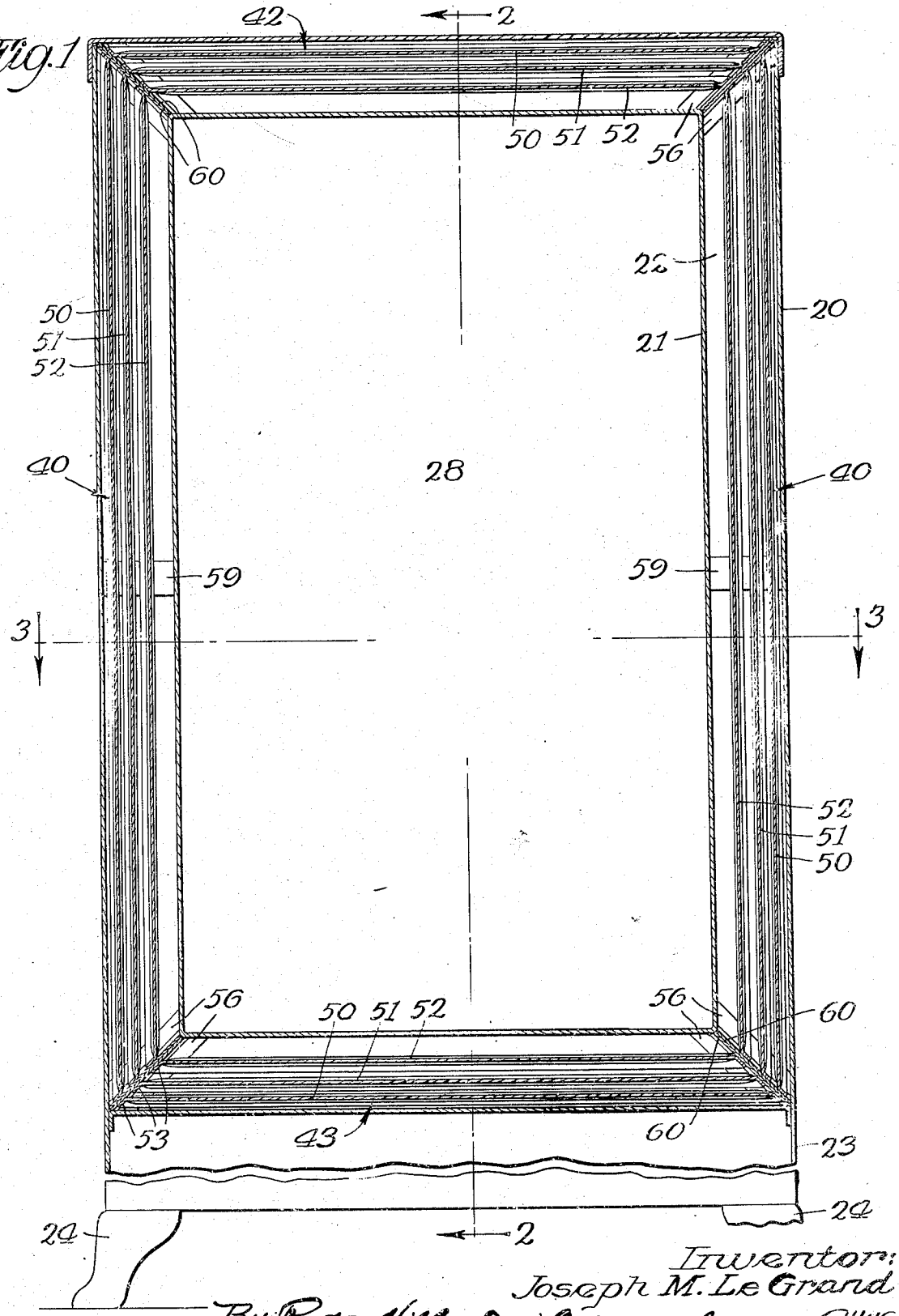
June 16, 1936. J. M. LE GRAND 2,044,731

THERMAL INSULATION STRUCTURE

Filed Feb. 7, 1934 8 Sheets-Sheet 1

Fig. 1



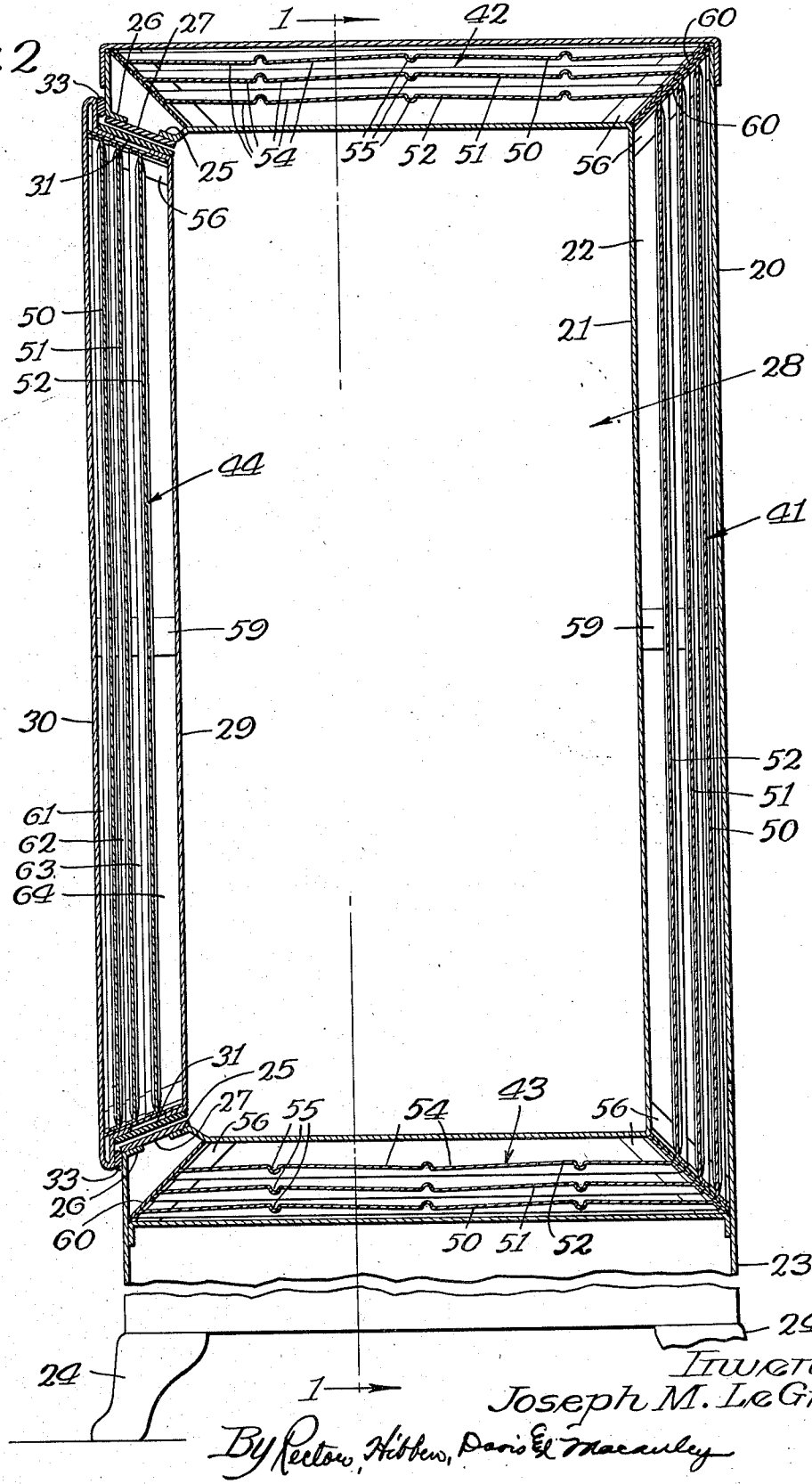
Inventor:
Joseph M. Le Grand
By Rector, Hibben, Davis & Macauley Attys.

June 16, 1936. J. M. LE GRAND 2,044,731

THERMAL INSULATION STRUCTURE

Filed Feb. 7, 1934 8 Sheets-Sheet 2

Fig. 2.



Inventor
Joseph M. LeGrand
By Rector, Hibben, Davis & Macauley Attys.

