May 11, 1943. H. G. PILLSBURY ET AL 2,318,967

WALL STRUCTURE

Filed Jan. 19, 1942

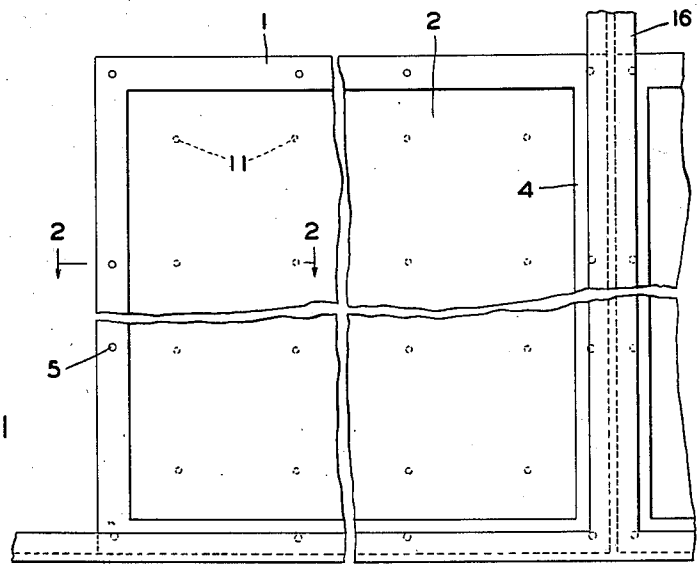


FIG.-1

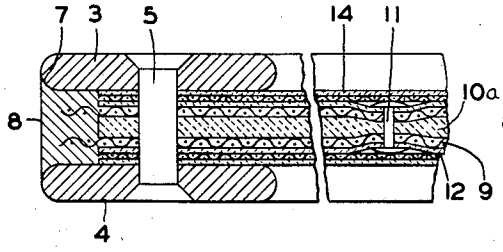


FIG.-2

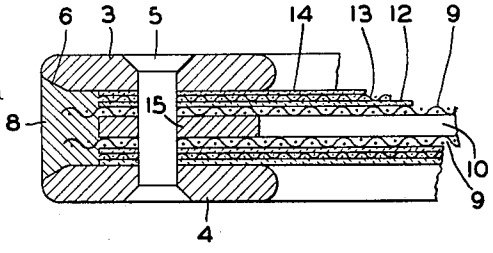


FIG.-3

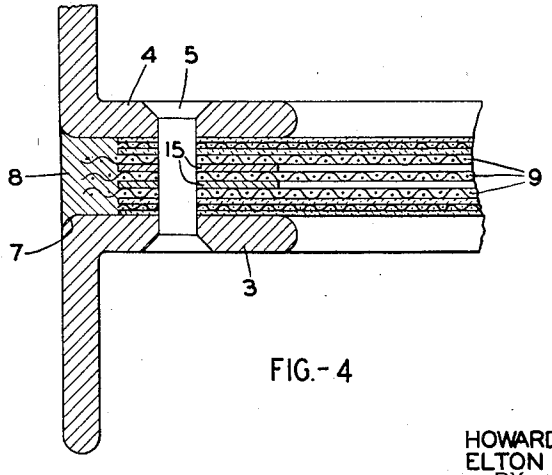


FIG.-4

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WALL STRUCTURE

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Application January 19, 1942, Serial No. 427,262

3 Claims. (Cl. 160—179)

This invention relates to panels such as are used in the construction of walls designed to enclose chambers where fire or explosions are likely to occur, for example, the walls of rooms or chambers in munitions factories, chemical plants, plants engaged in the production of metallic powders which unite violently with oxygen, chambers where powders of various kinds are stored or handled, or any room or chamber where materials of this kind are manufactured, stored or handled, or where there is any desire to safeguard against explosion produced in any way, as by the intrusion of bombs or the like. The invention is an improvement upon that illustrated, described and claimed in our prior application for Wall and building structure, filed March 27, 1941, Serial No. 385,403, to which reference may be had where necessary or desirable.

The object of the present invention is to provide a very simple form of wall panel for the purpose, and more particularly, a wall panel which can be made up in unit form and thus, by selection and arrangement of panels of the proper unit sizes, may be used to form a wall of any dimensions, and which panel is of simple form, is or may be made fireproof and flameproof, which is shatterproof and by yielding under pressure serves as a safety valve in case of explosion, and as a barricade to resist penetration of flying fragments to an adjoining room or chamber, and which also serves as an efficient insulator against heat and sound and may be made the base upon which any finish may be applied, either as a safety precaution or to improve the appearance.

