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(54) EXPLOSION-SUPPRESSIVE FILLER MASSES

(71) We, EXPLOSAFE S.A., a Swiss body corporate of 11, Rue d'Italie, P.O. Box 228, 1211 Geneva 3, Switzerland, do hereby declare the invention, for which we pray that a patent may be granted to us, and the method by which it is to be performed, to be particularly described in and by the following statement:—

The present invention relates to the production of filler masses for use as explosion-suppressive fillings in containers for fuels and other explosive fluids.

British Patent Specification No. 1,131,687 describes explosion-suppressive filler masses formed of layers of metal netting, the netting being composed of interconnected metal ribbons which are misaligned with the general plane of the netting. Such netting can be produced by metal-expanding procedures, employing metal expander machines of the reciprocating type, or of the rotary type. Both types of machine can produce expanded metal which has diamond-shape mesh openings and is composed of interconnected mesh strands which incline relative to the general plane of the metal.

We have found that the filler masses formed of multiple layers of expanded metal are often of unduly high bulk density. In particular when, in the course of an **economical manufacturing method,** coiled bales are formed by coiling expanded aluminum foil of the mesh and strand dimensions specified in the above-mentioned British patent 1,131,687 the bales obtained typically have a bulk density somewhat in excess of the value of 52.4 kilogramme per cubic metre which is recommended in the British patent. It is desirable that the bulk density should be kept low so as to minimize the weight added by the explosion-suppressive filling.

Further, the filler masses tend to be of uncontrolled variable density as they are susceptible to compaction under pressure, so that the eventual bulk density may tend to vary as a result of pressures applied to the mass during manufacture or in subsequent handling or in the course of placing and positioning the masses within the fuel or other containers.

It has now been found that filler masses which have stabilized reduced bulk densities, can be obtained by arranging the successive layers of expanded metal in such fashion that the inclining mesh strands in each layer are directed oppositely to the mesh strands in the adjacent layers. Whereas if similar layers of expanded metal are laid directly one on top of another with the edges of the successive layers in register, the layers tend to nest closely together, to a degree dependent on the pressures applied to the masses, when the layers are arranged so that the mesh strands in adjacent layers are oppositely directed, the oppositely inclining mesh strands engage together in such a manner that the layers are more widely spaced, giving a more springy, resilient filler mass of reduced bulk density, which does not tend to become permanently compacted.

Further, we have found that in the process of composing or compiling the expanded metal layers together into a multiple layer mass, the successive layers may become slightly displaced one from another in the same transverse direction as a result of the nesting mentioned above, with the result that the completed filler mass has sloped end faces. For example, where rotary slit expanded metal is reeled up lengthwise to form a coiled bale, the successive turns of metal become displaced transversely in the direction of the coil axis, so that the coiled bale has a coned projecting face at one end and a cone-shaped recess at the other.

The usual fuel containers typically have flat walls, at least at the top and bottom, and to give satisfactory explosion-suppressive protection it may be required that the filler masses should substantially completely fill the interior of the container without leaving empty voids in which an explosion may occur. It will be appreciated, therefore, that filler masses having coned or other sloped ends cannot satisfactorily be used directly as fillings for the containers without mismatching resulting between the profile of the filler mass and of the interior of the container, leaving unprotected voids between the container walls and the filler mass.

In accordance with the present invention, there is provided a method of forming an explosion-suppressive mass composed of layers of expanded metal each consisting of mesh strands each inclined at the same angle to the general plane of the layer, in which the successive layers are arranged so that the strands of each layer are inclined oppositely to the strands in each adjacent layer.

The invention also provides an explosion suppressive mass composed of layers of expanded metal each consisting of mesh strands each inclined at the same angle to the general plane of the layer, the strands of each layer being inclined oppositely to the strands in the adjacent layers.

Where the filler mass is formed as a coiled bale by reeling up a continuous length of the expanded metal, the desired arrangement of the layers can be obtained by interleaving the feed of the metal with an auxiliary length of expanded metal from an auxiliary supply, the metal of the auxiliary length having is strands oppositely inclined to the strands in the main length.

