The invention relates to a shelter and consists of an outer wall of metal plate, an inner wall of metal plate and a heat-insulating layer between the outer wall and the inner wall. The shelter is provided with openings, of which the frames connecting the inner wall and the outer wall are manufactured from metal plates which are welded all around to the inner wall and to the outer wall. The corners are also formed by welded seams which connect parts of the inner wall or parts of the outer wall. A layer of bullet-proof and/or splinter-proof material can further be arranged between the outer wall and the heat-insulating layer.
Shelter, method for providing a wall or a panel with a bullet-proof and/or splinter-proof layer, and shelter, vehicle, vessel or aircraft provided with a wall or a panel manufactured according to this method

The invention relates to a shelter comprising an outer wall of metal plate, an inner wall of metal plate and a heat-insulating layer between the outer wall and the inner wall, provided with at least one opening. Shelters of this type are frequently applied for generally temporary accommodation of persons, supplies or equipment. The shelters are often provided with an undercarriage with wheels, although they can for instance also be placed using a helicopter. They are then often placed in inhospitable areas with large temperature differences between day and night and with a high degree of humidity. Problems can then occur due to condensation, and more generally with moisture which, particularly at openings such as windows and doors, can penetrate into the heat-insulating layer and herein adversely affects the insulating value and results in fungal growth.

The shelter according to the invention obviates this drawback and has the feature that a frame of the at least one opening connecting the inner wall and the outer wall is manufactured from metal plate, and that the frame is welded all around to the inner wall and to the outer wall. This achieves that the heat-insulating layer is hermetically sealed all around by metal plate.

A favourable embodiment of the inventive shelter has the feature that the shelter has an at least substantially rectangular form and that the corners are formed by welded seams which connect parts of the inner wall or parts of the outer wall, so that the heat-insulating layer is also hermetically sealed by metal plate at the corners.

A further favourable embodiment has the feature that the heat-insulating layer is manufactured from polyurethane foam, which on the one hand has very good heat-insulating properties and on the other contributes toward the mechanical strength of the shelter. A drawback of polyurethane foam is that it is not heat-resistant. The heat-insulating layer around an opening or close...
to a corner is therefore preferably provided with a recess, this recess being filled with a mineral wool so that welding can take place around an opening or close to a corner without the heat-insulating layer being damaged by the heat.

Shelters of the above described type are often used in conditions in which it is not possible to rule out that the shelter will come under fire. According to a further aspect of the invention, a favourable embodiment therefore has the feature that a layer of bullet-proof and/or splinter-proof material is arranged between the outer wall and the heat-insulating layer. The bullet-proof and/or splinter-proof material preferably comprises aramid fibres, which combine a very high tensile strength with a low specific mass. A projectile striking the outer wall will in the first instance bend the outer wall. The underlying layer of heat-insulating material is here also compressed, and the aramid fibres are placed under strain of tension over a relatively large surface area. The aramid fibres are herein stretched, wherein they absorb energy. In this manner a projectile is effectively slowed down. The bullet-proof and/or splinter-proof material preferably comprises 10-50 layers of fabric of aramid fibres, each for instance having a weight of 175 grams per square metre, this subject to the anticipated threat and the resulting demands being made of the shelter. A significant additional advantage of this embodiment is that the bullet-proof and/or splinter-proof material does not increase the thickness of the wall, or hardly so, since a possible increase in the wall thickness is detrimental to the volume of the shelter as the outer dimensions are generally fixed.

A further favourable embodiment has the feature that the bullet-proof and/or splinter-proof material is glued against an inner side of the outer wall, preferably using an epoxy resin. In addition to improved bullet-proof and/or splinter-proof properties, the layer consisting of aramid fibres embedded in a layer of epoxy resin then moreover contributes toward the mechanical strength of the shelter.
The invention also relates to a method for providing with a bullet-proof and/or splinter-proof layer a wall or a panel comprising at least a first metal plate, an insulating layer and a second metal plate. The inventive method has the feature that the bullet-proof and/or splinter-proof layer is arranged between the first metal plate and the insulating layer or between the second metal plate and the insulating layer. In the position of use the wall or the panel is positioned here such that possible projectiles will strike on that side of the wall or the panel which is provided with the bullet-proof and/or splinter-proof layer.

A favourable realization of the inventive method has the feature that 10 to 50 layers of fabric of aramid fibres are arranged as bullet-proof and/or splinter-proof layer. Using an epoxy resin the layers of fabric are here preferably glued together and glued onto an inner side of the first metal plate or the second metal plate.

