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FIRE EXTINGUISHER COMPOSITION

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This invention relates to fire extinguishers, and more particularly to charges for such extinguishers.

One of the principal objects of the invention is to provide a fire extinguisher charge which has superior fire extinguishing properties.

Another object of the invention is to provide a fire extinguisher charge which is capable of withstanding, and of functioning with high efficiency at, extremely low temperatures.

Other objects and advantages of the invention will be apparent from the following disclosure and claims.

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.

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 sulfuric acid, being mounted within the casing so that when the extinguisher is inverted for use the acid will escape into the solution and react therewith to generate carbon dioxide which in turn exerts a pressure upon the extinguishing solution to expel it from the extinguisher. The expelled liquid from such an extinguisher consists primarily of the reaction product of the sodium bicarbonate and the acid, this liquid carrying some carbon dioxide bubbles.

One principal objection to an extinguisher of this character with the sodium bicarbonate charges heretofore used, is that the sodium bicarbonate solution will not withstand very low temperatures.

Another objection is that the chemicals employed in the ordinary soda-acid extinguisher will not react efficiently at such low temperatures, and for practical fire extinguisher operation become practically inert at temperatures considerably above −40° C., satisfactory functioning at which temperature The Underwriters' Laboratories prescribe as prerequisite to the certifying of such extinguisher as being of a preferred character.

We have discovered that a water solution of potassium carbonate prepared in accordance with this invention has exceptional and unexpected fire extinguishing properties, which render it a superior fire extinguishing medium to be discharged directly upon a fire. It is quite superior in its extinguishing effect to the reaction product heretofore discharged from the usual soda-acid type of extinguisher as the extinguishing fluid. Potassium carbonate solution is more effective in the extinguishing of wood fires than carbon tetrachloride, and in addition does not produce objectionable fumes or odors when expelled upon fires. It is, also, as effective as carbon tetrachloride in extinguishing oil fires in open vessels. None of the other aqueous carbonate solutions commonly used in extinguishers of the chemical reaction type are effective for oil fires.

We have found that relatively high concentrations of the potassium carbonate dissolved in water give the best results. Excellent results have been secured by using solutions containing 34% or more by weight of potassium carbonate. While weaker solutions have effective fire extinguishing properties, we prefer to use solutions of higher concentrations, as giving the best results. For example, in actual usage the potassium carbonate solution prepared in accordance with our invention has been found, on the average, to extinguish a fire in nine seconds which requires forty seconds to be extinguished by the conventional soda and acid type of extinguisher.

The lowest freezing point of a water solution of potassium carbonate as heretofore determined and given in freezing point tables is shown as attained with a solution

containing 39.6% by weight of potassium carbonate, this solution freezing at −36.5° C.

We have found however that a water solution of potassium carbonate can be produced which will remain liquid below −40° C. Solutions of the relatively high concentrations we prefer to use will under certain operating conditions remain liquid at temperatures below −40° C. provided the concentration of the solution does not approach too closely the saturation point at 0° C. As the concentration of a water solution of potassium carbonate increases, the freezing point falls until a concentration of 39.6% by weight is reached, and thereafter rises as the concentration is further increased. By using a solution having a concentration not above 42% by weight of potassium carbonate, the solution will remain liquid at the desired low temperatures which are below its normally expected freezing point.

A solution prepared from an anhydrous potassium carbonate salt, or one which has been freshly calcined, will more readily withstand these excessively low temperatures than a solution prepared from a crystalline salt of potassium carbonate containing water of crystallization, or potassium carbonate which has been allowed to stand exposed to the air and to absorb moisture.

The freezing point of a carbonate solution may be lowered by mixing therewith certain freezing temperature depressants. But heretofore there has been no such depressant which was free from serious objections, especially for fire extinguisher use. Such freezing temperature depressant should be chemically inert with respect to the solution. Further, it is desirable that only small proportions of such depressant be used, so that the solution may contain per unit volume the desired large quantities of potassium carbonate. The extremely high solubility of potassium carbonate enables large quantities to be dissolved within relatively small volumes of water; and from the standpoint of economy as well as to maintain the highly effective extinguishing properties of the potassium carbonate solution, preferably only small amounts of other substances, such as the depressant, are incorporated therewith.

