March 29, 1955 F. A. LOVING, JR 2,704,978

ELECTRICALLY FIRED GAS EXPANSION BLASTING DEVICE

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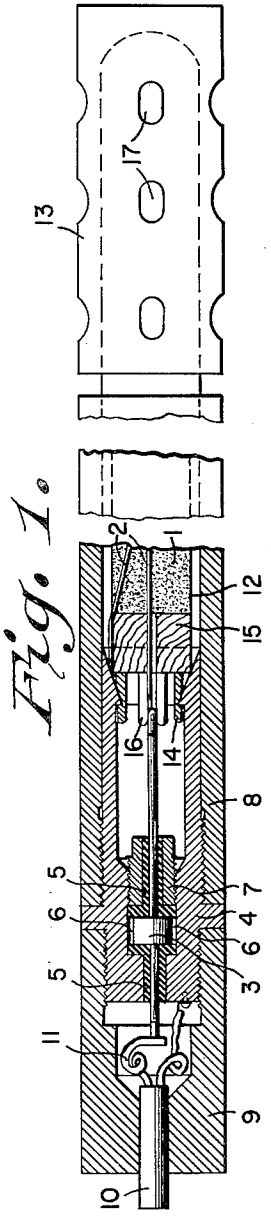


Fig. 1.

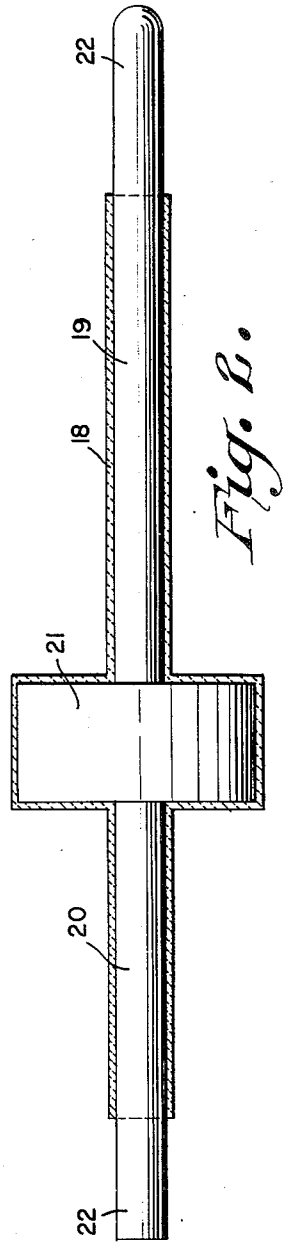


Fig. 2.

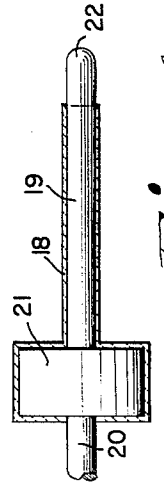


Fig. 4.

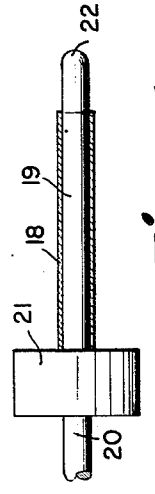


Fig. 3.

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ELECTRICALLY FIRED GAS EXPANSION BLASTING DEVICE

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1 Claim. (Cl. 102—25)

This invention relates to an electrically fired gas expansion blasting device. More specifically it is concerned with an improved electrode for such a device.

Electrically fired gas expansion blasting devices are known to the trade. A typical structure is described in U. S. Patent 2,207,191. It consists essentially of a head section, including insulated electrodes, a pressure build-up section adapted to accept a replaceable gas generating charge, and a gas discharge venting section. In the conventional structure, the head and the discharge venting sections are at opposite ends of the pressure build-up section. The pressure build-up section and discharge venting section are separated by valving or preferably by a frangible rupture disc. When readied for firing, the apparatus is positioned with its discharge venting section within a bore hole of suitable diameter. The gas generating composition is then fired by means of a heating element to which current is supplied through the electrodes. Usually the metal shell of the device constitutes one such electrode. The other is cored to the heating element through insulators, generally of the fiber washer type. The severe operating conditions, i. e., high temperature, violent mechanical shock, intimate contact with corrosive gases, moisture generation and condensation and the like, have been observed to promote current leakage in the electrical circuit. Such leakage results in hang fires and is therefore a hazard under operating conditions.

In accordance with the present invention, it has been found that such electrical leakage can be greatly reduced by applying to at least the pressure finger of the cored electrode a ribbon coating of glazed, non-porous, vitreous enamel extending along the pressure finger a distance, in each direction from its point of protrusion into the pressure section, of at least about five times the thickness of the fiber insulation of the cored electrode.

The invention will be more fully understood by reference to the drawings.

