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CHARLES A. THOMAS AND CARROLL A. HOCHWALT, OF DAYTON, OHIO

CHARGE FOR FIRE EXTINGUISHERS

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This invention relates to fire extinguishers, more particularly of the portable type, and particularly to charges for such extinguishers.

Portable fire extinguishers, as heretofore manufactured for many years, have been generally of two types,—one type having some form of pumping mechanism for expelling the fire-extinguishing liquid, and the other type having some form of chemical charge of such characteristics that during use chemical reaction will take place to produce a gaseous pressure for expelling the fire-extinguishing liquid. This invention relates more particularly to the latter form of extinguisher, although it is in some aspects of more general application.

Of the latter class of extinguishers, that generally known as the soda and acid extinguisher is typical.

Such an extinguisher as heretofore generally manufactured has consisted of a casing containing a fire-extinguishing liquid, ordinarily a solution of sodium bicarbonate in water, a bottle of some acid, such as sulphuric acid, being mounted within the container so that when the extinguisher is inverted for use the acid will escape into the carbonate solution and react therewith to generate carbon dioxide which in turn exerts a pressure upon the extinguishing solution to expel it from the container. One principal objection to an extinguisher of this character is that the sodium bicarbonate solution will not withstand very low temperatures. At temperatures of approximately 32° F. (depending upon the concentration of the bicarbonate solution) the carbonate will precipitate out and the main extinguishing liquid will then freeze rendering the extinguisher incapable of use. Not only does the bicarbonate solution freeze at comparatively high temperatures, but furthermore at very low temperatures the chemical activity of sulfuric acid is greatly decreased. This is of peculiar importance because the Underwriters' Laboratories refuse to certify as of a preferred character any extinguisher which will not withstand a temperature of −40° C. The ordinary soda and acid extinguisher has been deficient for certification on two grounds,—first that the carbonate solution would freeze at a temperature much above that prescribed, and furthermore the sulphuric acid itself would become, for practical fire extinguisher operation, chemically inert at this low temperature prescribed.

One of the principal objects of this invention is to provide a fire extinguisher having a charge composed of materials which function with high efficiency of reaction to produce a discharge pressure at the low temperature of −40° C. prescribed by the underwriters.

Another object of the invention is to provide a charge for fire extinguishers of this character, comprising materials which are in liquid form, and are non-freezing at the low temperature prescribed by the underwriters.

Another object of the invention is to provide such a charge, the constitutent materials of which are not only non-freezing but are chemically active at this low prescribed temperature.

Still another object of the invention is to provide a freezing temperature depressant, for use in connection with the constituent materials within the extinguisher, which is chemically inert with respect to those constituents at least in so far as concerns gas-forming reactions.

Still another object of the invention is to provide as one constituent of a fire-extinguisher charge, a gas-generating material which when in solution contains for a given volume of solution a large capacity for gas formation.

Other objects and advantages of this invention will be apparent from the following description, and claims.

This application is in part a continuation of the application of Charles A. Thomas and Carroll A. Hochwalt, Serial No. 85,386, filed February 1, 1926, for Antifreeze mixture for fire extinguishers.

As stated above chemical reaction fire extinguishers as heretofore used have been incapable of use at the extremely low temperature of −40° C., which the Board of National Fire Underwriters prescribes as a prerequisite for granting an A-1 rating upon a fire extinguisher. A solution of calcium chloride in water will serve adequately as the main fire-extinguishing liquid, at such low temperatures, a calcium chloride solution having a freezing point below −40° C. But no constituents have been heretofore known which were chemically active at this low temperature, to react at such a rate in the production of a pressure gas as would make an extinguisher containing calcium chloride solution suitable. With a view to meeting the requirements of the Board of Underwriters and obtaining an extinguisher capable not only of withstanding a temperature as low as −40° C., but also of operating at high efficiency at that temperature we have, by searching and sustained experiments, ascertained that a compound contaning a sulfonic acid radical, such as a halogenated sulfonic acid, will not freeze at extremely low temperatures, will react with any carbonate, either solid, in solution or in suspension, to produce carbon dioxide.

Such a halogenated sulfonic acid is chlorosulfonic acid, $ClSO_2OH$, fluorosulfonic acid, FSO_2OH, or, in fact, any sulfonic acid contaning any element of the halogen group. Chlorosulfonic acid, which will not freeze at extremely low temperatures, is admirably adapted to act upon a solid carbonate, such as sodium bicarbonate, $NaHCO_3$, to produce carbon dioxide with adequate efficiency at temperatures much lower than −40° C. This reaction may be accelerated by water to which any non-freezing agent such as calcium chloride may be added.

