March 9, 1965 H. GRISDALE ETAL 3,172,477

FOAM PRODUCING APPARATUS FOR MINE FIRE FIGHTING

Filed Aug. 7, 1961 2 Sheets-Sheet 1

Fig 1.

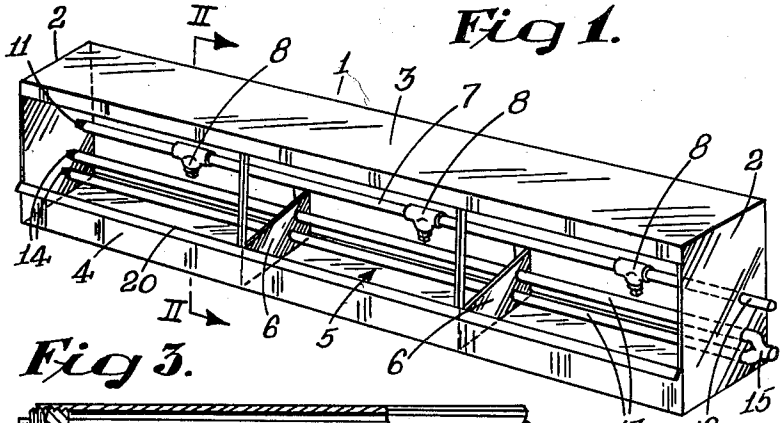


Fig 3.

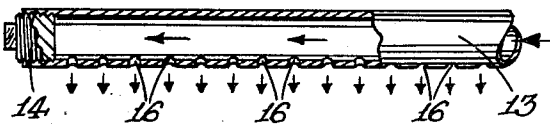
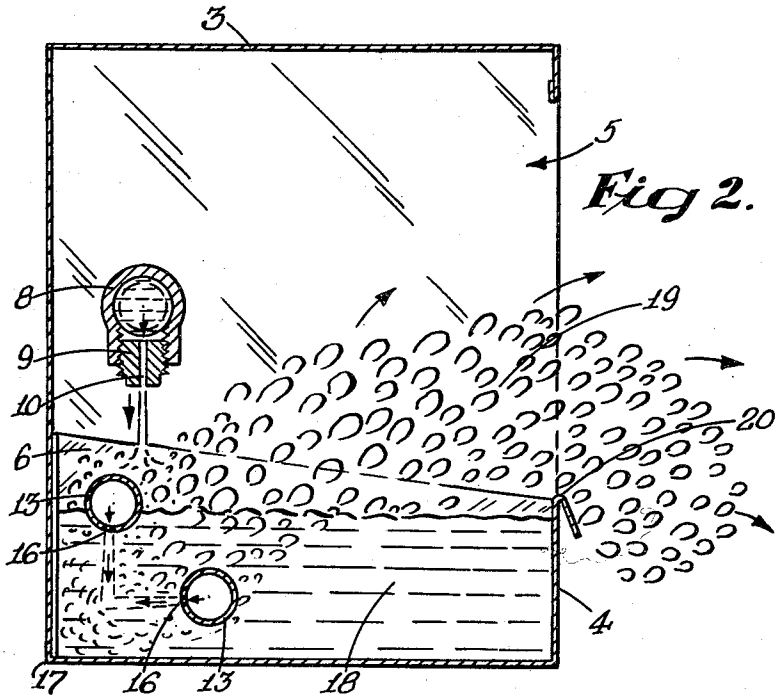


Fig 2.



