Jan. 7, 1969 W. A. NOLAN 3,420,026

THERMAL INSULATING APPARATUS AND METHOD OF MAKING SAME

Filed Oct. 6, 1966 Sheet 1 of 4

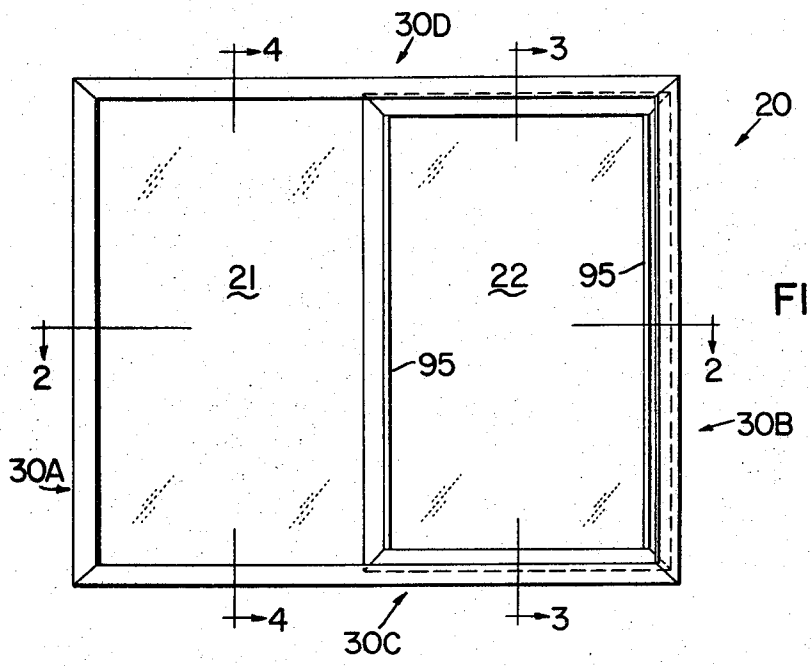

FIG-1

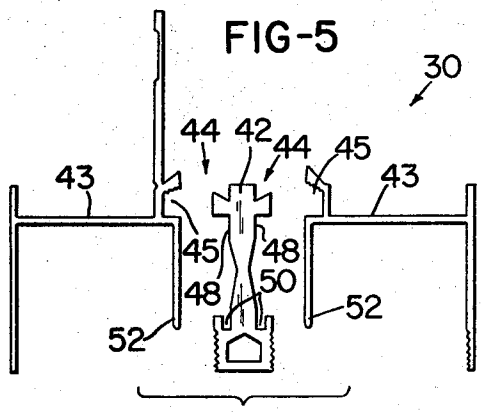

FIG-5

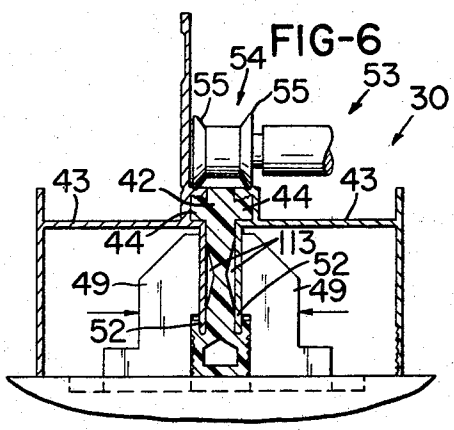

FIG-6

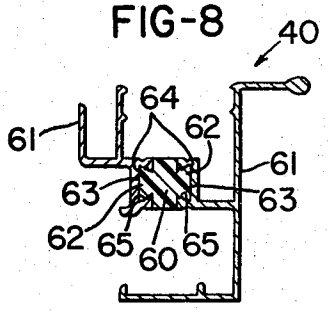

FIG-8

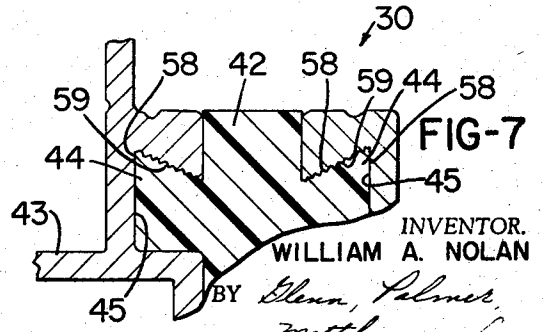

FIG-7

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THERMAL INSULATING APPARATUS AND METHOD OF MAKING SAME

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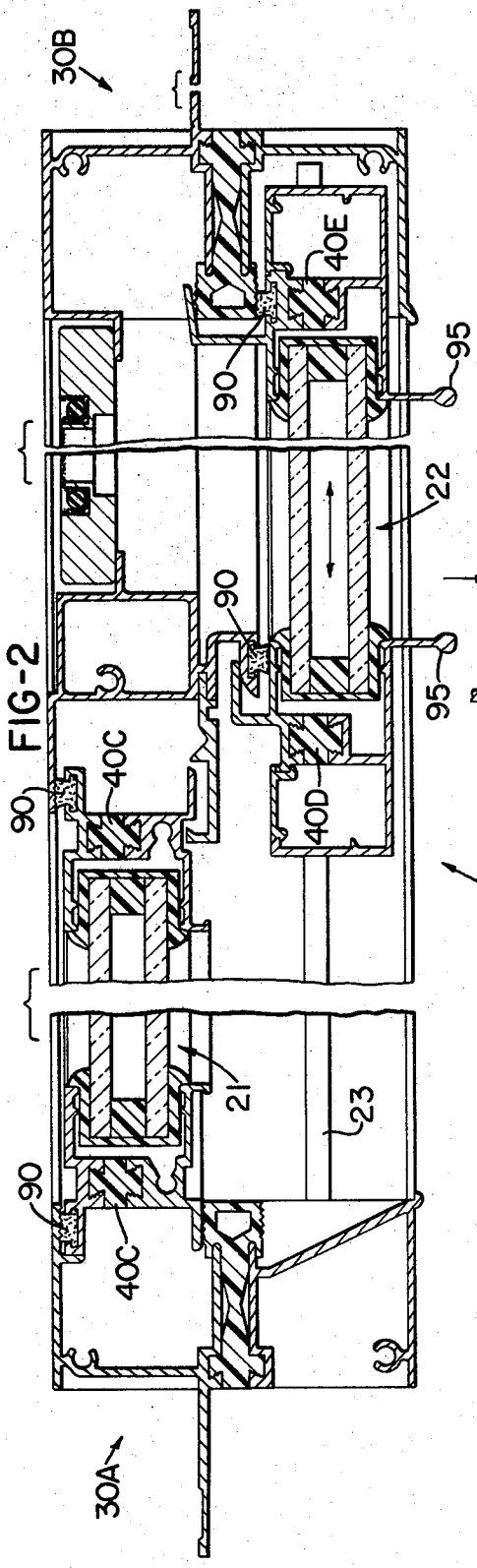

