July 5, 1966 G. MOSTOLLER 3,258,887

WALL ASSEMBLY INCLUDING EXPLOSION BOLTS

Filed Jan. 31, 1963

Fig. 1.

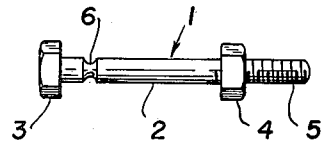


Fig. 2.

Fig. 3.

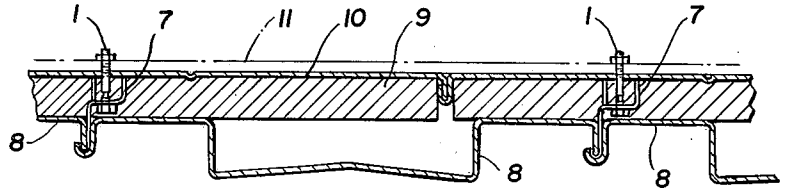


Fig. 4.

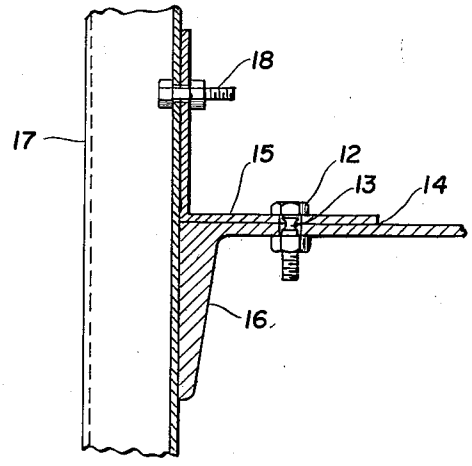
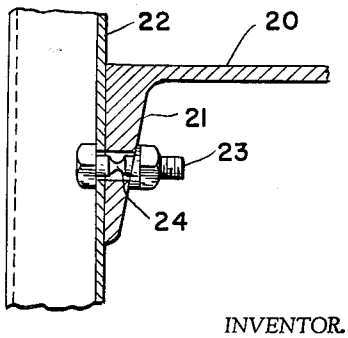


Fig. 5.



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WALL ASSEMBLY INCLUDING EXPLOSION BOLTS

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This invention relates to explosion fasteners, and, more particularly, to a wall assembly and elements thereof to enable the wall to be readily blown away from the building frame in the event of an explosion in the building.

In many industrial processes, explosive materials are manufactured, or explosive materials are used in a manufacturing process. Should an explosion occur within the confines of an enclosed building or room, its force must be dissipated upon the occupants and furnishings contained in the room or building.

If the roof or sidewalls are attached to the building in such a manner that the force of an explosion breaks the attachments, this force can be released to the outside of the room or building, thus causing much less damage to the occupants or furnishings within the building.

An object of the invention, therefore, is to provide novel explosion fasteners designed to fail under tension or shear, releasing the roof or sidewalls at as low a value as is consistent with good engineering practice. This desired release pressure may be about 30 pounds per square foot based upon past experience as the required strength of fastening devices to prevent roofing and siding panels from blowing off in high winds.

When properly designed explosion release fasteners are used in accordance with the present invention, with explosive force inside a room or building as it builds up to 30 pounds per square foot the fastening device fails and allows the roof or sidewall to be blown away; and any additional pressures or forces of the explosion are released to the outside and do not build up to greater pressures within the building unless the explosion is of great magnitude.

Another object of the invention is to provide a novel explosion fastener assembly that will yield under shear of the shank of a bolt.

Still another object of the invention is to provide a novel bolt construction for use as a yieldable fastener in the event of an explosion.

Other objects and advantages will become more apparent from a study of the following description taken with the accompanying drawing wherein:

FIG. 1 is a plan view of an explosion type bolt embodying the principles of the present invention;

FIG. 2 is a top, perspective, fragmentary view of an outside metallic wall panel assembly embodying explosion type bolts or fastener elements, such as shown in FIG. 1, which yield in tension as a consequence of the explosion;

FIG. 3 is a transverse, cross-sectional view of the wall assembly shown in FIG. 2;

FIG. 4 is a fragmentary, vertical, cross-sectional view of a modification of the invention wherein the fastener elements or bolts yield and are ruptured by shear forces as a consequence of the explosion; and

FIG. 5 is a modification of the structure of FIG. 4.

The general procedures for supplying fasteners for a wall or roof system having the release feature embodying the present invention are as follows:

(1) The total load per fastener at the desired release pressure is computed by multiplying the square feet of wall supported by each fastener times the desired release pressure in pounds per square foot. For example, a conventional wall panel might have fasteners spaced 1'–0" on centers through girts spaced 7'–0" apart; desired release pressure might be 7' x 1' x 30 pounds per square foot=210 lbs. Typical values for release pressure of fasteners for conventional metal wall systems are 100–300 lbs. per square foot, since fastener spacing is dictated by the general physical arrangement of the wall components rather than by the strength of the fasteners. Consequently, conventional fasteners are always much stronger than would be required should holding power be the only consideration.

(2) The explosion fasteners are designed to fail in tension. This failure at relatively low total load is accomplished by machining a notch **6** into the shank **2** of an aluminum fastener **1** shown in FIG. 1. The depth of this notch is such that the area of bolt remaining, times the ultimate strength of the metal, gives the desired release pressure. Aluminum is used because of its low value of ultimate strength.