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FOAM PRODUCING APPARATUS FOR MINE FIRE FIGHTING

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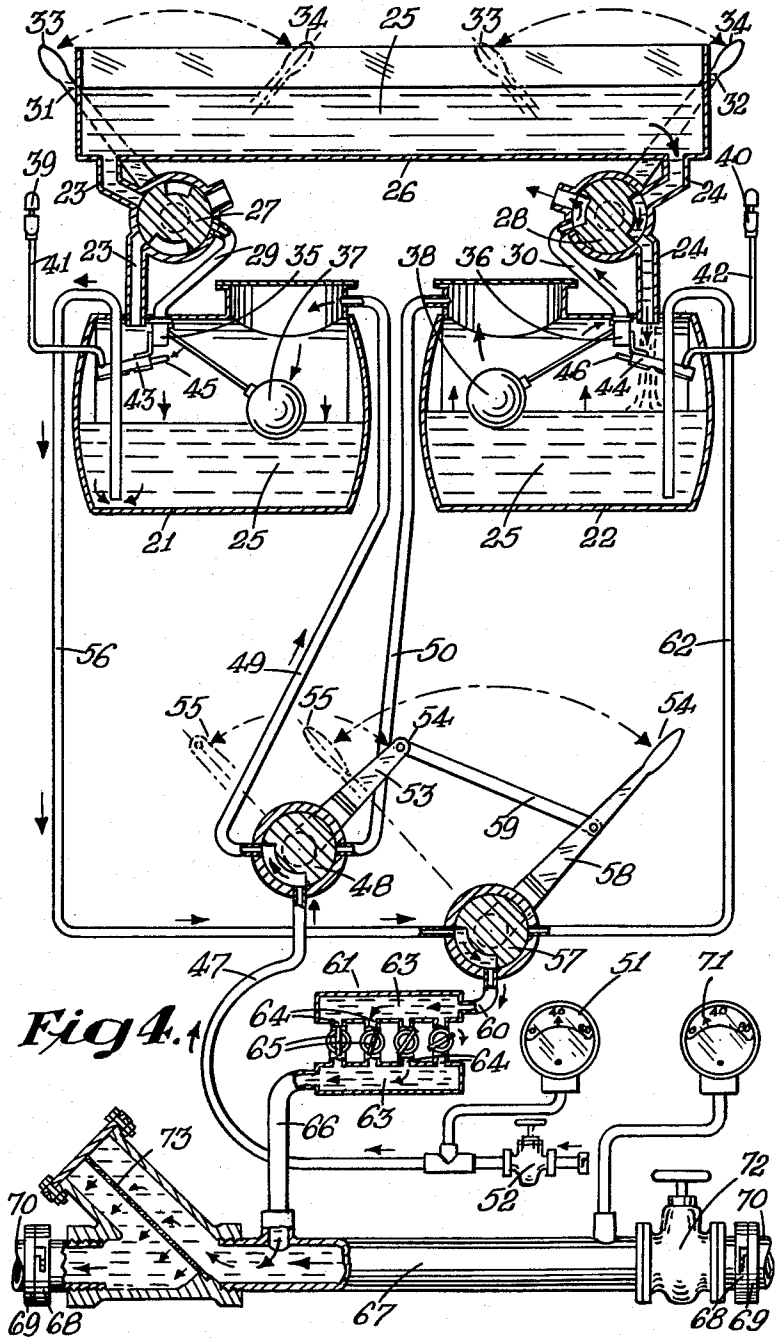


Fig 4.

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FOAM PRODUCING APPARATUS FOR MINE FIRE FIGHTING

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9 Claims. (Cl. 169—2)

This invention relates to fire-fighting and particularly to mine fire-fighting.

In a known method of producing extinguishing foam a foam compound and air are introduced into a water supply line by venturi action. Fire extinguishing foam is formed in the line and can be sprayed through a nozzle onto the fire.

By virtue of the confined space of mine workings and the concentration along the tunnel of heat generated by a fire, it is sometimes impossible to approach the fire close enough to direct a jet of foam onto it. The above method of producing fire extinguishing foam is therefore often unsatisfactory for use in mines.

In order to produce fire extinguishing foam in bulk in mine workings, it is known to provide a net across the working on the upstream side of a fire with respect to the flow of ventilation air. Foam producing liquid is sprayed onto the net and ventilation air passing through the net forms masses of foam bubbles which are carried downstream towards he fire.

This method works satisfactorily provided the slope of the working is not excessive and walls, floor and roof are regular. Under conditions such as those where steep stopes are encountered and workings have irregular boundaries, this method has proved unsatisfactory.

It is an object of the present invention to provide apparatus for producing fire extinguishing foam which may be used to minimize the above disadvantages.

According to the invention a method of producing fire extinguishing foam comprises introducing a suitable foam-producing liquid into an open vessel; agitating the liquid by injecting into it a non-combustible gas under pressure, thereby producing foam in bulk; and allowing the foam to exude from the vessel.

It will be appreciated that for the foam to be useful in fire-fighting the gas and foam must be non-combustible.

The preferred gas, especially in mines where it is readily available, is air.

The foam producing liquid may comprise a mixture of water and a foam compound. In order to produce foam continuously a foam compound may be introduced continuously in the required proportions into a water supply line feeding into the vessel. Any known foam compound, such as that sold under the trade name "Pyrene," may be used.

For satisfactory foaming without splashing liquid out of the vessel, it is preferable to inject air at a relatively high rate but at a relatively low pressure. A plurality of jets of compressed air are preferably used.

The method according to the invention is particularly suited for use in fighting fires in confined spaces such as mine tunnels since the foam produced is automatically directed onto the fire. Furthermore, it is desirable to be able to allow the foam to gravitate onto the fire. It is anticipated, however, that the foam may be directed from its source on a level surface by draught inducing means, such as fans.

