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METHOD OF EXTINGUISHING FIRES AND A  
COMPOSITION EMPLOYED IN THE METHOD  
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285,900, June 6, 1963. This application Sept. 6,  
1967, Ser. No. 665,713  
U.S. Cl. 252—3  
Int. Cl. A62d 3/00; A61c 1/14

6 Claims

## ABSTRACT OF THE DISCLOSURE

A method of extinguishing a fire by saturating the area of the flames of the fire with a spray of an aqueous solution of an amphoteric surfactant whose particles combine with fuel particles vaporized from the substance on fire to interrupt the chain reaction of the fire and a solution for use in the method.

This application is a continuation of my application Ser. No. 285,900, filed June 6, 1963 now abandoned.

This invention relates to a method of extinguishing fires and to a composite employed in the method.

It is generally recognized that for the efficient and quick extinguishment of fires of such substances as a pool or body of oil, the flames should be extinguished as quickly as possible in order to arrest the transfer or radiation of heat from the flames to the exposed surface of the oil which thus maintain the temperature of the oil at its exposed surface above its kindling point, that reignition of the oil at such exposed surface be prevented once the flames have been extinguished until the oil at such surface has been cooled below its kindling point, as by separating or isolating the oil from oxygen by floating or depositing a layer of foam over the surface, and that the oil at the exposed surface be cooled before the layer of foam disintegrates or is pierced to again expose such surface of the body of oil to oxygen. It is also generally recognized that a fire is a decomposition of organic products by certain physical agents, notably by heat, which begins with effective liberation of radicals whose existence in a free state is extremely short; which disappear either by association with each other or by combining with molecules in whose presence they were originally formed, that such decomposition and liberation of radicals results in the evaporation of the fuel into the air and in the formation of electrically charged particles, and under the conditions of high temperatures present, electrons are ejected from such particles, that whenever electrons are emitted from such particles radiant heat is generated, and that the ejection of electrons and the generation of radiant heat further increases the rate of ejection of electrons resulting in a generation of more radiant heat so that a fire constitutes a chain reaction. It is further generally recognized that once electrons are ejected from the particles, the particles are positively charged and very active chemically so that they react with oxygen and thus result in fire.

It is desirable therefore that such chain reaction be arrested in order to extinguish the flames of the flame front

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of a fire by preventing the combining of such positively charged particles with oxygen as by saturating the area of the flame front with particles bearing negative charges which combine with the positively charged particles instead of with oxygen and thus extinguish the flames.

It is further desirable that the composition containing such negative charged particles have the property of forming a water film about the fuel or oil particles suspended in the air at and adjacent to the flame front to isolate such fuel particles from oxygen and that the composition form a layer of foam over the exposed surface of the oil to isolate the oil from the air and also combine with the oil at such surface to form an oil in water emulsion at the exposed surface of further decrease the likelihood of reignition of the oil if the layer of foam is pierced or disintegrates at any location over the surface of the oil and also to assist in cooling the oil at such surface below its kindling point.

It is also desirable that such layer of foam have a large heat capacity to absorb heat from the oil.

It is also desirable that the composition be readily soluble in a commonly available liquid, such as water, which has a large heat capacity, that it decrease the surface tension of the water so that the water will readily form such oil in water emulsion, that the solution form a foam when sprayed through the usual spray nozzles of fire fighting equipment which may fall upon the surface of the oil to form a layer of foam therein, and that such foam have a high percentage of water per unit volume so that it may cool the oil below its kindling point by absorption of heat therefrom.

Accordingly, it is an object of the invention to provide a new and improved method of extinguishing fires which includes the step of spraying the flame front of the fire with a composition which quickly extinguishes the flame and isolates the combustible particles in the air from oxygen and forms a layer of foam over the ignited substance to isolate the combustible substance from air and to cool the exposed surface of the substance in order to retard its reignition.

Another object of the invention is to provide a method of extinguishing fires which also comprises the step of emulsifying a top layer of the combustible substance in water to further isolate the combustible substance from oxygen.

