(54) Title: LIQUID ATOMIZER AND FIRE-EXTINGUISHER

(57) Abstract: A liquid atomizer comprises a housing (12), a centrifugal liquid stream swirl unit, and a nozzle (17) with a profiled channel. The centrifugal swirl unit is configured as a hollow cylindrical insert (16) with an inlet axial channel (21) and tangentially oriented inlet channels (22) provided in the side wall of the insert (16). The cross-sectional sizes of the inlet channels of the centrifugal swirl unit are selected on the condition that: 4S ≤ S ≤ 6S, where S is a total cross-sectional area of the tangentially oriented channels (22), S is a cross-sectional area of the axial channel (21). A fire-extinguisher comprises a reservoir filled with a fire-extinguishing liquid, a system for replacing the liquid from the reservoir and a liquid atomizer including a centrifugal liquid stream swirl unit and a nozzle (17). During operation, a high-velocity gas-droplet jet is generated with droplets of uniform size and a stable spray cone angle.

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LIQUID ATOMIZER AND FIRE-EXTINGUISHER

Field of the Invention

The invention relates to the liquid atomizing equipment and portable fire-fighting units including fire-extinguishing liquid atomizers. More particularly, the invention relates to the structure of a liquid atomizer utilized as part of a fire-extinguisher. Liquid atomizers according to the invention may be employed as regular equipment for localizing and suppressing the fire sources.

Background of the Invention

Various types of liquid atomizers are currently employed. As an example, Patent US 3304013 (published 14.02.1967, IPC B05B 1/34) describes a liquid atomizer comprising a housing with an inlet connection, a centrifugal liquid stream swirl unit and a nozzle with a profiled channel. The centrifugal swirl unit is configured as a hollow cylindrical insert with a tangentially oriented inlet channel formed through the insert side wall. The interior of the cylindrical insert is communicating with an inlet aperture of the profiled channel of a nozzle. The insert is located within the housing by means of a position retainer mounted within the housing interior in axially aligned relation with respect to the nozzle channel.

The profiled channel of a discharge nozzle of the atomizer includes a succession of an inlet conical portion converging in the course of flow of the liquid stream and an outlet cylindrical portion. An apparatus of the prior art permits generation of a spatially homogeneous swirled atomized liquid jet formed as a hollow cone characterized by a significant tangential velocity value.

During operation of the atomizer of the prior art, substantial liquid stream kinetic energy losses occur when the liquid stream flows around the retainer adapted for keeping the insert in a set position and contacting the end wall of the cylindrical insert.

A published international application WO 99/11382 (published 11.03.1999, IPC-6 B05B 1/00, 1/34) describes a liquid atomizer comprising a housing including an inlet connection, a centrifugal liquid stream swirl unit, and a nozzle with a profiled channel. The centrifugal swirl unit is configured as a hollow cylindrical insert with one tangentially oriented inlet channel formed through the side wall of the insert.

The interior of the cylindrical insert is communicating with an inlet aperture of the profiled nozzle. The cylindrical insert is fixed between the components of the housing by means of supports adjoining the insert end wall.
The profiled channel of the atomizer discharge nozzle comprises a succession of an inlet conoid-shaped portion converging in the course of flow of the stream, a cylindrical portion joined thereto, and an outlet conical diverging portion.

The structure of an apparatus of the prior art permits fast mounting and centering of the insert in the interior of the housing. However, as the liquid is supplied to the discharge nozzle of the apparatus through the atomizer housing channel, substantial kinetic energy losses occur owing to the shape of supply passages adapted for connecting the inlet channel with the tangentially oriented channel.

The closest analog to the applied liquid atomizer is an atomizer described in Patent US 2428748 (published 07.10.1947, IPC B05B 1/34). The liquid atomizer comprises a housing including an inlet connection, a centrifugal liquid stream swirl unit, and a nozzle with a profiled channel. The centrifugal swirl unit is configured as a hollow insert with an inlet axial channel. The swirl unit is preferably formed as a truncated cone with a spherical end surface.

