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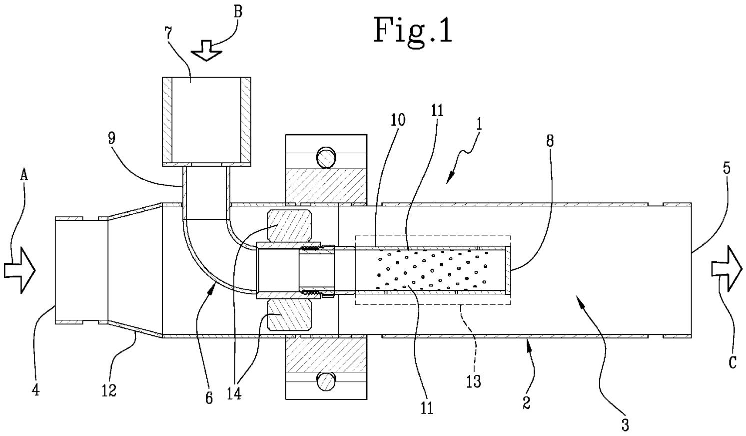
(54) MIXING DEVICE AND METHOD FOR CAF-SYSTEMS

(57) Mixing device (1) for CAFS systems, comprising a mixture source (A), a compressed air source (B), a first duct (2) in fluid communication with the mixture source (A) and a second duct (6) for injecting compressed air, extending from a first end (7) in fluid communication with the compressed air source (B) and a second end (8) within the first duct (2). The second duct (6) comprises at least a first (9) and a second tubular portion (10), the latter concentrically inserted within the first duct (2) and presenting at least one compressed air passage section (11).

Fig.1



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Description

[0001] The present invention relates to a mixing device and method for CAFS systems.

[0002] The present invention therefore relates to a device and method for mixing a solution of water and foam with compressed air to generate a Compressed Air Foam System capable of extinguishing fires.

[0003] As is well known, the necessary elements that fuel combustion, often referred to as "the fire triangle", are fuel, oxygen and heat.

[0004] Compressed air foam (CAFS) is more effective in extinguishing a fire than simple water or even a mixture of water and concentrated foam as it addresses all three elements of the fire triangle.

[0005] In fact, the CAFS system is highly effective because:

- it coats the fuel, cooling it below combustion temperature;
- it covers the fuel, separating it from the oxygen needed to keep it burning, which also prevents the outgassing of combustible gases;
- it cools an overheated environment by creating steam with the application of water-based foam.

[0006] Another advantage that the CAFS system has over water is that water damage and runoff are drastically reduced.

[0007] In fact, the CAFS system is a foamy solution that, depending on its consistency, flows at different, generally lower, speeds than the speed at which water alone is dispensed.

[0008] Lower speeds, and consequently lower flow rates, are correlated with a lower amount of mixture used and therefore less damage to the environment.

[0009] It follows that reduced speeds, compared to water pressure alone, result in greater protection with regard to possible damage to objects and/or persons.

[0010] Furthermore, depending on the need for action, a very dry CAFS system will remain in place like a blanket for hours, while a very wet CAFS system may drain off within minutes.

[0011] The distinction between wet CAFS and dry CAFS is related to the ratio of air flow to mixture flow (water + foam).

[0012] The dry CAFS system has a very long drainage time due to the bubbles bursting less easily and consequently not losing their water quickly.

[0013] In this way, the extinguishing action of the foam is prolonged for longer and until optimal cooling of the combusted parts.

[0014] In other words, the CAFS system can provide a range of useful consistencies, from very dry to very wet, by controlling the air/water ratio and foam concentrate.

[0015] The very wet CAFS system is often used in the initial phase of firefighting to immediately cool the fuel and the atmosphere.

[0016] The dry CAFS system, on the other hand, has a very long drainage time: the bubbles do not burst and quickly lose their water, which is effective when used at a later stage of firefighting, as a cover to separate fuel from oxygen, to protect exposed fuel from advancing fire and to prevent the outgassing of overheated materials.

[0017] Furthermore, CAFS systems can be particularly valuable for firefighters because the use of foam reduces the amount of water needed to extinguish a fire in areas where water sources may be limited or non-existent.