Still another object is to provide a method of extinguishing fires wherein the extinguishment of flames at the flame front is caused by the interruption of the fire chain reaction causing emission of electrons from the fuel particles by saturating the area in which the positively charged fuel particles are located with negatively charged particles whereby the negatively charged particles combine with the positively charged fuel particles and prevent the positively charged fuel particles from combining with oxygen.

A further object is to provide a composition usable for extinguishing fires comprising a surface active agent or surfactant which when dissolved in water decreases the surface tension of the water and exhibits the characteristics of having both cationic and anionic groups, whereby when the solution is sprayed on the flame the particles contained in the spray combine with the positively charged fuel particles and thus prevent the positively charged fuel particles from combining with oxygen and in addition, due

to the decreased surface tension, readily form a fuel in water emulsion with such fuel particles thus isolating the fuel particles from oxygen and insulating the fuel particles from heat.

A further object is to provide a composition of the type described which also includes a foam stabilizer which imparts strength and durability to the foam produced by the ampholyte.

A still further object is to provide a composition of the type described wherein the foam stabilizer is also a surface active agent and is effective to decrease the surface tension of the water and is an emulsifier to assist the surfactant in forming the fuel in water emulsion.

Another object is to provide a composition of the type described which is readily soluble in hard, soft and saline waters and which forms a foam even with water containing strong electrolytes so that it may be used with any water available at the location of the fire.

Still another object is to provide a composition of the type described which when sprayed through a conventional spray nozzle forms a foam which contains a relatively great proportion of water of low surface tension whereby the foam absorbs large amounts of heat from the combustible substances when in contact therewith and the water released from the foam easily penetrates the combustible substance.

Additional objects and advantages of the invention will be apparent upon reading the accompanying specification and claims.

In carrying out the method of extinguishing fires of the invention, a solution of a base surfactant and a foam stabilizer in water is sprayed directly on the flame front of a fire, for example, of a pool of liquid combustible fuel, such as oil, by means of the usual spray nozzles and very quickly extinguishes the flame since the negatively charged particles of the spray combine with or attach to the positively charged fuel particles at the flame front and above the exposed surface of the pool of oil from which such fuel particles are being vaporized. The particles of sprayed solution also emulsify such fuel particles in water and the sprayed solution when mechanically combined with air also forms a foam which falls upon the exposed surface of the oil and forms a layer or blanket thereover. The foam contains a large percentage of water per unit volume and is free flowing so that the foam spreads over the exposed surface of the oil and isolates the oil from oxygen. Since the percentage of water in the foam is relatively great, the water tends to flow out of or be released from the foam onto the surface of the oil and such released water as well as the water in the foam absorbs heat from the top layers of the pool of oil. A portion of such water evaporates and in the process absorbs an additional amount of heat from the top layer of the pool of oil. Other portions of the water, which has very low surface tension, readily flow or mix with the fuel and, having a greater density than the oil, flow downwardly through the oil to the bottom of the pool of oil carrying the heat absorbed thereby. The lower portions of the pool of oil are below the kindling temperatures of the oil. The heat thus absorbed from the top layers or strata of the oil by the water, transferred to the atmosphere by evaporation of the water and transferred to the bottom of the pool by the flow of water thereto quickly drops the temperature of the oil in such top layers or strata of the oil below the kindling temperature or point of the oil. The water itself, having a great heat capacity, of course lowers the temperature of the upper layers of the oil merely by absorption of the heat therefore. Once the temperature of the oil at its top surface has been lowered below the kindling point, the oil will not re-ignite even if the foam disintegrates and the oil is exposed to oxygen. In addition the low surface tension water from the foam forms an oil in water emulsion layer at the top surface of the pool of oil and thus further decreases the likelihood of the reignition of the oil should the layer of foam on the top surface of the oil

disintegrate or be pierced before the temperature of the upper layers of the oil has decreased below the kindling temperature. The emulsification process is endothermic and this also decreases the temperature of the top layers of oil wherein the emulsification takes place.

