Oct. 2, 1951 M. K. NEWMAN 2,569,490

CARBON DIOXIDE SNOW FORMING HORN

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Fig. 1

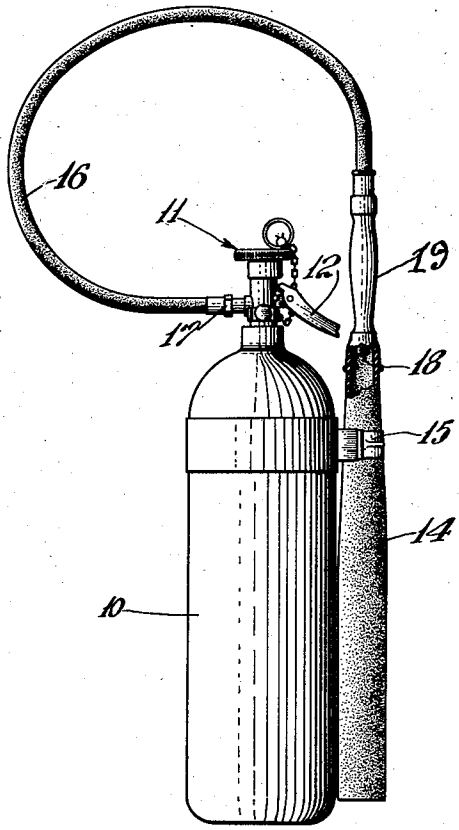
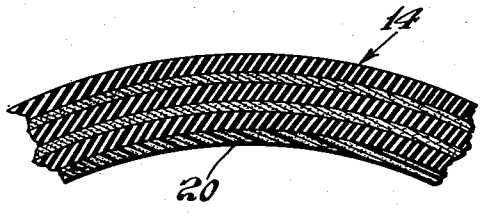


Fig. 2



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CARBON DIOXIDE SNOW FORMING HORN

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5 Claims. (Cl. 169—11)

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This invention relates to carbon dioxide snow forming shields or horns, and, more particularly, relates to such horns adapted to greatly minimize the accumulation of electrostatic charges.

In certain fire extinguishing apparatus, high pressure liquid and/or gaseous carbon dioxide is discharged through a nozzle surrounded by a funnel-shaped shield or horn which causes the carbon dioxide to be converted to a mixture of snow particles and gas. In passing through the nozzle, the carbon dioxide expands rapidly from a relatively high pressure to nearly atmospheric pressure to produce carbon dioxide snow, while the horn reduces the forward velocity of the discharged carbon dioxide to prevent the entrainment of air.

The horn, in most instances, is formed of dielectric material having an infinitesimal electrical conductivity to enable the same to be used safely on fires in the vicinity of an electrical current supply at very high voltages.

In cases where the horn is not grounded, for example, when the horn is used in connection with portable fire extinguishing apparatus adapted to be carried by the operator, electrostatic charges are generated and are accumulated by the horn, which acts in a sense as a condenser. These charges, when grounded through the operator, may subject the operator to severe and disagreeable shocks, particularly at conditions of low relative humidity.

It is believed that these charges are due to the fact that the carbon dioxide snow directed outwardly from the nozzle contacts the horn with explosive-like violence. This is because the carbon dioxide is permitted to expand very quickly from several hundred pounds per square inch to nearly atmospheric pressure, whereby the mixture of gas and snow leaving the nozzle will attain a relatively high velocity.

As a result of this rapid expansion, violent expansion shocks, high local velocities and low temperatures are established. Liquid carbon dioxide droplets freeze to snow crystals, and these snow crystals are blown by the gas to collide violently against the dielectric surface of the horn. Some of the snow crystals will be negatively charged before they collide with the horn, while others will be neutral. Upon such violent collision, a number of these snow crystals will lose one or more electrons, that is, negative charges, which are accumulated by the horn and may be dissipated in the form of an electrostatic discharge when the horn is grounded.

It has been established that the electrostatic

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charges generated may have an energy value of about 40 to 50 joules at a potential up to about 60 kilovolts, the potential of the charge on the horn being negative. While such charges are not injurious to human beings, they nevertheless produce shocks having distressing effects.

Accordingly, an object of the present invention is to substantially eliminate or greatly minimize the generation of electrostatic charges on carbon dioxide snow forming horns.

Another object is to effect substantial dissipation of the generated electrostatic charges tending to accumulate on the horns.

Another object is to provide horns of the foregoing character which can be used safely in the vicinity of very high voltage electrical installations.

A further object is to accomplish the foregoing objects in a simple, inexpensive manner.

Other and further objects of the invention will be obvious upon an understanding of the illustrative embodiment about to be described, or will be indicated in the appended claims, and various advantages not referred to herein will occur to one skilled in the art upon employment of the invention in practice.