[0018] The smaller amount of water required also drastically reduces the weight and footprint of the CAFS system, allowing for a reduction in manpower and finalising rapid reduction of the threat before additional equipment and/or personnel arrive.

[0019] Current methods and devices for mixing compressed air and foam solution feed the compressed air into a single injection port located in the outer periphery of a hydraulic component, which can be, for example, a valve body, a fitting or a pipe through which the foam solution flows.

[0020] With this single-point injection, the compressed air is not evenly distributed within the foam solution and the resulting bubble structure in the mixture is uneven.

[0021] In addition, the compressed air injection section is typically large, resulting in the production of bubbles with a diameter in the order of greater than 10^0mm.

[0022] For example, CAFS systems are known to use static mixers or scrubbers consisting of a series of perforated plates, discs or other irregular shapes arranged within the mixture delivery duct and downstream of the air injection position to interrupt the flow path and cause turbulence to further mix the compressed air and foam solution.

[0023] While this interruption in flow improves mixing and foam formation, the friction through the device is increased, resulting in a reduction in the pressure of the delivered flow. As a result, the CAFS systems described above have the major drawback of limiting the flow rate from a fire hose or nozzle directed at the fire to be extinguished.

[0024] Furthermore, although the systems and methods of the prior art described above (and other systems and methods currently used for foam generation) can lead to foam generation suitable for some specific purposes, these systems and methods nevertheless fail to generate foam in a manner and quality for widespread and effective use and are improvable in several respects.

[0025] Therefore, there remains a need for foam generation devices that are capable of producing high volumes of foam with homogeneous bubbles that can be delivered effectively when and where needed.

[0026] In this context, in order to improve the effectiveness of CAFS systems, it is necessary to achieve a flow with bubble sizes as small as possible and homogeneous in both spatial distribution and mean size dispersion.

[0027] All other things being equal, a smaller average bubble diameter and a more homogeneous distribution provide several advantages:

- for the same volume of air, smaller bubbles maximise the heat exchange surface area and thus directly affect the heat extracted from the target combustion;
- homogeneous injection of air with small bubble size maximises the expansion process of the bubbles in the mixture (water - foam - air) once ambient pressure is reached, resulting in foam with better extinguishing properties;
- homogeneous injection of air with small bubbles also maximises the clinging power of the foam thus generated on surfaces, allowing for a higher protection potential of the fire protection foam layer on vertical and/or very sloping walls;
- the higher extinguishing power allows less water to be used, resulting in a longer fire-fighting range for the same tank size.

[0028] Advantageously, the reduced use and consumption of water brings further benefits in terms of the size of the dispensing and transporting devices for the mixture, as the water-foam tanks are smaller.

[0029] In addition, there are also economic and environmental benefits from reduced water consumption.

[0030] The technical task of the present invention is therefore to provide a device and a mixing method for CAFS systems that can overcome the drawbacks of the prior art.

[0031] The aim of the present invention is therefore to provide a device and a mixing method for CAFS systems capable of minimising the average diameter of the air bubbles by implicitly maximising their quantity for the same injected volume per unit time.

[0032] A further aim of this solution is therefore to provide a device and mixing method for CAFS systems that can make the flow of air injected into the volume of foam fluid vein (water and foam) as homogeneous as possible in order to maximise the physical bubble generation reaction and consequently increase the density of compressed air foam.

[0033] Finally, a further aim of the present invention is to provide a device and a mixing method for CAFS systems capable of minimising the dimensional dispersion of the air bubble diameter.

[0034] The technical task outlined and the objects specified are substantially achieved by a mixing device and method for CAFS systems comprising the technical features set forth in one or more of the appended claims.

[0035] According to an aspect of the present invention, a mixing device for CAFS systems is made available.

[0036] The mixing device comprises a mixture source consisting of at least a water component and a fire-fighting foam component.

[0037] The mixing device also comprises a compressed air source.

[0038] The mixing device comprises a first duct and a second duct, connected to the mixture source and the compressed air source, respectively.

[0039] The first duct has a channel extending from an inlet to an outlet.

