



(11) **EP 2 484 981 A1**

(12) **EUROPEAN PATENT APPLICATION**

(43) Date of publication:
08.08.2012 Bulletin 2012/32

(51) Int Cl.:
F24C 15/20 (2006.01)

(21) Application number: **12154391.2**

(22) Date of filing: **08.02.2012**

(84) Designated Contracting States:
AL AT BE BG CH CY CZ DE DK EE ES FI FR GB GR HR HU IE IS IT LI LT LU LV MC MK MT NL NO PL PT RO RS SE SI SK SM TR
Designated Extension States:
BA ME

(71) Applicant: **FALMEC S.P.A.**
31029 Vittorio Veneto (Treviso) (IT)

(72) Inventor: **Poser, Danilo**
31029 Vittorio Veneto (TV) (IT)

(30) Priority: **08.02.2011 IT UD20110017**

(74) Representative: **Petraz, Gilberto Luigi et al**
GLP S.r.l.
Piazzale Cavedalis 6/2
33100 Udine (IT)

(54) **Suction apparatus**

(57) A suction apparatus (10) comprises a suction body (11) provided with an inlet aperture (19) to take in a stream (F) of air and/or fumes from a first environment, a discharge outlet (18) for the stream (F) taken in, to a second environment, suction means (17) to take in the air and/or fumes and soundproofing means suitable to reduce or eliminate the noise produced at least by the suction means (17) and/or the stream (F) taken in. The soundproofing means comprise a soundproofing body (12) made as a monoblock of soundproofing material, which houses inside itself the suction means (17) and, in substantial correspondence with the inlet aperture (19), has one or more means (29) to separate and divert the stream (F) toward at least the peripheral walls (12c, 12d) of the soundproofing body (12).

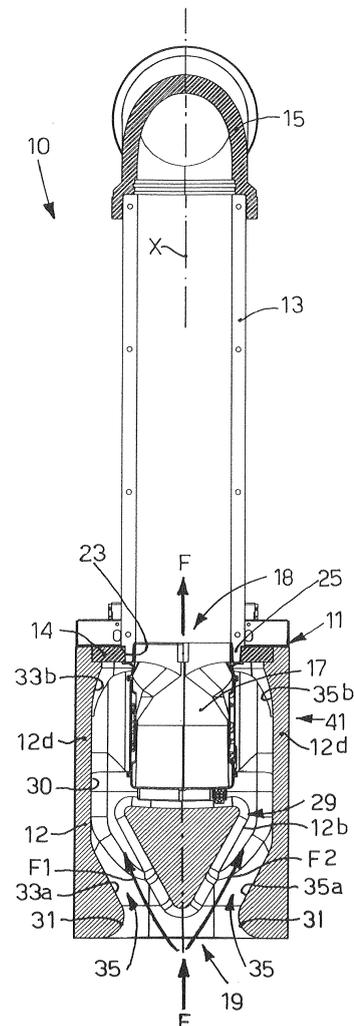


fig. 4

EP 2 484 981 A1

Description**FIELD OF THE INVENTION**

5 **[0001]** The present invention concerns a suction apparatus, for use in a domestic environment, for example a kitchen, or in a restaurant business or suchlike, which is not only configured for an efficacious suction of the fumes but also has great capacity for noise abatement.

BACKGROUND OF THE INVENTION

10 **[0002]** Suction apparatuses for domestic or professional use are known, which comprise means to take in air or fumes from a first environment toward a second environment.

[0003] The suction means are driven by an electric motor connected to a fan to take in the fumes, which can be made to rotate at different speeds and typically produces a noise emission which, for reasons of environmental comfort, it is preferable to abate, completely or at least partly, by using suitable insulating and/or soundproofing materials. Moreover, in this perspective, it is also preferable to reduce, if not abate, the noise produced by vortexes and turbulence generated by the stream of air taken inside the suction body. Although a reduction in the noise is achieved, it is never completely eliminated. Therefore, when the suction body is working, the user can be exposed to a noise which, even if it is of low intensity, is continuous and can be, over a period, annoying.

20 **[0004]** Document US-A-2004/194776 (US'776) describes a method and a system to reduce the noise of a kitchen extractor hood, having a containing body for a motor and a silencer mounted on an upper section of the body.

[0005] Document US'776 indicates that, in order to increase the capacity of abating the noise in extractor hoods in question, above all low frequency noises, it is not sufficient to only use passive devices based on soundproofing material such as polyester or melamine, but it is also necessary to use active reduction devices.

25 **[0006]** Consequently, the silencer in US'776 is configured as a reduction unit both to carry out a passive reduction of the noise, for example being made of or lined with soundproofing material such as polyester or melamine, which reduces frequencies above 1,000 Hz, and also to carry out an active reduction of the noise which reduces frequencies below 1,000 Hz, using microphones and loudspeakers which generate an opposite phase noise with an equal amplitude to the noise emanating through the silencer thereof, in order to dampen it.

30 **[0007]** The containing body of the motor, which can be made of a material which has an acoustic insulation capacity, such as polyester or melamine, can comprise a lining in a similar soundproofing material which is applied and disposed on the internal walls in proximity to the lower inlet aperture provided in the containing body and through which the air is taken in.

35 **[0008]** The lower inlet aperture is shaped with straight and squared walls and edges, with very little or no aerodynamic capacity.

[0009] Moreover, an active second noise reduction unit, similar to the one provided on the silencer, is mounted under the motor, facing toward the lower inlet aperture and used to reduce the low frequency noise generated by the air turbulence and in its turn lined by applied soundproofing lining.

40 **[0010]** The known solution described in US'776 is complex and costly, in particular because of the need to use several active noise reduction units, as well as linings for the passive reduction of the noise. Moreover, the production costs are not negligible either, because it is necessary to assemble the various parts which make up the soundproofing means and apply the soundproofing material in the desired regions and zones.

[0011] Moreover, the known solution is not satisfactory, above all at high suction speeds, because the configuration of the inlet aperture, with low aerodynamic characteristics, generates excessive turbulence and therefore additional noise.

45 **[0012]** Furthermore, in the solution described in US'776, the noise generated by the motor and by the turbulence of the air stream is not completely screened with respect to the lower inlet aperture provided in the containing body and through which the air is taken in, so that the noise can propagate freely through the inlet aperture, thus thwarting the attempt to reduce the overall noisiness of the hood.

50 **[0013]** The prior art document WO-A-2008/090080 (WO'080) describes an extractor hood for a kitchen similar to that provided in US'776, but without the provision of the active noise reduction unit, nor of the upper silencer. In this solution, a suction pipe of a box-like shape comprises internally shaped and perforated walls, associated with linings of soundproofing material with a rockwool base. A suction motor is mounted in the box-like suction pipe, inside another central body which has lateral apertures and a lower chamber through which the air coming from the lower inlet aperture is taken in. On the lower external wall of the central body a soundproofing device of a prism shape, with a triangular base and made from other shaped and perforated walls, is installed transversely, associated with linings of soundproofing material with a rockwool base.