FIG-2

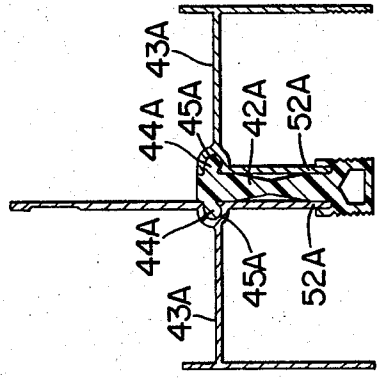

FIG-11

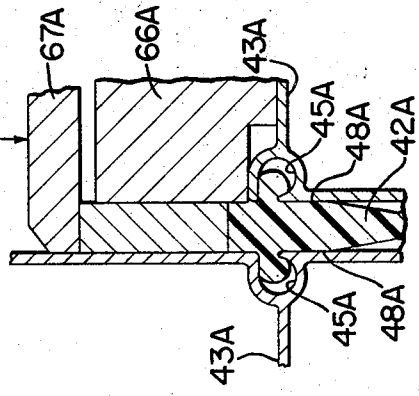

FIG-10

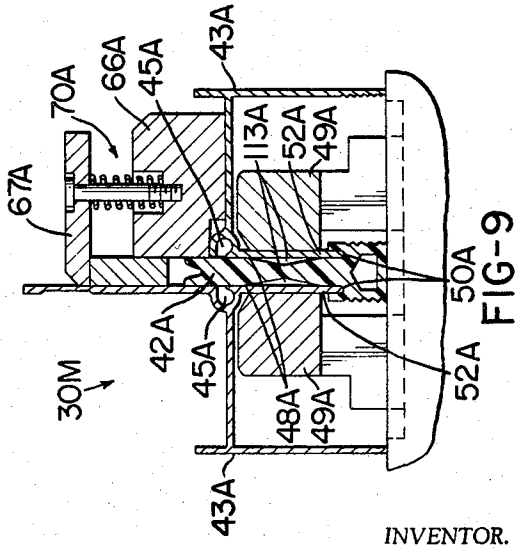

FIG-9

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THERMAL INSULATING APPARATUS AND METHOD OF MAKING SAME

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FIG-3

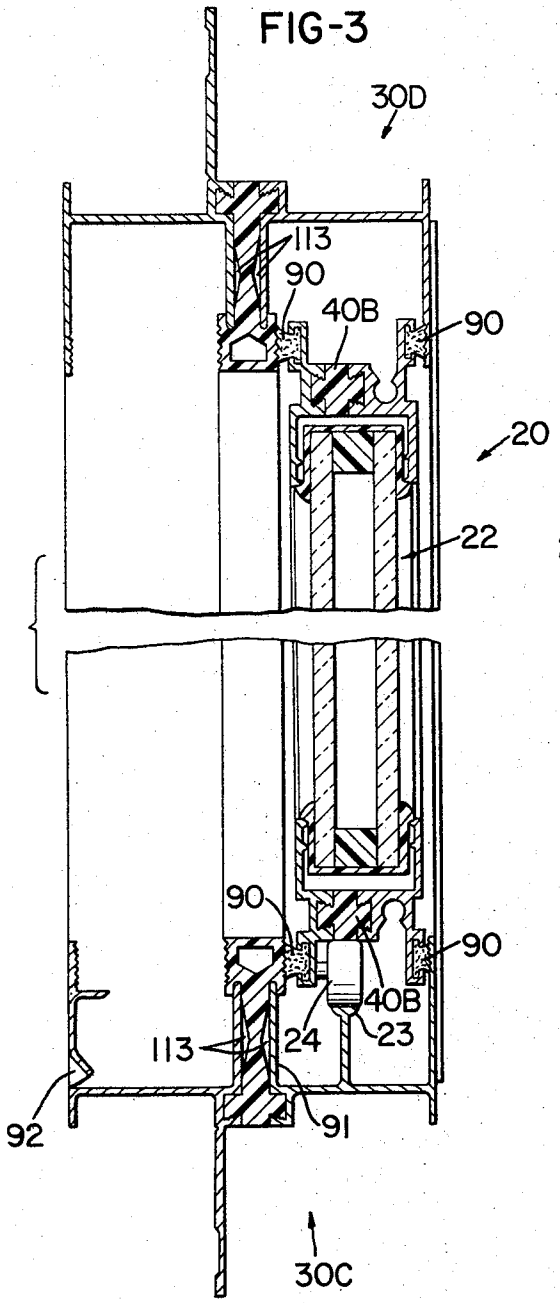
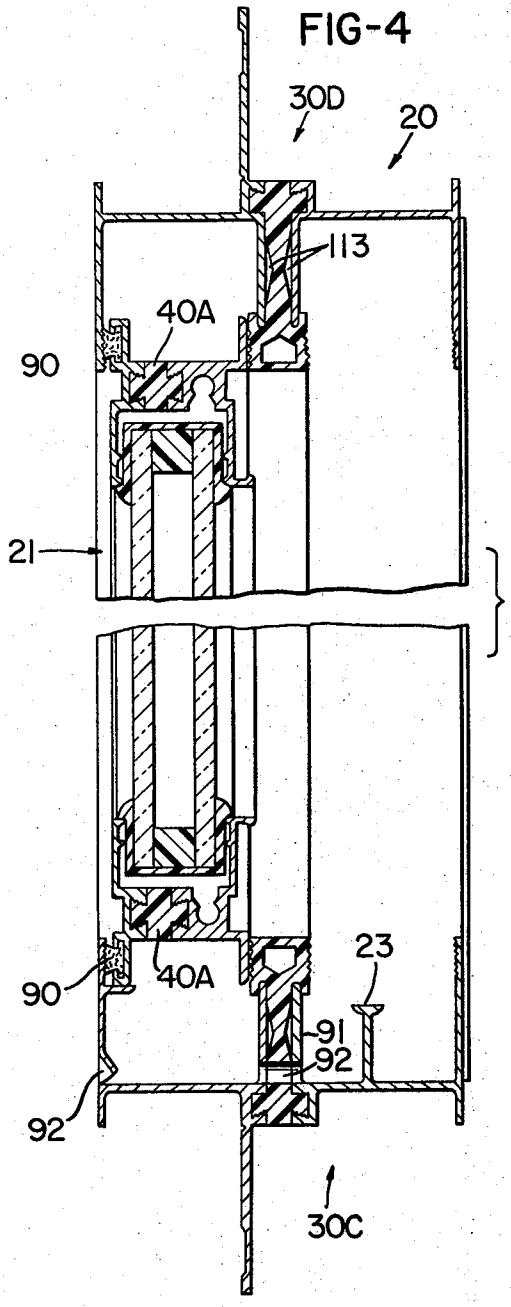


