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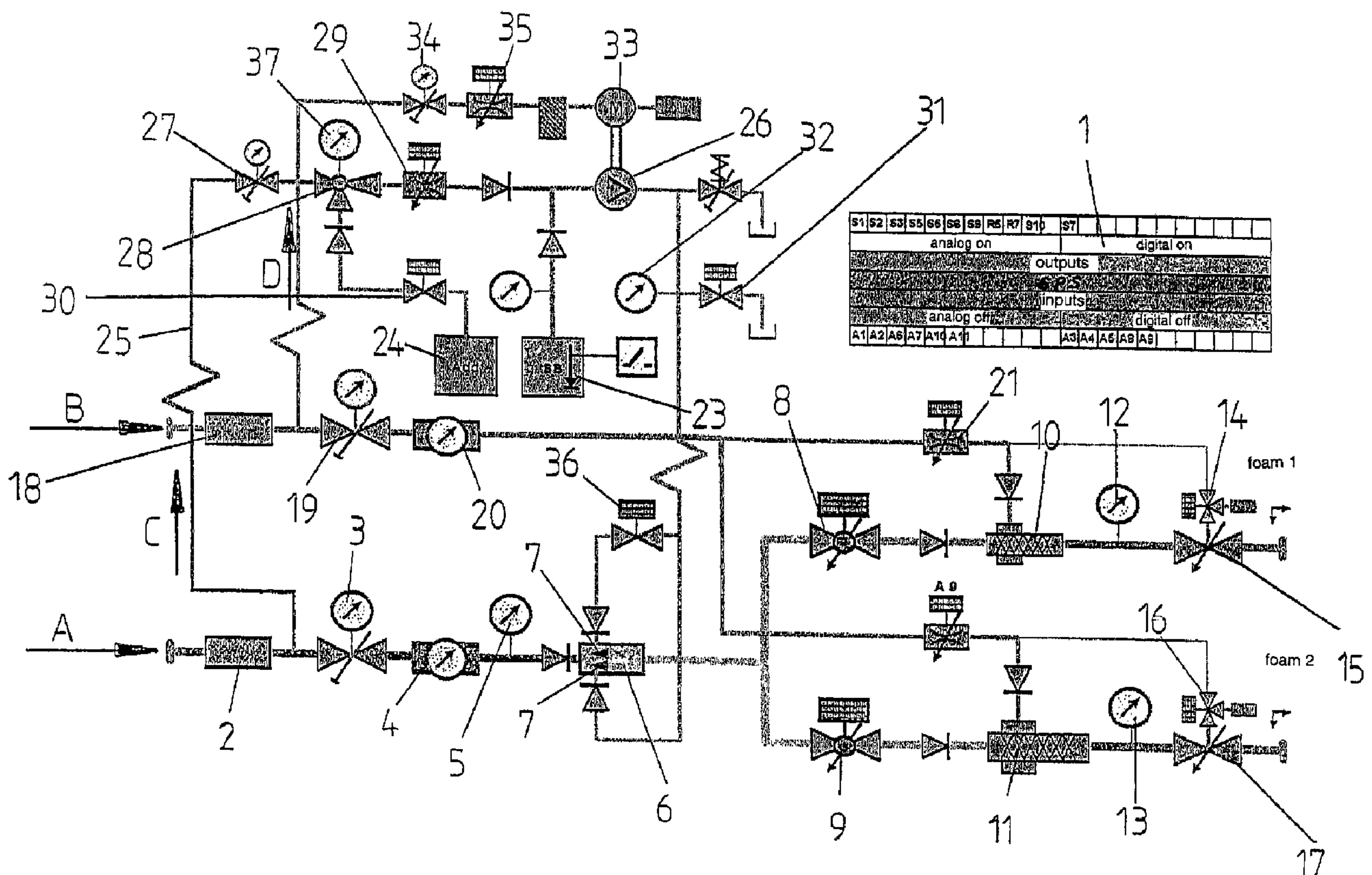
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(54) Titre : PROCEDE ET SYSTEME DE PRODUCTION DE MOUSSE A AIR COMPRI ME POUR LA LUTTE CONTRE
LES INCENDIES ET LA DECONTAMINATION
(54) Title: METHOD AND ARRANGEMENT FOR PRODUCING COMPRESSED AIR FOAM FOR FIRE FIGHTING AND
DECONTAMINATION



