



(12) **EUROPEAN PATENT APPLICATION**

(43) Date of publication:
27.07.2022 Bulletin 2022/30

(51) International Patent Classification (IPC):
A47L 9/24 (2006.01) **A47L 9/28** (2006.01)
A47L 5/38 (2006.01)

(21) Application number: **21193135.7**

(52) Cooperative Patent Classification (CPC):
A47L 9/2857; A47L 5/38; A47L 9/248;
A47L 9/2805; A47L 9/2842

(22) Date of filing: **25.08.2021**

(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
Designated Validation States:
KH MA MD TN

(71) Applicant: **Starvac SCS Onlus**
39100 Bolzano BZ (IT)

(72) Inventor: **FRANCESCHINI, Fabian**
39100 BOLZANO (IT)

(74) Representative: **Muraro, Alfeo Federico**
Studio Alfeo Muraro
Lungadige G. Leopardi, 81
38122 Trento (IT)

(30) Priority: **25.01.2021 IT 202100001361**

(54) **CONTROL UNIT AND METHOD FOR AN AIR-SUCTION SYSTEM AND AIR SUCTION SYSTEM COMPRISING SUCH CONTROL UNIT**

(57) Control unit (20) for an air-suction system (1) of the type comprising an air-suction device (8) and a duct (15) provided with a first end (15a) connected to the air-suction device (8) and a mouth (15b) at the opposite end communicating with a compartment (9) of a building, the control unit (20) comprising a microphone (21) that can be associated with the duct (15) to detect a sound

propagating through the duct (15), and a transducer device (22) to emit control signals in response to recognized predefined sound sequences detected by the microphone (21). A first predefined sound sequences comprises a first sound generated in correspondence of the mouth (15b) of the duct (15), in response to which a first control signals is emitted by the transducer device (22).

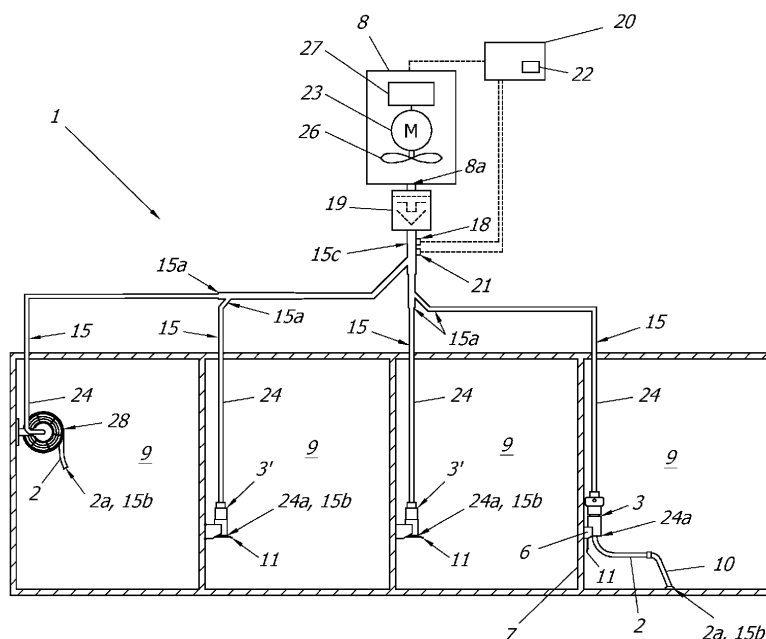


Fig. 1

Description

FIELD OF APPLICATION

[0001] The present invention is generally applicable to the technical field of centralized air-suction systems. In particular, an object of the invention is a control unit for a centralized air-suction system, in particular for industrial application.

STATE OF THE ART

[0002] Centralized air-suction systems are known to suck the dust and other residues from domestic or industrial environments. The above mentioned suction systems comprise a plurality of ducts, each one of which has an end in communication with an air-suction device and, at the opposite end, a mouth in communication with a corresponding one of the above environments.

[0003] The system generally comprises one or more flexible tubes, each one of which can be connected to the mouth of a corresponding duct when necessary, to allow a user to suck the dust from the corresponding environment. After the use, the flexible tube can be disconnected from the duct and stored.

[0004] According to a known variant, the flexible tubes are provided rolled up on respective hose roll devices, and, when needed, are connected to the respective ducts and unrolled by the length that is needed by the user.

[0005] According to a further known variant, one or more flexible tubes are slidably housed inside the corresponding ducts, so that a portion of them can be extracted by the needed length. After the use, they are withdrawn inside the corresponding ducts by exploiting the sucking effect generated by the air aspirator of the suction system.

[0006] Regardless of the configuration of the flexible tubes, it is known to provide an electric switch arranged close to the mouth of each duct in order to control the start and stop of the air-suction device. The switching of the above switch can be done manually by the user, or automatically, based on the movement of a mobile element associated to the corresponding mouth of the duct, for example a door to hermetically close the mouth, operable by the user at the end of use.

[0007] All the switches are connected to a central unit arranged close to the air-suction device, which controls the start and stop of the latter based on the position of the switches.

[0008] Clearly, the above switches require to be electrically wired to the above mentioned central unit, with the drawback of increasing the installation and maintenance costs of the system.

[0009] In the attempt to overcome the aforementioned drawback, a variant of the system is known, providing a centralized microphone arranged close to the air-suction device, that controls the start of the device on detecting a predefined sound corresponding to the shaking of the

flexible tube.

[0010] The variant embodiment just disclosed has the drawback that the need of shaking the flexible tube to achieve the start of the system brings some discomfort for the user.

[0011] The above variant has the further drawback that the shaking of the flexible tube does not generate a well defined sound, hence the microphone could fail to recognize it, and the start would be uncertain.

[0012] In some cases, for example when relatively long tubes are present, the sound wave generated by the shaking of the flexible tube could not be sufficiently strong to be detected by the microphone, and/or to be correctly recognized by it.

[0013] Moreover, the shaking of the flexible tube produces a sound that varies according to the kind of flexible tube used, in particular its length and its material, hence increasing the just mentioned drawback.

[0014] If, in order to overcome the aforementioned drawback, the range of sounds that are recognized by the microphone as suited to start the system is widened, a further drawback rises, i.e. the start could occur even with sounds that do not correspond to the shaking of the flexible tube, hence obtaining fake starts.

PRESENTATION OF THE INVENTION

[0015] The present invention aims at overcoming at least in part the above mentioned drawback of the prior art.

[0016] In particular, it is an aim of the invention to make a control unit for starting and/ or stopping an air-suction system, that does not require the presence of electric switches arranged at the end of each duct.

[0017] In particular, it is an aim of the invention that the aforementioned control unit allows to control the start and/or stop of the system in a more precise way as compared to the above mentioned control systems of known kind.

[0018] It is a further aim of the invention that the aforementioned control unit allows to control the start and/or stop of the system regardless of what kind of flexible tube is used, in particular of its material, length and configuration, that is to say, irrespective of the tube being connected to a fixed portion of a duct, or extracted by the latter, or unrolled from a hose reel device.