The axial channel is made diverging in the course of flow of the liquid stream. Radial guiding passages provided on the conical side wall are adapted for securing the insert in the housing. Three tangentially oriented inlet channels are defined on the side wall of the cylindrical insert between the guiding ribs. The tangential channels are evenly distributed around the circumference and have a rectangular cross-section.

The interior of the cylindrical insert is communicating with an inlet aperture of the profiled channel. The profiled channel of the atomizer discharge nozzle is formed of a succession of an inlet portion converging in the course of flow of the liquid stream and an outlet diverging portion. The portions of the profiled channel of the nozzle are made conoid-shaped.

During operation of the prior art apparatus, the working liquid delivered from the supply passage to the interior of the atomizer housing runs around the insert end surface with minimal hydraulic losses and thereafter is supplied to the inlet apertures of the tangentially oriented channels. While passing through the tangential channels, the liquid stream is swirled. As a result of flowing of the preliminarily swirled liquid stream through the profiled channel of the discharge nozzle conditions are created for a maximum efficient dispersion of the liquid stream.

The central liquid stream is created during passage of liquid through the axial aperture provided in the end part of the insert to function as a guiding stream with respect to a peripheral part of the swirled liquid stream.
The atomizer of the prior art ensures the generation of a spatially homogeneous tangentially swirled jet of a finely-atomized liquid with a spray cone angle of about 100°.

Because the axial channel of the insert is made diverging in a gas-droplet jet discharge direction, an atomized fire-extinguishing liquid jet with a relatively low linear velocity is produced. The given feature of the gas-droplet jet generated restricts the field of application of the apparatus, preferably for localization of a fire source and preventing the initiation of a fire, for example, by cooling the reservoirs filled with fire-hazard substances.

Yet, the atomizer of the prior art may not be employed for extinguishing the class B fires. In this case, the generation of a high-velocity atomized liquid jet is desirable in order to provide a required distance of discharging a fire-extinguishing substance to the fuel surface enveloped with flame. It should be also pointed out that the atomizers generating wide-cone gas-droplet jets do not ensure a required fire-extinguishing efficiency. This is due to the fact that the gas-droplet jet density optimal for the extinguishing of a fire is created by means of widely atomized jets only in the central portion of the surface to be sprayed.

Various types of fire-extinguishers including liquid atomizers are currently known. It is known from a published patent application JP 07-328140 (published 19.12.1995, IPC A62C 13/64) an automatic fire-extinguisher. The fire-extinguisher comprises a reservoir filled with a fire-extinguishing liquid, a liquid replacement system for replacement of the liquid from the reservoir, a locking-and-starting device connected to the outlet of the reservoir, and a liquid atomizer connected through a pipeline to the locking-and-starting device.

The liquid atomizer comprises a liquid stream swirl unit and a discharge nozzle. The liquid stream swirl unit is configured as an insert equipped with helical channels. A thermal lock with fusible members is disposed at the outlet of the nozzle.

The employment of a fire-extinguisher module provides for fast and effective automatic extinguishing of insignificant fire sources at the initial inflammation stage in dwellings and office rooms. In such a case it is desirable that the fire source be spaced from an atomizer nozzle section by a distance equal to or less than 1 m.

It should be also noted that the utilization of the prior art fire-extinguisher does not ensure the generation of a long-distance gas-droplet jet with a spray cone angle optimal for fire-extinguishing procedure.

A published patent application US 2003/0173422 A1 (published 18.09.2003, IPC-7 B05B 1/34, A62C 31/12) discloses the structure of a portable fire-extinguisher. The prior art fire-extinguisher comprises a reservoir filled with a fire-extinguishing liquid, a liquid replacement system for replacement of the liquid from the reservoir, a locking-and-starting...
device, and a liquid atomizer. The outlet of the locking-and-starting device is joined to the liquid atomizer through a flexible pipeline.

The liquid atomizer comprises a centrifugal liquid stream swirl unit and a discharge nozzle, said swirl unit and discharge nozzle being arranged in succession. An intermediate expansion chamber is provided between an inlet of the nozzle and the liquid stream swirl unit. An operator may adjust the dimension of this chamber during functioning of the liquid atomizer by providing rotation and axial movement of the nozzle body.