(57) Abrégé/Abstract:

The invention relates to a compressed air foam producer, wherein a fire or decontamination specific additive is injected directly into the foam forming flow supplied to the main water flow and/or the main water flow. A mixing pump for the foaming agent draws off



(57) **Abrégé(suite)/Abstract(continued):**

an auxiliary and motive water flow, wherein initially the additive and then the foaming agent is injected. The foaming agent-additive-water mixture, which is produced directly on site, is mixed well together and with the main water flow ensuring a fine, uniform distribution of the additives in the compressed air foam. The thus produced compressed air foam ensures optimal, economical and environmentally friendly fire-fighting and decontamination.

ABSTRACT

The invention relates to a compressed air foam producer, wherein a fire or decontamination specific additive is injected directly into the foam forming flow supplied to the main water flow and/or the main water flow. A mixing pump for the foaming agent draws off an auxiliary and motive water flow, wherein initially the additive and then the foaming agent is injected. The foaming agent-additive-water mixture, which is produced directly on site, is mixed well together and with the main water flow ensuring a fine, uniform distribution of the additives in the compressed air foam. The thus produced compressed air foam ensures optimal, economical and environmentally friendly fire-fighting and decontamination.

Method and arrangement for producing compressed air foam
for fire fighting and decontamination

Description

This invention relates to a method of producing compressed air
5 foam (CAF) for fire fighting and decontamination in which a main
water stream is mixed with a foaming agent stream and the mixture
of water and foaming agent is foamed along a foaming line with
a compressed air stream, and further relates to an arrangement
for performing the method.

10 The generation of CAF in the way described above is known. When
this document mentions CAF production with compressed air, the
term 'compressed air' is of course meant to include pressurized
gases suitable for fire extinction. Fire fighting and
decontamination of objects with CAF has proved its worth in many
15 application cases. Formulated application-specific mixtures of
foaming agents and specific additives are provided to be able
to use the CAF as optimally and efficiently as possible for the
respective type of fire or contamination with as little
environmental impact as possible. The production and provision
20 of such mixtures is limited inasmuch as foaming agents with
specific additives adjusted to the respective type of fire or
decontamination often dissolve with difficulty or not at all in
the stock solution, result in high-viscosity mixtures or tend
to clot, which makes them hard to deliver or distribute evenly
25 in the compressed water stream and prevents them from unfolding
their full effect. Apart from difficulties in the production or
provision and processing of mixtures with the most varied
additives, it is also not feasible to keep a multitude of
mixtures or even a mixture of the same components in different
30 compositions available at the respective site and for the
respective application case, for example to enable optimum fire
fighting using variable portions of additives.

It is therefore the object of the invention to state a method of producing compressed air foam (CAF) that ensures high efficiency in terms of its effectiveness, quantity of agents used, and environmental impact in different applications and conditions of use depending on the type of the fire or decontamination as well as a plant for performing this method with as little hardware use as possible.

This problem is solved according to the invention by a method and apparatus in accordance with the characteristics of claims 1 and 9. The subordinate claims disclose further characteristics and advantageous improvements of the invention.

The inventive idea, in other words, is that during the production of the CAF, i. e. directly on the application site, at least one specific additive adjusted to the respective type of fire or the respective decontamination purpose is admixed to a stream of foaming agent that is added to the main water stream or directly to the main water stream and ensures an optimum effect of the CAF with regard to fast and safe fire fighting or decontamination. It was found that the addition of just one special additive is sufficient and that it is especially the accurately dosed separate feeding of the additive into the foaming agent stream that ensures thorough mixing in the foaming agent and particularly a uniform, fine distribution in the fire extinguishing or decontamination foam resulting in maximum effectiveness of the additive combined with low consumption and reduced environmental pollution. In particular, various types of fires and various and differently contaminated objects can be fought or decontaminated effectively.