FIG-4



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THERMAL INSULATING APPARATUS AND METHOD OF MAKING SAME

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FIG-12

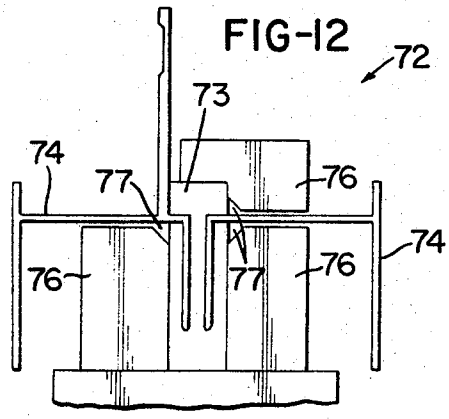


FIG-16

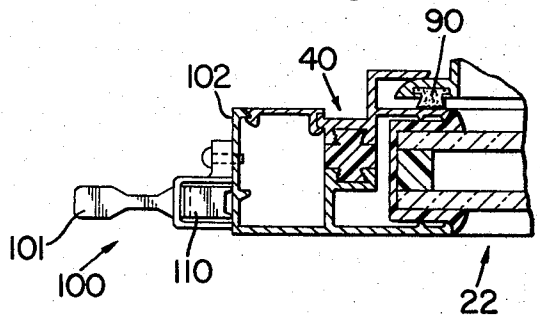
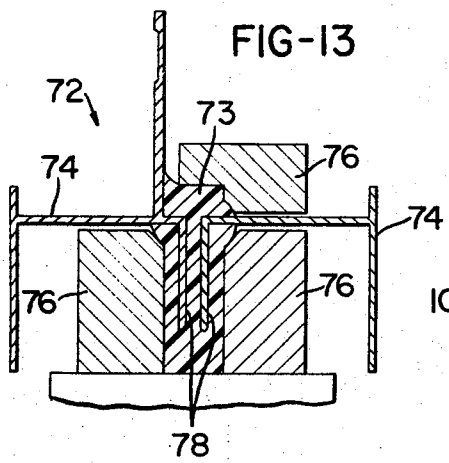


FIG-13



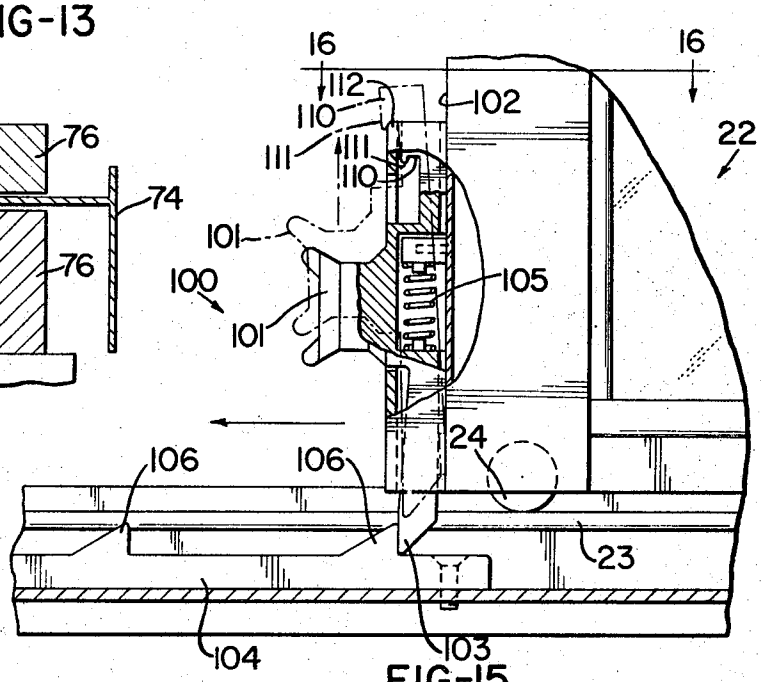
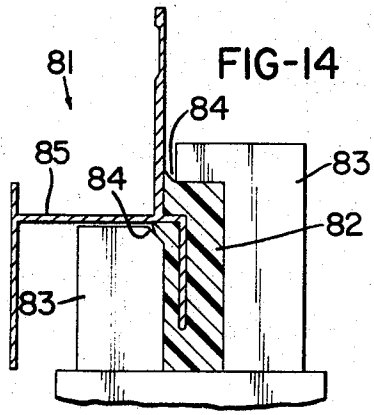


FIG-15

FIG-14



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United States Patent Office 3,420,026 Patented Jan. 7, 1969

3,420,026

THERMAL INSULATING APPARATUS AND METHOD OF MAKING SAME

William A. Nolan, Louisville, Ky., assignor to Reynolds Metals Company, Richmond, Va., a corporation of Delaware

Filed Oct. 6, 1966, Ser. No. 584,878
U.S. Cl. 52—403 18 Claims
Int. Cl. E04b 1/62

ABSTRACT OF THE DISCLOSURE

A thermal insulating apparatus of the type adapted to prevent or reduce condensation problems encountered in using metal frame windows, or the like. The apparatus utilizes metal member means having groove means therein which is deformed about cooperating projection means in thermal insulating member means without deforming such projection means to thereby provide an interlocked assembly which is nondemountable.

This invention pertains to thermal insulating means and more particularly to an apparatus for preventing free heat transfer between window or door means, or the like, and a supporting structure therefor.

It has been previously proposed to thermally isolate windows mounted in suitable metal frames from their supporting structure to eliminate condensation problems which often occur due to different temperature and relative humidity conditions present on the interior and exterior of such windows. The previously proposed techniques are generally complicated and expensive. In addition, the interlocking connection presently provided between a metallic structural member and a member providing thermal insulation is generally inadequate for optimum structural strength.

Accordingly, it is a feature of this invention to provide an improved thermal insulating apparatus adapted for use in window means, door means, or the like, which is of simple and economical construction.

Another feature of this invention is to provide an improved thermal insulating apparatus which provides the desired thermal isolation between a window unit, or the like, and its supporting structure while also providing optimum structural strength.

Another feature of this invention is to provide an improved thermal insulating apparatus having thermal insulating member means as an integral part of structural means thereof which is nondemountable in construction, provides optimum structural rigidity, and is assembled without deformation of such thermal insulating member means.

Another feature of this invention is to provide an insulating apparatus comprising metallic structural member means having thermal insulating member means extruded therearound to provide improved structural strength and thermal insulation.

Another feature of this invention is to provide an improved insulating apparatus comprising thermal insulating member means made from a thermoplastic material in which a portion thereof is heated to cause melting and plastic flow into associated groove means of metallic member means, such that upon cooling thereof a high strength interconnection and the desired thermal insulation are provided.

