these between the fibres 6. In the case in which such eventuality occurs, the momentary blockage of the cartridge 20 and the constant inflow of gases to the interior thereof cause an excess pressure which does not exceed a predetermined safety level since the discharge gas can momentarily flow out through the hole 40 allowing the purifier means 5 to digest the overload of combustion residues.

Finally, the combined action of the diffuser 12 and the flow deflectors 37, 38 permits possible damage due to the rapid expansion of the exhaust gas jet flowing into the interior of the cartridge 20 to be reduced to the minimum.

From a study of the characteristics of the device formed according to the present invention the advantages which it allows to be obtained are therefore evident.

The high efficiency of the purifier means 5, conveniently supported by the stocking 15 of resiliently deformable woven metal wire permits a drastic reduction in the more noxious and repeated emissions, such as the particles, oxides of nitrogen oxides of carbon and unburnt hydrocarbons, containing the back pressure within more than acceptable limits.

Beyond the overall improvement in the purifying efficiency and functionality, it is observed that the device 1 can be made at an overall cost which is significantly less than the cost of ceramic devices currently utilised and described above.

As far as the possible utilisation of the device formed according to the present invention is concerned, it is noted that, as a rule, it can be utilised advantageously to treat exhaust gases from internal combustion engine of the Diesel cycle installed on

vehicles or in fixed installations (for example generators) as well as to treat the exhaust gases of heating boilers adapted for industrial and civil installations.

Finally, it is clear that the device 1 described above can have modifications and variations introduced thereto without however departing from the present invention.

For example, it is evident that wide modifications can be introduced to the structure of the cartridge 2 whilst retaining the principle of interposing between the inlet 3 and the outlet 4 of the casing 2 alternate layers of mineral fibres and stockings of woven wire-like material. In the case in which these two elements are wound in a spiral (as illustrated in Figure 4) the stocking 15 could be disposed on a single face of the layer 6 of fibres in that during the course of the winding this alternation of layers described above would in any case be obtained.

The support for the cartridge 20 could be achieved by means of several tie rods either positioned within or outside the cartridge itself, the concept of utilising a material with a coefficient of thermal expansion as close as possible to that of the rigid meshes 18, 19 remaining the same. It is also evident that other ways of support could be thought up, for example utilising resilient means able to maintain the cartridge in the correct working position whilst allowing termal expansion in longitudinal and transverse directions within the associated case.

The number of flow deflectors could be greater or less than two, and the associated structure could be different from the conical structure described above.

Claims

1. A device reducing atmospheric pollution by the exhaust gases of internal combustion engines of the type comprising a hollow casing (2) provided with an inlet (3) for exhaust gases to be purified, and an outlet (4) for the purified exhaust gases, and purifier means (5) interposed between said inlet (3) and said outlet (4) and essentially comprising mineral fibres (6), characterized by support means (15) for said mineral fibres (6) essentially constituted by woven filiform material in contact with said fibres (6) in such a way to define, between said inlet (3) and outlet (4), a substantial alternation of layers of filiform material (15) and mineral fibres (6).

2. A device according to Claim 1, characterized in that said support means (15) are essentially constituted by a stocking of filiform material having a plurality of resiliently deformable free loops conveniently obtained by mechanically knitting a stainless steel wire particularly adapted to resist high temperatures.

3. A device according to Claim 1 or 2, characterized in that said mineral fibres (6) are constituted by quartz and/or silica.

4. A device according to any of Claims 1 to 3, characterized in that said mineral fibres (6) are rendered active by a catalyst.

5. A device according to Claim 2, characterized in that said mineral fibres (6) and said stocking (15) of filiform material are wound into a spiral in such a way to define a tubular mattress (17) interposed between an inner (18) and an outer tubular metal mesh (19), said mineral fibres (6), said stocking (15) and said rigid meshes (18, 19) together defining a cartridge (20).