[0040] The inlet is in fluid communication with the mixture source.

[0041] The outlet is configured to release compressed air foam.

[0042] The second duct, for the injection of compressed air, extends from a first end in fluid communication with the compressed air source and a second end within the first duct.

[0043] The second duct comprises at least a first tubular portion and at least a second tubular portion inserted concentrically within the first duct.

[0044] The second tubular portion also comprises at least one passage section of the compressed air.

[0045] This feature makes it possible to maximise the physical reaction of bubble generation and consequently increase the density of compressed air foam. The specified technical task and purposes are also achieved by a mixing method for CAFS systems.

[0046] The method comprises the step of injecting mixture into a first duct, internally defining a channel, connected to a mixture source towards an outlet, of the first duct, configured to release compressed air foam.

[0047] The method further comprises the step of injecting compressed air transversally to the mixture injection direction into the channel of the first duct.

[0048] This feature makes the mixture of compressed air and foam as homogeneous as possible.

[0049] Further features and advantages of the present invention will become more apparent from the indicative and therefore non-limiting description of a mixing device and method for CAFS systems.

[0050] Such description will be set forth herein below with reference to the accompanying drawings, provided for merely indicative and therefore non-limiting purposes, wherein:

- Figure 1 shows a side elevation and longitudinal section view of a mixing device for CAFS systems according to the present invention;
- Figure 2 is a side elevation view of the device of Figure 1; and
- Figure 3 is a perspective and front view of the device of Figure 1.

[0051] With reference to the appended figures, 1 indicates in its entirety a mixing device for CAFS systems which, for simplicity of description, will be referred to below as the mixing device 1.

[0052] The mixing device 1 comprises a mixture source "A", a compressed air source "B", a first conduit 2 in fluid communication with the mixture source "A" and a second conduit 6 for the injection of compressed air.

[0053] The mixture source "A" consists of at least a water component and a fire-fighting foam component.

[0054] The first duct 2 has a channel 3 extending from an input 4 to an output 5.

[0055] Preferably, the channel 3 of the first duct 2 comprises at least one expansion 12 of the section.

[0056] The input 4 is in fluid communication with the mixture source "A", while the output 5 is configured to release compressed air foam "C" to a fire to be extinguished.

[0057] The second duct 6, for the injection of compressed air, extends from a first end 7 in fluid communication with the compressed air source "B" and a second end 8 within the first duct 2.

[0058] Preferably, the second end 8 of the second duct 6 is occluded.

[0059] In other words, the second duct 6 has an inlet, i.e. the first end 7 in fluid communication with the compressed air source "B", but at the second end 8 there is no opening or outlet for the passage of compressed air.

[0060] The second duct 6 comprises at least a first tubular portion 9 and at least a second tubular portion 10 concentrically inserted within the first duct 2.

[0061] In other words, the second tubular portion 10 is arranged with its respective longitudinal extension axis coinciding with the longitudinal extension axis of the first duct 2. This positioning is achieved by means of respective tabs 14 (visible in Figures 1 and 3) which engage the second tubular portion 10 in position with respect to the inner surface of the first duct 2.

[0062] In particular, four tabs 14 are equally spaced and arranged around the peripheral extension of the second tubular portion 10. Each tab 14 engages the outer surface of the second tubular portion 10, next to the first portion 9, at the inner surface of the duct 2. In this way, the tabs 14 serve the function of centring the second portion 10, keeping it in the centre and inside the duct 2.

[0063] Advantageously, from a structural point of view, the tabs 14 prevent hazardous vibration phenomena.

[0064] In addition, each tab 10 is arranged shear, i.e. with a flat surface parallel to the direction of the mixture feed, so as not to deviate or interfere with that feed.

[0065] Preferably, the first tubular portion 9 is transverse to the second tubular portion 10 and the first tubular portion 9 is arranged perpendicular to the longitudinal extension of the first duct 2.

[0066] According to a possible embodiment, at least one expansion 12 of the channel section 3 of the first duct 2 is located in the vicinity of the first tubular portion 9 of the second duct 6.