The centrifugal liquid stream swirl unit is mounted on an end part of an inlet connection. In order to swirl the liquid stream, helical channels are provided on the side surface of the swirl unit for directing the liquid into the intermediate chamber of the nozzle.

During operation of the prior art fire-extinguisher, an atomized liquid jet is generated, said jet being discharged to a predetermined distance and at predetermined spray flare angle. The preliminary swirling of the working liquid in the intermediate chamber located upstream from the inlet of the nozzle channel enhances the velocity of the atomized fire-extinguishing liquid jet. Also, an atomization angle of the jet generated may be regulated. By regulating the atomization angle, an atomized jet with a larger cone angle or a compact jet with a small cone angle may be generated depending upon the extent of the fire source and burning intensity.

However, despite the evident benefits of the prior art apparatus, during passing of the liquid through the atomizer internal channels, substantial kinetic energy losses occur, primarily in the helical supply channels.

The closest analog to the applied invention is a fire-extinguisher, the structure of which is disclosed in an international application WO 94/06517 (published 31.03.1994, IPC A62C 31/03; B05B 1/12). The fire-extinguisher comprises a reservoir filled with a fire-extinguishing liquid, a liquid replacement system adapted for replacing the liquid from the reservoir and including a siphon pipe, and a locking-and-starting device connected to the outlet of the siphon pipe. The fire-extinguisher comprises a liquid atomizer including a centrifugal liquid stream swirl unit and a discharge nozzle. The inlet of the atomizer is connected to the locking-and-starting device through a flexible pipeline.

The housing of the atomizer incorporates a number of nozzles: a central nozzle and peripheral nozzles the outlet apertures of which are evenly distributed around the circumference of the outlet aperture of the central nozzle. The atomizer housing is provided with passages for connecting the inlet portions of the nozzle channels with a common flow-through channel of the atomizer.
In each of the supply channels a liquid stream swirl unit is located, said unit being configured as a cylindrical insert provided with tangential liquid supplying channels or with a spring, with helical liquid flow paths being defined between the loops of the spring in an annular channel. The liquid flow paths of the swirl unit are communicating with the intermediate chamber that is joined to the nozzle channel. Filters are located at the inlet ends of the swirl unit flow paths and adapted for preliminary purifying of the liquid supplied to the nozzle.

The flow rate of the liquid through the nozzle is adjusted automatically by varying the cross-section and length of the helical liquid flow paths defined between the spring loops. The expansion or compression of the spring depending on pressure in supply lines allows constant liquid flow velocity and flow rate through each of the atomizer channels to be maintained.

The expansion of the spring, as the pressure in the reservoir decreases, leads to changing of an angle of obliquity of the helical flow paths. The result of this is that a tangential velocity of liquid droplets in the jet generated is changed. So, in the process of suppressing the fire source, a cone angle of the atomized jet spray is changed.

Furthermore, the cooperation of streams discharged from an axial nozzle and side nozzles leads to a decrease in the tangential swirling velocity of droplets in the jet and to an increase in their sizes.

**Disclosure of the Invention**

It is the object of the invention to provide the generation of a high-velocity gas-droplet jet homogeneous with regard to droplet sizes and having a cone angle of spray unchangeable throughout the entire operating time.

The technical result achieved through the solution of the tasks set forth involves an increase in the efficiency of extinguishing class A and B fire sources.

The achievement of the aforesaid technical result is provided by implementing a liquid atomizer comprising a housing including an inlet connection, a centrifugal liquid stream swirl unit, and a nozzle with a profiled channel. The centrifugal swirl unit is configured as a hollow insert with an axial inlet channel and tangentially oriented inlet channels provided in the side wall of the insert. The interior of the cylindrical insert is communicating with an inlet aperture of the profiled nozzle, which aperture includes a portion converging in the course of flow of the liquid stream.