The auxiliary length may be provided from a previously wound coil of the expanded metal which is then turned end over end before feeding from the coil in overlying relationship with the main expanded metal length.

The desired orientation of the mesh strands can also be obtained by fan-folding a continuous length of the expanded metal along fold lines extending parallel to the direction in which the mesh strands are inclined, that is to say transversely of the length in the case of rotary slit material, or longitudinally of the length in the case of expanded metal supplied from a reciprocating type expander machine. A similar result can be achieved by severing the expanded metal into uniform pieces, and inverting alternate pieces of turning them in their plane so as to give the desired mesh strand orientation before starting the pieces one on the other to form a multiple layer mass.

Methods in accordance with the present invention will now be described in greater detail, by way of example only, with reference to the accompanying drawings in which:

Figure 1 illustrates a method for forming expanded metal into a coiled bale;

Figure 2 shows a cross-section on the line II—II of Figure 1;

Figure 3 illustrates a fan-folding method;

Figure 4 illustrates a stacking method; and

Figure 5 shows a fuel container having an explosion-suppressive filling.

Referring to Figure 1, this shows a continuous length 10 of expanded metal supplied from an expander machine which expands rotary slit metal, such as that described in our British Patent Applications 36391/76 and 36392/76 (cognate). The metal 10 is reeled into a coiled bale 11 on a spindle 12. As can be seen in Figure 2, the metal 10 is composed of interconnected flat metal strands 13 which are inclined transversely at the same angle to the general plane of the metal length 10.

A secondary expanded metal length 14 of similar expanded metal mesh is interleaved with the main length 10 as it is wound on the spindle 11. The secondary length 14 is supplied from a precoiled auxiliary supply reel 15 rotatably supported above the main length 10. As can be seen in Figure 2 the mesh of the secondary length 14 is orientated so that its mesh strands 16 are inclined transversely oppositely with respect to the strands 13 of the main length 10.

Hence, in the completed bale 11, the strands of adjacent layers of mesh are transversely oppositely inclined, as illustrated in Figure 2, where there is shown in broken lines the orientation of the strands 17 constituting the next turn of the main length 10 of mesh on the bale.

The auxiliary supply reel 15 may be prewound from the main length 10 from the expander machine, the reel obtained then being turned end over end so that when the secondary length 14 is uncoiled from it, it will present itself with its mesh strands 16 oppositely inclined to those of the main length.

Alternatively, two separate expander machines operating on rotary slit metal could be used, one supplying the main metal length 10, and the other the secondary length 14, with the expander arms of one machine being counter-inclined as compared with the other machine so as to provide output meshes with mutually oppositely inclining strands.

As shown in Figure 1, the superimposed metal lengths 10 and 14 may be severed longitudinally before being wound up, employing upper and lower sets of co-operating, counter-rotating cutter discs 18, so as to provide coiled-up segments 11a of shorter length for matching the interior dimensions of fuel or other containers into which the segments are to be fitted as explosion-suppressive fillings.

If, contrary to the invention, the interleaving of the secondary length 14 is omitted, and successive turns of the main length 10 are laid directly one on another, the expanded metal layers tend to become nested closely together, with the faces of the mesh strands in close alignment. This leads to a greater bulk density for the completed filler mass. Further, even though the successive layers are laid with their edges initially in register, the layers become displaced transversely over one another as a result of the nesting of the inclining mesh, resulting in the coiled bale having a coned face at one end and a coned recess at the other. As can be seen from Figure 2, the interleaving of the secondary length 14 increases the effective spacing between the layers of expanded metal, and there is no tendency for the layers to nest together. Employing the interleaving procedure described above, there is obtained a coiled bale with a bulk density about two-thirds of that obtained when the interleaving is omitted.

