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(54) **A device for evacuating exhaust gases from an internal combustion engine for portable work tools**

Vorrichtung zum Ablassen von Abgasen aus einem Verbrennungsmotor für tragbare Arbeitswerkzeuge

Dispositif d'évacuation de gaz d'échappement d'un moteur à combustion interne pour outils de travail portables

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(56) References cited:
DE-U1-202005 013 804 GB-A- 568 140
US-A- 6 164 410

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Description

[0001] The invention relates to a device for evacuating exhaust gases from an internal combustion engine of a type installed on mobile work tools, such as for example chainsaws, bush-cutters, portable blowers, hedge-cutters and like garden tools.

[0002] As is known, see for example US 6164410, portable work tools can be provided with a small internal combustion engine, typically a two-stroke motor, which powers the operating implements mounted on the work tool.

[0003] Like all internal combustion engines, those installed on portable work tools are also provided with a device for evacuating the exhaust gases produced by combustion of the fuel mixture in the motor.

[0004] The device comprises a usual exhaust pipe via which the exhaust gases issuing from the motor are first conveyed internally of a muffler, sometimes catalytic, which in turn exhibits an outlet mouth which opens into a small terminal conduit from which the exhaust gases flow out into the external environment.

[0005] During functioning, the internal combustion engine produces a very considerable amount of heat.

[0006] At times this heat can become an element of danger, not only because a portable work tool is held by its user, who therefore may run the risk of burning him or herself, but also because a portable work tool is often used and then placed down near inflammable objects, such as for example leaves, branches or dry shrubs.

[0007] For this reason safety standards exist which ideally establish a series of reference surfaces at progressive distances from the portable tool, and for each of these reference surfaces the standards fix the maximum temperature that may be measured during the functioning of the engine.

[0008] To respect these standards, protective covers can be used which screen the hottest zones of the engine, such as to prevent the user or any eventual inflammable objects from coming into contact or getting excessively near to the tool.

[0009] There is however a limit beyond which the protective covers can no longer be used, as they would excessively reduce the ergonomics and ease of use of the portable tool.

[0010] For this reason, a further strategy for respecting the above-cited standards is to directly reduce the heat emissions produced by the internal combustion engine.

[0011] One of the most intense heat sources is the device for evacuating exhaust gases.

[0012] It is via these devices that the exhaust gases exit at high temperature, in the form of a fluid current which diffuses into the surrounding environment up to quite long distances from the engine.

[0013] On portable work tools the evacuation device is therefore normally covered by a protection grating, which reduces the risk of contact with the user and with any inflammable objects, while at the same time enable the exhaust gases to escape.

[0014] Apart from the adoption of this protective grating, evacuation devices have been developed in which the terminal outlet conduit is able to rapidly dissipate the heat contained in the exhaust gases, such that even at short distances from the engine the temperature of the exhaust gases falls within acceptable values.

[0015] For example, the prior art comprises a terminal outlet conduit from the muffler a transversal section of which is not perfectly circular but exhibits a crushed, almost elliptical shape.

[0016] Given a same passage area, a conduit with an almost-elliptical transversal section provides a larger heat-exchange surface for the gases with respect to a circular section, thus obtaining a greater dissipation of the heat.

[0017] Further, by passing through a circular-section conduit, the exhaust gases tend to exit in the form of a laminar current, for which reason they can travel relatively long distances without mixing with the external and cooler air. Differently, in a conduit with a nearly elliptical section, the exhaust gases distribute on a greater contact surface with the external air, which enables a more rapid mixing of the exhaust gases with the cool external air and thus a more immediate dissipation of the heat in proximity of the outlet of the terminal conduit.

[0018] The above-cited conduit with the almost-elliptical section further exhibits a generally tapered shape towards the outlet, thus obtaining an increase in the velocity of the exhaust gases, which further contributes to the dissipation of the heat.

[0019] Though providing good results, the terminal conduits with an almost-elliptical section do not enable reaching efficiency levels that are always satisfactory.

[0020] An aim of the present invention is thus to make available a device for evacuating exhaust gases from an internal combustion engine, which allows a more efficient dissipation of the heat contained in the exiting exhaust gases.

[0021] A further aim of the invention is to attain the above-mentioned objective with a simple, rational and relatively inexpensive solution.

[0022] The aims are attained by the characteristics of the invention as reported in independent claim 1. The dependent claims delineate preferred and/or particularly advantageous aspects of the invention.