One freezing temperature depressant which satisfies the above mentioned requirements is ethylene glycol, which is structurally a polyhydric alcohol. Ethylene glycol need be used in only small proportions, satisfactory results being obtained with as low as .8% by weight in a solution containing the proper concentration of potassium carbonate. We prefer to use from .8% to 5% by weight of ethylene glycol, depending upon the proportions of the other ingredients of the solution. While higher percentages of ethylene glycol may be used to give a non-freezing solution at such extremely low temperatures, from the standpoint of economy and to avoid reducing the concentration of the potassium carbonate below the desired highly effective range, only such small proportions as mentioned are used. Another suitable freezing temperature depressant is glycerine, also a polyhydric alcohol, this being used in substantially the same proportions as ethylene glycol. A lævulose containing material, such as ordinary bees honey, is also a suitable freezing temperature depressant for the potassium carbonate solution, about 2% to 5% by weight of honey giving satisfactory results.

A potassium carbonate solution tends to produce objectionable corrosion of the extinguisher fluid container. We have found that this corrosion may be prevented by incorporating therewith a compound liberating chromate ions in the solution. Any suitable chromate may be used, but preferably a soluble chromate such as an alkali metal chromate, which may be readily put into solution, is selected. Dichromates may also be used for this purpose. When dichromates are added to the solution they are converted into chromates with the production of the chromate ions in the solution. The chromates, when added originally or when formed from dichromates in solution, are chemically inert with respect to the solution, and so may be used as a part of the extinguisher charge. We preferably select sodium dichromate as the anti-corrosive agent because of its solubility characteristics and cheapness. This compound not only functions to prevent corrosion within the extinguisher, but also serves as a freezing temperature depressant in the solution, assisting in the lowering of the freezing point. Only small amounts of the anti-corrosive agent need be used, as little as .8% by weight of sodium dichromate being satisfactory. We prefer to use from .8% to 2% by weight of sodium dichromate in the solution depending upon the concentrations of the other ingredients. Higher percentages need not be used to secure the desired anti-corrosive and freezing temperature depressant properties.

As examples of potassium carbonate fire extinguishing solutions prepared in accordance with this invention, which solutions have superior fire extinguishing properties, have no objectionable corrosive effect, and have freezing points below −40° C., the following are listed for illustrative purposes:

	Percent by weight	
(1)	39.6	K_2CO_3
	58.8	H_2O
	.8	Ethylene glycol
	.8	$Na_2Cr_2O_7$
	100.0	Freezing point −41° C.

	Percent by weight	
(2)	39.6	K_2CO_3
	54.6	H_2O
	5.0	Ethylene glycol
	.8	$Na_2Cr_2O_7$
	100.0	Freezing point −46° C.

	Percent by weight	
(3)	39.6	K_2CO_3
	53.4	H_2O
	5.0	Ethylene glycol
	2.0	$Na_2Cr_2O_7$
	100.0	Freezing point −49° C.

It is to be noted from reference to Examples (1) and (2) that increasing the percentages of ethylene glycol while maintaining the percentages of potassium carbonate and sodium dichromate constant lowers the freezing point within the range given. Attention is also called to Examples (2) and (3) which illustrate particularly the freezing temperature depressing effect of the sodium dichromate, the percentages of potassium carbonate and ethylene glycol being maintained constant in these examples. In general, as the percentage of potassium carbonate is varied below or above 39.6%, increasing percentages of ethylene glycol should be added to give the desired low freezing point. Thus, while .8% ethylene glycol is sufficient when using 39.6% by weight of potassium carbonate, this percentage should be increased somewhat as the proportion of potassium carbonate is reduced and approaches 34% or is increased and approaches 42%. However, percentages of 2% to 5% of ethylene glycol may be used throughout the range mentioned with satisfactory results for practical fire extinguisher use.

The use of such small amounts of a liquid freezing temperature depressant such as ethylene glycol, effects another advantage, in that the shipping and handling of the charge is facilitated. The dry potassium carbonate salt and the dry sodium dichromate may be readily mixed in the proper proportions and shipped in the solid state. Moreover, the small amount of the liquid ethylene glycol may be mixed with the solid salt or salt mixture, and the solid phase of the carbonate material maintained, the ethylene glycol being readily held within the salt. The resultant mixture retains in all respects its solid characteristics, and can be readily handled. Thus a charge mixed in the proper proportions may be shipped in the solid state to the user, where it is placed in solution in the proper amount of water, the extinguisher being usually marked to indicate the proper water level. The charge is quite readily soluble, so the solution of the dry charge by the user is easily effected.