[0019] The above aims are achieved by a control unit according to the main claim, by an air-suction systems comprising such control unit according to claim 9, and by a method for controlling the aforementioned system according to claim 15.

[0020] Further detail features of the invention are specified in the corresponding dependent claims.

[0021] Advantageously, because the control unit of the invention does not need switches at the mouth of each duct, the need of the corresponding wiring to the central unit is avoided.

[0022] Still advantageously, the greater operating pre-

cision of the control unit of the invention allows its bigger versatility, thus allowing its use with air-suction systems of different kinds, provided with flexible tubes of different configurations.

[0023] Still advantageously, the control unit of the invention does not require using batteries, remote controls, or other similar auxiliary devices.

[0024] The above aims and advantages, together with others that will be mentioned hereinafter, will be clearer from the following disclosure of some preferred embodiments of the invention, that are illustrated for indicative, exemplary and nonlimiting purpose with the aim of the attached drawings.

BRIEF DESCRIPTION OF THE DRAWINGS

[0025]

Fig. 1 shows the air-suction system comprising the control unit of the invention, in schematic view.

Fig. 2 shows a detail of the air-suction system of the invention, in lateral view.

Fig. 3 shows the detail of Fig. 2, sectioned according to the median plane.

Fig. 4 shows a detail of Fig. 2 in a different operating configuration, in sectioned view.

Fig. 5 shows the detail of Fig. 2 in a further operating configuration, in sectioned view.

DETAILED DESCRIPTION OF SOME PREFERRED EXEMPLARY EMBODIMENTS

[0026] The control unit 20 of the invention is particularly suited to a centralized air-suction systems of the kind indicated in the overall in Fig. 1 by 1, and comprising an air-suction device 8 configured to generate a depression at a suction mouth 8a. Preferably, the above depression is generated by an impeller 26 operated by an electric motor 23.

[0027] The system 1 further comprises a network made of one or more ducts 15, each one of which has a first end 15a connected to the aforementioned suction mouth 8a, for example through a single manifold 15c to which all ducts 15 merge, and a mouth 15b at the opposite end, that leads to a corresponding compartment 9 of a building, for example a room, a laboratory, an industrial compartment, or another similar space.

[0028] Preferably, the network comprises a filter 19 interposed between the manifold 15c and the air-suction device 8, suited to stop the solid material sucked through the ducts 15.

[0029] Each one of the ducts 15 comprises a first portion 24 that is permanently connected to the air-suction device 8 and that is provided with a corresponding mouth 24a at the opposite end, which leads in the corresponding compartment 9. Preferably, the first portion 24 is rigid.

[0030] The air-suction systems 1 further comprises a flexible tube 2, one of which is shown in Fig. 1. An end

of the flexible tube 2 is constrained to the aforementioned mouth 24a. The opposite free end of the flexible tube 2 can be gripped by a user, and is provided with a mouth 2a to suck dust or other similar materials from the corresponding compartment. The flexible tube 2 can be provided with a suction member 10 of a known kind, such as, for example, a brush, a shaped nozzle, etcetera, in which case the aforementioned mouth 2a belongs to the suction member 10.

[0031] It is understood that, when the flexible tube 2 is constrained to the mouth 24a of a corresponding first portion 24, it becomes an integral part of the duct 15. As a consequence, the mouth 15b of the duct 15 may correspond either to the mouth 2a of the flexible tube 2, when this is constrained to the first portion 24, or to the mouth 24a of the first portion 24, when the flexible tube 2 is not constrained to it, for example when the tube is not present or when it is inserted into the first portion 24.

[0032] Preferably, the mouth 24a of each first portion 24 is defined by a corresponding stop unit 3 that allows to constrain the flexible tube 2 to the first portion 24 itself. The stop unit 3 is unremovably associated to a bearing element 7 arranged in the compartment 9 through connection means 6, for example a bracket 16, that may be welded to the stop unit 3, and screws for fixing the bracket to the wall 7, not shown in the drawings but in themselves known. In the figures, the aforementioned bearing element 7 is shown in the form of a wall delimiting the compartment 9. Nevertheless, in variant embodiments of the invention, the bearing element 7 may be any bearing element such as, for example, a pillar, a pole, a beam, etcetera.

[0033] Still preferably, the stop unit 3 is arranged outside to the aforementioned wall 7 in order to be located inside the compartment 9 of the building. Advantageously, thanks to the configuration just disclosed, it is easier for the user to constrain the tube 2 to the first portion 24.

[0034] Still advantageously, the arrangement of the stop unit 3 outside the wall 7 simplifies the maintenance of the stop unit 3 itself, especially when it comprises movable parts.

[0035] Preferably, the flexible tube 2 is slidably housed in the corresponding first portion 24 in such a way that it can be partially extracted from the latter through its mouth 24a for such a portion of length as the user needs.

[0036] Fig. 2 shows, for exemplary and non limiting purpose, a stop unit 3 of a system 1 according to the configuration just disclosed.

[0037] Preferably, the aforementioned stop unit 3 is configured so that it can be moved between a rest position, shown in Fig. 3, where it allows the flexible tube 2 to slide in the first portion 24 for extraction and insertion, and an operating position, shown in Fig. 5, where it hinders or prevents the aforementioned sliding of the tube 2 once extracted, preferably through friction, in order to constrain the tube 2 to the first portion 24 to keep the length of the aforementioned extracted portion fixed, and, in particular, to avoid that it is accidentally sucked inside

of the first portion **24** during use.

[0038] The movement of the stop unit **3** between the two aforementioned positions can be achieved by mutually rotating two annular elements **4**, **5** belonging to the stop unit **3** itself, arranged coaxially and that receive the flexible tube **2**. The two annular elements **4**, **5** are configured in such a way that, as a consequence of their mutual rotation around a common axis according to two alternate directions, one of the said annular elements **4**, **5**, or a further annular element **17** interposed between them, which can be seen in the sections of Figs. 3 and 5, be elastically deformed in such a direction as to become compressed or, respectively, widened in radial direction, so as to be pushed against the tube **2** or, respectively, released.

[0039] Still preferably, one of the two annular elements **5** comprises a handle **14** that can be gripped by the user to facilitate the aforementioned rotation relative to the other annular element **4**, that instead is fixed relative to the bearing element **7**.

[0040] Still preferably, the stop unit **3** is configured in such a way that, when arranged in operating position, it closes the gap between the first portion **24** and the flexible tube **2** in order to prevent air from passing through the gap.

[0041] According to a variant embodiment, not shown in the drawings, the stop unit **3** comprises one or more wings movable according to a radial direction, that are pushed against the tube **2** and, respectively, released, as a consequence of the rotation of one of the two annular elements **4**, **5** in two opposite respective directions, so as to define the two operating positions.

[0042] Preferably, the air-suction systems **1** envisages that one of the flexible tubes **2**, instead of being housed in the first portion **24** as above disclosed, is being connected to the mouth **24a** of the corresponding first portion **24** when needed by means of a variant of the stop unit, that is indicated in Fig. 1 with **3'**. The stop unit **3'** according to the aforementioned variant is configured in such a way as to allow connecting the flexible tube **2** to the first portion **24** of the duct **15** as above explained, as well as its subsequent disconnection from it.

