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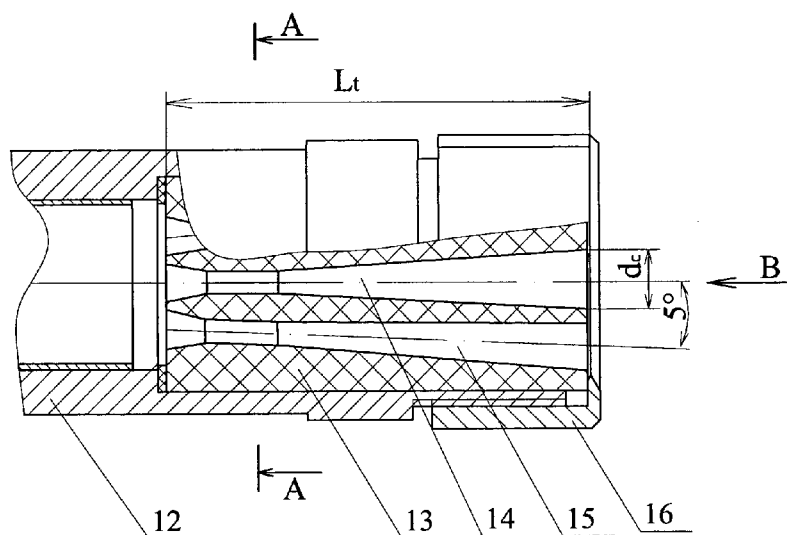
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(54) Title: FIRE-FIGHTING APPARATUS



(57) Abstract: A fire-extinguishing apparatus comprises a reservoir for storage of a fire-extinguishing liquid, a liquid feeding system, and a directed gas-and-droplet flow generating device. A discharge nozzle of the apparatus is provided with a central profiled channel (14) and peripheral profiled channels (15). Each of the profiled channels consists of successively arranged portions including a conical converging portion, a cylindrical portion, and a conical diverging portion. Outlet apertures of peripheral channels (15) are uniformly distributed around the circumference at a predetermined pitch distance about the outlet aperture of the central profiled channel (14). The discharge nozzle may be formed as an attachment (13) with profiled channels (14 and 15) provided within the spraying head casing. Utilization of the apparatus for extinguishing with fine dispersed water of fires on electric installations, which are under high voltage, provides for stable electric safety.

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FIRE-FIGHTING APPARATUS

Field of invention

The invention relates to fire-fighting technique, in particular, fire-fighting means
5 wherein the operating principle is based on generation of gas-liquid streams and mist screens.

Background of the invention

Fire-fighting apparatuses comprising liquid sprayers of various designs are known nowadays. For example, it is known from the description to the author's certificate
10 SU 1243746 (IPC: A62C 31/02, published 15.07.1986) a sprayer used in fire-fighting technique, wherein parameters of a generated gas-and-droplet flow may be adjusted. The apparatus consists of a branch pipe with a flow-through channel and a sprayer defined by a bundle of tubes equal in diameter and adapted for liquid feeding. The tubes are rigidly fixed within a plate made from elastic material. A forming mechanism cooperating with the tubes is
15 provided on the branch pipe. The forming mechanism is made as a barrel having a perforated spherical bottom with a bundle of tubes penetrating through said bottom.

The dispersion ability of the generated flow across its section is varied by moving the barrel toward the plate. As a result, the perforated bottom deflects the resilient plate and the tubes rigidly fixed in the plate are deviated toward the center. On changing the spatial
20 orientation of the feeding tubes, the dispersion ability of the generated flow and uniformity in the distribution of liquid droplets across the flow section are varied. The given apparatus allows the dispersion ability of the gas-and-droplet flow to be continuously reduced so that a mixed compactly sprayed flow including a central compact flow and a peripheral sprayed flow is formed.

25 However, operation of the apparatus under consideration does not provide for a sufficiently high dispersion ability and homogeneity in spatial distribution of finely-dispersed liquid droplets. The given property of a gas-and-droplet flow is required for maintaining dielectric characteristics of the generated flow in order to provide for electric safety of the apparatus during extinguishing of fires on electric installations.

30 Also, known from an author's certificate SU 334986 (IPC: A62C 31/02, published 11.04.1972) is a spraying head for a fire-hose lance, said spraying head comprising a casing with two parallel, profiled channels arranged symmetrically relative to an axis of symmetry of the casing. The distance between the profiled channels is at least 1.2 the diameter of their outlet apertures. The liquid dispersion ability is enhanced and the sprayed liquid flow

dispersion ability is adjusted through using an injector including a cone attachment located at the side near the outlet apertures of the profiled channels with possibility of rotation relative to an axis of symmetry of the casing within the range of 90°.

The given apparatus does not enable generation of spatially homogeneous gas-and-droplet flow at a high degree of dispersion ability of liquid droplets.

It is disclosed in the description to the patent US 6425537 (IPC: A62C 31/00, published 30.07.2002) a fire-extinguishing apparatus designed for extinguishing of various classes of fires including fires occurred on electric installations operating under high voltage.