When the potassium carbonate fire extinguishing liquid is exposed to the atmosphere, particularly when exposed to a damp or humid atmosphere, the solution tends to absorb moisture and thereby change its concentration, which affects its freezing point. We have found that this may be prevented by using, within the extinguisher, a non-miscible liquid of lower specific gravity than the carbonate solution, this liquid remaining on the surface of the potassium carbonate solution to form a sealing layer thereover. Any suitable sealing liquid having the above mentioned properties, and which is inert with respect to the solution, may be used. Very satisfactory results are secured when a paraffine oil is used as the sealing liquid. Only a sufficient amount of the paraffine oil or other sealing liquid need be used to cover the exposed surface of the carbonate solution with a thin sealing layer.

The fire extinguishing liquid or solution is adapted to be used in a chemical type extinguisher, or in any other type of extinguisher, pump tank, or the like having means for expelling the liquid itself upon the fire. Thus the potassium carbonate solution may be pumped directly upon the fire from a pump extinguisher. Or the potassium carbonate solution may be used as the extinguishing liquid in a chemical type extinguisher having a separate gas generating charge for expelling this liquid; or the potassium carbonate solution itself may be used as a part of the gas generating portion of the charge. We prefer to use as the acid constituent of the charge a compound containing a sulfonic acid radical, such as a halogenated sulfonic acid, for the reason that such a compound will react with high efficiency with a carbonate solution even at such extremely low temperatures. Such a halogenated sulfonic acid is chlorosulfonic acid or in fact any sulfonic acid containing any element of the halogen group. When chlorosulfonic is used, means is preferably provided for preventing objectionable fuming of the acid. However, when conditions of use warrant other commonly used acids, such as sulfuric and hydrochloric acid, may be used as the acid portion of the charge.

When used in such a chemical reaction extinguisher, this potassium carbonate charge is particularly advantageous since in such a solution there is present a very large excess of carbonate over that required for reaction with the acid used. The carbonate solution is provided to perform a double function,—namely, a small portion of the solution reacts with the acid to generate an expelling gas, and the balance of the solution is expelled directly from the container as such without reaction and serves as a

superior fire extinguishing medium. The solubility of potassium carbonate in water is such that when a relatively concentrated solution of potassium carbonate is used, sufficient carbonate is contained in solution in that volume of liquid that can be received within the ordinary portable extinguishers of this type, to accomplish the above results. As only a small proportion of the potassium carbonate is used up in reaction with the acid, the liquid expelled directly upon the fire from such an extinguisher consists primarily of the potassium carbonate solution having the exceptional fire extinguishing properties.

As an example, a suitable charge for a two and one-half gallon extinguisher, is 11.7 pounds of potassium carbonate in 2.1 gallons of water. This amount makes up 2½ gallons of extinguishing liquid. With this carbonate solution, 55 cc of chlorosulfonic acid will give the desired effective generation of gas pressure. In the reaction, 55 cc of chlorosulfonic acid react with approximately .38 pounds of potassium carbonate, leaving approximately 11.32 pounds of potassium carbonate in solution as such to function as a fire extinguishing medium having high extinguishing properties. In such charge approximately 3% of the potassium carbonate in the solution is used in reaction with the acid, the balance being left in solution as such to be discharged directly upon the fire. Of course, the proportions of the elements of the complete extinguisher charge may be considerably varied and still only a minor portion of the potassium carbonate solution be used in reaction with the acid to generate the expelling gas, leaving the major portion available to serve as a fire extinguishing medium. Ordinarily it is desirable that the potassium carbonate be present in such excess in the solution that less than 10% of the potassium carbonate is used up in the reaction with the acid.