Further objects of the invention are in part obvious and in part will appear more in detail hereinafter.

In the drawing, Fig. 1 represents an elevation of a portion of a wall made of panels constructed according to our invention; Fig. 2 is a detail section, on a larger scale, on the line 2—2, Fig. 1; Fig. 3 is a similar cross section, illustrating a modification; and Fig. 4 is another similar section illustrating still another modification.

Munitions factories where explosives are manufactured, or buildings in which explosives are stored or handled, or where other materials or powders likely to produce violent combustion or explosions are made, stored or handled, are usually constructed from the standpoint of confining the effects of a fire or explosion to a single chamber, not only for the purpose of preventing the fire or explosion itself from being communicated to combustibles in an adjoining chamber, but also to prevent damage to property or to persons in adjoining chambers, either by the advance of flame into the adjoining chamber, or by the propulsion of metal fragments or missiles thereinto as the result of the explosion. Thus, it is common to plan such buildings in such a way that the force of the explosion is dissipated more readily downwardly into the earth, upwardly and freely through the roof or through an outside wall of the chamber into the outside atmosphere, the inner walls which separate the chamber from adjoining chambers or hallways being designed to withstand the effects of the fire or explosion or at least to prevent it from entering an adjoining chamber.

The panel forming the subject matter of the present invention is designed more particularly for use on such interior walls separating the chamber in which the fire or explosion is likely to occur from adjoining chambers or spaces. To that end the panel is so constructed that in the event of an explosion it will yield to a reasonable degree without actual rupture or fracture, so that in the majority of cases, and at least in those instances of relatively light explosions, the yield of the panel will leave it imperforate as a whole. Nevertheless, the panel is still so formed that if the explosive force is so great as to rupture it, it ruptures without shattering or the production of flying fragments, such as would occur in the case of a panel made of glass, rigid plastic, or readily frangible, nonyielding material. Also, our improved panel is so formed as to be sound insulating, heat insulating and of a nature which will furnish a proper basis for the application of paint, enamel or other surface finishing materials, so that a wall made in accordance with our invention presents a neat or pleasing appearance, and may be made smooth to prevent it from collecting explosive dust or powder.

Each panel made according to our invention comprises an outer rigid frame 1 in which are secured the edges of the various sheets or layers of material forming the yieldable screen member or web 2. This web, as will appear more fully hereafter, consists of a number of layers of material applied to each other in pile or laminated form, although in use the sheets lie in a vertical plane and are piled side by side horizontally instead of on top of each other vertically, as will be understood.

The frame 1 may be of any suitable form for supporting the edges of the web sheets. In the drawing, for purposes of illustration, the frame is shown as comprising inner and outer members 3, 4 of identical form, each made of four pieces

of steel or other metal of suitable cross section, such as channels, or the angle irons shown in Fig. 4, or the flat strips or bars of metal shown in Fig. 1. The metal pieces are welded at their ends to form the frame corners, the two members **3**, **4** being placed one on each outer surface of the pile of web sheets, and the two frame members being suitably secured together at suitable intervals by rivets **5** or other equivalent fastening devices. The securing operation is performed while the frame members are squeezed toward each other under pressure and when it is accomplished the edges of the sheets are very firmly held or secured in the frame members not only by the gripping or clamping effect of the frame members themselves, but by the hold of the rivets where they pass through the web sheets. However, to more firmly secure the web in the frame other securing means may be employed, such for example as that form illustrated, described and claimed in a prior application of Howard G. Pillsbury for Panel securing means, filed April 19, 1941, Serial No. 389,275. That is to say, the outer edges of the frame members **3**, **4** may be flared or curved outwardly as at **6**, Fig. 3, or 7, Fig. 4, so that the edges of the finished panel present outwardly a recess which may be filled with a mass **8** of self-hardening material, such as a cement, molten lead or the like which surrounds and encloses, penetrates and becomes practically integral with the outer edges of the perforated screen sheets of the web, and which mass of material, when hardened, becomes an anchor solidly holding the screen web in the frame and preventing its escape therefrom.