Figure 1 is an elevation partly in cross-section of a typical electrically fired gas expansion device;

Figure 2 is a sectional elevation of an electrode suitable for use in the device of Figure 1, bearing a continuous coating of glazed, non-porous, vitreous enamel along its pressure finger, its firing head finger and around its retaining ring;

Figure 3 is a sectional elevation of an electrode containing a ribbon of glazed, non-porous, vitreous enamel along its pressure finger;

Figure 4 is a sectional elevation of an electrode having a continuous coating of glazed, non-porous, vitreous enamel along its pressure finger and also along the pressure face, side and the sealing face of its retaining ring.

Referring to Figure 1, the device is fired by igniting the gas generating charge, **1**. This is accomplished by supplying current to filament **2**, through cored electrode **3** and metal electrode housing **4**. The cored electrode is insulated from its metal housing by fiber washers **5** and air space **6**. The electrode and washers are retained within the cored electrode housing by retaining nut **7**. The cored electrode housing acts as a connecting sleeve for the pressure build-up section wall **8** and the firing head **9**. Lead wire **10**, containing insulated

cores **11** connect the device to an external source of current. The container **12** for the gas generating charge and its filament is normally loaded through the discharge end of the pressure build-up section after removal of the gas discharge venting section **13**. The gas generating charge container is held in place by metal retaining clips **14** which act to make electrical connection of one end of the filament to the electrode housing. The retaining clips are attached to the insulating container plug **15**, as is socket **16** which makes electrical connection between the other end of the filament and the cored electrode. Alternatively the retaining clip may be integral with and of the same material as plug **15**. Employing such construction, the electrical connection with the filament is made by pinching its projecting end between the plug and the electrode housing.

After the gas generating container is loaded into the device, the discharge end of the pressure build-up section is sealed with a frangible disc (not shown). This disc is held in place by the gas discharge venting section which is normally threaded to the pressure build-up section. Upon firing, a pressure build-up occurs until the rupture pressure of the frangible disc is reached. Thereafter the gas expands into the gas discharge venting section and escapes through ports **17**.

Figures 2, 3 and 4 are enlarged sectional elevations of the cored electrode **3** each bearing a vitreous enamel coating **18**. Figure 2 represents the preferred embodiment wherein the enamel coating is applied along the pressure finger **19**, the firing head finger **20** and retaining ring **21**. Suitable insulation free contact areas **22** are provided at each end of the device for electrical contact purposes. It is not essential that the coating be as extensive as that in Figure 2. A ribbon band along the pressure finger acts to reduce current leakage. It is preferable to have it extend a distance, in each direction from the point of protrusion into the pressure section, of at least about five times the thickness of the fiber washer insulator. The structure of Figure 4 offers protection over both the pressure finger and the retaining flange. Since the discharge of the device tends to seal the firing head section from the pressure build-up section at the retaining flange, little or no enamel is necessary along the firing head finger.

By the term vitreous enamel as used herein is meant a fused silicate coating. It may be applied by conventional methods to the cored electrode by either the wet or dry process. The enamel should have a high glazing temperature. Enamels with glazing temperatures above about 1400° F. are particularly effective. A glazing temperature within the range of about 1400 to about 1600° F. is preferred. The normal glazing period of from about 1 to about 15 minutes in a dust free atmosphere under the usual uniform heating and cooling conditions provides a satisfactory coating.

The thickness of the coating should be about at least ½ mil. It should not exceed about 4 mils. A coating which is both non-porous and sufficiently flexible to be shock resistant is of a thickness between the limits of about 2 to 3 mils. Such a coating may be applied in a single or multiple firing.

Various conventional components and additives in the nature of refractories, fluxes, opacifiers, colors, floating agents and peptizers may be included within the coating composition. The cored electrode proper may be of any metal. Preferably it is of steel because of the combined properties of strength, conductivity and the strength of its bond to enamel. Copper, cast iron and various other metals having suitable electrical conductivity may also be used.

The material employed as the gas generating charge may vary widely. It may be any liquid or solid substance or any combination of substances which, upon the application of heat, will generate gaseous products. Liquid or solid carbon dioxide, liquid oxygen, ammonium nitrate and the like are typical of such materials. How-

ever the electrode of the present invention is particularly valuable where one product of the gas generation is water or water vapor.

Many modifications will be apparent to those skilled in the art as a result of the foregoing disclosure without a departure from the inventive concept.

What is claimed is:

In an improved gas-expansion blasting device including an electrode-housing at one end, an elongated terminal electrode having a central portion of enlarged diameter with respect to its ends mounted in said housing, and a washer electrically insulating said electrode from said housing, said electrode being uniformly coated over its entire surface except for a short contact section at each of said ends with a ½ to 3 mils thickness of a non-porous, glazed, vitreous enamel which has a glazing temperature of at least 1400° F.

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