June 16, 1936. J. M. LE GRAND 2,044,731

THERMAL INSULATION STRUCTURE

Filed Feb. 7, 1934 8 Sheets-Sheet 3

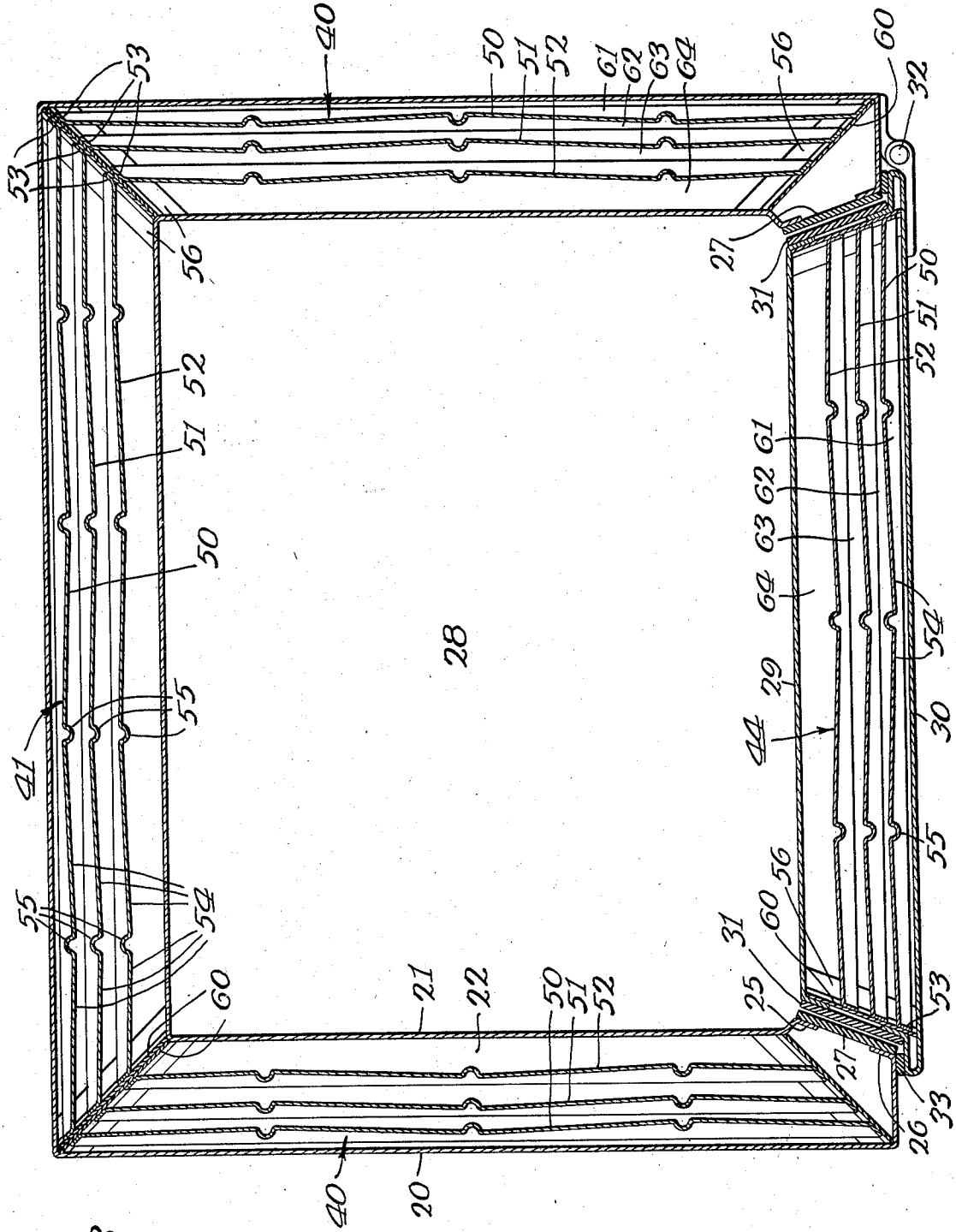


Fig. 3

Inventor
Joseph M. Le Grand
By Rector, Hibben, Davis & Macauley Attys.

June 16, 1936. J. M. LE GRAND 2,044,731

THERMAL INSULATION STRUCTURE

Filed Feb. 7, 1934 8 Sheets-Sheet 4

Fig. 4

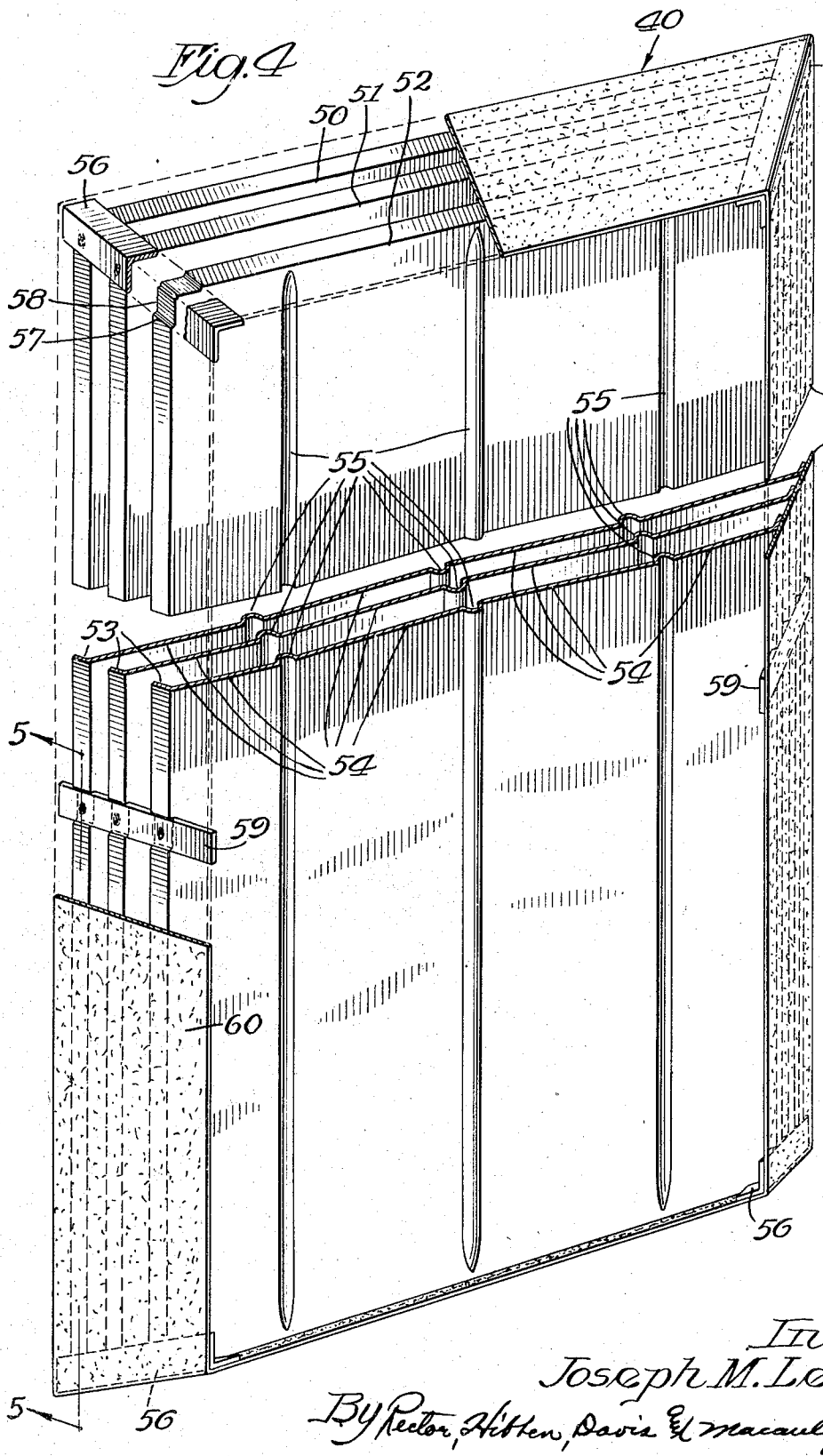
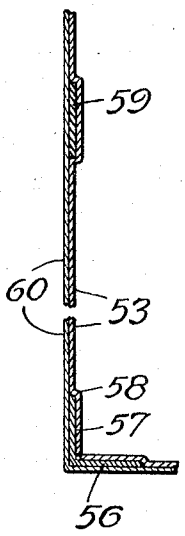


Fig. 5



Inventor
Joseph M. Le Grand
By Rector, Hibben, Davis & Macauley Attys.

