

UNITED STATES PATENT OFFICE

2,212,735

FIRE EXTINGUISHING MEANS

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No Drawing. Application August 23, 1937,
Serial No. 160,450

3 Claims. (Cl. 23-8)

The present invention relates to means for and methods of extinguishing fires, electric arcs and the like.

The use of liquid media for extinguishing fires is well known. Similarly gas blankets for fire extinguishing purposes are well known. For extinguishing burning liquids inert materials of granular character, such as sand, dust or finely comminuted materials have been employed.

The present invention aims to provide means for extinguishing fires which means will have certain advantages in convenience, permanence, and effectiveness not heretofore attainable.

Liquid fire extinguishers are subject to leakage of the liquid, corrosion of the container if made of metal, and breakage if made of glass or the like. Furthermore, liquid for extinguishing a fire is generally very wasteful in that it tends to gravitate out of the burning mass and be ineffective. Also, it has a destructive effect upon adjacent materials. As is well known, water often damages more than the fire which it puts out.

The inert granular type of fire extinguishing material is ineffective except as it forms a blanket covering the combustible material or shutting it off from the supporting air.

The use of a gas blanket for extinguishing fires is available only under certain circumstances, and is not capable of general application.

Other methods of fire extinguishing, such as foam blankets and the like, require special apparatus and employment of a liquid which it is difficult to handle and to keep available in working condition.

The present invention provides a fire extinguishing material which is in solid form suitably subdivided into blocks, pellets, grains, flakes or the like. The material in subdivided form which for convenience of terminology I shall designate as consisting of particles, whether consisting of pieces as large as briquets or as fine as powder, is intended to be, so far as possible, free flowing. The particles in the preferred form of the invention comprise three functionally related components: first, a carrier material, second, an arc extinguishing fluid, and, third, a protective coating. Under some circumstances, the coating may be omitted if desired.

The carrier material gives shape and definition to the final particle. Adsorbent material has the power to coact with the vapor phase or gaseous phase of the fluid to be carried, and condense it upon the surface or in the pores or interstices of the material, apparently reducing it to the liquid phase. In this respect it has a greater power to

take back and recondense vapors and gases which may have been driven off by changes in temperature or pressure than has absorbent material.

A carrier material acting as an absorbent for a liquid has crevices or interstices of capillary dimensions in which are held by the surface tension of the liquid small quantities of such liquid. It appears that a material to act as an adsorbent of vapor or gas has crevices or interstices of much smaller dimensions, so small in fact as to hold individual molecules. An absorbent material may not have any appreciable adsorbent properties, but an adsorbent material may be wet with liquid, some of which is retained in the pores or interstices as though condensed therein from the vapor or gaseous phase. The material may also act externally to retain the liquid in the interstices between granules or particles which provide capillary spaces. An adsorbent material may be charged with the desired fluid as by wetting the same and removing the excess. The excess may be removed by evaporation at a temperature below that at which the adsorbed fluid will yield any appreciable vapor pressure. It appears that adsorbed vapor phase fluid is held in condensed form upon the surface or in the pores of the adsorbent material, substantially as a liquid. The active fluid carried either by adsorbent material or absorbent is subject to being driven off by a rise in temperature or reduction in pressure beyond a critical range of pressure-temperature combinations.

Absorbent carrier material wet with a liquid is generally not free flowing because of the effect of liquid film holding the particles together. The adsorbent carrier charged with the vapor phase of a suitable fluid is sensibly dry externally and tends to have greater freedom of flow. A free flowing adsorbent carrier may be employed where absorbent material in the mass would not serve the purpose.

In order to avoid loss of carried fluid by variations of the temperature-pressure relation, which variations may arise because of atmospheric changes or the like, it is, for certain purposes, desirable to provide a suitable form of coating material or sealing material which will retain the carried fluid. Thus, for example, particles of the carrier material may be charged with the desired fluid, and then covered with a sealing or coating material which seals the particles against loss of the fluid. Where the particle of carrying material is adsorbent, the individual particles may be coated or groups of particles may be agglomer-

ated into pellets or the like, and the pellet sealed or coated.

According to one phase of the present invention diatomaceous or porous earth, such as kieselguhr, fuller's earth, chalk, talc, bentonite, zeolite, and any of the usual porous or adsorbent mineral substances may be impregnated with various known fire extinguishing liquids, and then the individual particles or groups of particles sealed by a non-combustible material in the form of a covering or coating, such, for instance, as sodium silicate. While the coating or sealing material is preferably non-combustible, under certain circumstances, the employment of certain combustible sealing coatings, which when subject to the arc extinguishing material become non-combustible, is permissible.