The fire-extinguishing apparatus has a reservoir containing a fire-extinguishing liquid, a pressurized gas cylinder, a pipeline system, a pressure regulator, a back valve, a feeding hose, a gun, and a spraying nozzle. The nozzle is designed so as to provide for fire-extinguishing mode controlling depending on the type of a fire-extinguishing composition utilized. Either water free from additives or water containing a foam former may be utilized as a fire-extinguishing liquid. The nozzle comprises a casing with a central foam feeding channel and peripheral water feeding channels, a foam and air mixing chamber, a distribution chamber, and is additionally equipped with a reverse valve for fire-extinguishing mode controlling. A stopper provided on the end part of the casing is furnished with discharge openings communicating with the liquid feeding channels.

The apparatus operates as follows. A gas feeding valve is initially opened so that the pressurized gas is delivered from the cylinder through the pressure regulator into the reservoir containing a fire-extinguishing liquid to displace the latter through the pipeline into a hose. The fire-extinguishing mode is selected using a special control valve. Depending on the mode selected, respective water feeding channels or foam feeding channel are opened. The fire-extinguishing liquid is directed through the hose to the spraying nozzle and is then sprayed onto the fire hazard zone.

With the extinguishing mode using water, the control valve is in a position where the foam feeding branch pipe is closed and the water feeding branch pipe is opened. Water is supplied through the water feeding channel via the distribution chamber to the peripheral outlet apertures of the nozzles.

In case water containing a foam former is utilized as a fire-extinguishing liquid, the reverse control valve is moved to a position where the liquid feeding branch pipe is closed and the foam former feeding branch pipe is opened. The water containing a foam former is delivered into the mixing chamber to be mixed with the air drawn from the environmental

atmosphere. The foam generated is fed through the central channel into the nozzle, from which nozzle the resultant fire-extinguishing composition is sprayed onto the hotbed of fire.

The fire-extinguishing apparatus of the given design does not provide for a required degree of spatial homogeneity and high dispersion ability of the liquid droplets, said properties
5 being necessary for enabling electric safety during extinguishing of fires occurred on electric installations, which are under the voltage of up to 1,000 V.

The closest prior art to the invention is a backpack type fire-extinguishing apparatus comprising a reservoir containing a fire-extinguishing liquid (water), a pressurized gas (air) cylinder and a fire-hose lance with a mechanism for controlling the feeding of liquid and gas
10 (Patent RU 2121390, IPC: A62C 31/02, published 10.11.1998). Directed gas-and-droplet flow of the fire-extinguishing substance are generated using the fire-hose lance of the apparatus. Before the fire-extinguishing substance is fed into a profiled channel of the fire-hose lance of the apparatus, the liquid and gas are preliminarily mixed in a mixing chamber whereto the liquid (water) and gas (air) are separately fed through a valve mechanism. The length of the
15 profiled channel of the nozzle is selected depending on the diameter of its minimum section.

Upon actuation of the apparatus, the pressurized air is delivered from the high-pressure cylinder through the pressure regulator into the reservoir filled with the liquid. The liquid is displaced by the pressurized gas from the reservoir through feeding hoses into a liquid cavity of the mixing chamber to be mixed with the gas. The generated two-phase gas-and-droplet
20 flow is then speeded up in the profiled channel of the nozzle. The range of discharge of the gas-and-droplet flow generated using the prior art apparatus is at least 12 m.

During functioning of the given apparatus, the film flow of the liquid is provided along the surface of the profiled channel of the nozzle. As a result, the maximum of the volumetric density of droplets is urged to a wall, and the gas-and-droplet flow acquires a circular
25 structure. Moreover, the so-called "liquid plugs" are formed in the circular gas-and-droplet flow. The result is that an average size of the liquid droplets in the flow is increased and an opening angle of the flow cone is periodically altered. On the whole, the above processes lead to non-uniform spatial distribution of liquid droplets in the generated gas-and-droplet flow and non-homogeneous distribution of sizes of the liquid droplets.

30 The electric safety tests carried out with the fire-extinguishing apparatus had shown that the apparatus did not provide for a required electric safety degree throughout the entire operation time during extinguishing of electric installations which were under the voltage of up to 1,000 V. The electric conductivity of the generated gas-and-droplet flow was determined by the value of leakage currents. With the prior art fire-extinguishing apparatus, the leakage

current value at switch-on and switch-off modes exceeded the permitted value – 0.5 mA - according to the general technical requirements.

Disclosure of the invention

5 The major object of the invention is to create a fire-extinguishing apparatus providing a uniform spatial distribution of finely dispersed liquid droplets across a section of a generated flow, to enable a homogeneous dispersion ability of liquid droplets in a gas-and-droplet flow and stability of a cone of a sprayed liquid flow.

10 The technical result to be achieved by solving the technical tasks set forth involves providing a required electric safety during extinguishing by means of finely dispersed water of hotbed of fire occurred on electric installations which are under high voltage of up to 1,000 V without the necessity for cutting-off of electric power, and also providing an increase in the efficiency of extinguishing of various class fires (depending on kinds of burning substances and materials).