[0043] Still preferably, one of the flexible tubes **2** belongs to a corresponding reel device **28**, which comprises a central body on which the tube **2** is rolled up and from which the latter can be unrolled to the length that is needed. The reel device **28** is further provided with a mouth in communication with the tube **2** and connected to the mouth **24a** of the corresponding first portion **24**, similarly to the previous variant embodiment.

[0044] Clearly, the air-suction systems **1** may comprise any one of the variants just disclosed, or also more of them in combination.

[0045] Regardless of the specific embodiment of the air-suction systems **1**, the system comprises a control unit **20** meant to control the starting and stopping of the system itself.

[0046] The aforementioned control unit **20** comprises

a microphone **21** associated to the ducts **15** in such a way as to be capable to detect the sounds propagating through the ducts **15**. The microphone **21** can be arranged either inside to, or outside of, the ducts **15**.

[0047] The aforementioned microphone **21** is associated to a transducer device **22**, configured to react to one or more predefined and mutually different sound sequences detected by the microphone **21** by emitting corresponding control signals that can be used to control the air-suction systems **1**, as it will become apparent in the following. Clearly, the microphone **21** is configured to detect at least the sounds belonging to the aforementioned predefined sound sequences.

[0048] It is hereby specified that each predefined sound sequence may comprise a single isolated sound, or a sequence of sounds temporally spaced from one another.

[0049] It is as clear that the transducer device **22** is configured to emit mutually different control signals in response to different predefined sound sequences that it can recognize.

[0050] Since all ducts **15** merge towards the suction mouth **8a** of the air-suction device **8**, so that they are in mutual communication, a single microphone **21** is generally sufficient to detect the sounds propagating through any duct **15** of the duct network.

[0051] Preferably, the microphone **21** is arranged close to the air-suction device **8**, bringing the advantage to limit the electric wiring between the microphone **21**, the transducer device **22**, and the air-suction device **8**. To that aim, the microphone **21** may be associated, for example, to the aforementioned manifold **15c**, or to the duct that connects the manifold **15c** with the suction mouth **8a** of the air-suction device **8**.

[0052] Nevertheless, it is clear that variant embodiments of the invention may envisage a plurality of microphones **21**, arranged in several locations of the duct network. For example, the latter configuration may be advantageous in particularly complex air-suction systems **1**, having many and/or lengthy ducts **15**. It is hereby specified that, in the remaining of the present description, reference will be made to a single microphone **21**, being clear, though, that what will be disclosed is also applicable in a similar way to control units **20** comprising a plurality of microphones **21**.

[0053] As regards the transducer device **22**, preferably it can be configured to react to different sound sequences. Advantageously, the aforementioned configuration allows to adapt the transducer device **22** to each particular air-suction systems **1**. As an example, the aforementioned configuration may concern the frequency range, the duration, the number of repetition of a given sound or sequence of sounds, the time interval between two successive repetitions and/or the time interval within which the aforementioned repetitions are executed.

[0054] Still preferably, the transducer device **22** is an electronic device suited to process the signals coming from the microphone **21**. Still preferably, the electronic

device can be programmed. Still preferably, the electronic device comprises a microprocessor and a memory unit operatively interconnected.

[0055] According to the invention, the transducer device **22** is configured to recognize a first predefined sound generated in correspondence of the mouth **15b** of one of the ducts **15**, emitting a corresponding first control signal as a response. Thus, the aforementioned first predefined sound corresponds to a first one of the aforementioned predefined sound sequences. Hereinafter, for simplification purpose, reference to the first predefined sound will be made to indicate also the first predefined sound sequence.

[0056] The applicant of the present invention has observed that the first sound produced as above disclosed is well distinguishable from other sounds that may be generated accidentally in other locations of the ducts **15** and be transmitted along the same. Moreover, since the aforementioned sound is generated directly at the mouth **15b** of the duct **15**, it propagates very effectively along the duct itself, reaching directly the microphone **21**.

[0057] Therefore, the aforementioned first predefined sound is particularly suited to be used for controlling the air-suction systems **1**, in particular for controlling its start and/or stop, at the same time limiting accidental starts and/or stops of the system due to sounds of different nature.

[0058] In particular, the control unit **20** is configured to start the air-suction device **8** when the transducer device **22** emits the first control signal in response to the recognition of the aforementioned first predefined sound.

[0059] According to a variant embodiment, the first predefined sound sequence comprises other sounds beyond the first predefined sound. Clearly, what has been disclosed for the previous variant is applicable to this variant as well.

[0060] Preferably, the aforementioned first predefined sound results from a percussion of the mouth **15b**.

[0061] Advantageously, the percussive sound just disclosed is a sharp sound, hence it is particularly precise, repeatable and distinguishable, both for the frequency and for the duration. In particular, the applicant of the present invention could observe that such a sound comprises frequencies higher than 100 Hz, that can reach up to 1.000 - 10.000 Hz. Due to the relatively high frequency of the aforementioned percussion, the latter is particularly distinguishable from other sounds of lower frequency that may occur during the normal use of the air-suction systems **1**.

[0062] The aforementioned percussion may be generated directly by the user, by hitting the mouth **15b** with his hand.

[0063] Nevertheless, preferably, the aforementioned percussion is made by means of a percussion body **11**, movably constrained to the mouth **15b** of each duct **15** in such a way as to being able to be arranged in a contact position in contact with the mouth **15b**, as in Figs. 2 and 3, and a distal position distanced from the mouth **15b**,

as in Fig. 4.

[0064] Advantageously, the hitting of the aforementioned percussion body **11** against the mouth **15b** occurs always through the same movement, thus allowing to obtain a particularly clear and repeatable percussion.

[0065] Preferably, the percussion body **11** is associated to the mouth **15b** by means of a pivot **11a**, that defines for the percussion body **11** a rotary movement with respect to the mouth **15b**.

[0066] Preferably, elastic means **12** are present, for example a spring **12a**, configured to force the movement of the percussion body **11** towards the aforementioned contact position. Advantageously, the movement on the percussion body **11** from the distal position to the contact position induced by the elastic recall of the aforementioned elastic means **12** allows to achieve the percussion in a simple and repeatable way. Thus, it is sufficient that the user displaces the body **11** from the mouth **15b** and then releases it to obtain its automatic returning to the contact position.

[0067] Preferably, the percussion body **11** is associated to the mouth **24a** of the first portion **24**, for example to the stop units **3** and **3'**.

[0068] According to a variant embodiment non shown in the drawings, the percussion body **11** is associated to the mouth **2a** of the flexible tube **2**.

[0069] Still preferably, the percussion body **11** is configured to close the mouth **15b** of the duct **15** at least temporarily during percussion. The applicant of the present invention could observe that the sound generated by such a percussion is particularly crisp and well distinguishable from other sounds.

[0070] Preferably, the percussion body **11** is a door **25** configured to close the mouth **15b** when in contact position, as shown in Figs. 2 and 3, and to free it when in distal position, as shown in Fig. 4.