6. A device according to Claim 5, characterized in that said cartridge (20) is maintained in its working position inside said casing (2) by a disc (30) resting against an outlet portion of said cartridge (20) and mechanically connected to an inlet wall (8) of said casing (2) by at least an axial tie rod (32).

7. A device according to Claim 6, characterized in that said tie rod (32) is made of a material of the same type as the one of said meshes (18, 19) as to present substantially a thermal expansion similar to that of said meshes (18, 19).

8. A device according to Claim 6 or 7, characterized in that said disc (30) is provided with spacer and guide means (35) for excursions of the outlet portion of said cartridge (20) along a side wall (7) of said casing (2).

9. A device according to Claim 8, characterized in that said spacer and guide means comprise a plurality of equidistant tongues (35) radially extending from said disc (30) toward the inner surface of said side wall (7) without engaging said inner surface.

10. A device according to Claim 9, characterized in that said tongues (35) are bent with respect to the plane of said disc (30) toward said inlet wall (8) and present a circular outer profile such as not digging into said side wall (7) even when expanded due to the working temperature.

11. A device according to any Claim from 6 to 10, characterized in that said disc (30) is provided with a through-hole (40) for direct communication between said inlet (3) and said outlet (4), said outlet (4) having a through-hole (13) which is offset with respect to said inlet (3).

12. A device according to any Claim from 6 to 11, characterized in that said inlet (3) is connected to a through-hole (11) of said inlet wall (8) by means of a diffuser (12) located downstream of said inlet (3), at least a deflector (37, 38) having a conical profile being located between said inlet (3) and said cartridge (20) coaxially with centering means (21, 22) for an upper portion of said cartridge (20) with respect to said inlet wall (8) of said casing (2).

13. A device according to any preceding Claim, characterized in that said inlet (3) is connected to the exhaust of a diesel engine and said outlet (4) is con-

nected to a heat recovery unit.

Patentansprüche

1. Vorrichtung zur Reduktion der Luftverschmutzung durch die Auspuffgase eines Verbrennungsmotors, enthaltend ein hohles Gehäuse (2) mit einem Einlass (3) für die zu reinigenden Auspuffgase, einem Auslass (4) für die gereinigten Auspuffgase sowie Reinigungselementen (5), die zwischen dem Einlass (3) und dem Auslass (4) angeordnet sind und im wesentlichen Mineralfasern (6) enthalten, gekennzeichnet durch Stützmittel (15) für die Mineralfasern (6), die im wesentlichen aus gewirktem, fadenförmigem Material bestehen, das derart in Kontakt mit den Fasern (6) ist, dass zwischen dem Einlass (3) und dem Auslass (4) im wesentlichen abwechselnde Schichten von fadenförmigem Material (15) und Mineralfasern (6) gebildet sind.

2. Vorrichtung nach Anspruch 1, dadurch gekennzeichnet, dass die Stützmittel (15) im wesentlichen durch einen Strumpf aus fadenförmigem Material gebildet sind, der mehrere elastisch deformierbare, freie Schlaufen enthält, die vorzugsweise durch mechanisches Stricken eines rostfreien Stahldrahtes von hoher Temperaturbeständigkeit erhalten wurden.

3. Vorrichtung nach Anspruch 1 oder 2, dadurch gekennzeichnet, dass die Mineralfasern aus Quarz und/oder Kieselerde bestehen.

4. Vorrichtung nach einem der Ansprüche 1 bis 3, dadurch gekennzeichnet, dass die Mineralfasern (6) durch einen Katalysator aktiviert sind.

5. Vorrichtung nach Anspruch 2, dadurch gekennzeichnet, dass die Mineralfasern (6) und der Strumpf (15) aus fadenförmigem Material in eine Spirale aufgewickelt sind, derart, dass eine rohrförmige Matte (17) zwischen einem inneren (18) und einem äusseren rohrförmigen Metallgitter (19) angeordnet ist, wobei die Mineralfasern (6), der Strumpf (15) und die festen Gitter (18,19) zusammen eine Kartusche (20) bilden.