Due to the tendency of most of the above porous inert materials to be resolved into the form of a fine powder, such material may be made into pellets, which pellets are then charged with the arc extinguishing fluid and suitably sealed with a coating. As above explained, the coating may make these particles or pellets flow more freely over each other or in respect to a solid such as a container or the guiding passageways through which they must flow.

The pellets or tablets or briquets are then impregnated with the fire extinguishing liquid in the liquid phase, the excess of which is removed, and the liquid is retained indefinitely by covering the carrier, preferably the individual particles, pellets, tablets or the like with a suitable sealing coating impervious to the liquid or to the normal evaporation of the liquid.

It is contemplated that the size of the particles, pellets, or tablets may range from BB shot up to a briquet.

The coating material, whatever it may be, for example, sodium silicate, is dried on the surface of the carrier at a temperature lower than the vapor tension of the fire extinguishing liquid contained within the interstices and pores of the adsorbent material.

The arc extinguishing material suitable for adsorption may be of any of the halogenated hydrocarbons, such as carbon tetrachloride, trichloroethylene, tetrachloroethylene, and the like. The heavier liquids which have higher boiling points and higher vapor tensions give less difficulty from drying out, but they are generally not as desirable for fire and arc extinguishing purposes as liquids of lower boiling point and lower vapor tension, although this varies with the circumstances under which they are to be used. For arc extinguishing purposes, a fluid of low molecular weight appears to be most desirable.

According to another phase of the present invention, granular, flaky, flocculent, or pulverulent material or materials having adsorptive properties is employed to adsorb fluid or fluids such as vapors or gases, of fire extinguishing character, and these granular solids automatically give up the adsorbed fire extinguishing fluids when heated by the fire which they are to extinguish. According to this phase of the present invention, granular, flaky, flocculent, or pulverulent inert material, such as "Lamisilite" (adsorptive and absorptive silica flakes), silica gel, activated aluminum, calcium chloride, lithium chloride, aluminum hydroxide, or other adsorbent materials is charged with arc extinguishing material in the gas or vapor phase. Such arc extinguishing material may be, for example, a suitable halogenated hydrocarbon, such as car-

bon tetrachloride, trichloroethylene, tetrachloroethylene, and the like. Various compounds of halogen derivatives of aliphatic hydrocarbons chiefly compounds of fluorine and chlorine or both may be employed. Likewise derivatives of aliphatic hydrocarbons comprising bromine or bromine and chlorine may be utilized.

The adsorbent material having adsorbed fluid within its pores or openings tends to retain the fluid so long as the temperature pressure conditions surrounding the carrier do not exceed certain limits which are determined by the vapor pressure of the liquid contained within the openings, pores or capillaries of the adsorbent carrier.

The simplest way to charge the adsorbent material with the desired fluid is to soak the material in the liquid and allow the excess to dry off under conditions which would not exceed the vapor tension of the entrapped liquid within the pores or interstices of the material. While the tendency for the liquid to dry out of an adsorbing carrier material is greater than that of the tendency of the adsorbed fluid to dry out of an adsorbing carrier, it is desirable, in the preferred form of the invention to coat either material with the sealing coating, so as to retain the carried fluid and prevent its loss.

Certain of the aforesaid adsorbents are more active in the adsorption of particular arc extinguishing gases or vapors. All of them will adsorb moisture to a high degree.

The "Lamisilite" (adsorptive and absorptive silica flakes), and silica gel are, chemically, silicon dioxide of a special physical form, and they are completely inert to most reagents under all usual conditions.

By gathering the fines which occur in mining or working of the vermiculite or other ores from which "Lamisilite" (adsorptive and absorptive silica flakes) or silica gel, for example, are derived, the raw material may be procured substantially as a by-product or waste. The other materials referred to such as calcium chloride, lithium chloride and aluminum hydroxide may also be secured in many cases as industrial wastes. When treated by heating to drive off any undesired material which has been adsorbed, and then subjected to the specific fire extinguishing gas or vapor which it is desired to absorb, these materials may be charged with gases or vapors or both to many volumes. These gases and vapors are given up when the material is subjected to an increase in temperature. The adsorptive character of the material is generally a function of the absolute temperature and absolute pressure of the medium which it adsorbs. Hence, by proper selection of the adsorbed material and the adsorbent, a fire extinguishing material, suitable for normal subjection to a particular temperature, such, for example, as a boiler room or other location where the temperatures are relatively high, may be produced with sufficient margin of adsorbed material to give the desired effect upon exposure to the heat of the fire to be extinguished.