(3) The diameter of the metal remaining at the base of the notch must be accurately maintained to avoid wide variations in strength between fasteners. In addition, the ultimate strength of the metal must be maintained the same between fasteners. Since machining of the bolt during manufacture and the machining of cutting the notch induces varying degrees of cold working, the ultimate strength of various finished bolts can be different one from the other. These effects of cold working are eliminated by annealing the finished fasteners, thus reducing the ultimate strength to its original value. Any variations are then only those present in the parent metal, and these are relatively small since chemical compositions of metal alloys are closely controlled during manufacture. This annealing also reduces the ultimate strength to lower values than for tempered metal, thus allowing larger diameters at the base of the notch. This is desirable to avoid failure in torsion during installation. This is also the reason for using bolts made of aluminum, or some other relatively soft metal or alloy having a low ultimate strength in tension.

(4) In use, the placement of the notch is critical, in that the notch must be located at some point along the shank where the shearing stress is small since the shear strength at the notch is low. When desired, arrangement of the fasteners can be accomplished so that failure is by shearing action rather than by tension. The same type of bolt is then used and the notch is made at the point where greatest shearing stress occurs in the shank of the fastener.

Referring more particularly to FIGS. 1–3 of the drawing, numeral **1** denotes a bolt, shown in detail in FIG. 1, which is preferably made of aluminum or other soft metal, having a shank portion **2** which is notched out circumferentially to form a neck portion of reduced diameter **6**, and having a head portion **3** and a nut screwed onto a threaded portion **5**. If the bolt **1** were of steel it would not be very suitable for the purposes of the present invention since the diameter of shank portion **6** would be below .06 inch diameter, therefore would be easily broken by twisting or turning of the head **3** by a wrench—and yet the reduced diameter shank portion **6** would be sufficiently strong to withstand high tensile forces, except those resulting from an explosion. An important and not readily apparent feature of the present invention is in selecting aluminum or other soft metal for the bolt and providing a reduced shank portion of greater than .06 inch—preferably of the order of .09 inch, so that the shank portion **6** of reduced diameter will not be ruptured by application of normal torque forces by a wrench to the head **3** of the bolt. In short, aluminum is a preferred metal since, for a given rupturing force, the portion **6** of reduced diameter can be made sufficiently large so as to withstand normal torque forces applied to the bolt during assembly of the wall.

FIGS. 2 and 3 show an outside metal wall assembly

comprising vertically extending metallic panels **10** having vertically extending interlocking flanges between which extend insulating bats **9** which are held in place by a plurality of clip elements **7** of substantially *"h"* form whose leg portions pierce and extend through the insulation and rest against the outside faces of panels **10**. Clip elements **7** have outwardly projecting, reversely bent flanges which clamp the outwardly extending end flanges of the outside channel shaped metallic wall panels **8**. A plurality of bolts **1** have shank portions which extend through holes in the horizontally extending structural frame work; indicated by dash and dot lines **11**, of a building. Thus the shanks of the bolts constitute the sole means for holding the entire wall assembly together and for securing it to the structural frame work of the building.

In operation, therefore, in the event of an explosion inside the building, the explosive pressure against the wall assembly will cause the bolts **1** to rupture at the reduced neck portions **6** and the wall will be blown outwardly away from the structural frame work of the building.

FIG. 4 shows a modification of the invention comprising a structural steel frame **16** to which is attached a clip angle **15** by means of bolts **12** having shank portions **13** of reduced diameter. The clip angles **15** are bolted by means of bolts **18** or other suitable fastening means to the building panels **17**. Thus, in the event of an explosion inside the building, the explosive force will push the vertical flange of clip angle **15** to the left, as viewed in FIG. 4, causing relative sliding movement between flange **14** of the steel frame **16** and the horizontal flange of clip angle **15**. This will cause a shearing force on the shank portion of reduced diameter **13** which is in alignment with the parting line between the aforesaid relatively slidable horizontal flanges.

FIG. 5 is a modification of FIG. 4 showing a structural steel frame **21** bolted to building panel **22** by bolt **23** having a shank of reduced diameter **24**. Thus in the event of an explosion, tensional forces will break the shank of reduced diameter **24**.

It will be apparent that bolts **1** can be used in other wall assemblies than those shown so as to rupture at the portion of reduced diameter **6**, either as a consequence of abnormal tension or abnormal shearing forces. In situations where it is desired not to rupture the bolt from shearing forces, portion **6** should be in a hole surrounded by a solid wall portion, as distinguished from being surrounded by relatively slidable portions, as shown in FIG. 4.

The fasteners illustrated in the drawing provide only for the release of the wall or roof panels and do not provide for retaining the panels loosely to the building. Depending on the force of the explosion, the panels may be blown away from the building and might damage adjoining property or injure nearby persons. There are various methods for losely retaining the panels to the building after release, such as with sections of light chains or by a hinge arrangement at one end of the panel (not shown).

Thus it will be seen that I have provided a novel wall assembly including bolts which allow the wall assembly to be blown outwardly as a consequence of a violent explosion, but which will securely hold the wall in place while subject to high velocity winds; furthermore, I have provided a novel bolt of such construction that it will not readily rupture by ordinary torsion forces ordinarily applied to screw the bolt in place and yet will readily rupture as a consequence of an explosion to allow the wall to become readily detached from the structural steel framework.

While I have illustrated and described several specific embodiments of my invention, it will be understood that these are by way of illustration only, and that various changes and modifications may be made within the contemplation of my invention and within the scope of the following claim.

I claim:

A wall assembly including metal panels and clip angles secured to said metal panels and extending horizontally in engagement with and resting on top of a horizontally extending structural building frame and a plurality of bolts for bolting said clip angles and said building frame together, said bolts including shank portions of reduced diameter occurring in the parting line between adjoining flanges of said clip angle and frame, whereby said shank portions of reduced diameter will rupture as a consequence of shearing forces at said parting line caused by an explosion.

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