Figure 3 illustrates fan-folding a continuous length 19 of expanded metal having its mesh strands inclining transversely of the direction of the length, similar to the expanded metal length 10 described above. The length 19 is folded along regularly spaced alternating transverse fold lines 20 to produce a multiple layer rectangular section mass 21. The alternate layers in the mass 21 are inverted with respect to one another as a result of the fan-folding, whereby the mesh strands in each layer are oppositely inclined with respect to the strands in the adjacent layers.

A further procedure is illustrated in Figure 4, where a web of expanded metal 22, again with its mesh strands inclining transversely of the direction of web, similar to the length 10 described above in connection with Figure 1, is severed into uniform lengths along transverse lines of cut 23, and the rectangular sections thus obtained are stacked one on top of the other to form a rectangular mass 24. Every other section is turned about so that its mesh strands incline oppositely with respect to the strands of the preceding section in the mass 24. In order to obtain the desired orientation of the mesh strands, the said alternate sections are rotated through 180°, either by inverting them about the transverse axis 25, as indicated by the arrow 26, or by turning them in their plane about the normal axis 27, as indicated by the arrow 28.

The detailed description above refers to expanded metal, such as rotary slit expanded metal, in which the mesh strands are inclined transversely of the expanded metal length. When using expanded metal in which the mesh strands are inclined longitudinally of the length, such as are obtained from reciprocating metal-expanding machines, multiple layer masses having strands in adjacent layers oppositely inclined can be obtained by using the appropriate orientation of the successive layers.

The interleaving method described above with reference to Figures 1 and 2 may be used, or the method of severing into sections and rotating alternate sections through 180° in their plane as described above with reference to the arrow 28 in Figure 4. Longitudinal fan-folding as shown in Figure 3 cannot, however, be used, nor can the method of rotating alternate severed sections about their transverse axes, as indicated by the arrow 26 in Figure 4, since these methods leave the strands of adjacent layers inclined parallel to one another. With expanded metal of suitably large width, a mass with the desired opposite inclination of strands can be obtained by severing the web transversely and then fan-folding the severed sections along fold lines extending longitudinally of the original length.

A further procedure would be to employ a method generally similar to that described with reference to Figure 4, but to invert alternate sections by turning them through 180° about axes extending longitudinally of the direction of feed.

By arranging the layers of expanded metal so that the mesh strands in adjacent layers are oppositely inclined, the interengagement of the oppositely inclining strands stabilizes the mass against lateral slippage of the layers, which could lead to the mass becoming distorted in shape either during the manufacturing procedure or subsequently. This interengagement also prevents the layers from nesting closely together and serves to space the material of adjacent layers further apart. Thus, the overall density is reduced as compared with masses in which all the mesh strands are inclined parallel to one another, and this can give a significant reduction in the weight of material which is required to fill a container of given volume.

The filler masses which are obtained can be used directly as fillers for the interiors of fuel containers or other containers for inflammable or explosive fluids, or may be trimmed to an appropriate size or shape for matching the interiors of the containers.

The coiled segments 11a shown in Figure 1 may, for example, be used directly as fillers for conventional cylindrical fuel cans e.g. gasoline cans.

Figure 5 shows a metal gasoline can body 29 in the form of a cylindrical container having a pouring opening equipped with a pouring spout 31. The interior of the body is filled with a coiled segment 11a of the expanded metal. In manufacture of the can, the segment 11a is inserted into the can prior to applying the lid 32 which closes the top of the container 10.

WHAT WE CLAIM IS:—

1. A method of forming an explosion-suppressive mass composed of layers of expanded metal each consisting of mesh strands each inclined at the same angle to the general plane of the layer, in which

successive layers are arranged so that the strands of each layer are inclined oppositely to the strands in each adjacent layer.

2. A method according to claim 1 comprising coiling a length of expanded metal into a bale and interleaving the length prior to coiling with a secondary layer of expanded metal having its mesh strands oppositely inclined to the strands of the first-mentioned length.

3. A method according to claim 1 comprising severing a continuous length of expanded metal into sections and rotating alternate sections through 180° in their own plane prior to stacking the sections one on another.