June 16, 1936. J. M. LE GRAND 2,044,731

THERMAL INSULATION STRUCTURE

Filed Feb. 7, 1934 8 Sheets-Sheet 5

Fig. 6

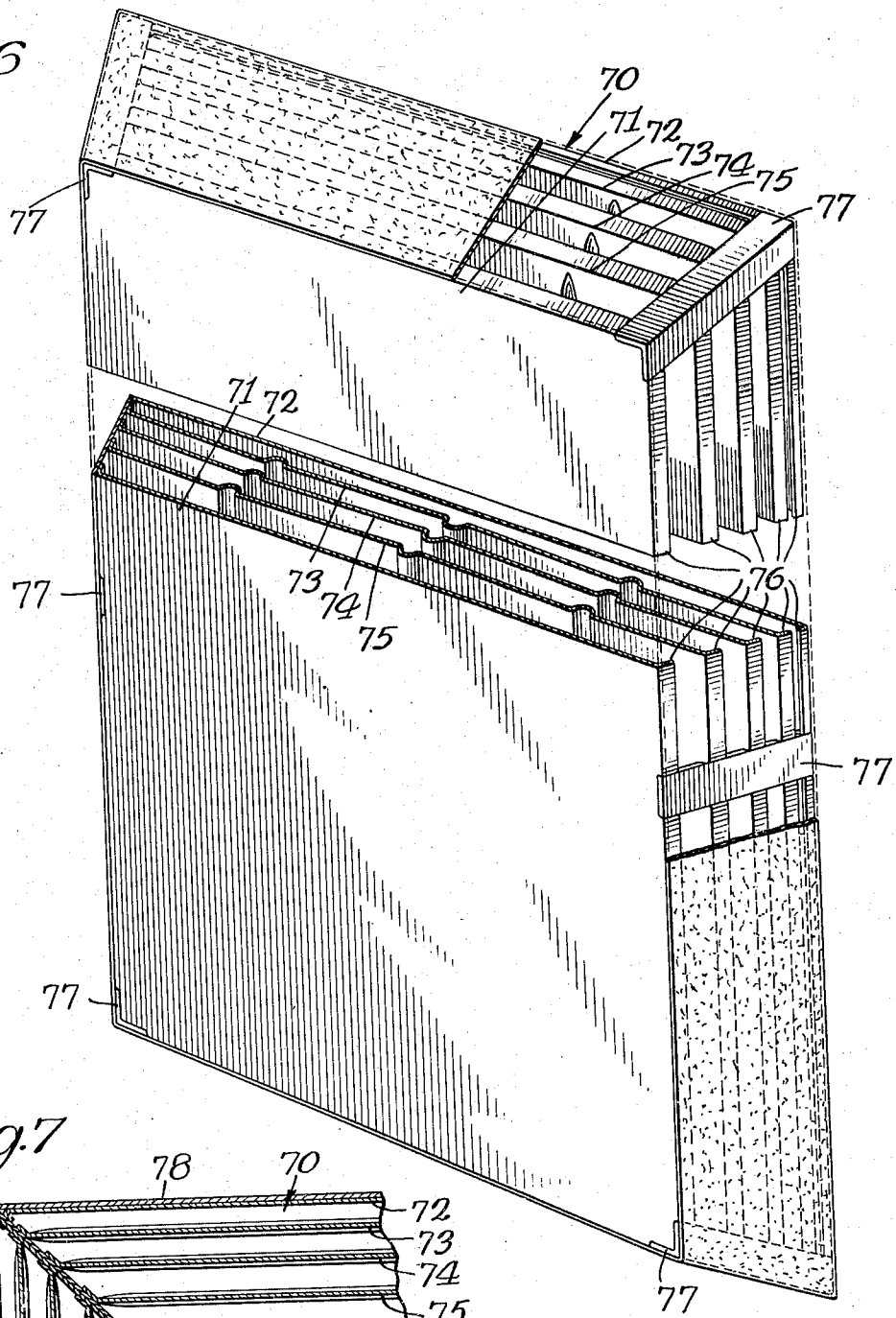
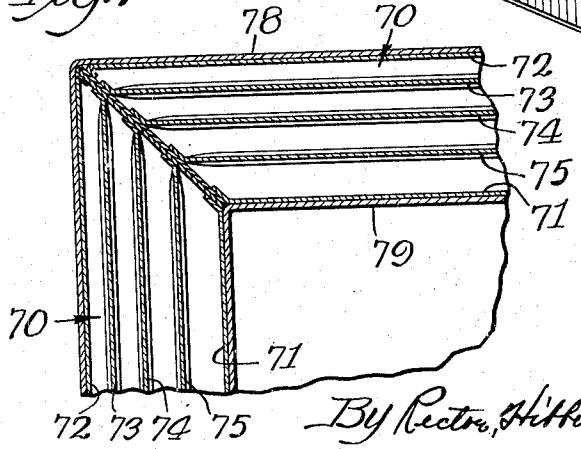


Fig. 7



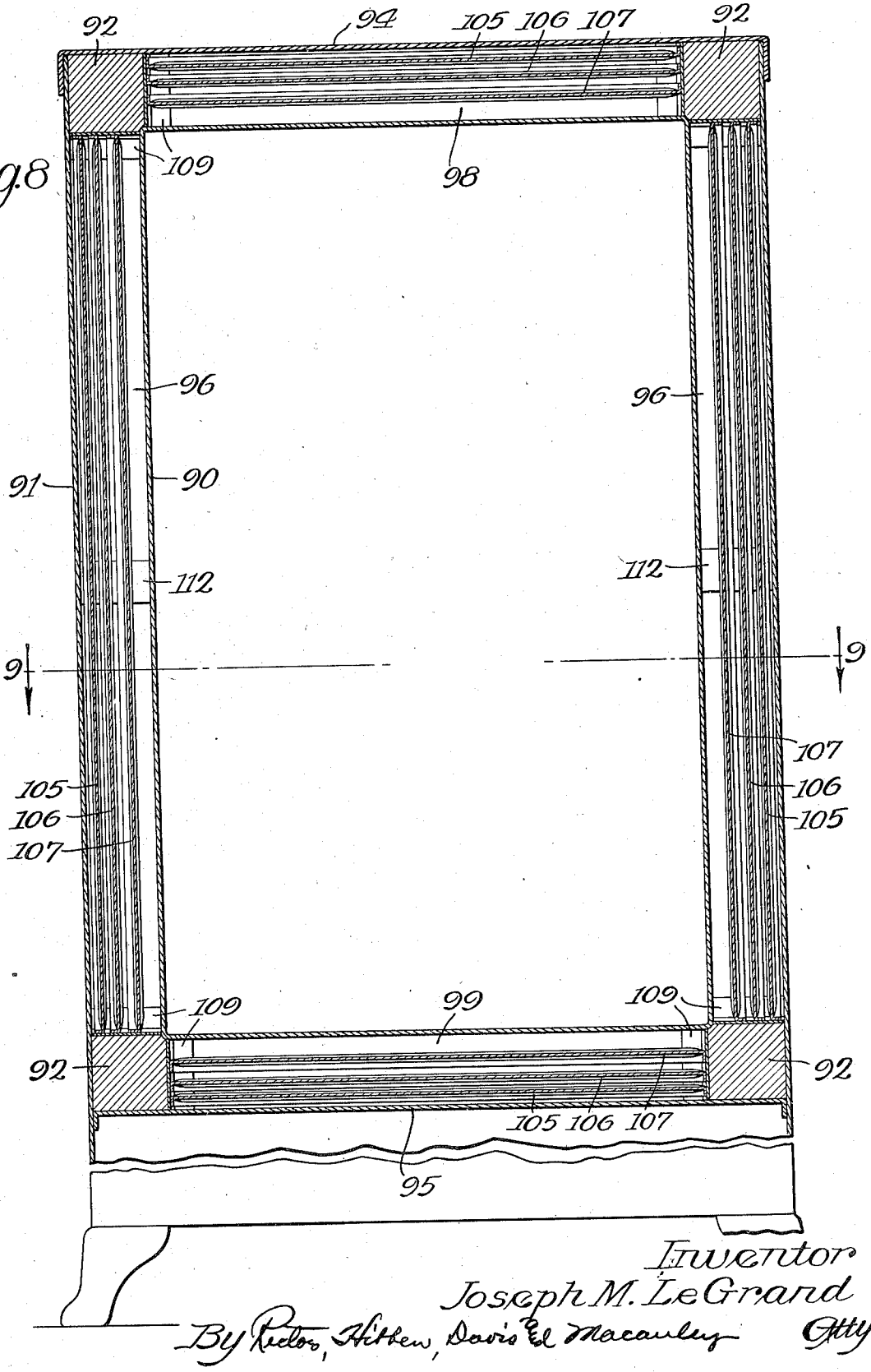
Inventor:
Joseph M. Le Grand
By Rector, Hibben, Davis & Macauley Attys.