[0067] Specifically, the at least one expansion 12 of the channel section 3 may be located between the inlet 4 of the first duct 2 and the first tubular portion 9 of the second duct 6.

[0068] In other words, the geometry of the first duct 2 has an expansion 12 of the channel 3 in proximity to the insertion of the second duct 6.

[0069] Advantageously, the expansion 12 of the channel 3 is arranged upstream of the second duct 6.

[0070] The resulting recovery of local static pressure, resulting from the geometric positioning of at least one expansion 12 of the section, allows the containment of the local volume of bubbles created by the mixing of mixture and compressed air.

[0071] In other words, it is essential that the correct formation and distribution of the bubbles that form the compressed air foam takes place, thanks to which it is possible to derive, depending on their physical and chemical properties, all the technical characteristics that facilitate the extinguishing of fires.

[0072] The second tubular portion 10 further comprises at least one compressed air passage section 11.

[0073] Injection takes place coaxially in the centre of the channel 3 so that the mixture of air and foam is as homogeneous as possible.

[0074] More specifically, injection occurs from the centre of the channel 3 and towards the periphery, in a direction radial to the cross-section of channel 3 itself.

[0075] Advantageously, coaxial injection allows the compressed air to follow the channel 3 of the first duct 2, where the mixture is injected, without creating a high pressure drop within the mixing device 1.

[0076] Also advantageously, coaxial injection, unlike a 90° inlet, prevents the fluid section from being blocked by the incoming air, always leaving a passage section for the mixture.

[0077] The proposed geometries maximise the shear stresses generated by the mixture around the coaxial injector as high tangential stresses minimise the size of the bubbles generated by the mixture source "A".

[0078] Advantageously, the geometries proposed for the mixing device 1 maximise local turbulence with a significant contribution to the maintenance of relatively small diameter bubbles.

[0079] Preferably, at least one passage section 11 has a diameter of 1 mm.

[0080] More preferably, the passage sections have the same size.

[0081] According to a possible embodiment, the passage section 11 comprises multiple perforations.

[0082] The multiple perforations along the second tubular portion 10 are shaped to deliver compressed air transversally to the mixture injection direction along the channel 3.

[0083] Preferably, none of the multiple perforations deliver compressed air into the channel 3 of the first duct 2 in a direction concordant with the mixture injection direction.

[0084] For this purpose, as specified above, the terminal end 8 is occluded to prevent air from being dispensed in a direction parallel to the mixture dispensing direction.

[0085] The multiple perforations run along a longitudinal section of the second tubular portion 10 of the second duct 6.

[0086] Preferably, the multiple holes are evenly distributed along the second tubular portion 10 of the second duct 6.

[0087] Therefore, as can be seen from Figure 1, the holes are made on the cylindrical outer surface of the second tubular portion 10.

[0088] According to a possible embodiment, the second tubular portion 10 may comprise a surface layer.

[0089] In a first case, the second tubular portion 10 comprises a wire mesh surrounding the portion itself.

[0090] Alternatively, the second tubular portion 10 may comprise a surface layer made of sintered material.

[0091] In Figure 1, the possible presence of a wire mesh or sintered material around the second tubular portion 10 is depicted by hatching, surrounding the portion itself, and indicated for both cases with the number 13.

[0092] Preferably, the surface layer 13 made of sintered material has a porosity in the range of 50 μm to 100 μm.

[0093] The dependence on pore size (as defined in terms of degree of the medium) and the volume of compressed air injected shows that lower degrees and lower flow rates correspond to smaller bubble sizes and less dispersed dimensions.

[0094] Advantageously, the use of porous injectors is the preferred methodology for producing a larger population of bubbles per unit time.

[0095] Preferably, the sintered material 13 has a hydrophilic substrate.

[0096] Advantageously, the hydrophilic substrate promotes the formation of bubbles with a smaller size than a hydrophobic substrate.

[0097] In other words, the injection of compressed air can take place through the second tubular portion 10 comprising multiple small holes that can be covered in turn by a wire mesh and/or a surface layer 13 made of sintered material.

[0098] Advantageously, the diameter of the at least one passage section 11 obtained on the second tubular portion 10, from the many proposed solutions, is proportional to the size of the bubbles in the mixture.

