United States Patent

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[54] **INSULATED WINDOW ASSEMBLY WITH MOVABLE SASH**
17 Claims, 6 Drawing Figs.

[52] U.S. Cl. **49/404,** 52/403
[51] **Int. Cl.** **E06b 1/32**
[50] **Field of Search** ..... 49/404, 504, DIG. 1; 52/202, 207, 212, 393, 403, 656, 476

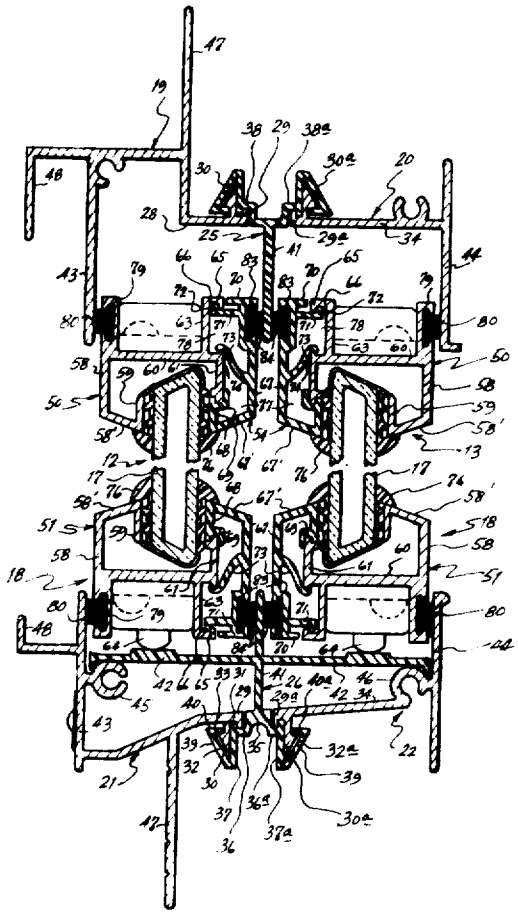
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Primary Examiner—J. Karl Bell
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ABSTRACT: In a window assembly having an outer frame within which inboard and outboard lapping sashes are mounted for horizontal or vertical relative movement, the outer frame includes interior and exterior metal frame members and a rigid plastic or other nonmetallic thermal barrier member therebetween connecting the metal frame members in thermally insulated relation to each other, each sash includes an inner frame embracing the periphery of a glass or other panel and constituted by a metal frame member and a rigid plastic or other nonmetallic thermal insulating frame member respectively defining the entire opposite lateral surfaces of the frame, and the inboard and outboard sashes have their insulating frame members at their exterior and interior sides, respectively, so as to be adjacent to the thermal barrier member of the outer frame. The insulating frame member of each sash desirably includes a web or webs defining the respective lateral surface of the sash frame and flanges extending therefrom and having free marginal portions interlocking with the metal sash frame member to substantially space the latter from the web and to cooperate with the web and the metal frame member in defining cavities therebetween.