As illustrative of a suitable charge when using sulfuric acid, 11.7 pounds of potassium carbonate dissolved in 2.1 gallons of water and forming 2½ gallons of fire extinguishing liquid are used with 4 fluid ounces of 66° Baumé sulfuric acid. In the reaction, approximately .6 pounds of potassium carbonate are used, leaving about 11.1 pounds as potassium carbonate in the solution which is thrown upon the fire. Thus about 5% only of the potassium carbonate is used up in the reaction.

As set forth above the potassium carbonate fire extinguishing liquid of this invention is peculiarly applicable to the extinguishing of oil fires in open vessels, being as effective as carbon tetrachloride in this respect. None of the other carbonate solutions heretofore commonly used in extinguishers of this type are effective for oil fires. It is found that the most effective results in the extinguishing of an oil fire are secured when the liquid is thrown upon the burning oil in the form of a broken stream or a spray.

While the forms of invention herein described constitute preferred embodiments thereof, it is to be understood that the invention is not limited to these 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 fire extinguishing liquid comprising a water solution formed by dissolving in water potassium carbonate, ethylene glycol and sodium dichromate.

2. A solid adapted to be dissolved in water to form a fire extinguishing liquid comprising a mixture of a carbonate salt, and a liquid polyhydric alcohol freezing temperature depressant, said salt and said liquid depressant being mixed in such proportions that the liquid depressant is absorbed by the salt whereby the solid characteristics of the salt are maintained.

3. A solid adapted to be dissolved in water to form a fire extinguishing liquid comprising a mixture of a carbonate of potassium in salt form, a salt adapted to liberate chromate ions in the solution, and ethylene glycol, the said salts and the said ethylene glycol being mixed in such proportions that the ethylene glycol is absorbed by the salts whereby the solid characteristics of the salts are maintained.

4. A fire extinguishing liquid having high fire extinguishing properties adapted to be projected upon a fire comprising a water solution of potassium carbonate containing approximately 34% to 42% by weight of potassium carbonate, and less than 10% by weight of a polyhydric alcohol freezing temperature depressant chemically inert with respect thereto, said solution having a freezing point below −40° C.

5. A fire extinguishing liquid having high fire extinguishing properties adapted to be projected upon a fire comprising a water solution of potassium carbonate containing approximately 34% to 42% by weight of potassium carbonate, less than 6% by weight of a glycol, and less than 3% by weight of a chromate, said solution having a freezing point below −40° C.

6. A charge for fire extinguishers consisting of two normally separated gas generating portions, comprising an acid, and a solution containing approximately 34% to 42% by weight of a carbonate of potassium having high fire extenguishing properties adapted to react with said acid to generate an expelling gas for expelling the said solution from the extinguisher as the fire extinguish-

ing medium, said carbonate solution containing a considerable excess of carbonate of potassium over the chemical equivalent amount which reacts with said acid, a major portion of the carbonate of potassium in the solution being expelled as such from the extinguisher, the expelled liquid thereby having high fire extinguishing properties.

7. A charge for fire extinguishers consisting of two normally separated gas generating portions, comprising an acid, and a solution containing approximately 34% to 42% by weight of a carbonate of potassium having high fire extinguishing properties adapted to react with said acid to generate an expelling gas for expelling the said solution from the extinguisher as the fire extinguishing medium, said carbonate of potassium solution being of such concentration and supplied in such volume that less than 10% of the carbonate of potassium in said solution is used in the reaction with said acid, the balance of said carbonate of potassium in the solution being expelled as such from the extinguisher, the expelled liquid consisting primarily of the solution of the carbonate of potassium having high fire extinguishing properties.

8. A fire extinguishing liquid having high fire extinguishing properties adapted to be projected upon a fire, comprising a water solution containing approximately 34% to 42% by weight of a carbonate of potassium, and less than 3% by weight of a chromate compound.

9. A fire extinguishing liquid having high fire extinguishing properties adapted to be projected upon a fire, comprising as essential ingredients a water solution of potassium carbonate containing approximately 34% to 42% by weight of potassium carbonate, and a temperature depressant in the amount of not more than 10% by weight.

10. A fire extinguishing liquid having high fire extinguishing properties adapted to be projected upon a fire, comprising as essential ingredients a water solution of potassium carbonate containing approximately 34 to 42% by weight of potassium carbonate, and a temperature depressant, said solution with temperature depressant having a freezing point at least as low as −40° C.

In testimony whereof we hereto affix our signatures.

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