The spray may be formed by injecting into water being sprayed on the flame or fire front by the usual spray nozzles  $\frac{1}{2}$  to 6% by volume of the resultant solution of a composition having the following formula by volume:

	(A)	Percent
Carboxy methyl amido betaine	-----	9.0-50
Di (hydroxyethyl) lauramide	-----	2.2-7.3
Water	-----	88.8-42.7

15 The composition of the actual spray thus has the following formula by volume:

	(B)	Percent
Carboxy methyl amido betaine	-----	0.075-3.00
Di (hydroxyethyl) lauramide	-----	0.011-0.438
Water	-----	99.914-96.562

This composition is of course water soluble and readily mixes with the water into which it is injected at such spray nozzles. If desired, a suitable chemical, such as alcohol or glycol, may be added to the composition to lower the freezing point of the composition.

While the proportions of the various elements of the composition may be varied within the above ranges as desired in accordance with the characteristics of the combustible substance which is on fire and of its environment, a composition which has been found particularly effective in extinguishing oil fires which is injected into water being sprayed on the fire to form  $\frac{1}{2}$  to 6% by volume of the resultant solution or spray has the following formula by volume:

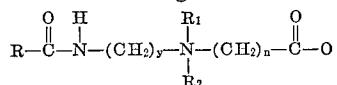
	(C)	Percent
Carboxy methyl amido betaine	-----	13.44
Ethyl alcohol	-----	9.00
Di (hydroxyethyl) lauramide	-----	3.80
Water	-----	73.76

The composition of the resultant solution and actual spray thus has the following formula by volume:

	(D)	Percent
Carboxy methyl amido betaine	-----	.0680-.816
Ethyl alcohol	-----	.0455-.546
Di (hydroxyethyl) lauramide	-----	.0192-.231
Water	-----	99.8673-98.410

55 It will be seen that the aqueous solution for extinguishing fires consists essentially of by volume 9% to 50% of an amphoteric surfactant and approximately 85% to 50% of water and that this aqueous solution is mixed with 99 $\frac{1}{2}$ % to 94% of water to form a low surface tension solution which contains negatively charged particles.

The carboxymethyl betaine used in the above described composition has the following structure.



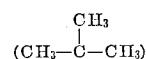
60 y is 2-3, n is 1

65 R is coco fatty chain

R<sub>1</sub> and R<sub>2</sub> is methyl radicals (CH<sub>3</sub>)

R<sub>1</sub> and R<sub>2</sub> need not necessarily be methyl radicals, they may be ethyl (CH<sub>3</sub>-CH<sub>2</sub>), n-propyl

70 (CH<sub>3</sub>-CH<sub>2</sub>-CH<sub>2</sub>), butyl (CH<sub>3</sub>-CH<sub>2</sub>-CH<sub>2</sub>-CH<sub>2</sub>), iso propyl (CH<sub>3</sub>-CH-CH<sub>3</sub>), 2 methyl iso propyl



75 or other substituted derivatives.

The choice of these radicals for the above structure is limited to those derivatives which exhibit the desired properties of water solubility, foam production, and substantivity. The R chain is limited to those derivatives whose chain length falls in the length of fatty chain of coconut derived category whose structural formula is substantially that shown in Table I.

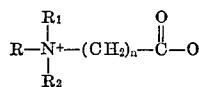
TABLE I

Weight percent	Chemical formula	Common name	International Union of Chemistry name	Number of double bonds
Tr.-1	C <sub>6</sub> H <sub>12</sub> X	Caproic	Hexanoic	0
6-8.5	C <sub>8</sub> H <sub>16</sub> X	Caprylic	Octanoic	0
6-10	C <sub>10</sub> H <sub>20</sub> X	Caprie	Decanoic	0
44-51.6	C <sub>12</sub> H <sub>24</sub> X	Lauric	Dodecanoic	0
13-18	C <sub>14</sub> H <sub>28</sub> X	Myristic	Tetradecanoic	0
8-10	C <sub>16</sub> H <sub>32</sub> X	Palmitic	Hexadecanoic	0
0.5-3	C <sub>18</sub> H <sub>36</sub> X	Stearic	Octadecanoic	0
Tr.-0.4	C <sub>16</sub> H <sub>30</sub> X	Palmitoleic	Hexadecanoic	1
5-8.5	C <sub>18</sub> H <sub>34</sub> X	Oleic	Octadecanoic	1
Tr.-3	C <sub>18</sub> H <sub>32</sub> X	Linoleic	Octadecadienoic	2