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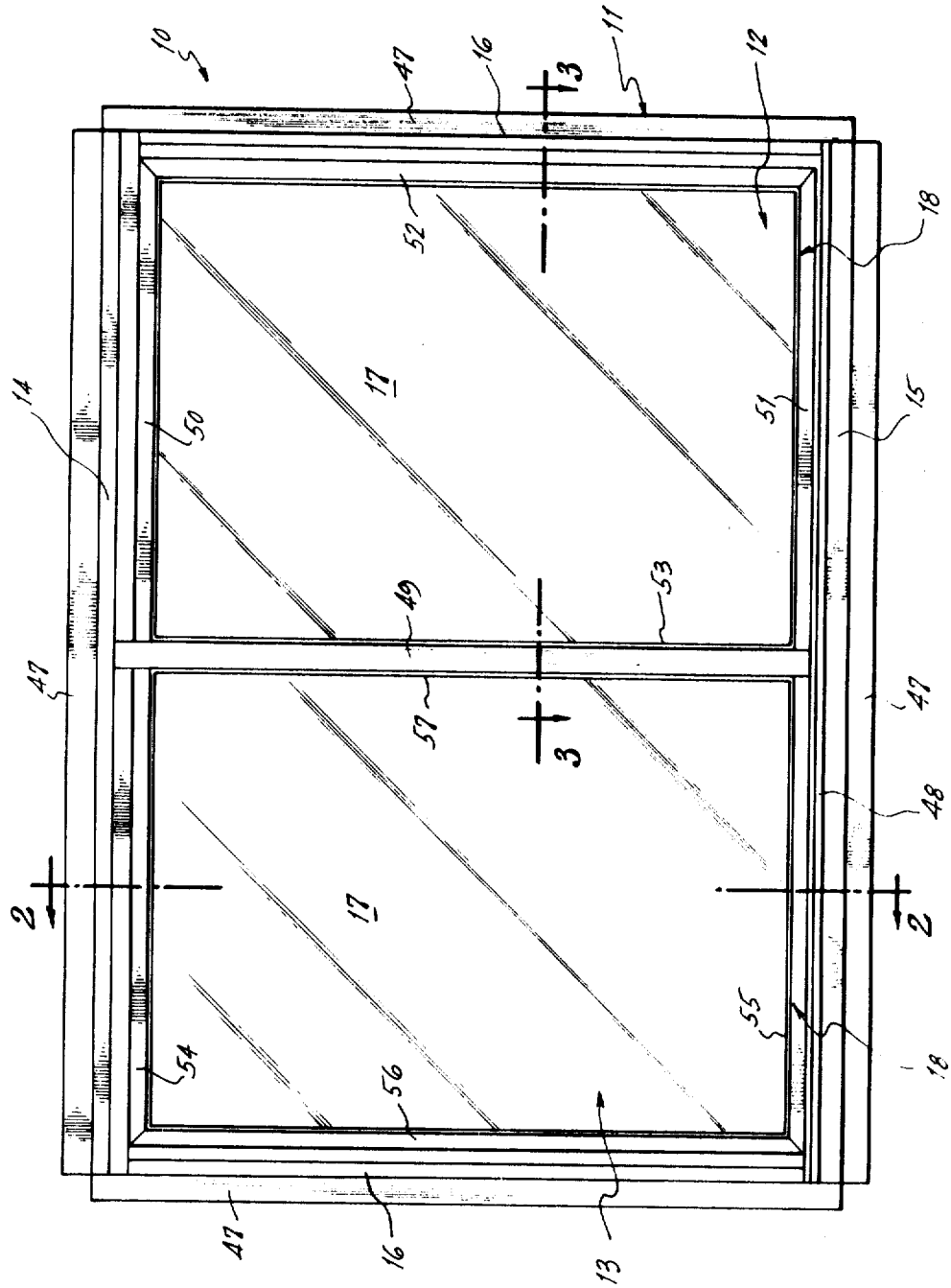
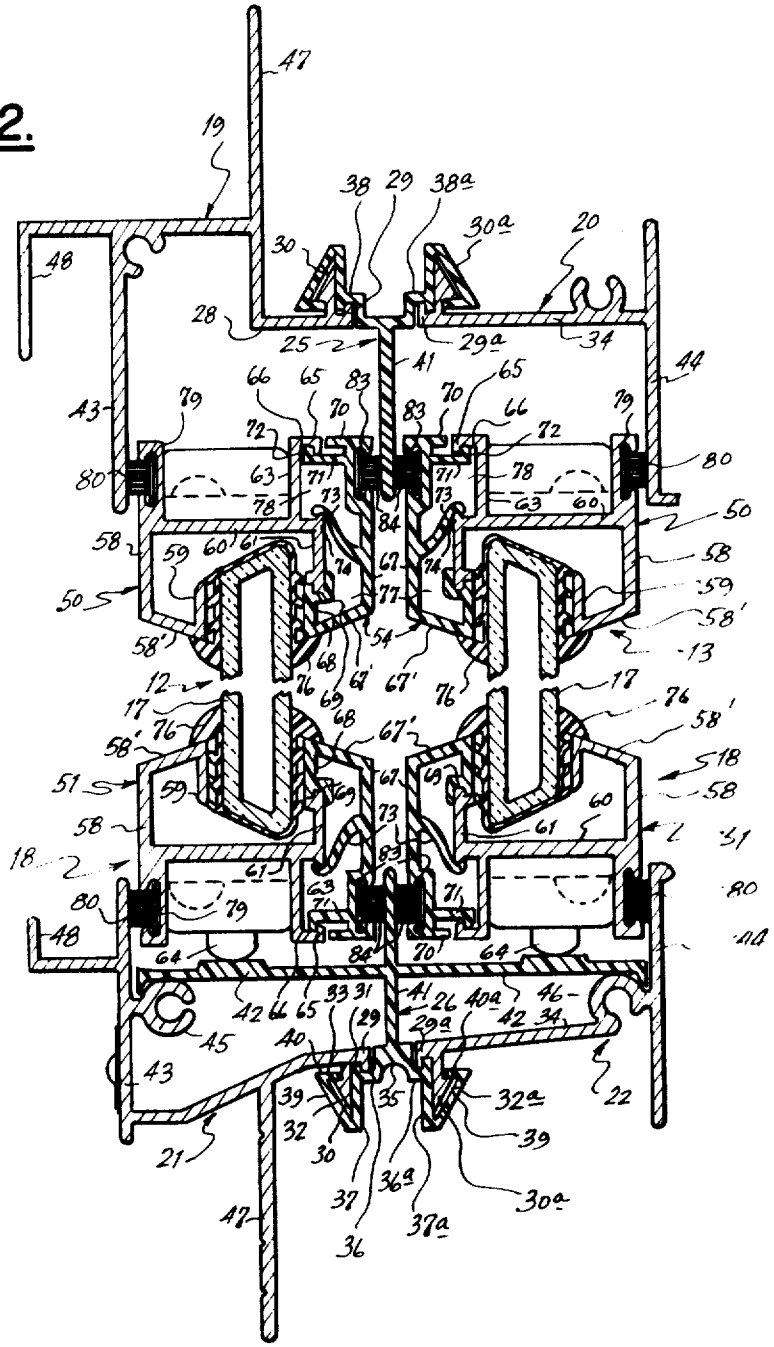