15 The indicated technical result is enabled by utilization of a fire-extinguishing apparatus comprising at least one reservoir for storage of a fire-extinguishing liquid, a liquid feeding system, a directed gas-and-droplet flow generating device including a discharge nozzle with a central profiled channel. The nozzle channel consists of successively arranged portions, namely, a conical portion converging in the course of flow of the liquid, a cylindrical portion, 20 and a conical portion diverging in the course of flow of the liquid.

 According to the present invention, the discharge nozzle additionally comprises at least four peripheral profiled channels with equally sized outlet apertures. Each of said channels consists of successively arranged portions, namely, a conical portion converging in the course of flow of the liquid, a cylindrical portion, and a conical portion diverging in the course of 25 flow of the liquid. The outlet apertures of the peripheral channels are uniformly distributed around the circumference, on end surface of the nozzle casing, about the outlet aperture of the central profiled channel. A pitch t between axes of symmetry of the nearby outlet apertures of the peripheral channels, around the circumference, is selected on the condition that: $1.2 d_0 \leq t \leq 2.5 d_0$, where d_0 is the diameter of the outlet apertures of the peripheral profiled 30 channels.

 The above-mentioned combination of essential features enables creation of conditions advantageous for the gas-and-droplet flows flowing from the outlet apertures of the profiled channels of the nozzle, said conditions facilitating the impingement of the liquid streams, splitting of the streams into fine droplets followed by mixing of separate streams and

generation of a single finely dispersed gas-and-droplet flow having a high spatial homogeneity. The generated gas-and-droplet flow is free from large-sized liquid inclusions as well as from substantial non-homogeneity in droplet sizes and in spatial distribution of droplets. Owing to maintaining the required spatial homogeneity in the gas-and-droplet flow and density of filling the volume of the generated flow of fire-extinguishing substance with finely dispersed droplets, a maximum electric resistance lengthwise of the flow and, correspondingly, minimum leakage currents lengthwise of the flow are achieved. The given conditions provide for stable electric safety during extinguishing of hotbed of fire on electric installations, which are under high voltage, without the necessity for cutting-off of electric power and also high efficiency in extinguishing of various class hotbeds of fire.

In order to increase an angle of spray cone of the generated gas-and-droplet flow, the profiled channels are directed at an angle to an axis of symmetry of the central profiled channel. An angle of inclination of axes of symmetry of the peripheral channels to an axis of symmetry of the central channel is preferably up to 10° .

The maximum uniform distribution of the liquid droplets is found with the sizes of the outlet apertures of the central and peripheral profiled channels optimized according to the condition that: $d_0 \leq d_c \leq 1.5d_0$, where d_c is the diameter of the outlet aperture of the central profiled channel.

The maximum range of discharging the gas-and-droplet flow (more than 12 m) is achieved with the total length L_t of each of the profiled channels selected on the condition that: $L_t \geq 5d_{\min}$, where $d_{\min}$ is the diameter of the minimum section of the profiled channel.

Observation of the above conditions allows high-speed finely dispersed gas-and-droplet flows to be generated with an optimum average liquid droplet size (from 100 to 200 micron).

The nozzle may be formed in various design embodiment versions. According to one of the versions, the nozzle construction may be formed from a number of tubes whose flow-through channels define profiled channels of the nozzle. According to another version, the nozzle may be made in the form of an attachment with profiled channels provided within its casing.

Brief description of drawings

The given invention is clarified by an example of embodiment of the invention, which may be used as part of a backpack type fire-extinguishing apparatus, with references to the explaining drawings illustrating the following:

– Fig. 1 is an pneumatic-hydraulic circuit of a fire-extinguishing apparatus;

– Fig. 2 is a longitudinal section of a discharge nozzle with a central profiled channel and four peripheral profiled channels (scale 2:1);

– Fig. 3 is a cross-section of the nozzle illustrated in Fig. 2 in a plane A-A;

– Fig. 4 is the nozzle illustrated in Fig. 2 and viewed from the side of outlet apertures of the profiled channels (in direction B);

– Fig. 5 is a longitudinal sectional view of a discharge nozzle with a central profiled channel and five peripheral profiled channels (scale 2:1);

– Fig. 6 is a cross-section of the nozzle illustrated in Fig. 5 in a plane C-C;

– Fig. 7 is a nozzle illustrated in Fig. 5 and viewed from the side of outlet apertures of the profiled channels (in direction D).

Preferred examples of embodiment of the invention

A fire-extinguishing apparatus (see Fig. 1) comprises a reservoir 1 filled with a fire-extinguishing liquid, a pressurized gas cylinder 2, a gas pressure regulator 3, connection hoses 4, 5 and 6, a liquid feeding valve 7, and gas feeding valves 8 and 9. The apparatus also includes a fire-hose lance designed for generation of a directed gas-and-droplet flow and including a liquid and gas mixing chamber 10 and a discharge gas-dynamic nozzle 11 having profiled channels. In the example under consideration, either water or water containing foam former additives is used as a fire-extinguishing liquid and air is used as a working gas.