The invention also relates to a shelter, vehicle, vessel or aircraft provided with a wall or a panel manufactured according to the method as specified in the foregoing paragraphs.

The invention will now be further elucidated with reference to the following figures, wherein:

Fig. 1 shows a side view of a possible embodiment of a shelter according to the invention;

Fig. 2A shows a cross-section of a possible embodiment of a frame of an opening in the shelter;

Fig. 2B shows a cross-section of an alternative frame of an opening in the shelter;

Fig. 2C shows a cross-section of a further alternative frame of an opening in the shelter;

Fig. 3A shows a cross-section of a possible embodiment of a corner of the shelter;
Fig. 3B shows a cross-section of an alternative embodiment of a corner of the shelter;

Fig. 4A shows a cross-section of a possible embodiment of an armoured wall part;

Fig. 4B shows a cross-section of this wall part close to a frame.

Fig. 1 shows a side view of a possible embodiment of a shelter 1 according to the invention, consisting of an outer wall 2 of metal plate, for instance an aluminium alloy, an inner wall 3 of metal plate, for instance an aluminium alloy, having therebetween a thermal insulation layer 4, here consisting of polyurethane foam. A number of openings are arranged in shelter 1, for instance a door opening 5 in which a door frame can be placed, a window opening 6 in which a window frame can be placed, and passage openings 7a, 7b, 7c, into which cable bushings can for instance be placed. Before delivery to the user, shelters of this type are generally subjected to a number of environmental tests which take account of condensation, rotting, oxidation and the adverse effects of fungus. In shelter 1 the frames of openings 5, 6, 7a, 7b, 7c likewise consist of metal plate and the frames are welded to outer wall 2 and inner wall 3. The corners in outer wall 2 and inner wall 3 are also welded where necessary, so that the entire surface of shelter 1 consists of metal plate which wholly encloses insulating layer 4. This effectively prevents rotting and fungus taking hold in shelter 1. An existing door frame, window frame and throughfeed panels can then be mounted in the frames of the openings.

Fig. 2A shows a cross-section of a possible embodiment of a frame of an opening in the shelter. Visible are aluminium outer wall 2, aluminium inner wall 3 and thermal insulating layer 4, as well as a part of a frame 8, here consisting of aluminium plate which is welded to outer wall 2 and inner wall 3 with respective welded seams 9a, 9b. A frame 10 can then be welded or screwed onto frame 8 in a manner which is further self-evident. In order to prevent the thermal insulation layer 4 consisting of polyurethane foam being damaged during welding, a recess 11 is provided around frame 8, this
recess 11 being filled with rockwool 12. It is of course possible to
manufacture the thermal insulation layer entirely from rock wool, although a
significant advantage of polyurethane foam is that it mutually connects outer
wall 2 and inner wall 3 and herein contributes to the mechanical strength of
shelter 1.

Fig. 2B shows a cross-section of an alternative frame of an opening in the
shelter, with aluminium outer wall 2, aluminium inner wall 3 and thermal
insulation layer 4, as well as a part of a frame 8, here consisting of
aluminium plate which is welded to outer wall 2 and inner wall 3 using
respective aluminium corner profiles 13a, 13b and with welded seams
9a,9b,9c,9d. In order to prevent the thermal insulation layer 4 consisting of
polyurethane foam being damaged during welding, a recess 11 is provided
around frame 8, this recess 11 being filled with rockwool 12.

Fig. 2C shows a cross-section of a further alternative frame of an opening in
the shelter, with aluminium outer wall 2, aluminium inner wall 3 and thermal
insulation layer 4, as well as a part of a frame 8, here consisting of an
aluminium U-profile 14 which is welded to outer wall 2 and inner wall 3 with
respective welded seams 9a,9b. In order to prevent the thermal insulation
layer 4 consisting of polyurethane foam being damaged during welding, a
recess 11 is provided around frame 8, this recess 11 being filled with
rockwool 12.

Fig. 3A shows a cross-section of a possible embodiment of a corner of the
shelter, with aluminium outer walls 2a,2b, aluminium inner walls 3a,3b and
thermal insulation layer 4. Aluminium outer walls 2a,2b are welded together
with a welded seam 15 and aluminium inner walls 3a,3b with a welded seam
16. In order to prevent the thermal insulation layer 4 consisting of
polyurethane foam being damaged during welding, a recess 17 is provided
in the corner, this recess 17 being filled with rockwool 18.

