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ELECTRICAL CONDUCTORS

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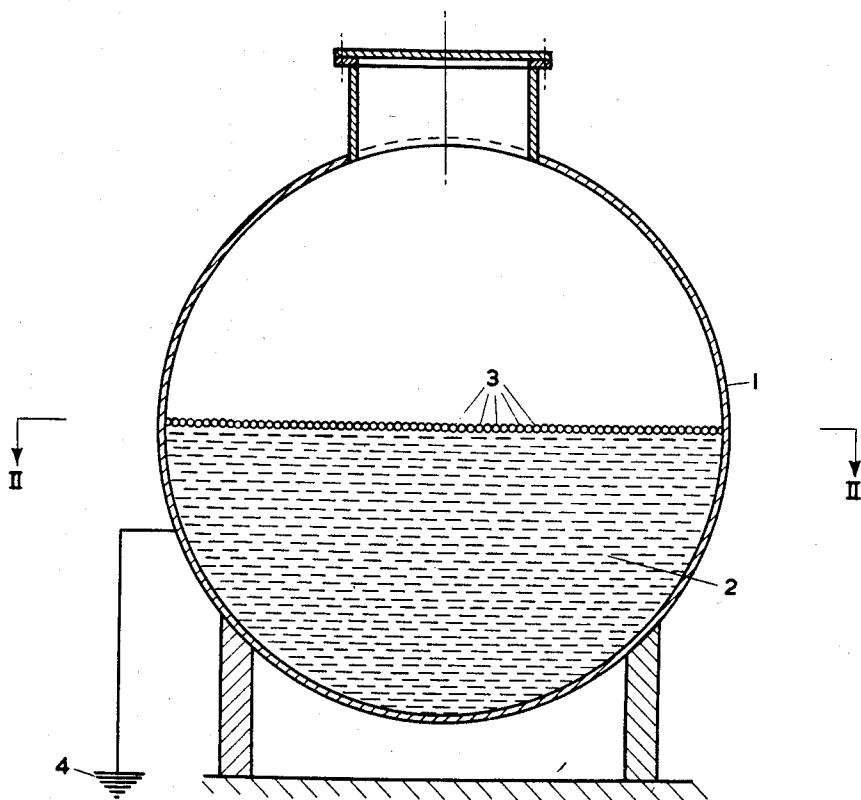


FIG. 1

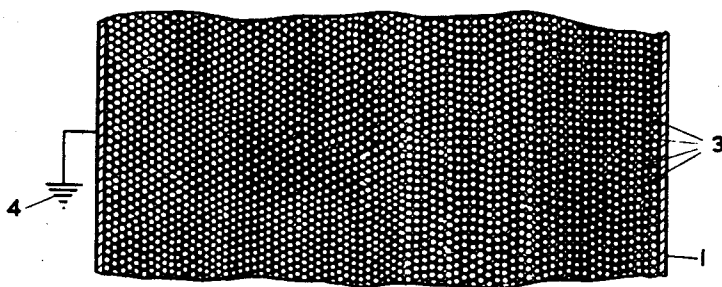


FIG. 2

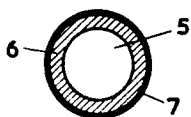


FIG. 3

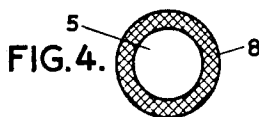


FIG. 4.

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ELECTRICAL CONDUCTORS

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The present invention relates to the elimination or reduction of electrical charges, such as static electrical charges, at the surface of a liquid.

It is known that liquids when passing through an atmosphere, for example when being transferred from one container to another, tend to accumulate an electrical charge, known as a static electrical charge, particularly in dry atmospheres. The charge so collected may be high and especially so in liquids which are poor conductors of electricity; even when in contact with a grounded conductor the lack of conductivity within the liquid may result in some accumulation of electrical charge. Furthermore, even when the liquid is a moderately efficient conductor the electrical charge may build up temporarily during the various operations before it can be conducted away by suitable grounding means.

Such electrical charges may be high enough to produce a spark discharge under certain conditions, for example when a metal object such as a funnel or dipstick touches the surface of a liquid so charged and is in contact with a surface at a different potential, for example the container. Such a spark discharge in the presence of an inflammable air/vapour mixture is a very serious fire risk and has been recognised as such for many years, particularly in the case of the storage of large quantities of inflammable liquids as, for instance, in oil and gasoline installations and in solvent storage, and it is essential that any electrical charge present should be eliminated or reduced as quickly as possible below a level whereby a spark discharge may be caused.