The pile of sheets forming the web includes a plurality (two, three or more) of sheets **9** of foraminous or perforated metal of any suitable form to be yieldable within reasonable limits. Wire screen made of steel is suitable for the purpose. Stainless steel may be used, but is necessarily more expensive. A wire screen made of fairly strong steel wire, either galvanized or ungalvanized, may be employed. One screen which we have found suitable for the purpose is made of wire having a tensile strength of the order of 100,000 pounds per square inch, with the wires having a diameter of .063 inch and spaced 6 wires to the inch in the fabric. But wire of any size and strength suitable for the purpose may be employed. The particular wire mesh just described is considerably heavier than that used for ordinary window screens. The two layers of this heavy wire may be spaced any suitable distance apart, usually from ⅛ to ¼ or ⅜ of an inch. As more layers are used the spacing may be reduced to avoid unnecessary increase in the overall thickness.

Between each two adjacent layers of this heavy wire fabric is a chamber or space **10** which may be left open or empty, as in Fig. 3, and which thus provides an air space serving as a cushion and also as an insulator for heat and sound, but, if desired, the spaces between adjacent layers of the heavy wire screen may be filled with suitable filling material, indicated at **10***a*, Fig. 2. One suitable material for the purpose is a thin blanket of fireproof rock wool compressed to a thickness of ¼ to ⅜ of an inch. Another suitable material is a fibrous material commercially available in sheet form and frequently used as a cushion beneath carpets and rugs. If the final spacing between sheets **9** of wire mesh is to be a quarter of an inch this rock wool or felted material will be selected of a normal thickness of more than that, such as a half inch or more, so that it is compressed when the wire sheets are squeezed together for securement along their edges, and the felted material is therefore quite compact and firm. In such event the wire sheets may be held together at intervals over the area of the web in any suitable manner, such as by small rivets **11**, which maintain a substantially uniform thickness of the web as a whole over its entire area.

Cork, either in pulverized form, or in the form of small fragments either loose or bound together in sheet form, also may be employed as a filler between the heavy screen sheets **9**, although it should be understood that both cork and the felted fibrous material first referred to are combustible and in that sense are not fireproof. However, they might be suitable for certain walls where protection against the effects of explosions is desired rather than protection against flame. If a completely fireproof panel is desired loose fibrous asbestos or rock wool, such as is used as a heat insulator in building construction, may be used for the filling material.

The number of sheets of heavy wire mesh **9** to be used depends upon several factors, such as the desired strength of wall, and the degree of yielding protection to be afforded in view of the maximum explosive forces to be encountered. Whatever number of layers of heavy mesh is employed, the outer surfaces of the two outermost layers—those which otherwise would be exposed to the chambers which the wall separates—are more or less rough, so much so that it is difficult to apply a finish of any kind thereto. Nor does heavy wire of this kind prevent the passage of flame in case surface coatings on the wire mesh are stripped off.

Accordingly, we may apply to the outer otherwise exposed faces of the two outermost heavy wire webs **9** a thin fireproof layer **12** of suitable material, such as thin asbestos paper, which may be purchased in web or roll form. This material is either laid loosely in place or it may be pasted on with any suitable adhesive or glue to form a continuous imperforate covering, sealing the spaces between the heavy wire sheets, and assisting in insulation against sound and heat. This asbestos layer may be applied either above or below the heads of rivets **11**, and is shown in the latter position. Over this layer of thin asbestos paper we apply, on either or both of the outer exposed faces of the web, another layer **13** of relatively light wire mesh.

The light wire mesh layer **13** is used primarily as a backing or support for a suitable finishing coating (not shown), such as paint or the like, which not only serves as a decoration but also provides a smooth surface to which dust will not cling, which is a desirable factor where inflammable or explosive powders are present. The fine wire also serves as a guard against the passage of flame, after the manner of the wire in the Davey lamp, in case any other outer coatings crack or flake off or are stripped off.

One way in which the fine wire screen layers may be made to serve as a support for the finishing coating, is to embed the wire mesh in a very thin layer of suitable plastic fireproof composition, applied with a brush, a trowel, or in other suitable manner, but in so small a quantity that the total thickness of the coated wire sheet, when finished, is substantially no greater than the thickness of the uncoated wire sheet. A product of this kind, suitable for the purpose, is available

on the open market under the name "Cel-O-Glass" and is described more fully in the said prior application.

