July 15, 1952 D. MAPES 2,603,299

ELECTROSTATIC CHARGE PROTECTED CARBON DIOXIDE DISPENSING SHIELD

Filed April 9, 1951

Fig. 1.

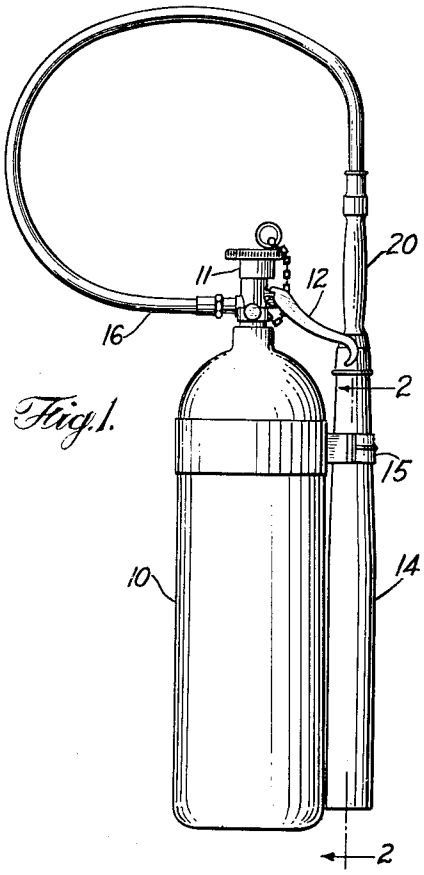


Fig. 2.

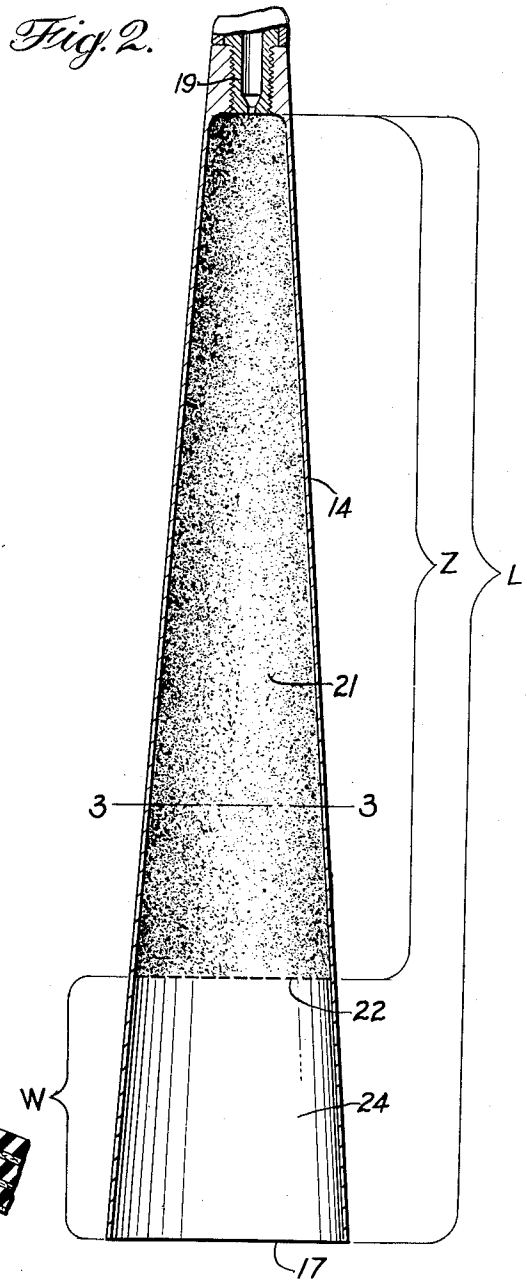
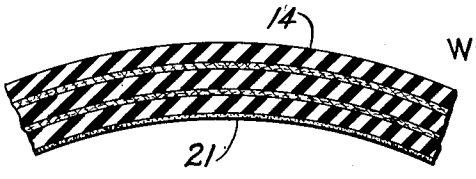


Fig. 3.



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ELECTROSTATIC CHARGE PROTECTED CARBON DIOXIDE DISPENSING SHIELD

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Application April 9, 1951, Serial No. 219,906

4 Claims. (Cl. 169—11)

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The present invention relates to shields or horns such as generally utilized in dispensing carbon dioxide for fire extinguishing purposes which shields are protected against the generation and/or accumulation of electrostatic charges thereon, and, more particularly, relates to such shields which are an improvement over the shield or horn disclosed in the co-pending application for United States Letters Patent of Marcel K. Newman, Serial No. 743,739, filed April 25, 1947, now Patent No. 2,569,490, dated October 2, 1951, and issued to my assignee.

