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## DESCRIPTION

**[0001]** The present invention refers to a fog-generating device, adapted to produce very thick fog, to increase the safety level of an alarm system.

**[0002]** Fog-generating devices are adapted to produce a very thick fog, which completely prevents the vision. To obtain this result, it is necessary that a fog-generating fluid is quickly evaporated and afterwards condensed into micro-droplets. The size of these droplets is rather big for them not to be crossed by light without interfering therewith, and consequently they cause a diffusion phenomenon (scattering) which precludes visibility.

**[0003]** These devices are therefore adapted to prevent a theft or a robbery, since they quickly produce an amount of fog which, for a long time, completely prevents the vision, so that a thief or robber, getting confused, often refrains from continuing.

**[0004]** To minimize the chance that a thief completes his theft or causes damages, it is necessary that the environment saturation occurs in the shortest possible time. To obtain this result, it is necessary to give the fluid a high power, at least equal to the specific evaporation heat for the number of units of required liquid mass.

**[0005]** The necessary power to have adequate effects ranges from few kW, for machines with scarce performances, to tens or even hundreds of kW for machines at top level. It is clear that such powers cannot be delivered by meters of the supplier of electric energy, but extracted from an "energy warehouse" placed on site. The sizes of this warehouse in terms of kWh give the maximum amount of fog-generating fluid capable of evaporating from the apparatus.

**[0006]** Such energy is stored in thermal form in the sensitive heat of a metallic mass. This mass is preferably heated by an electric resistance for a time long enough not to require high powers, the accumulated heat being quickly given when it is crossed by a fog-generating fluid which moves along the serpentine and/or meatuses obtained therein.

**[0007]** The construction of these internal circuits is critical for the correct extraction of energy from the accumulator, this extraction having to be performed in very short times.

**[0008]** Currently, the circuits are made with deep holes connected in the high and low parts of the accumulator through transverse holes and welding. This work is very long and costly, both in terms of execution time and in terms of tools and waste of material. Moreover, the space of the hole is subtracted from the thermal mass of the accumulator.

**[0009]** Upon increasing the required power, the number of holes must increase in order to increase the exchange surface, and a technical/economic limit is soon reached for the construction.

**[0010]** WO-A1-2014/102365 discloses a fog-generating device according to the preamble of claim 1.

**[0011]** Currently used devices are technical and economic compromises, which makes it difficult and not convenient the completion of the application of such technology. Moreover, the use of materials with high thermal conductivity, such as aluminum, if on one hand enable extracting heat, on the other hand makes the fluid too quickly evaporate, creating a gas cushion which insulates the drop of fluid from a thermal contact. This is known as "Leidenfrost effect". Vice versa, if the metal has a low thermal conductivity, the temperature of the surface, in contact with the fluid, quickly decreases. The Leidenfrost effect is cancelled, but the chance of quickly extracting head from the metallic part far from the channel, is reduced.

**[0012]** Object of the present invention is solving the above prior art problems, by providing a new solution which overcomes the above limitations.

**[0013]** The above and other objects and advantages of the invention, as will appear from the following description, are obtained with a device as claimed in claim 1.

**[0014]** Preferred embodiments and non-trivial variations of the present invention are the subject matter of the dependent claims.

**[0015]** It is intended that all enclosed claims are an integral part of the present description.

**[0016]** It will be immediately obvious that numerous variations and modifications (for example related to shape, sizes, arrangements and part with equivalent functionality) can be made to what is described, without departing from the scope of the invention as appears from the enclosed claims.

**[0017]** The present invention will be better described by some preferred embodiments thereof, provided as a non-limiting example, with reference to the enclosed drawings, in which:

- Figures 1 and 2 show the fog-generating device of the invention, respectively from its upper part and its lower part; and
- Figures 3, 4 and 5 show the internal elements of the fog-generating device of the invention.

**[0018]** With reference to the Figures, the fog-generating device 1 of the invention is adapted to produce a thick fog to increase the safety level of an alarm system, and is of the type which comprises a heat accumulator adapted to store thermal energy and to release it to a fog-generating fluid, to produce steam.