6. Vorrichtung nach Anspruch 5, dadurch gekennzeichnet, dass die Kartusche (20) in ihrer Arbeitsstellung innerhalb des Gehäuses (2) durch eine Scheibe (30) gehalten ist, die gegen einen Aussenteil der Kartusche (20) anliegt und mechanisch mit einer Einlasswand (8) des Gehäuses (2) durch mindestens eine axiale Zugstange (32) verbunden ist.

7. Vorrichtung nach Anspruch 6, dadurch gekennzeichnet, dass die Zugstange (32) aus derselben Art von Material besteht wie die Gitter (18,19), so dass ihre thermische Ausdehnung jener der Gitter (18,19) entspricht.

8. Vorrichtung nach Anspruch 6 oder 7, dadurch gekennzeichnet, dass die Scheibe (30) mit Abstands- und Führungsmitteln (35) für die Verschiebung des Auslassteils der Kartusche (20) längs einer Seitenwand (7) des Gehäuses (2) versehen ist.

9. Vorrichtung nach Anspruch 8, dadurch gekennzeichnet, dass die Abstands- und Führungsmittel mehrere gleichmässig beabstandete Zungen (35) umfassen, die radial von der Scheibe (30) gegen die Innenseite der Seitenwand (7) abstehen, ohne diese zu berühren.

10. Vorrichtung nach Anspruch 9, dadurch gekennzeichnet, dass die Zungen (35) gegenüber der Ebene der Scheibe (3) zur Einlasswand (8) hin abgebogen sind und ein kreisförmiges äusseres Profil haben, derart, dass sie sich auch nach der Expansion infolge der Arbeitstemperatur nicht in die Seitenwand (7) eingraben.

11. Vorrichtung nach einem der Ansprüche 6 bis 10, dadurch gekennzeichnet, dass die Scheibe (30) eine Durchgangsbohrung (40) zur direkten Verbindung zwischen dem Einlass (3) und dem Auslass (4) aufweist, wobei der Auslass (4) eine Durchgangsöffnung (13) hat, die gegenüber dem Einlass (3) versetzt ist.

12. Vorrichtung nach einem der Ansprüche 6 bis 11, dadurch gekennzeichnet, dass der Einlass (3) mit einer Durchgangsöffnung (11) der Einlasswand (8) mittels eines Diffusors (12) verbunden ist, der stromabwärts des Einlasses (3) angeordnet ist, wobei mindestens ein Deflektor (37,38) mit einem konischen Profil zwischen dem Einlass (3) und der Kartusche (20) koaxial zu Zentriermitteln (21,22) für einen oberen Teil der Kartusche (20) bezüglich der Einlasswand (8) des Gehäuses (2) angeordnet ist.

13. Vorrichtung nach einem der Ansprüche 1 bis 12, dadurch gekennzeichnet, dass der Einlass (3) mit dem Auspuff eines Dieselmotors und der Auslass (4) mit einer Wärmerückgewinnungseinheit verbunden ist.

Revendications

1. Dispositif pour réduire la pollution atmosphérique due aux gaz d'échappement de moteurs à combustion interne, du type comprenant un carter creux (2) pourvu d'un orifice d'entrée (3) pour les gaz d'échappement devant être purifiés et d'un orifice de sortie (4) pour les gaz d'échappement purifiés, et un moyen purificateur (5) interposé entre l'orifice d'entrée (3) et l'orifice de sortie (4) et comprenant essentiellement des fibres minérales (6), caractérisé en ce qu'il comprend des moyens supports (15) pour les fibres minérales (6) lesquels sont constitués essentiellement par une matière filiforme tissée en contact avec les fibres (6) de manière à définir pratiquement, entre les orifices d'entrée (3) et de sortie (4), une alternance de couches de matière filiforme (15) et de fibres minérales (6).