Upon application of such granular, flaky, flocculent, or pulverulent solid to a fire, the material acts in a dual capacity. First, it acts like any inert granular or pulverulent material, for example, sand, so that if sufficient quantities are applied it will form an inert blanket over the burning material, for example, a burning fluid such as oil. Due to its granular or solid character, it will not run away as does a liquid, or escape as does a gas. As soon as it is subjected

to an increase in temperature it begins to give off the adsorbed fire extinguishing material. Due to its solid form it tends to remain in place wherever projected and give off its gaseous material due to rise in temperature whereby to evolve a blanket of gas or vapor which cuts off access of the oxygen of the air to the combustible material. The evolution of gas or vapor is not explosive but gradual, and hence the continued evolution of gas or vapor maintains a blanket of inert gaseous fluid over the area of combustion thereby serving to prevent combustion.

The material is normally chemically and physically inert, and as it is in granular flakelike powder or other sub-divided form, it may be packaged in any convenient container, and may be applied in any suitable manner.

This inert material with adsorbed gas or vapor of fire extinguishing properties may be applied to the fire by being projected into the fire either mechanically as by being thrown from the container, or distributed pneumatically, as by means of a hose and compressed air or any other suitable or preferred manner. It might even be applied in connection with a liquid of the type which it tends to adsorb or any other fire extinguishing liquid, but the material of my invention exhibits its most desirable features for general use when used in the dry form. When so used in the dry form, it tends to remain where projected, and leaves no residual liquid to wet the surroundings. Hence, its use does substantially no damage to materials that would be injured by liquids. After the fire is extinguished, the material may be brushed, swept up, or removed by a vacuum cleaner or other well known means for removing a granular or pulverulent material.

It is to be understood that the particles may be sealed with sealing material such as sodium silicate or any other impervious coating. Certain gummy or resinous coatings, insoluble with respect to the contained fluid may also be employed. Water soluble coatings of organic or inorganic materials may be employed. This sealing material tends to render the material more stable and will allow it to keep its properties indefinitely under ordinary atmospheric changes of temperature and pressure.

As a specific example of preparing a material in accordance with my invention, I subject fines of vermiculite to sulphuric acid by a leaching process which causes the vermiculite to open up into flakelike particles of silicon dioxide having enormous surface per unit of weight. This material is then dried as by heat and the gases or vapors driven off and carried away by a stripping current of air, to prepare the same for the adsorption of a suitable gas or vapor, or be charged with a suitable liquid.

Thereupon the "Lamisilite" (adsorptive and absorptive silica flakes), in finely divided form is charged with the desired fire extinguishing or arc extinguishing fluid. This may be done, either by dipping the material in liquid, or wetting it with liquid and allowing the excess to dry off at a temperature and pressure such that it will not tend to lose the fluid contents.

Alternatively, the carrier material may be subjected to the vapor phase of suitable material, for example, carbon tetrachloride, trichloroethylene, tetrachloroethylene or any one or more of the group of halogen derivatives of hydrocarbons which will have the desired properties of being adsorbed to the desired degree at a given tem-

perature, and being driven off at the temperature of ignition of the usual combustible materials. This fire extinguishing material so prepared is disposed in a suitable can or container, from which it may be projected upon the burning area. As soon as it is subjected to the heat of the fire, it throws off the adsorbed arc extinguishing gas and shuts off the supporting oxygen thereby extinguishing the fire.

The material of my invention, either coated or uncoated, has a further utility in the art of extinguishing electric arcs.

Where the material is to be employed in a casing substantially gas tight, so that external changes of pressure do not affect the internal pressure of the casing, or so that vapor if evolved in the casing cannot escape, the material may be employed in the shape of particles without the sealing coating. If, however, the casing in which the material is to be contained is not fluid-tight, then the material with the sealing coating is preferably employed.

It appears to be the fact that a gas of low molecular weight has ability to extinguish arcs in a manner not fully understood. Water vapor is an excellent gaseous medium for this purpose, as is well known to those skilled in the art. The conductivity of the arc in a gas is explained in general on the theory that the gas is dissociated into positively and negatively charged particles. Under the influence of the electrostatic field or the temperature involved, these charged particles remain segregated or in other words the gas is ionized and in that state or condition it provides a conductive path for the flow of current. Gases of low molecular weight appear to resist decomposition and appear to recombine more rapidly than gases of a higher molecular weight. At all events, it is known that projecting a stream of gas of a low molecular weight through an electric arc tends to reduce the conductivity of the space in which the arc is formed. Where the arc is maintained by an alternating potential, the current flow passes through zero when the potential is at or near zero. The flow of arc extinguishing gas through the arc space at the time that the current passes through zero and the potential is substantially zero, tends to remove the dissociated or ionized gas and replace it with gas which is not dissociated or ionized, and if the recovery of dielectric strength in the arc space is more rapid than the rise of potential or the tendency of the potential to break the gas down, the arc will remain extinguished. The gas which I employ serves the dual purpose first of excluding oxygen to limit the oxidation or burning of the metal and other combustible vapors and second of providing a gas of the type which facilitates the extinguishing of the arc.