[0023] In particular, a device is made available for evacuation of exhaust gases from an internal combustion engine provided at least with an outlet mouth which opens into a terminal conduit the transversal passage section of which terminal conduit exhibits a substantially bilobate shape comprising two broadened portions, reciprocally side-by-side in the direction of the width thereof and separated by an intermediate choke.

[0024] Thanks to the bilobate shape of the transversal section, experiments have revealed a decided increase in the heat dissipated by the exhaust gases in proximity of the outlet of the terminal conduit, and thus a reduced temperature gradient in the surrounding environment.

[0025] This effect can be attributed both to the large heat exchange surface provided for the exhaust gases by a conduit with the above-mentioned bilobate shape, and due to a significant increase in the turbulence of the outflow.

[0026] In a preferred aspect of the invention, the transversal section of the terminal conduit is variable along a longitudinal development of the terminal conduit. In particular, the terminal conduit exhibits an overall tapered shape, in which the transversal sections all have a bilobate shape but a passage area which progressively decreases towards the outlet.

[0027] In this way, the velocity of exit of the exhaust gases is advantageously increased, which facilitates the dissipation of the heat.

[0028] Further characteristics and advantages of the invention will emerge from a reading of the following description which is provided by way of non-limiting example, with the aid of the accompanying figures of the drawings, in which:

figure 1 illustrates a bush-cutter provided with an internal combustion engine and a device for evacuating exhaust gases of the invention;

figure 2 schematically shows the internal combustion engine and the exhaust gas evacuation device, which are mounted to the bush-cutter of figure 1;

figure 3 is a perspective view of the terminal conduit of the exhaust gas evacuation device of the invention;

figure 4 is a front view of the terminal conduit of figure 3, mounted on the muffler;

figure 5 is section V-V of figure 4;

figure 6 is section VI-VI of figure 5;

figure 7 is an orthogonal projection of figure 6.

[0029] The bush-cutter 1 comprises a cutting tool 2 which is typically constituted by a rotating disc provided with rigid blades or bands or threads of flexible nylon. The cutting tool 2 is protected by an enveloping cover 3 and is borne at an end of a rigid support rod 4, which is provided with at least a grip 5 for a user to hold.

[0030] The bush-cutter 1 further comprises an activating engine 6, which is fixed to an end of the support rod 4 opposite the cutting tool 2, to which it is connected via a usual transmission system which passes internally of the hollow support rod 4.

[0031] As illustrated in figure 2, the activating engine is an internal combustion engine, which in the illustrated example is a two-stroke single-cylinder engine.

[0032] The motor 6 comprises an external cover 60, an internal volume of which is subdivided by a sliding piston 61 into two chambers, an upper combustion chamber 62 and a lower compression chamber 63.

[0033] The sliding piston 61 is connected by a con rod 64 to a crankshaft 65, which is directly housed internally of the compression chamber 63.

[0034] The compression chamber 63 is in communi-

cation with a supply conduit 66, through which the mixture of air, petrol and oil is supplied.

[0035] The combustion chamber 62 is in communication with a exhaust pipe 67, through which the exhaust gases produced by the combustion of the mixture are evacuated to the outside.

[0036] The combustion chamber 62 and the compression chamber 63 are reciprocally connected by a cross-flow conduit 68, afforded in the body of the engine.

[0037] A spark plug 69 projects into the combustion chamber 62, which spark plug 69 discharges a spark which will ignite the mixture.

[0038] The functioning of the two-stroke engine is of known type and is thus only very briefly described in the following.

[0039] When the piston 61 is in proximity of the upper endrun position, the exhaust pipe 67 and the crossflow conduit 68 are closed, while the supply conduit 66 from which the fresh mixture enters the compression chamber 63 is open. During the following descent run, the piston 61 closes the supply conduit 66 and opens the crossover conduit 68, such that the fresh mixture passes into the combustion chamber 62, at the same time pushing the exhaust gases to exit through the exhaust pipe 67.

[0040] During the following ascending run, the piston 61 re-closes the exhaust pipe 67 and the crossover conduit 68, such as to compress the fresh mixture in the combustion chamber 62 up to the moment in which the spark plug 69 releases the spark, when the expansion stage begins and with it a new descent run.

[0041] As illustrated in figure 2, the exhaust pipe 67 opens internally of a muffler 70, which makes available a rather large chamber, in which the exhaust gases are forced to slow down, reducing their noise emission level.