[0099] Thanks to the proposed solutions, the bubbles of the compressed air foam "C" delivered to the outlet 5 of the first duct 2 can reach sizes in the order of $10\text{-}10^2$ μm.

[0100] Advantageously, the smaller diameter of the bubbles, all other conditions being equal, statistically reduces the probability of coalescence of the bubbles as they feed into the channel 3 up to outlet 5 of the latter.

[0101] The small cross-sections 11 and/or the porosity of the sintered material of the second tubular portion 10 realise a high total injection area of compressed air resulting in a low inlet speed of compressed air into the channel 3.

[0102] It follows that, for the same volume of compressed air foam "C" per unit time delivered, lower compressed air inlet speeds are correlated with a smaller average diameter of bubbles generated.

[0103] Advantageously, the generation of bubbles with a low average diameter allows the number of bubbles in the channel 3 to be increased for the same amount of compressed air foam "C" per unit time.

[0104] The present invention also provides a mixing method for CAFS systems.

[0105] The mixing method includes the steps of injecting mixture and compressed air into a common channel 3.

[0106] The phase of injecting mixture occurs in a first duct 2, defining the channel 3, from an input 4 of the channel 3, connected to a mixture source "A", to an outlet 5 of the channel 3 configured to release compressed air foam "C" to a fire to be extinguished.

[0107] The phase of injecting compressed air, on the other hand, takes place transversally to the mixture injection direction into the channel 3.

[0108] Preferably, the compressed air injection step takes place by means of a second duct 6 from a central portion to the outside of the duct 3.

[0109] The second duct 6 appears to be located internally and concentrically to the first duct 2.

[0110] More preferably, the compressed air injection step does not take place in a direction concordant with the mixture injection direction.

[0111] According to a possible embodiment of the method, the compressed air injection step takes place downstream of an expansion 12 of the channel section 3 of the first duct 2.

[0112] Advantageously, the present invention provides a device 1 and a mixing method for CAFS systems capable of overcoming the drawbacks of the prior art.

[0113] In fact, it should be noted that the present invention makes it possible to minimise the average diameter of the air bubbles by implicitly maximising their quantity for the same volume injected per unit time. This advantage is derived from the presence of the passage section 11 in the form of holes or pores in the sintered material. Moreover, the mesh 13 further minimises the cross-section of the bubbles.

[0114] Advantageously, the present invention is also able to make the flow of air injected into the volume of fluid mixture vein (water and foam) as homogeneous as possible in order to maximise the physical reaction of bubble generation and consequently increase the density of compressed air foam "C". This advantage is derived from the compressed air injection direction, which is always transverse to the direction of the foam flow and concentric at the point of maximum fluid speed.

[0115] In addition, this condition also minimises the dimensional dispersion of the air bubble diameter, and consequently increases the fire-fighting properties of the compressed air foam.

[0116] Advantageously, a possible production of lighter hoses follows from the present invention, which can help personnel to be more efficient during an emergency, as there is a limited use of water and a consequent decrease in the density of the compressed air foam delivered by the device.

[0117] Advantageously, a reduced use of foaming agent increases the autonomy of the mixing device 1, as well as saving money.

[0118] Advantageously, the present invention provides an environmental benefit by reducing the dispersion of toxic gases.

Claims

1. Mixing device (1) for CAFS systems, comprising:

   - a mixture source (A), wherein said mixture consists of at least a water component and a fire-fighting foam component;
   - a compressed air source (B);
   - a first duct (2) having a channel (3) extending from an inlet (4) to an outlet (5), said inlet (4) being in fluid communication with the mixture source (A) and said outlet (5) being configured to release compressed air foam (C); and
   - a second duct (6) for injecting compressed air, extending from a first end (7) in fluid communication with the compressed air source (B) and a second end (8) within the first duct (2);

   characterised in that said second duct (6) comprises at least a first tubular portion (9) and at least a second tubular portion (10) concentrically inserted within said first duct (2), said second tubular portion (10) comprising at least one passage section (11) of the compressed air.