It is common practice to attempt to achieve this result when transferring liquids, by the grounding of stored liquids through the metal container or by the equalisation of the potential between two containers by bonding. It has been found, however, that even when such precautions are taken it is still possible for a charge to accumulate at the surface of the liquid due to the inefficient conduction of the charge through the liquid to the bonded or earthed surfaces if the liquid is a poor conductor of electricity. This phenomenon is shown, for example, in the analogous case wherein an ebonite plate may be charged with an electrostatic potential and this charge may then be discharged at several different points on the surface of the plate by a conductor before the whole charge is eliminated due to lack of conductivity between different areas of the ebonite plate. This is particularly true in the case of bulk storage of non-polar liquids, for example hydrocarbons such as benzene and gasoline and in other cases such as the storage of ethers, esters, or carbon disulphide. Even in the case of liquids which are moderately good conductors of electricity, the charge may remain at a sufficiently high level to cause a spark discharge for a short period of time and a very considerable fire risk may still exist, if only temporarily.

It is an object of this invention to provide a means whereby the electrical charge may be very rapidly conducted away to a grounded or bonded surface, for ex-

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ample a grounded container, from any portion of the liquid surface.

This invention comprises the novel products as well as the novel processes and steps of processes according to which such products are manufactured, the specific embodiments of which are described hereinafter by way of example and in accordance with which I now prefer to practice the invention.

In carrying out the invention, a liquid tending to accumulate an electrical charge in ignitable vapour on its surface is placed in an electrically grounded or bonded container. Such liquids may be benzene, gasoline or similar liquid. On the surface of the liquid there is formed an electrically conductive stratum which is in contact with the electrically grounded and bonded container. This stratum may be the vapour itself in ionised form induced by emanations from radio-active materials as described below, or it might be in the form of electrically conductive particles and beads floating on the surface of the liquid. Such particles may be electrically hollow metallic beads and hollow plastic beads which have been coated with a conducting layer, such as a metallic layer. Such beads, if electrically conducting due to the incorporation of conducting material need not be metallically coated.

It is desirable that such particles, in addition to possessing conducting properties, should have a density as low as possible in order to ensure that they rapidly form a layer on the surface of the liquid and float thereon irrespective of the method of introduction into the liquid, for example introduction into the base of the tank or from above the liquid, and of the density of the liquid treated. To achieve such a low density it is preferable that the ratio of the volume of the particles to their weight shall be as great as possible, and this may be achieved by ensuring that a large space, or alternatively, numerous small spaces, exists within the particle and by using material which has itself a low density.

Such particles may, for example, consist of hollow metallic particles, wherein the metallic portion consists of a thin shell surrounding an air space or air spaces, and is preferably of a metal of low density, such as aluminium, and of high resistance to attack by liquids for which protection is desired.

Suitable particles may also be produced, for example, by using plastic materials processed in such a manner that vapour is formed within the particles of plastic when in a liquid state, wherein an outer coating of hardened plastic material is formed around a central space or spaces on cooling. The material used should be chosen for its resistance to solvent attack by a wide range of liquids, and thermosetting resins, for instance, phenol formaldehyde resins, are very suitable for the purpose of the invention, as are other resinous materials showing a marked degree of cross-linking, for example certain of the ion exchange type of resins.

In order to render such particles conducting all particles may be treated by methods whereby conducting materials, for example substances such as aluminium, magnesium, silver, copper, nickel or graphite are deposited upon them or alternatively or additionally conducting material may be incorporated into the material before the particle formation, for example suitable proportions of metal powder or graphite.

Where metals are to be deposited upon particles this may be accomplished by known methods such as, for example, precipitation of the metal upon the particles from solutions of its salts. In the case of graphite this may be applied to the particles by bringing them into close contact with finely divided graphite.

Besides metal and plastics, any material possessing the properties hereinbefore described may be used, and the

particles may be any other suitable electrically conducting particles of low density.

Furthermore it is within the scope of this invention to incorporate into the particles, which may or may not themselves be conducting, a proportion of a radioactive substance or substances, preferably of long life, which is capable of emitting suitable emanations which can ionise the gaseous layer above the liquid and thus render this layer itself conducting. By this means any electrical charge present at the surface of the liquid may be conducted away to an earthed or bonded surface such as the container. Suitable radioactive materials, for example those emitting β -radiations which have a short range of penetration only may be produced as a waste product in various nuclear reactions, and, since the disposal of such wastes is extremely difficult, these radioactive materials may readily be available at a low cost for the purpose of the invention. One example of a very suitable material is the element strontium 90 or compounds containing this.