The carboxy methyl amido betaine used in the composition may be formed by reacting a tertiary amido amine with halogenated carboxy acids. A carboxy methyl amido betaine of this type usable in the composition of the invention as set forth in Formulas A, B, C and D is commercially available under the trade name "Velvex."

The base surfactant may also have instead of the amide structure shown in Formula E the following structure:

G



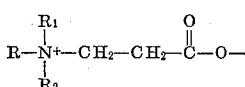
R is fatty coco chain

n is 1, 2, or 3

R<sub>1</sub> and R<sub>2</sub> are methyl, ethyl, n-propyl, iso propyl, n-butyl radicals

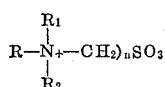
The carboxy portion of the ampholyte shown in Formula E may also be modified as follows:

H



Sulfobetaines may also be employed as the ampholyte or base surfactant in the composition. The sulfobetaines may have the following structure.

I



In the above Formulas G, H and I, R<sub>1</sub> and R<sub>2</sub> are C<sub>1</sub>, C<sub>2</sub>, C<sub>3</sub>, or C<sub>4</sub> hydrocarbon chains, both normal and branched, n is 1, 2 or 3, and R is a derivative whose chain length falls in the coconut derived category whose statistical composition may be substantially that shown in Table I. R, R<sub>1</sub> and R<sub>2</sub> may be normal as derived from fatty acids or branched as derived from synthetic product. Any of the above described amphoteric surfactants whether a carboxy methyl amido betaine or a sulfobetaine are usable in the composition as long as they are characterized by being readily soluble in water, by being surface active agents and decreasing the surface tension of the water in which they are dissolved, by being amphoteric, that is, exhibiting the characteristics of having both the cationic and anionic characteristics so that when the solution is sprayed on the flame front, the sprayed particles have the negatively charged groups concentrated on their surfaces so that the particles tend to combine or attach to the positively charged fuel particles or radicals in the flame front or above the fuel from which they

have vaporized, by being emulsifiers to form an oil in water emulsion when in aqueous solution, and by producing foam when sprayed in an aqueous solution through a nozzle.

The foam stabilizer, such as the di (hydroxyethyl) lauramide is preferably also a surface active agent and reduces the surface tension of water and preferably also is an emulsifier. The foam stabilizer employed in the composition C is available commercially under the trade name "Nitrene L90."

The decrease in surface tension of water with increase of the concentration of the composition having the Formula C dissolved therein obtained by actual tests is given in Table II.

TABLE II - SURFACE TENSION, DYNES/CM.

Weight percent	N-625F (tap water, 125 p.p.m. TH*)	N-625F distilled water
0	71.5	71.5
0.01	48.0	31.9
0.03	39.1	31.2
0.05	36.8	30.6
0.07	36.4	30.4
0.10	32.9	30.6
0.15	31.8	30.5
0.20	29.2	30.2

\*Total hardness

The decrease in surface tension and increase in the penetrating ability of water having varying concentrations of the composition C dissolved therein was also tested by observing the time necessary to thoroughly wet a canvas strip by such solutions. The results of these wetting tests are shown in Table III.

TABLE III

Wetting tests (canvas strip 1" x 10"—50 gm. weight) Seconds

Water, wetting time	488
Soln. of composition C, percent:	
0.1	42
0.2	33
1.0	21
2.0	9

The decrease in surface tension and increase in penetrating ability of water of various degrees of salinity and pH having 2% of the composition C dissolved therein was also tested by observing the time necessary to thoroughly wet the usual Clarkson Draves Synthron Tape by such solutions. The results of these wetting tests are shown in Table IV.