2. Dispositif suivant la revendication 1 caractérisé

en ce que les moyens supports (15) sont essentiellement constitués par un fourreau de matière filiforme ayant une pluralité de boucles libres déformables élastiquement, avantageusement obtenu par tricotage mécanique d'un fil d'acier inoxydable particulièrement adapté pour pouvoir résister à des températures élevées.

3. Dispositif suivant l'une quelconque des revendications 1 ou 2 caractérisé en ce que les fibres minérales (6) sont constituées par du quartz et/ou de la silice.

4. Dispositif suivant l'une quelconque des revendications 1 à 3 caractérisé en ce que les fibres minérales (6) sont rendues actives par un catalyseur.

5. Dispositif suivant la revendication 2 caractérisé en ce que les fibres minérales (6) et le fourreau (15) de matière filiforme sont enroulées sous la forme d'une spirale de manière à définir un matelas tubulaire (17) interposé entre des treillis métalliques tubulaires interne (18) et externe (19), les fibres minérales (6), le fourreau (15) et les treillis tubulaires (18,19) définissant conjointement une cartouche (20).

6. Dispositif suivant la revendication 5 caractérisé en ce que la cartouche (20) est maintenue dans sa position de fonctionnement, à l'intérieur du carter (2), par un disque (30) en appui contre une partie, située du côté de l'orifice de sortie, de la cartouche (20) et relié mécaniquement à une paroi (8), située du côté de l'orifice d'entrée, du carter (2), par l'intermédiaire d'au moins un tirant axial (32).

7. Dispositif suivant la revendication 6 caractérisé en ce que le tirant (32) est réalisé en une matière du même type que celle des treillis (18,19), de manière à présenter une dilatation thermique pratiquement semblable à celle des treillis (18,19).

8. Dispositif suivant l'une quelconque des revendications 6 ou 7 caractérisé en ce que le disque (30) est pourvu de moyens d'espacement et de guidage (35) pour permettre des déplacements, le long d'une paroi latérale (7) du carter (2), de la partie de la cartouche (20) située du côté de l'orifice de sortie.

9. Dispositif suivant la revendication 8 caractérisé en ce que les moyens de guidage et d'espacement comprennent une pluralité de languettes équidistantes (35), s'étendant radialement, à partir du disque (30), en direction de la surface interne de la paroi latérale (7), sans venir en contact avec cette surface interne.

10. Dispositif suivant la revendication 9 caractérisé en ce que les languettes (35) sont cambrées, par rapport au plan du disque (30), en direction de la paroi (8) située du côté de l'orifice d'entrée et elles présentent un contour externe circulaire tel qu'il ne puisse pas venir buter contre la paroi latérale (7) même lorsque les languettes sont dilatées sous l'effet de la température de fonctionnement.

11. Dispositif suivant l'une quelconque des revendications 6 à 10 caractérisé en ce que le disque (30) est percé d'un trou (40) établissant une communication directe entre l'orifice d'entrée (3) et l'orifice de sortie (4), cet orifice de sortie (4) ayant un trou (13) qui est décalé par rapport à l'orifice d'entrée (3).

12. Dispositif suivant l'une quelconque des revendications 6 à 11 caractérisé en ce que l'orifice d'entrée (3) est relié, par l'intermédiaire d'un diffuseur (12) disposé en aval de l'orifice d'entrée (3), à une ouverture (11) prévue dans la paroi (8) située du côté de l'orifice d'entrée, au moins un déflecteur (37,38) ayant une forme conique étant disposé coaxialement entre l'orifice d'entrée (3) et la cartouche (20), des moyens (21,22) étant prévus pour centrer une partie supérieure de la cartouche (20) par rapport à la paroi (8), située du côté de l'orifice d'entrée, du carter (2).

13. Dispositif suivant l'une quelconque des revendications précédentes caractérisé en ce que l'orifice d'entrée (3) est relié à l'échappement d'un moteur diesel et l'orifice de sortie (4) est relié à une unité de récupération de la chaleur.