In the aforementioned application, it is stated that high pressure liquid and/or gaseous carbon dioxide, when discharged through a nozzle surrounded by a shield or horn, is converted to a mixture of snow particles and gas. The carbon dioxide, upon leaving the nozzle, expands rapidly from a relatively high pressure to nearly atmospheric pressure to produce a considerable amount of snow, while the shield provides for further expansion of gaseous carbon dioxide to sufficiently reduce its forward velocity upon discharge from the shield to prevent substantial entrainment of air.

The shield generally is formed of dielectric material having an infinitesimal electrical conductivity which material can be said to be non-conductive in the sense that it is safe for use in the vicinity of high voltage installations. Due to the nature of this material, it has been found that, where the shield is not grounded as in the use thereof 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.

The aforementioned application proposes to protect the operator against such shocks by providing a tubular shield or horn, in which carbon dioxide snow is formed, wherein the inner wall is provided with a surface of a material having a surface resistance of a value to effect dissipation of electrostatic charges without grounding the shield and still maintaining the shield sufficiently non-conductive for safe use in the vicinity of high voltage installations. This is accomplished by providing such a surface on the

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inner wall of the shield from one end to the other.

It is believed that, by reason of such leakage conductivity of the applied surface, a substantial number of the electrons forming the charge flow along the interior surface of the shield in the direction of the expanding carbon dioxide stream and recombine with the carbon dioxide snow crystals which may have lost one or more electrons upon initial impact with the shield adjacent the nozzle, thereby effecting substantial neutralization or dissipation of the charge generated to minimize charge accumulation. It is also believed that the generation of charges is minimized because the specific inductive capacity (dielectric constant) of the applied surface approximates that of carbon dioxide snow crystals. Since a generally accepted theory is that one of the functions upon which the value of an electrostatic charge depends is the difference of the dielectric constants of two bodies coming in contact with each other, two bodies of materials having like dielectric constants should generate a minimum charge.

While shields constructed in accordance with the disclosure of the aforementioned application have been proven to be useful, it has now been discovered that such shields can be greatly improved insofar as their safe use is concerned.

Accordingly, the primary object of the present invention is to provide such shields which can be used with even greater safety in the vicinity of high voltage electrical installations under any conditions of relative humidity without sacrificing the effectiveness and which electrostatic charges are dissipated but in fact making it possible to increase the charge dissipating effectiveness.

Another object is to provide such improved shields without increase in cost.

A further object is to provide such improved shields which can be readily manufactured.

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 present invention, the

foregoing objects are accomplished by providing a tubular shield having an open end and an inlet at its opposite end for introducing carbon dioxide under pressure, the shield being constructed of dielectric material which normally is non-conductive in the sense that it has an infiinitesimal electrical conductivity and is safe for use in the vicinity of high voltage installations, and the shield being provided on its inner surface with a substantially continuous lamina of a material having a surface resistance of a value to effect dissipation of an electrostatic charge without grounding the inner wall; the present invention being characterized in that the lamina extends from adjacent the inlet to an annular zone spaced from the open end, but closer to the open end than to the inlet, to provide an inner wall surface band of dielectric material at the open end, whereby the electrostatic charge dissipating lamina is provided in the zone of most rapid extension of the carbon dioxide but does not constitute a hazard when using the shield in the vicinity of high voltage installations under any conditions of relative humidity.

A preferred embodiment of the invention has been chosen for purposes of illustration and description, and is shown in the accompanying drawing, forming a part of the specification, wherein:

Fig. 1 is an elevational view, illustrating a portable fire extinguisher provided with a shield or horn embodying the present invention.

Fig. 2 is an enlarged sectional view of the shield alone taken along the line 2—2 on Fig. 1, illustrating the inner wall of the shield and the location of the electrostatic charge dissipating lamina thereon.

Fig. 3 is a further enlarged fragmentary sectional view taken along the line 3—3 on Fig. 2, the thickness of the lamina shown being exaggerated.

Referring to the drawing in detail and more particularly to Fig. 1 thereof, 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 the extinguisher, a tubular 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 of the discharge head to the inlet end of the shield.

