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FIRE EXTINGUISHER

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This invention relates to fire extinguishers and is particularly directed to fire extinguishing compositions and charges for fire extinguishing apparatus containing as one gas-generating component dry sulfamic acid.

In the art of extinguishing fires by smothering the flames with a non-combustible gas, such as carbon dioxide, two components, adapted when united to produce such a gas, are brought together in a manner such that the gas is produced, liberated, or conveyed to the combustion zone where it displaces oxygen and thus smothers the flames. For the most part, water is an essential constituent of at least one component and serves as a reaction medium for acid and basic constituents capable of reacting in aqueous medium to form a non-combustible gas. The acid and basic constituents must either be maintained separated or must be maintained in a non-reactive condition. However, no satisfactory mixtures containing both acid and basic constituents have been heretofore provided so that all practical fire extinguishers heretofore available have required that the acid and basic constituents be maintained separate.

A common type of fire extinguishing apparatus depends for its operation upon the action of sulfuric acid on aqueous bicarbonate solutions, the carbon dioxide evolved being relied upon to generate sufficient pressure to spray the gas-charged solution upon the flames. To create an effective spray the carbon dioxide must be generated very rapidly and under considerable pressure, thus requiring a highly active acid constituent such as sulfuric acid. Such highly active liquid acids, however, are known to have numerous disadvantages, particularly in regard to the hazards involved in handling them and using them in fire extinguishers. The acids are highly corrosive and must be stored in glass containers which are susceptible to breakage, thus presenting a distinct hazard in handling during periodic inspections and recharging of the apparatus. They are hazardous, moreover, in that they react exceedingly vigorously with the bicarbonate solution over a short period of time so that the pressure within the extinguisher apparatus is frequently created at an almost explosive rate. As a matter of fact, such extinguishers have been known to rupture because of the excessive pressure which has suddenly developed. Moreover, the bicarbonate required is relatively insoluble so that, if the extinguishers are exposed to low temperatures, the salt crystallizes out unless employed in

low concentrations and at such low concentrations the solutions are susceptible to freezing.

In the present invention I provide new types of two-component fire extinguishers which avoid the numerous disadvantages of the prior art, which extinguishers are characterized in that one component is dry and contains an acid constituent consisting essentially of crystalline sulfamic acid. I have discovered that sulfamic acid combines all the necessary qualities to make it useful as an acid constituent of a non-aqueous component of a fire-extinguishing charge. It combines the quality of high inertness in the solid state with good solubility and high acidity (reactivity) in the solute state whereby it may be handled for storage and refilling without hazard in suitable containers either of paper or metal, or of other suitable material of any desired strength and, moreover, acts to discharge carbon dioxide from carbonate solutions at a rate sufficiently great for spray purposes but without the explosion hazard heretofore associated with the use of sulfuric acid. When dissolved it reacts immediately and completely with the bicarbonate solution but its rate of reaction is controlled by its rate of solution. I have found that sulfamic acid combines just the right solubility properties with its high acidity so that the required pressure is more gradually developed and more uniformly maintained at a given level than when sulfuric acid is employed. So far as I am aware no other solid acidic material which might conceivably be used as the acid constituent of a non-aqueous component of a fire extinguishing charge combines these properties.

Moreover, sulfamic acid is non-hygroscopic (it does not form a hydrate) and is practically inert in the solid form. Thus, sulfamic acid may be used as a constituent of an acid-base component without substantial deterioration during storage. Consequently, when sulfamic acid is used as the acid constituent of a fire extinguishing charge it is entirely possible and practical to employ a non-aqueous acid-base component, such as dry mixtures containing sulfamic acid and a basic constituent.

Fire extinguishers using sulfamic acid as the acid constituent can also employ nitrites as gas-forming salts, reagents which with other acids, such as sulfuric acid, are impractical due to the formation of noxious fumes. Nitrites react rapidly with sulfamic acid to liberate nitrogen and are of advantage in that the nitrites show considerably higher water-solubility, especially at low temperatures, than the corresponding carbonates.

The basic constituent may advantageously contain both carbonates and nitrites and in proper proportions will yield two mols (2 volumes) of gas for each mol of sulfamic acid (the carbonates and nitrites alone each yield but one mol (one volume) of gas per mol of sulfamic acid). By varying the proportions of carbonate and nitrite the amount of gas evolved may be varied as desired from one to two mols per mol of sulfamic acid.

When sulfamic acid reacts with nitrites each supplies an atom of nitrogen. Sulfamic acid, therefore, when used in conjunction with nitrites, is one of the gas supplying constituents. Advantage may be taken of this property to increase the gas-producing capacity of a fire extinguisher. Sulfamic acid in the combined form, e. g., sodium sulfamate, may be mixed with sodium nitrite and sodium bicarbonate to form a basic constituent. This mixture in the proportions of about two mols of sodium bicarbonate to one mol each of sodium sulfamate and sodium nitrite will yield with one mol of sulfuric acid about two mols of carbon dioxide and one mol of nitrogen (3 volumes of gas) per mol of acid.

The sulfamic acid component may advantageously be packed in a suitable water-proof frangible container which may be used as a cartridge or refill for charging apparatus of suitable design. With such a cartridge disposed in a fire extinguisher charged with bicarbonate solution and provided with externally operable means for rupturing the cartridge, such an extinguisher may be handled freely and transported with ease, and unlike the conventional soda-acid extinguishers need not be inverted to be actuated and, indeed, may be inverted or located in any position without being actuated.