[0071] Advantageously, the aforementioned door **25** avoids that the suction device **8** sucks air from the mouth **15b** when the duct **15** is not used.

[0072] Still advantageously, the presence of the elastic means **12** facilitates the closing of the door **11** and, moreover, avoids its accidental opening when the duct **15** is not used.

[0073] Still preferably, the elastic means **12** are configured in such a way that, for a first portion of the stroke of the door **25** comprising the aforementioned distal position, the elastic means **12** force the movement of the door **25** itself towards the distal position, as shown in Fig. 5. Advantageously, the configuration just disclosed allows to keep the door **25** open during the operation of constraining the flexible tube **2** to the first portion **24** of the duct **15**, thus facilitating the corresponding operation.

[0074] Still preferably, an annular gasket **13** is interposed between the door **25** and the mouth **15b** of the duct **15**, the gasket being configured to prevent air from passing between the two elements when the door **25** is in closed position. Advantageously, the aforementioned gasket **13** avoids dispersions when the air-suction device

8 is active but the door **25** is closed, as it might happen when the door corresponding to a different duct **15** of the system **1** is open.

[0075] Clearly, the aforementioned gasket **13** can be equally associated to the door **25** or to the mouth **15b**.

[0076] According to a variant embodiment of the invention, the first predefined sound can correspond to a percussion of the mouth **15b** with a body suited to close the mouth **15b**. Such a percussion may also be done manually by the operator, which may hit the mouth **15b** with the palm of his hand so as to close it. As anticipated, the mouth **15b** can coincide, alternatively, with the mouth **2a** of the flexible tube **2** or with the mouth **24a** of the first portion **24** of the duct **15**, depending on the flexible tube **2** being constrained to the first portion **24** or not.

[0077] According to a further variant embodiment, the first predefined sound may correspond to a particular sound emitted by the user with his voice close to the mouth **15b** of the duct **15**.

[0078] It is understood that the control unit **20** may be configured to react to the first predefined sound obtained through any one of the above mentioned ways, for example through the percussion of any one of the aforementioned mouths **2a** or **24a** and/or with the voice of the user.

[0079] Preferably, the control unit **20** also comprises one or more sensors configured to detect corresponding parameters representing the operating state of the air-suction system **1**. The value of each parameter varies as the operative state varies between a first operating condition, in which the mouth **15b** of at least one of the ducts **15** is open, and a second operating condition, in which the mouths **15b** of all corresponding ducts **15** are closed, for example due to the closing of the doors **25** above disclosed.

[0080] In particular, the transducer device **22** is configured to recognize the second operating condition based on the signals of the aforementioned sensors.

[0081] Preferably, the control unit **20** is configured to stop the air-suction device **8** when the transducer device **22** detects the aforementioned second operating condition.

[0082] Advantageously, thanks to the configuration of the control unit **20** just disclosed, the stop of the air-suction device **8** occurs automatically, with no need for an intervention by the user.

[0083] Preferably, the control unit **20** is configured to stop the air-suction device **8** if the second operating condition lasts for a predefined time interval. Advantageously, this prevents accidental stops of the air-suction device **8** due to the event that the above operating parameters of the system **1** take values that correspond to the second operating condition only temporarily. Such an event may happen, for example, when only one of the ducts **15** of the system **1** is used and it is accidentally closed for a limited time.

[0084] Preferably, the above parameters that represent the operating condition comprise the pressure in the

duct network. In fact, when the system **1** is in operation, the aforementioned network is in depression due to the suction effect generated by the air-suction device **8**. Therefore, the increase of the aforementioned depression and the consequent reduction of the absolute pressure in the network below a threshold, induced e.g. by the closing of all doors **25**, may indicate the occurrence of the second operating condition. The detection of the aforementioned pressure may occur for example by means of one or more pressure sensors in communication with one or more components of the network.

[0085] Preferably, only one of the aforementioned pressure sensors is present, arranged in communication with the manifold **15c**, with the advantage of limiting the wiring. Nevertheless, in variant embodiments of the invention, the aforementioned pressure sensor may be arranged in any location of the system **1**, as long as it is in communication with the network. Further variant embodiments of the invention may envisage a plurality of the aforementioned pressure sensors, that are in communication, for example, with corresponding ducts **15**.

[0086] The aforementioned parameters may further comprise the overall air flow conveyed through the ducts **15** by the action of the air-suction device **8**. In fact, the said air flow is substantially proportional to the number of ducts **15** that are open and in use. On the contrary, when all ducts **15** are closed, the aforementioned air flow goes to zero, except for possible leaks through the sealing members. In this case, the second operating condition is represented by a reduction of the aforementioned parameter below a threshold which is lower than the value corresponding to the air flow occurring when a single duct **15** is open.

[0087] The overall air flow can be measured, for example, by means of one or more flow sensors, arranged in a similar way as that disclosed for the pressure sensors. The aforementioned sensors may be arranged in any location of the system **1** but, preferably, they are arranged downstream of the filter **19** or of the suction device **8**, with the advantage of not being in contact with the sucked material that is blocked by the filter **19**.

[0088] The overall air flow may as well be estimated by detecting the noise generated by the same air flow in the system **1**. In fact, it is clear that the aforementioned noise increases as the overall air flow increases. In this case, the sensor may coincide with the microphone **21** used for detecting the predefined sound sequences, with the advantage of limiting the complexity of the control unit **20**.

[0089] According to a variant embodiment of the invention, the parameters may further comprise the noise of the electric motor **23** that operates the air-suction device **8**, that is correlated as well with the operating state of the system **1**.

[0090] The aforementioned parameters may further comprise the speed (rpm) of the air-suction device **8**. This latter parameter may be used when the air-suction device **8** is controlled by an inverter **27** configured to supply the

electric motor **23** of the air-suction device **8** with a variable power frequency. More specifically, the variation of the power frequency corresponds to a variation on the rpm of the electric motor **23**, in order to keep the value of the pressure inside the ducts **15** within a preset interval. In other words, when the air flow through the ducts **15** decreases as a result of the closing of one or more of them, the absolute pressure in the ducts **15** tends to reduce, and the inverter **27** reduces the rpm of the electric motor **23**, hence of the impeller **26**. This allows to identify the second operating condition of the system **1** when the aforementioned rpm reduces below a predefined minimum value.

[0091] The aforementioned rpm may be indirectly determined, by detecting the power frequency supplied by the inverter **27** to the motor **23**, that in turn can be detected through an electric or electronic device. Preferably, the aforementioned device comprises a specific output from the inverter **27** where a signal representing the aforementioned power frequency is made available.

[0092] As an alternative, the rpm may be measured directly at the shaft through a mechanical, optical or magnetic device of known kind.

[0093] It is clear that the control unit **20** may be configured to detect one or more of the aforementioned parameters, and to determine the occurrence of the second operating condition based on a combined analysis of the parameter values.