It has been definitely ascertained that one molecule of chlorosulfonic acid acts with three molecules of sodium bicarbonate to produce three molecules of carbon dioxide, these agents resisting a temperature as low as −80° C.

An effective charge of these non-freezing agents for expelling a gallon and a half of liquid from a fire extinguisher, consists of 8 ounces of sodium bicarbonate and 2½ fluid ounces of chlorosulfonic acid.

While we have found sodium bicarbonate to be an effective carbonate for reacting with chlorosulfonic acid to produce carbon dioxide at extremely low temperatures, any other carbonate, such as sodium carbonate, magnesium carbonate, potassium carbonate and ammonium carbonate may be used with a halogenated sulfonic acid for this purpose with highly satisfactory results.

We have also found that other materials containing a sulfonic acid radical ($-SO_2OH$) such, for example, as the sulfonic acid of acetic acid, $CH_2SO_2OHCOOH$, and other sulfonic acid radical containing compounds, will react with a carbonate to produce carbon dioxide at extremely low temperatures.

The sulfonic acid compound when used with a carbonate, not in solution, will react satisfactorily at temperatures much below −40° C. However, the underwriters object to the use of a solid, or non-solution, form of carbon dioxide producting material. This is partly due to the fact that the reaction between the acid material and the solid carbonate material may be non-uniform, and consequently may not generate a continuous gas pressure to effect uniform discharge of the fire-extinguishing liquid. Furthermore the solid carbonate material is apt to agglomerate into comparatively large lumps, which may acquire a hardened surface, so that the rate of reaction will be greatly slowed down due to the incapacity of the acid to contact with a large quantity of the carbonate material in a short time. Consequently it is extremely desirable, and almost commercially necessary, that the carbonate material be in solution. However, all carbon dioxide producing materials heretofore used in fire extinguishers have been incapable of use at the low temperatures specified herein since they will freeze at those temperatures.

For example sodium bicarbonate in solution is inadequate because it freezes at a temperature considerably above −40° C. But we have discovered that ethylene glycol ($(CH_2)_2(OH)_2$) when used with a carbonate in a water solution is chemically inert with respect to that carbonate, at least in so far as concerns any reaction which results in liberating the carbon dioxide or rendering the carbonate incapable of subsequent reaction with an acid to produce carbon dioxide, and is at the same time of such character that it will greatly lower the freezing temperature of such a carbonate in water.

Not only is this true but ethylene glycol being an uninflammable material lends itself nicely as an anti-freeze for the carbonate solution of the fire extinguisher. And a carbonate solution with ethylene glycol, with the water and the carbonate and ethylene glycol admixed in suitable proportions will have a considerably depressed freezing temperature.

However, a carbonate solution containing sodium bicarbonate, or any of the other usual carbonates, admixed with ethylene glycol is objectionable for use in a fire extinguisher, when used in a container separate from the fire-extinguishing liquid, because even though its freezing temperature may be lowered adequately, the volume of the resulting charge is so great that it occupies an undesirably large portion of the total space available inside the extinguisher, and thus cuts down to an impracticable degree the quantity of fire extinguishing liquid which is to be expelled as a result of the chemical reactions between this carbonate charge and acid charge. Of course the container could be filled with any suitable fire-extinguishing liquid such as a solution of carbonate in water with sufficient ethylene glycol admixed therewith to produce the desired depression of the freezing point. At present, however, this is commercially undersirable because of the comparatively high cost of ethylene glycol which would make the use of it, in the large quantities needful for sufficiently lowering the freezing point of such a large quantity of carbonate solution as would constitute the main extinguishing liquid of the extinguisher, run the cost of the charging materials for the extinguisher to a commercially unfeasible point. However, if it is desired to use ethylene glycol as a freezing temperature depressant in the main extinguishing liquid, the extinguisher would work satisfactorily, with only the substitution of chlorosulfonic acid, or some analogous compound, in the place of the sulfuric acid ordinarily used in the soda and acid extinguisher, where extremely low temperatures are to be met.

However, such a carbonate as is ordinarily used in a fire extinguisher, for example sodium bicarbonate, is of such character that when placed in solution and used in a smaller separate container as described immediately above in order that there may not be too great displacement of the main extinguishing fluid, there will not be enough CO_2 generated during the reaction with the acid from each unit volumn of carbonate solution to provide from such small volume of sodium bicarbonate solution sufficient expelling gas, and as a consequence where any of the ordinary used carbonates constitute the carbon dioxide producing material the quantity of carbonate producing solution in the charge is excessive. We have found, however, that sodium potassium carbonate ($NaKCO_3$) is so constituted that when placed in solution in water the CO_2 content per unit of volume will be quite high. Sodium potassium carbonate is quite soluble in water as compared with other generally used carbonates such as sodium bicarbonate, approximately 185 parts of sodium potassium carbonate going into solution in 100 parts of water at 15° C. This compares with 35 parts of sodium bicarbonate which will go into solution into 100 parts of water at 15° C.