**[0019]** The fog-generating device 1 comprises:

- first heating means adapted to produce the thermal energy;
- second means adapted to put the fog-generating fluid in contact with the heat accumulator;
- third means adapted to support a quick thermal exchange between the heat accumulator and the fog-generating fluid, the thermal exchange being quick enough to support a production of steam; and
- fourth means adapted to expel the steam produced following the vaporization of the fog-generating fluid.

**[0020]** The third means, adapted to support a quick thermal exchange between the heat accumulator and the fog-generating fluid, comprise a thermal mass composed of a plurality of small metal plates 11, 12, 13, 14, 15, 16, 17, 18, 19, 20 housed, inside a container 2, in order to locate a path of the fog-generating fluid adapted to lick the surface of the small metal plates 11, 12, 13, 14, 15, 16, 17, 18, 19, 20, generating a vaporization of the fog-generating fluid, the small plates 11, 12, 13, 14, 15, 16, 17, 18, 19, 20 being composed of first small plates 11, 13, 15, 17, 19 and second small plates 12, 14, 16, 18, 20 and being assembled in order to locate meatuses adapted to allow the flow of the fog-generating fluid.

**[0021]** Means are provided which are adapted to hydraulically mutually connect the meatuses, the hydraulic connection means, adapted to hydraulically mutually connect the meatuses, comprising a plurality of first pouring holes or areas 11a, 13a, 15a, 17a, 19a and a plurality of second pouring holes or areas 12a, 14a, 16a, 18a, 20a obtained on the small plates 11, 12, 13, 14, 15, 16, 17, 18, 19, 20.

**[0022]** The first pouring holes or areas 11a, 13a, 15a, 17a, 19a are made next to the external edge of the first small plates 11, 13, 15, 17, 19, while the second pouring holes or areas 12a, 14a, 16a, 18a, 20a are arranged inside the second small plates 12, 14, 16, 18, 20 next to the core of the fog-generating device 1, the first small plates 11, 13, 15, 17, 19 being alternated with the second small plates 12, 14, 16, 18, 20 inside the container 2.

**[0023]** With reference to Figures 1 and 2, 1 designates the fog-generating device with disks of the invention. The fog-generating device 1 is a boiler comprising a container 2, for example with a cylindrical shape, closed in its lower part by a first small plate 3 and in its upper part by a second small plate 4.

**[0024]** A central hole 5 is obtained on the first small lower closing plate 3, in which a metallic core 6 is inserted, which extends till it touches the second small upper closing plate 4 or is inserted inside it. The metallic core 6, in turn, has a longitudinal hole 6a to insert one or more electric resistances for heating the fog-generating device 1.

**[0025]** On the first small lower closing plate 3 there is also a hole 7 for entering the fog-generating liquid, as shown by arrow "I". on the small lower closing plate 3 there are possibly

also threaded holes 8 for supporting feet, should the fog-generating device 1 be rested on a sheet of a container or a horizontal plane.

**[0026]** On the second small upper closing plate 4 a hole 9 is obtained, through which the vaporized the fog-generating fluid goes out, as pointed out by arrow "O".

**[0027]** Inside the container 2 a plurality of small metal plates 11, 12, 13, 14, 15, 16, 17, 18, 19, 20 are inserted (Figure 3), included between the small lower 3 and upper 4 closing plates, the small plates being mutually separated, in order to locate meatuses whose thickness is a few millimeters, these meatuses being mutually communicated by a plurality of pouring holes 11a, 12a, 13a, 14a, 15a, 16a, 17a, 18a, 19a, 20a obtained on the small plates 11, 12, 13, 14, 15, 16, 17, 18, 19, 20.

**[0028]** According to a preferred embodiment, the small plates 11, 12, 13, 14, 15, 16, 17, 18, 19, 20 are axially drilled in order to be inserted on the metallic core 6.