According to the present invention, a cross-sectional area of the tangentially oriented inlet channels is selected on the condition that:

\[ 4S_a \leq S_t \leq 6S_a, \]
where $S_t$ is a total cross-sectional area of the tangentially oriented channels; $S_a$ is a cross-sectional area of the axial channel, with at least four tangentially oriented channels being provided in the side wall of the hollow insert.

The combination of the above essential features of the invention allows the cone angle of a liquid spray at the outlet of the nozzle to be maintained at a constant predetermined level when the liquid flow rate changes. The given effect is due to the formation of a swirled liquid stream in the profiled channel of the nozzle. The preliminary swirling of the liquid flow is effectuated by means of the tangentially oriented supply channels of the centrifugal swirl unit. Thereafter, the revolving liquid streams are delivered directly into the inlet aperture of the profiled channel of the nozzle. The individual liquid streams flowing in the nozzle channel having a portion converging in the course of flow of the liquid stream combine to produce a single accelerated liquid stream. Thus, a stable gas-droplet jet is generated at the nozzle outlet, said jet being characterized by a constant tangential velocity which, in turn, defines a predetermined cone angle of the atomized liquid spray.

The tangential velocity value in reference to the linear velocity value is determined as a ratio of the total area of the tangentially oriented channels to the area of the axial channel. When an essential condition of selecting the area ratio of the axial channel and tangentially oriented channels is fulfilled, in compliance with the present invention, a gas-droplet jet is generated at the nozzle outlet with the cone angle of the atomized jet ranging between the optimal values of from $17^\circ$ to $23^\circ$.

In case of a decrease in the total cross-sectional area $S_t$ of the tangentially oriented channels below $4S_a$ or an increase in the area $S_t$ above $6S_a$, the cone angle of the atomized liquid jet is beyond the optimal value range, at which the maximal fire-extinguishing efficiency is ensured for the fire sources of A and B classes.

According to a preferred embodiment of the invention, there may be provided in the side wall of the insert of the centrifugal swirl unit four tangentially oriented inlet channels evenly distributed around the circumference. The axes of symmetry of the adjacent inlet channels are perpendicular to one another.

For the purpose of reducing the hydraulic losses, the converging portion of the profiled channel of the nozzle is made conical or conoid-shaped.

In the preferred embodiment of the invention, the profiled channel of the discharge nozzle of the atomizer may comprise a succession of an inlet portion converging in the course of flow of the liquid stream and an outlet diverging portion. The given structural embodiment
enables an increase in the distance that the gas-droplet jet may be discharged. In order to reduce the hydraulic losses, the aforesaid portions of the profiled channel of the nozzle are made conical or conoid-shaped.

When the preliminarily swirled liquid streams pass through the converging inlet portion of the nozzle, the said liquid streams are mixed to thereby accelerate the liquid jet generated. Tangentially swirled liquid droplets are split in the channel of the outlet diverging nozzle portion. A countercurrent air stream is flowing through a low-pressure zone lengthwise of the diverging nozzle portion to promote the liquid splitting procedure for splitting the liquid jet into droplets.

The technical result obtained is also provided through the employment of a fire-extinguisher comprising a reservoir filled with a fire-extinguishing liquid, a liquid replacement system for replacement of the liquid from the reservoir, a locking-and-starting device, a liquid atomizer equipped with a centrifugal liquid stream swirl unit and a discharge nozzle, and a pipeline for connecting the outlet of the locking-and-starting device to the liquid nozzle.

According to the present invention, the discharge nozzle of the liquid atomizer is provided with a profiled channel including a portion converging in the course of flow of the liquid stream. The centrifugal swirl unit is configured as a hollow insert having tangentially oriented inlet channels provided in the insert side wall and an inlet axial channel. The interior of the insert is communicating with the inlet aperture of the profiled nozzle.

The cross-sectional area of the channels provided in the insert is selected on the condition that: $4S_a \leq S_t \leq 6S_a$,
where $S_t$ is a total cross-sectional area of the tangentially oriented channels, $S_a$ is a cross-sectional area of the axial channel, with at least four tangentially oriented channels being provided in the side wall of the hollow insert.