In accordance with the invention, it has been found that these objects may be accomplished by utilizing carbon dioxide snow forming horns constructed of dielectric material provided with an interior surface of a material having a specific inductive capacity of a value which will greatly minimize the generation of an electrostatic charge and having a surface resistance of a value to establish surface leakage which effects substantial dissipation of the charge generated, whereby the charge accumulated by the horn is greatly reduced. Such a surface is provided by applying to the interior of the horn a coating of a material having the aforementioned properties.

In the accompanying drawing:

Figure 1 is an elevational view illustrating a portable fire extinguisher provided with a horn embodying the invention, a portion of the horn being shown in section.

Figure 2 is an enlarged, fragmentary sectional view of the horn illustrating the coating at the interior thereof.

Referring to Figure 1, there is shown a portable fire extinguisher comprising a container 10 for storing carbon dioxide under pressure, a discharge head or valve 11 for releasing the carbon dioxide from the container, a handle 12 on the discharge head to facilitate carrying of the

extinguisher, a discharge directing shield or horn 14 supported by a bracket 15 on the container when the extinguisher is not in use, and a flexible hose 16 connecting the outlet 17 of the discharge head 11 to the horn 14. At the interior of the horn, a nozzle 18 is provided which is in communication with the hose 16 and through which carbon dioxide is expanded into the horn as aforementioned.

The horn generally is formed of a resin or plastic of the type having high dielectric strength and infinitesimal electrical conductivity. For example, as shown in Figure 2, the horn may be formed of one or more layers of fabric impregnated and coated with a phenolformaldehyde-type resin. The horn is provided with a handle 19 to facilitate manual handling thereof.

As illustrated in Figure 2, the interior wall of the horn is provided with a surface of a material having the aforementioned desired properties, the surface being shown as a coating 20 applied to the interior wall.

The coating comprises finely divided particles of electrically conductive material which are dispersed in a substantially nonconductive resin or plastic composition. In practice, it has been found that excellent results can be obtained by applying a lacquer-like composition comprising colloidal carbon, such as carbon black, and a vinyl-type resin, dissolved in a suitable solvent or thinner which is driven off by heat after application of the coating to expedite setting of the resin with the carbon particles dispersed therein. This lacquer-like composition may be applied by brushing, spraying, dipping or pouring the same on the interior surface or the interior and exterior surface of the horn.

In practicing the invention, it has been found that suitable coatings can be provided by compositions comprising ten parts by weight of solids consisting of carbon and resin and about ninety parts by weight of solvent or thinner. The amount of carbon and resin may vary between 1 to 9 parts by weight of carbon and 9 to 1 parts by weight of resin and totalling ten parts by weight carbon and resin.

It was found, that by varying the thickness of the coating and the carbon content of the coating, coatings could be provided having a surface resistance on the order of between .5 to 500 megohms per inch. Such coatings, when applied to the interior surface of the horn, were effective to greatly minimize the generation and accumulation of electrostatic charges.

Preferably, the coatings applied should have a surface resistance on the order of between about 1 to 10 megohms per inch and the over-all surface resistance of the coating measured from a point at the open end of the horn to a point at the closed end of the horn should be at least 10 megohms, whereby the horn is safe for use in the vicinity of high voltage electrical equipment.

As a specific example of practicing the invention, a lacquer-like composition was prepared by dissolving five parts by weight of a vinyl acetate-vinyl chloride copolymer resin in ninety parts by weight of methyl isobutyl ketone and then dispersing therein five parts by weight of colloidal carbon.

This composition was applied to the inner wall of a horn having a length of seventeen inches by pouring a quantity of the composition into the large end of the horn and centrifuging the horn with its small end extending radially outwardly while revolving the horn about its longitudinal axis to provide a relatively light coating thereon. The horn was placed in an oven for one hour in which a temperature of 225° F. was maintained, whereupon the solvent was driven off and a resin-like coating was provided.

The interior surface of the horn was found to have an average surface resistance of 1.8 megohms per inch and was found to have an average over-all resistance of 10.3 megohms.

The horn then was tested for electrostatic charge by discharging about 10 pounds of liquid carbon dioxide through the nozzle 18 at a rate of about .5 pound per second in an atmosphere having a relative humidity of 35%. It was found that very little charge was generated and that very little charge was accumulated. The operator conducting the discharge test grasped the handle 19 of the horn in one hand in the usual manner and did not experience any disagreeable shocks.

The test was repeated by mounting the cylinder and the horn on a platform insulated from the ground. Electrical measurements were taken and it was found that the electrostatic charge accumulated on the horn was 70 microcoulombs.