The mixing chamber 10 is designed for preliminary dispersion of a liquid in a gas flow and comprises a cylindrical casing with slot-type channels for feeding a dispersed liquid flow into a pressurized gas flow directed through an axial channel of the casing. In other versions of embodiment of the invention, the fire-extinguishing apparatus may be free from a liquid and gas mixing chamber. In such embodiment of the apparatus, the liquid is directed immediately to an inlet of each profiled channel of the nozzle.

According to the first version of embodiment of the invention illustrated in Figs 2, 3 and 5, the discharge nozzle 11 includes a casing 12 with a fluoroplastic attachment 13 located within internal cavity of the casing. The attachment 13 is equipped with a central channel 14 and four peripheral profiled channels 15. The attachment 13 is fixed within the casing 12 by means of a captive nut 16. Outlet apertures of the peripheral profiled channels 15 are uniformly distributed around the circumference, on end surface of the nozzle casing, about the outlet aperture of the central profiled channel 14.

The diameter d_c of the outlet aperture of the central profiled channel 14 is 5 mm, and the diameter of the outlet apertures of the peripheral profiled channels 15 is 4 mm to conform with

the condition that: $d_0 \leq d_c \leq 1.4d_0$. In the example under consideration, the peripheral profiled channels are arranged at an angle of 5° relative to an axis of symmetry of the central channel, along the course of outflow of the gas-and-droplet flow. The pitch distance t between the axes of symmetry of nearby outlet apertures of the peripheral channels is 8 mm to conform to the condition that: $1.2d_0 \leq t \leq 2.5d_0$.

Each of the profiled channels 14 and 15 has a conical portion converging in the course of flow of the liquid, a cylindrical portion, and a conical portion diverging in the course of flow of the liquid. The total length L_t of each of the profiled channels is selected according to the condition that: $L_t \geq 5d_{\min}$. With the diameter of a minimum section of the profiled channel $d_{\min}=2$ mm, the total length L_t of the channel in the example under consideration is 36 mm.

According to another example of embodiment of the invention illustrated in Figs 5, 6 and 7, the nozzle of the apparatus comprises the central profiled channel 14 and five peripheral profiled channels 15. An inclination angle of axes of symmetry of the peripheral profiled channels 15 to an axis of symmetry of the central profiled channel 14 is also 5° . The diameter d_c of the outlet aperture of the central channel 14 is equal to the diameters d_0 of the outlet apertures of the peripheral channels 15 and constitutes 4 mm. The pitch distance t between the axes of symmetry of the nearby outlet apertures of the peripheral channels is 6 mm. The total length of the profiled channels 14 and 15 is 36 mm.

Along with the examples of embodiment of the invention illustrated in the drawings, the discharge nozzle may be formed from a set of tubes whose flow-through channels define profiled channels of the nozzle. The tubes are retained by means of grids fixed within the nozzle casing.

The above-described fire-extinguishing apparatus operates as follows.

The locking-and-starting gas feeding valve 8 is preliminarily opened. The air is delivered from the pressurized gas cylinder 2 via the gas pressure regulator 3 and the hose 4 into a decreasing space of the reservoir 1. The pressurized air is delivered from the output of the gas pressure regulator 3 through the hose 5 to the controlled gas feeding valve 9, through which valve the air is fed in a controlled manner into the liquid and gas mixing chamber 10. The gas pressure downstream of the gas pressure regulator 3 in a gas feeding mode is from about 0.9 MPa to about 1.1 MPa. The water displaced by the pressurized gas from the reservoir 1 is directed via the hose 6 to the controlled liquid feeding valve 7 to be then fed into the liquid and gas mixing chamber 10.

In order to generate the gas-and-droplet flow using the fire-extinguishing apparatus, the controlled gas feeding valve 9 is initially opened followed by opening at time delay of about 0.3 s of the liquid feeding valve 7. The above sequence of procedures, upon opening of the valves 7 and 9, results in preliminary delivering into the liquid and gas mixing chamber 10 of a gas flow supported liquid ejection into gas flow through the slot-type channels in the form of thin uniformly distributed streams. The velocity vector of the liquid streams at the outlet of the slot-type ejection apertures is extending perpendicular to the axis of symmetry of the flow-thorough channel of said chamber and, correspondingly, perpendicular to the velocity vector of the gas flow. As a result of cooperation of the liquid streams with the gas flow, the liquid is dispersed into fine droplets.

The dispersed gas-and-droplet flow is then delivered from the liquid and gas mixing chamber 10 into the profiled channels 14 and 15 of the discharge nozzle. The gas-and-droplet flow is divided in the attachment 13 illustrated in the Figs 2, 3 and 4 into five separate flows. While issuing through the conical converging portion, the gas-and-droplet flow is additionally dispersed. Once passed through the conical portion, the gas-and-droplet flow is directed into the cylindrical portion of the channel wherein the profile of velocities is leveled across the flow section.