June 16, 1936. J. M. LE GRAND 2,044,731

THERMAL INSULATION STRUCTURE

Filed Feb. 7, 1934 8 Sheets-Sheet 6

Fig. 8



Inventor
Joseph M. LeGrand
By Rector, Hibben, Davis & Macauley Attys.

June 16, 1936. J. M. LE GRAND 2,044,731

THERMAL INSULATION STRUCTURE

Filed Feb. 7, 1934 8 Sheets-Sheet 7

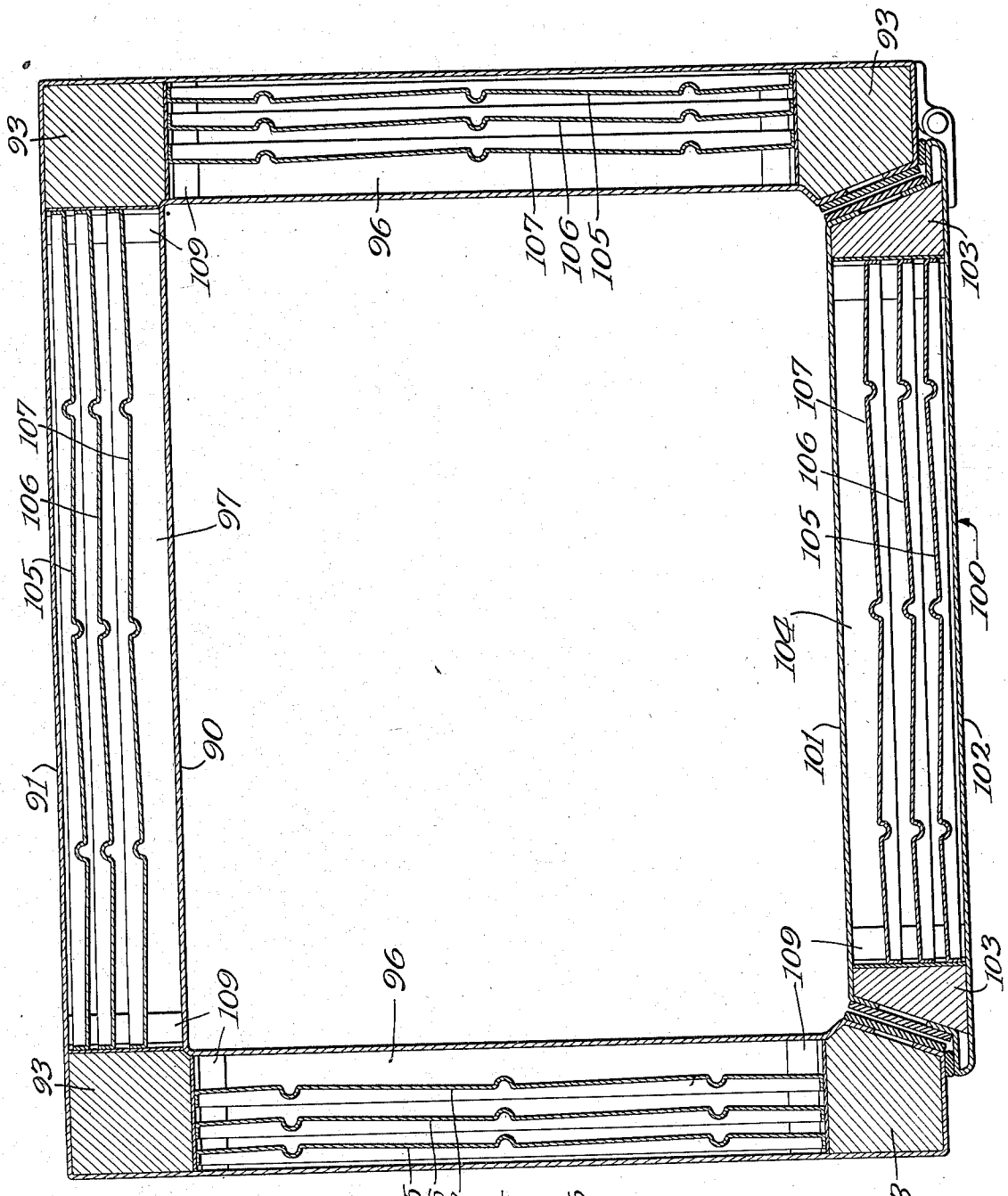


Fig. 9

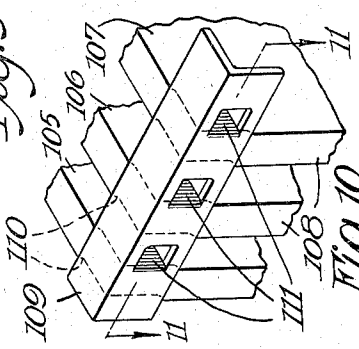


Fig. 10

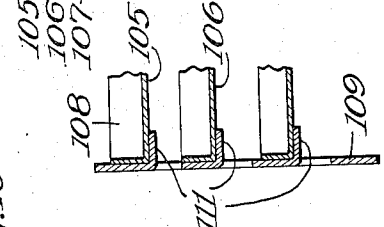


Fig. 11

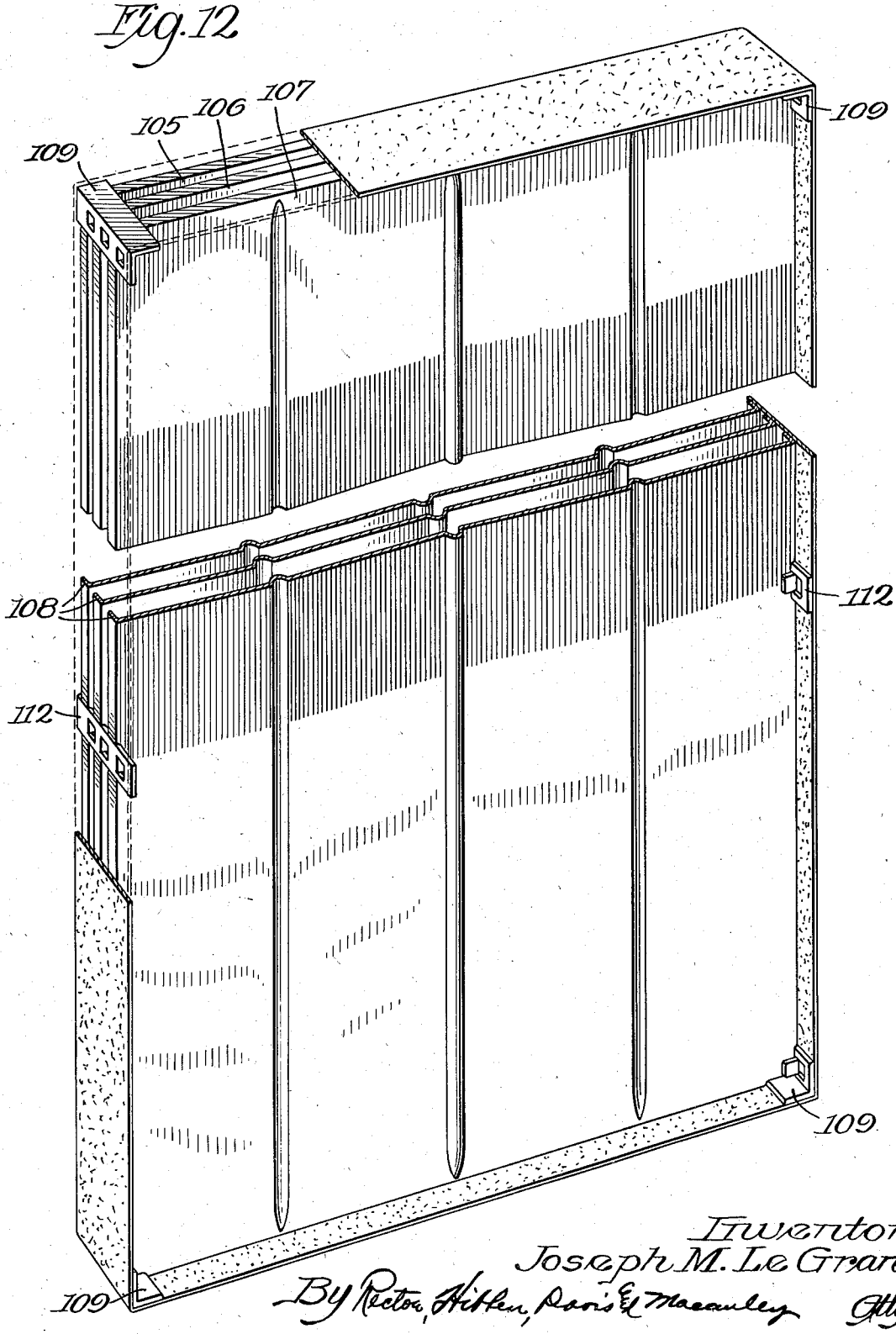
Inventor
Joseph M. LeGrand
By Rector, Hibben, Davis & Macauley Attys.