The particles may vary widely in size and may be of any size suitable to the container, thus for example larger particles may be used in large storage tanks and smaller particles in smaller containers. The size is preferably such that a large number of conducting surfaces are present in order to ensure efficient conduction and, suitably, in this respect particles as small as can be conveniently handled are used in order to provide a large conducting area throughout the layer. The shape of the particles is not of great importance but owing to ease of production it is preferred to use substantially spherical particles.

If the particles are to be introduced into the storage container with the liquid, and they are sufficiently small, for example in the range about 2 to 100 microns in diameter, they may be passed through the pumping machinery of large installations without damage to such machinery and such a method forms a convenient means of introduction on a large scale. However, the particles may equally well be introduced above the liquid for example through the mouth of the storage vessel, and such considerations of size need not then apply.

It is a preferred embodiment of this invention that a sufficiently large number of particles may be added to the storage vessel to form a complete layer over the surface of the liquid to ensure the most efficient conduction of the charge through the conducting particles which are in contact with each other, although the addition of a smaller amount may be effective providing a conducting path for the electrical charge at any given time. The amount required to give the desired results may be readily found by experiment. For the purposes of economy, the particles may suitably be recovered and re-used as desired.

It has already been proposed to form on the surface of a liquid a layer of small plastic spheres, known as microspheres or "plastic foam," in order to reduce the loss of liquid from such surfaces due to evaporation.

Whereas this method of preventing evaporation is effective, the presence of a layer of non-conducting plastic particles, usually of a phenol-formaldehyde resin tends to favour the accumulation of a static electrical charge and the fire risk due to spark discharge remains unreduced if not enhanced. Furthermore, although the layer of particles considerably reduces the evaporation, it may by this means also tend to increase the period of time in which the vapour/air mixture above the liquid is in the proportions wherein the mixture is susceptible to ignition and the period of fire risk may thus be prolonged.

On the contrary the process according to the present invention not only eliminates or reduces the fire risk but also prevents or reduces loss of liquid by evaporation.

As stated before the present invention is of particular value in the bulk storage of liquids which are indifferent conductors of electricity and whose vapours form inflammable mixtures with air, but it may be applied with advantage to almost any liquid in which there is a fire risk

since it ensures that no dangerous electrical charges shall exist for any lengthy period after their formation.

The following examples show methods by which suitable particles may be formed and used in the process of the present invention.

Example 1

Hollow particles of phenol-formaldehyde resin having a size range from 2 to 40 microns in diameter are prepared by spraying a 10% aqueous solution of partially polymerised phenol-formaldehyde resin containing 1% ammonium carbonate into a heated chamber having an inlet temperature of about 700° F. at a rate of about 95 mls./minute. The decomposition of the ammonium carbonate at this temperature provides a gaseous phase around which the phenol-formaldehyde resin hardens to give the desired hollow particles. The particles so formed are recovered, washed and dried.

About 30 grams of the dried particles are then placed in a container and to these are added 40 mls. of a solution of silver nitrate (containing 17 grams of silver nitrate, 48 mls. of concentrated ammonia and 8.6 grams of sodium hydroxide per litre of solution) and 2 mls. of a solution containing 190 grams of cane sugar, 370 mls. of 96% ethyl alcohol and 6 mls. of concentrated nitric acid per litre, stirring being maintained during the additions. The reaction is allowed to continue, with stirring, for about two hours when the plastic particles, now coated with silver, are removed, washed with water and dried. When these particles are added to benzene contained in a grounded container to form a layer on the surface and more benzene is poured into the container the accumulation of a static electrical charge at the surface of the liquid is prevented.

Example 2

Particles of phenol-formaldehyde resin are prepared as described in Example 1 and these are treated as follows. To 25 grams of the particles in a container are added the following solutions with stirring. (a) 78 mls. of a solution of 50 grams of copper acetate, 200 mls. of concentrated ammonia and 260 mls. of distilled water. (b) 318 mls. of a solution containing 17.5 grams of potassium hydroxide in 110 mls. of distilled water and (c) 60 mls. of a solution of 15 mls. of hydrazine hydrate in 39 mls. of distilled water. The mixture is then heated in a water bath for 2 hours, stirring during this time, and the particles, now coated with copper are recovered, washed with water and dried. When these particles are added to gasoline stored in a grounded container to form a layer on the surface the accumulation of a static charge at the surface of the liquid is prevented.