The gas-and-droplet flow is then speeded-up within the conical diverging portion of the profiled channel. Conical finely dispersed gas-and-droplet flows are generated at the outlet of the profiled channels of the nozzle to impinge with one another in a space downstream of the nozzle section.

The generated high-velocity finely dispersed gas-and-droplet flow is directed by an operator onto a hotbed of fire, for example, on an electric installation which is under high voltage. Effective extinguishing of the hotbed of fire is provided due to a high velocity and uniform distribution of small liquid droplets in the vicinity of the flame. The required electric resistance lengthwise of the flow is obtained by high spatial homogeneity of the gas-and-droplet flow and uniform filling of the volume of the generated fire-extinguishing substance with finely dispersed liquid droplets.

The apparatus furnished with the nozzle illustrated in Figs 5, 6 and 7 operates in the similar manner. The mixed gas-and-droplet flow generated in the mixing chamber 10 is additionally dispersed and speeded-up in the six profiled channels 14 and 15 to form six gas-and-droplet flows. The generated gas-and-droplet flows impinge with one another within a space downstream of the section of the profiled channels to mix and be split into fine droplets. Owing to an increased number of the peripheral profiled channels, a homogeneous wide-

aperture gas-and-droplet flow is generated at the discharge nozzle. The said flow consists liquid droplets with high kinetic energy.

As a result of creating a single gas-and-droplet flow from individually generated flows spaced from one another by a distance defined by the pitch distance t between the axes of symmetry of the nearby outlet apertures of the peripheral channels, around the circumference of arrangement of said channels, the uniformity in distribution of the fine dispersed liquid droplets within the space is improved. As a consequence, the gas-and-droplet flow generated has a required electric resistance which is necessary for electric safety of an operator during extinguishing of fires on electric installations which are under a high voltage (up to 1,000 V).

Prior to putting the apparatus out of service, the process of feeding the fire-extinguishing liquid into the liquid and gas mixing chamber is preliminarily stopped before gas feeding into said chamber is stopped. Such a succession of actions is effectuated by initially closing of the liquid feeding valve 7 followed by closing, at time delay of about 0.3 s, of the gas feeding valve 8.

By changing the position of the gas-dynamic nozzle 11 (see Fig. 1) in a vertical and horizontal plane, the operator can extinguish fires on vast areas in an open space as well as in closed rooms. On application of water containing a foam former for extinguishing of fires, a thin film of foaming substance is formed on the burning surface, said film being adapted for restricting ingress of oxygen from the environment into the fire zone.

The velocity of the liquid droplets reaching the fire is at least 5 m/s at the liquid feeding intensity of 0.4 l/s. The velocity of the gas-and-droplet flow at the discharge of the gas-dynamic nozzle 11 approximates 80 m/s. With fire-extinguishing liquid supply of 12 l, the backpack type fire-extinguishing apparatus may be advantageously used for extinguishing of solid material fires having a total area of about 60 m², of burning inflammable liquid fires covering the area of more than 7 m², and also for extinguishing of fires on electric installations which are under the voltage of up to 1,000 V.

The backpack type fire-extinguishing apparatus having a discharge nozzle equipped with various numbers of profiled channels was tested on an electric test bench. In terms of the electric safety requirements, the permeated leakage current value is no more than 0.5 mA. The distance between the discharge nozzle and a target under the voltage of $\sim 36 \pm 4$ kV A.C. with a frequency of 50 Hz was 1,000 mm. The test results are represented in a table.

Table

Number of peripheral profiled channels of the nozzle	Number of test	Voltage at the target, kV	Maximum leakage current value lengthwise of fire-extinguishing substance flow, mA
4	1	32	0.18
4	2	32	0.18
4	3	32	0.18
5	1	32	0.22
5	2	32	0.25
5	3	34	0.18

It follows from the table presented that with four or more peripheral profiled channels, the leakage current value lengthwise of the generated flow did not exceed the permitted leakage current value of 0.5 mA. With the number of the peripheral profiled channels less than four, the leakage current value was 0.65 mA and more, i.e., it was higher than a maximum permitted value.

Thus, the application of the invention provide a demanded level of electric resistance of the fire-extinguishing substance flow owing to an increase in the uniformity of spatial distribution of finely dispersed liquid droplets in the flow generated. With the indicated conditions, the electric safety requirements are observed in extinguishing of fires on electric installations, which are under the voltage of up to 1,000 V, and high efficiency in extinguishing of various class fires is achieved.

Industrial applicability

The invention may be widely utilized in mobile fire-fighting means of various designations as well as in stationary fire technique. Portable and stationary fire-extinguishing apparatuses implemented according to the invention enable the generation of adjustable gas-and-droplet flows with high electric resistance.