**[0029]** Figure 5 shows first small plates designated by odd numbers 11, 13, 15, 17, 19, while Figure 4 shows second small plates designated with even numbers 12, 14, 16, 18, 20.

**[0030]** The first small plates, designated with odd numbers 11, 13, 15, 17, 19, alternate with the second small plates, designated with even numbers 12, 14, 16, 18, 20. On the first small plates 11, 13, 15, 17, 19 the pouring holes 11a, 13a, 15a, 17a, 19a are made next to the external edge of the small plates themselves, while on the second small plates 12, 14, 16, 18, 20 the pouring holes 12a, 14a, 16a, 18a, 20a are made in the internal area, in particular next to the central core 6.

**[0031]** According to a preferred embodiment, layers of small plates with different thickness and of the same or different materials are alternated (as a non-limiting example, steel and aluminum), the choice being made depending on requested performances. Solution which use aluminum in combination with steel allow improving the thermal capacity of the heat exchanged with the same weight, and avoiding, or at least minimizing, the Leidenfrost effect, which occurs in boilers only made of aluminum.

**[0032]** In particular, the thickness of the various small plates will be related with the thickness of the corresponding meatuses, in order to optimize the amount of heat and the thermal exchange step by step in the process, as will be better specified below.

**[0033]** Once the pack of small plates has reached the operating temperature, the fog-generating fluid is inserted through the hole 7 present on the small lower closing plate 3, and will therefore get in contact with the various layers composed of small plates 11, 12, 13, 14, 15, 16, 17, 18, 19, 20. The particular position of the pouring holes 11a, 12a, 13a, 14a, 15a, 16a, 17a, 18a, 19a, 20a compels the fog-generating fluid to lick the whole exchange surface, optimally subtracting heat.

**[0034]** The exchange surfaces, the thermal capacities of each small plate licked by the fog-generating fluid and the thickness of the meatuses will have to be chosen in order to optimize the amount of heat and the thermal exchange step by step in the process.

**[0035]** In the first section of the path, the sensible fluid temperature will be increases, in the second section the evaporation will occur and in the third section the steam overheating will occur.

**[0036]** Each step is associated with an optimum combination of accumulated energy and exchange surface, which can be easily made with the proposed technique.

**[0037]** According to the described embodiment, the container 2 is cylindrical. In this case, the small plates 11, 12, 13, 14, 15, 16, 17, 18, 19, 20 have a circular shape; however, the container 2 can also have a rectangular or polygonal shape: in such case, the small plates contained therein will have a corresponding shape.

**[0038]** Also the pouring holes 11a, 12a, 13a, 14a, 15a, 16a, 17a, 18a, 19a, 20a can have a shape different from the circular one, or can be replaced by continuous areas included between the external edge of the small plates and the external container 2, combined with other internal passage areas included between the internal edge of the small plates and the metallic core 6.

**[0039]** The metallic core 6 is an integral part of the machine sizing. Though scarcely contributing to the thermal exchange with the fog-generating fluid, it determines the transfer speed of heat between the heating element and the small accumulating plates 11, 12, 13, 14, 15, 16, 17, 18, 19, 20 and further acts as separating element (buffer) due to which the heating element is not subjected to sudden temperature variations during the vaporization of the fluid.

**[0040]** The thereby constructed boiler 1 allows the passage of the fog-generating fluid on the whole surface of the small plates 11, 12, 13, 14, 15, 16, 17, 18, 19, 20, optimizing the exchange surface and allowing to make also big-sized heat exchangers, because it width and thickness of the small plates can be easily dimensioned, allowing the use of all energy contained in the exchanger.

