

May 30, 1944.

A. S. KOS ET AL

2,349,907

METAL DOOR

Filed July 9, 1941

2 Sheets-Sheet 1

Fig. 1

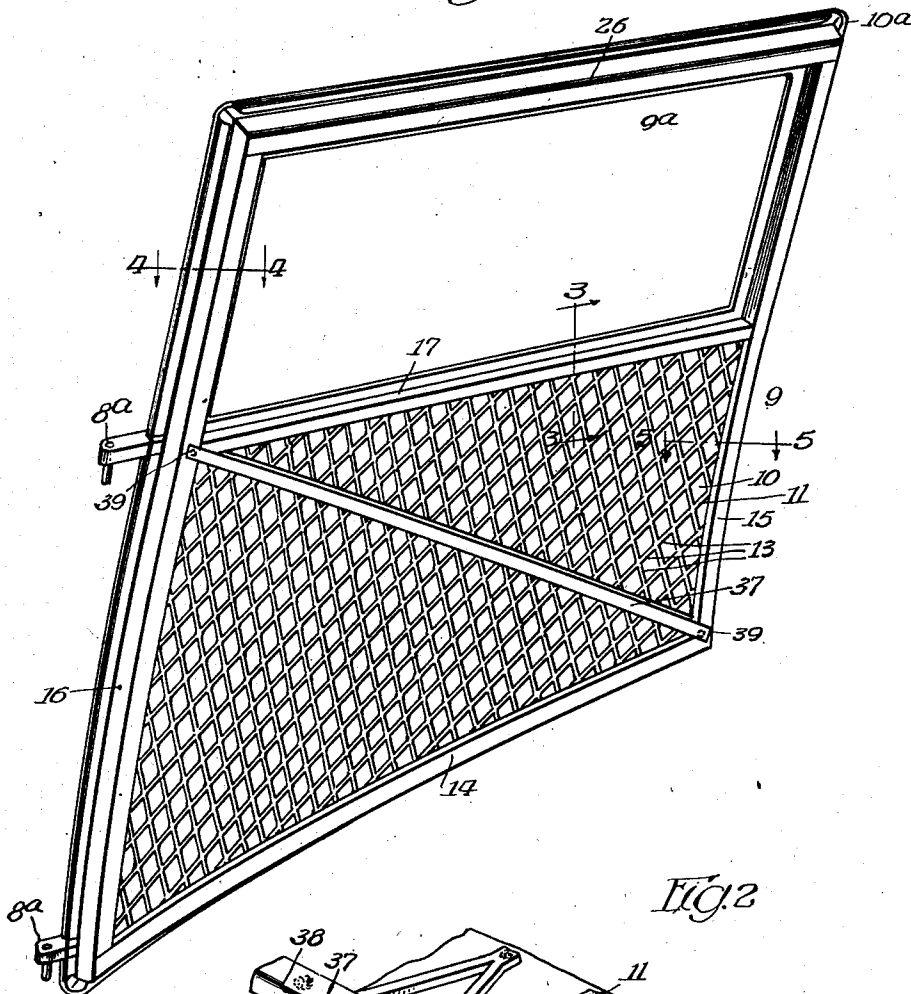
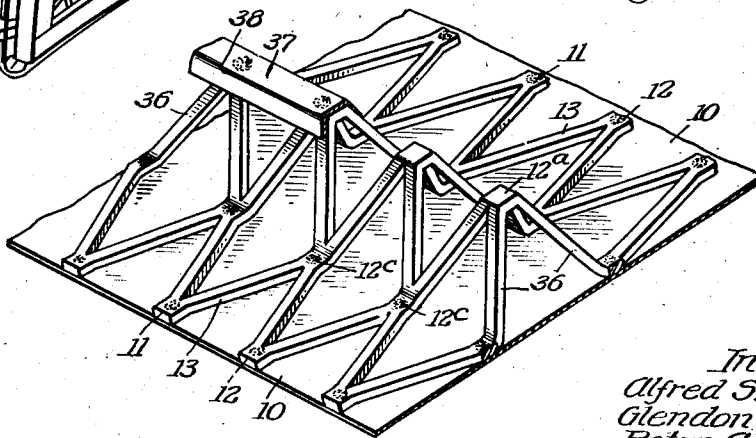