55 **[0014]** The known solution described in WO'080 suffers from similar disadvantages as US'776, because the configuration of the inlet aperture, being square and straight, is not aerodynamic and generates turbulence and other noise.

[0015] Moreover, WO'080 also has high production costs, due also to the need to assemble the various components which carry out the soundproofing function.

[0016] Moreover, in WO'080 too the noise generated by the motor and by the turbulence of the air stream is not completely screened with respect to the lower inlet aperture provided in the box-like suction pipe.

[0017] In addition, the presence of the suction chamber in the central body in WO'080 not only defines a complex and tortuous path of the air taken in but also distances the motor too much from the soundproofing device mounted on the lower external wall of the central body and defines a resonance box which amplifies the noise of the motor and of the stream of turbulent air.

[0018] Purpose of the present invention is to achieve a suction apparatus, typically for domestic use but not excluding professional use, which allows to reduce the noise emissions considerably, produced both by the suction motor and by the air stream taken in, at the same time maintaining a high suction efficiency.

[0019] The Applicant has devised, tested and embodied the present invention to overcome the shortcomings of the state of the art and to obtain these and other purposes and advantages.

SUMMARY OF THE INVENTION

[0020] The present invention is set forth and characterized in the independent claims, while the dependent claims describe other characteristics of the invention or variants to the main inventive idea.

[0021] In accordance with the above purpose, a suction apparatus according to the present invention can be used in domestic environments, in a kitchen for example, or in restaurant activities or suchlike, and comprises a suction body, provided with an inlet aperture to take in a stream of air and/or fumes from a first environment and a discharge outlet to discharge the stream taken in to a second environment. The apparatus of the present invention also comprises air and/or fumes suction means and soundproofing means, suitable to reduce or eliminate the noise produced by the suction means and/or by the stream taken in.

[0022] According to one feature of the present invention, the soundproofing means comprise a soundproofing body made completely as a monoblock of soundproofing material, which houses inside itself the suction means and, in substantial correspondence with the inlet aperture, has one or more means to separate and divert the stream into a plurality of sub-streams directed toward at least the peripheral walls of the soundproofing body.

[0023] According to the present invention the transverse extension of the one or more separation and diversion means is slightly bigger than the transverse extension of the inlet aperture, the peripheral edges of the one or more separation and diversion means, in cooperation with the peripheral edges of the inlet aperture, functioning as a whole as a screen against the noise emission with respect to the inlet aperture, so that there is no direct communication at least between the source of noise of the suction means and the environment outside the inlet aperture.

[0024] In this way, the present invention allows a considerable abatement of the noise, without, however, having to resort to costly and complex active noise abatement devices.

[0025] Furthermore, contrary to the state of the art, the present invention allows reduced assembly costs, together with a high quality and repeatability of soundproofing in production because, by making the soundproofing body as a monoblock, or as a single body without substantial interruption of material between the parts which constitute it, including also the one or more means to separate and divert the stream, one avoids the manual assembly steps of the various components which perform the soundproofing function, which in themselves are not without uncertainties and possible errors or inaccuracies.

[0026] On the other hand, according to the present invention, preliminarily developing the shape, possibly by means of simulation and modeling using an electronic processor, and suitably sizing the soundproofing body consisting of a monoblock, the repeatability and correct positioning of the means which perform the soundproofing function are guaranteed.

[0027] In some forms of embodiment, the soundproofing body is shaped to define a first external part that extends between the inlet aperture and the discharge outlet, and a second part inside the first part, disposed in substantial correspondence with the inlet aperture. The first external part comprises peripheral walls that delimit inside them a suction chamber. The suction chamber in turn is formed by a first section, in proximity to the inlet aperture, and a second section, downstream of the first section in a main direction of travel of the stream of air and fumes, and upstream of the discharge outlet, in which the suction means are housed.

[0028] The second internal part is provided inside the first section, immediately downstream of the inlet aperture and is shaped to act as means to separate and divert the main stream entering through the inlet aperture in internal suction sub-streams. The second internal part which acts as a separation and diversion mean cooperates with the peripheral walls of the first part so as to define passage channels, diverging toward the outside with respect to the main direction of travel of the stream. The passage channels are configured to selectively receive the suction sub-streams and to convey them at least toward the soundproofing material that forms the peripheral walls, so as to reduce and/or eliminate the noise emissions of the suction body.

[0029] In accordance with one form of embodiment of the present invention, in proximity to the inlet aperture the peripheral walls comprise convex regions which define a gradual and desired narrowing in section thereof, suitable to channel the stream of air and/or fumes toward the second internal part which functions as a separation and diversion mean, immediately downstream of the inlet aperture. The curve defined by the convexity of the inlet walls is advantageously suitable to prevent the generation of turbulence and vortices in the stream, reducing the noise emissions.

[0030] According to another form of embodiment, the second internal part which functions as a separation and diversion mean is substantially shaped like a prism with its axis transverse to the direction of flow of the stream taken in, having an edge facing toward the inlet aperture defined by associated converging walls that determine the separation and diversion of the stream taken in into sub-streams.

[0031] In some forms of embodiment, the separation and diversion mean extends longitudinally between two opposite peripheral walls of the first external part of the soundproofing body defining, in the suction chamber, at least a first passage channel, configured to selectively receive a first sub-stream, and a second passage channel, configured to selectively receive a second sub-stream. The two channels thus defined have all the walls made of soundproofing material, and are therefore suitable to absorb the noise of the channeled streams.

[0032] According to one form of embodiment, in a first segment that develops in the first section of the suction chamber, the first passage channel and the second passage channel are inclined with respect to the main direction of the stream by an angle comprised between about 20° and about 40°, preferably between about 25° and about 35°.

[0033] According to another form of embodiment, each of the passage channels has a cross section that progressively reduces in the direction of travel of the stream taken in, from the inlet aperture toward the discharge outlet, that is, larger in size near the inlet aperture and smaller toward the second section of the suction chamber.

[0034] According to another form of embodiment, the convex regions of the peripheral walls delimit a maximum narrowing in section of the suction chamber in proximity with the inlet aperture and substantially flush with the edge of the separation and diversion mean of the stream taken in.

[0035] In some forms of embodiment, the reciprocal disposition of the second internal part, that functions as a separation and diversion mean of the stream, and of the peripheral walls that delimit the inlet aperture, determines a complete screening effect of the noise emissions, particularly the noise generated from inside the suction body, so that there is no direct sound communication between the suction means and the inlet aperture. Therefore, any noise emission emitted by the suction means cannot exit from the inlet aperture without being intercepted by the soundproofing material, hence without being at least partly attenuated by it.

[0036] In particular, the transverse extension of the separation and diversion mean of the stream is slightly greater than the transverse extension of the inlet aperture, so that there is no direct communication at least between the source of the noise of the suction means and the inlet aperture, so that the noise emission is intercepted by the soundproofing material.

[0037] In some forms of embodiment where the separation and diversion mean is a prism, the lateral wall facing toward the suction means is slightly longer than the inlet aperture, and is aligned with the latter with respect to the main direction of the stream, so as to obtain the desired masking effect of the noise.