[0094] According to a variant embodiment of the invention, the control unit **20** may be configured to stop the air-suction device **8** when the microphone **21** detects a second predefined sound sequence that, for example, may comprise the repetition of a predefined number of percussions of the mouth **15b** of one of the ducts **15**, preferably occurring within a preset time interval, or with a frequency of repetition comprised within a predefined range of values.

[0095] In this latter variant embodiment, the stop of the air-suction device **8** may be subjected to the occurrence of the second operating condition for the system **1**.

[0096] The variant embodiment just disclosed brings the advantage to avoid accidental stops of the system **1**. In fact, for stopping the system the occurrence of the second operating condition is not enough, being it also required a deliberate intervention of the user, which must execute the aforementioned repetition of percussions on the mouth **15b**. Clearly, it is still possible that the control unit **20** be configured in such a way as to stop the system **1** when the second operating condition lasts for a predefined time interval, in order to avoid that, due to inattention by the user, the system **1** remains active even though it is not used.

[0097] It is understood that the control unit **20** disclosed so far brings the further advantage of being easily applicable to a pre-existing air-suction systems **1**, since it does not require substantial changes to the system itself.

[0098] Operatively, the air-suction systems **1** provided with the aforementioned control unit **20** may be activated

as follows.

[0099] The following description concerns a system **1** provided with a plurality of ducts **15**, each one of which corresponds to a flexible tube **2** that is arranged in a corresponding compartment **9** of a building and that can be connected to a corresponding stop unit **3, 3'**, or rolled up on a hose reel device **28**. However, it is clear that the same considerations are valid as well, with the due and obvious changes, for a system provided with a single duct **15**.

[0100] In a first rest configuration of the system **1**, the air-suction device **8** is inactivated.

[0101] When it is needed to suck dust or other materials from one of the compartments **9**, the user hits the mouth **15b** of the corresponding duct **15**.

[0102] For example, if the mouth **15b** is provided with a door **25** of the kind above disclosed, the user can open the door **25** and then release it immediately afterwards, to let it hitting against the mouth **15b** under the action of the corresponding elastic means **12**.

[0103] The control unit **20** may be configured to detect the aforementioned percussion and, in response, to start the air-suction device **8**.

[0104] Meanwhile, the user may constrain the flexible tube **2** to the duct **15**, either connecting to it an outer flexible tube **2**, or extracting the tube **2** from the first portion **24** if the system **1** is of that kind. Before this operation, the user will have opened the door **25** in such a way that it is kept opened by the elastic means **12**, thanks to their particular configuration as previously disclosed.

[0105] At the end of use, the user may close the mouth **15b**, for example by means of the corresponding door **25**, after having released the flexible tube **2** from the first portion **24**. At this point, the control unit **20** can detect the occurrence of the second operating condition and, after a given time, control the stop of the air-suction device **8**.

[0106] As an alternative, the control unit **20** can wait for the repetition of the percussions on the mouth **15b** before controlling the aforementioned stop.

[0107] The present invention also comprises a method for controlling an air-suction systems **1**, comprising one or more of the operations previously disclosed. In particular, the aforementioned method comprises starting and/or stopping the air-suction device **8** as a consequence of the generation of the aforementioned predefined sound sequences and of its recognition by means of the transducer device **22**. In particular, the predefined sound sequences comprise corresponding sounds that are generated in correspondence of the mouth **15b** of one of the ducts **15**. The aforementioned sounds are generated in any one of the ways that were previously disclosed.

[0108] From the above, it is understood that the control unit disclosed so far, the control method executed by the control unit and the air-suction systems comprising the control unit achieve the preset aims.

[0109] The invention is susceptible of changes and var-

variants all comprised in the inventive concept expressed in the attached claims. In particular, the elements of the invention might be replaced by other technically equivalent elements.

[0110] Moreover, the materials might be chosen according to the needs, yet without departing from the scope of the invention.

[0111] Moreover, one or more elements of a specific embodiment of the invention, technically compatible with another specific embodiment of the invention, might be introduced in the latter in addition to, or in replacement of, elements of the latter.

[0112] Where technical features specified in the claims are followed by reference signs, those reference signs are included for the sole purpose of improving the understanding of the invention, hence they do not imply any limitation to the scope of protection claimed.

Claims

1. Control unit (20) for an air-suction system (1) of the type comprising an air-suction device (8) and a network comprising one or more ducts (15), each duct (15) being provided with a first end (15a) connected to said air-suction device (8), and a mouth (15b) at the opposite end communicating with a corresponding compartment (9) of a building, said control unit (20) comprising:

- a microphone (21) that can be associated with said network in such a way as to detect a sound propagating through said ducts (15);
- a transducer device (22) configured to recognize one or more predefined sound sequences detected by said microphone (21) and to emit corresponding control signals in response thereof;

characterized in that a first one of said predefined sound sequences comprises a first sound generated in correspondence of said mouth (15b) of one of said ducts (15), said transducer device (22) being configured to emit a first one of said control signals in response to the recognition of said first predefined sound sequence.

2. Control unit (20) according to claim 1, **characterized in that** said first sound is a sound resulting from a percussion of said mouth (15b) of one of said ducts (15).
3. Control unit (20) according to claim 2, **characterized in that** said percussion occurs through a body suited to plug said mouth (15b) at least during said percussion.
4. Control unit (20) according to any claims from 1 to

3, **characterized in that** it comprises one or more sensors (18) configured to detect corresponding parameters indicative of the operating state of said air-suction system (1), and whose values change as said operating state changes between a first operating condition, in which the mouth (15b) of at least one of said ducts (15) is open, and a second operating condition, in which all mouths (15b) of said ducts (15) are closed, said transducer device (22) being configured to recognize said second operating condition based on the signals from said sensors (18).

5. Control unit (20) according to claim 4, **characterized in that** said parameters comprise the pressure in said network.

6. Control unit (20) according to any claims 4 or 5, **characterized in that** said parameters comprise the total air flow rate conveyed from said ducts (15).

7. Control unit (20) according to any claims from 4 to 6, **characterized in that** said parameters comprise the rotational speed of said air-suction device (8).

8. Control unit (20) according to any claims from 4 to 7, **characterized in that** said parameters comprise the noise caused by the air flow rate in said ducts (15).

9. Air-suction system (1), comprising:

- an air-suction device (8);
- a network comprising one or more ducts (15), each duct (15) being provided with a first end (15a) connected to said air-suction device (8), and a mouth (15b) at the opposite end communicating with a corresponding compartment (9) of a building;
- a control unit (20) according to any preceding claim, said microphone (21) being associated with said network in such a way as to detect a sound propagating through said ducts (15);

characterized in that said control unit (20) is configured to start said air-suction device (8) in response to said first control signal emitted by said transducer device (22).

10. Air-suction system (1) according to claim 9, **characterized in that** it comprises a percussion body (11) movably constrained to said mouth (15b) of at least one of said ducts (15) in such a way that said percussion body (11) can be moved between a distal position distanced from said mouth (15b) and a contact position in contact with said mouth (15b), said percussion of said mouth (15b) being generated by said percussion body (11) hitting said mouth (15b)

as a consequence of the movement of said percussion body (11) from said distal position to said contact position.

eration of starting said air-suction device (8) in response to the emission of said first control signal.

