

May 11, 1943.

H. G. PILLSBURY ET AL
WALL AND BUILDING STRUCTURE

2,318,966

Filed March 27, 1941

2 Sheets-Sheet 1

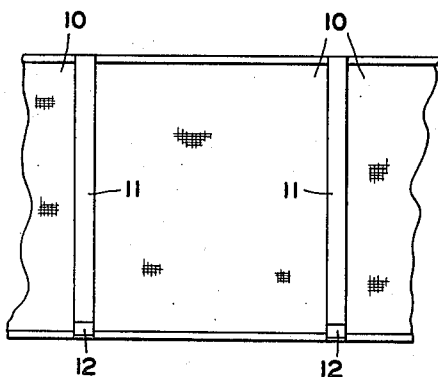


FIG.-1

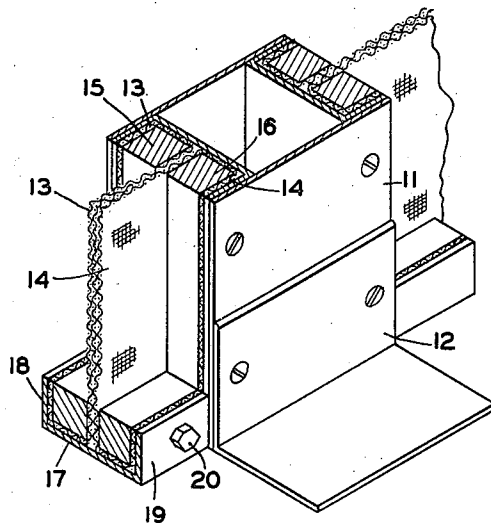


FIG.-2

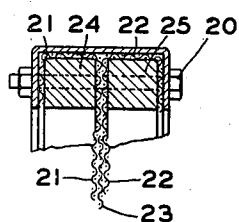


FIG.-3

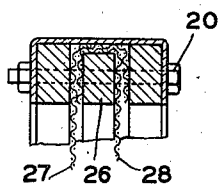


FIG.-4

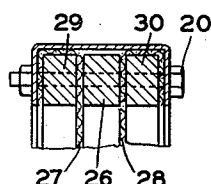


FIG.-5

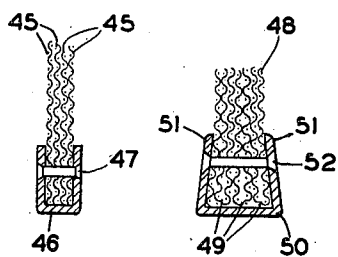


FIG.-7

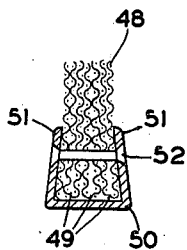


FIG.-8

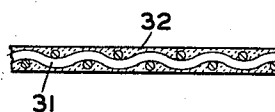


FIG.-6

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2 Sheets-Sheet 2

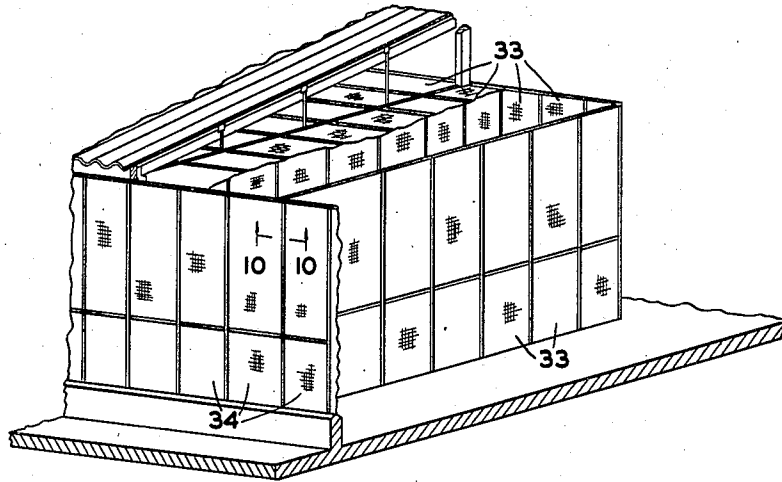


FIG-9

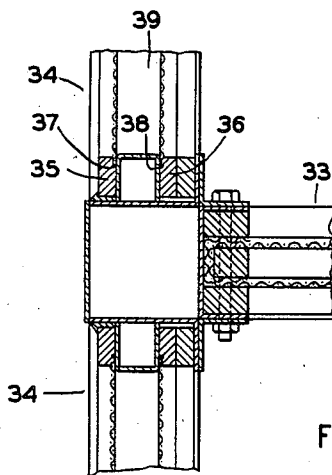


FIG-10

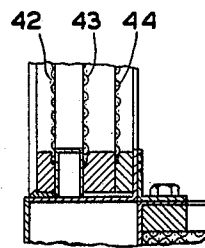


FIG-11

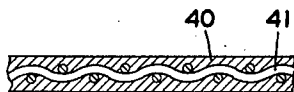


FIG-12

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2,318,966

WALL AND BUILDING STRUCTURE

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Application March 27, 1941, Serial No. 385,403

3 Claims. (Cl. 72—1)

The invention relates to a fireproof wall construction. It relates more particularly to a structure of this nature to be used for walls, partitions and ceilings in buildings devoted to the manufacture, storage, or handling of materials which constitute an explosion or fire hazard.

As is well known to those who have made extensive studies in the mechanics of the origination, propagation, and prevention of explosions, a rigid wall structure or partition affords little or no protection in case of explosion, unless of course the wall is made so thick and strong as to make its cost generally prohibitive. In the usual explosion all retaining, rigid partitions shatter immediately and the injurious effects incident on the explosion, such as the usually accompanying fire, are communicated to adjoining chambers.

We have devised a wall structure which is, to a high degree, fireproof, and which offers a resiliently yielding barrier to explosions. We have found, by actual tests under explosive conditions, that the wall structure hereinafter to be described is much more resistant to the destructive effects of explosions than is the usual rigid wall construction, and the flame resistance of our wall material is so high, and its heat conductivity is so low, that it prevents fire transmission therethrough to a surprising extent, in view of the simplicity and economy of the structure.