TABLE IV

Clarkson Draves synthron tape

Seconds

Water	>28,800
2% solutions of N-625F in:	
Tap water	9
1% NaCl Soln.	37
5% NaCl Soln.	34
10% NaCl Soln.	43
4% NaCl plus 500 p.p.m. CaCl <sub>2</sub>	30
4% NaCl plus 5000 p.p.m. CaCl <sub>2</sub>	28
4 pH Soln.	23
7 pH Soln.	24
9 pH Soln.	26
11 pH Soln.	30
12.4 pH Soln.	36

The foaming property of the composition having the Formula C dissolved therein was tested by subjecting 6% solutions of the Compositon C in water having various chemicals in various proportions dissolved therein and of different pH properties to the usual Ross Miles foam test and observing the amount of foam produced and the disintegration of the foam with time. The results of these tests are shown in Table V.

TABLE V.—ROSS MILES FOAM TEST  
[In millimeters]

	6% Solution of Composition C in—													
	Dis-tilled water	Tap water, TH*	1% NaCl	5% NaCl	10% NaCl	25% NaCl	4% NaCl plus 500 p.p.m. CaCl <sub>2</sub>	4% NaCl plus 5,000 p.p.m. CaCl <sub>2</sub>	2 pH	4 pH	7 pH	9 pH	11 pH	12.5 pH
	125 p.p.m.	TH*	NaCl	NaCl	NaCl	NaCl	CaCl <sub>2</sub>	CaCl <sub>2</sub>						
Instant	199	197	194	194	190	187	203	209	189	190	194	196	231	247
2 min.	168	170	170	163	148	145	166	178	152	158	163	163	203	205
5 min.	148	170	161	152	145	142	161	174	148	152	158	161	200	197
15 min.	144	170	161	152	139	139	155	170	142	145	152	152	190	190
20 min.	142	170	158	148	136	136	152	166	139	142	148	148	187	187

\*Total Hardness.

The emulsification properties of the composition C were tested by adding to a mixture of equal amounts of diesel oil and water different amounts of the composition C, thoroughly mixing the resulting liquid and visually observing the degree of emulsification. The results of these tests are shown in Table VI.

TABLE VI.—EMULSIFICATION TEST—50 CC. DIESEL/50 CC. WATER

Cone.	Emulsion (visual)	Standing time, minutes	Emulsion	Phase	Break
.25	Fair	0		O/W	Fast.
.25		15	Good	O/W	Slow.
2.7	Good	0		O/W	Do.
2.7		15	Excellent	O/W	Do.

It will be apparent that from the results of the above tests, that the composition having the Formula C reduces greatly the surface tension of the aqueous solution of which it is a constituent increases greatly the wetting or penetrating ability of the solution, causes the solution to form large volumes of foam when mixed with air, and that it forms a fuel in water emulsion when placed in contact with such fuels as oil.

It has been proved by actual tests that the method and composition or aqueous solution of the invention extinguishes fires, such as that of a pool of oil, much more quickly than conventional methods which employ a protein base, such as licorice, oak bark extract, glue and the like, for producing foam which is sprayed not on the flame but onto the surface of the pool of oil to gradually spread from the point of deposition over the whole surface of the pool. Since the flames fed by vaporizing oil from the portions of the surface of the pool not covered by such foam radiate great quantities of heat, the advancing layer of foam is heated and its water content vaporized which of course causes disintegration of the foam and requires additional quantities of foam to be deposited on the pool. In addition, such conventional foams contain relatively small quantities of water per unit volume and, when overlying the pool of oil, act as a heat insulating means so that the temperature of the top layers of oil drops relatively slowly and may be maintained above the kindling point a considerable period of time after the flames have been extinguished so that if the layer of foam disintegrates or is pierced, as by falling debris, the oil again reignites.