CLAIMS

1. A fire-extinguishing apparatus, comprising at least one reservoir (1) for storage of a fire-extinguishing substance, a liquid feeding system, a directed gas-and-droplet flow generating device including a discharge nozzle (11) with a central profiled channel (14) consisting of successively arranged portions including a conical portion converging in the course of flow of the liquid, a cylindrical portion, and a conical portion diverging in the course of flow of the liquid, *is characterized in that* the discharge nozzle (11) additionally comprises at least four peripheral profiled channels (15) equal in sizes of their outlet apertures, each of said channels being defined by successively arranged portions including a conical portion converging in the course of flow of the liquid, a cylindrical portion, and a conical portion diverging in the course of flow of the liquid, the outlet apertures of the peripheral channels (15) being uniformly distributed around the circumference, on end surface of the nozzle casing, about the outlet aperture of the central profiled channel (14), a pitch distance t between axes of symmetry of nearby outlet apertures of the peripheral channels (15) around the circumference being selected from the condition that: $1.2d_0 \leq t \leq 2.5d_0$, where d_0 is a diameter of the outlet apertures of the peripheral profiled channels (15).

2. An apparatus according to the claim 1 *is characterized in that* the peripheral profiled channels (15) are directed at an angle to an axis of symmetry of the central profiled channel (14), with the inclination angle of axes of symmetry of the peripheral channels to an axis of symmetry of the central channel making up to 10° .

3. An apparatus according to the claim 1 *is characterized in that* the diameter d_c of the outlet aperture of the central profiled channel (14) is selected on the condition that: $d_0 \leq d_c \leq 1.5d_0$.

4. An apparatus according to the claim 1 *is characterized in that* the total length L_t of each of the profiled channels of the discharge nozzle (11) is selected on the condition that: $L_t \geq 5d_{\min}$, where $d_{\min}$ is the diameter of the minimal section of said profiled channel.

5. An apparatus according to the claim 1 *is characterized in that* the discharge nozzle (11) is formed from a set of tubes whose flow-through channels define the profiled channels of the discharge nozzle.

6. An apparatus according to the claim 1 *is characterized in that* the discharge nozzle (11) is formed as an attachment (13) with profiled channels (14) and (15) provided within an attachment casing.

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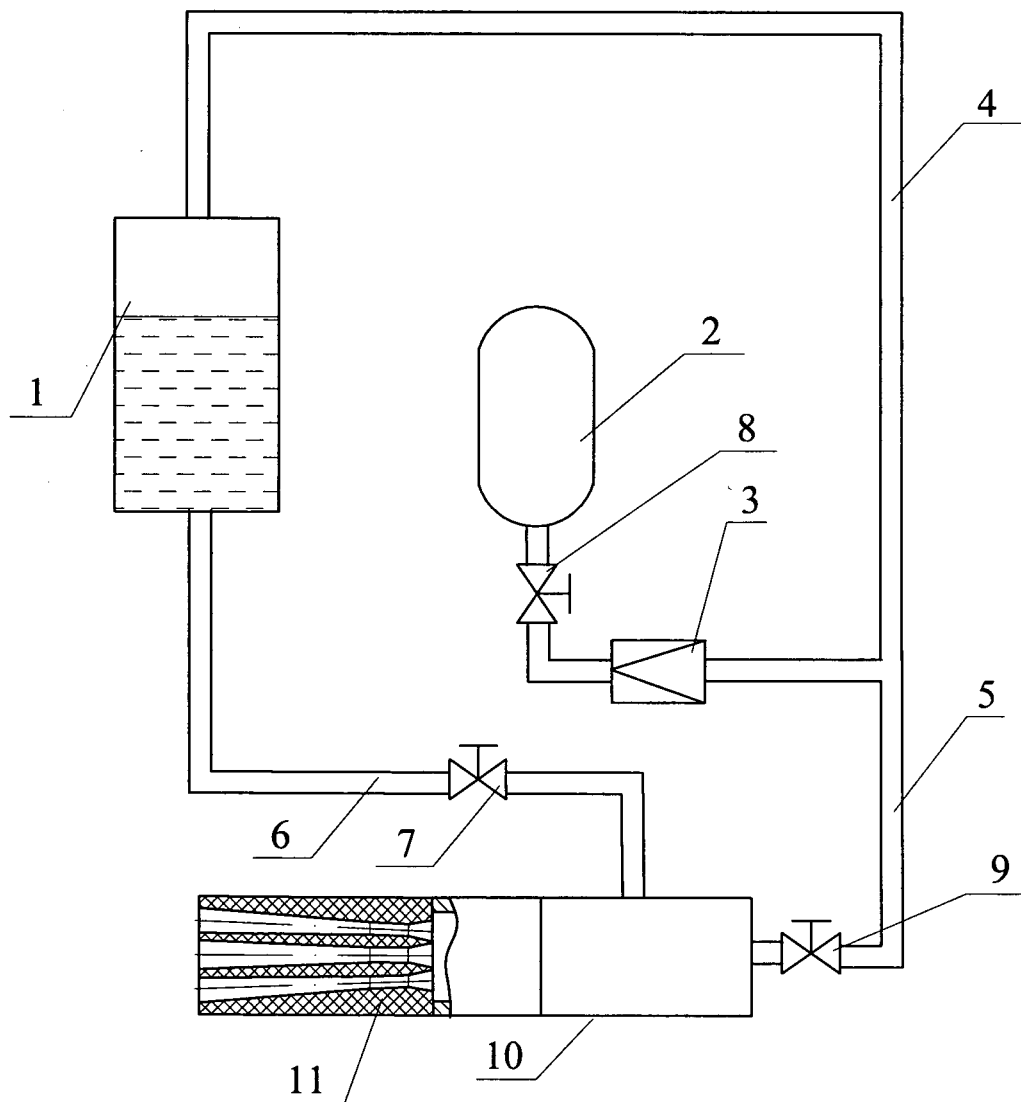