As shown more particularly in Fig. 2, the shield 14 has an open end 17 constituting an outlet for carbon dioxide discharged through the shield and has an inlet at its opposite end provided by a nozzle or orifice member 19 formed with an opening for introducing carbon dioxide to be expanded in the shield. The shield generally is formed of a resin or plastic material of the type having high dielectric strength and infinitesimal electrical conductivity. For example, as shown in Fig. 3, the shield may be formed of one or more layers of fabric impregnated and coated with a phenol-formaldehyde-type resin. A handle 20 is provided at the inlet end of the shield to facilitate manual handling thereof.

In accordance with the invention, as shown in Fig. 2, the inner wall surface of the shield is provided with a substantially continuous lamina 21 of an electrostatic charge dissipating material which extends from adjacent the nozzle 19 to an annular zone 22 (shown in broken lines) near the open end, but spaced therefrom, to provide an inner wall surface band 24 of the non-conductive material of which the shield is formed. By so setting back the charge dissipating lamina, the lamina, which is more conductive than the shield material, does not constitute a hazard when using the shield in the vicinity of high voltage installations. Also, the band 24, by being less conductive than the lamina, increases the over-all surface resistance of the inner wall surface measured from the open end 17 to the opposite end, this characteristic being an advantage as will be described hereinater.

The lamina 21 may be applied as a coating of a material which when dried and/or cured has a surface resistance of about .5 to about 500 megohms per inch under any conditions of relative humidity. Such a material, as described in the aforementioned application, generally comprises colloidal carbon such as carbon black and a vinyl-type resin, dissolved in suitable solvent or thinner which is driven off during the drying or curing of the coating. Ten parts by weight of carbon and resin may contain between 1 to 9 parts by weight of carbon and 9 to 1 parts by weight of resin. It will be appreciated that other compositions or materials having similar surface conductivities or resistances may be utilized in practicing the present invention. The thickness of the lamina or coating may be varied within suitable limits to vary the conductivity or surface resistance thereof. A coating having a thickness of about .0001 inches has been found to be effective.

Usually, the discharge rate of carbon dioxide through the nozzle is increased with the size of the extinguisher, that is, the weight of the carbon dioxide stored in the container, and the over-all length L of the shield is increased with the discharge rate to provide for sufficient expansion of the carbon dioxide within the shield to reduce its forward velocity upon leaving the shield to a value which will not cause substantial entrainment of air. It is generally believed that the length of the zone in which electrostatic charges are generated is dependent upon the discharge rate and the lineal velocity of the snow particles adjacent the nozzle and the velocity of the expanding gaseous carbon dioxide propelling these particles through the shield. Thus, it has been found desirable to provide the coating in the zone where the majority of electrostatic charges are produced and forwardly thereof to conduct the charges picked up by the shield back into the mixture of gaseous carbon dioxide and snow particles whereby the generated charges are substantially dissipated. It is also believed that the value of the charge generated is not a function of the over-all length of the shield, hence the length Z of the zone in which the coating is provided is a function of the discharge rate rather than a function of the length of the shield.

Based on observations, it is believed, for example, that for a certain discharge rate requiring a shield of about fifteen inches in length a coated zone having a length of about ten inches is adapted to effectively dissipate the charges; for discharge rates requiring a twenty inch shield a fifteen inch coated zone is sufficient; and for a thirty inch shield a twenty inch coated zone is sufficient. This leaves considerable leeway in adjusting the width W of the uncoated band 24.

In practice, it has been found that the objects of the invention can be accomplished by providing a band 24 having a minimum width W of about one inch but not exceeding half the length L of the shield, except possibly in extreme-

ly long shields. For shields having a length between about fifteen and twenty inches, the band may vary in width between about one and five inches to provide the optimum over-all resistance characteristics while maintaining the length Z of the coated zone of a value to effectively dissipate the generated charges. For shields having a length of about thirty inches, the width of the band may vary between one and ten inches to provide a wide range of over-all resistance characteristics. In most applications, it is desirable that the band have a width of at least about 20% of the over-all length of the shield to set back the coating a sufficient distance to guard against direct contact of live high voltage current conductors therewith.