We have used, in combination with our fireproof wall construction, an exterior wall assembly such as is described and claimed in a copending application of Elton B. Ingersoll and Leon E. Willett, Serial No. 385,402 filed of even date herewith. The advantage of this combination will become more fully apparent as the description proceeds, but, briefly, we have provided an exterior wall of sturdy construction and light weight, and assembled from spaced panels of translucent material which is substantially shatterproof. As more fully described hereinbelow and in the aforesaid copending application, this exterior wall structure is an excellent heat insulator and withstands ordinary shocks, but serves more or less as a safety valve in severe explosions, since it yields or blows out more readily than the fireproof interior wall structure mentioned in preceding paragraphs. We therefore prefer to use our spaced panels of translucent material in exterior walls so that explosive forces may be dissipated into the outer air, whereas in the interior partitions and ceiling we use the stronger and more flame resistant wall structure so as, in

effect, to direct the explosive forces in a desired direction.

While the invention disclosed herein may be embodied in a variety of forms, differing only in detail, and not in essence, we have chosen for illustration several embodiments which are to be regarded as exemplary, and not limiting.

In the drawings,

Fig. 1 shows in elevation, and partly broken away, several adjacent panels, in edge abutting relationship in a partition wall or ceiling, and constructed and assembled in fire resistant relationship in accordance with the present invention.

Fig. 2 is a fragmentary perspective view, partly in section, of a portion of Fig. 1 showing details of construction at the meeting edges of adjoining panels.

Fig. 3 is a fragmentary sectional view of a fireproof panel edge assembly, three layers being shown in laminated contact.

Fig. 4 is a fragmentary sectional view of a fireproof panel edge assembly, showing one method of assembling a two-ply fireproof panel, the components being spaced somewhat apart in parallel planes.

Fig. 5 is a fragmentary sectional view of a fireproof panel edge assembly, generally similar to Fig. 4, but showing a somewhat different method of gripping the edges.

Fig. 6 is an enlarged, fragmentary sectional view, showing a single fireproof layer.

Fig. 7 is an enlarged fragmentary sectional view showing still another method of gripping the panel edges.

Fig. 8 is an enlarged fragmentary sectional view showing yet another method of gripping the panel end edges.

Fig. 9 is a perspective view, partially broken away, of a chamber structure showing interior partitions and ceiling, and exterior wall and roof to illustrate our preferred construction wherein the interior partitions and ceiling are fireproof and resiliently resistant to explosion pressure, whereas the exterior wall is weaker or less resistant to explosion pressure.

Fig. 10 is a fragmentary section, somewhat enlarged, and taken on the line 10—10 of Fig. 9.