## **REFERENCES CITED IN THE DESCRIPTION**

Cited references

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**Patent documents cited in the description**

- [WO2014102365A1 \[0010\]](#)

## Patentkrav

1. Tågegenererende indretning (1), der er tilpasset til at frembringe tåge med henblik på at forøge et alarmsystems sikkerhedsniveau, af den type, der omfatter en varmeakkumulator, som er tilpasset til at lagre varmeenergi og at frigive den til et tågegenererende fluid til

- 5 frembringelse af damp, hvilken tågegenererende indretning (1) omfatter:
- et første opvarmningsmiddel, der er tilpasset til at frembringe varmeenergien;
  - et andet middel, der er tilpasset til at bringe det tågegenererende fluid i kontakt med varmeakkumulatoren;
  - et tredje middel, der er tilpasset til at understøtte en varmeveksling mellem
  - 10 varmeakkumulatoren og det tågegenererende fluid, idet varmevekslingen er tilstrækkelig til at understøtte en frembringelse af damp;
  - et fjerde middel, der er tilpasset til at udstøde den damp, som frembringes efter en fordampning af det tågegenererende fluid;

hvor det tredje middel, der er tilpasset til at understøtte en varmeveksling mellem

15 varmeakkumulatoren og det tågegenererende fluid, omfatter en varmemasse, som er sammensat af en flerhed af metalplader (11, 12, 13, 14, 15, 16, 17, 18, 19, 20), der er indeholdt i en beholder (2), med henblik på at lokalisere en bane for det tågegenererende fluid, der er tilpasset til at tildække metalpladernes (11, 12, 13, 14, 15, 16, 17, 18, 19, 20) overflade, hvilket genererer en fordampning af det tågegenererende fluid, idet pladerne (11, 12, 13, 14, 15, 16,

20 17, 18, 19, 20) er sammensat af førsteplader (11, 13, 15, 17, 19) og andenplader (12, 14, 16, 18, 20) og er samlet med henblik på at lokalisere passager, der er tilpasset til at tillade en strøm af det tågegenererende fluid, idet der er tilvejebragt midler, som er tilpasset til hydraulisk indbyrdes at forbinde passagerne, idet midlerne til hydraulisk forbindelse er tilpasset til hydraulisk indbyrdes at forbinde passagerne, der omfatter en flerhed af førstehuller

25 eller -områder (11a, 13a, 15a, 17a, 19a) og en flerhed af andenhuller eller -områder (12a, 14a, 16a, 18a, 20a), der er fremstillet på pladerne (11, 12, 13, 14, 15, 16, 17, 18, 19, 20), **kendetegnet ved, at** førstehullerne eller -områderne (11a, 13a, 15a, 17a, 19a) er fremstillet ved siden af yderkanten på førstepladerne (11, 13, 15, 17, 19), mens andenhullerne eller -områderne (12a, 14a, 16a, 18a, 20a) er anbragt på indersiden af andenpladerne (12, 14,

30 16, 18, 20) ved siden af kernen af den tågegenererende indretning, idet førstepladerne (11, 13, 15, 17, 19) alternerer med andenpladerne (12, 14, 16, 18, 20) inde i beholderen (2).

2. Tågegenererende indretning ifølge krav 1, **kendetegnet ved, at** pladerne (11, 12, 13, 14, 15, 16, 17, 18, 19, 20) er udboret aksialt med henblik på at blive indsat på en metalkerne (6).
3. Tågegenererende indretning ifølge et hvilket som helst af kravene 1 til 2, **kendetegnet ved, at** midlerne til hydraulisk forbindelse omfatter kontinuerlige områder, der er indbefattet mellem en yderkant af førstepladerne (11, 13, 15, 17, 19) og den ydre beholder (2), kombineret med andre indre passageområder, der er indbefattet mellem inderkanten på andenpladerne (12, 14, 16, 18, 20) og metalkernen (6).
4. Tågegenererende indretning ifølge et hvilket som helst af kravene 1 til 2, **kendetegnet ved, at** det første opvarmningsmiddel omfatter én eller flere elektriske modstande, der er indsat i et langsgående hul (6a), som er fremstillet i metalkernen (6).
5. Tågegenererende indretning ifølge krav 1, **kendetegnet ved, at** det andet middel, der er tilpasset til at bringe det tågegenererende fluid i kontakt med varmeakkumulatoren, omfatter et indgangshul (7), som er fremstillet i den nedre lukkeplade (3).
6. Tågegenererende indretning ifølge krav 1, **kendetegnet ved, at** det fjerde middel, der er tilpasset til at udstøde dampen, som frembringes af det tågegenererende fluid, omfatter et udgangshul (9), der er fremstillet på den øvre lukkeplade (4).
7. Tågegenererende indretning ifølge et hvilket som helst af kravene 1 til 6, **kendetegnet ved, at** pladerne (11, 12, 13, 14, 15, 16, 17, 18, 19, 20) er fremstillet af aluminium.
8. Tågegenererende indretning ifølge et hvilket som helst af kravene 1 til 6, **kendetegnet ved, at** pladerne (11, 12, 13, 14, 15, 16, 17, 18, 19, 20) delvist er fremstillet af aluminium og delvist er fremstillet af stål.