In a preferred improvement of the method according to the invention, the additive is first injected into an auxiliary and motive water stream by aspirating the respective additive based on the water jet pump principle while an auxiliary and motive

water stream for the fire extinguishing or decontaminating agent is produced by suctioning off the main water stream using the same admixing pump that also aspirates the foaming agent from a tank for foaming agent. The introduction of the additive and
5 the foaming agent into a water jet already provides good premixing and finally ensures even distribution in the main water stream.

In another embodiment of the invention, foaming agent and additive are admixed at different mixing ratios depending on a
10 pressure and water volume control system of the auxiliary and motive water stream in conjunction with the adjustable admixing pump speed. It is of course possible to just introduce the foaming agent or the respective additive or none of the two into the main water stream.

15 In an embodiment of the method, the auxiliary or motive water stream can be used to introduce an antifreeze or rinsing agent instead of an additive into the system.

In another embodiment, the foam pressure and thus the quality of the CAF produced with the additive and the foaming agent can
20 be influenced by modifying the foaming period using a valve arrangement.

The arrangement according to the invention for performing the method, for the case where an additive is admixed to the foaming agent, includes a mixer that is integrated into the main water
25 stream in which the main water stream is intermixed with the additive-water-foaming agent mixture. An additive container that is in a functional connection with the admixing pump is provided for intermixing the foaming agent aspirated with the admixing pump and the respective additive. The admixing pump is
30 connected to the main water stream to provide the auxiliary and motive water stream via a bypass line to which first a Venturi admixer and then the foaming agent tank are connected in the

direction of flow. The admixing pump is preferably driven by a pneumatic motor that takes the required driving air from the main air stream for compressed air foaming and can be controlled using an air pressure and air volume controller. A speed-controlled

5 DC motor to which the zero shift of non-stall-resistant motors described below can be applied can be used instead of the pneumatic motor. A pressure sensor is associated with and an upstream water pressure controller and a downstream water volume flowrate control unit are connected to the Venturi admixer. The

10 required quantities of foaming agent and additive can be set by a controller using the respective pressure conditions and volume flowrates. The mixer is provided with two injection nozzles with different k values to introduce differing quantities of foaming agent-additive mixture into the main water stream.

15 The arrangement according to the invention can be used to provide compressed air foams using the method described above that contain an additive admixed in situ at different quantities depending on the respective application case, i. e. the type of fire or decontamination, and evenly distributed in the foam so

20 that these foams enable efficient fire fighting and decontamination. The system is of a very simple design as it uses compressed air and water as energy sources for operating the admixing system which are required anyway for producing the CAF. While the foaming agents are generally the same, all that is

25 needed to be held in stock are different additives that are finely and evenly admixed into, and distributed in, the foaming agent without demixing or clotting and contained in the same even distribution in the fire extinguishing or decontaminating foam so that they can unfold their full effect.

30 One embodiment of the invention is explained in more detail with reference to the only figure that shows the schematic diagram of a system for producing a two-component foam in two foaming lines having different foaming capacities.

A programmable logic controller 1 with digital and analog electric inputs and outputs that cooperates with the system-specific sensors and control valves is assigned to the system for monitoring and control.

5 Water is fed into the system from a fire extinguishing pump or pressurized-water reservoir (not shown) and flows via a water filter 2, a water pressure controller 3, a water volume flowrate control unit 4, and a water pressure sensor 5 into a mixer 6. Two injection nozzles 7 with different k values lead into the
10 mixer 6 via which injection nozzles 7 a mixture of a commercial foaming agent (SB) and an application-specific second component (Add) depending on the current fire fighting or decontaminating requirements is fed into the water volume flow. The water volume flow intermixed with the two components (foaming agent and
15 additive) flows via first and second water flowrate control valves 8 or 9, respectively, into a first or second foaming line 10 and 11 in which the respective water mixture is foamed using compressed air. The first or second, respectively, compressed air foam produced in this way flows via foam pressure sensors
20 12 or 13 and electro-pneumatically operated valves 14, 15 or 16, 17, respectively, that form a closed-loop control circuit for setting the foam consistency and consequently, the foam quality to the respective foam ejection device (not shown). Compressed air is conducted into the foaming lines 10, 11 from a compressed
25 air source or a compressor (not shown) via an air filter 18, an air pressure controller 19, an air pressure sensor 20 and respective first and second air volume flowrate control valves 21 located upstream of respective the foaming lines 10, 11.