June 16, 1936. J. M. LE GRAND 2,044,731

THERMAL INSULATION STRUCTURE

Filed Feb. 7, 1934 8 Sheets-Sheet 8

Fig. 12



Inventor:
Joseph M. Le Grand
By Rector, Hibben, Davis & Macauley Attys.

Patented June 16, 1936 2,044,731

UNITED STATES PATENT OFFICE

2,044,731

THERMAL INSULATION STRUCTURE

Joseph M. Le Grand, Heathsville, Va.

Application February 7, 1934, Serial No. 710,131

28 Claims. (Cl. 189—1)

My invention relates generally to thermal insulation and it has to do more particularly with structure adapted to insulate against the transfer of heat through a space bounded by relatively higher and lower temperature areas.

One of the objects of the invention is to provide an improved structure of the foregoing character which is simple in construction, is easy and inexpensive to manufacture, is light in weight, and which insures high insulation efficiency at low cost to the user.

Another object is to provide an improved insulation structure embodying thermal insulation features disclosed in Letters Patent 1,910,703, granted to me on May 23, 1933.

A further object is to provide an improved all-metal insulation structure which is practically free from condensation effects, moisture absorption effects and other objectionable psychrometric conditions; which insures substantially uniform insulation effect throughout the entire structure insulated; and which is strong and durable and insures substantially uniform and maximum insulation results for the life of the structure insulated.

An additional object is to provide a closed insulating unit of package-like form which is light in weight, which may be easily and quickly applied to and removed from the structure to be insulated, and which may be readily packed and shipped.

Still another object is to provide an insulation structure including a plurality of units so constructed and arranged that they find support upon the walls defining the space to be insulated, the arrangement being such that heat loss by conduction through the points of support and through the unit as a whole is reduced to the minimum.

A more specific object is to provide an insulating unit consisting of a plurality of spaced sheets formed of a material possessing relatively low reflective characteristics when exposed to radiation of wave lengths within the visible portion of the electromagnetic spectrum and relatively high reflective characteristics when exposed to radiation of longer wave lengths than the visible portion of the electromagnetic spectrum, said sheets being held in desired spaced relation with respect to each other and the wall surfaces defining the space to be insulated by members formed of a metallic material of relatively low heat conduction capacity which are connected to said sheets at spaced points around the latter.

An additional object is to provide a unit of the foregoing character wherein the edges of the sheets throughout the width of the unit are bounded by a sheet of relatively thin, non-heat-conducting material, whereby the air spaces formed by said sheets and the wall surfaces defining the space to be insulated are sealed apart from each other and from the air spaces of adjacently disposed units.

Other objects and advantages will become apparent as this description progresses and by reference to the drawings wherein,—

Figure 1 is an elevational sectional view through one form of structure embodying my invention, said view being taken substantially on line 1—1 of Fig. 2;

Fig. 2 is an elevational sectional view taken substantially on line 2—2 of Fig. 1;

Fig. 3 is an enlarged plan sectional view taken substantially on line 3—3 of Fig. 1;

Fig. 4 is an enlarged perspective view of one of the insulation units shown in the previous figures, certain portions thereof being cut away and shown in section to more clearly illustrate the structure;

Fig. 5 is a section taken taken substantially on line 5—5 of Fig. 4;

Fig. 6 is a perspective view of another form of insulating unit embodying my invention, certain of the parts of the same being cut away and shown in section;

Fig. 7 is a fragmental sectional view of a walled structure, such as that shown in Fig. 1 illustrating units of the form of Fig. 6 applied thereto for insulation purposes;

Fig. 8 is an elevational sectional view of another form of structure embodying my invention;

Fig. 9 is an enlarged plan sectional view taken substantially on line 9—9 of Fig. 8;

Fig. 10 is an enlarged fragmental perspective view of a corner portion of the form of unit shown in Figs. 8 and 9;

Fig. 11 is a section taken substantially on line 11—11 of Fig. 10; and

Fig. 12 is an enlarged perspective view of one of the units shown in Fig. 9, certain of the parts thereof being cut away and shown in section.

In the drawings I have illustrated my invention as applied to different forms of household refrigerator cabinets. It is to be understood, however, that my invention is not limited to this particular use but that it has utility in numerous other instances where the advantages and results afforded thereby are desired; such, for example, as various other kinds of refrigerators, ice boxes, refrigerator cars, cold storage vaults, furnaces, boilers, buildings, bake ovens, driers,

hot rooms, railway cars, automotive vehicles, spray booths, air craft, vessels, etc.

The cabinet structure shown in Figs. 1 to 5, inclusive, takes the form of an outer shell 20 of rectangular shape in cross section and a similarly-shaped inner shell 21 defining a substantially continuous wall space 22 extending around the top, bottom side and rear walls of the cabinet. The vertical walls of the outer shell 20 are extended downwardly beneath its bottom, as at 23, to receive legs 24, for supporting the cabinet in an upright position. The front walls of both the inner and outer shells are provided with aligned openings (the outer of which is larger) surrounded, respectively, by flanges 25 and 26, which are joined together by a facing strip 27 which serves to support, in part, the shells 20, 21 in spaced relation with respect to each other. The facing strips 27 extend entirely around the shell openings and define a rather deep and wedge-shaped doorway through which access is had to the interior of the inner shell 21 which serves as a refrigerator compartment 28.

The door opening is adapted to be closed by a shell-like door comprising an inner wall 29 and an outer wall 30, both of which are provided with peripheral flanges to which facing strips 31 are secured to space apart the walls 29 and 30 and to provide an enclosed shell structure. The door is provided along one vertical edge with hinge structure 32, and along its opposite edge with suitable latch means (not shown) whereby the door may be opened and closed and latched in a manner which will be well understood. The outer door wall 30 is slightly larger than the outer part of the door opening so that it overlaps the outer shell wall 20 around the door opening. A bumper strip 33 formed of rubber, or other suitable material, is carried by the overlapping edge of the outer door wall 30 so that a substantially sealed closure will be effected when the door is closed and latched.

Thermal insulation means constructed and arranged in accordance with my invention is mounted within the cabinet wall space 22 and within the door space. This insulation means takes the form of a plurality of units of package-like form which are mounted within the space 22 in abutting relation with respect to each other and the inner and outer shell walls 21, 20. A single unit of this form is mounted within the door.

The insulation structure includes side wall units 40, rear wall unit 41, top unit 42, bottom unit 43 and door unit 44. These several units differ somewhat in outline dimensions to suit the dimensions of the particular wall space in which they are mounted; however, all of these units are of the same general form and construction and only one of them, therefore, will be described in detail.

The insulation unit (Fig. 4) comprises a plurality of metallic sheets 50, 51 and 52 which have the thermal insulation characteristics and properties disclosed in my said Letters Patent No. 1,910,703. More particularly, these sheets are formed of a material of sufficient thickness and stiffness to retain preformed shape; which material also possesses relatively low reflective characteristics when exposed to radiation of wave lengths within the visible portion of the electromagnetic spectrum and relatively high reflective characteristics when exposed to radiation of longer wave lengths than the visible portion of the electromagnetic spectrum. One material which possesses these characteristics, and which I preferably employ, is commercial black steel. This material is of a dull non-bright character which reflects a low percentage of visible light as distinguished from bright surfaces or materials such as aluminum foil, tin foil, etc. It will be understood, however, that, so far as certain of the structural features of my invention are concerned, any suitable material adapted to give adequate insulation value under the existent conditions of use may be employed without departing from my invention.