[0038] According to another form of embodiment, the suction means, cooperating with the peripheral walls, define a second segment of each of the passage channels that develops inside the second section of the suction chamber. The second segment of each of the passage channels extends in a direction substantially parallel to the main direction of travel of the stream in the suction body.

[0039] According to another form of embodiment, the soundproofing material which makes up the shaped monoblock is based on flexible expanded polyurethane agglomerate, in some variants with a density comprised between about 100 g/dm³ and 200 g/dm³, preferably between about 160 g/dm³ and 180 g/dm³. The latter is a material with good soundproofing qualities and suitable to achieve a self-bearing structure which can support its own weight without deforming or breaking.

[0040] In some forms of embodiment, the suction apparatus also comprises a discharge pipe for the stream taken in and an elbow connection, made of the same material that forms the soundproofing body and also advantageously made as a monoblock of soundproofing material.

[0041] The present invention also concerns a method to take in a stream of air and/or fumes using a suction apparatus having a suction body, provided with an inlet aperture to take in the stream of air and/or fumes from a first environment, a discharge outlet to discharge the stream taken in toward a second environment, means to take in the air and/or fumes and soundproofing means suitable to reduce or eliminate the noise produced at least by the suction means and/or the stream taken in.

[0042] The method comprises at least a first step in which a stream of air is taken in by the suction body through the inlet aperture, a second step in which the stream is divided into a plurality of sub-streams, which are selectively directed, advantageously in passage channels of the suction body, toward desired soundproofing means, suitable to absorb the noise, and a third step in which the sub-streams, passing through the suction means, are emitted through the discharge outlet. The method according to the present invention provides to prevent the direct communication at least between the source of the noise of the suction means and the inlet aperture using as a screen the transverse extension of the

one or more separation and diversion means slightly bigger than the transverse extension of the inlet aperture.

BRIEF DESCRIPTION OF THE DRAWINGS

5 [0043] These and other characteristics of the present invention will become apparent from the following description of a preferential form of embodiment, given as a non-restrictive example with reference to the attached drawings wherein:

- fig. 1 is a perspective view from above of a suction apparatus according to the present invention;
- fig. 2 is another perspective view from below of the suction apparatus in fig. 1;
- 10 - fig. 3 is a section of the suction apparatus in fig. 1;
- fig. 4 is another section of the apparatus in fig. 1;
- fig. 5 is a partial detail of the section of fig. 4.

15 [0044] To facilitate comprehension, the same reference numbers have been used, where possible, to identify identical common elements in the drawings.

DETAILED DESCRIPTION OF A PREFERENTIAL FORM OF EMBODIMENT

20 [0045] With reference to fig. 1, a suction apparatus 10 according to the present invention comprises a suction body 11 connected to a discharge pipe 13 to discharge the fumes, which in turn is connected to an elbow connection 15, to take in the air and/or fumes from a first environment, for example a kitchen, to a second environment, for example outside the house. The suction body 11 may be coupled, as needed, to various known types of extractor hoods, not shown here.

[0046] The suction apparatus 10 is for example suitable to be installed above a cooker or suchlike, to suck in and then remove the fumes and vapors produced, for example during cooking.

25 [0047] The suction body 11 comprises an external casing 20, for example made of metal such as zinc-plated sheet, and has an inlet aperture 19 to suck in a stream of air and/or fumes, and a discharge outlet 18, associated in this case with the discharge pipe 13.

[0048] The suction body 11 comprises inside itself an aspirator, also called conveyor 17 (figs. 3 and 4), of a known type, housed in a corresponding suction chamber 30, fed by a suitable electric motor, not shown, and suitable to suck in the fumes from the inlet aperture 19, and to expel them to the discharge pipe 13.

30 [0049] In particular the suction body 11 comprises a soundproofing body 12 formed by a monoblock of soundproofing material, advantageously made by molding. The soundproofing material which makes up the shaped monoblock is based on flexible expanded polyurethane agglomerate, with a density comprised between about 100 g/dm³ and 200 g/dm³, preferably between about 160 g/dm³ and 180 g/dm³, which guarantees an optimum compromise between soundproofing capacity and self-bearing structural properties. In particular, the structure of the open-cell material allows to disperse and absorb the sound waves in a wide range of frequencies. Furthermore, it is a material suitable for shaping by means of molding processes.

35 [0050] Advantageously, the discharge pipe 13 and the elbow connection 15 are also made with the same soundproofing material as above, and actively contribute to reducing the noise exiting from the suction body 11. In particular, the elbow connection 15 has a section equal to that of the discharge pipe 13, and a curvature suitable to limit to the utmost the noisiness of the stream of air, at the same time reducing load losses to a minimum. The discharge pipe 13 and the elbow connection 15 may advantageously be rendered substantially impermeable, for example by applying a lining or covering that is not permeable to air, since the porosity of the soundproofing material of which they are made would make them permeable to the air expelled from the aspirator 17.

40 [0051] The soundproofing body 12 is shaped so as to define a first external part 12a (fig. 5), which extends between the inlet aperture 19 and the discharge outlet 18, and a second part 12b, inside the first part 12a, disposed in substantial correspondence with the inlet aperture 19.

[0052] The first part 12a comprises peripheral walls 12c, 12d, in particular a pair of front peripheral walls 12c and a pair of lateral peripheral walls 12d, disposed mutually opposite, which delimit inside them the suction chamber 30 (figs. 3, 4 and 5). The suction chamber 30 is delimited at the upper part by an upper closing element or lid 14, advantageously made of the same soundproofing material as the soundproofing body 12, on which upper closing element 14 the discharge outlet 18 is made.

45 [0053] In particular, the upper closing element 14 has a through aperture 23 associated with the discharge outlet 18, which is shaped so as to house a terminal portion 25 of the discharge pipe 13. The terminal portion 25 and the through aperture 23 are reciprocally mating to achieve a same-shape coupling. The same-shape coupling substantially determines a reliable fluidic seal, as well as a resistant mechanical constraint, so that there is no passage or leakage of air and therefore no propagation of the noise. Consequently, the solution of attaching the discharge pipe 13 and the upper closing element 14 through same-shape coupling further contributes to limiting the noisiness of the suction apparatus

10 according to the present invention.

[0054] The main function of the upper closing element 14 is to separate the aspirator 17 mechanically from the external casing 20 in order to eliminate possible transmissions of vibrations between the latter, and also to function as an absorption for and a barrier against the propagation of the noise. The aspirator 17 determines a stream of air F and/or fumes taken in from the inlet aperture 19 (at the bottom in fig. 5) to the discharge outlet 18 (at the top in fig. 5).

[0055] Following the path of the stream F taken in (fig. 4), the suction chamber 30 has a first section 39 in substantial correspondence with the inlet aperture 19, and a second section 41 downstream of the first section 39 in a main direction X in which the stream F travels, which in this specific solution is also the axis of symmetry of the suction chamber 30, and upstream of the discharge outlet 18, in which a seating 37 is provided in which the aspirator 17 is housed.