Example 3

Plastic particles are prepared as described in Example 1 and 25 grams of these particles are then placed in a container and the following solutions are added, (a) 150 mls. of a solution containing 50 grams of nickel acetate, 200 mls. of concentrated ammonia and 360 mls. of distilled water. (b) 150 mls. of a 28% aqueous solution of hydrazine hydrate and (c) 30 mls. of a 0.16% aqueous solution of potassium platinum chloride. The mixture is then heated to 75° C. for one hour, stirring being maintained throughout. The nickel coated particles when added to benzene in a grounded container prevent the accumulation of a static charge at the liquid surface.

Example 4

A 5% aqueous solution of polyvinyl alcohol containing 1% of ammonium nitrite is sprayed in to a heated chamber having a temperature at the inlet of about 600° F. at a rate of 91 mls./minute. The decomposition of the ammonium nitrate provides the gaseous phase around which the polyvinyl alcohol plastic hardens to give the desired hollow particles. The particles are then re-

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covered, washed with water and dried. The particles have diameters in the range 3 to 30 microns.

These particles are treated as described in Examples 1, 2 and 3 to provide coatings of silver, copper and nickel respectively. The coated particles are then added to gasoline stored in grounded containers to form a layer on the surface of the liquid and, by this means, the accumulation of a static electrical charge at the liquid surface is prevented.

In the accompanying drawing forming part of this application Fig. 1 is a sectional elevation of a grounded container with a liquid having an ignitable vapor therein with an electrically conducting stratum of floating electrically conducting particles, showing an embodiment of my invention;

Fig. 2 is a fragment of a horizontal section on the line II—II of Fig. 1;

Fig. 3 is an enlarged cross-section through a particle having a conducting coating; and

Fig. 4 is an enlarged cross-section of a particle having a resinous portion and containing radio-active material.

Referring now to these drawings, the numeral 1 indicates a container having a volatile non-conducting liquid 2 therein which may be benzene, gasoline or the like. The numeral 3 designates floating electrically conducting particles which lie on the surface of the liquid. This liquid, such as mentioned, is substantially electrically non-conducting and has an ignitable gas thereabove. The floating particles are on the surface of the liquid. The container 1 is of conducting material and is grounded as shown at 4.

In Fig. 3 is shown a particle having a conducting coating 7 surrounding a resinous portion 6 surrounding the space 5, these particles being prepared in accordance with the above examples. In Fig. 4 a particle is shown which has no outer coating 7, but the resinous portion of the type described in the examples has combined with it a radio-active material capable of producing ionizing radiations as above described.

I claim:

1. A safety means for use with stored liquids comprising a grounded storage container of conducting material

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containing an inflammable and substantially electrically non-conducting liquid phase and a gase phase and at the surface of the liquid an electrically conducting stratum from the surface of the liquid to the storage container of floating electrically conducting particles.

2. A safety means as claimed in claim 1 wherein the particles are metal coated hollow particles of synthetic resin wherein the metal is selected from the group consisting of aluminum, magnesium, silver, copper and nickel.

3. A safety means as claimed in claim 1 wherein there is incorporated into the particles a radio active substance producing emanations capable of ionizing the gaseous phase at the liquid surface.

4. A process which comprises adding floatable conductive beads to a liquid having an ignitable gas phase at the surface, forming a floating layer of such beads at the surface thereof sufficient to collect any static electricity developed in the gas phase, and discharging such electricity through a conductor.

5. A process which comprises adding floatable conductive beads to a liquid having an ignitable gas phase at the surface, the conductive portion of said beads being selected from the group consisting of the substances aluminum, magnesium, silver, copper, nickel and graphite, forming a floating layer of such beads at the surface thereof sufficient to collect any static electricity developed in the gas phase, and discharging such electricity through a conductor.

6. A process according to claim 5, in which the beads are hollow and having a diameter in the range of 2 to 100 microns.

References Cited in the file of this patent

UNITED STATES PATENTS

1,524,423	Chapman	Jan. 27, 1925
1,564,855	Jurs	Dec. 8, 1925
1,642,434	Faunce	Sept. 13, 1927
2,433,968	Wiseley	Jan. 6, 1948

FOREIGN PATENTS

21,737	Great Britain	1913
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