[0042] The muffler 70 may contain a catalyser for reducing the toxicity of the exhaust gases before they are released to the outside.

[0043] The exhaust gases exit from the muffler 70 through an outlet mouth 71, which is defined by a circular hole afforded flush with the lateral wall of the muffler 70 itself.

[0044] The outlet mouth 71 opens into a terminal conduit 8, which opens directly into the outside environment.

[0045] The terminal conduit 8 is welded to a fastening flange 80, which is screwed to the muffler 70 with interposing of a special seal means.

[0046] As illustrated in figures from 3 to 7, the terminal conduit 8 is formed by an axially-developing single hollow body, a lateral wall of which exhibits two facing recesses 81 which develop in a longitudinal direction over the whole length of the terminal conduit 8.

[0047] The facing recesses 81 give the terminal conduit a transversal section of a substantially bilobate shape, i.e. comprising two broadened portions 82, facing width-wise and separated by an intermediate choke 83.

[0048] The broadened portions 82 are practically identical to one another, and have a rounded shape which in the illustrated example is elliptical, and which connects

with the curved profile of the recesses 81 defining the intermediate choke 83.

[0049] Thanks to the bilobate shape of the transversal section, given a same passage area, the terminal conduit 8 offers the exhaust gases coming from the muffler 70 a greater heat exchange surface with respect to a traditional cylindrical conduit, such that the gases cool down more rapidly.

[0050] Beyond this aspect, the bilobate shape of the transversal section especially enables the turbulence of the exhaust gases to be significantly increased, such that at the outlet the gases mix immediately with the environmental air, dissipating the majority of the transported heat.

[0051] In the illustrated example, the transversal passage section is not always constant but varies along the longitudinal development of the terminal conduit 8.

[0052] In particular, the terminal conduit 8 is substantially tapered towards the exit. This means that at each point of the longitudinal development thereof, the transversal section of the terminal conduit 8 exhibits the bilobate shape previously delineated, but has a passage area which progressively decreases starting from the inlet section 84 and going towards the outlet section 85.

[0053] The inlet section 84 is the one from which the exhaust gases coming from the muffler 70 enter, while the outlet section 85 is the one from which the exhaust gases exit directly into the outside environment.

[0054] In this way, the exhaust gases which cross the terminal conduit 8 progressively increase their velocity, facilitating dissipation of the heat.

[0055] Note that all the transversal sections of the terminal conduit 8 might be similar to one another in the geometrical sense of the term, but this is not a strictly necessary aspect for the invention.

[0056] In general the overall width of each transversal section of the terminal conduit 8 is greater than the maximum height, i.e. than the height of the broadened portions 82 in the transversal section.

[0057] As illustrated in figures from 4 to 6, at the inlet section 84, the area of the broadened portion 82 should preferably be greater than or equal to the outlet mouth 71 of the muffler 70.

[0058] At the outlet section 85, the area of the broadened portions 82 should preferably be less than or equal to the area of the outlet mouth of the muffler 70.

[0059] It is even possible that the recesses 81 might touch at the outlet section 85, which would in fact close up the choke.

[0060] As illustrated in figure 7, the length L of the terminal conduit 8 should preferably be greater than or equal to the diameter D of the outlet mouth 71 of the muffler 7.

[0061] Constructionally, the terminal conduit 8 can be realised starting from a single tubular body made of thin metal, for example truncoconical, which is deformed in a nearing direction of two opposite generatrices, resulting in the bilobate shape.

[0062] The deformation can be obtained with a punch-

ing machine or other suitable tools.

[0063] After deformation, the terminal conduit can be welded to the fastening flange 80.

[0064] Obviously a technical expert in the sector might make numerous modifications of a technical-application nature to the exhaust gas evacuation device as described herein, without its forsaking the ambit of protection of the invention as claimed herein below.