[0056] The second part 12b is provided in the first section 39 and comprises a stream deflector 29, in a single piece with the remaining soundproofing body 12, which separates the main stream F entering through the inlet aperture 19 into sub-streams F1, F2 (fig. 4).

[0057] Even if in this part of the description and in fig. 4, two sub-streams F1 and F2 are shown, this is not to be taken as restrictive of the field of protection of the present invention, since by suitably shaping and modifying the deflector 29 it will also be possible to define more than two sub-streams, with the provision of directing them preferentially toward the soundproofing walls of the soundproofing body 12 in order to reduce noisiness.

[0058] In particular, the deflector 29, cooperating with the peripheral walls 12c, 12d of the first part 12a, defines passage channels 33, 35 diverging toward the outside, that is, toward the inlet aperture 19, and configured to selectively receive the sub-streams F1, F2 and to convey them at least toward the soundproofing material which forms the peripheral walls 12c, 12d, so as to reduce and/or eliminate the noise emissions of the suction body 11.

[0059] In some specific forms of embodiment, given as examples but not restrictive of the present invention, the stream deflector 29 made of soundproofing material is substantially shaped like a prism, in this case with a triangular base and disposed with its axis perpendicular to the direction X, extending between the walls of a desired pair of peripheral walls 12c or 12d, in this case between the walls of the pair of front peripheral walls 12c (figs. 3, 4 and 5).

[0060] Advantageously, the deflector 29 has rounded or beveled edges to determine an optimum aerodynamic behavior and to promote the passage of the stream F taken in and to reduce the formation of vortices and turbulence that would generate noise.

[0061] A lateral wall 28a, upper during normal use, of the prism which in this case, given as a non-restrictive example of the invention, forms the deflector 29, is disposed facing toward the discharge outlet 18, closely adjacent to the aspirator 17, although the minimum space necessary for components or protruding parts of the aspirator 17 is guaranteed, so as to intercept directly the noise emission of the above (fig. 5).

[0062] One edge 26 of the prism, in a position opposite the lateral wall 28a and defined by the remaining two lateral walls 28b, 28c, in normal use converging downward, faces toward the inlet aperture 19 of the suction body 11, and near the latter, to function as a separator of the stream F.

[0063] The length of the lateral wall 28a is slightly greater than the length of the inlet aperture 19, so that there is no direct sound communication between the source of the noise, represented by the aspirator 17, and the inlet aperture 19, thus reducing the overall noise.

[0064] As can be seen in figs. 4 and 5, the pair of lateral peripheral walls 12d, in proximity to the inlet aperture 19, has convex regions 31, advantageously rounded and beveled, to obtain an optimum aerodynamic behavior, with the purpose of reducing turbulence and vortices; facing each other, they delimit the inlet aperture 19 and define a narrowing in the cross section of the suction chamber 30 in proximity with the inlet aperture 19 (figs. 4 and 5), which promotes the channeling of the stream F toward the deflector 29.

[0065] In particular, the transverse extension of the deflector 29, in this case given as a non-restrictive example of the invention, with reference to the length or distance between the peripheral edges of the lateral wall 28a, is slightly greater than the cross section of the inlet aperture 19, defined substantially by the convex regions 31, so as to define all in all a physical screen against the noise coming from the aspirator 17 with respect to the environment outside the inlet aperture 19. In particular, the peripheral edges of the lateral wall 28a of the deflector 29 cooperate, overlapping in height, with the convex regions 31 which delimit the peripheral edges of the inlet aperture 19, defining overall the desired screening effect.

[0066] The remaining segment of the lateral peripheral walls 12d above the convex regions 31 has a thickness that gradually diminishes until it is stabilized at a predefined value in the second section 41 of the suction chamber 30.

[0067] In this case, the lateral peripheral walls 12d identified above and the deflector 29 define a first passage channel 33 and a second passage channel 35 suitable to receive respectively the sub-streams F1 and F2 into which the main stream F has been divided at inlet (fig. 4) by the deflector 29.

[0068] The channels 33 and 35, in proximity to the inlet aperture 19, have a first segment 33a, 35a which has a section that narrows as it proceeds in the direction of the sub-streams F1 and F2, diverging and inclined by an angle of about 30° with respect to the direction X.

[0069] In the second section 41 of the suction chamber 30, above the stream deflector 29, the passage channels 33

and 35 have a second segment 33b, 35b, delimited externally by the peripheral walls 12c and 12d, and internally by the aspirator 17, which have a substantially vertical development and parallel to direction X (figs. 4 and 5).

[0070] The aspirator 17, of a known type, is installed in the seating 37 (figs. 3, 4 and 5) and comprises two suction apertures for the air to enter; they are positioned vertically and respectively face toward the first passage channel 33 and the second passage channel 35.

[0071] The sub-streams F1 and F2 of the air and/or fumes in the passage channels 33 and 35 are sucked in by the aspirator 17 and are then thrust inside the discharge pipe 13 through the discharge outlet 18 located in the upper part of the aspirator 17 (figs. 3 and 4).

[0072] Advantageously, the aspirator 17 is mounted above the deflector 29 (fig. 4) in great proximity to the lateral wall 28a, upper during use, of the deflector 29. In this way, the noise emitted from the lower part of the aspirator 17 is intercepted and reduced immediately by the lateral soundproofing wall 28a, and moreover, the reduced distance in the reciprocal positioning prevents phenomena of amplification and reverberation of the noise. Furthermore, with this disposition the air is sucked in laterally by the aspirator 17, following the shortest and most direct route, after it has passed through the passage channels 33, 35, preventing the formation of tortuous paths of the air taken in, and hence the formation of unwanted turbulence and noisiness.

[0073] It is clear that modifications and/or additions of parts may be made to the suction apparatus 10 as described heretofore, without departing from the field and scope of the present invention.

[0074] For example, according to a variant, the separation and diversion means, always in a single piece with the soundproofing body 12, instead of being made as the deflector 29 described above, can be formed by two or more separation and diversion elements, shaped with different geometric forms according to needs, for example as an upturned prism, beveled, rounded at the edges, upturned wedge, or other, so as to define the separation of the stream into more than two sub-streams, for example three, four or more sub-streams, which are directed toward respective channels defined by the separation and diversion elements themselves, suitably distanced and reciprocally positioned. In this variant too, the present invention therefore provides to direct the plurality of sub-streams in a desired manner toward the soundproofing walls, in order to reduce noise.

EXPERIMENTAL DATA

[0075] Applicant has carried out experiments to compare the noise emissions, with the same functioning conditions, of the suction apparatus 10 according to the present invention and a known suction apparatus without means for reducing noise. The measurements were carried out according to the international standard CEI IEC 60704-2-13:2000.

[0076] In particular, the experiments were carried out using a suction apparatus 10 according to the present invention, but with a discharge pipe and elbow connection made of stainless steel (sample A), and also with a suction apparatus 10 according to the present invention with a discharge pipe and elbow connection made of soundproofing material, in this case flexible expanded polyurethane agglomerate, (sample B).