The metallic sheets 50, 51, and 52 are also, preferably, spaced apart in parallel relation in the manner taught by my aforesaid prior patent. That is to say, the sheets are so spaced apart that sheet 50 is located quite close to the outer shell 20 (or the higher temperature wall surface) and the other sheets are spaced progressively farther apart toward the inner shell 21 (or the lower temperature wall surface). Also, the sheets are so spaced with respect to the higher temperature wall surface that the central plane of the group of sheets is closer to the outer shell 20 (or higher temperature wall) than to the inner shell 21 (or lower temperature wall) and this central plane is spaced from the outer shell a distance which falls within the dimensional limits of less than one-half and more than one-third of the distance between the inner and outer shells 20 and 21 or the space-defining wall surfaces.

Each metallic sheet of the unit is of pan-like shape, having an angularly-disposed peripheral flange 53 therearound. Each sheet, in accord with the teaching of my prior Patent No. 1,910,703, is preformed to divide its body surface into a plurality of angular and intersecting plane surfaces 54, and alternately directed ribs 55 are provided at the intersections of the plane surfaces 54. By thus forming the sheet, the insulation efficiency of the unit is increased, the propagation of sound waves by vibration of the sheets is prevented and additional strength and rigidity is provided for in the sheet per se and in the unit as a whole.

The unit employed in the form of Figs. 1 to 5, inclusive, is miter-shaped being provided with mitered side edges so that, when the several units are assembled within the wall space 22 in abutting relation with respect to each other, a strong and substantially rigid structure will be provided for. In forming the miter-shaped unit, such as the unit 40 shown in Fig. 4, the sheets 50, 51, and 52 are, respectively, of progressively decreasing size so that when they are joined together in substantially parallel relation in unit fashion, the sides of the unit will be disposed at substantially 45 degrees with respect to the planes of the sheets.

The several sheets 50, 51, and 52 are joined together in the spaced relation hereinabove more particularly set forth by angled spacing members 56 located at the corners of the sheets. These spacing members are, preferably, formed of a high chrome nickel alloy which possesses approximately only one-third of the heat conduction ability of the material from which the sheets 50, 51, and 52 are formed. The corner portions 57 of the metallic sheets (Fig. 5) which receive the angled spacing members 56 are countersunk at 58 so that the outer surfaces of the spacing members 56 will lie substantially flush with the outer surfaces of the sheet flanges 53. The spacing members 56 are, preferably, secured to the sheet flanges by spot welding in

any suitable fashion. For example, the several sheets and spacing members may be assembled in a welding rack or jig which is shaped and sized to receive the different-sized sheets and to hold them in the proper spaced relation. The welding structure may be such that all of the sheets and spacing members may be welded at a single welding operation; or if desired, the spacing members may have tongues struck out therefrom in planes parallel with the planes of the sheets 53 in such positions as to properly space the sheets apart, such tongues being welded, or otherwise secured, to the sheets to hold the several parts in fixed assembled relation.

Since the spacing members 56 are located at the corners of the units they will be located at the corners of the shells when assembled in the latter, and these members are of such length that their ends extend beyond the sheets 50 and 52 to abut against the adjacent shell corners. The extent of projection of the opposite ends of the members 56 beyond the sheets determines the extent to which the plane surfaces of the sheets are spaced from the shell walls or surfaces defining the space to be insulated. In certain instances where the units are of considerable length, as for example, the side units 40, it may be desirable to employ additional edge supporting means to insure the desired rigid unit arrangement. To this end, I may employ intermediate strips or members 59 (Fig. 4) which are of the same material and are secured to the edge flanges 53 of the metallic sheets in the same manner as the corner members 56. These intermediate members 59 are also of the same length as the corner members 56 so that they abut the wall surfaces and insure the proper positioning of the intermediate portion of the unit within the space to be insulated.

In further carrying out my invention, it is desirable that the air spaces between the several metallic sheets be positively sealed from each other for reasons which will be well understood from my aforesaid prior patent. To that end, I, therefore, cover the miter edges of the unit with paper 60 or other suitable non-heat-conducting material. I have found that a gummed asphalt paper well serves this purpose. A mineral adhesive is applied to one side of the paper 60 so that it will adhere to the outer surfaces of the sheet flanges 53 and the spacing members 56 and 59. The sheet of paper 60 is of a width substantially equal to the length of the spacing members 56 and 59 so that not only the spaces between the sheets 50, 51, and 52 are sealed, but also the spaces defined by the sheets 50 and 52 and their adjacent wall surfaces (shells 20 and 21) are likewise sealed from the spaces between the sheets.

In Figs. 1 to 3, inclusive, I have illustrated the relationship of the several units when they are assembled in the cabinet structure. Due to the miter shape of the units, it will be seen (Fig. 1) that when the units are assembled in the space 22, the bottom edge portion of the side units 40 abut against the mitered side edges of the bottom unit 43. This is also true of the bottom edge portion of the rear wall unit 41 and the rear edge portion of the bottom unit 43. In this manner, the bottom unit serves, in effect, as a support for the side and rear units. The mitered edges of the top unit 42 abut the adjacent edges of the side and rear units 40 and 41 and the vertical mitered edges of the side units 40 abut the complemental vertical mitered edges of the rear unit 41, so that when all of the insulating units are assembled within the cabinet walls, a comparatively solid block-like structure is provided. The paper binding strip 60 around the several units serves to space apart the metallic surfaces of the units at the points where they abut each other, as well as to seal the air spaces of one unit from the air spaces of adjacent units.

The door insulation unit 44 is of the same general shape as the other cabinet wall units and it finds support upon the inner and outer door walls 29 and 30 in the same manner that the other units find support with respect to their adjacent wall surfaces.

When the units are thus assembled within the cabinet structure, it will be seen that the metallic sheet 50 of each unit is located comparatively close to the outer shell wall 20 or outer door wall 30, as the case may be, and that the other sheets bear the spaced relationship with respect to each other and to the shell walls which I have pointed out more particularly hereinbefore. They provide, in conjunction with the shell walls 20, 21, a plurality of uni-planar unobstructed insulating spaces 61, 62, 63, and 64 along the several walls of the cabinet which are substantially free from connection currents.

It is to be understood that, while I have found that in certain structures and in insulation spaces of certain widths three metallic sheets well serve the purpose, the number of metallic sheets may be varied without departing from my invention. If the number of sheets is increased or diminished, I preferably mount and space the same in the manner hereinabove described; and the unit, except for the number of sheets, remains substantially of the same construction as already described.

In some instances, it may be desirable to employ a unit wherein the several sealed air spaces corresponding to the spaces 61, 62, 63, and 64 of the form of Figs. 1 to 5, inclusive, are fully enclosed within the unit. In that case I preferably employ the structure illustrated in Figs. 6 and 7.

Specifically, the unit 70 (Fig. 6) is similar in all respects to the unit 40 of Fig. 4 except that metallic outer seal plates 71 and 72 are employed. These seal plates are of the same outline shape as the metal insulation sheets 73, 74, and 75 and they may be formed of the same metallic material as sheets 73, 74, and 75. Also, these seal plates may be plain-surfaces or ribbed, as desired. All of the sheets and plates of the unit are provided with angled edge flanges 76 to which high chrome nickel alloy members 77 are secured for holding the same in the desired substantially parallel and spaced relationship.

When the unit 70 is placed in the space to be insulated (Fig. 7), the outer plate 72 seats against the higher temperature or outer wall 78 and the other outer plate 71 seats against the lower temperature or inner wall 79. When several units 70 are assembled in the space to be insulated they bear the same relationship to each other as do the previously described units. Heat loss by conduction, regardless of the kind of material from which the walls 78 and 79 are formed, is kept at the minimum since the several sheets and plates are connected only by the low heat conducting spacing members 77.

Another form of cabinet structure which is well suited for household refrigerator purposes,

and to which my invention may be applied, is illustrated in Figs. 8 to 12 inclusive. Specifically, this cabinet structure takes the form of inner and outer shells 90 and 91 of rectangular shape in cross-section and formed, preferably, of metal. The inner and outer shells are spaced apart and supported by horizontal girts 92 and vertical posts 93 (Fig. 9) which together with the inner and outer shells 90 and 91, a top plate 94 and a bottom plate 95 define side, rear, top and bottom spaces 96, 97, 98, and 99. The girts and posts are formed, preferably, of a fibrous or the like material, which has comparatively low heat conduction capacity.