The combination of the above essential features characteristic for the structure of the fire-extinguisher enables the generation of a high-velocity atomized jet of fire-extinguishing liquid having a predetermined spray cone angle. The given effect is due to the application of a liquid stream atomizer as part of the fire-extinguisher, said liquid stream atomizer being equipped with a centrifugal swirl unit. The tangentially oriented supply channels of the swirl unit encourage a preliminary swirling motion of the flow of fire-extinguishing liquid delivered from the reservoir through the pipeline to the atomizer nozzle.

The revolving liquid streams are discharged directly into the inlet aperture of the profiled channel of the discharge nozzle, within which a swirling flow of the fire-extinguishing liquid is
formed. The individual liquid streams combine into a single accelerated fire-extinguishing liquid stream generated in the nozzle channel having a portion converging in the course of flow of the liquid stream. At the outlet of the nozzle, a stabilized gas-droplet jet of the fire-extinguishing liquid is produced, said jet being characterized by a constant tangential velocity, which, in turn, defines a predetermined cone angle of the fire-extinguishing liquid spray.

When the ratio defining the cross-sectional sizes of the tangentially oriented channels and the axial channel is provided, a fire-extinguishing liquid jet with optimal cone angles ranging between 17° and 23° is generated. The indicated range of cone angles of the atomized liquid jet is considered optimal in terms of effective extinguishing of A and B class fire sources.

In the preferred embodiment of the invention, four tangentially oriented inlet channels are formed in the side wall of the cylindrical insert of the centrifugal swirl unit, said inlet channels being evenly distributed around the circumference. The axes of symmetry of the adjacent inlet channels are perpendicular to one another.

For the purpose of decreasing the hydraulic losses, the converging portion of the profiled channel of the liquid atomizer nozzle may be made conical or conoid-shaped.

In the preferred embodiment, the profiled channel of the discharge nozzle may comprise a succession of an inlet portion converging in the course of flow of the liquid stream and an outlet diverging portion. In order to decrease the hydraulic losses, the said portions of the profiled channel are made conical or conoid-shaped.

While passing through the inlet converging portion of the nozzle, the swirling liquid streams are mixed and the resultant liquid jet is accelerated. The tangentially swirled liquid droplets are split in the channel of the outlet diverging nozzle portion.

In order to increase the distance that the gas-droplet jet might be discharged, the profiled channel of the discharge nozzle of the atomizer may be comprised of a succession of an inlet conoid-shaped portion converging in the course of flow of the liquid stream, a converging conical portion joined to the converging conoid-shaped portion, and an outlet cylindrical portion.

**Brief Description of Drawings**

The invention is further exemplified by a concrete embodiment of the liquid atomizer and the fire-extinguisher comprising the liquid atomizer, as well as by the accompanying drawings illustrating the following:

Fig. 1 is a schematic sectional view of a fire-extinguisher equipped with a liquid atomizer;
Fig. 2 is a longitudinal sectional view of a liquid atomizer presented in 2:1 scale (turned through 180°); Fig. 3 is a longitudinal sectional view of a centrifugal swirl unit as part of an atomizer; Fig. 4 is a cross-sectional view of a centrifugal swirl unit illustrated in Fig. 3 and presented in A-A plane.

Preferred Example of Embodiment of the Invention

The fire-extinguisher illustrated in Fig. 1 comprises a reservoir 1 filled with a fire-extinguishing liquid. The fire-extinguishing liquid may be water or an aqueous solution of chemical admixtures adapted for promoting the fire-extinguishing efficiency. The volume of a fire-extinguishing charge is 6 l. The total volume of the reservoir 1 including the volumes of a liquid cavity and a gas cavity is 9 l.

The gas cavity of the reservoir 1 is filled with a pressurized gas at a predetermined gas storage pressure (2 MPa). A system for replacement of the liquid from the reservoir 1 includes a siphon pipe 2 and a locking-and-starting device 3 hermetically connected through a sealing bushing 4 to the outlet of the siphon pipe 2. The locking-and-starting device 3 includes a springy member configured as a spring 5, a locking member 6 and a control lever 7. The outlet of the locking-and-starting device 3 is connected to a liquid atomizer 8 through a flexible pipeline 9. The locking-and-starting device 3 is secured on the throat of the reservoir 1 with the use of a captive nut 10. A filter 11 is mounted at the open end of the siphon pipe 2.