[0077] The suction motor of the suction apparatuses 10 used in the experiments had a nominal suction capacity of 800 m³/hr.

[0078] The experiments were carried out at four different suction speeds, commonly available in the suction apparatuses in question.

[0079] The suction apparatus 10 according to the present invention showed, in percentage terms, an average advantage in reducing noise intensity comprised between 20% and 30% compared with the apparatus that did not have the noise reduction means.

[0080] Furthermore, Applicant also carried out experiments to compare noise emissions, where possible with the same functioning conditions, of the suction apparatus 10 according to the present invention using sample B, with two known suction apparatuses (samples C and D) and available on the market, comprising noise reduction means according to the state of the art, where possible comparing homogeneous or comparable IEC flow rates of air taken in (m³/hr) and similar or comparable powers of the corresponding suction motors.

[0081] The measurements, carried out according to the international standards referred to above, showed an average advantage in reducing noise intensity of the suction apparatus 10 according to the present invention comprised between 3% and 10% in the event of equal flow rates, as will be explained in more detail hereafter.

[0082] The following Table 1 shows the experimental data relating to the tests carried out with sample A. The Table shows sound power values (noise), pressure and flow rate of the air taken in, with the corresponding measurement units.

Table 1

	Speed 4	Speed 3	Speed 2	Speed 1
Sound power (dba)	53.3	45.2	40.1	34.2

EP 2 484 981 A1

(continued)

	Speed 4	Speed 3	Speed 2	Speed 1
Pressure (Pa)	520	410	310	190
IEC Flow rate (m ³ /hr)	690	490	345	220

[0083] The following Table 2 shows the experimental data relating to the tests carried out with sample B, compared with the data obtained for samples C and D. The Table shows sound power values (noise), pressure and flow rate of the air taken in, with the corresponding measurement units. Where the flow rate data were not homogeneous for the purposes of the comparison, the Table indicates the difference in the corresponding value of sample B according to the present invention with respect to samples C and D.

Table 2

	Speed 4	Speed 3	Speed 2	Speed 1	
Sample B	Sound power (dbA)	51	43.2	38.4	33.2
	Pressure (Pa)	520	410	310	190
	IEC Flow rate (m ³ /hr)	690	490	345	220
Comparison with Sample C	Sample B noise less than about 3.2%	Sample B noise less than about 9.5%	N/A	N/A	
	Sample B Flow rate greater than + 30 m ³ /hr	Sample B Flow rate greater than + 20 m ³ /hr			
Comparison with Sample D	Sample B noise less than about 6%	N/A	N/A	N/A	
	Same Flow rate				

[0084] From the data in Table 1 and the comparison in Table 2, it is clear how the present invention represents an improvement in terms of reducing the noise, compared with the state of the art.

[0085] In general, it can be seen that the technical effect of noise reduction shown above is further improved by using the suction apparatus 10 according to the present invention with a discharge pipe 13 and elbow connection 15 made of soundproofing material.

[0086] In the comparison with sample C, an obvious reduction in noise can be seen for sample B of the present invention by 9.5% at speed 3, and 3.2% at speed 4, also taking into account that sample B had a greater flow rate by respectively 20 m³/hr and 30 m³/hr compared with the flow rate value seen for sample C at speeds 3 and 4. It is therefore reasonable to expect that, given the same flow rate, the reduction obtainable with sample B will be even greater compared with sample C.

[0087] On the contrary, with regard to the comparison sample B - sample D, the advantage of the present invention is clear: with the same flow rate at speed 4, the noise is reduced by 6%.

Claims

1. Suction apparatus comprising a suction body (11) provided with an inlet aperture (19) to take in a stream (F) of air and/or fumes from a first environment, a discharge outlet (18) for the stream (F) taken in, to a second environment, suction means (17) to take in the air and/or fumes and soundproofing means able to reduce or eliminate the noise produced at least by the suction means (17) and/or the stream (F) taken in, **characterized in that** said soundproofing means comprise a soundproofing body (12) made as a monoblock of soundproofing material, which houses inside itself the suction means (17) and, in substantial correspondence with the inlet aperture (19), has one or more means (29) to separate and divert the stream (F) toward at least the peripheral walls (12c, 12d) of the soundproofing body (12), wherein the transverse extension of said one or more separation and diversion means (29) is slightly bigger than the transverse extension of the inlet aperture (19), the peripheral edges of said one or more separation and diversion means (29), in cooperation with the peripheral edges of said inlet aperture (19), acting overall as a screen for the emission of noise with respect to said inlet aperture (19), so that there is no direct communication at least

between the source of the noise of said suction means (17) and the environment outside said inlet aperture (19).

2. Apparatus as in claim 1, **characterized in that** the suction means (17) are disposed above and in great proximity to said one or more separation and diversion means (29) with respect to the direction of the stream (F) taken in.
- 5
3. Apparatus as in claim 1 or 2, **characterized in that** said soundproofing body (12) is shaped to define a first external part (12a) that extends between the inlet aperture (19) and the discharge outlet (18), and a second part (12b) inside the first part (12a), disposed in substantial correspondence with the inlet aperture (19), wherein the first part (12a) comprises peripheral walls (12c, 12d) that delimit inside them a suction chamber (30) formed by a first section (39) in substantial correspondence with the inlet aperture (19), and a second section (41) downstream of the first section (39) and upstream of the discharge outlet (18), with respect to a main direction (X) in which said stream (F) travels in the suction body (11), in which suction chamber (30) the suction means (17) are housed, said second part (12b) being provided inside said first section (39) immediately downstream of the inlet aperture (19), which is shaped so as to function as a mean (29) to separate and divert the stream (F) into a plurality of suction sub-streams (F1, F2), said second part (12b) that functions as a separation and diversion mean (29) cooperating with the peripheral walls (12c, 12d) of the first part (12a) so as to define passage channels (33, 35) diverging with respect to the main direction (X) of travel of said stream (F), the passage channels (33, 35) being configured to selectively receive the suction sub-streams (F1, F2) and to convey them at least toward the soundproofing material that forms said peripheral walls (12c, 12d), so as to reduce and/or eliminate the noise emissions of the suction body (11).
- 10
20
4. Apparatus as in claim 3, **characterized in that**, in proximity to said inlet aperture (19), said peripheral walls (12c, 12d) comprise convex regions (31) which delimit the peripheral edges of the inlet aperture (10) and able to define a gradual and desired narrowing in section of the inlet aperture (19) in order to channel said stream (F) toward said separation and diversion mean (29) disposed immediately downstream of the inlet aperture (19).
- 25
5. Apparatus as in claim 4, **characterized in that** the convex regions (31) are shaped rounded or beveled.
6. Apparatus as in claims 3, 4 or 5, **characterized in that** said second part (12b) that functions as a separation and diversion mean (29) has a substantially prism shape with an axis transverse to the direction of travel of the stream (F) taken in, having an edge (26) facing toward the inlet aperture (19) defined by associated convergent walls (28b, 28c) that determine the effect of separating and diverting the stream (F) into sub-streams (F1, F2).
- 30
7. Apparatus as in claim 6, **characterized in that** the substantially prism shaped separation and diversion mean (29) extends longitudinally between two opposite peripheral walls (12c, 12d) of the first part (12a) of the soundproofing body (12), defining in the suction chamber (30) at least a first passage channel (33), configured to selectively receive a first sub-stream (F1), and a second passage channel (35), configured to selectively receive a second sub-stream (F2).
- 35
8. Apparatus as in claim 7, **characterized in that** said first passage channel (33) and said second passage channel (35), in a first segment (33a, 35a) that develops in the first section (39) of said suction chamber (30), are inclined with respect to said direction (X) by an angle comprised between about 20° and about 40°.
- 40
9. Apparatus as in any claim from 3 to 8, **characterized in that** each of said passage channels (33, 35) has a cross section that progressively reduces in the direction (X) of travel of the stream (F) taken in, toward the discharge outlet (18).
- 45
10. Apparatus as in claims 4 and 6, **characterized in that** said convex regions (31) of said peripheral walls (12c, 12d) delimit a maximum narrowing in section of the suction chamber (30) in proximity with the inlet aperture (19) and substantially flush with said edge (26) of the separation and diversion mean (29).
- 50
11. Apparatus as in any claim from 3 to 10, **characterized in that** the reciprocal disposition of the second part (12b) that functions as a separation and diversion mean (29) and the peripheral walls (12c, 12d) that delimit the inlet aperture (19), determines a complete screening effect of the noise emissions of said suction means (17).
- 55
12. Apparatus as in claims 6 or 6 and 11, **characterized in that**, in the prism shaped separation and diversion mean (29), the lateral wall (28a) facing toward the suction means (17) is slightly longer in length than the inlet aperture (19), and is aligned with the inlet aperture (19) with respect to the direction (X).