In the case where a fire is located in a sloping tunnel such as a mine stope, the tunnel may be blocked below the fire, the open vessel is placed in the tunnel at a level

higher than the fire, and the foam which exudes from the vessel is allowed to gravitate onto the fire.

Further according to the invention there is provided a vessel adapted to produce fire extinguishing foam and comprising a casing; an inlet to the casing for foam producing liquid; a plurality of nozzles adapted for connection to a compressed gas feed, the nozzles being arranged so that at least two gas jets emanating therefrom converge upon one another within the casing; and an outlet in the casing for foam.

Preferably, the above vessel includes a pair of substantially parallel pipes which extend at low level across the vessel, are closed at one end and are adapted at the other end to be connected to the compressed gas feed. Each of the pipes is provided along its length with a row of spaced apertures, the rows of apertures being arranged for the two rows of compressed gas jets emanating therefrom to converge upon each other in the zone of a wall of the vessel.

In a preferred embodiment the vessel is elongated and is of rectangular cross-section. The casing has a top cover plate and the upper portion of one of its side walls is cut away to provide an outlet for foam. This construction permits the stacking of two or more vessels on top of one another for the rapid production of foam, which will flow over the cut away side walls of the vessels.

In use, the level of foam producing liquid is preferably maintained above the apertures in the pipes and below the top of the cut away side wall.

In a further preferred embodiment the vessel includes at least one transverse partition member which divides the vessel into a plurality of compartments; and an inlet to each compartment for foam producing liquid. When the vessel is placed on uneven ground so that it slopes longitudinally, the difference in height of opposite ends of each compartment will be less than the opposite ends of the vessel so that the apertures in the pipes are less likely to become uncovered than with an uncompartmented vessel.

Still further according to the invention there is provided means adapted for continuously supplying liquid foam compound to a water supply line comprising at least two fluid-tight containers; an inlet to each container for foam compound; a liquid delivery line leading from low level in each container to the water supply line; an inlet to each container for compressed gas for expelling foam compound via the delivery line; and valve means for controlling the compressed gas supply and liquid delivery, the valve arrangement being such that gas may be fed alternately to the containers and that there is a passage for foam compound from a container to the water supply line only when gas is being fed to the container; each container being adapted to be charged with foam compound when the latter is being expelled from the other container.

Preferably, the continuous supply means includes a filler trough above the containers connected to the inlets for foam compound in the containers; a gas vent in each container; and valves controlling the inlet for foam compound and the gas vent, the valves being interlocked and so arranged that opening of the inlet valve to charge the containers with foam compound from the trough causes opening of the gas-vent valve to release pressure in the container.

Preferably also, the delivery lines lead from the containers to an induction pipe which is adapted for connection in the water supply line.

In a preferred embodiment each container is provided with a gas operated signal means which is provided with a float operated valve, the valve being arranged to open when the foam compound in the container falls below a

predetermined level thereby to permit compressed gas in the tank to operate the signal means.

Preferred embodiments of the invention will now be described with reference to the accompanying drawings in which FIG. 1 is a perspective view of a foam producing vessel constituting part of the apparatus according to the invention.

FIG. 2 is an enlarged cross-section taken on the line II—II in FIG. 1;

FIG. 3 is an inlet pipe for compressed air, the pipe being shown partly in cross-section and

FIG. 4 is a front elevation partly in section of means for continuously supplying foam compound to a water supply line feeding to the vessel of FIG. 1.

Referring now to FIGS. 1, 2 and 3 of the drawings foam producing vessel 1 includes an elongated casing 2 of rectangular cross-section. The casing 2 presents a top cover plate 3 upon which similar vessels may be stacked. The upper portion of side wall 4 is cut away to provide an opening 5 through which foam generated in the vessel 1 may exude. Transverse plates 6 partition the vessel 1 into three compartments. Foam producing liquid inlet pipe 7 protrudes into the vessel 1 and extends across the three compartments thereof. The T connectors 8 which join successive lengths of pipe 7 are provided with plugs 9 having apertures 10 through which foam producing liquid pours into each compartment of the vessel 1. The end 11 of pipe 7 is plugged closed and the end 12 is adapted to be connected to a water supply line which is being dosed with a foam compound. Pipes 13 are substantially parallel and extend at low level across the vessel 1. The ends 14 of pipes 13 are plugged closed while the opposite ends 15 are adapted to be connected to a compressed air supply. A row of holes 16 is provided in each pipe 13, the said holes comprising nozzles through which jets of compressed air enter the vessel 1. The holes 16 in each pipe are aligned so that each compressed air jet converges upon another. The holes 16 and pipes 13 are further so arranged that the compressed air jets converge in the zone of the longitudinal corner 17 of vessel 1. The compressed air jets thus cause agitation in foam producing liquid 18, especially in the zone of corner 17, thereby producing a large amount of foam 19. The foam 19 builds up when use of the vessel 1 is started, and then exudes from the vessel 1 via mounth 5. The foam producing liquid 18 is maintained at a level above holes 16 but below the lip 20 of mouth 5. The holes 16 are of a size such that the compressed air jets are relatively fast flowing and have a relatively low pressure.