The liquid atomizer 8 (see Fig. 2) includes a housing 12 with an inlet connection 13 that is joined with a flexible pipeline 9. A centrifugal liquid stream swirl unit configured as a hollow cylindrical insert 16 and a nozzle 17 are located in the housing 12 by means of a captive nut 14 and a sealing ring 15.

In the example of embodiment under consideration, a profiled channel of a discharge nozzle 17 is comprised of a succession of an inlet conoid-shaped portion 18 converging in the course of flow of the liquid stream, a conical converging portion 19 joined with the portion 18, and an outlet cylindrical portion 20. The interior of the insert 16 is communicating with the inlet portion 18 of the profiled channel of the discharge nozzle 17 (see Fig. 2).

It should be noted that other forms of embodiments of the invention are possible. The profiled channel of the discharge nozzle of the atomizer may be comprised of a succession of an inlet portion converging in the course of flow of the liquid stream and an outlet diverging portion. With the given embodiment of the atomizer nozzle, the portions of the profiled channel are made conical or conoid-shaped.
The insert 16 (see Figs 3, 4) is equipped with an axial channel 21 provided in the end wall of the insert 16 and with four tangentially oriented inlet channels 22 provided in the side wall of the insert 16.

In order to decrease the hydraulic losses, the axial channel 21 includes an inlet conical portion converging in the course of flow of the liquid stream (see Fig. 3). Tangentially oriented channels 22 are evenly distributed around the circumference. The axes of symmetry of adjacent inlet channels 22 are perpendicular to one another (see Fig. 4). In the embodiment of invention under consideration, the total cross-sectional area $S_t$ of the tangentially oriented channels 22 corresponds to the ratio:

$$S_t = 4S_i,$$

where $S_i$ is a cross-sectional area of each of the tangentially oriented channels.

The cross-sectional areas of the channels 21 and 22 are correlated as $S_t = 4S_a$ in accordance with an essential condition of the invention:

$$4S_a \leq S_t \leq 6S_a.$$

Therefore, in the example of embodiment under consideration, the cross-sectional area $S_i$ of each of the tangentially oriented channels 22 is as great as the cross-sectional area $S_a$ of the axial channel 21. The diameter of the axial channel and the tangentially oriented channels is 4 mm.

It should be emphasized that in the example of embodiment of the structure under consideration, the liquid atomizer is presented as part of a fire-extinguisher, however the atomizer of the present invention may be utilized as an independent unit in an apparatus of other designation, for example, as part of an apparatus for spraying of a purifying liquid.

The operation of the fire-extinguisher and the liquid atomizer as part thereof is accomplished in the following manner.

The reservoir 1 of the fire-extinguisher is preliminarily charged with a fire-extinguishing liquid (water containing a foaming agent). The said liquid is charged into the fire-extinguisher through the throat of the reservoir 1, wherein the locking-and-starting device 3 is then located and fixed by means of the captive nut 10.

The gas cavity of the reservoir 1 is supercharged with a pressurized gas (air) to the storage pressure (2 MPa). In the process of charging the fire-extinguisher with the pressurized gas, the locking-and-starting device 3 is in its open position. The gas is injected under an excessive pressure into the reservoir 1 through the outlet aperture of the locking-and-starting device 3. The liquid is forced out by the pressurized gas from the channel of the siphon pipe 2.
through the filter 11. While passing through the volume filled with the liquid, the gas is further forced out into the gas cavity of the reservoir 1.

After filling the gas cavity to the predetermined storage pressure, the locking-and-starting device 3 is closed and the gas and liquid pressure values are equalized in the channel of the siphon pipe 2. The liquid level in the siphon pipe 2 is set at some equilibrium state after handling operations experienced by the fire-extinguisher during storage.