11. Air-suction system (1) according to any claims 9 or 10, **characterized in that** it comprises elastic means (12) to force the movement of said percussion body (11) towards said contact position. 5
12. Air-suction system (1) according to any claims from 9 to 11, **characterized in that** said percussion body (11) is a door (25) configured to close said mouth (15b) when in said contact position and to leave said mouth (15b) open when in said distal position 10
15
13. Air-suction system (1) according to any claim from 9 to 12, **characterized in that** said control unit (20) is according to any claims from 4 to 8 and is configured to stop said air-suction device (8) when said transducer device (22) detects said second operating condition. 20
14. Air-suction system (1) according to claim 13, **characterized in that** said air-suction device (8) comprises an impeller (26) operated by an electric motor (23), and an inverter (27) to power said electric motor (23) with a variable input frequency for consequently changing the rotational speed of said electric motor (23) in such a way as to maintain the value of the pressure in said network within a predefined interval, said control unit (20) being according to claim 4, said parameters comprising said input frequency. 25
30
15. Method for controlling an air-suction system (1) of the type comprising an air-suction device (8) and a network comprising one or more ducts (15), each of said ducts (15) being provided with a first end (15a) connected to said air-suction device (8), and a mouth (15b) at the opposite end communicating with a corresponding compartment (9) of a building, said method of control comprising the following operations: 35
40
 - detecting sounds propagating through said ducts (15);
 - in response to the recognizing of one or more predefined sound sequences in said sounds, emitting corresponding control signals; 45
 - controlling said air-suction device (8) based on said control signals; 50

characterized in that a first one of said predefined sound sequences comprises a first sound generated in correspondence of said mouth (15b) of one of said ducts (15), said operation of emitting said control signals comprising emitting a first one of said control signals in response to the recognition of said first predefined sound sequence, said operation of controlling said air-suction device (8) comprising the op- 55