Fig. 11 is a fragmentary section, similar to Fig. 10, but showing a slightly modified form of the invention.

Fig. 12 is a fragmentary section, somewhat enlarged, of a translucent, shatterproof sheet as used in the outer wall construction.

Before the present invention is described in

detail, it is to be understood that such invention is not limited to the details of construction and/or the specific arrangement of parts herein illustrated and/or described, as the invention obviously may take other forms. It also is to be understood that the phraseology or terminology herein employed is for the purpose of description and not of limitation.

We will first describe the fireproof panel unit which may be used wherever convenient or desirable, even in exterior wall construction, although preferred for interior walls. We will thereafter describe the use of this fireproof construction for interior partitions and ceilings in conjunction with an exterior wall of translucent, shatterproof, relatively frangible material. As used herein we comprehend, by the term shatterproof, a material which will not fly in splinters like ordinary glass, but a yieldable material which will not splinter or fly in fragments though it may rip or tear under severe explosive forces.

Our fireproof wall structure (Figs. 1 to 8) has as its basic element a layer or sheet of screen wire, or metallic mesh fabric, which screen is used as a resilient supporting framework or skeleton for a more or less impermeable layer of fireproof material. While a variety of refractory materials is available, we prefer to use a fibrous composition of matter which, in preliminary stages, is quite plastic, and which may be applied to the supporting and strengthening screen with a brush or trowel, or in any suitable manner.

Such a material is available commercially under the general designation of rock wool cement, and consists of finely ground rock wool fiber carried in a tacky binder. While this cement may be used as so procured, we prefer to add thereto a certain proportion of desiccated asbestos fiber. One such composition which we have found very suitable is made up from about two parts of rock wool cement to one part of desiccated asbestos. This is preferably applied on one or both sides of a supporting screen and allowed to dry. It dries to a flat surface, is relatively crackproof, and is highly resistant to destruction by shock. It is impermeable to ordinary flame attack and its heat conductivity is extremely low.

As a strengthening and supporting element for our wall structure we have used a 12-mesh screen of stainless steel wire of 0.028 inch in diameter. This has a high tensile strength and ductility and provides the fireproof panel with exceptional shock resistance. Another supporting screen which we have found very suitable is a 14-mesh screen of galvanized steel wire of 0.022 inch diameter.

While a panel composed of a single layer as above described affords substantial protection against both fire and explosion, we have provided assembled wall structures comprising two or more laminations in juxtaposed relationship. Each lamination is preferably composed of a screen impregnated with fireproof material. The juxtaposed laminations may be actually in contact with each other, or they may be spaced apart, for instance, one-half or one-quarter of an inch. When the laminations are in contact, or in close juxtaposition, an explosive force must rupture the wire of all laminations simultaneously, so that a wall so formed is stronger, or offers greater resistance to explosive forces, than one whose laminations are spaced, and it is therefore more suitable for interior walls. While an interstitial air space affords excellent heat

installation and shock-cushioning protection, we may fill this space with a fireproof plastic material of the nature already described. Two or more laminations either coated and in close juxtaposition, or spaced, with fireproof material packed therebetween, afford a high degree of fire prevention and represent the most efficient protection against the destructive effects of explosion.

We have shown, in Figs. 1 to 8, several embodiments of fireproof wall elements, and one method of assembling adjacent fireproof panels in edge abutment. Referring first to Figs. 1 and 2, we show, in Fig. 1, three panels 10 of fireproof nature as described, maintained in edge abutment by any suitable means such as a conventional retaining frame construction 11 fixed in place by floor or ceiling brackets 12. Each panel 10, in the embodiment shown in Figs. 1 and 2, is assembled from two or more closely juxtaposed laminations 13 and 14. The peripheral edges of the said laminations 13 and 14 diverge from each other so as to be lapped around stiffeners 15 and 16 respectively. A conventional channel member having a base 17 and upturned flanges 18 and 19 serves as a retaining seat for the edges of the laminations, when assembled as described, and the complete panel assembly, with sheathed edges as shown, is assembled in the manner illustrated in detail in Fig. 2. Spaced rivets or bolts 20 are used to make a unitary, compact, panel assembly.