The wire screen of this layer may be of the character ordinarily used for window screens. It may be either galvanized or ungalvanized; its steel may be of the character before referred to, having a tensile strength of the order of 100,000 pounds per square inch; and it may be made of wire having a diameter of the order of .015 to .028 inch, spaced 20 wires to the inch, more or less.

As a substitute for a plastic material applied to the fine wire mesh, a layer of thin asbestos paper 14 may be employed similar to that applied to the outer surfaces of the heavy wire mesh layers 9. This thin asbestos paper may be pasted, cemented or otherwise secured to the fine wire mesh, if desired.

In either case, whether the wire is coated with plastic or supports a layer of thin asbestos paper, or has any other equivalent preferably fireproof coating material, it supplies a relatively smooth surface, smoothing out any depressions or projections in the heavy wire fabric and presenting a good appearance in the finished product.

In the fabrication of the panel as a whole, all of the layers forming the central web, as described, preferably are assembled first. They are then secured together and to the frame by the application of the frame members thereto, as described. That is to say, the two or more heavy wire mesh layers are laid upon each other with layers of filling material 10a between them, if such are used. If open spaces 10 between them are desirable, as in Fig. 3, the edges of the heavy metal sheets are separated by suitable metal spacers 15 extending around their edges, as shown. Asbestos sheets 12 are then pasted or secured to the outer faces of the outermost sheets 9. Rivets 11 are applied either before or after the asbestos sheets 12 are applied. Then the layers of fine wire mesh are laid in place, with the outermost sheets 14 of asbestos pasted thereto.

Conveniently the heavy metal sheets with the outer asbestos layers therefor, and any desirable filling materials, can be piled together and the rivets 11 fastened to them at intervals, so that this pile can be handled as a unit.

When all layers are piled on top of each other, the frame members are applied and the web layers are compressed and secured together as before described, followed by the application of the self-hardening securing material to the outer edges of the frame.

In building a wall of these panels a suitable framework 16 is provided, preferably made of metal channels, T's or like structural units, into which the metal panels conveniently may be inserted and secured. Panels of the proper size are then chosen and inserted and secured together.

In the completed wall, upon the occurrence of an explosion of moderate force, the web of the panel yields in the frame and without material distortion of the latter. That is to say, an explosion occurring in the chamber on one face of the panel causes its web to bulge or bend outwardly. Such flexibility is provided not only by the stretch of the wires of the several layers of screen material, but also by the lost motion provided by the bending of the wires running one way around those running the other way in each metal sheet. Thus, in a panel three feet square the web may bulge out as much as two or three inches on one side without actual fracture. Moreover, in case of an explosion where metal or other fragments are scattered through the air, they have been found to pepper and mar the asbestos coating on the near side of the web, but without puncturing it. But, in case the explosive force is great enough to actually burst through the web, it tears without shattering and thus reduces the possibility of damage. Further, the panel as a whole provides insulation against the passage of heat and sound and may be made fireproof and flameproof.

Other advantages of the invention will be apparent to those skilled in the art.

What we claim is:

1. A yielding flexible wall panel for a chamber where explosions are likely to occur, comprising a frame, and a plurality of sheets of relatively heavy foraminous screen material mounted in spaced parallel position in said frame, and a sheet of relatively light foraminous screen material applied to the outer face of each outermost sheet of heavy screen material, each sheet of light screen material suporting a thin layer of fireproof material and providing a surface on which a finishing coating may be applied.

2. A yielding flexible wall panel for a chamber where explosions are likely to occur, comprising a frame, and a plurality of sheets of relatively heavy foraminous screen material mounted in parallel position in said frame and arranged to provide an open space between two adjacent sheets, a filling of insulating material in said space, and the outer faces of the two outermost sheets having applied thereto a thin layer of fireproof material and providing a surface on which a finish may be applied.

3. A yielding flexible wall panel for a chamber where explosions are likely to occur, comprising a frame, and a plurality of sheets of relatively heavy foraminous screen material mounted in parallel position in said frame and arranged to provide an open space between two adjacent sheets, a filling of insulating material in said space, means securing said adjacent sheets together at intervals to confine said filling material and preventing sheet separation, and a sheet of relatively light foraminous screen material applied to the outer face of each outermost sheet of heavy screen material, each sheet of light screen material supporting a thin layer of fireproof material and providing a surface on which a finish may be applied.

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