Furthermore ethylen glycol when admixed with a solution of sodium potassium carbonate in water within a certain range of proportions will not only lower the freezing temperature of that sodium potassium carbonate solution to below −40° C., but in the proportion of 25% by weight of sodium potassium carbonate, 39% by weight of water and 36% by weight of ethylene glycol will form a eutectic mixture having a freezing point considerably below −40° C. Furthermore these particular proportions afford the maximum weight of sodium potassium carbonate that will remain in solution with ethylene glycol in water at −40° C. And because of what may be called the CO_2 concentration of the resulting solution the quantity of the solution necessary to produce the desired quantity of CO_2, when compared with a solution of an ordinary carbonate such as sodium bicarbonate, is quite small; and consequently a commercially feasible chemical reaction extinguisher may be provided, active at −40° C., and having an adequate supply of fire-extinguishing liquid in the casing.

Of course if the volumetric capacity of the extinguisher permits, a lower percentage by weight of sodium potassium carbonate may be used which would merely mean increasing the quantity of carbonate solution forming the chemical charge. Varying the proportions of the various constituents in either direction, from those above named as constituting the eutectic mixture, of course raises the temperature at which the carbonate will precipitate out and the solution freeze. However within the limitations of volumetric capacity in the extinguisher and the low temperature conditions which have to be met, the relative proportions of the sodium potassium carbonate, the ethylene glycol, and the water may be varied as desired; for example 20% by weight of sodium potassium carbonate with 40% by weight of ethylene glycol and 40% by weight of water give very satisfactory results. But if the percentage of sodium potassium carbonate is increased materially above the 25% referred to above, then the water and ethylene glycol would be relatively decreased accordingly, and the result would be a raising of the freezing point.

For example, if the percentage of sodium potassium carbonate is increased to 30% by weight and the water and ethylene glycol are present in the proportion of substantially 35% by weight of each, the freezing point would be above −40° C., at which temperature some of the sodium potassium carbonate will precipitate out of the ethylene glycol-water solution which will then freeze.

The most desirable results so far attained by us have been with a solution of the proportions producing the eutectic mentioned above,—namely, 25% by weight of sodium potassium carbonate, 39% by weight of water, and 36% by weight of ethylene glycol.

Such a solution permits of a fire extinguisher having all the desirable characteristics that are present when a material such as chlorosulfonic acid is used with a solid carbonate, and has in addition desirable characteristics that are not present when a solid carbonate is used.

Where the chlorosulfonic acid is to react with a solution of sodium potassium carbonate combined with ethylene glycol as a freezing temperature depressant, satisfactory production of expelling carbon dioxide gas may be secured through the use of approximately 1.7 fluid ounces of chlorosulfonic acid to react with a solution of 7 ounces of sodium potassium carbonate in 14 ounces of water,—ethylene glycol in suitable proportions as set out above being admixed with the sodium potassium carbonate solid to give suitable lowering of the freezing point. Such specified quantities of chlorosulfonic acid and sodium potassium carbonate solution will liberate sufficient carbon dioxide gas to expel 2½ gallons of fire-extinguishing liquid. As illustrating actual proportions that give very satisfactory results for expelling 2½ gallons of fire extinguishing liquid, the carbon dioxide producing portion of the charge contains 14 ounces of water, 7 ounces of sodium potassium carbonate, and 11.3 ounces of ethylene glycol, to be used for reaction with 1.72 fluid ounces of chlorosulfonic acid. Such proportions will have a freezing point above the freezing point of the eutectic mixture specified above, but substantially below the prescribed temperature of −40° C.

While the invention has been described above particularly with reference to choloro-sulfonic acid as the acid constituent of the carbon dioxide forming charge, reference is made primarily to this particular acid as one which functions very satisfactorily, and is commercially available. However all the compounds secured from replacing the carbon atom normally attached to the sulfonic acid radical, in an organic acid compound, or replacing a hydroxyl group similarly connected in an inorganic acid compound containing the sulfonic radical ($-SO_2OH$) will react with a carbonate with varying degrees of activity at varying temperatures.

While the forms of invention herein described constitute preferred embodiments thereof, it is to be understood that the invention is not limited to such precise forms, and that changes may be made therein without departing from the scope of the invention which is defined in the appended claims.