Referring now to FIG. 4 fluid tight containers 21 and 22 are provided with inlet pipes 23 and 24 for foam compound 25 contained in filler trough 26. Valves 27 and 28 are provided in pipes 23 and 24 respectively. Air vent pipes 29 and 30 lead from containers 21 and 22 to valves 27 and 28 respectively. The valves 27 and 28 are provided with handles 31 and 32 respectively which move between positions 33 and 34 for closing and opening the valves. Handle 31 is in position 33 in which the valve 27 is closed thus preventing the entry of foam compound 25 to container 21 via pipe 23 and the escape of compressed air from container 21 via pipe 29. Handle 32 is in position 34 in which valve 28 is open thus allowing the flow of foam compound 25 into container 22 via pipe 24 and the escape of compressed air via pipe 30. The pipes 29 and 30 are also provided with valves 35 and 36 operated by floats 37 and 38 respectively. When the container 22 is charged to a predetermined level with foam compound 25 the float 38 closes valve 36 and handle 32 may be moved to position 33 in which the valve 28 is closed. The containers 21 and 22 are further provided with whistles 39 and 40 communicating with the containers by means of pipes 41 and 42 respectively. The latter are provided inside the containers 21 and 22 with valves 43 and 44 having stems 45 and 46 which are biased towards the closed position. When the foam compound 25 in container 21 sinks to a predetermined level the stem of float 37 engages the stem 45 thus opening the valve 43. Compressed air in the container 21 is thus forced through the whistle 39 which emits an audible signal as a warning that re-charging of the container 21 with foam compound 25 is necessary. The handle 31 may then be moved to position 34 in which valve 27 is open, and the operations of containers 21 and 22 are reversed.

Air line 47 for compressed air enters valve 48 from which air lines 49 and 50 lead to the containers 21 and 22 respectively. Air line 47 is provided with a pressure gauge 51 and a gate valve 52 for throttling back the pressure, preferably to about 40 p.s.i.g.

The valve 48 is provided with a handle 53 which can move between two positions 54 and 55. In position 54 as shown compressed air is free to flow from air line 47 through valve 48 and air line 49 into container 21. The air line 50 is shut off from the air line 47 when the handle 53 is in position 54 so that no compressed air enters the container 22. The air pressure in container 21 forces foam compound 25 out of the container via delivery line 56 which extends from low level in container 21. The delivery line 56 leads to valve 57 which is provided with a handle 58 connected to the handle 53 by link 59. The handle 58 can move between two positions 54 and 55 as can handle 53. In position 54 as shown, foam compound 25 is free to flow from delivery line 56 through valve 57 into pipe 60 and regulating valve 61. With the handle 58 in position 54 the delivery line 62 extending from low level in container 22 is shut off from pipe 60. The link 59 ensures that both handles 53 and 58 are in position 54 or 55 at the same time. In this way air may be fed into only one container at a time and there is a passage for foam compound from a container through to the regulating valve 61 only when air is being fed to such container. The regulating valve 61 includes reservoirs 63 connected by four down-comers 64. Valve cocks 65 in the down-comers regulate the quantity of foam compound 25 which is allowed to pass into pipe 66 and induction pipe 67. If a large amount of foam producing liquid is required the valve cocks 65 will all be opened to allow the maximum amount of foam compound to enter the induction pipe 67. The latter is provided with socket connection means 68 at either end for engagement with spigot connecting means 69, thus connecting the induction pipe 67 in water supply line 70. The induction pipe 67 is provided with a water gauge 71 and a gate valve 72 for throttling back the water pressure preferably to about 25 p.s.i.g. It has been found in practice that by maintaining a difference of about 15 lbs. p.s.i. in the water pressure and air pressure in the induction pipe 67 and air line 47 respectively, an even and constant feed of foam compound 25 into the water supply line 70 is obtained. The induction pipe is further provided with strainer means 73 which prevents any large particles from getting through to a foam producing vessel.