13. Apparatus as in claim 8, **characterized in that** the suction means (17) define, in cooperation with the peripheral walls (12c, 12d), a second segment (33b, 35b) of each of the passage channels (33, 35) which develops along the second section (41) of the suction chamber (30), extending in a direction substantially parallel to said direction (X).
- 5 14. Apparatus as in any claim hereinbefore, **characterized in that** said soundproofing material is based on flexible expanded polyurethane agglomerate.
- 10 15. Apparatus as in claim 14, **characterized in that** said flexible expanded polyurethane agglomerate has a density comprised between about 100 g/dm³ and 200 g/dm³, preferably between about 160 g/dm³ and 180 g/dm³.
- 15 16. Apparatus as in any claim hereinbefore, **characterized in that** it also comprises a discharge pipe (13), made of the same material that forms said soundproofing body (12) and also made as a monoblock that extends from the discharge outlet (18).
- 20 17. Apparatus as in claim 16, **characterized in that** it also comprises an elbow connection (15), substantially with the same section as said discharge pipe (13), and connected at the upper part to the latter, consisting of the same material that forms said soundproofing body (12) and also made as a monoblock.
- 25 18. Method to take in a stream (F) of air and/or fumes using a suction apparatus having a suction body (11), provided with an inlet aperture (19) to take in a stream (F) of air and/or fumes from a first environment, a discharge outlet (18) for the stream (F) taken in, to a second environment, suction means (17) to take in the air and/or fumes and soundproofing means able to reduce or eliminate the noise produced at least by the suction means (17) and/or the stream (F) taken in, comprising at least a first step in which a stream (F) of air is taken in by said suction body (11) through said inlet aperture (19), **characterized in that** it also comprises a second step in which said stream (F) is divided, by means of one or more separation and diversion means (29) into a plurality of sub-streams (F1, F2), which are selectively directed toward desired soundproofing means (12), suitable to absorb the noise, and a third step in which said sub-streams (F1, F2), passing through said suction means (17), are emitted through said discharge outlet (18), wherein it is provided to prevent the direct communication at least between the source of the noise of said suction means (17) and said inlet aperture (19) using as a screen the transverse extension of said one or more separation and diversion means (29) slightly bigger than the transverse extension of the inlet aperture (19).
- 30