Claims

1. A device for evacuating exhaust gases from an internal combustion engine for mobile work tools, comprising a muffler (70) provided with at least an outlet mouth (71) which opens in a terminal conduit (8) through which the exhaust gases are released directly into an outside environment, **characterised in that** a transversal section of the terminal conduit (8) comprises two broadened portions (82) arranged side-by-side in a direction of a width thereof and separated by an intermediate choke (83).
2. The device of claim 1, **characterised in that** the broadened portions (82) are equal to one another.
3. The device of claim 1, **characterised in that** the broadened portions (82) have a rounded shape.
4. The device of claim 1, **characterised in that** the transversal section of the terminal conduit (8) is variable along a longitudinal development of the terminal conduit (8).
5. The device of claim 4, **characterised in that** a passage area of the transversal section diminishes in a direction towards an outlet (85) of the terminal conduit (8).
6. The device of claim 1, **characterised in that** the outlet mouth (71) is a hole which is flush with and afforded in a wall of the muffler (70).
7. The device of claim 1, **characterised in that** at a transversal section of the outlet (85), an area of the broadened portions (82) is less than or equal to an area of the outlet mouth (71) of the muffler (70).
8. The device of claim 1, **characterised in that** at a transversal section of inlet (84) of the terminal conduit (8), the area of the broadened portions (82) is greater than or equal to the area of the outlet mouth (71) of the muffler (70).
9. The device of claim 1, **characterised in that** a length (L) of the terminal conduit (8) is greater than or equal to a diameter of the outlet mouth (71) of the muffler (70).

10. The device of claim 1, **characterised in that** the terminal conduit (8) is made from a single axially-developing hollow body.
11. The device of claim 1, **characterised in that** the intermediate choke is defined by two reciprocally-facing longitudinal recesses (81) of the terminal conduit (8).
12. The device of claim 1, **characterised in that** the terminal conduit (8) exhibits a fastening flange (80) which is destined to be fitted to the muffler (70) by interposing of sealing means.

Patentansprüche

1. Vorrichtung zum Abführen von Abgasen von einem Verbrennungsmotor für mobile Arbeitswerkzeuge, die einen Auspufftopf (70) umfasst, der mit mindestens einer Auslassöffnung (71) versehen ist, die in einen Endkanal (8) mündet, durch den die Abgase direkt an eine Außenumgebung abgegeben werden, **dadurch gekennzeichnet, dass** ein Querschnitt des Endkanals (8) zwei verbreiterte Bereiche (82) umfasst, die in Richtung ihrer Breite nebeneinander angeordnet und durch eine mittlere Verengung (83) getrennt sind.
2. Vorrichtung nach Anspruch 1, **dadurch gekennzeichnet, dass** die verbreiterten Bereiche (82) einander gleich sind.
3. Vorrichtung nach Anspruch 1, **dadurch gekennzeichnet, dass** die verbreiterten Bereiche (82) eine gerundete Form haben.
4. Vorrichtung nach Anspruch 1, **dadurch gekennzeichnet, dass** sich der Querschnitt des Endkanals (8) längs eines Verlaufs in Längsrichtung des Endkanals (8) ändert.
5. Vorrichtung nach Anspruch 4, **dadurch gekennzeichnet, dass** eine Durchlassfläche des Querschnitts in Richtung eines Auslasses (85) des Endkanals (8) abnimmt.
6. Vorrichtung nach Anspruch 1, **dadurch gekennzeichnet, dass** die Auslassöffnung (71) ein Loch ist, das bündig in einer Wand des Auspufftopfs (70) erzeugt ist.
7. Vorrichtung nach Anspruch 1, **dadurch gekennzeichnet, dass** bei einem Querschnitt des Auslasses (85) eine Fläche der verbreiterten Bereiche (82) kleiner oder gleich einer Fläche der Auslassöffnung (71) des Auspufftopfes (70) ist.

8. Vorrichtung nach Anspruch 1, **dadurch gekennzeichnet, dass** bei einem Querschnitt des Einlasses (84) des Endkanals (8) die Fläche der verbreiterten Bereiche (82) größer oder gleich der Fläche der Auslassöffnung (71) des Auspufftopfs (70) ist.
9. Vorrichtung nach Anspruch 1, **dadurch gekennzeichnet, dass** eine Länge (L) des Endkanals (8) größer oder gleich einem Durchmesser der Auslassöffnung (71) des Auspufftopfs (70) ist.
10. Vorrichtung nach Anspruch 1, **dadurch gekennzeichnet, dass** der Endkanal (8) aus einem sich axial ausdehnenden einzigen Hohlkörper besteht.
11. Vorrichtung nach Anspruch 1, **dadurch gekennzeichnet, dass** die mittlere Verengung durch zwei einander zugewandte Einbuchtungen (81) des Endkanals (8) definiert wird.
12. Vorrichtung nach Anspruch 1, **dadurch gekennzeichnet, dass** der Endkanal (8) einen Befestigungsflansch (80) aufweist, der dazu bestimmt ist, am Auspufftopf (70) unter Einfügung von Abdichtungsmitteln befestigt zu werden.