The door opening of this cabinet structure, and the door 100 for closing the same, are formed like those shown in Fig. 3. The space defined by the inner and outer door walls 101 and 102 receives vertical posts 103 and horizontal girts (not shown) which form an insulation space 104 similar to the insulation spaces formed in the cabinet walls.

The cabinet wall spaces 96, 97, 98, and 99 receive insulation units which are similar to the unit of Fig. 4, except that they are of rectangular-shape in cross section instead of miter-shape. In this form of unit (Fig. 12), the sheets 105, 106, and 107 are all the same size, each being provided with a substantially right-angled peripheral flange 108. The sheets are supported as a unit in spaced relation by angled corner members 109 which are fitted in countersunk corner portions 110 of the sheet so that their outer surfaces lie flush with the outer surfaces of the sheet flanges 108. Each of the corner members 109 is provided with a plurality of struck-out tongues 111 along its length and at such positions that, when the sheets are seated thereon, as shown in Fig. 11, the sheets are spaced apart the desired distance as explained in connection with the previously-described forms of my invention. The tongues 111 may be welded, or otherwise secured to the sheets to effect the permanent assembly of the parts. If desired, the tongues 111 may be omitted and the sheets may then be secured to the corner members 109 by welding as in the previously-described form. Or, tongues may be struck out from the sheet flanges 108 and interlocked with the corner members 109 in any desired manner, as by clinching, welding, etc. Intermediate support members 112 may be employed, if that is found desirable. These intermediate pieces are applied and secured in the same manner as the corner members 109 or in the manner described in connection with the members 59 of Fig. 4. Both the corner and intermediate spacer members are formed, preferably, of high chrome nickel alloy to minimize heat loss by conduction through these pieces which abut the inner and outer shells 90, 91 as in the previous form. The units are of such size that they fit snugly within the wall and door spaces 96, 97, 98, 99, and 104. Other than above described, this form of unit is of the same construction and arrangement as the previously-described units.

I believe that the operation, as well as the features and advantages, of my invention will be readily understood from the foregoing. The arrangements described provide for the near maximum insulation against the transfer of heat by radiation, convection, and conduction. The structure employed is quite simple, inexpensive materials are employed, and the units may be cheaply manufactured; thereby reducing the cost of insulated structures to the user. The package-form insulating units are light in weight and they may be easily and quickly installed. In the use of my invention, very light and inexpensive cabinet structures may be employed, the insulation structure being of such character as to give strength and rigidity to the structure as a whole. Heat loss by conduction through the units is reduced to the very minimum, due to the use of a very few supporting and connecting members which are of themselves low heat conductors. The structure is very durable and will function with substantially uniform efficiency throughout the life of the cabinet structure. The space insulated, in the use of my invention, remains practically free from condensate and the detrimental effects thereof. There are no parts in the insulation structure which will deteriorate and materially affect the insulation efficiency of the structure as a whole.

It is to be understood that while I have shown and described several forms of my invention, other changes in details and arrangements of parts may be made without departing from the spirit and scope of my invention as defined by the claims which follow.

I claim:

1. In structure of the class described, a plurality of walls each formed by spaced wall surfaces defining a space to be insulated, and means for thermally insulating each of said walls which comprises a plurality of spaced metallic sheets of sufficient thickness and stiffness to retain preformed shape, said sheets being so arranged that the sheet next to the higher temperature wall is comparatviely close thereto and the other sheets are spaced progressively farther apart toward the lower temperature wall, means located at spaced points around the periphery of said sheets and secured to said sheets for holding said sheets in said spaced relation, said means including members engaging said wall surfaces and for supporting said sheets as a unit upon said wall surfaces, and means formed of non-heat-conducting material mounted upon the peripheral edges of said sheets and upon said spacing means for sealing apart from each other the spaces between said sheets and between said sheets and wall surfaces.

2. In structure of the class described, a plurality of walls each formed by spaced wall surfaces defining a space to be insulated, and means for thermally insulating each of said walls which comprises a plurality of spaced metallic sheets which are formed of a material possessing relatively low reflective characteristics when exposed to radiation of wave lengths within the visible portion of the electromagnetic spectrum and relatively high reflective characteristics when exposed to radiation of longer wave lengths than the visible portion of the electromagnetic spectrum, and means located at spaced points around the periphery of said sheets and secured to said sheets for holding said sheets in spaced relation, said means including members engaging said wall surfaces and for supporting said sheets as a unit upon said wall surfaces.

3. In structure of the class described, a plurality of walls each formed by spaced wall surfaces defining a space to be insulated, and means for thermally insulating each of said walls which comprises a plurality of spaced commercial black steel sheets, means located at spaced points around the periphery of said sheets and secured

to said sheets for holding said sheets in spaced relation, said means including members engaging said wall surfaces and for supporting said sheets as a unit upon said wall surfaces, and means mounted over the edges of said sheets for sealing the spaces formed by said sheets and walls from each other.

4. In structure of the class described, a plurality of walls each formed by spaced wall surfaces defining a space to be insulated, and means for thermally insulating each of said walls which comprises a plurality of spaced metallic sheets arranged in group form, means located at spaced points around the periphery of said sheets and secured to said sheets for holding said sheets in such spaced relation that the central plane of the group of sheets is spaced from the higher temperature wall a distance which falls within the dimensional limits of less than one-half and more than one-third of the distance between said space-defining wall surfaces, said means including members engaging said wall surfaces and for supporting said sheets as a unit upon said wall surfaces, and non-heat-conducting means extending around the edges of said sheets sealing apart from each other the spaces formed by said sheets and walls.

5. In structure of the class described, a plurality of walls formed by spaced wall surfaces defining a space to be insulated, and means for thermally insulating said space which comprises a plurality of miter-shaped units each including a plurality of spaced metallic sheets which together with said space-defining wall surfaces define a plurality of air spaces, means surrounding the edges of said units for sealing said air spaces apart from each other, said units being so arranged that the miter edges of adjacent units abut each other, and means for spacing said sheets which also abuts the adjacent space-defining wall surfaces for support of said units in said space to be insulated.

6. In structure of the class described, a plurality of walls formed by spaced wall surfaces defining a space to be insulated, and means for thermally insulating said space which comprises a plurality of miter-shaped units each including a plurality of spaced metallic sheets which together with said space-defining wall surfaces define a plurality of disconnected air chambers, the arrangement being such that the miter edges of adjacent units abut each other and said units also abut the adjacent space-defining wall surfaces for support of said units in said space to be insulated, and a thin sheet of non-heat-conducting material secured around the miter edges of said units sealing said air chambers of each unit apart from each other and from the air chambers of the adjacent abutted units, and for insulating said units from each other.

7. In structure of the class described, a plurality of walls formed by spaced wall surfaces defining a space to be insulated, and means for thermally insulating said space which comprises a plurality of miter-shaped units each including a plurality of spaced metallic sheets which together with said space-defining wall surfaces define a plurality of disconnected air chambers, the arrangement being such that the miter edges of adjacent units abut each other, means secured to said units for support of said units in said space to be insulated, and a thin sheet of paper material adhesively secured around the miter edges of said units throughout the width of the latter, inclusive of said support means, sealing the air chambers of each unit apart from each other and apart from the air chambers of adjacent units and preventing metallic contact between abutting units.

8. In structure of the class described, spaced wall surfaces defining a space to be insulated, and means for insulating said space which comprises a unit including a plurality of spaced metallic sheets mounted substantially parallel with each other and said wall surfaces, a plurality of spacer members of a length substantially equal to the distance between said wall surfaces and to which the edge portions of said sheets are secured for holding said sheets in said spaced relation and in spaced relation to said wall surfaces, and a thin covering over the edges of said sheets and said spacer members sealing apart from each other the air spaces formed by spacing said sheets from each other and said wall surfaces.

9. In structure of the class described, spaced wall surfaces defining a space to be insulated, means for insulating said space which comprises a unit which includes a plurality of metallic sheets the outer of which are adapted to seat against said wall surfaces with the intermediate sheets spaced from each other and from said outer sheets, spacing members located at spaced points around and secured to the edge portions of said sheets for holding them in said spaced relation, and a thin non-heat-conducting covering around the edges of said sheets sealing the air spaces therebetween apart from each other.