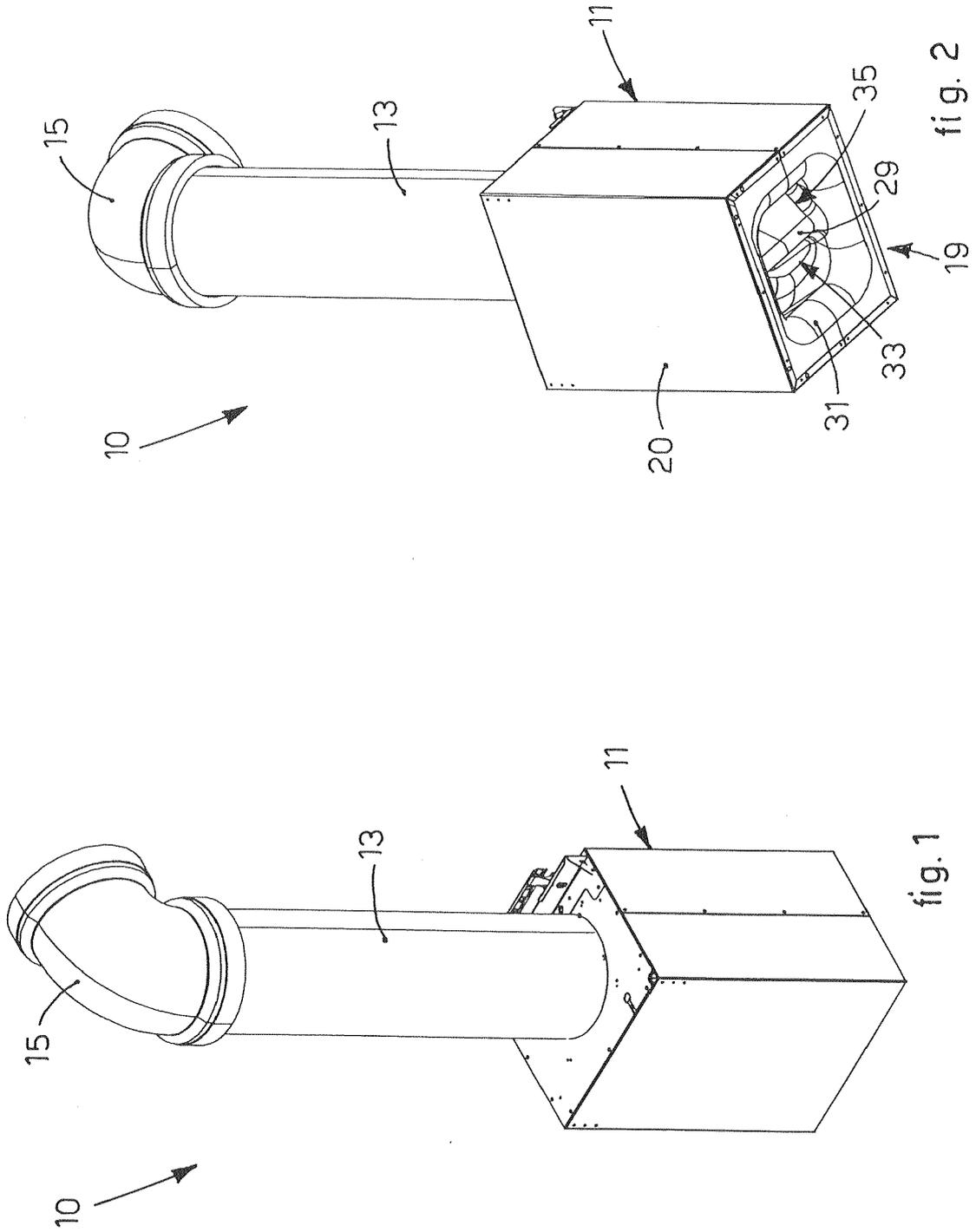
35

40

45

50

55



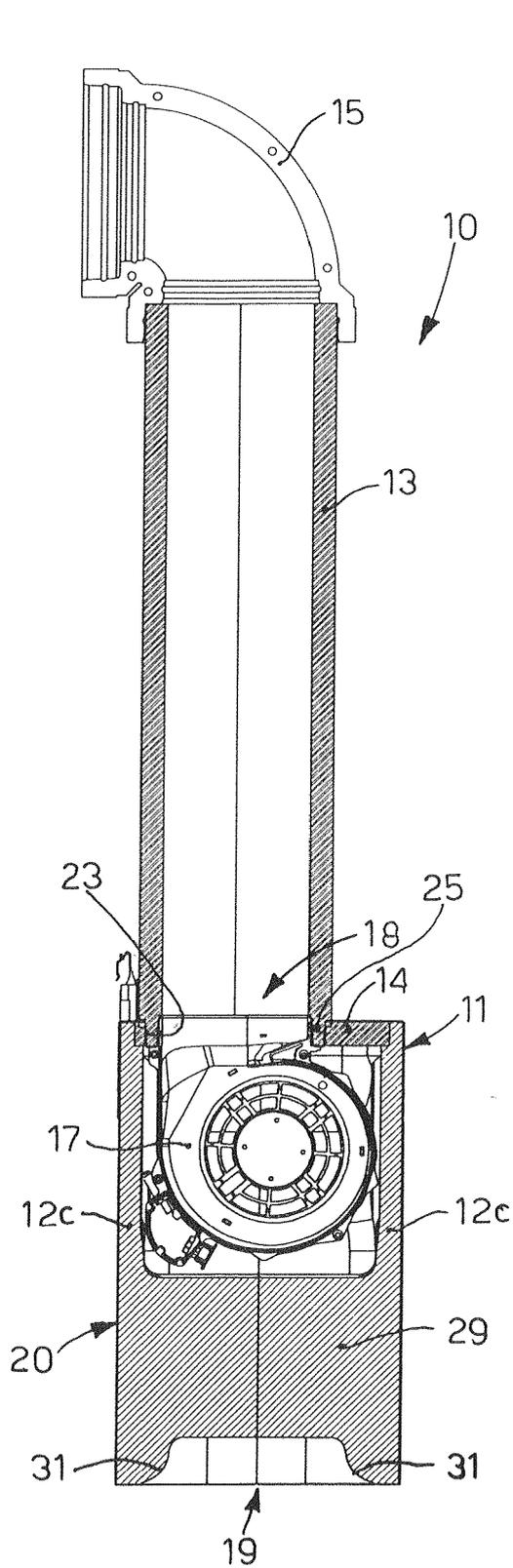


fig. 3

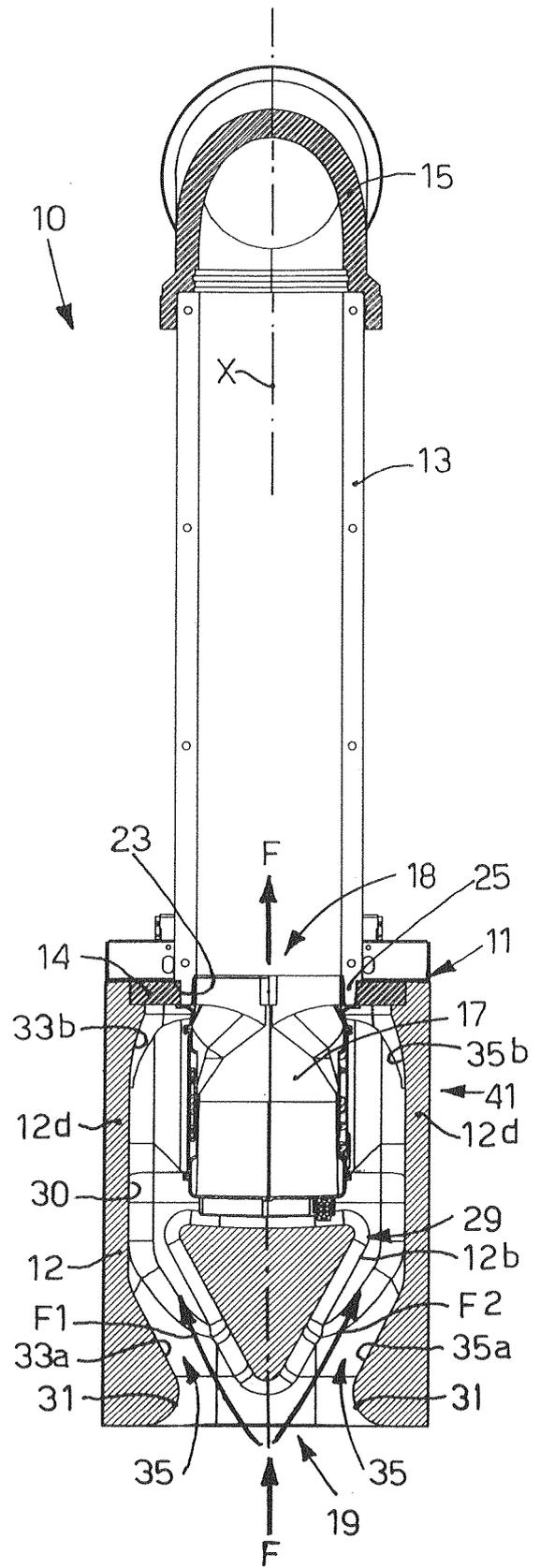


fig. 4

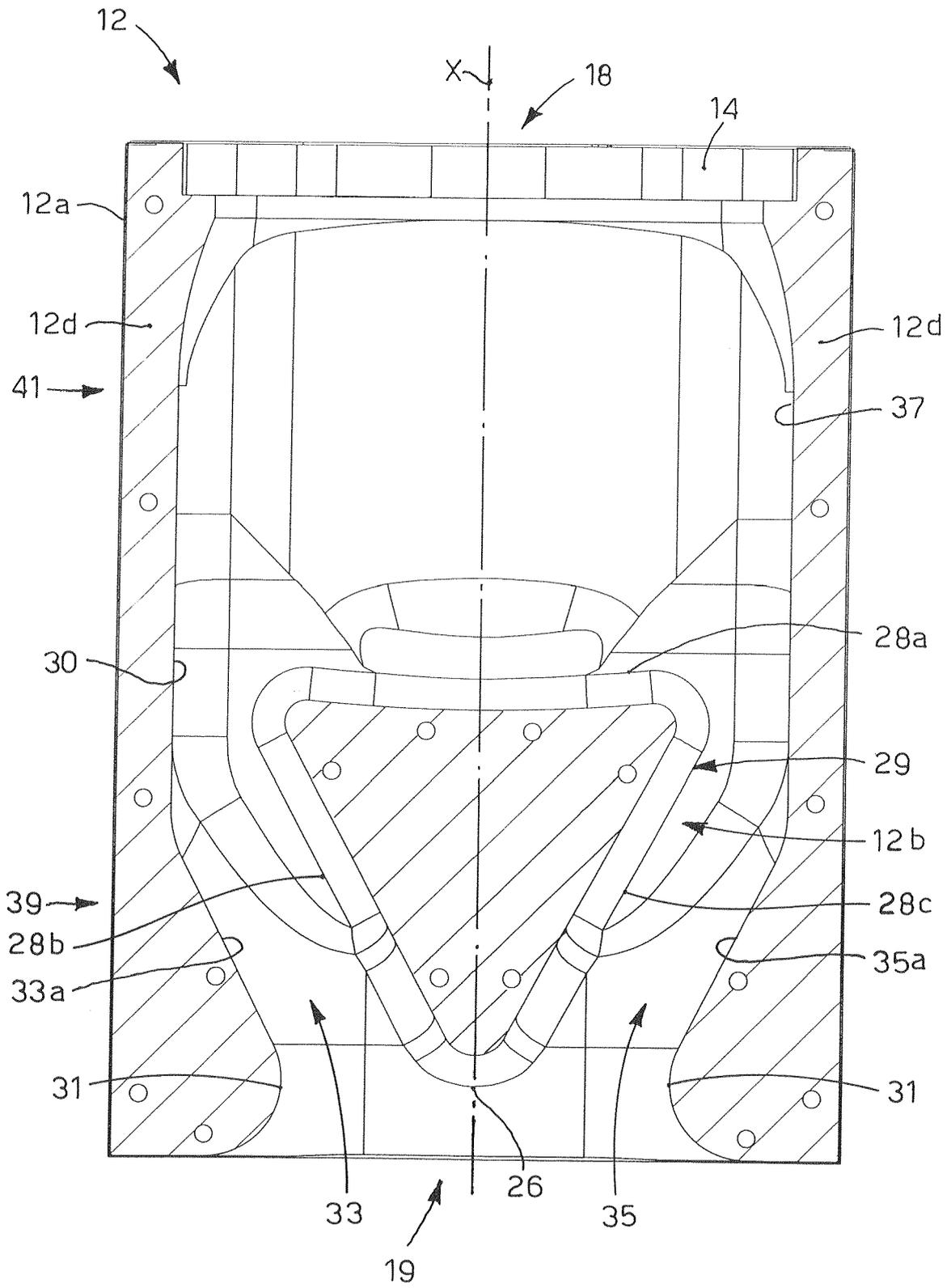


fig. 5



EUROPEAN SEARCH REPORT

 Application Number
 EP 12 15 4391

DOCUMENTS CONSIDERED TO BE RELEVANT				
Category	Citation of document with indication, where appropriate, of relevant passages	Relevant to claim	CLASSIFICATION OF THE APPLICATION (IPC)	
Y	US 2004/194776 A1 (AMIR NEHEMIA [IL]) 7 October 2004 (2004-10-07) * abstract; figures 1,2 * * paragraphs [0040], [0044] * -----	1-18	INV. F24C15/20	
Y	DE 20 2007 017089 U1 (WENDT SIT GMBH & CO KG [DE]) 15 May 2008 (2008-05-15) * abstract *	1-18		
Y	WO 2008/090080 A1 (ROBLIN SAS [FR]; LETELLIER BRUNO [FR]) 31 July 2008 (2008-07-31) * abstract; figures 1,3 * * page 2, line 18 - page 3, line 20 *	3,4,6-9, 11,13,14		
A	EP 0 840 063 A1 (ELECTROLUX ABP [SE]) 6 May 1998 (1998-05-06) * abstract; figures 1,2 * * column 3, lines 11-20 *	1		
A	DE 34 01 210 A1 (ASEA AB [SE]) 25 July 1985 (1985-07-25) * abstract; figure 1 *	1		TECHNICAL FIELDS SEARCHED (IPC)
A	EP 2 267 373 A1 (BSH BOSCH SIEMENS HAUSGERAETE [DE]) 29 December 2010 (2010-12-29) * abstract; figures 1-11 * -----	1		F24C
The present search report has been drawn up for all claims				
Place of search		Date of completion of the search	Examiner	
The Hague		12 June 2012	Moreno Rey, Marcos	
CATEGORY OF CITED DOCUMENTS				
X : particularly relevant if taken alone		T : theory or principle underlying the invention		
Y : particularly relevant if combined with another document of the same category		E : earlier patent document, but published on, or after the filing date		
A : technological background		D : document cited in the application		