It was found in such tests that the fire of a pool of oil in a gravel pit was extinguished in ten seconds or less by the use of the above described method of employing the composition or aqueous solution of the invention and that the layers of foam and oil in water emulsion on the surface of the pool of oil could be pierced two or three minutes after the flames were extinguished without causing reignition of the oil. In contra-distinction, such conventional methods of extinguishing fires using such conventional foam producing agents took more than ten minutes to extinguish the fire and the oil would reignite if the foam on the pool of oil was broken or pierced within a period of some ten minutes after the flames were extinguished.

It will now be seen that the new and improved method for extinguishing fires which employs the composition or aqueous solution of the invention is very efficient and

extinguishes fires rapidly since by its use, the flames are extinguished almost immediately upon the initiation of spraying the aqueous solution at the flames or flame front so that the flames no longer generate and radiate heat which would vaporize the solution and disintegrate the foam formed thereby as the spraying of the surface of the pool of oil or other substance which was on fire continues to form a layer of wet foam thereon which releases low tension water to cool and emulsify the oil, if the substance is oil, and to penetrate into such other substance on fire as cotton, paper wood or the like, to thus thoroughly wetten such other substances and penetrate deeply therein to cool inner portions thereof and prevent smouldering thereof and possible subsequent production of open flames.

It will further be seen that since the spray particles of aqueous solution are negatively charged, they readily combine with the positively charged radicals or fuel particles vaporized from the burning substance to prevent not only their combination with oxygen but also to encapsulate or emulsify such fuel particles in such solution and cool them below their kindling point and that any such particles which fall back on the surface of the oil or other fuel, form an oil or fuel in water layer on the exposed surface of the substance.

It will further be seen that the spray of aqueous solution, once the flames have been extinguished, is directed on the surface of the substance which was on fire in order to cover the substance with a layer of wet foam to isolate the substance from oxygen and to cool it below its kindling point.

It will further be seen that the foam releases low surface tension water which, in the case of a pool of oil, combines with the top layers of oil to form an oil in water emulsion, and which in the case of other substances, such as wool, baled cotton, paper and the like, readily penetrates and wettens such other substances and thus cools the substances below their kindling point at locations disposed interiorly of the outer surfaces of such other substances.

It will also be seen that the method of extinguishing fires of the invention includes the steps of extinguishing the flames of a fire by directing a spray of an aqueous low surface tension solution on the flame front or flames of the fire to saturate the area of the flames with negatively charged spray particles of the solution, directing the spray after the flames are extinguished onto the surface of the fuel or substance on fire to deposit on the fuel a layer of foam which contains a large portion of the solution and to form a layer of fuel in solution emulsion on the surface of the fuel, if the fuel is a liquid, by the emulsification of the top layers of fuel by the solution released from the foam.

It will further be seen that the method also includes the step of transporting heat from the upper strata of the liquid fuel to the lower strata thereof by the flow of the solution released from the foam whose specific gravity is greater than that of the liquid fuel to the lower strata of the liquid fuel.

It will also be apparent that the foam stabilizer is added to the composition merely to strengthen the foam and increase its durability or persistence and that, if desired, it may be omitted from the composition if it is to be used

to extinguish fires which do not require that the foam have relatively great strength and relatively long life.

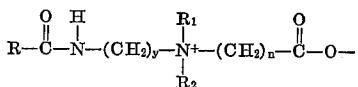
The foregoing description of the invention is explanatory only, and changes in the details of the construction illustrated may be made by those skilled in the art, within the scope of the appended claims, without departing from the spirit of the invention.

What is claimed and desired to be secured by Letters Patent is:

1. A method of extinguishing a fire of a liquid fuel including: directing a spray of a low surface tension foam forming solution consisting by volume

0.075% to 3.00% carboxy methyl amido betaine  
0.011% to 0.438% di (hydroxyethyl) lauramide  
99.914% to 96.526% water

at the flames of the fire to saturate the area of the flames with particles of the low surface tension solution to cause the particles to combine with particles of the fuel vaporized from the liquid fuel to interrupt the chain reaction of the fire, and directing the spray onto the foam on the fuel and emulsify the top layer of the liquid fluid by solution released from the foam to foam a layer of oil in water emulsion on the liquid fuel, said carboxy methyl amido betaine having the structure



y is 2-3,  
n is 1

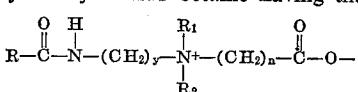
R is coco fatty chain

R<sub>1</sub> and R<sub>2</sub> are methyl, ethyl, propyl, butyl, iso propyl, 2 methyl iso propyl radicals.