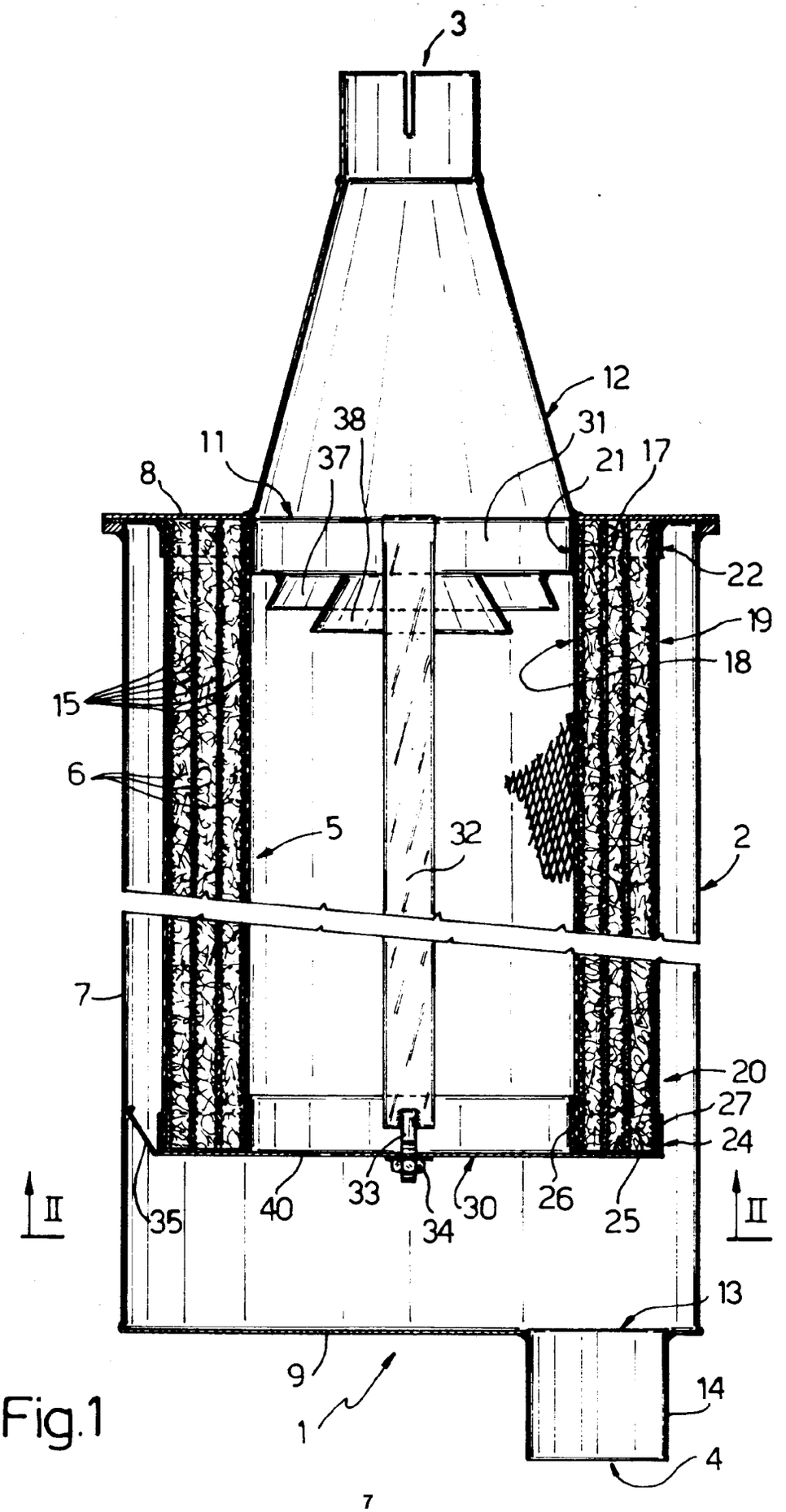
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Fig.1