O : non-written disclosure		L : document cited for other reasons		
P : intermediate document		& : member of the same patent family, corresponding document		

1
EPO FORM 1503 03.82 (P04C01)

ANNEX TO THE EUROPEAN SEARCH REPORT
ON EUROPEAN PATENT APPLICATION NO.

EP 12 15 4391

This annex lists the patent family members relating to the patent documents cited in the above-mentioned European search report. The members are as contained in the European Patent Office EDP file on
The European Patent Office is in no way liable for these particulars which are merely given for the purpose of information.

12-06-2012

Patent document cited in search report	Publication date	Patent family member(s)	Publication date
US 2004194776 A1	07-10-2004	NONE	

DE 202007017089 U1	15-05-2008	NONE	

WO 2008090080 A1	31-07-2008	FR 2911520 A1	25-07-2008
		WO 2008090080 A1	31-07-2008

EP 0840063 A1	06-05-1998	DE 69713561 D1	01-08-2002
		DE 69713561 T2	30-01-2003
		DK 840063 T3	14-10-2002
		EP 0840063 A1	06-05-1998
		ES 2179292 T3	16-01-2003
		NO 975024 A	04-05-1998
		SE 507735 C2	06-07-1998
		SE 9604000 A	02-05-1998
		US 5803072 A	08-09-1998

DE 3401210 A1	25-07-1985	NONE	

EP 2267373 A1	29-12-2010	DE 102009027170 A1	30-12-2010
		EP 2267373 A1	29-12-2010
		US 2010329850 A1	30-12-2010

REFERENCES CITED IN THE DESCRIPTION

This list of references cited by the applicant is for the reader's convenience only. It does not form part of the European patent document. Even though great care has been taken in compiling the references, errors or omissions cannot be excluded and the EPO disclaims all liability in this regard.

Patent documents cited in the description

- US 2004194776 A [0004]
- WO 2008090080 A [0013]