A gas-droplet jet of the fire-extinguishing substance is generated during operation of the fire-extinguisher and the liquid atomizer as part thereof upon depression by an operator of the lever 7. The force applied to the lever 7 urges the locking member 6 to detach and thereby open the passage channel of the locking-and-starting device 3. The liquid replaced by the pressurized gas from the reservoir 1 is discharged through the filter 11 into the channel of the siphon pipe 2. While passing through a fine-mesh structure of the filter 11, the liquid is purified from solid inclusions formed during a prolonged storage.

The purified liquid stream is delivered from the channel of the siphon pipe 2 through the open locking-and-starting device 3 and the flexible pipeline 9 into the liquid atomizer 8.

A vortex flow created in the interior of the insert 16 functioning as a centrifugal liquid swirl unit, encourages swirling of the liquid stream issuing from the axial channel 21. The swirled liquid stream is generated in the interior of the insert 16 as a result of mixing the streams issuing from the tangentially oriented channels 22.

The liquid stream produced at the outlet of the interior of the insert 16 is characterized by a constant tangential velocity. An angular velocity of the swirled liquid stream in the channel of the nozzle 17 of the atomizer determines a cone angle of the gas-droplet jet generated.

The tangential velocity in the interior of the insert 16 is dependent upon the ratio of the total cross-sectional area of the tangentially oriented channels 22 and the cross-sectional area of the axial channel 21. With the condition $4S_2 \leq S_1 \leq 6S_2$ fulfilled, the gas-droplet jet produced at the outlet of the nozzle 17 has optimal values of a cone angle ranging between $17^\circ$ and $23^\circ$.

The swirled liquid stream generated in the centrifugal swirl unit is delivered into the inlet aperture of the profiled channel of the nozzle 17. The nozzle channel comprises a succession of the inlet conoid-shaped portion 18 converging in the course of flow of the liquid stream, the converging conical portion 19, and the outlet cylindrical portion 20. During passage through the portions 18 and 19, an accelerated liquid stream is created. An intensive generation of cavitation bubbles in the swirled liquid stream occurs within the outlet cylindrical portion 20.
An atomized jet of fire-extinguishing liquid generated at the outlet of the nozzle 17 is characterized by a homogeneous droplet size, an cone angle of 17°, an average droplet size of about 200 micron, and a distance that the fire-extinguishing liquid is discharged of at least 9 m.

In order to deactivate the fire-extinguisher, the locking-and-starting device 3 is brought to a normally closed position by releasing the control force from the lever 7. The locking member 6 is moved by the elastic force of the spring 5 to close the passage section of the flow-through channel of the locking-and-starting device 3.

The fire-extinguisher and the liquid atomizer as part thereof were subjected to tests the results of which have proved the possibility of generating a high-velocity gas-droplet jet with homogeneous droplet sizes and a stable cone angle ranging between 17° and 23°. The given optimal values of the cone angle ensure the fire suppression most effective for the fire sources of A and B classes.

**Industrial Applicability of the Invention**

The fire-extinguisher of the present invention may be widely utilized as a standard fire-fighting means in a variety of objects, such as rooms in the hospitals, libraries, museums and dwellings, as well as for suppressing the ignition sites in the open space.

Apart from employment in the fire-fighting systems, the liquid atomizer may be utilized for fuel spraying applications in heat engineering, as well as for wetting of environment and spraying of various substances used in agriculture and other branches of industry.

The above examples of embodiment are preferable, though they do not cover any other possible versions of embodiment within the claims of the invention, which may be implemented with the use of technical means and methods known to those skilled in the art.
We claim:

1. A liquid atomizer, comprising a housing (12) with an inlet connection (13), a centrifugal liquid stream swirl unit, and a nozzle (17) with a profiled channel, wherein the centrifugal swirl unit is configured as a hollow insert (16) with an inlet axial channel (21) and tangentially oriented inlet channels (22) provided in the side wall of the insert (16), with the interior of the insert communicating with the inlet aperture of the profiled channel of the nozzle (17) including a portion (19) converging in the course of flow of the liquid stream, characterized in that a cross-sectional area of the tangentially oriented inlet channels (22) is selected on the condition that: $4S_n \leq S_t \leq 6S_n$, where $S_t$ is a total cross-sectional area of the tangentially oriented channels (22); $S_n$ is a cross-sectional area of the axial channel (21), with at least four tangentially oriented channels (22) being provided in the side wall of the hollow insert (16).