**DRAWINGS**

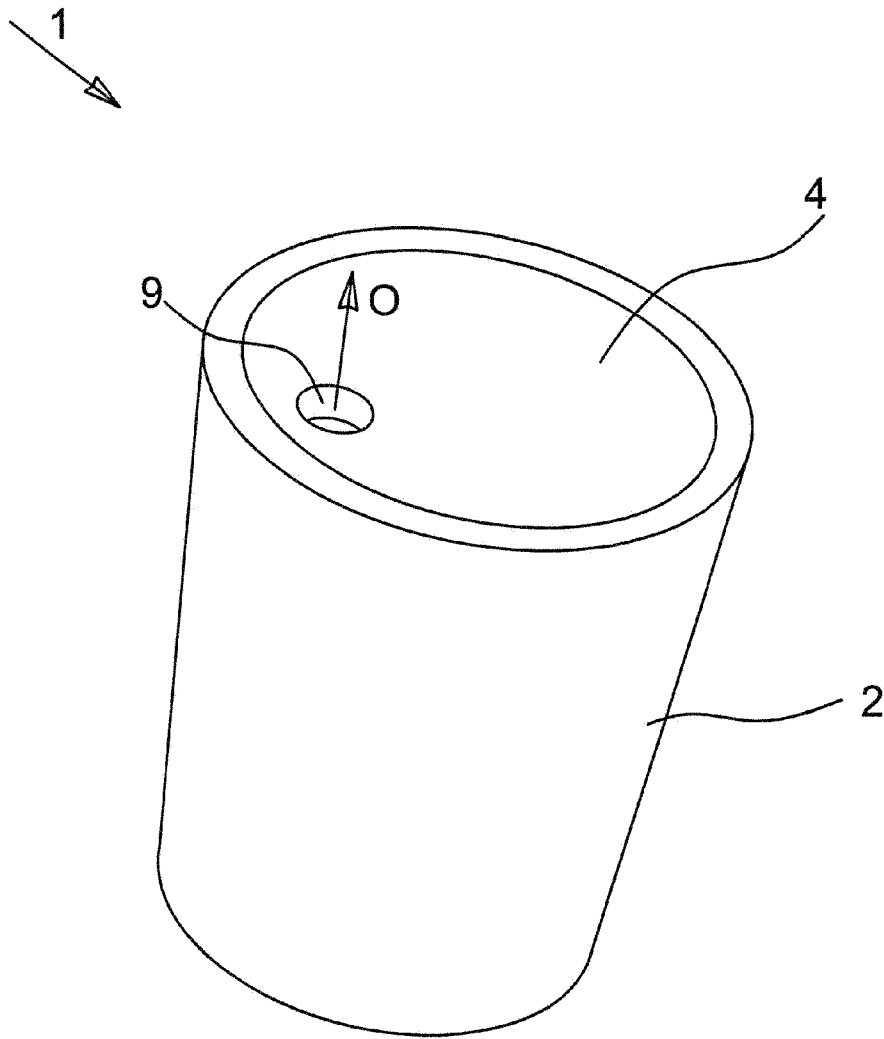


Fig. 1