Revendications

1. Dispositif pour évacuer des gaz d'échappement d'un moteur à combustion interne pour des outils de travail mobiles, comprenant un silencieux (70) pourvu d'au moins une bouche de sortie (71) qui s'ouvre dans un conduit terminal (8) à travers lequel les gaz d'échappement sont rejetés directement dans un environnement extérieur, **caractérisé en ce qu'une** section transversale du conduit terminal (8) comprend deux parties élargies (82) disposées côte-à-côte dans une direction d'une largeur de celui-ci et séparées par un étranglement intermédiaire (83).
2. Dispositif de la revendication 1, **caractérisé en ce que** les parties élargies (82) sont égales l'une à l'autre.
3. Dispositif de la revendication 1, **caractérisé en ce que** les parties élargies (82) ont une forme arrondie.
4. Dispositif de la revendication 1, **caractérisé en ce que** la section transversale du conduit terminal (8) est variable le long d'un développement longitudinal du conduit terminal (8).
5. Dispositif de la revendication 4, **caractérisé en ce qu'une** zone de passage de la section transversale se réduit dans une direction vers une sortie (85) du conduit terminal (8).

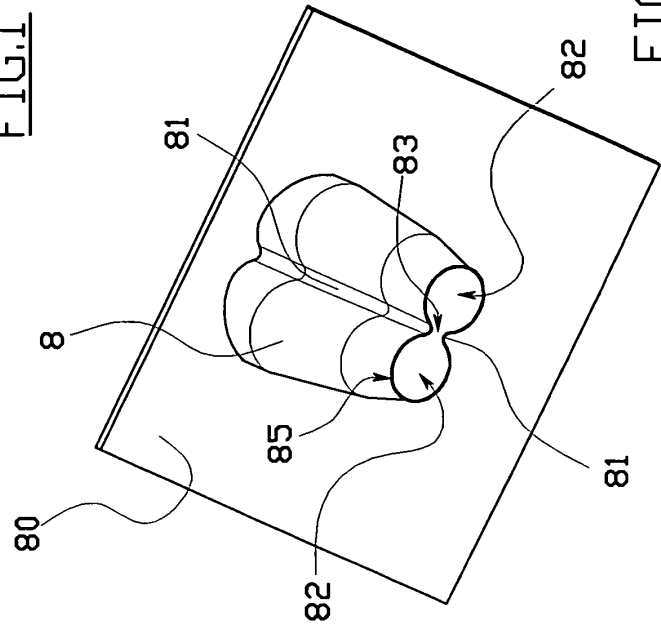
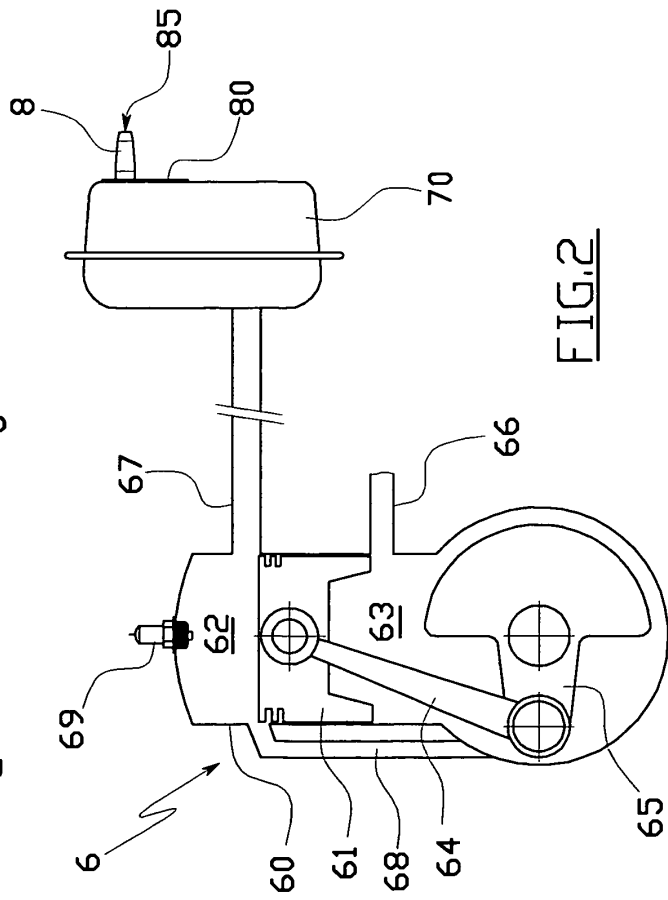
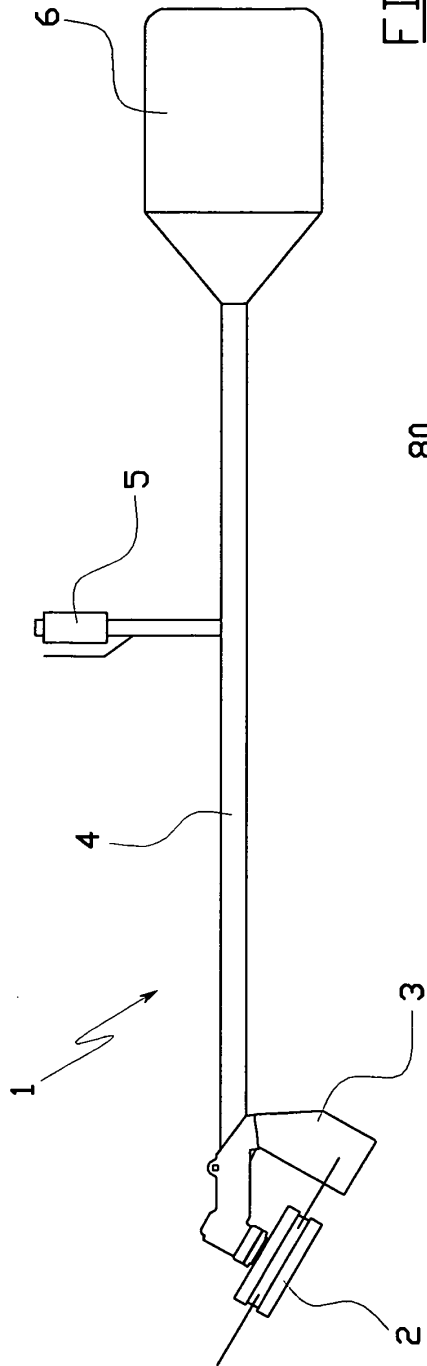