Another feature of this invention is to provide such thermal insulating apparatus utilizing thermal insulating member means having means therein enabling fastening of a plurality of associated metallic structural member means on spaced apart surface means of such thermal insulating member means lying in different planes.

Another feature of this invention is to provide an improved thermal insulating apparatus of the character mentioned constructed and arranged to provide air space means in addition to the insulating characteristics of thermal insulating member means provided as an integral part thereof to thereby provide improved thermal insulation.

Another feature of this invention is to provide an improved thermal insulating apparatus having groove means provided in metallic structural member means thereof adapted to be deformed by reducing the cross-sectional area thereof against projection means of an associated cooperating ridged thermal insulating member means without deforming such associating thermal insulating member means to thereby provide a strong interlocking connection.

Another feature of this invention is to provide an improved method of making a thermal insulating apparatus which is simple and economical and provides the desired insulation and structural support.

Another feature of this invention is to provide an improved method of making a thermal insulating apparatus utilizing die means to support an elongated structural member means as well as define channel means extending along selected portions of such structural member means and then placing a semimolten thermal insulating material within such channel means and allowing it to solidify, whereby a thermal insulating apparatus is provided which has improved structural integrity and improved thermal insulating qualities.

Another feature of this invention is to provide an improved method of forming a thermal insulating apparatus utilizing thermal insulating member means made of thermoplastic material in which a portion thereof is heated and allowed to plastic flow into cooperating groove means of adjoining metallic member means to provide improved interlocking and thermal insulation.

Another feature of this invention is to provide an improved method of permanently forming a thermal insulating apparatus which is nondemountable in nature and which is readily adaptable to forming window means, door means, or the like.

Therefore, it is an object of this invention to provide an improved insulating apparatus and an improved method of making such insulating apparatus having one or more of the novel features of this invention as set forth above or hereinafter shown or described.

Another object of this invention is to provide such improved apparatus for and method of making an insulating apparatus of the character described particularly adapted for use in constructing window means, door means, or the like.

Other objects, uses, and advantages of this invention are apparent from a reading of this description which proceeds with reference to the accompanying drawings forming a part thereof and wherein:

FIGURE 1 is a front view of a double section window construction having a single slidable window section adapted to slide horizontally.

FIGURE 2 is a sectional view on the line 2—2 of FIGURE 1, with parts broken away, illustrating the cooperating arrangement of the fixed and slidable window sections and the horizontal track upon which the slidable window section moves and particularly illustrating the use of a plurality of thermal insulating apparatus of this invention.

FIGURE 3 is a sectional view on the line 3—3 of FIGURE 1, with parts broken away, particularly illustrating the horizontally slidable window section and track therefor.

FIGURE 4 is a sectional view on the line **4—4** of FIGURE 1, with parts broken away, particularly illustrating the fixed window section of the double window construction of FIGURE 1.

FIGURE 5 is an end view of one exemplary embodiment of thermal insulating apparatus of this invention showing a central thermal insulating member means or member with structural member means or members arranged on both sides thereof prior to fastening such members together in a nondemountable manner.

FIGURE 6 is a sectional view showing the members of FIGURE 5 being suitably held together by clamping means and illustrating mandrel means used to deform selected portions of such structural members to interlock such structural members on either side of the central thermal insulating member.

FIGURE 7 is an enlarged fragmentary sectional view showing the metallic structural members interlocked in position against the central thermal insulating member, illustrating ridge means in the metallic structural members and insulating member to provide improved interlocking action, and particularly showing that such thermal insulating member is not deformed in order to provide such interlocking action.

FIGURE 8 is a sectional view illustrating another embodiment of thermal insulating apparatus of this invention having a central thermal insulating member and a pair of metallic structural members on either side thereof and illustrating such metallic structural members after groove means provided in each metallic member has been permanently deformed in position against associated projection means in the central thermal insulating member.

FIGURE 9 is a sectional view illustrating another embodiment of thermal insulating apparatus having a pair of metallic structural members with groove means therein being suitably clamped on opposite sides of a thermal insulating member made of a thermoplastic material and particularly illustrating the relative position of heating means used to heat an end portion of such thermoplastic insulating member to melt such end portion and cause plastic flow into such groove means.

FIGURE 10 is a fragmentary sectional view after the heating means has engaged such end portion of the central thermoplastic member and showing the groove means in each structural member partially filled with plastic material.

FIGURE 11 is a sectional view of the apparatus of FIGURE 9 completely assembled in interlocked relation.

FIGURE 12 is an end view illustrating a pair of elongated structural members supported by die means in parallel spaced apart relation wherein such die means define channel means around selected portions of such structural members to enable a semimolten thermoplastic material to be flowed through such channel means to surround such selected portions and then allowed to solidify to form another exemplary embodiment of the thermal insulating apparatus of this invention.

FIGURE 13 is a sectional view illustrating the pair of structural members of FIGURE 12 with thermoplastic material solidified around the selected portions thereof to define a thermal insulating apparatus having high strength.

FIGURE 14 is a sectional view illustrating a modification of the embodiment of this invention shown in FIGURE 13 wherein thermoplastic material is flowed and solidified around a portion of only one structural member.

FIGURE 15 is a fragmentary view with parts in elevation and parts in section illustrating another embodiment of means for sliding the sliding section of the window of FIGURE 1 and particularly illustrating lock means for locking such window in a fixed open position, to thereby enable further sliding movement thereof, or in a fixed closed position.

FIGURE 16 is a fragmentary sectional view on the line **16—16** of FIGURE 15 particularly illustrating one embodiment of the improved thermal insulating apparatus of this invention utilized in association with the apparatus of FIGURE 15.

While the various features of this invention are hereinafter illustrated and described as being particularly adaptable for providing an improved thermal insulating apparatus and a method of making such apparatus adapted for use in a window construction having a single slidable horizontal section, it will be appreciated that the various features of this invention can be utilized singly or in any combination thereof to provide a thermal insulating apparatus for windows, doors, or other similar constructions.

Therefore, this invention is not to be limited to only the embodiments illustrated in the drawings because the drawings are merely utilized to illustrate one of the wide variety of uses of this invention.

In the exemplary embodiment of this invention illustrated particularly in FIGURE 1 of the drawings, a window construction or window designated generally by the numeral **20** uitlizing the thermal insulating apparatus of this invention is illustrated. Window **20** has a pair of double thickness sections of glass panes comprising a fixed section designated by the numeral **21** and a movable section designated by the numeral **22.**

Window section **22** in this illustration is movable horizontally on track means shown as a horizontal track **23,** see FIGURES 2 and 3, suitably supported on the supporting structure for window **20.** Movable section **22** utilizes a plurality of rotatable roller means or rollers each designated by the numeral **24** which enable moving such window in a horizontal rectilinear path in an essentially frictionless manner.