With a single foam producing vessel to supply with foam producing liquid, only one valve cock 65 need be partly opened while with all the valve cocks 65 open, as much as twelve vessels may be amply supplied.

A trial run was held in a sloping stope in a Witwatersrand gold mine, in Transvaal, South Africa. The stope was nine feet wide, five feet high and fifty feet long. A fire was built in the stope which was blocked at a level lower than the fire. Nine foam producing vessels were placed in the stope in three stacks of three vessels packed one on top of the other, two stacks being against opposite walls of the stope and one across the stope. The respective pipes in the vessels were connected to a compressed air line and a water supply line and a continuous foam compound supply means was connected to the water supply line at an advantageous point some distance from the vessels. After commencing the foam producing process

the stope was sufficiently filled in fourteen minutes completely to kill the fire.

We claim:

1. A vessel adapted to produce fire extinguishing foam comprising a casing; an inlet to the casing for foam producing liquid; a plurality of nozzles adapted for connection to a compressed gas feed, the nozzles being arranged so that at least two gas jets emanating therefrom converge upon one another within the casing; and an outlet in the casing for foam, the casing being elongated and of rectangular cross-section, the casing including a top cover plate and side walls and having the upper portion of one of its side walls cut away to provide said outlet for foam.

2. A vessel as claimed in claim 1 including a pair of substantially parallel pipes which extend at low level across the vessel, said pipes being closed at one end and adapted at the other end to be connected to the compressed gas feed, each of the pipes being provided along its length with a row of spaced apertures, the rows of apertures being arranged for the two rows of compressed gas jets emanating therefrom to converge upon each other in the zone of a wall of the vessel.

3. A vessel as claimed in claim 1 including at least one transverse partition member which divides the vessel into a plurality of compartments, and an inlet to each compartment for foam producing liquid.

4. Apparatus adapted to produce fire extinguishing foam for use in fighting fires in sloping tunnels, said apparatus comprising a vessel; an inlet to the vessel adapted for connection to a water supply line; means for continuously supplying a liquid foam compound to the water supply line; a plurality of nozzles in the vessel which are adapted for connection to a compressed gas feed, the nozzles being arranged so that at least two gas jets emanating therefrom converge within the vessel; and an opening in the vessel to permit foam generated therein to exude therefrom, said vessel being elongated and of rectangular cross-section, one of the side walls of the vessel being cut away to provide the opening for the discharge of foam.

5. Apparatus as claimed in claim 4, comprising a pair of substantially parallel pipes located in the vessel and extending at a lower level across the latter, the pipes being closed at one end and adapted at the other end to be connected to the compressed gas feed, each of the pipes being provided along its length with a row of spaced apertures, the rows of apertures being arranged for the two rows of compressed gas jets emanating therefrom to converge in the zone of a wall of the vessel.

6. Apparatus as claimed in claim 4 in which the vessel includes at least one partition member which divides the vessel into a plurality of compartments, an inlet to each compartment being provided for connection to the water supply line.

7. Apparatus adapted to produce fire extinguishing foam for use in fighting fires in sloping tunnels, said apparatus comprising a vessel; an inlet to the vessel adapted for connection to a water supply line; means for continuously supplying a liquid foam compound to the water supply line; a plurality of nozzles in the vessel which are adapted for connection to a compressed gas feed, the nozzles being arranged so that at least two gas jets emanating therefrom converge within the vessel; and an opening in the vessel to permit foam generated therein to exude therefrom, said means for continuously supplying a liquid foam compound to the water supply line including at least two fluid-tight containers; an inlet to each container for foam compound; a liquid delivery line leading from a lower level in each container to the water supply line; an inlet to each container for compressed gas for expelling foam compound via the delivery line; and valve means for controlling the compressed gas supply and liquid delivery, the valve means being effective to feed gas alternately to the containers while a passage for foam compound from a container to the water supply line is provided only when gas is being fed to the container; each container being adapted to be charged with foam compound when the latter is being expelled from the container, said means for continuously providing liquid foam further including a filler trough above the containers connected to the inlets for foam compound in the containers; a gas vent in each container; and valves controlling the inlet for foam compound and the gas vent, the valves being interlocked and arranged such that opening of the inlet valve to charge the cylinders with foam compound from the trough causes opening of the gas vent valve to release pressure in the container.

8. Apparatus as claimed in claim 7 in which the delivery lines lead from the containers to an induction pipe which is adapted for connection in the water supply line.

9. Apparatus as claimed in claim 7 in which each container is provided with gas operated signal means which is provided with a float operated valve, the latter valve being arranged to open when the foam compound in the container falls below a predetermined level thereby to permit compressed gas in the tank to operate the signal means.

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