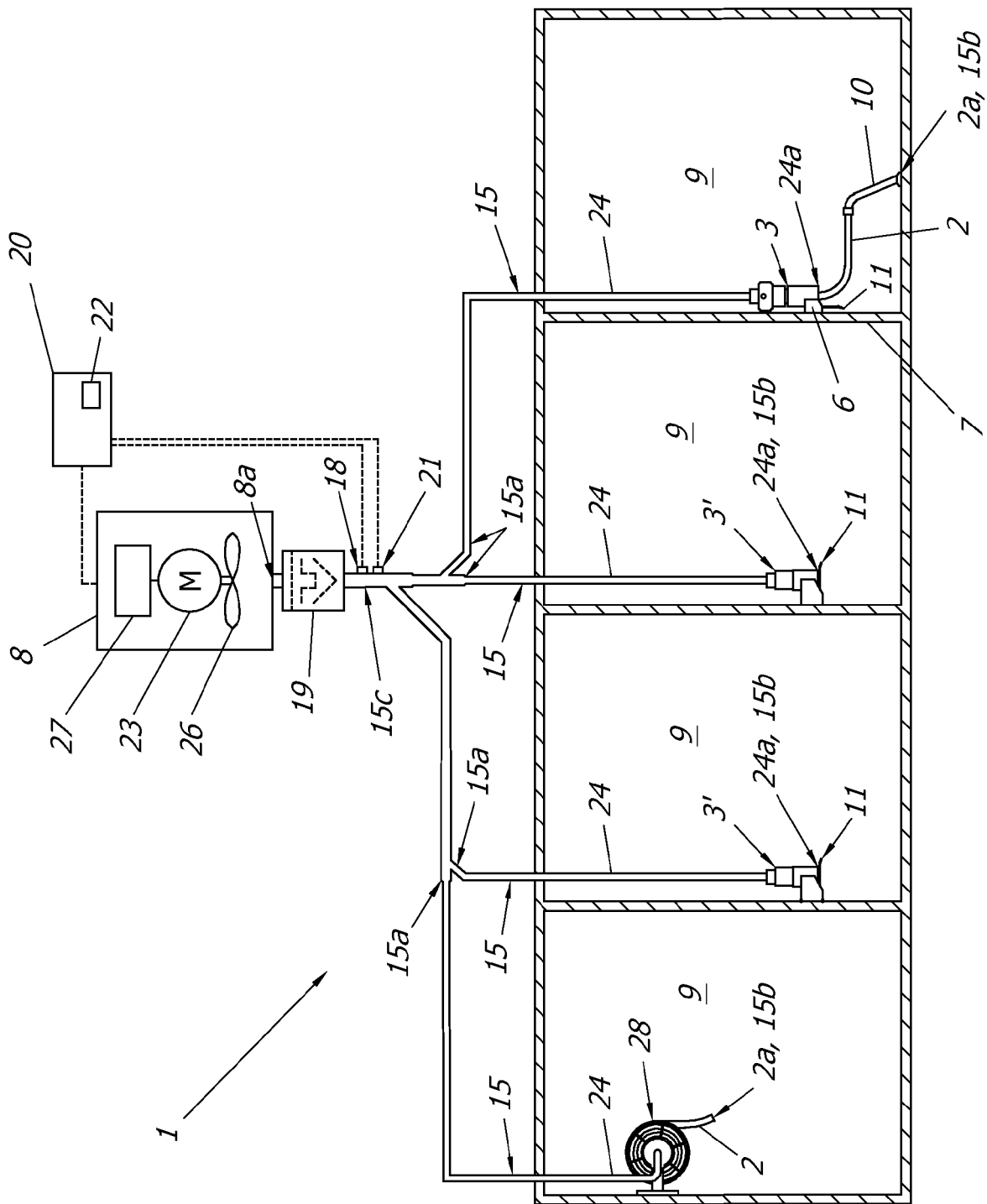


Fig. 1

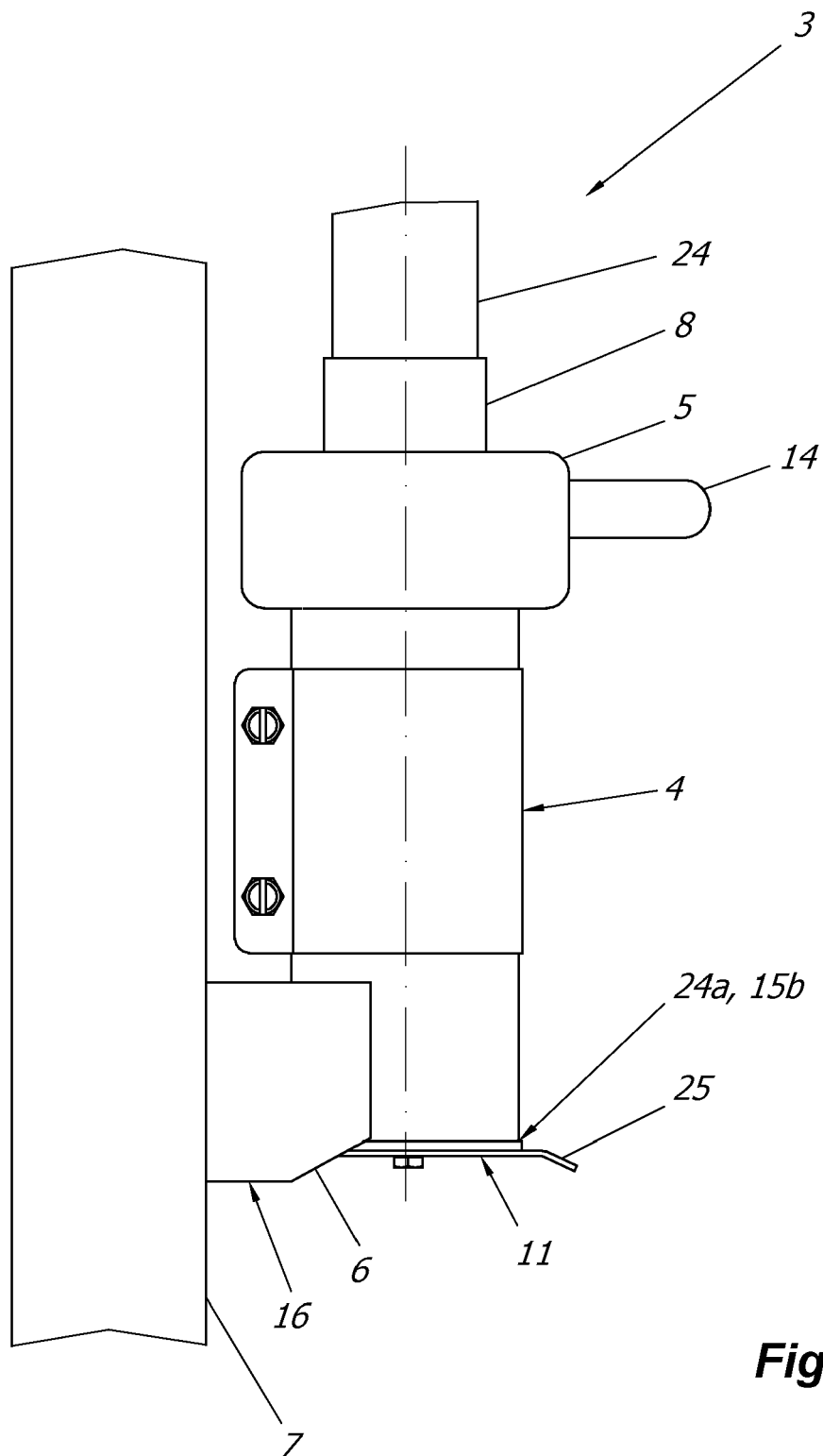


Fig. 2

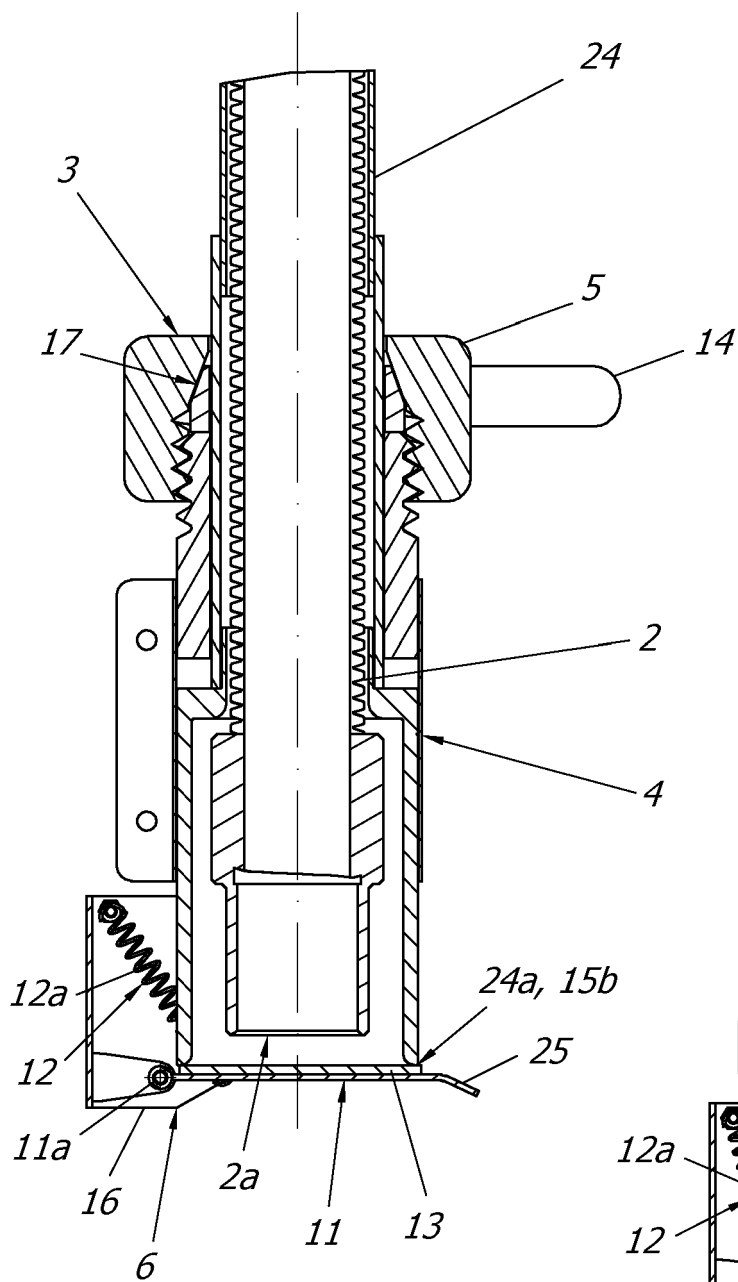


Fig. 3

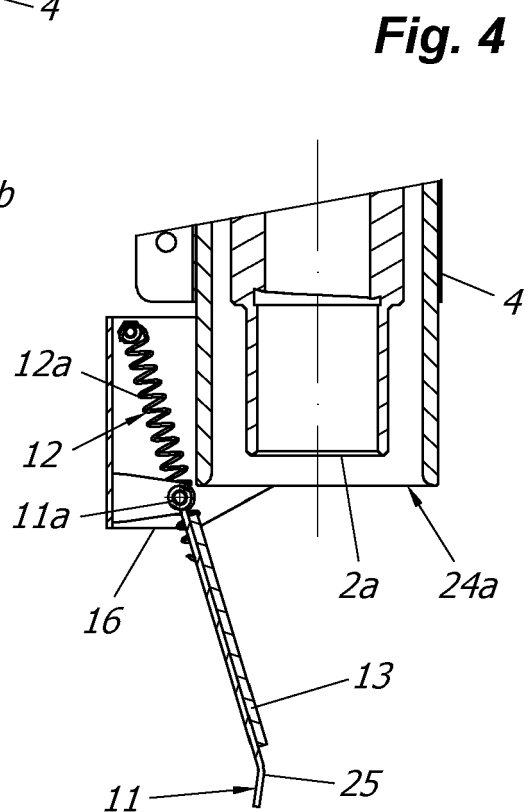


Fig. 4

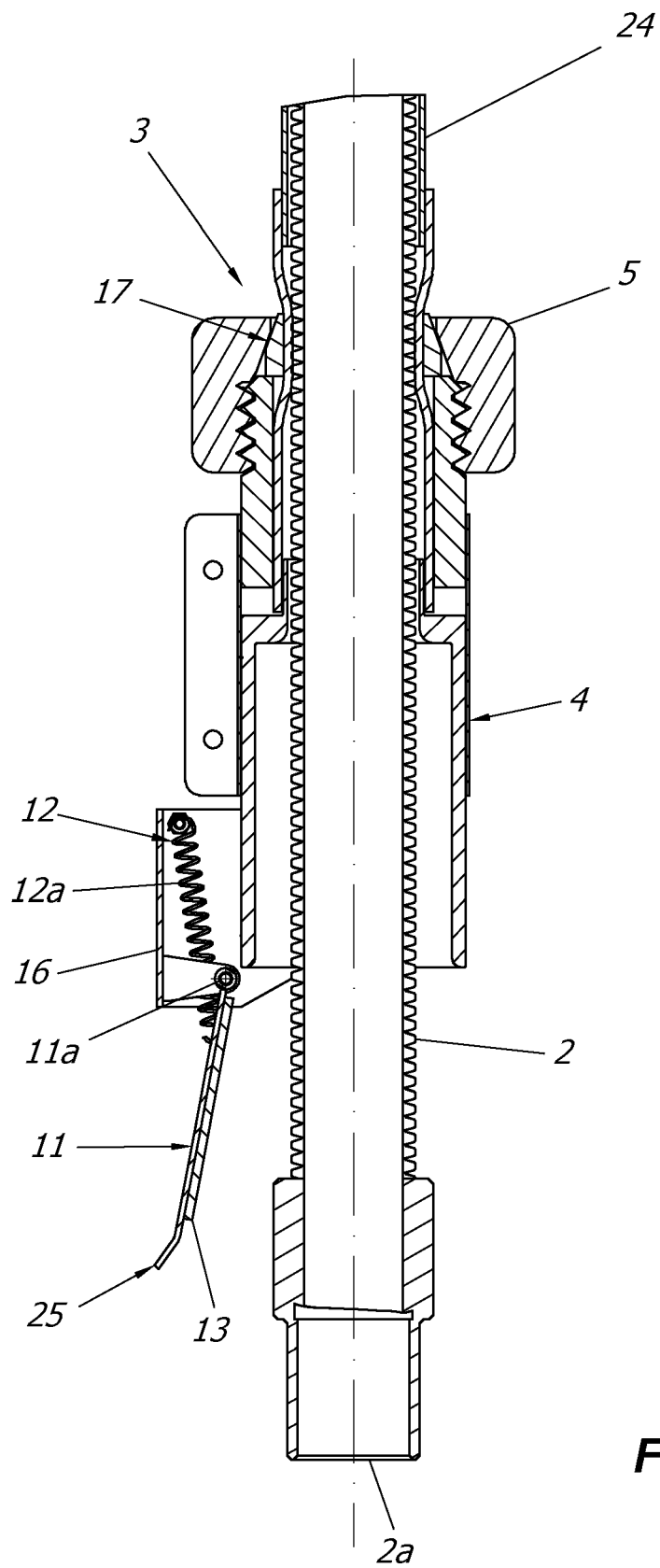


Fig. 5



EUROPEAN SEARCH REPORT

 Application Number
 EP 21 19 3135

5

10

15

20

25

30

35

40

45

50

55

DOCUMENTS CONSIDERED TO BE RELEVANT			
Category	Citation of document with indication, where appropriate, of relevant passages	Relevant to claim	CLASSIFICATION OF THE APPLICATION (IPC)
X	US 5 850 665 A (BOUSSET SERGE [FR]) 22 December 1998 (1998-12-22)	1-6, 9-13,15	INV. A47L9/24
A	* the whole document *	7,8,14	A47L9/28 A47L5/38
X	US 5 924 164 A (LINDSAY JR EDWARD W [US]) 20 July 1999 (1999-07-20)	1,9,15	
A	* the whole document *	2-8, 10-14	
A	US 5 191 673 A (DAMIZET PATRICK [FR]) 9 March 1993 (1993-03-09)	1-15	
A	GB 2 015 652 A (PALMOVIST K) 12 September 1979 (1979-09-12)	1-15	
A	US 2007/251046 A1 (KANG HEUNG-MOOK [KR]) 1 November 2007 (2007-11-01)	1-15	
A	* paragraph [0029] - paragraph [0044] *	1-15	
A	US 5 263 502 A (DICK JACK [US]) 23 November 1993 (1993-11-23)	1-15	
	* column 5, line 27 - column 6, line 50 *		
The present search report has been drawn up for all claims			TECHNICAL FIELDS SEARCHED (IPC) A47L
Place of search Munich		Date of completion of the search 14 September 2021	Examiner Jezierski, Krzysztof