6. Dispositif de la revendication 1, **caractérisé en ce que** la bouche de sortie (71) est un trou qui affleure et est disposé dans une paroi du silencieux (70).
7. Dispositif de la revendication 1, **caractérisé en ce qu'en** correspondance d'une section transversale de la sortie (85), une surface des parties élargies (82) est inférieure ou égale à une surface de la bouche de sortie (71) du silencieux (70). 5
8. Dispositif de la revendication 1, **caractérisé en ce qu'en** correspondance d'une section transversale d'entrée (84) du conduit terminal (8), la surface des parties élargies (82) est supérieure ou égale à la surface de la bouche de sortie (71) du silencieux (70). 10 15
9. Dispositif de la revendication 1, **caractérisé en ce qu'une** longueur (L) du conduit terminal (8) est supérieure ou égale à un diamètre de la bouche de sortie (71) du silencieux (70). 20
10. Dispositif de la revendication 1, **caractérisé en ce que** le conduit terminal (8) est fabriqué à partir d'un unique corps creux se développant axialement. 25
11. Dispositif de la revendication 1, **caractérisé en ce que** l'étranglement intermédiaire est défini par deux retraits longitudinaux réciproquement opposés (81) du conduit terminal (8). 30
12. Dispositif de la revendication 1, **caractérisé en ce que** le conduit terminal (8) présente une bride de fixation (80) qui est destinée à être montée sur le silencieux (70) en interposant des moyens de scellement. 35