As seen in FIGURES 2–4 of the drawings, several modifications of the thermal insulating apparatus of this invention are utilized in both the fixed window section **21** and the movable window section **22.** Such thermal insulating apparatus assures that condensation problems normally occuring due to different temperature and relative humidity environments on opposite sides of window **20** are essentially eliminated.

Window **20** has a pair of supporting frame means or side frame members at opposite side edges thereof designated generally by the numerals **30A** and **30B** and a bottom and top supporting frame member designated respectively by the numerals **30C** and **30D.** Members **30A–30D** support and thermally isolated window **20** about the entire outer periphery thereof in an associated supporting wall means using basically one embodiment of thermal insulating apparatus and such embodiment will be designated generally by the numeral **30** and shown in FIGURES 5–7.

The specific configuration of apparatus **30** shown in FIGURES 5–7 is of top frame member **30D;** nevertheless, the basic description will only be made once and is fully applicable to the other frame members **30A, 30B,** and **30C** by taking into account minor configurational changes in the metallic members of such other members.

Apparatus **30** has a thermal insulating member shown as a central insulating member **42** and structural member means shown as a pair of metallic structural members each designated by the numeral **43** and arranged on both sides thereof as seen in FIGURE 5. Thermal insulating member **42,** in this example of the invention, has first projection means or a projection shown as a wedge-like projection **44** extending from opposite side surface means thereof. Each metallic structural member **43** has first groove means **45** adapted to receive an associated projection means **44** therewithin upon being assembled together.

As seen in FIGURES 6 and 7 of the drawings, groove **45** is deformed around an associated projection **44** in a clamping manner without substantially crimping or deforming such projection to provide an interlocked assembly comprised of members **43** on either side of thermal insulating member **42.**

It will be appreciated that once groove 45 is deformed around an associated projection, portions of such groove of necessity contact such projection and may make minor indentations therein; nevertheless, the fastening action is provided by the interlocking configuration provided by ridged locking surface means shown as a ridge 58 in each projection 44 being interlocked by a cooperating ridged locking surface means shown as surface 59 of groove 45 upon deforming groove 45 into position about an associated projection, see FIGURE 7.

Once apparatus 30 is assembled and interlocked in the manner described, it is nondemountable, that is, it cannot be demounted or taken apart without damaging the various components comprising such nondemountable insulating apparatus 30. As used in this disclosure of the invention the word nondemountable emphasizes the fact that it is not normally expected that apparatus 30 or similar apparatus to be later described are to be taken apart or demounted once assembled to form integral units of the types shown. In fact any attempt to take apparatus 30 apart would probably result in sufficient damage to render the apparatus in question unuseable.

Each projection means 44, in the illustrated example, is provided in oppositely arranged surface means defining a pair of parallel spaced apart planes each designated by the numeral 48 in thermal insulating member 42. It will be appreciated that with this arrangement a metallic structural member 43 can be easily fastened in position on either side of member 42.

Member 42 also has groove means therein shown as a groove 50 adjoining each plane surface 48. Each groove 50 is adapted to receive an associated cooperating projection 52 provided in each member 43. Thus, it will be seen that interlocking of each structural member 43 with an associated side of the thermal insulating member 42 is provided by inserting projection 52 in an associated groove 50, placing groove 45 in clamping arrangement around an associated projection 44, and then deforming groove 45 about such associated projection to define spaced apart interlocking means at each side of thermal insulating member 42.

The manner of deforming groove 45 in surrounding relation about an associated projection 44 is seen in FIGURE 6. Projection 52 of each member 43 is placed in an associated groove 50 while groove 45 thereof is placed in surrounding relation around an associated projection 44. Clamping means shown as a pair of clamps each designated by the numeral 49 is provided for compressing and holding member 42 sandwiched between members 43 on opposite sides thereof.

With the assembly thus clamped together by clamps 49, mandrel means shown as a mandrel 53 having a rotatable spool-like end 54 is provided for deforming grooves 45 in position. End 54 has a pair of spaced apart edges each designated by the numeral 55. Each edge 55 engages and deforms a nondeformed leg of groove 45 of an associated member 43 to deform such leg against an associated projection 44 to provide a firm interlocked assembly as illustrated particularly in FIGURE 7 of the drawings.

The overall window 20 is isolated from its surrounding supporting wall structure by thermal insulating apparatus 30 in the form of frame members 30A–D; the detailed construction of which was previously described; however, each individual section 21 and 22 employs a plurality of additional thermal insulating apparatus each designated by the numeral 40 and shown in FIGURE 8. Each apparatus 40 is identical in basic performance to apparatus 30 and cooperates therewith to further assure window 20 does not have condensation problems.

As in the case of apparatus 30, apparatus 40, as used in window 20, has one basic configuration and several different modifications all of which have been given the same numeral designation followed by a different letter designation for each different modification. Insulating

apparatus 40A is used at the top and bottom of window section 21 and similarly apparatus 40B is used at the top and bottom of window section 22. An apparatus 40C is used at both side edges of window section 21; however, window section 22 employs an apparatus 40D along one side edge and another apparatus 40E along the opposite side edge.

The detailed description of apparatus 40 will be made referring to FIGURE 8 of the drawings; nevertheless, such description is fully applicable to each apparatus 40A–40E taking into account the minor variations in certain metal components in each instance.

Apparatus 40 employs a centrally arranged insulating member 60 and a pair of structural metallic members each designated by the numeral 61 arranged on either side thereof.

In a similar manner as discussed in connection with apparatus 30, each structural member 61 on opposite sides of member 60 is not of the same detailed configuration even though it carries the same numeral designation. However, it will be appreciated that for the purposes of this invention the thermal insulating apparatus is defined essentially by those portions of metallic members 61 immediately adjacent thermal insulating member 60 and by thermal insulating member 60 so that the detailed configuration beyond the immediate vicinity of the interlocked portions is not of paramount importance.

Thermal insulating member 60 has projection means 62, including ridged surface means such as a ridge 64, extending from each opposite surface thereof. Each metallic structural member 61 has groove means 63, including ridged surface means 65, cooperating with projection 62 and ridge 64 thereof such that upon deforming groove 63 around projection 62 in a manner as previously described in connection with groove means 45 (and using similar deforming apparatus) a nondemountable insulating apparatus having improved thermal insulating properties and improved structural strength is provided.

As in the case of the embodiment of apparatus illustrated in FIGURES 5–7, the embodiment of FIGURE 8 provides unique interlocking action without substantial deformation of projection means in the central thermal insulating member provided as an integral part thereof.

Another embodiment of thermal insulating apparatus of this invention similar to the embodiment of FIGURES 5–7 is illustrated in FIGURES 9–11 of the drawings. Because of the basic similarity of construction and operating performance, the overall insulating apparatus of FIGURES 9–11 will be designated generally by the same numerals 30 as before followed by the letter designation M in this latter embodiment. In addition, similar components of apparatus 30M even though not having the exact detailed configuration of corresponding components of apparatus 30 of the previous embodiment will be designated by the same numerals followed in this latter embodiment by the letter designation A and not described again.