4. A method according to claim 1, 2 or 3 in which the metal is reciprocating-cut expanded metal.

5. A method according to claim 1, 2, or 3 in which the metal is rotary slit expanded metal.

6. A method according to claim 5 in which a continuous length of the metal is fan-folded about transverse lines.

7. A method according to claim 5 in which a continuous length of the metal is severed transversely into sections and each alternate section is rotated about a transverse axis through 180° before stacking the sections one on another.

8. A method of forming an explosion-suppressive mass substantially as described herein with reference to Figures 1 and 2, Figure 3, or Figure 4 of the accompanying drawings.

9. An explosion-suppressive mass comprising layers of expanded metal each consisting of mesh strands each inclined at the same angle to the general plane of the layer, the strands of each layer being inclined oppositely to the strands in the adjacent layers.

10. A mass as claimed in claim 9 constituted by two interleaved expanded metal layers coiled into a cylindrical bale.

11. A mass as claimed in claim 9 comprising expanded metal pieces of similar shape stacked one on another with the strands in each piece disposed in selected orientation relative to the strands of the adjacent pieces.

12. A mass as claimed in claim 9 and substantially as described herein and as shown in Figure 1, 3, or 4 of the accompanying drawings.

13. A container for liquids having an explosion-suppressive mass as claimed in any of claims 9 to 12.

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1584955 COMPLETE SPECIFICATION

2 SHEETS *This drawing is a reproduction of the Original on a reduced scale*

Sheet 1

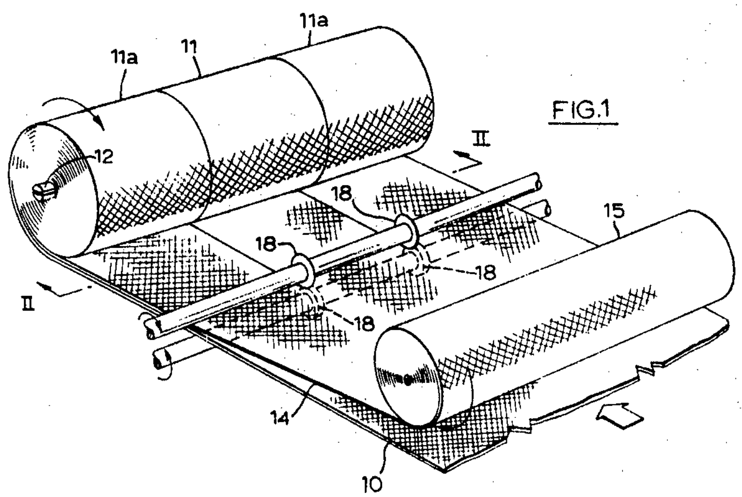

FIG.1

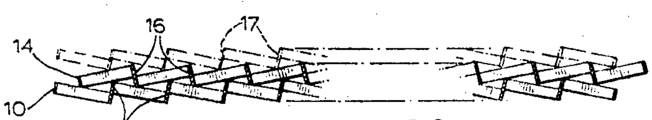

FIG.2

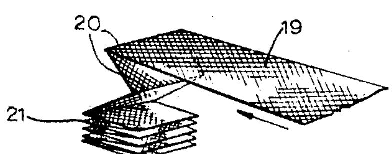

FIG.3

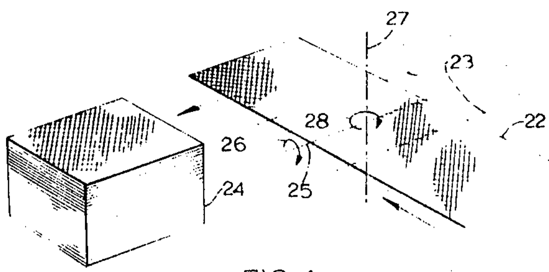

FIG.4

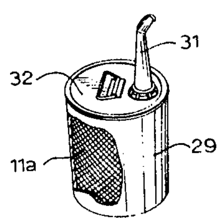

FIG.5