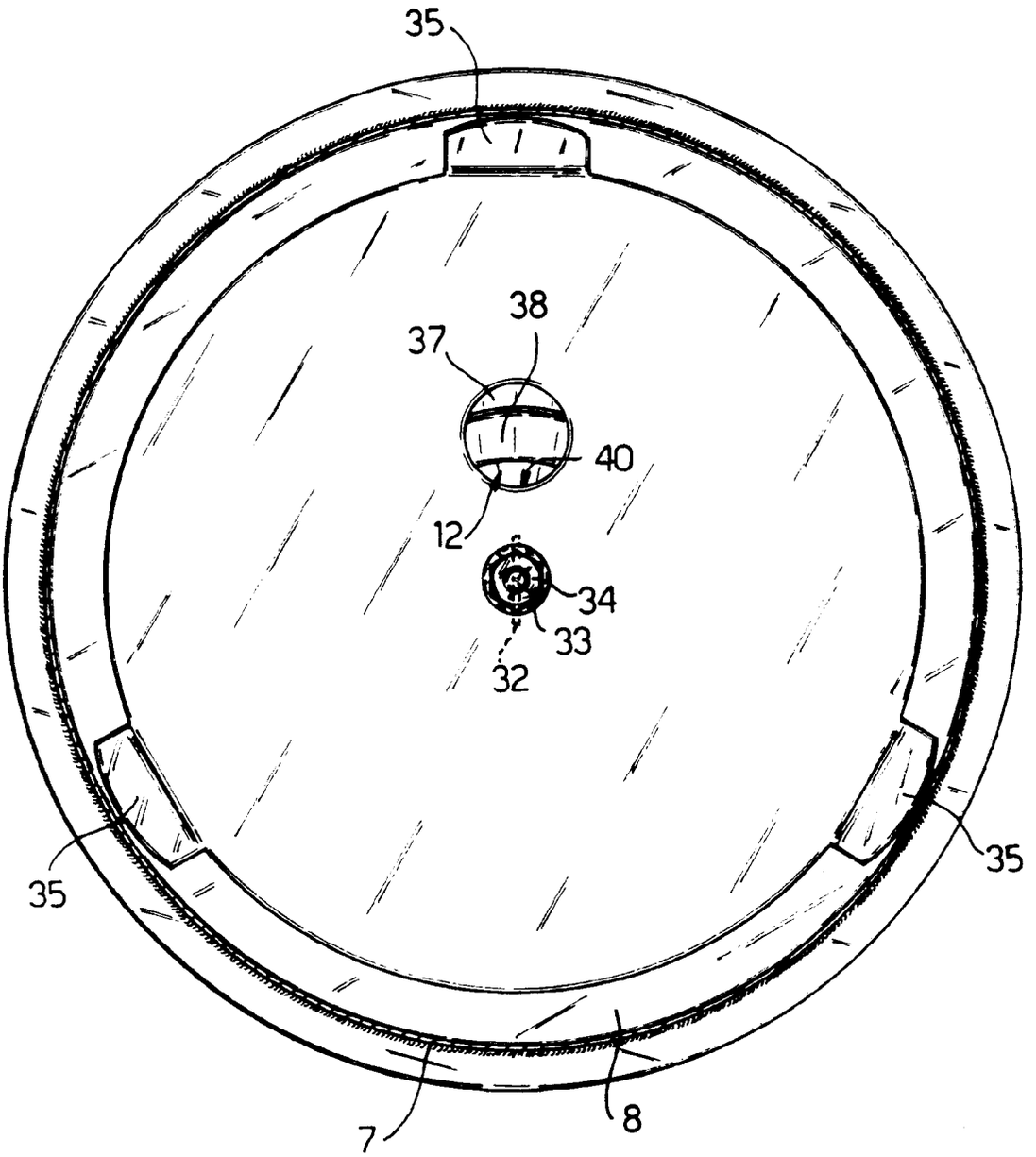

Fig. 2

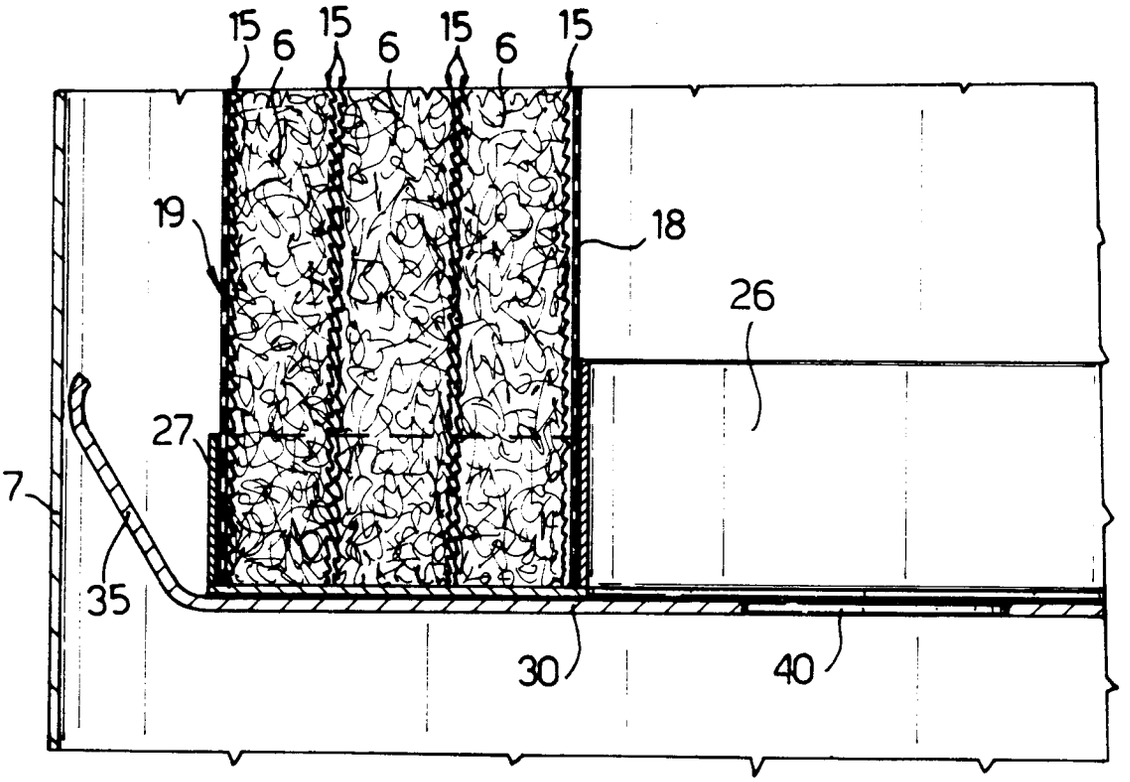

Fig.3

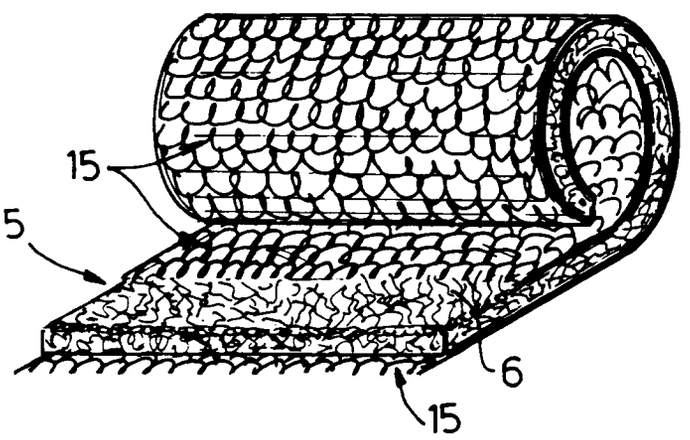

Fig.4

Fig.5