Apparatus 30M comprises a central thermal insulating member 42A having a pair of essentially parallel spaced apart mounting surfaces 48A and groove means 50A adjoining each surface 48A. A structural member 43A is provided on each side of apparatus 30M and mounted against a surface 48A.

Each groove means 50A is adapted to receive a cooperating projection 52A provided in an associated metallic structural member 43A similar to member 43. Member 43A has groove means shown as a preformed groove 45A therein which is fixed in nature and not subjected to deformation as in the case of groove 45 of the previous embodiment and as will be readily apparent from the description which follows.

The thermal insulating member 42A has its projection means 44A defined therein in a unique manner. Member 42A is preferably made of a thermoplastic material and

once each projection means 44A is formed, it is not necessary to deform such member in order to provide a firm interlocking connection between members 43A and member 42A.

Clamping means is provided for clamping members 42A and 43A together and such clamping means comprises a cooperating pair of clamps each designated by the numeral 49A and corresponding to clamp jaws 49 of FIGURE 6.

Heating means is provided for heating an end portion shown as the top end portion of member 42A which is made of a thermoplastic material. The heating means comprises a heating block 66A and a heating plunger assembly 67A to heat the upper end portion of thermoplastic insulating member 42A.

Heating plunger assembly 67A is urged away from heating block 66A by spring means shown generally at 70A. Thus, contact is not made with the upper end portion of thermoplastic member 42A except by overriding spring means 70A and at such time as heating block 66A is arranged in confining relation against the upper end portion of thermoplastic member 42A.

Upon holding members 42A and 43A in clamping means 49A and applying heat through heating block 66A and heating plunger 67A, the upper end portion of thermoplastic block 42A is caused to melt and flow in a plastic manner into groove 45A provided in each of the members 43A to interlock the members together upon cooling of assembly 30M.

Once the hot plastic material flows into grooves 45A it is not further deformed but remains intact and cools to form a solid nondeformed projection 44A. The locking action provided by groove 45A in association with projection 44A is particularly illustrated in FIGURE 11 of the drawings and is similar in nature and function to the interlocking action provided and illustrated in FIGURE 7 of the drawings.

FIGURE 10 of the drawings illustrates the action of the heating block 66A and the heated plunger assembly 67A as the upper end portion of the thermoplastic thermal insulating member 42A starts to flow into associated grooves 45A. The interlocked arrangement is provided in each assembly 30M by the unique manner of forming such assembly yet without deformation of projection means 44A thereof.

In the exemplary embodiment of this invention illustrated in FIGURES 12 and 13 a thermal insulating apparatus designated generally by the numeral 72 is illustrated. Insulating apparatus 72 has a central thermal insulating member means or central insulating member 73 preferably made of a thermoplastic material and a pair of structural metallic members each designated by the numeral 74 are provided in spaced apart parallel relation adjacent opposite sides of member 73. Apparatus 72 is formed by extruding or flowing plastic material defining member 73 around selected portions of members 74 and allowing it to solidify to form integral unit or apparatus 72 having high strength.

Apparatus 72 is used practically interchangeably with apparatus 30 previously described. Also (as in previous embodiments) the metal structural members on each side of member 73 have the same numeral 74 even though they are not identical in configuration in every respect because the configuration thereof remote from member 73 is not critical insofar as this invention is concerned.

Die means designated by the numeral 76 is provided and preferably arranged so as to support structural members 74 in parallel spaced apart relation. Die means 76 is suitably constructed and arranged to define channel means within its central portion and in this exemplary embodiment of the invention such channel means has a substantially rectangular peripheral outline corresponding to the peripheral outline of member 73 as particularly illustrated in FIGURE 13 of the drawings.

Each structural member 74 is supported by die means 76 so that selected portions thereof are supported within the rectangular channel means of die means 76. In particular, each structural member 74 has projection means shown as a leg portion 78 which is arranged within such rectangular channel together with portions of each member 74 which adjoin an associated leg portion 78.

Leg portion 78 are arranged within the rectangular channel of die means 76 in parallel spaced apart relation and in this example thermoplastic material which is in a semi-molten or comparatively viscous state is flowed within such rectangular channel on both sides of each leg portion 78 as well as around portions of each member 74 adjoining an associated leg and allowed to solidify. The resulting apparatus or construction with the thermoplastic material solidified to define member 73 is shown in FIGURE 13.

Die means 76 has small groove means therein shown at a plurality of locations each designated by the numeral 77. Such groove means, in effect, increase the area of contact between thermoplastic member 73 and structural members 74 upon solidification of the semimolten plastic material and provide a construction having improved strength. As the semimolten plastic material flows within groove means 77, it tends to cool and solidify quite rapidly thereby tightly sealing the rectangular channel.

Once the thermoplastic material forming member 73 cools the die means 76 is easily moved away from the resulting thermal insulating apparatus 72.

A thermal insulating apparatus similar to apparatus 72 may also be formed using liquid plastic material which flows rather freely and then solidifies upon setting to define an integral unit similar to apparatus 72. In the case of such a free flowing plastic, die means 76 is placed snugly against portions of members 74 so as to define a comparatively tight rectangular channel means to confine the liquid plastic until it solidifies.

Another exemplary thermal insulating apparatus designated by the numeral 81 is shown in FIGURE 14 of the drawings. Apparatus 81 is formed in a similar manner as apparatus 72 and utilizes die means 83 to define a substantially rectangular channel means within which a selected portion of a single elongated structural member 85 is supported. Die means 83 has a plurality of groove means 84 which serve a similar function as groove means 77 provided in die means 76 as previously explained.

A thermoplastic material is flowed around the selected portions of member 85 within the rectangular channel defined by die means 83 and allowed to solidify to define thermal insulating member 82. The resulting apparatus is shown in FIGURE 14 with the thermoplastic material solidified in position.

It will be appreciated that in some applications only one elongated structural member is required having a portion thereof thermally isolated by placing a thermoplastic material therearound. The technique shown in FIGURE 14 enables thermal isolation of a portion of a structural member in a simple and inexpensive way.

Each thermal insulating apparatus 72 and 81 has been formed by extruding or flowing a thermoplastic material around structural member means and allowing it to solidify. However, it will be appreciated that it may be desirable in some applications to hold an elongated block of suitable plastic material in a suitable fixture and then mechanically force structural member means therethrough. Such mechanical forcing may be achieved to define elongated constructions similar in mechanical arrangement of components to apparatus 72 as well as similar to apparatus 81 and the length of the elongated constructions thus formed would of course depend on the application and the characteristics of the structural members and thermal insulating member utilized.