The last mentioned test was repeated with an uncoated horn of the same size and shape as the aforementioned coated horn and it was found that the electrostatic charge accumulated on the horn was 160 microcoulombs. These comparisons demonstrate that a coated horn minimizes the accumulated charge about 56%. Electrical measurements made during the discharge tests further indicated that the charge generated with a coated horn was much less than that generated with an uncoated horn.

The low value of the charge accumulated was further evidenced by the fact that upon discharge of carbon dioxide (under the conditions aforementioned and through a horn in accordance with the invention) in a dark, dry, warm room no corona effect was exhibited. A horn without the coating of the present invention exhibited a very powerful brilliant corona accompanied by crackling sounds and a smell of ozone and oxides of nitrogen.

By the term "accumulated charge" as used herein is meant the charge equal to the generated charge less the dissipated charge. This accumulated charge is of the smallest value when the charge generated is of a minimum value and a maximum of the generated charge is dissipated.

It is believed that in practicing the present invention the generated charge is minimized because the specific inductive capacity (dielectric constant) of the coating approximates that of carbon dioxide snow crystals. This belief is based on the generally accepted theory that one of the functions upon which the value of an electrostatic charge depends is the difference in the dielectric constants of two bodies coming in contact with each other. For example, two bodies of like material or materials having like dielectric constants should generate a minimum of charge, whereas two bodies of materials having greatly varying dielectric constants should generate a very substantial charge.

It has been found that a coating having a surface resistance on the order of about .5 to 500 megohms per inch establishes surface leakage adapted to effect substantial dissipation of the electrostatic charge generated to thereby minimize the value of the accumulated charge. It is believed that by reason of such leakage conductivity a substantial number of the electrons

forming the charge flow along the interior surface of the horn in the direction in which the carbon dioxide stream flows and recombine with the carbon dioxide snow crystals which have lost one or more electrons as the stream leaves the horn, thereby effecting substantial neutralization of the charge generated. While the coating is very slightly conductive in a sense, nevertheless it permits safe use of the horn in proximity to electrical installations of about 100,000 volts.

It was further found that the discharge of carbon dioxide at high pressure into the horn did not injure the coating. The coating did not exhibit any change in physical appearance and resistivity, and resistance measurements made before and after the discharge tests were very nearly the same. The coating was also washed with soap and warm water which had no effect thereon.

From the foregoing description, it will be seen that the present invention provides carbon dioxide snow forming horns which minimize the generation of electrostatic charges and increase the dissipation of such charges and, at the same time, can be used safely in the vicinity of a very high voltage electrical installations. The coating is readily applied to the horns and does not materially increase the cost of the horns. The coating will not chip, peel or flake and will resist the abrasive action of carbon dioxide snow particles. The coating can be readily applied to horns now in use, thereby conditioning the same to minimize the accumulation of electrostatic charges in the same manner as newly manufactured horns.

As various changes may be made in the details set forth herein, without departing from the spirit and scope of the invention and without sacrificing any of its advantages, it is to be understood that all matter herein is to be interpreted as illustrative and not in any limiting sense.

I claim:

1. A tubular shield in which carbon dioxide snow is formed including an inner wall provided with a surface of a material having a surface resistance on the order of between .5 and 500 megohms per inch, said shield being characterized in that dissipation of an electrostatic charge is effected without grounding said inner wall and that said shield is safe for use in the vicinity of high voltage installations.

2. A tubular shield in which carbon dioxide snow is formed including an inner wall provided with a surface of a material having a surface resistance on the order of between .5 and 500 megohms per inch and having a specific inductive capacity approximating that of carbon dioxide snow, said shield being characterized in that dissipation of an electrostatic charge is effected without grounding said inner wall and that said shield is safe for use in the vicinity of high voltage installations.

3. A tubular shield in which carbon dioxide snow is formed including an inner wall provided with a surface of a material having a surface resistance on the order of between .5 and 500 megohms per inch, said shield being characterized in that dissipation of an electrostatic charge is effected without grounding said inner wall and that said shield is safe for use in the vicinity of high voltage installations, said inner wall surface being of a length to provide an overall surface resistance of at least 10 megohms.

4. A tubular shield in which carbon dioxide snow is formed including an inner wall provided with a surface of a material comprising a vinyl-type resin and a sufficient quantity of colloidal carbon dispersed in said resin to give the material a surface resistance of between .5 and 500 megohms per inch.

5. A tubular shield in which carbon dioxide snow is formed including an inner wall provided with a surface of a material comprising in 10 parts by weight about 1 to 9 parts by weight of a vinyl-type resin and about 9 to 1 parts by weight of colloidal carbon dispersed in said resin, said material having a surface resistance on the order of between about .5 and 500 megohms per inch.

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