CATEGORY OF CITED DOCUMENTS X : particularly relevant if taken alone Y : particularly relevant if combined with another document of the same category A : technological background O : non-written disclosure P : intermediate document T : theory or principle underlying the invention E : earlier patent document, but published on, or after the filing date D : document cited in the application L : document cited for other reasons & : member of the same patent family, corresponding document			

EPO FORM 1503 03.82 (P04C01)

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

EP 21 19 3135

5

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.

14-09-2021

10

15

20

25

30

35

40

45

50

55

Patent document cited in search report	Publication date	Patent family member(s)	Publication date
US 5850665 A	22-12-1998	NONE	
US 5924164 A	20-07-1999	AU 713430 B1 CA 2269691 A1 US 5924164 A US 5926908 A	02-12-1999 22-10-2000 20-07-1999 27-07-1999
US 5191673 A	09-03-1993	AT 129393 T CA 2017311 A1 DE 69023165 T2 DK 0399931 T3 EP 0399931 A1 ES 2080817 T3 FR 2647510 A1 HK 1007480 A1 US 5191673 A	15-11-1995 23-11-1990 21-03-1996 26-02-1996 28-11-1990 16-02-1996 30-11-1990 16-04-1999 09-03-1993
GB 2015652 A	12-09-1979	DE 2904102 A1 GB 2015652 A SE 410384 B US 4225272 A	23-08-1979 12-09-1979 15-10-1979 30-09-1980
US 2007251046 A1	01-11-2007	AT 506883 T CA 2539352 A1 EP 1667567 A1 KR 200342668 Y1 US 2007251046 A1 WO 2005027704 A1	15-05-2011 31-03-2005 14-06-2006 18-02-2004 01-11-2007 31-03-2005
US 5263502 A	23-11-1993	CA 2092266 A1 US 5263502 A	07-01-1994 23-11-1993

EPO FORM P0459

For more details about this annex : see Official Journal of the European Patent Office, No. 12/82