As mentioned above, a foaming agent and an additive adjusted to
30 the respective application case with which the fire can be fought in a controlled manner and more efficiently than before are injected into the water volume flow using the mixer 6. The substances are admixed from a foaming agent tank 23 and an

additive container 24 that was filled before use with an additive that is adjusted to the type of fire or substances to be decontaminated and highly effective but cannot be mixed durably and homogeneously with the foaming agent. The foaming agent tank 23 and the additive container 24 are connected to a bypass line 25 that branches off from the overall water flow downstream of the water filter 2 and runs into the injection nozzles 7 of the mixer 6 at its other end. An admixing pump 26 with upstream water pressure controller 27, a Venturi admixer 28 and a water flowrate control unit 29 is inserted into the bypass line 25. The additive container 24 is connected to the Venturi admixer 28 via a valve 30, and a delivery line from the foaming agent tank 23 runs directly into the bypass line 25 upstream of the admixing pump 26. A valve 31 for flushing and bleeding the admixing pump 26 and a flow meter 32 are integrated into the portion of the bypass line 25 that is located between the mixer 6 and the admixing pump 26. The admixing pump 26 is driven by a pneumatic motor 33 that is connected to the compressed air feed line behind the air filter 18 via an air pressure controller 34 for setting the operating pressure and an air volume flowrate control valve 35 for controlling the motor speed.

The foaming agent with additive fed via the bypass line 25 is injected into the water volume flow delivered by the mixer 6. The foaming agent-additive-water mixture flows via the water volume flowrate control valves 8 and/or 9 and the compressed air foam generators 10 and/or 11 into which compressed air is inserted at preset pressure and volume parameters via the air volume flowrate control valves 21 and/or 22. The foam quality of the compressed air foam spread using foam ejecting devices (not shown) depends on the flow rate and therefore on the dwell time of the foam in the foaming lines 10, 11 and is controlled via the foam pressure determined by the foam pressure sensors 12, 13 using valves 14, 15 or 16, 17, respectively (foam pressure

control).

The speed of the pneumatic motor 33 of the admixing pump 26 is controlled by the air volume flowrate control valve 35. The controller 1 determines the setpoint control signal for the motor speed in conjunction with the pump characteristic from the setpoint value preset for the foaming agent-additive admixing rate and the actual value determined by the water volume flow sensor 4. In the embodiment shown here - without using a flow meter for the foaming agent - the pressure difference between the initial pressure at the admixing pump 26 and the flow pressure of the water at the inlet of the mixer 6 is measured using the water pressure sensor 5 and the pressure sensor 32. The foaming agent-additive mixture is injected into the water stream via the injection nozzles 7. The volume flows through the respective injection nozzle 7 as a function of the differential pressure are stored as a parameter table in the controller 1. The admixture of foaming agent and additive is controlled depending on pressure using the setpoint values preset in comparison with the water volume flow determined by the water flow sensor 4, the speed control of the admixing pump 26, the differential pressure measurement mentioned above, and the parameter tables stored in the controller 1. To ensure as small pressure-volume flow curves as possible, smaller volume flows or volume flows defined in specific limits are admixed using an injection nozzle 7 with a small k value while a second injection nozzle 7 with a larger k value is connected via the valve 36 for larger volume flows, thereby ensuring a maximum volume flow for admixing the foaming agent-additive mixture.

According to the embodiment discussed here, volume flowrate control valves 8, 9 for the water-foaming agent-additive mixture and air volume flowrate control valves 21, 22 are inserted upstream of the respective CAF generator 10, 11 to be able to provide even very small volume flows, especially when

decontaminating.