In this manner, the lamina is provided in the zone in which the most violent and rapid expansion of carbon dioxide takes place and in which zone the major generation of electrostatic charges occurs, so that such charges are effectively dissipated. Since the forward end of the zone in which the lamina is provided is spaced from the open end of the shield, it has been found that the lamina may be slightly more conductive to enhance its charge dissipating effectiveness without unduly reducing the over-all surface resistance of the shield measure from end to end and without making the use of the shield in the vicinity of high voltage installations hazardous. Thus by utilizing the present invention, a shield may be provided with a lamina of high charge dissipating effectiveness and a safe over-all surface resistance, the exact width of the band and the location of the lamina usually being governed by the length of the shield and the discharge characteristics of the nozzle 19 at the inlet.

In each instance, it is desirable that the lamina be sufficiently conductive at low relative humidities where electrostatic charge generation is more pronounced to effectively dissipate such charges and yet be sufficiently non-conductive to effectively resist high voltages under conditions of extremely high relative humidity.

A shield having an over-all surface resistance of at least twenty-five megohms measured under conditions of extremely high relative humidity (that is, between about 70% and nearly 100%) is considered acceptable and safe for use according to present standards under any conditions of humidity in the vicinity of exposed conductors carrying electrical current at potentials of about 125,000 volts.

In order to illustrate the present invention more specifically, a coating composition was prepared by dissolving approximately five parts by weight of 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. Two clean shields constructed of the materials specified herein and having an over-all length of seventeen inches were masked at the open end to cover an annular band at the inner wall surface thereof having a width of about four and one-half inches. With the nozzle removed and the inlet end closed, the composition was poured into the shields, while in upright position, up to the lower margin of the masked band. The composition was then withdrawn by opening the inlet end, and the shields were centrifuged while in a position to expel the excess coating through the inlet end opening and while being rotated about their longitudinal axes. The shields were placed in an oven for one hour in which a temperature of about 225° F. was maintained, whereupon the solvent of the composition was driven off and a resin-like film, coating or lamina was provided. The masking material was then removed.

These shields were humidified by supporting the same over water in a large crock and placing the crock in an oven for seventy-two hours in which a temperature of about 90° F. was maintained to produce an extremely high relative humidity. The resistance of the shields was determined on galvanometer equipment using, as one electrode, the inlet opening of the shields, and, as the other electrode, a spot at the open end of the shields. Contact to this spot was made by the use of a piece of metal foil which was clamped to the surface of the spot, the metal foil being approximately one-eighth of an inch from the very end of the shields. The over-all resistance of these shields was found to be as follows:

Shield	Resistance
	Megohms
No. 1	28.0
No. 2	29.0

Three shields were prepared and tested in the foregoing manner having an uncoated band of three inches in width, and were found to have an average over-all resistance of 19.6 megohms. This demonstrates the effect of width of the band on over-all surface resistance.

Three shields were prepared and tested at relatively low humidity having an uncoated band of four and one-half inches in width, and were found to have an average over-all resistance of about 500 megohms, thus demonstrating the effect of humidity on resistance.

All of these shields, upon being subjected to a carbon dioxide discharge test at low humidities, indicated that the coating as applied herein dissipated more than 50% of the charge normally accumulated on uncoated shields, in spite of the relatively wide uncoated band at the open end of the shield.

From the foregoing description, it will be seen that the present invention provides a greatly improved shield for dispensing carbon dioxide which meets rigid safety requirements, is simple and practical in construction and is economical to manufacture.

As various changes may be made in the form, construction and arrangement of the parts 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 having an open end and an inlet at the opposite end for introducing carbon dioxide under pressure, said shield being constructed of dielectric material which normally is non-conductive in the sense that it is safe for use in the vicinity of high voltage installations, and said shield being provided on its inner wall surface with a substantially continuous lamina of a material having a surface resistance of a value to effect dissipation of an electrostatic charge without grounding the inner wall, said lamina extending from adjacent said inlet to an annular zone spaced from said open end but closer to said open end than to said inlet to provide an

inner wall surface band of dielectric material at said open end, whereby the electrostatic charge dissipating lamina does not constitute a hazard when using said shield in the vicinity of high voltage installations, said shield having an over-all surface resistance of at least twenty-five megohms measured from said open end to a point adjacent said inlet under conditions of extremely high relative humidity.

2. A shield according to claim 1, wherein said band has a minimum width of about one inch.

3. A shield according to claim 1, wherein said band has a width of at least about 20% of the over-all length of said shield.

4. A shield according to claim 1, wherein said band has a width of at least about 20% of the over-all length of said shield and said lamina has a surface resistance of between .5 and 500 megohms per inch under any conditions of relative humidity.

DANIEL MAPES.

No references cited.