2. An aqueous solution for use in extinguishing fires consisting essentially of by volume

9% to 50% carboxy methyl amido betaine  
2.2% to 7.3% di (hydroxyethyl) lauramide  
88.8% to 42.7% water

said carboxy methyl amido betaine having the structure



y is 2-3, n is 1

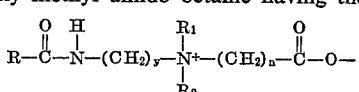
R is coco fatty chain

R<sub>1</sub> and R<sub>2</sub> are methyl, ethyl, propyl, butyl, iso propyl, 2 methyl iso propyl radicals.

3. An aqueous solution for use in extinguishing fires consisting essentially of by volume

0.075% to 3.00% carboxy methyl amido betaine  
0.011% to 0.438% di (hydroxyethyl) lauramide  
99.914% to 96.562% water

said carboxy methyl amido betaine having the structure



y is 2-3, n is 1

R is coco fatty chain

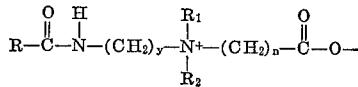
R<sub>1</sub> and R<sub>2</sub> are methyl, ethyl, propyl, butyl, iso propyl, 2 methyl iso propyl radicals.

4. An aqueous solution for use in extinguishing fires consisting essentially of by volume:

13.44% carboxy methyl amido betaine

9.00% ethyl alcohol  
3.80% di (hydroxyethyl) lauramide  
73.76% water

said carboxy methyl amido betaine having the structure



y is 2-3, n is 1

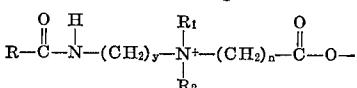
R is coco fatty chain

R<sub>1</sub> and R<sub>2</sub> are methyl, ethyl, propyl, butyl, iso propyl, 2 methyl iso propyl radicals.

5. An aqueous solution for use in extinguishing fires consisting essentially of by volume:

9% to 50% of an amphoteric surfactant, and  
85% to 50% of water

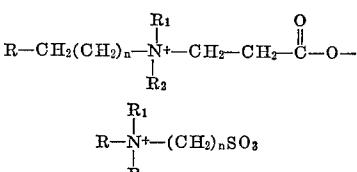
which is mixed with 99½% to 94% of water to form a low surface tension solution which contains negatively charged particles, wherein the amphoteric surfactant is selected from the group consisting of



y is 2-3, n is 1

R is coco fatty chain

R<sub>1</sub> and R<sub>2</sub> are methyl, ethyl, propyl, butyl, iso propyl, 2 methyl iso propyl radicals; and



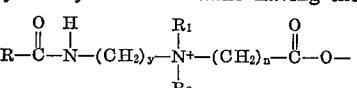
R<sub>1</sub> and R<sub>2</sub> are C<sub>1</sub>, C<sub>2</sub>, C<sub>3</sub>, C<sub>4</sub> hydrocarbon chains  
n is 1, 2, or 3

R is coco fatty chain

6. An aqueous solution for use in extinguishing fires consisting essentially of by volume:

45 .0680% to 0.816% carboxy methyl amido betaine  
.0455% to 0.546% ethyl alcohol  
.0192% to 0.231% di (hydroxyethyl) lauramide  
99.8673% to 98.410% water

50 said carboxy methyl amido betaine having the structure



55 y is 2 or 3, n is 1

R is coco fatty chain

R<sub>1</sub> and R<sub>2</sub> are methyl, ethyl, propyl, butyl, iso propyl, 2 methyl iso propyl radicals.

#### References Cited

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