In the embodiment shown in Fig. 3 we have illustrated fireproof assembly of three-ply form. Here, two laminations 21 and 22 are attached at their peripheral edges as previously described but diverging somewhat throughout their exposed surface to permit the inclusion therebetween of a third lamination 23 which increases the heat resistance, shock absorption characteristics, and general strength and resiliency of the panel. In an actual construction of this type we have used for the center lamination 23 a galvanized steel wire screen impregnated with fireproof material, and for the two outer laminations 21 and 22 a stainless steel screen similarly impregnated. While the panel 23, as shown, is retained merely by the pressure of panels 21 and 22, it may of course have its peripheral edge portion extended so as to be held between the stiffening strips 24 and 25 as previously described.

In the construction shown in Fig. 3 I may substitute for the centrally disposed lamination 23, a layer of relatively heavy screen or guard wire, thereby adding strength to the composite assembly while retaining the fireproof characteristics of the outer layers 21 and 22. The forms shown in Figs. 2 and 3 are particularly suitable for interior walls, on account of their unusual strength or resistance to explosive forces.

Figs. 4 and 5 illustrate still another embodiment of our invention. In this embodiment a spacing strip 26 is placed between the edge portions of laminations 27, 28. In Fig. 4 the edges are shown as being mutually overlapped around the spacing strip 26 and in Fig. 5 the edges are upturned over the stiffeners 29 and 30. In each case the laminations 27 and 28 are spaced apart a substantial distance, for instance one-half inch, and while an inert air space therebetween may serve as a quite adequate shock cushion and heat insulator, we have found that still more satisfactory construction is achieved by packing the interstitial space with fireproof plastic material of the nature already described. But with the wire laminations spaced, the wall

is not so strong as that shown in Figs. 2 and 3, and is more suitable for an exterior wall.

Fig. 6 shows, in section, and somewhat enlarged, a fireproof panel such as previously indicated in the various embodiments by reference numerals 13, 14, 21, 22, 23, 27 or 28. The wire mesh 31 is embedded in the fireproof coating 32, but the over-all thickness of the panel as a whole is not materially greater than the thickness of the uncoated wire mesh.

Fig. 7 shows in section, and somewhat enlarged, a fireproof panel comprising four sheets of fireproof material 45, constructed as previously described, and gripped at their peripheral edge portions by a channel member 46, to which they are firmly attached by some suitable means such as rivet 47. Since in many applications a compact, neat, and dustproof assembly is desired, the structure shown in Fig. 7 meets these requirements.

Fig. 8 shows in section, and somewhat enlarged another method of assembly for a fireproof panel comprising a plurality of laminations. Instead of using assembled, separate sheets such as shown in previous figures, Fig. 8 shows a single sheet 48 folded successively back and forth upon itself so as to provide a plurality of adjacent end folds 49 overlapped in the manner shown. This construction results in an appreciable increase in thickness at the folding zone, and enables us to apply a channel member 50 having side flanges 51 which have a converging taper as shown. When secured by spaced rivets 52, the grip is exceedingly tight and secure.

Extensive tests have been made by constructing special chambers having wall portions made up from panels of one or other of the embodiments so far discussed. Severe explosions have been generated within the chambers and the panels have withstood the destructive tendencies of the explosion in very favorable contrast to failures in solid panels tested simultaneously. This is especially true of panels comprising two or more laminations in close juxtaposition. In the latter instances we have directed blow torch flames against one lamination for an extended period, thereby raising the temperature of the supporting metallic mesh screen to a visual red heat, without appreciable effect on the neighboring superposed lamination and without raising the temperature of said neighboring lamination to a point which would induce combustion even in turpentine soaked paper placed in contact therewith. Panels constructed as described have sometimes warped slightly under intense heat (and returned practically to normal contour on cooling), and they have yielded somewhat when bounding an inclosure within which an explosion has occurred, but they have nevertheless maintained an integral continuity without tearing or shattering.

One-ply panels, or a plurality of laminations in close juxtaposition as described, are recommended for ceilings and interior walls of chambers where it is desirable that the effect of a fire or explosion be prevented from spreading to adjoining chambers. They are particularly advantageous in factories which are manufacturing munitions and explosives, and also in plants engaged in the production of metallic powders which frequently unite violently with oxygen. Panels such as we have described may be finished to a very smooth surface on which paint may be quite satisfactorily applied, and the acoustical properties of paneled walls of this na-

ture are excellent, being just sufficiently absorptive to deaden unpleasant vibrations and echoes. They are preferably rendered waterproof by being coated with any suitable waterproofing material.