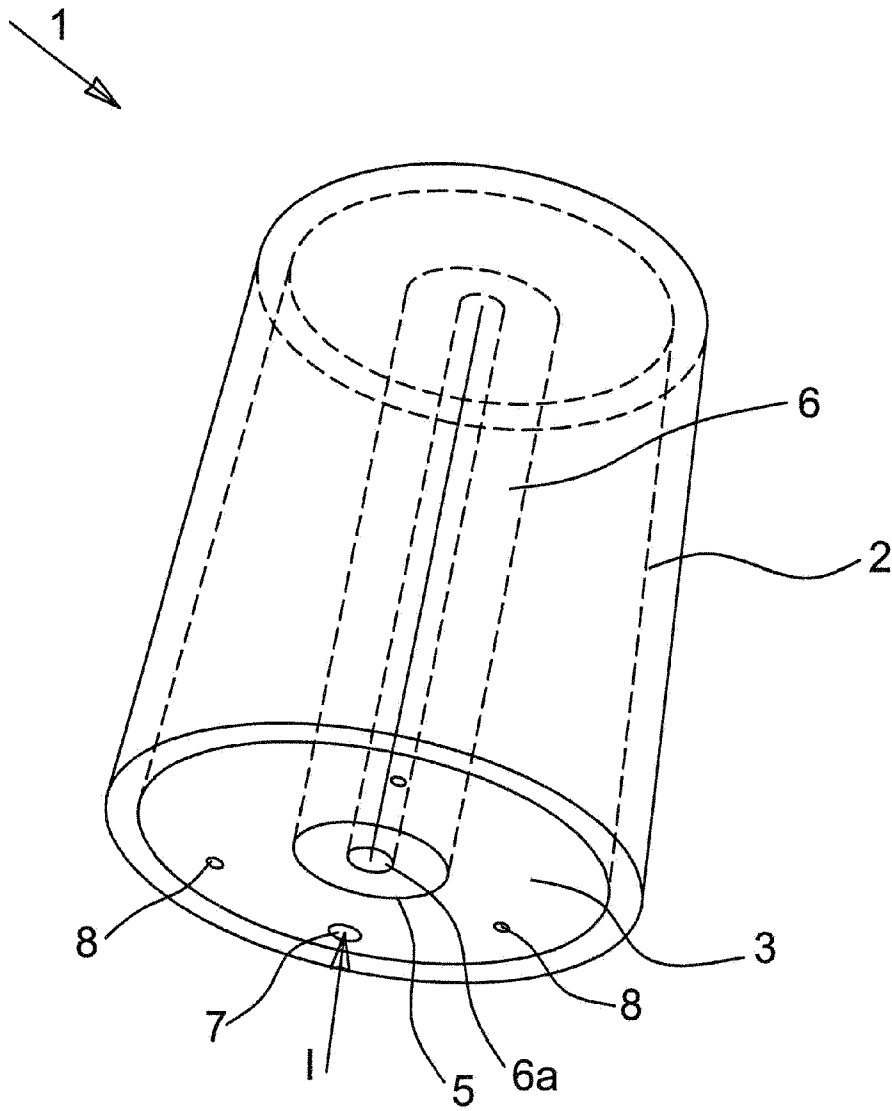


Fig. 2