However introduced into the bicarbonate solution, the sulfamic acid, when used in the dry crystalline form, exercises a self-imposed control upon the reaction and generation of the gas. For example, if about 1½ pounds of dry crystalline sulfamic acid is discharged into about 2½ gallons of 10% sodium bicarbonate solution in a suitable extinguisher of the soda-acid type, the liberated carbon dioxide will develop adequate pressure for spraying the charged solution yet the pressure is generated evenly and uniformly rather than in an almost explosive surge as in the case of sulfuric acid. Moreover, in the reaction the sulfamic acid is converted to the corresponding sulfamate which has a fire-retardant action not possessed by the corresponding sulfate.

In place of sodium bicarbonate as described above, a 5% solution of sodium nitrite may be used. In such case a rapid evolution of nitrogen by the sulfamic acid serves to develop the pressure required for ejecting the charged solution from the fire extinguisher.

Sulfamic acid, because of its nonhygroscopicity and because of its inertness in the dry crystalline form, may be used in admixture with the dry basic constituents. Such a mixture containing equivalent amounts of sulfamic acid and sodium bicarbonate or sodium nitrite or both may be packaged in suitable frangible water-proof cartridges of any suitable material, such as water-proof paper, cellulosic sheeting, rubber, rubber hydrochloride, polymerized rubber, or metal or the like, and offer the advantage not only of convenience but also that the liquid component of the extinguisher may be composed of water, thus obviating any corrosion problem incident to the storage of salt solutions. Like-

wise, since the time any fire extinguisher is in actual use is relatively small, metals which normally would be unsatisfactory because of the corrosive action of salt solutions may be used in its construction.

Cartridges containing both acidic and basic constituents, if made of paper or suitably frangible material, may be used as bombs to be thrown into the combustion zone and there sprayed with water. Such cartridges, as in the case of the refills previously described, may contain a mixture of sulfamic acid and the dry basic constituent or the two constituents may be maintained in separate compartments of the cartridge. Two-component fire extinguishers of these types have the advantage that the gas is generated in the immediate vicinity of the fire and also in that they are effective when thrown into a pool of water covered with burning oil or gasoline. Sulfamic acid is of advantage in such extinguishers for the reasons already pointed out and, in addition, because of its high density. Thus, well weighted package units, which may be thrown easily for great distances, are formed.

Except as pointed out above and as set forth in the appended claims, the basic constituent does not form a part of my invention, and I desire it understood, therefore, that my invention is not restricted to any particular basic constituent, particularly since those skilled in the art are fully cognizant of the various gas-producing compounds which are useful in conjunction with acidic constituents in fire extinguishers. Generally, however, the stable highly soluble salts, which do not readily crystallize at low temperature and which preferably show minimum corrosive effects, are comprised within the group consisting of carbonates and nitrites, especially of the alkali (including ammonia) and alkaline earth (including magnesium) metals, for example, ammonium carbonate, magnesium carbonate, potassium carbonate, sodium bicarbonate, potassium bicarbonate, sodium nitrite, lithium nitrite, ammonium nitrite, calcium nitrite and potassium nitrite. As supplements may be included various wetting and foaming agents in accordance with recognized practices in the art and also fire retardant salts, such as ammonium sulfamate, ammonium phosphate, ammonium sulfate, to increase the effectiveness of the generating components in extinguishing fires.

I am aware that organic acids are known which may be safely stored in frangible paper or like containers. Such acids, however, usually dissolve only very slowly and yield solutions of relatively low acid strength (of low hydrogen ion concentration) compared with equivalent mol solutions of sulfamic acid. Thus, such acids develop a gas pressure only slowly and do not give a maximum pressure response in the desired length of time, the result being that the extinguisher is sluggish in its reaction and does not give off an adequate pressure even when solutions of excessively high concentrations of bicarbonate are used. I am also aware that numerous inorganic acids and acid substances have been suggested for and used in fire extinguishers, some of which, e. g., aluminum sulfate, are solids tho generally used in aqueous solutions. As far as it is known, however, sulfamic acid is the only inorganic acid which combines the quality of high inertness in the solid state with good solubility and high acidity (reactivity) in the solute state. With this unique quality sulfamic acid combines the property of non-hygroscopicity which makes for un-

usual stability in non-aqueous components of the character herein set forth.

Since many apparently widely differing embodiments of my invention may be made without departing from the spirit and scope thereof, it is to be understood that my invention is not limited to any of the particular considerations described above except as pointed out in the appended claims.

I claim:

1. A fire extinguisher comprising a charge consisting of a dry component and an aqueous component, said components containing substances adapted to unite in aqueous solution to produce fumes non-supporting to combustion, and said dry component comprising sulfamic acid and means for bringing said components together when it is desired to use the extinguisher.

2. A fire extinguisher comprising a charge consisting of a dry component and an aqueous component, said charge containing acidic and basic

constituents adapted to unite in aqueous solution to produce fumes non-supporting to combustion, said acidic constituent consisting essentially of dry crystalline sulfamic acid and being comprised in said dry component, and means for bringing said components together when it is desired to use the extinguisher.

3. A fire-extinguishing unit comprising acidic and basic constituents adapted to unite in aqueous solution to produce fumes non-supporting to combustion, the acid constituent of which consists of dry crystalline sulfamic acid.

4. A fire extinguishing unit comprising acidic and basic constituents adapted to unite in aqueous solution to produce fumes non-supporting to combustion, the acid constituent of which consists of dry crystalline sulfamic acid, said unit being characterized in this that said acidic and basic constituents are confined by frangible means.

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