10. In structure of the class described, means including a pair of substantially parallel spaced wall surfaces defining a closed space of substantially rectangular outline shape, and means for insulating said space which comprises a unit of substantially the size and shape of said space mounted in the latter, said unit including a plurality of spaced metallic sheets of substantially the outline shape and dimensions of said space, means for holding said sheets in spaced relation with respect to each other and said wall surfaces, and a thin non-heat-conducting material secured around the edges of said sheets sealing the spaces between said sheet and said wall surfaces apart from each other and also holding said sheet edges out of contact with said space-defining means.

11. In structure of the class described, means including a pair of substantially parallel spaced wall surfaces defining a closed space of substantially rectangular outline shape, and means for insulating said space which comprises a unit of substantially the size and shape of said space mounted in the latter, said unit including a plurality of spaced metallic sheets of substantially the outline, shape and dimensions of said space, spacer strips mounted at intervals around and secured to the edge portions of said sheets for holding said sheets in spaced relation with respect to each other and said wall surfaces, and a thin paper covering secured around the edges of said sheets sealing the spaces between said sheet and said wall surfaces apart from each other and also holding said sheet edges out of contact with said space-defining means.

12. In structure of the class described, vertical posts, horizontal girts, wall members supported by said posts and girts to define a closed space to be insulated, and means for insulating said space which includes a unit of the outline shape of said space adapted to fit therein, said unit including a plurality of metallic sheets, spacer

members secured around the edges of said sheets and engaging said wall members for holding said sheets in a predetermined spaced relation with respect to each other and said wall members, and means extending around the edges of all said sheets for sealing the spaces between said sheets and wall members from each other and for preventing contact between said sheets and said posts and girts.

13. A thermal insulation unit which comprises a plurality of metallic sheets of sufficient thickness and stiffness to retain pre-formed shape, means located at spaced points around said sheets for fixedly supporting said sheets in a predetermined spaced relation with respect to each other, and a thin covering secured to the edges of said sheets sealing the air spaces therebetween apart from each other and concealing said supporting means.

14. A thermal insulation unit which comprises a plurality of metallic sheets, spacing members located at spaced points around the peripheral edges of said sheets and to which said sheets are secured for fixedly supporting said sheets in a predetermined spaced relation, said members projecting beyond the planes of the outermost of said sheets for supporting said sheets as a unit in a space to be insulated, and a thin covering of non-heat-conducting material secured to the edges of said sheets and to said members sealing the air spaces formed by said sheets apart from each other.

15. A thermal insulation unit which comprises a plurality of metallic sheets of rectangular shape and of sufficient thickness and stiffness to retain pre-formed shape, spacing members connected to the corners of said sheets and projecting beyond the planes of the outermost sheets for holding said sheets as a unit in predetermined spaced relation with respect to each other and the surfaces defining the space to be insulated, and a covering secured over the edges of said sheets and over said spacing members.

16. A thermal insulation unit which comprises a plurality of spaced metallic sheets having normally a high heat conduction capacity and of sufficient thickness and stiffness to retain preformed shape, spacing members formed of a high chrome nickel steel alloy material secured to said sheets at spaced points around the edges thereof, and a relatively thin and non-heat-conducting covering secured over the edges of said sheets sealing the spaces between said sheets apart from each other.

17. A thermal insulation unit which comprises a plurality of spaced metallic sheets having normally a high heat conduction capacity, spacing members formed of a high chrome nickel alloy material of low heat conduction capacity secured to the corner portions of said sheets for holding the latter in a predetermined spaced relation, other spacing members of similar material connected to the edge portions of said sheets intermediate of and spaced from said corner spacing members, and a covering formed of a non-heat-conducting material secured over the edges of said sheets.

18. A thermal insulation unit which comprises a plurality of stiff spaced metallic sheets having normally a high heat conduction capacity, spacing members secured to said sheets for holding the latter in a predetermined spaced relation, all of said spacing members being countersunk within the edge portions of said sheets so that their outer surfaces are substantially flush with the edge surfaces of said sheets, and a thin non-heat-conducting covering secured over said sheet edges and said spacing members to seal the spaces between said sheets apart from each other.

19. A thermal insulation unit which comprises a plurality of stiff metallic sheets having edge flanges giving the same a pan-shape, spaced members against which said flanges seat for securing said sheets in a predetermined spaced relation, and a comparatively thin covering extending around the edges of said sheets and secured to said flanges for sealing apart from each other the spaces between said sheets.

20. A thermal insulation unit which comprises a plurality of stiff metallic sheets having edge flanges giving the same a pan-shape, spacing members against which said flanges seat for securing said sheets in a predetermined spaced relation, the opposite ends of said members extending beyond said sheets for spacing said sheets as a unit from surfaces defining the space to be insulated, and a comparatively thin covering of a width substantially equal to the length of said spacing members extending around the edges of said sheets and secured to said flanges and to said spacing members for sealing from each other the spaces between said sheets.

21. A thermal insulation unit which comprises a plurality of stiff metallic sheets normally of comparatively high heat conduction capacity, a plurality of means spaced apart and of comparatively low heat conduction capacity for spacing said sheets predetermined distances with respect to each other and surfaces defining the space to be insulated, and non-heat-conduction means covering the edge portions of said sheets and the spaces therebetween for sealing apart from each other the spaces defined by said sheets.

22. A thermal insulation unit which comprises a plurality of metallic sheets of sufficient thickness to maintain preformed shape and formed of a material possessing relatively low reflective characteristics when exposed to radiation of wave lengths within the visible portion of the electromagnetic spectrum and relatively high reflective characteristics when exposed to radiation of longer wave lengths than the visible portion of the electromagnetic spectrum, metallic members of relatively low heat conduction capacity secured at spaced points to said sheets to space the latter in a predetermined manner, and a non-heat-conducting covering for the edges of said sheets and the spaces therebetween.

23. A thermal insulation unit which comprises a plurality of metallic sheets of sufficient thickness to maintain preformed shape and formed of a material possessing relatively low reflective characteristics when exposed to radiation of wave lengths within the visible portion of the electromagnetic spectrum and relatively high reflective characteristics when exposed to radiation of longer wave lengths than the visible portion of the electromagnetic spectrum, means secured to said sheets at spaced points to space said sheets predetermined distances with respect to each other and the wall surfaces defining the space to be insulated, and separate means enclosing the edges of said sheets and sealing the spaces formed by said sheets apart from each other.

24. A thermal insulation unit which comprises a plurality of stiff spaced metallic sheets of similar shape and decreasing progressively in outline dimensions from one of the outermost sheets to the other outermost sheet, spacing members secured to said sheets at spaced points around the

edges of the latter to secure said sheets together in predetermined spaced relation and to form a miter-shaped unit, and means covering the sides of the unit and secured to the edges of said sheets for sealing the spaces between said sheets.

25. A thermal insulation unit comprising a plurality of metallic sheets and of sufficient thickness and stiffness to retain pre-formed shape, the outer of which are adapted to engage surfaces of the space to be insulated, spacing members of a length substantially equal to the width of the unit connected to said sheets at spaced points around said sheets for holding the latter as a unit in predetermined spaced relation with respect to each other, and a relatively thin covering of substantially the width of the unit secured around the edges of said sheets for sealing the air spaces therebetween.

26. A thermal insulation unit comprising a plurality of relatively stiff metallic sheets normally of relatively high heat conduction capacity, the outer of which are adapted to engage surfaces of the space to be insulated, spacing members formed of a material of relatively low heat conduction capacity and of a length substantially equal to the width of the unit connected to said sheets at spaced points around said sheets for holding the latter as a unit in predetermined spaced relation with respect to each other, and a relatively thin non-heat-conducting covering secured over the edges of said sheets throughout the width of the unit for sealing the air spaces therebetween.

27. A thermal insulation unit which comprises a plurality of stiff metallic sheets having their several edges provided with flanges, members located at spaced points around said flanged edges and welded thereto at predetermined positions along said members for holding said sheets in a predetermined spaced relation, and a covering mounted over the edges of said sheets throughout for sealing the air spaces therebetween, said means being secured to said flanges and to said members.

28. A thermal insulation unit comprising a plurality of stiff spaced metallic sheets, spacing members located at spaced points around said sheets, said members having sheet-supporting elements thereon which are spaced apart to predetermined extents, said sheets being seated upon and secured to said elements, and a cover member extending over the edges of said sheets substantially throughout the width of the unit for sealing the spaces between said sheets apart from each other.

JOSEPH M. LE GRAND.