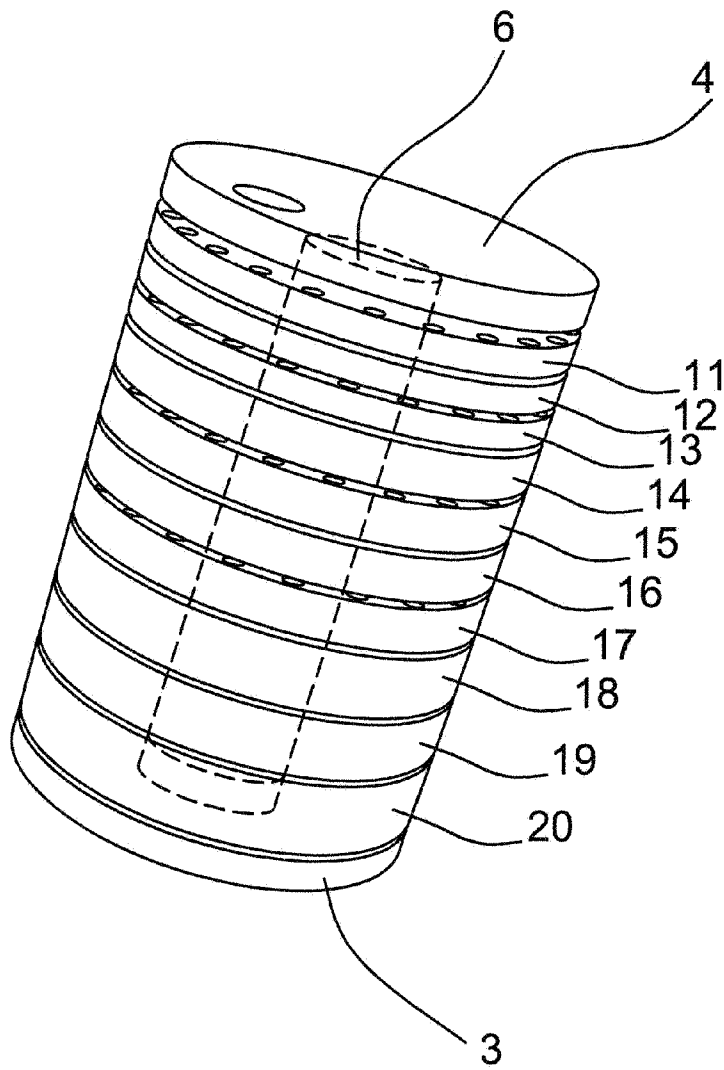


Fig. 3

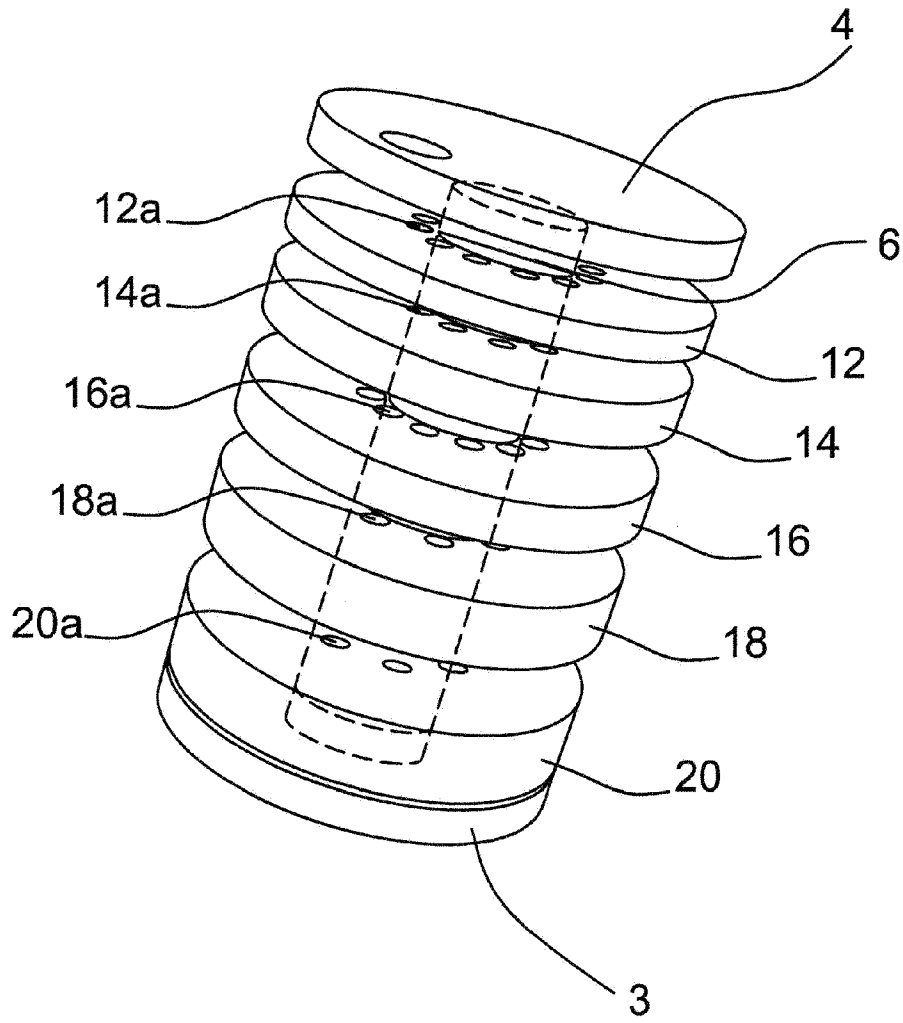