Fig. 3B shows a cross-section of an alternative embodiment of a corner of
the shelter, with aluminium outer walls 2a,2b, aluminium inner walls 3a,3b
and thermal insulation layer 4. Aluminium outer walls 2a, 2b are welded together with a corner profile 19a and welded seams 15a, 15b and aluminium inner walls 3a, 3b with a corner profile 19b and welded seams 16a, 16b. In order to prevent the thermal insulation layer 4 consisting of polyurethane foam being damaged during welding, a recess 17 is provided in the corner, this recess 17 being filled with rockwool 18.

Fig. 4A shows a cross-section of a possible embodiment of an armoured wall part, consisting of an outer wall 2 of metal plate, for instance an aluminium alloy, an inner wall 3 of metal plate, for instance an aluminium alloy, having therebetween a thermal insulation layer 4, here consisting of polyurethane foam. A layer 20 consisting of bullet-proof and/or splinter-proof material, here consisting of a per se known fabric of aramid fibres, is arranged between outer wall 2 and thermal insulation layer 4. Depending on the demands made of shelter 1, layer 20 comprises for instance 10-50 layers of aramid fabric, each having a weight of for instance 175 grams per square metre. For standard munitions it is generally possible to suffice with ten layers of aramid fabric, while thirty layers are generally sufficient for high-velocity munitions. The layers of aramid fabric are preferably embedded in an epoxy resin and in this way glued fixedly to the inner side of outer wall 2 so that the armour moreover makes a significant contribution toward the mechanical strength of shelter 1.

Fig. 4B shows a cross-section of this wall part close to a frame 8. In order to prevent the thermal insulation layer 4, consisting of polyurethane foam, and layer 20 consisting of aramid fabric being damaged during welding of welded seams 9a, 9b, a recess 11 is provided all around frame 8, this recess 11 being filled with rockwool 12.

Although only flat panels are shown in the above described possible embodiments, it is of course also possible to provide curved panels and curved wall parts in corresponding manner with a bullet-proof and/or splinter-proof layer without this entailing significant additional costs. This in contrast
to bullet-proof and/or splinter-proof layers which are based on the application of ceramic layers.
Claims

1. Shelter, comprising an outer wall of metal plate, an inner wall of metal plate and a heat-insulating layer between the outer wall and the inner wall, provided with at least one opening, characterized in that a frame of the at least one opening connecting the inner wall and the outer wall is manufactured from metal plate, and that the frame is welded all around to the inner wall and to the outer wall.

2. Shelter as claimed in claim 1, characterized in that the shelter has an at least substantially rectangular form and that the corners are formed by welded seams which connect parts of the inner wall or parts of the outer wall.

3. Shelter as claimed in claim 2, characterized in that the heat-insulating layer is manufactured from polyurethane foam.

4. Shelter as claimed in claim 3, characterized in that the heat-insulating layer around an opening or close to a corner is provided with a recess, this recess being filled with a mineral wool.

5. Shelter as claimed in any of the foregoing claims, characterized in that a layer of bullet-proof and/or splinter-proof material is arranged between the outer wall and the heat-insulating layer.

6. Shelter as claimed in claim 5, characterized in that the bullet-proof and/or splinter-proof material comprises aramid fibres.

7. Shelter as claimed in claim 6, characterized in that the bullet-proof and/or splinter-proof material comprises 10-50 layers of fabric of aramid fibres.
8. Shelter as claimed in claim 6 or 7, characterized in that the bullet-proof and/or splinter-proof material is glued against an inner side of the outer wall.

9. Shelter as claimed in claim 8, characterized in that the bullet-proof and/or splinter-proof material is glued against an inner side of the outer wall with an epoxy resin.

10. Method for providing with a bullet-proof and/or splinter-proof layer a wall or a panel comprising at least a first metal plate, an insulating layer and a second metal plate, characterized in that the bullet-proof and/or splinter-proof layer is arranged between the first metal plate and the insulating layer or between the second metal plate and the insulating layer.

11. Method as claimed in claim 10, characterized in that 10 to 50 layers of fabric of aramide fibres are arranged as bullet-proof and/or splinter-proof layer.

12. Method as claimed in claim 11, characterized in that using an epoxy resin the layers of fabric are glued together and glued onto an inner side of the first metal plate or the second metal plate.

13. Shelter, vehicle, vessel or aircraft provided with a wall or a panel manufactured according to the method as specified in any of the claims 10-12.