The foaming agent and the other specific component depending on the respective type of fire or decontamination job are admixed using the admixing pump 26 which is driven by a pneumatic motor 33 speed-controllable to adjust capacity using the air volume flowrate control valve 35. Water is aspirated through the bypass line connected to the main water stream via the water pressure controller 27 and the Venturi mixer as well as the water volume flowrate control unit 29 using the admixing pump 26.

10 As the pneumatic motors, mostly designed as compressed air rotating piston type motors, are not stall-resistant at a specific speed, i.e. stall at slow speeds and high torques, which means that major mechanical damage is prevented in case of failure but that the admixing pumps cannot continuously be
15 driven from standstill to maximum speed, a defined water volume flow of a size which the admixing pump 26 would deliver at the stalling torque or stalling speed of the pneumatic motor 33 is injected into the bypass line on the inlet side of the admixing pump 26 via the water pressure controller 27 and the water volume
20 flowrate control unit 29. The admixing pump 26 must rotate at stalling speed for the injected water volume flow to flow. When the speed is increased, foaming agent is aspirated from the foaming agent tank 23 at the desired quantity (between zero and a maximum) in proportion to the speed due to the limited water
25 volume flow injected. The injected water volume flow prevents the admixing pump from running dry and supports the aspiration process when aspirating the foaming agent. If no additive is to be aspirated as fire- or decontamination-specific component, the auxiliary water flow can be shut down by closing the water
30 volume flowrate control unit 29, and the entire capacity of the admixing pump 26 can be used for delivering foaming agent. The zero shift caused with the arrangement described above of the non-stall-resistant pneumatic motor 33 can similarly be used for

speed-controlled DC motors applied instead of the pneumatic motor.

The second component that is - if necessary - to be admixed to the foaming agent is aspirated, with the valve 30 open, from the additive container 24 in proportion to the differential pressure via the auxiliary water stream mentioned above that flows through the Venturi admixer 28 at a pressure set by the water pressure controller 27 and while reducing the differential pressure using the water volume flowrate control unit 29 and intensely intermixed with the auxiliary water stream if the speed of the admixing pump 26 is increased using the air volume flowrate control unit at the same time. At increased pump speed and simultaneously constant differential pressure, the admixing pump 26 aspirates foaming agent from the foaming agent tank 23 via the Venturi admixer 28 together with the auxiliary water stream and the additive while both partial streams are intensely intermixed.

Thus an additive suitable for the specific application case can be added to the main water stream together with a foaming agent in the mixer 6 enabling highly controlled and effective fire fighting or decontamination. The foaming agent and the additive may be mixed at variable ratios in the quantities required. The foaming agent and the additive can also be the sole admixed substances: the foaming agent can be admixed solely in quantities from zero to a maximum related to the delivery volume of the admixing pump 26, the additive up to the 1.6-fold of the auxiliary and motive water stream flowing through the Venturi admixer 28.

List of reference symbols [as far as necessary]

	1	Controller
	2	Water filter
5	3	Water pressure controller
	4	Water volume flow sensor
	5	Water pressure sensor
	6	Mixer
	7	Injection nozzles
10	8	First volume flowrate control valve (water)
	9	Second volume flowrate control valve (water)
	10	First foaming line
	11	Second foaming line
	12	First foam pressure sensor
15	13	Second foam pressure sensor
	14	Valve
	15	Valve
	16	Valve
	17	Valve
20	18	Air filter
	19	Air pressure controller
	20	Air pressure sensor
	21	First air volume flowrate control valve
	22	Second air volume flowrate control valve
25	23	Foaming agent tank
	24	Additive container
	25	Bypass line
	26	Admixing pump
	27	Water pressure controller
30	28	Venturi admixer
	29	Water volume flowrate control unit
	30	Valve
	31	Valve