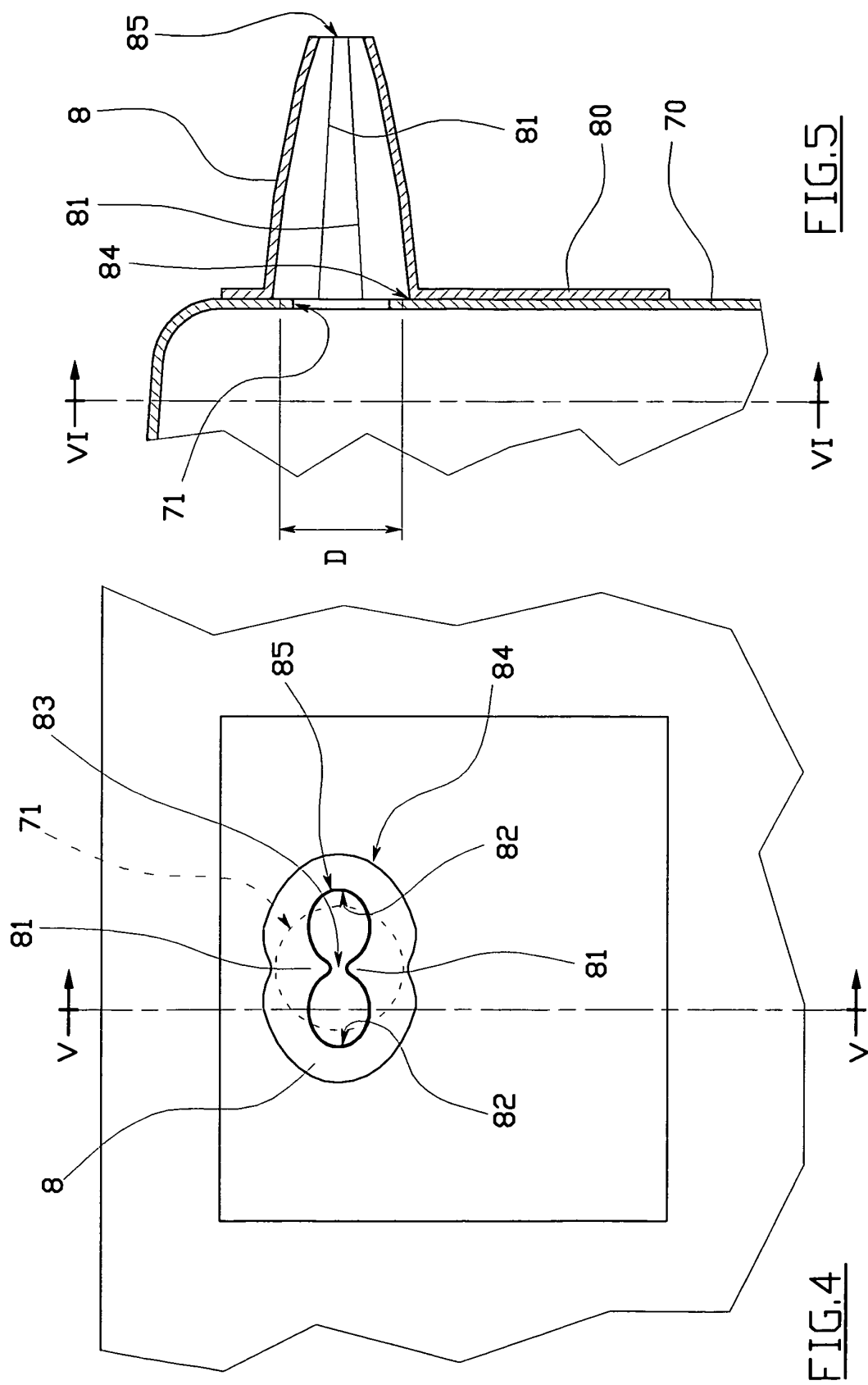
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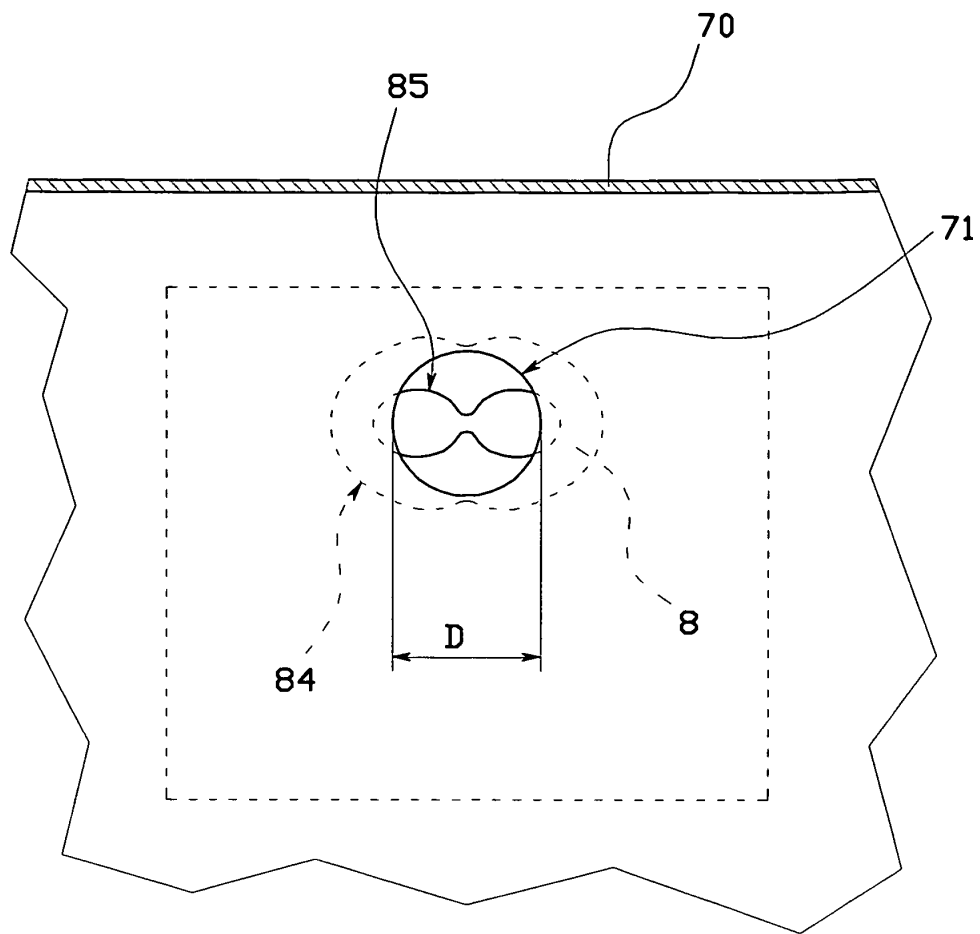