In this aspect my invention provides an inert material serving as an adsorbent for a gaseous medium which of itself has a high degree of utility in extinguishing an arc. An example of such an adsorbent material is silicon dioxide in the form of "Lamisilite" (adsorptive and absorptive silica flakes), or silica gel, or the like. Other normally inert materials, such as aluminum hydroxide and the like act as adsorbents. These electrically and chemically inert materials are charged by adsorption with gases or vapors of low molecular weight which gases or vapors have highly effective arc extinguishing properties.

Thus, for example, "Lamisilite" (adsorptive and absorptive silica flakes), or silica gel charged with such media as water, carbon, tetrachloride,

trichlorethylene or the like, may be employed in the granular, flake or powder form in an electric fuse. Water vapor may be employed as the gaseous arc extinguishing medium adsorbed in a suitable inert carrier of the type herein disclosed. Preferably such fuse should be provided with an arc blast tube, that is, a tube surrounding the arc for the direction of gases at high velocity lengthwise of the arc. Thus a fuse of great effectiveness is provided without the disadvantage of either a liquid or previously known solids, such as boric acid and the like. In other words, the material of my invention secures its properties through the inert character of the adsorbing medium and the active properties in extinguishing the arc by the adsorbed medium.

The powdered inert material, that is, the remaining solid serves the useful purpose of forming nuclei for the recombination of ionized or dissociated gases to provide rapid recovery of dielectric strength of the medium in the space where the arc is formed. Thus the material of my invention acts in a dual capacity, first, in giving off a fluid arc extinguishing medium, and, second, serving as an adsorbing and recombining medium for the high temperature products of the arc.

I may form an arcing tube of the material of my invention, or may line a tube of suitable insulation with the material of my invention to produce the desired arc extinguishing effect.

It is to be noted that in no case is it necessary to break down the chemical composition of the material as the evolution of the desired gas is secured by the change in temperature as distinguished from breakdown or disruption of the material itself.

I do not intend to be limited to the specific details herein disclosed, nor the specific materials herein disclosed, inasmuch as the teaching of the invention goes broadly to the combination of a suitable inert adsorbent with a selected one or more materials which are adsorbed and which are given off by changes in temperature or pressure, and the character and composition of these adsorbed materials are quite independent of the composition of the adsorbing material.

It is to be observed that certain of the adsorb-

ents are better adapted to the adsorption of the desired gases, vapors and the like than are others. It is within the skill of these workers in the art guided by the above teaching to select the desired constituents for the specifically different effects which may be desired.

I claim:

1. A dry, free-flowing fire extinguishing material comprising finely divided particles of adsorptive material, said particles being charged with and retaining by adsorptive power a fire extinguishing fluid which is given off as a relatively heavy vapor when subjected to the heat of a fire to be extinguished, and a coating of protective material tending to prevent loss of the adsorbed fluid from the pores of said particles by changes in ambient temperature and pressure, said coating being ruptured at temperatures below those at which it is desired to have the vapor evolved.

2. A dry free flowing fire extinguishing material consisting of finely divided activated silica particles having adsorptive properties in high degree, said particles being charged with and retaining by adsorptive power a fire extinguishing fluid which is given off as a relatively heavy vapor when subjected to the heat of a fire to be extinguished, and a coating of protective material tending to prevent loss of the adsorbed fluid from the pores of said particles by temperature and pressure changes of the ambient atmosphere, said coating being ruptured at a temperature below that at which it is desired to have the vapor given off.

3. A dry, free-flowing fire extinguishing material comprising finely divided activated silica particles having adsorptive properties in high degree, said particles being charged with and retaining by adsorptive power a fire extinguishing fluid which is given off as a relatively heavy vapor when subjected to the heat of a fire to be extinguished, and a coating of water glass tending to prevent loss of the adsorbed fluid from the pores of said particles by changes in ambient temperature and pressure, the water glass coating being broken at a temperature below that at which it is desired to have the vapor given off.

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