Fig. 2



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2 Sheets-Sheet 2

Fig 3

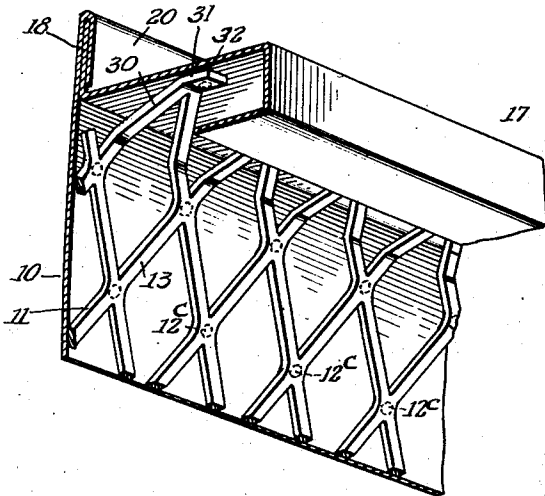


Fig 4

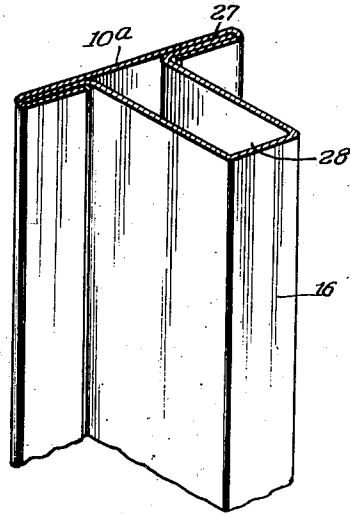


Fig 5

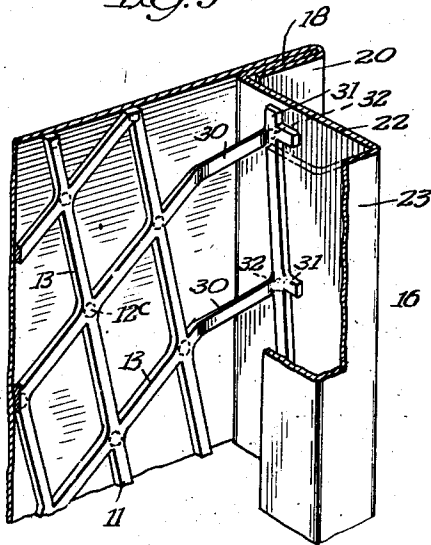
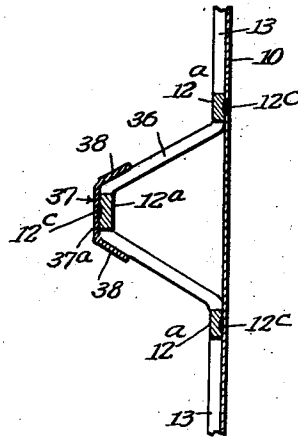


Fig 6



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2,349,907

METAL DOOR

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Application July 9, 1941, Serial No. 401,614

11 Claims. (Cl. 189-46)

The invention relates to metal doors.

One object of the invention is to provide a metal door which has a high strength-weight ratio for use in vehicles such as airplanes or automobiles.

One object of the invention is to provide a door which is light in weight, durable and possesses the desired degree of stiffness for use in vehicles.

Other objects of the invention will appear from the detailed description.

The invention consists in the several novel features which are hereinafter set forth and are more particularly defined by claims at the conclusion hereof.

In the drawings: Fig. 1 is a perspective of a door embodying the invention. Fig. 2 is a perspective illustrating a portion of the composite metal panel in the door and the diagonal stiffening member in the panel. Fig. 3 is a sectional perspective taken on line 3-3 of Fig. 1. Fig. 4 is a sectional perspective taken on line 4-4 of Fig. 1. Fig. 5 is a perspective taken on line 5-5 of Fig. 1. Fig. 6 is a section across the beam-structure in the lower panel.