FIG. 1.

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FIG. 2.



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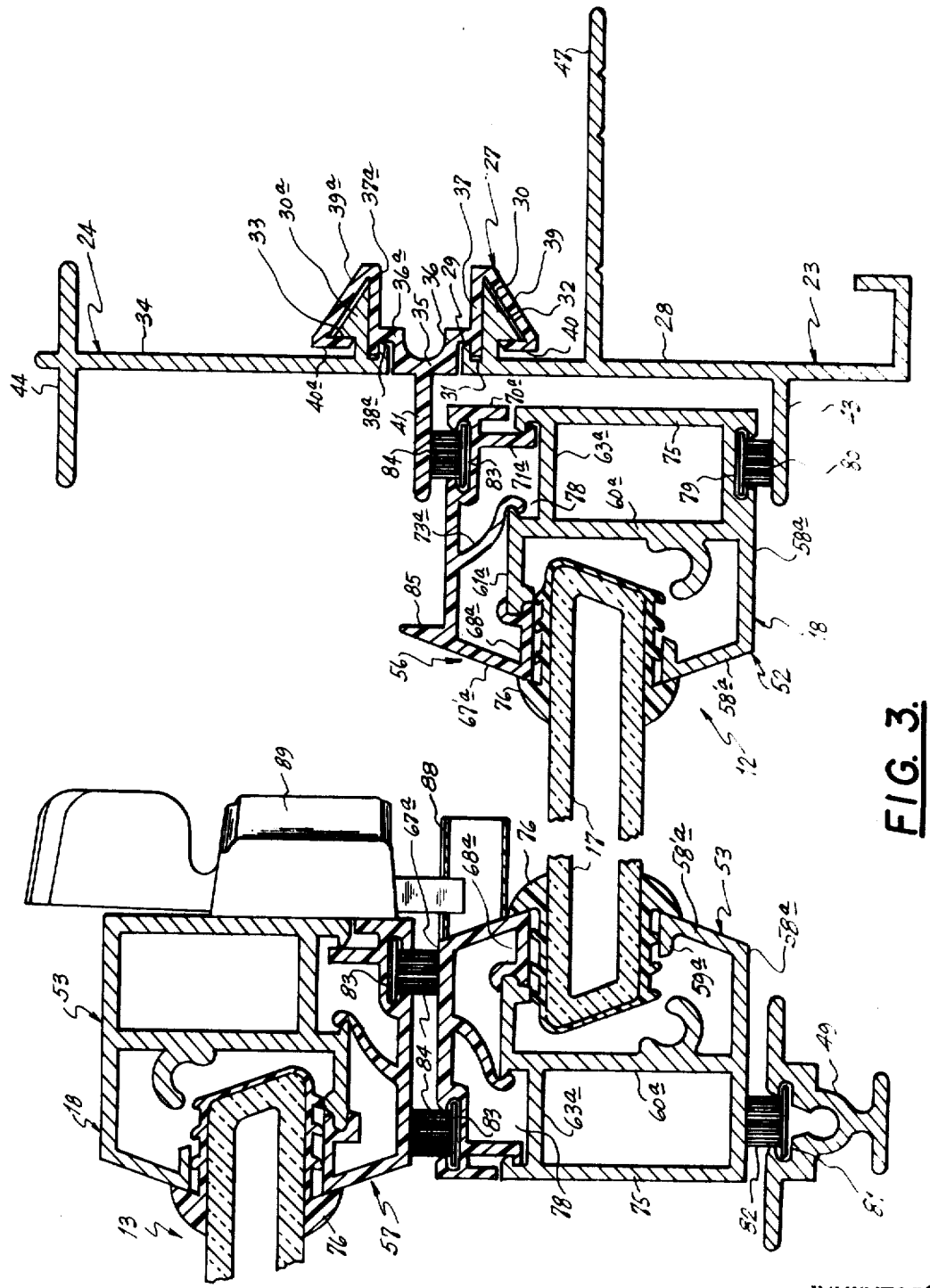


FIG. 3.