2. Mixing device (1) according to the preceding claim, wherein said at least one passage section (11) comprises multiple perforations, said multiple perforations extending along a longitudinal segment of the second tubular portion (10) of said second duct (6).

3. Mixing device (1) according to claim 2, wherein said multiple perforations are evenly distributed along said second tubular portion (10) of said second duct (6).

4. Mixing device (1) according to one or more of the preceding claims, wherein said second tubular portion (10) comprises a wire mesh (13) surrounding said portion.

5. Mixing device (1) according to one or more of the preceding claims, wherein said at least one passage section (11) has a diameter of 1 mm.

6. Mixing device (1) according to one or more of the preceding claims, wherein said second tubular portion (10) comprises a surface layer (13) made of sintered material surrounding said portion.

7. Mixing device (1) according to claim 6, wherein said surface layer (13) made of sintered material has a porosity in the range of 50 μm to 100 μm.

8. Mixing device (1) according to one or more of the preceding claims, wherein said first tubular portion (9) is transverse to said second tubular portion (10) and wherein said first tubular portion (9) is arranged perpendicular to the longitudinal extension of the first duct (2).

9. Mixing device (1) according to one or more of the preceding claims, wherein said channel (3) of said first duct (2) comprises at least an expansion (12) of the section.

10. Mixing device (1) according to claim 9, wherein said at least an expansion (12) of the section of said channel (3) of said first duct (2) is placed near said first tubular portion (9) of said second duct (6).

11. Mixing device (1) according to claim 9 or 10, wherein said at least an expansion (12) is placed between said inlet (4) of said first duct (2) and said first tubular portion (9) of said second duct (6).

12. Mixing method for CAFS systems, including the steps of:

    - injecting mixture into a first duct (2), defining a channel (3), from an inlet (4) of said channel (3), connected to a mixture source (A), towards an outlet (5) of said channel (3) configured to release compressed air foam (C); and
    - injecting compressed air transversally to the mixture injection direction into said channel (3).

13. Mixing method for CAFS systems according to the preceding claim, wherein said compressed air injection step occurs from a central portion outwardly of a second duct (6), said second duct (6) being internal and concentric to said first duct (2).

14. Mixing method for CAFS systems according to claim 12 or 13, wherein said compressed air injection step occurs near an expansion (12) of the channel section (3) of said first duct (2).

15. Mixing method for CAFS systems according to one or more of the preceding claims 12 to 14, wherein said compressed air injection step does not occur in a direction concordant with the direction of mixture injection.