The invention is exemplified in a door which comprises a lower closed panel 9 and an upper panel 9^a for holding a glass window in any usual manner, and is provided with hinge-members 8^a whereby the door may be supported in the frame of a vehicle. The lower panel comprises a sheet 10 of metal, such as thin steel, which forms the smooth outer face on the door. The lower panel also comprises diamond-mesh expanded metal 11, which extends over substantially the entire inner face of the sheet 10. The expanded metal is originally formed with the faces of the bonds extending nearly at right angles to the faces of the strands. This expanded metal is flattened so the faces of the bonds and strands will be coplanar. The flattened expanded metal and the sheet 10 are bonded together as for example by spot-welding preferably across the bonds 12 between the diagonal strands 13 of the flattened expanded metal. The margin of the sheet 10 projects beyond the margins of the expanded metal, as shown in Figs. 3 and 5. The border of the lower panel is formed by a sheet-metal bottom strip 14, upright side-strips 15 and 16, and an upper strip 17. Each of these strips is box-like in cross-section and comprises a flange 18 fitting against the inner face of the sheet 10, the margin of which is folded or lapped around the outer edge of flange 18, as at 20, to secure the strips around the margin of the sheet 10 and to form an abutment on the door for engaging the door-frame.

Each flange 18 is spot-welded to the flange 20 and the margin of sheet 10. Each of the strips 14, 15, 16 and 17 comprises a transverse inwardly extending flange 22, an inner side-flange 23, and an intumed transverse flange 24 which form a boxing around the margins of the lower panel. The strips 15 and 16 are extended above the strip 17 to form the sides of the window panel and their upper ends are rigidly connected by a strip 26. An extension 10^a of the sheet 10 extends over the outer face of the strips 15 and 16 above strip 17 and the strip 26. Strip 26 and strips 15 and 16 above strip 17 each have a pair of flanges 27 lapped by the extension 10^a of sheet 10, and flanges forming a closed boxing 28, as illustrated in Fig. 4. The boxing 28 on strips 15 and 16 may each be formed of a continuation of the flanges 18, 22 and 23, the extension of flange 24 to the sheet 10^a and added outturned flange 27.

The lowermost panel is usually subjected to transverse and other loads and it is desirable to provide means for preventing the bending or warping of the door during use. For this purpose a diagonal row between the upper corner of the panel at the pivoted side of the door to the lower corner at the free side of one series of bonds and adjacent strands of the expanded metal are deflected or arched away from the sheet 10, as at 36, so that the bonds 12^a will be spaced from the sheet. A diagonal channel-strip 37 has a flange 37^a which fits on the bonds 12^a and flanges 38 which fit along the adjacent angular portions of the strands and is spot-welded as at 12^a to all of the bonds 12^a in the diagonal row. The ends of the flange 37^a of strip 37 are extended to overlap the flanges 22 of the border-strips and welded thereto at 39. The strip is bent to conform to the plane of the sheet 10. These arched portions of the expanded metal and the strip 37, when welded together as described, form a diagonal beam for stiffening the panel and preventing flexing thereof. This also functions to prevent diaphragming of the door when it is in use. The expanded metal is arched and the strip 37 is welded thereto before the expanded metal is welded to the sheet 10 so that the bonds 12^a of expanded metal and the strip 37 will be accessible to the electrodes for spot-welding. This is done by inverting the strip 37 and placing its outer face on the lower electrode with the arches 36 between the flanges 37^a so the inner faces of the bonds 12^a will be accessible to the upper electrode.

The marginal portions of expanded metal 11

are not bonded to the sheet 10, are bent obliquely away from the sheet 10, as at 30, and have substantially right-angled terminals 31 which fit against the inner faces of the flanges 22 of strips 14, 15, 16 and 17 and are spot-welded thereto, as at 32, to reinforce and stiffen the border of the door. Usually the lower panels of the doors are somewhat bulged or curved to conform to the vehicle body. In fabricating the door the expanded metal may be formed to the desired curve before the sheet 10 is bonded thereto, or the composite panel of sheet and expanded metal may be formed to the desired curve if bonded after flattening, and in either case retain its curved contour. The side strips 15 and 16 and the bottom and top strips 14 and 17 are also curved according to the curvature and contour of the door-frame.

Strip 37 extends across the short axis of the diamond-shaped spaces in the expanded metal to stiffen the panel against stresses in the weakest direction of the expanded metal. The expanded metal is arranged so the long axes of the diamonds, which provide the greater transverse strength, extend diagonally, as nearly as practically possible, between the lower inner corner and the upper outer corner of the panel 9 and this provides sufficient diagonal strength between those corners to render an additional beam-structure unnecessary. This arrangement of the long axes of the diamonds in the expanded metal and the beam formed by arches 36 and strip 37 extending across the short axes of the diamonds constitutes a simple and effective X-bracing for the lower panel 9.