FIG. 6

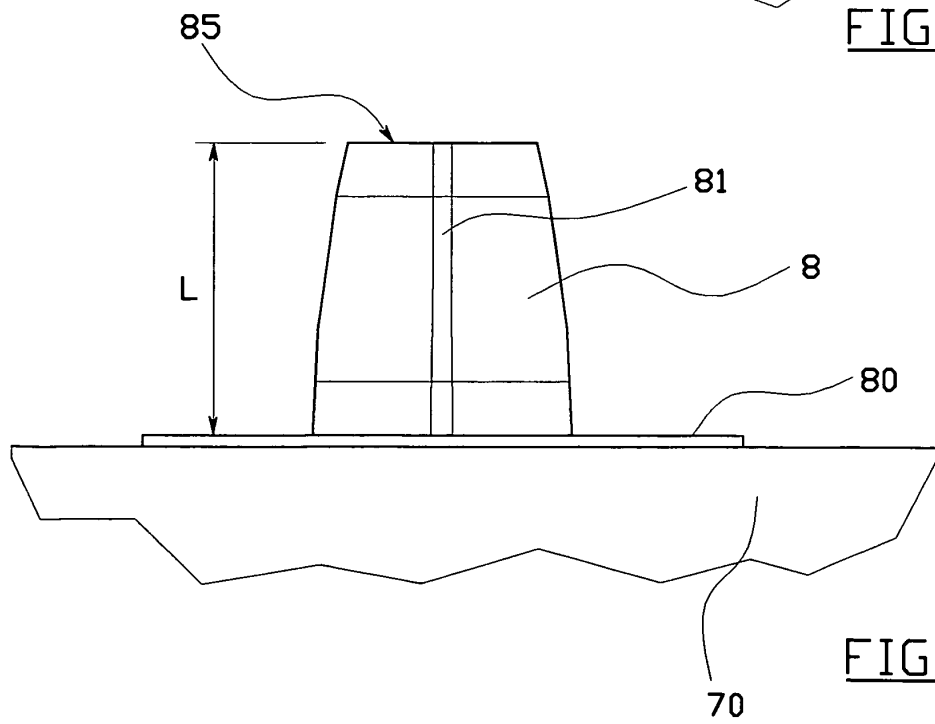


FIG. 7

REFERENCES CITED IN THE DESCRIPTION

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Patent documents cited in the description

- US 6164410 A [0002]