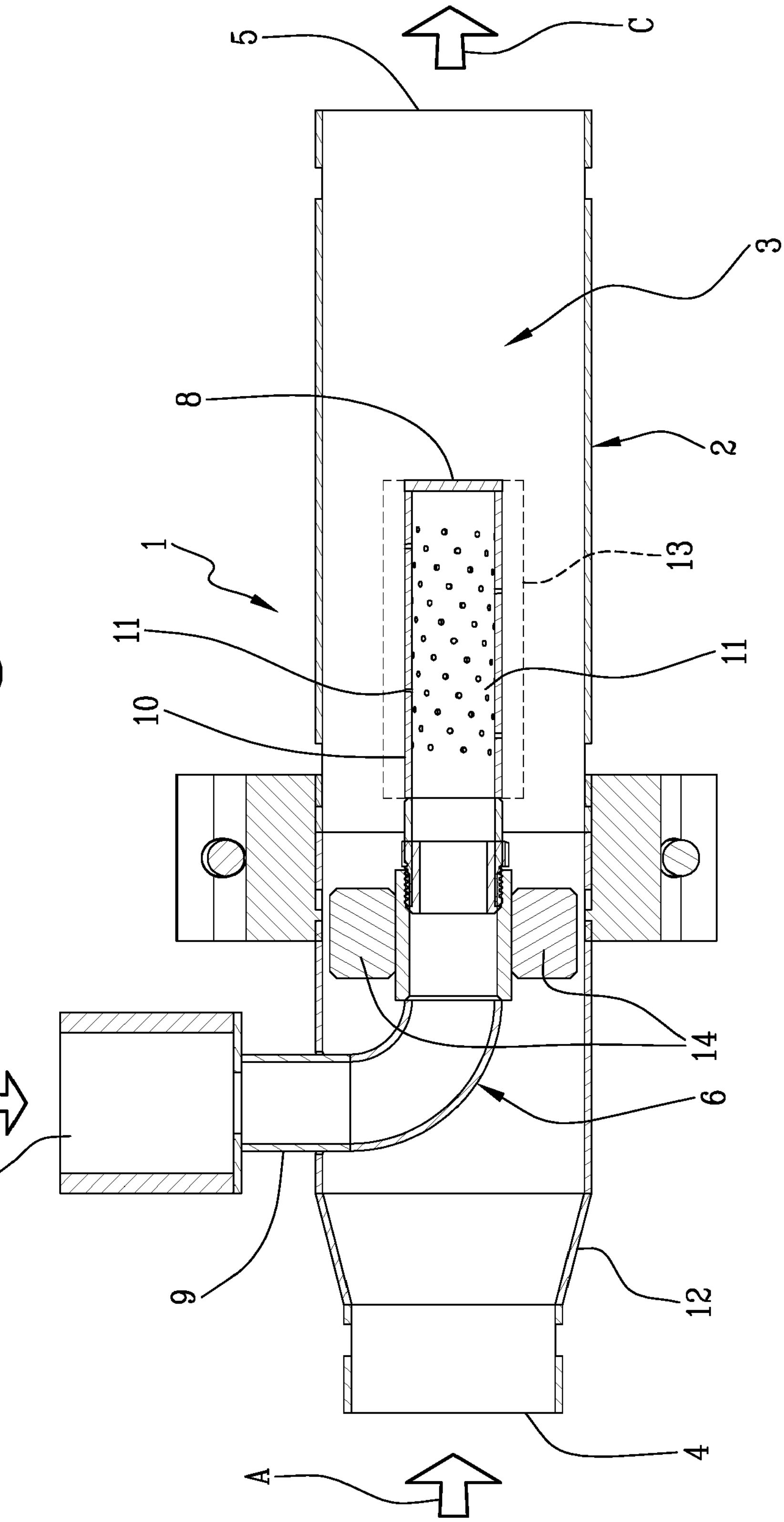


Fig.1

Fig.3

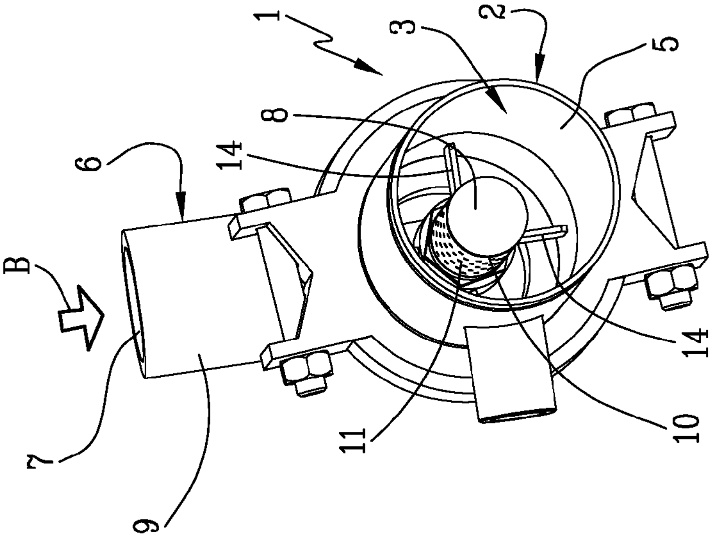
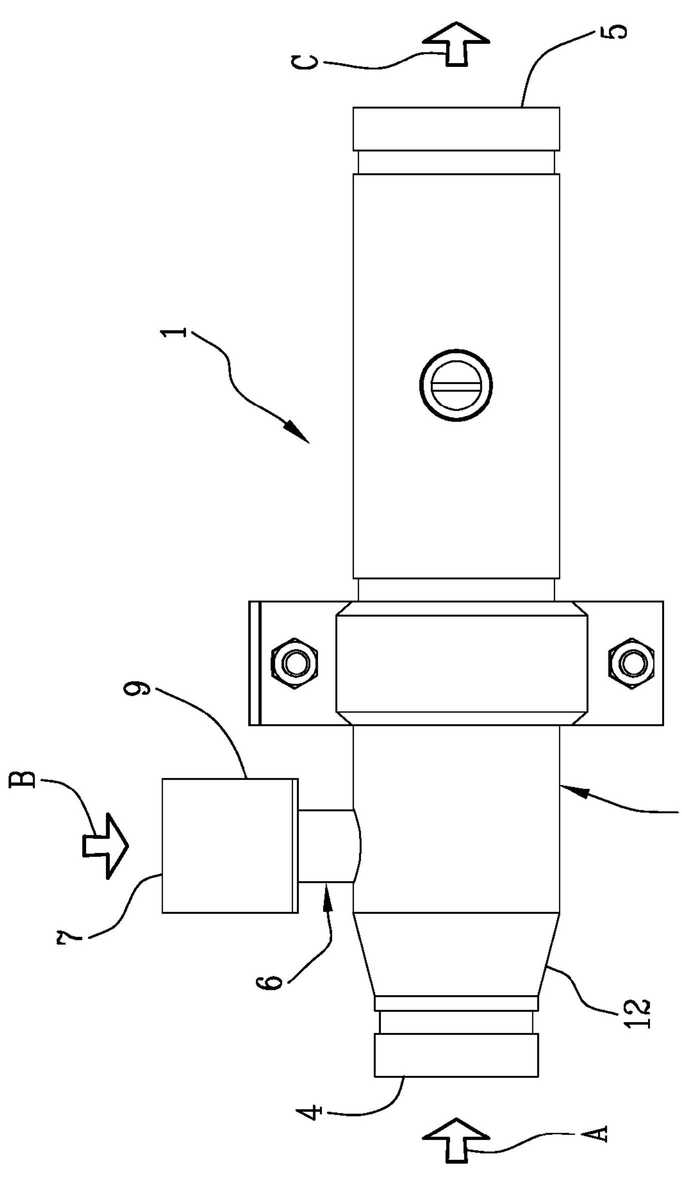


Fig.2



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EUROPEAN SEARCH REPORT

Application Number
EP 24 15 3831

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 A	US 2010/126738 A1 (KRUEGER TINO [DE] ET AL) 27 May 2010 (2010-05-27) * paragraph [0090] - paragraph [0097] * * figure 2 *	1-3, 12-14 4-11,15	INV. A62C5/02 ADD. A62C31/12
X	CN 112 156 403 A (TIANJIN FIRE RES INSTITUTE OF MEM) 1 January 2021 (2021-01-01) * paragraph [0036] - paragraph [0039] * * figures *	1-15	
X A	CN 110 975 193 A (PAVLN SECURITY TECH LTD) 10 April 2020 (2020-04-10) * figures 1,2,11 *	1-3,8-15 4-7	

TECHNICAL FIELDS SEARCHED (IPC)
A62C

The present search report has been drawn up for all claims

Place of search	Date of completion of the search	Examiner
The Hague	24 June 2024	Nehrdich, Martin

1

CATEGORY OF CITED DOCUMENTS

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

EP 24 15 3831

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
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24-06-2024

Patent document cited in search report	Publication date	Patent family member(s)	Publication date
US 2010126738 A1	27-05-2010	BR PI0811417 A2	16-06-2015
		CA 2685105 A1	06-11-2008
		CN 101754785 A	23-06-2010
		EP 1985333 A1	29-10-2008
		EP 2144676 A1	20-01-2010
		ES 2395204 T3	11-02-2013
		JP 5244903 B2	24-07-2013
		JP 2010525851 A	29-07-2010
		PT 2144676 E	11-12-2012
		RU 2008151529 A	27-06-2010
		US 2010126738 A1	27-05-2010
		WO 2008132604 A1	06-11-2008
CN 112156403 A	01-01-2021	NONE	
CN 110975193 A	10-04-2020	NONE	

EPO FORM P0459

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