While we have given examples of several refractory plastic compositions, and of several screen materials of specific mesh size and wire diameter, it is of course obvious that these details may be varied to suit individual requirements. For instance, the screen may be greatly strengthened in manner well known to those skilled in the metallurgical arts, by increase in the wire diameter, or change in the alloy, or by various thermal treatments or otherwise. It is likewise obvious that a number of suitable fireproof mixtures are available, or may hereafter be developed, which can be applied in some convenient manner to the strengthening screen. The screen is preferably of a fine enough mesh to serve as an adequate skeleton structure to permanently retain the fibrous fireproofing material. Fine mesh is also desirable because it reduces the diameter of the wire and hence the over-all thickness of the screen.

While we have shown a method of mounting the panels in a more or less rigid supporting frame structure, it is obvious that the general resiliency of the wall could be improved by mounting each individual panel assembly in a spring supported frame such as is coming into use for absorption of shock, accidental or intentional, in retaining guard screens, for instance in psychiatric institutions.

Figs. 9 to 12 illustrate a fireproof interior partition and ceiling structure, such as has been described above, in combination with an exterior wall of translucent, shatterproof structure which yields or fractures somewhat more readily than the wall structures described in connection with Figs. 2 and 3, on account of the difference in the strength, or manner of resistance, of the coating material. Since, generally speaking, an explosion will do less damage if allowed to expand its force through an outer wall into the open air than if the expanding gases break through partitions into adjoining chambers, we have here and in Figs. 4 and 5 provided an outer wall which, in safety valve fashion, gives way immediately upon a serious explosion so as to protect the other interior walls of the chamber and restrict the effect of an explosion to a definite or desired point of exit.

Fig. 9 shows, in perspective from an elevated viewpoint, a chamber having interior partition walls and ceiling assembled from relatively strong panel units 33 such as hereinabove described. The weaker safety wall is built up from shatterproof, translucent units 34 such as are more fully described and claimed in the said copending application, Serial No. 385,402, filed of even date herewith, and above referred to. Referring more particularly to Fig. 10, an outer wall unit 34 consists of two juxtaposed panel carrying frames 35, 36, each frame carrying a sheet of translucent material firmly united to the frame at 37, 38 respectively, so as to provide an inert air space 39 therebetween. The sheet is preferably of shatterproof plastic material 40 (Fig. 12) having imbedded therein a strengthening mesh 41. A material of this nature and of physical characteristics satisfactory for my purpose is commercially available under the trade name "Cel-O-Glass." A completed wall unit preferably com-

prises at least two such sheets retained in compact assembly, for instance in the manner shown in Fig. 10.

We have illustrated, in Fig. 11, a further shatterproof assembly comprising "Cel-O-Glass" sheets 42 and 43 in combination with a sheet of fine mesh wire screen 44 such as used, for example, on the Davy safety lamp. A screen of this nature is impervious to ordinary tongues of flame unless the screen is subjected to a general and continuous fire at a temperature sufficient to melt the wires thereof. This fire screen is, of course, permeable to outrushing, expanding gases, and does not detract from the safety blow-out features of our invention. Adjoining wall units may be abutted in edge-to-edge relationship as shown in Fig. 10 or in any other suitable way. Injured panels are readily repaired by substituting a new "Cel-O-Glass" sheet for the injured one, or by replacing the complete unit which is readily removable from the supporting frame.

What we claim is:

1. A wall panel for a chamber where explosives are stored or handled, said wall panel comprising a plurality of sheets of foraminous screen material, said sheets lying in parallel relation and being secured to each other, each of said sheets having thereon a continuous coating of fireproof plastic material, the over-all thickness

of each coated sheet being not materially greater than that of the uncoated sheet.

2. A wall panel for a chamber where explosives are stored or handled, said wall panel comprising a plurality of parallel sheets of foraminous screen material, two of said sheets retaining therebetween and being secured together by a filling compound of fireproof plastic material, the over-all thickness of the filled sheets being not materially greater than that of the unfilled sheets.

3. In a building having a room adapted for containing explosives or highly inflammable material, a wall structure for said room, comprising in combination, an interior partition panel including two parallel closely juxtaposed sheets of foraminous screen material, each of said sheets having thereon a coating of fireproof material, the coating of the two sheets securing them together, and an exterior wall panel including at least two parallel spaced sheets of foraminous screen material, each embedded in its own coating of translucent, shatterproof plastic material, said translucent sheets providing therebetween an inert air space and the wall formed by said sheets being less resistant to explosive forces within said room than said interior wall.

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