This forcing (extruding) technique may in some instances be used in conjunction with the extrusion forming of a metal structural member directly out of an extrusion die into an elongated block of plastic material,

provided that the temperature of the metal member as it leaves its die is compatible with the melting point of the plastic material.

Window **20** of this exemplary illustration of the invention employs double thickness glass panes in each section **21** and **22** and an air space is provided between the glass panes in each section for better thermal insulation. In addition, window sections **21** and **22** are each mounted against associated portions of apparatus **30C** and **30D** at the bottom and top thereof respectively using a pair of wick-like insulating strips therebetween for each window and each designated by the numeral **90**. A plurality of similar strips, each also designated by the numeral **90**, is also provided between opposite sides of window sections **21** and **22**, see FIGURE 2, and adjoining structure.

Each strip **90** may be made of any suitable material to provide a weathertight construction for window **20**. Also, the wick-like or yielding construction thereof provides a construction which is less likely to rattle.

There may be some tendency for slight condensation on surface means indicated by the numeral **91** in FIGURE 3, for example, In the event such condensation occurs it will be appreciated that the configuration of apparatus **30C** confines such condensation and weep holes each designated by the numeral **92** are provided in member **30C** to allow flow toward the outside of the window construction.

Movable window section **22** in this example of the invention is moved horizontally on track **23** by grasping handles **95** provided adjoining opposite side edges of section **22** and rolling such window along its track. In some applications of this invention it may be desirable to provide a movable window section which can be locked at a plurality of positions along its track to which it is moved. A window locking apparatus for this purpose is illustrated in FIGURES 15 and 16 of the drawings and designated by the numeral **100**.

Apparatus **100** is shown installed basically along one side edge of movable window section **22** and thus components of such window section, track, etc. which were previously described will not be described again although the same reference numerals will be used for identical members.

Apparatus **100** has a handle assembly **101** suitably fastened to a side edge indicated at **102** of window **22**. Assembly **101** has a downwardly projecting stop **103** which is adapted to engage a cooperating toothed strip **104** supported at the bottom of window **22** parallel to track **23**.

Assembly **101** with its stop **103** are suitably supported for vertical sliding movement and a suitably supported spring **105** yieldingly urges handle assembly **101** and its stop **103** downwardly against strip **104**.

Strip **104** has a plurality of spaced apart teeth **106** therealong and the action of spring **105** causes stop **103** to engage a tooth **106** and prevent window section **22** from being opened further. It will be noted that the configuration of the lower tip of stop **103** and the upper configuration of each tooth **106** is such that window section **22** can be pushed closed, with spring **105** being compressed as stop **103** is pushed to the right past a tooth, but (except by pulling up on handle assembly **101**) can not be opened further.

Handle assembly **101** has an upper projecting portion **110** having a downwardly hooking terminal end **111**. The hooking end **111** enables handle **101** to be fastened in its upper (unlocked) position over a cooperating projection **112** fixed to section **22** for free horizontal movement toward both an open position or a closed position.

Thus, it is seen that handle assembly **101** enables locking of window section **22** at a plurality of positions, corresponding to the number of teeth **106**, to prevent further opening thereof or it may be hooked open using hook **111** to prevent free movement in both directions. It will be noted that apparatus **100** utilizes thermal insulating apparatus **40** as a part thereof.

The manner of forming the improved apparatus **30** and **40** of this invention wherein a thermal insulating member is provided with preformed projections therein and then metallic members are clamped therearound by deforming groove means in such metal members makes it possible to provide an improved assembly without requiring that the individual components be precisely formed for sliding fit or the like. Also because the extent of deforming groove means of the metal members comprises deformation until contact is made with an associated thermal insulating member without appreciable deformation of such insulating member also makes it possible to reduce the control of dimensional tolerances on the mating members.

Each apparatus **30M**, **72**, and **81** is also easily formed in an inexpensive manner without precise dimensional control of component members as will be apparent from the drawings and previous description of such members.

Each exemplary apparatus **30** and **30M** of this invention is constructed for optimum thermal insulation. In each instance the central thermal insulating member is necked down in the form of an hour glass or the like. Upon interlocking a metallic member in position against surface **48** or **48A**, for apparatus **30** and **30M** respectively, a roughly triangular air space is provided between such central insulating member and the outer metallic member. Such triangular air space is designated by the numeral **113** in apparatus **30** and **113A** in apparatus **30M**.

The structural members employed in the various embodiments of insulating apparatus presented herein are all preferably made of metal containing aluminum thereby providing high strength, light weight, while being corrosion resistant.

The thermal insulating members of the various embodiments of this invention may be made of any suitable rubber-like or plastic material such as vinyl plastic, polyethylene, or the like, for example. The plastic material is usually of a type which is easy to mold or work and lends itself to being formed by extruding through suitable die means.

Terms such as "bottom," "top," "sides," "inside," "outside," etc. have been used throughout this application for ease of description and merely to correspond to the illustrations in the drawings. Such terms should not be considered as limiting the scope of this invention in any way.

Thus, it is seen that an improved nondemountable thermal insulating apparatus has been provided which is of simple and economical construction and which is particularly adaptable for use in constructing window means, door means, and the like.

Further, this invention provides an improved method of economically fabricating such apparatus.

While the form of the invention now preferred has been disclosed as required by statute, other forms may be used, all coming within the scope of the claimed subject matter which follows.

What is claimed is:

1. A thermal insulating apparatus comprising, thermal insulating member means, structural member means, first projection means in one of said member means, and first groove means in the other of said member means for receiving said first projection means therein to form said thermal insulating apparatus which is nondemountable in construction, said member means being interlocked together without substantially deforming said first projection means, said first projection means comprising said structural member means with said thermally insulating member means being formed with said first groove means as an integral part thereof by flowing liquid plastic material comprising said thermal insulating member means around said first projection means and allowing it to solidify to form said nondemountable apparatus.

2. An apparatus as set forth in claim 1 in which said structural member means comprises a pair of structural member means each having first projection means supported in parallel spaced apart relation to enable said liquid plastic material to surround both of said first projection means in a simultaneous manner and said solidified plastic material defining thermally insulating member means defines an interlocking thermally insulated interconnection between said pair of structural member means utilizing said thermal insulating member means as interconnecting junction means as well as insulating member means.

3. A thermal insulating apparatus comprising, thermal insulating member means, structural member means, first projection means in one of said member means, and first groove means in the other of said member means for receiving said first projection means therein to form said thermal insulating apparatus which is nondemountable in construction, said member means being interlocked together without substantially deforming said first projection means, said first projection means having first ridged locking surface means and said first groove means having second cooperating ridged locking surface means which is brought into locking engagement with said first ridged locking surface means by permanently deforming said first groove means into clamping engagement around said first projection means.

4. An apparatus as set forth in claim 3 in which said first projection means comprises a pair of said first projection means oppositely arranged on said thermal insulating member and each having said first ridged locking surface means and said first groove means and second locking surface means is provided in each structural member means of a pair of separate structural member means each cooperating with an associated projection means of said pair of first projection means to form a high strength nondemountable interlocking connection between said pair of structural member means.