Fig.1

2/3

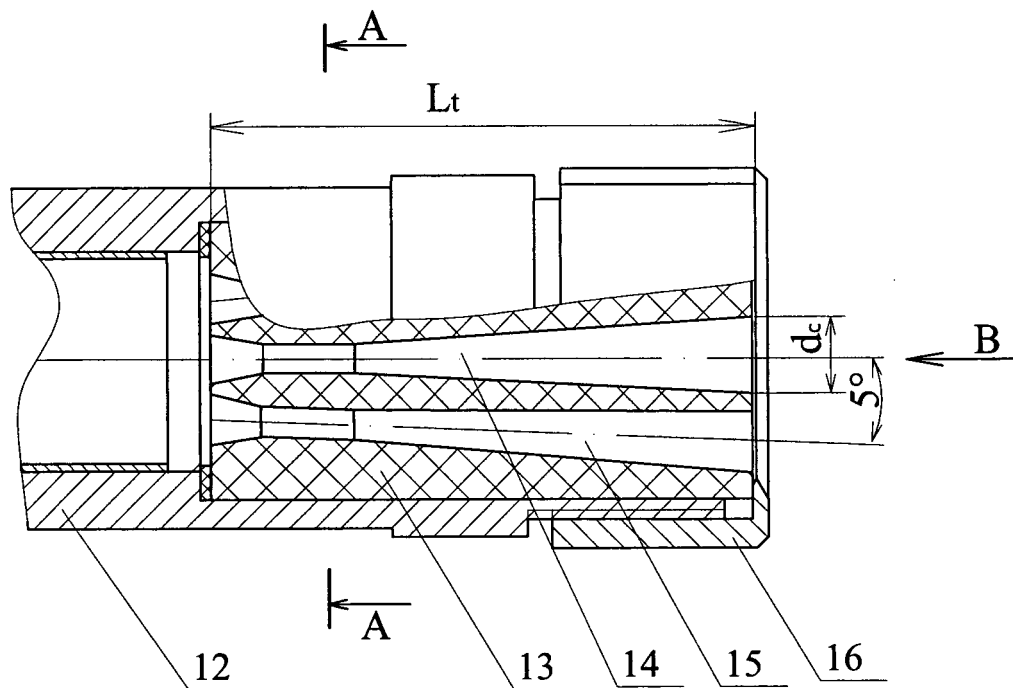


Fig.2

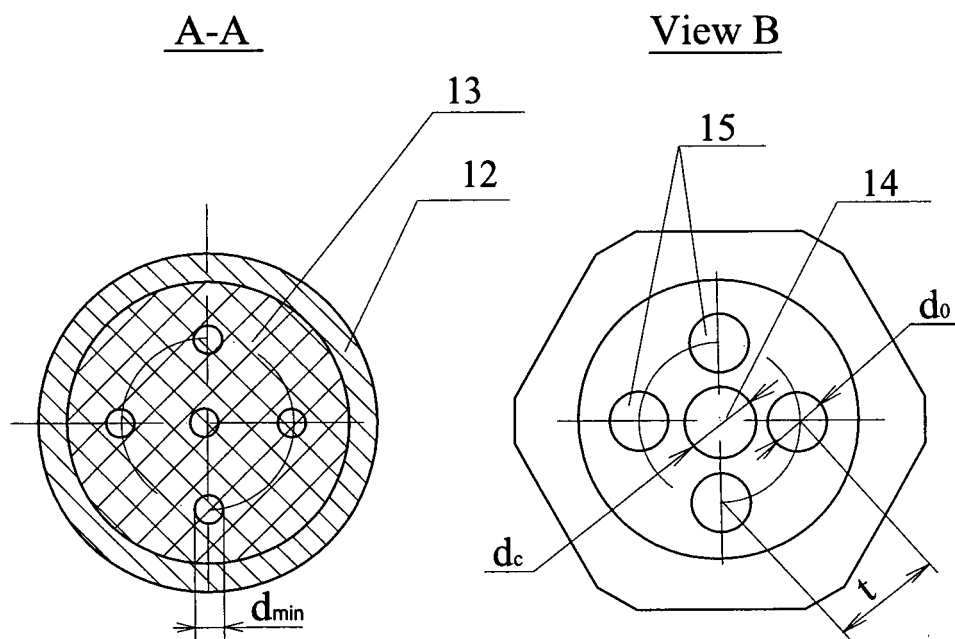


Fig.3

Fig.4

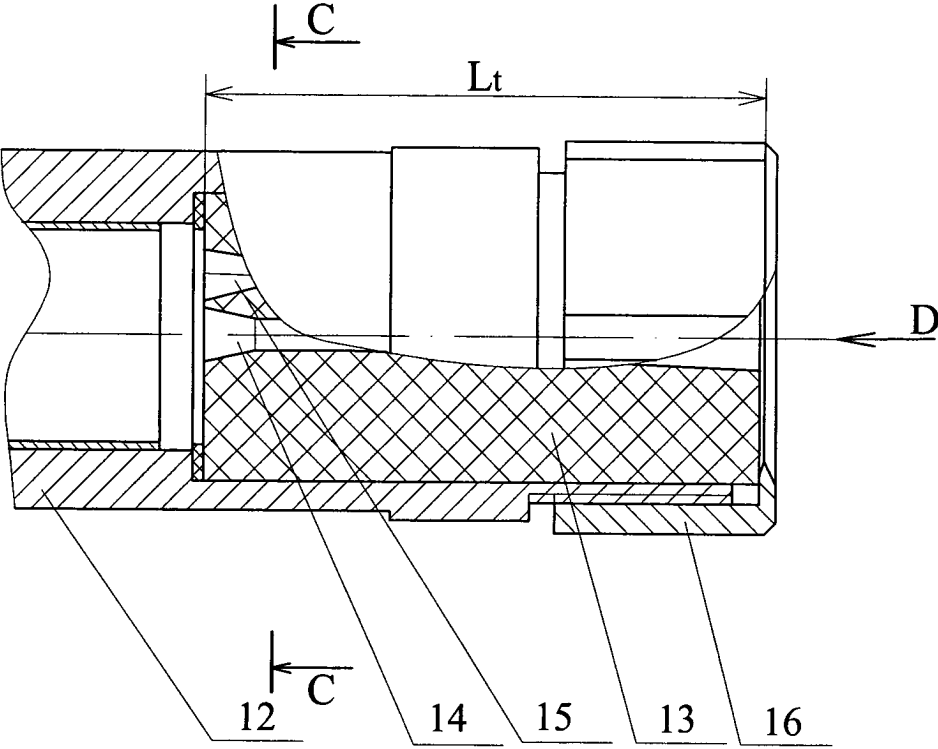


Fig.5

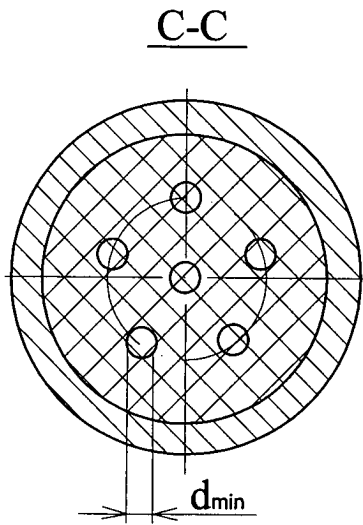


Fig.6

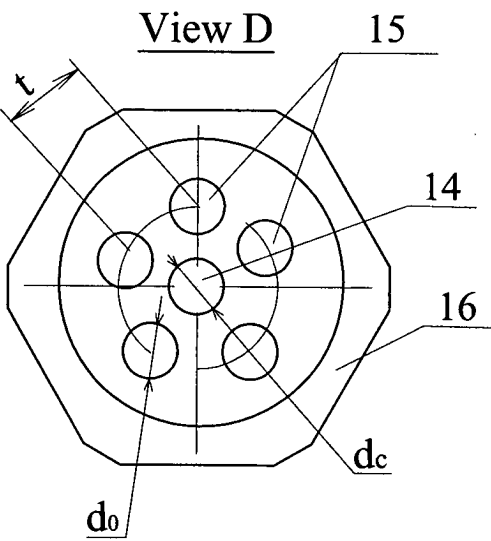


Fig.7

INTERNATIONAL SEARCH REPORT

International application No

PCT/RU2007/000306

A. CLASSIFICATION OF SUBJECT MATTER

INV. A62C31/05

According to International Patent Classification (IPC) or to both national classification and IPC

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)

A62C

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

Electronic data base consulted during the International search (name of data base and, where practical, search terms used)

EPO-Internal, WPI Data

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X	DE 39 05 223 A1 (WERNER) 14 September 1989 (1989-09-14) figures 6,7,11,12 column 6, lines 26-34 column 6, lines 42-46 column 7, lines 27-34 column 7, lines 40-50	1,3,4,6

☐ Further documents are listed in the continuation of Box C.

☒ See patent family annex.

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Date of the actual completion of the international search

29 October 2007

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INTERNATIONAL SEARCH REPORT

Information on patent family members

International application No

PCT/RU2007/000306

Patent document cited in search report	Publication date	Patent family member(s)	Publication date
DE 3905223	A1	14-09-1989	NONE