Fig. 4

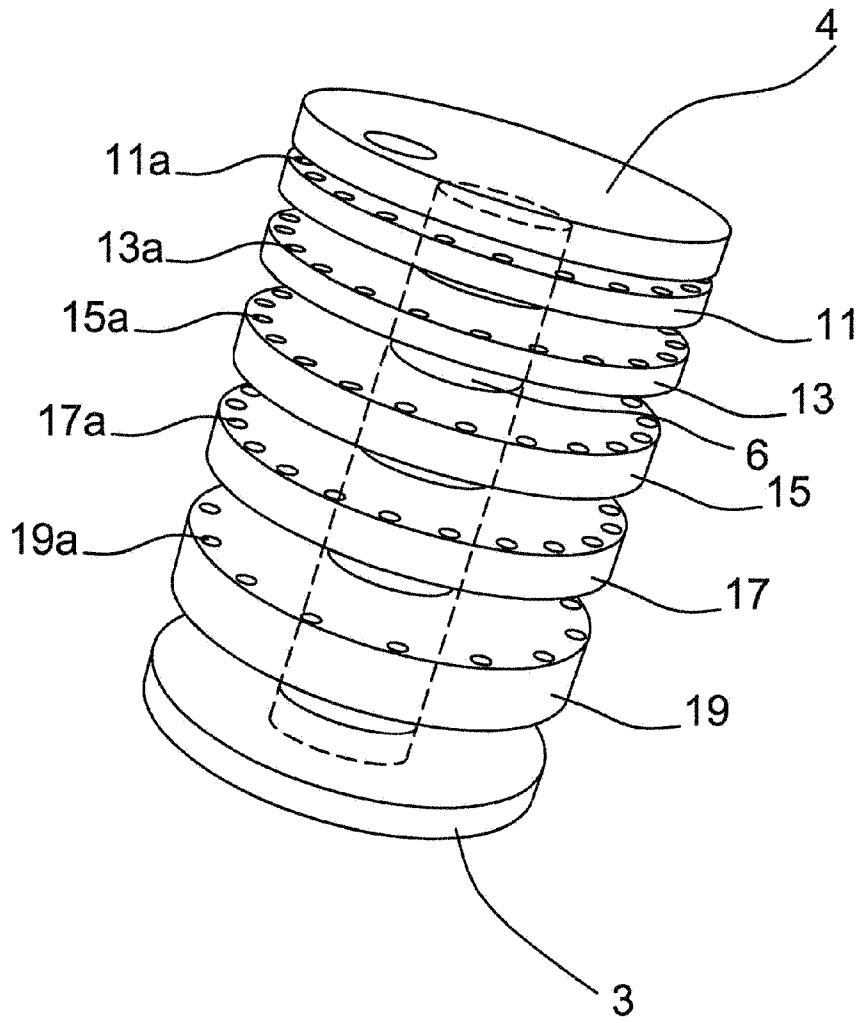


Fig. 5