5. A thermal insulating apparatus comprising, thermal insulating member means, structural member means, first projection means in one of said member means, and first groove means in the other of said member means for receiving said first projection means therein to form said thermal insulating apparatus which is nondemountable in construction, said member means being interlocked together without substantially deforming said first projection means, said first groove means being provided in said structural member means and said thermal insulating member means being made of a thermoplastic material having said first projection means integrally formed therein by heating an end portion of said thermoplastic material while confining said end portion to cause melting and plastic flow of said thermoplastic material into said first groove means to thereby interlock said member means upon cooling said thermoplastic material.

6. A thermal insulating apparatus comprising, thermal insulating member means, structural member means, first projection means in one of said member means, and first groove means in the other of said member means for receiving said first projection means therein to form said thermal insulating apparatus which is nondemountable in construction, said member means being interlocked together without substantially deforming said first projection means, one of said member means having said first projection means comprising first interlocking means thereof and having second groove means comprising second interlocking means thereof, and the other of said member means having said first groove means therein cooperating with said first projection means to form said first interlocking means and having second projection means cooperating with said second groove means to form said second interlocking means, whereby said first and second interlocking means provide a high strength interlocking action while enabling said member means to be interlocked together without said substantial deformation of said projection means.

7. An apparatus as set forth in claim 6 in which said one member means comprises said thermal insulating member means made of a thermoplastic material and said other member means comprises said structural member means having said first groove means provided therein, said thermal insulating member having said first projection means integrally formed therein by heating an end portion thereof while confining said end portion to cause melting and plastic flow of said thermoplastic material into said first groove means to thereby interlock said member means upon cooling of said thermoplastic material.

8. An apparatus as set forth in claim 6 in which said member means are interlocked by said first and second interlocking means to define a generally triangular air space therebetween to provide increased thermal insulation.

9. An apparatus as set forth in claim 8 in which said first projection means and said second groove means are provided in surface means of said thermal insulating member lying essentially in a first plane, identical first projection means and second groove means are provided in said thermal insulating member in a second plane spaced apart from said first plane, and wherein said first groove means and second projection means are provided in each of a pair of separate structural member means, whereby a high strength nondemountable interlocking connection is provided between said structural member means by interlocking associated portions thereof in said first and second planes.

10. A method of making a thermal insulating apparatus comprising the steps of, providing thermal insulating member means, providing structural member means, providing first projection means in one of said member means, providing first groove means in the other of said member means for receiving said first projection means therein, and interlocking said first groove means and said first projection means without substantially deforming said first projection means to provide an interlocked assembly defining said apparatus which is nondemountable in construction, and said step of providing first projection means comprises providing first projection means in said structural member means and said step of providing first groove means comprises the further step of forming said thermal insulating member means with said first groove means as an integral part thereof by flowing liquid plastic material comprising said thermal insulating member means around said first projection means and allowing it to solidify to form said nondemountable apparatus.

11. The method as set forth in claim 10 in which said step of providing structural member means comprises providing a pair of structural member means each made of metal and each having integral first projection means, and comprising the further step of supporting said pair of first projection means in parallel spaced apart relation to enable said liquid plastic material to surround both of said first projection means in a simultaneous manner and said solidified plastic material defining thermally insulating member means defines an interlocking thermally insulated interconnection between said pair of structural member means utilizing said thermal insulating member means as interconnecting junction means as well as insulating member means.

12. A method of making a thermal insulating apparatus comprising the steps of, providing thermal insulating member means, providing structural member means, providing first projection means in one of said member means, providing first groove means in the other of said member means for receiving said first projection means therein, and interlocking said first groove means and said first projection means without substantially deforming said first projection means to provide an interlocked assembly defining said apparatus which is nonde-

mountable in construction, and said step of providing first projection means comprises providing first projection means having first ridged locking surface means, said step of providing first groove means comprises providing first groove means having second cooperating ridged locking surface means, and said interlocking step comprises permanently deforming said first groove means into clamping engagement around said first projection means.

13. The method as set forth in claim 12 comprising the further steps of, providing forming roll means, providing clamping means for clamping said member means together, and said permanent deforming of said groove means is provided with said roll means while clamping said member means together with said clamping means.

14. The method as set forth in claim 12 in which said step of providing first projection means comprises providing a pair of said first projection means oppositely arranged on said thermal insulating member means and each having said first ridged locking surface means and said step of providing first groove means comprises providing second locking surface means in each structural member means of a pair of separate metal structural member means each cooperating with an associated projection means of said pair of first projection means to form a high strength nondemountable interlocking connection between said pair of structural member means.

15. The method as set forth in claim 14 in which said thermal insulating apparatus thus made is adapted for use in providing thermal barrier means in window means, and said step of providing thermal insulating member means comprises providing such member means capable of serving the dual function of providing a structural interconnection as well as thermal insulation.

16. A method of making a thermal insulating apparatus comprising the steps of; providing thermal insulating member means; providing structural member means; providing first projection means in one of said member means; providing first groove means in the other of said member means for receiving said first projection means therein; and interlocking said first groove means and said first projection means without substantially deforming said first projection means to provide an interlocked assembly defining said apparatus which is nondemountable in construction; said step of providing first groove means comprises providing said first groove means in said structural member means; said step of providing thermal insulating member means comprises providing said thermal insulating member means made of a thermoplastic material; and said interlocking step comprises the further steps of, providing heating means, and heating an end portion of said insulating member means while confining said end portion to cause melting and plastic flow thereof into said first groove means, whereby said first projection means is integrally formed in said first groove means in an intact manner to interlock said member means upon cooling of said thermoplastic material.

17. A method of making a thermal insulating apparatus comprising the steps of, providing thermal insulating member means, providing structural member means, providing first projection means in one of said member means, providing first groove means in the other of said member means for receiving said first projection means therein, and interlocking said first groove means and said first projection means without substantially deforming said first projection means to provide an interlocked assembly defining said apparatus which is nondemountable in construction, one of said member means being made of a thermoplastic material and having said first projection means comprising first interlocking means thereof and also having second groove means comprising second interlocking means thereof, and the other of said member means being made of metal and having said first groove means therein cooperating with said first projection means to form said first interlocking means and also having second projection means cooperating with said second groove means to form said second interlocking means, and said interlocking step comprises interlocking said second interlocking means first followed by interlocking said first interlocking means, whereby a high strength interlocked connection is provided without said deformation of said projection means.

18. The method as set forth in claim 17 in which said one member means has a roughly triangular indention along first surface means thereof and said other member has planar surface means which is arranged adjoining said first surface means upon interlocking said member means during said interlocking step to thereby define a triangular air space therebetween which provides increased thermal insulation.

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