32 Pressure sensor

33 Pneumatic motor

34 Air pressure controller

35 Air volume flowrate control valve

5 36 Valve

37 Pressure sensor

Arrow A Main water stream

Arrow B Main air stream

Arrow C Auxiliary and driving water stream

10 Arrow D Drive air stream

CLAIMS

- 5 1. A method for producing compressed air foam (CAF) for fire fighting and for
decontamination in which a main water stream is mixed with a foaming agent
stream and the water-foaming agent mixture is loaded with a compressed air
stream in a foaming line, characterized in that at least one additive adjusted to
10 the application case and specific to the type of fire or decontamination is injected
into one or both of the foaming agent stream and the main water stream.
- 15 2. The method according to claim 1, characterized in that, when the additive is
admixed to the foaming agent stream, said stream is produced by a
pneumatically or electrically operated admixing pump that is connected to a
foaming agent reservoir and that also aspirates an auxiliary and motive water
stream from the main water stream and injects it into the admixing pump for its
zero shift, the additive being first suctioned off a separate reservoir using the
auxiliary and motive water stream, then intermixed with that stream, then sucked
20 into the additive-water mixture of the foaming agents.
- 25 3. The method according to claim 2, characterized in that the foaming agent and the
additive are injected together with the auxiliary and motive water stream at
variable mixing ratios with portions between zero and a maximum value into the
main water stream.
- 30 4. The method according to claim 3, characterized in that the auxiliary and motive
water volume stream is set via a pressure and water volume flowrate control
system using the pump speed of the admixing pump so that the foaming agent
and additive in the auxiliary and motive water stream are intermixed in variable
compositions depending on the differential pressure measured for the additive
using a Venturi admixer and the speed of the admixing pump.
5. The method according to claim 2, characterized in that either only the foaming
agent at quantities from zero to a maximum value in relation to the delivery

capacity of the admixing pump or only the additive is admixed to the main water stream together with the auxiliary and motive water stream.

- 5 6. The method according to claim 1, characterized in that the foam quality of the CAF formed from the foaming agent and the additive is additionally adjusted using its flow rate in foaming lines of the foam generator by regulating the foam pressure with valves.
- 10 7. An arrangement for performing the method according to claim 1, comprising a mixer for a foaming agent integrated into the main water stream, and a foaming line through which the water-foaming agent mixture flows and into which a main compressed air stream runs for foaming the water-foaming agent mixture, as well as an admixing pump driven by a pneumatic motor or speed-controlled DC motor for aspirating the foaming agent from a foaming agent tank and introducing it into
15 the mixer, characterized in that an additive container (24) filled with the additive that is specific to the respective type of fire or goal of decontamination is also connected to said admixing pump (26).
- 20 8. The arrangement according to claim 7, characterized in that, when the additive is admixed to the foaming agent stream, the admixing pump (26) is connected to the main water stream (A) via a bypass line (25) and an auxiliary and motive water stream (C) runs through it, and that the foaming agent tank (23) and via a Venturi admixer (28) the additive container (24) are connected to the bypass line (25); that a pressure sensor (37) is assigned to the Venturi admixer and a water
25 pressure controller (27) is inserted upstream and a water volume flowrate control unit (29) is inserted downstream of the Venturi admixer; and a pneumatic motor (33) driving the admixing pump (26) is connected to the main air stream (B) for providing a driving air stream (D), and that an air pressure controller (34) and an air volume flowrate control unit (35) are integrated into a feed line for the driving
30 air stream (D).

9. The arrangement according to claim 8, characterized in that a valve (30) for shutting the connecting line off is integrated into a connecting line between the Venturi admixer (28) and the additive container (24).
- 5 10. The arrangement according to claim 8, characterized in that a pressure sensor (32) and a valve (31) connected with a collecting basin are inserted in the connecting line between the admixing pump (26) and the mixer (6).
- 10 11. The arrangement according to claim 8, characterized in that at least two injection nozzles (7) with different k values connected to the connecting line with the admixing pump (26) are associated with the mixer (6), and that a valve (36) is placed upstream of the injection nozzle (7) with the greater k value.
- 15 12. The arrangement according to claim 7, characterized in that a foam pressure sensor (12, 13) and a valve arrangement (14, 15; 16, 17) for foam pressure adjustment are placed downstream of the foaming line (10)(11).