2. A liquid atomizer of claim 1, characterized in that four tangentially oriented inlet channels (22) are provided in the side wall of the insert (16), said inlet channels (22) being evenly distributed around the circumference, with axes of symmetry of the adjacent inlet channels (22) extending perpendicular to one another.

3. A liquid atomizer of claim 1, characterized in that the converging portion of the profiled channel of the nozzle (17) is made conical or conoid-shaped.

4. A liquid atomizer of claim 1, characterized in that the profiled channel of the nozzle (17) of the atomizer is composed of a succession of an inlet portion converging in the course of flow of the liquid stream and an outlet diverging portion, said portions of the profiled channel of the nozzle being made conical or conoid-shaped.

5. A liquid atomizer of claim 1, characterized in that the profiled channel of the nozzle (17) of the atomizer is composed of a succession of an inlet conoid-shaped portion (18) converging in the course of flow of the liquid stream, a conical converging portion (19) joined with the inlet conoid-shaped converging portion (18), and an outlet cylindrical portion (20).
6. A fire-extinguisher comprising a reservoir (1) filled with a fire-extinguishing liquid, a system for replacement of liquid from the reservoir, a locking-and-starting device (3), a liquid atomizer including a centrifugal liquid stream swirl unit and a nozzle (17), and a pipeline (9) for connecting an output of the locking-and-starting device (3) with the liquid atomizer, characterized in that the nozzle (17) of the liquid atomizer is provided with a profiled channel including a portion converging (19) in the course of flow of the liquid stream, the centrifugal swirl unit being configured as a hollow insert (16) with tangentially oriented inlet channels (22) provided in the side wall of the insert (16), and with an inlet axial channel (21), that the interior of the insert is communicating with an inlet aperture of the profiled channel, and that the cross-sectional sizes of the inlet channels of the centrifugal swirl unit are selected on the condition that: $4S_a \leq S_t \leq 6S_a$, where $S_t$ is a total cross-sectional area of the tangentially oriented channels (22), $S_a$ is a cross-sectional area of the axial channel (21), with at least four tangentially oriented channels (22) being provided in the side wall of the hollow insert (16).

7. A fire-extinguisher of claim 6, characterized in that four tangentially oriented inlet channels (22) are provided in the side wall of the cylindrical insert (16) of the centrifugal swirl unit, said inlet channels (22) being evenly distributed around the circumference, with the axes of symmetry of the adjacent inlet channels (22) extending perpendicular to one another.

8. A fire-extinguisher of claim 6, characterized in that the converging portion of the profiled channel of the liquid atomizer nozzle is made conical or conoid-shaped.

9. A fire-extinguisher of claim 6, characterized in that the profiled channel of the outlet nozzle (17) of the liquid atomizer is composed of a succession of an inlet portion converging in the course of flow of the liquid stream and an outlet diverging portion, with the portions of the profiled channel of the nozzle (17) being made conical or conoid-shaped.

10. A fire-extinguisher of claim 6, characterized in that the profiled channel of the nozzle (17) of the liquid atomizer is composed of a succession of an inlet conoid-shaped portion (18) converging in the course of flow of the liquid stream, a converging conical portion (19) joined to the inlet conoid-shaped portion, and an outlet cylindrical portion (20).
INTERNATIONAL SEARCH REPORT

A. CLASSIFICATION OF SUBJECT MATTER
IPC 7 B05B1/34 A62C31/02

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)
IPC 7 B05B 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)
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C. DOCUMENTS CONSIDERED TO BE RELEVANT

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Date of the actual completion of the international search: 6 October 2005
Date of mailing of the international search report: 19/10/2005

Authorized officer: Schut, T
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