The invention exemplifies a door in which the closed panel comprises a thin sheet of metal, such as steel, and flattened expanded metal which will provide a high strength-weight ratio for transverse stability. It also exemplifies stiffening means which consists of arches in the expanded metal and a connecting strip bonded to the arches and secured to the border-strips of the door.

The invention is not to be understood as restricted to the details set forth, since these may be modified within the scope of the appended claims, without departing from the spirit and scope of the invention.

Having thus described the invention, what we claim as new and desire to secure by Letters Patent is:

1. A door having a closed panel comprising a thin imperforate metal sheet and expanded metal bonded to the inner face of the sheet at spots distributed throughout the area of the sheet and forming a rigid backing for preventing flexure of the sheet and box-like border-strips having transversely extending portions around the margins of the expanded metal, the margin of the sheet and the border-strips being interfolded and bonded together, the marginal portions of the expanded metal having transversely extending portions bonded to the transversely extending portions of the strips.

2. A door having a closed panel comprising a thin imperforate sheet of metal, expanded metal bonded to the inner face of the sheet at spots distributed throughout the area of the sheet and forming a rigid backing for preventing flexure of the sheet and border-strips around the margins of the expanded metal and secured to the sheet and comprising transversely extending flanges, the expanded metal having portions extending away from the sheet and bonded to the flanges.

3. A door having a closed panel comprising a thin metal sheet, expanded metal bonded to the inner face of the sheet, the expanded metal having portions bent away from the sheet, and a strip extending across and bonded to the bent-away portions of the expanded metal.

4. A door having a closed panel comprising a thin metal sheet, expanded metal bonded to the inner face of the sheet, border-strips around the margins of the expanded metal, the expanded metal being provided with substantially V-shaped portions bent away from the sheet, and a strip extending across and bonded to the apices of the V-shaped portions of the expanded metal.

5. A door having a closed panel comprising a metal sheet, expanded metal bonded to the inner face of the sheet, border-strips around the margins of the expanded metal, the expanded metal being provided with portions bent away from the sheet, and a strip provided with flanges and extending across and bonded to the bent portions of the expanded metal.

6. A door having a closed panel comprising a thin metal sheet, expanded metal bonded to the inner face of the sheet, border-strips around the margins of the expanded metal, the expanded metal having a row of portions bent away from the sheet, and a strip extending across and bonded to the bent portions of the expanded metal and secured to the border-strips.

7. A door having a closed panel comprising a thin metal sheet, flattened diamond-mesh expanded metal bonded to the inner face of the sheet, the expanded metal having a row of portions bent away from the sheet along a line diagonally of the panel, and a strip connecting and bonded to the row of bent portions of the expanded metal.

8. A door having a closed panel comprising a thin metal sheet, diamond-mesh expanded metal bonded to the inner face of the sheet, the expanded metal having a row of portions bent away from the sheet along a line diagonally of the panel and across the short axis of the diamonds in the expanded metal, the long axis of the diamonds extending substantially across the other diagonal of the panel, and a strip connecting and bonded to the bent portions of the expanded metal.

9. A door having a closed panel comprising a thin metal sheet, diamond-mesh expanded metal bonded to the inner face of the sheet, border-strips around the margins of the expanded metal, the expanded metal having a row of portions bent away from the sheet along a line diagonally of the panel and across the short axis of the diamonds in the expanded metal, the long axis of the diamonds extending substantially across the other diagonal of the panel, and a strip connecting and bonded to the bent portions of the expanded metal, and bonded to the border-strips.

10. A door having a closed panel comprising a thin imperforate metal sheet, flattened expanded metal which has one face of the strands and bonds coplanar with the contiguous face of the sheet and bonded to the inner face of the sheet at spots distributed throughout the area of the sheet and forming a rigid backing for preventing flexure of the sheet, and transversely extending border-strips around the margins of the expanded metal, the margin of the expanded metal having diagonally extending portions secured to the border strips.

11. A door having a closed panel comprising a thin imperforate sheet of metal, expanded metal

bonded to the inner face of the sheet at spots distributed throughout the area of the sheet and forming a rigid backing for preventing flexure of the sheet, and border-strips around the margins of the expanded metal, secured to the sheet and having portions extending transversely to the plane of the sheet, the expanded metal hav-

ing diagonally extending marginal portions with ends bonded to the transversely extending portions of the border-strips.

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