What is claimed is:—

1. A charge for fire extinguishers, which comprises two normally separated portions, one of which consists of an acid constituent chemically active at temperatures as low as −40° C., the other of which comprises a solution of a second constituent adapted to react with said first constituent to generate gas but normally freezing at a higher temperature than −40° C., and a freezing temperature depressant comprising a glycol in said solution and chemically inert with respect thereto for lowering the freezing point of said solution.

2. A charge for fire extinguishers, which comprises two normally separated portions, one of which comprises a compound containing a sulfonic acid radical, and the other of which consists of a solution of a carbonate, said solution also containing a freezing temperature depressant which is chemically inert with respect to said carbonate solution.

3. A charge for fire extinguishers, which comprises two normally separated portions, one of which consists of a compound containing a sulfonic acid radical, and the other of which consists of a solution of a carbonate, admixed with ethylene glycol to lower the freezing point thereof.

4. A charge for fire extinguishers, which comprises two normally separated portions, one of which consists of a compound containing a sulfonic acid radical, and the other of which consists of a water solution of a carbonate, admixed with ethylene glycol to lower the freezing point thereof.

5. An anti-freeze mixture for fire extinguishers, consisting of ethylene glycol and a carbonate in a water solution.

6. An anti-freeze mixture for fire extinguishers, consisting of ethylene glycol and sodium potassium carbonate in a water solution.

7. An anti-freeze mixture for fire extinguishers, consisting of sodium potassium carbonate by weight 25%, water by weight 39% and ethylene glycol by weight 36%.

8. A charge for fire extinguishers, comprising a carbonate solution of high carbon dioxide concentration, and a freezing temperature depressant chemically inert with respect to carbon dioxide producing reactions with said carbonate solution, comprising ethylene glycol.

9. A charge for fire extinguishers, which includes a water solution of sodium potassium carbonate containing a freezing temperature depressant which is chemically inert with respect thereto.

10. A charge for fire extinguishers, which includes a eutectic mixture of water, sodium potassium carbonate, and a freezing temperature depressant which is chemically inert with respect thereto.

11. A charge for fire extinguishers, which includes a eutectic mixture of water, sodium potassium carbonate, and ethylene glycol.

12. A charge for fire extinguishers, which comprises two normally separated portions, one of which comprises a compound containing a sulfonic acid radical and the other of which consists of a solution of sodium potassium carbonate containing ethylene glycol to lower the freezing point thereof.

13. A charge for fire extinguishers, which comprises three normally separated portions, one of which consists of a water solution of a freezing temperature depressant, said solution being non-freezing at very low temperatures and being adapted to serve as a

fire-extinguishing liquid, the other two of which are normally separated gas-generating portions consisting of a constituent having a sulfonic acid radical, and a solution of sodium potassium carbonate containing a chemically inert freezing temperature depressant therein.

14. A charge for fire extinguishers, which comprises an acid constituent and a solution of a carbonate constituted to liberate an expelling gas on reaction with said acid constituent, said acid and said carbonate solution being chemically active with respect to each other to produce such expelling gas at temperatures ranging downwardly from substantially 0° C., and a glycol inactive to effect gas generating reaction with said carbonate solution for lowering the freezing point of the solution of said second constituent.

15. A charge for fire extinguishers, which comprises three normally separated portions, one of which consists of a fire extinguishing liquid which is non-freezing at low temperatures, the other two of which are normally separated gas-generating portions consisting of an acid constituent and a solution of a carbonate constituted to liberate an expelling gas on reaction with said acid constituent, said acid and said carbonate solution being chemically active with respect to each other to produce such expelling gas at low temperatures ranging downwardly from substantially 0° C. and which solution normally freezes at a temperature above said low temperatures, and a glycol in said solution chemically inert with respect thereto.

16. A fire extinguishing liquid comprising a gas generating water solution including a compound of an alkali metal element having high fire extinguishing properties at low temperatures and containing a glycol therein.

17. A fire extinguishing liquid comprising a gas generating water solution including a compound of potassium and containing a glycol therein.

18. A charge for fire extinguishers having normally separated gas generating portions, comprising a gas generating water solution including a compound of potassium, and an acid compound containing a sulfonic acid radical.

19. The use in a fire extinguisher of a water solution of sodium potassium carbonate containing in excess of 15% by weight of sodium potassium carbonates.

20. A fire extinguishing charge comprising a glycol mixed with a liquid having high fire extinguishing properties at low temperatures and chemically inert with respect thereto.

In testimony whereof we hereto affix our signatures.

CHARLES A. THOMAS.
CARROLL A. HOCHWALT.