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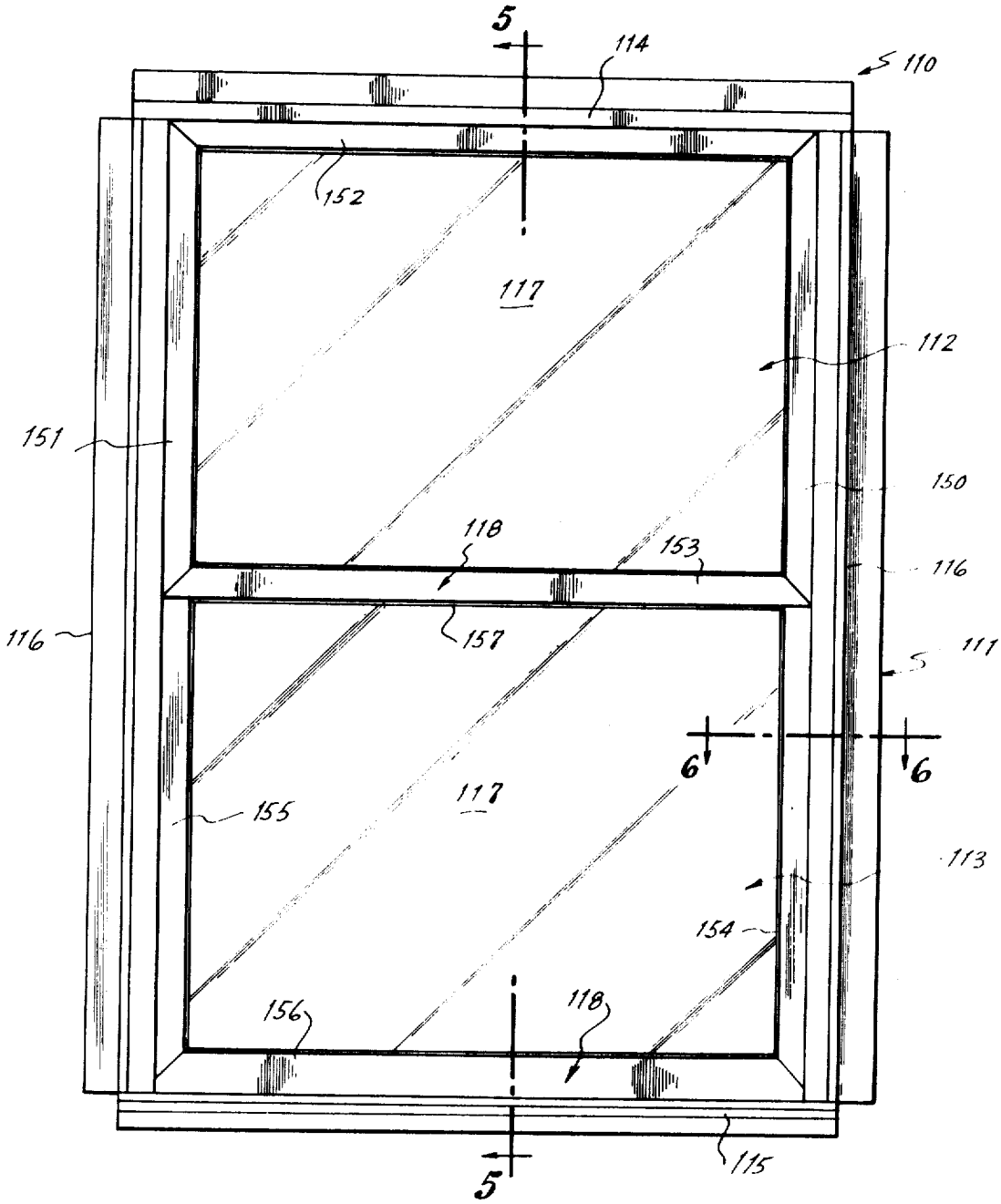
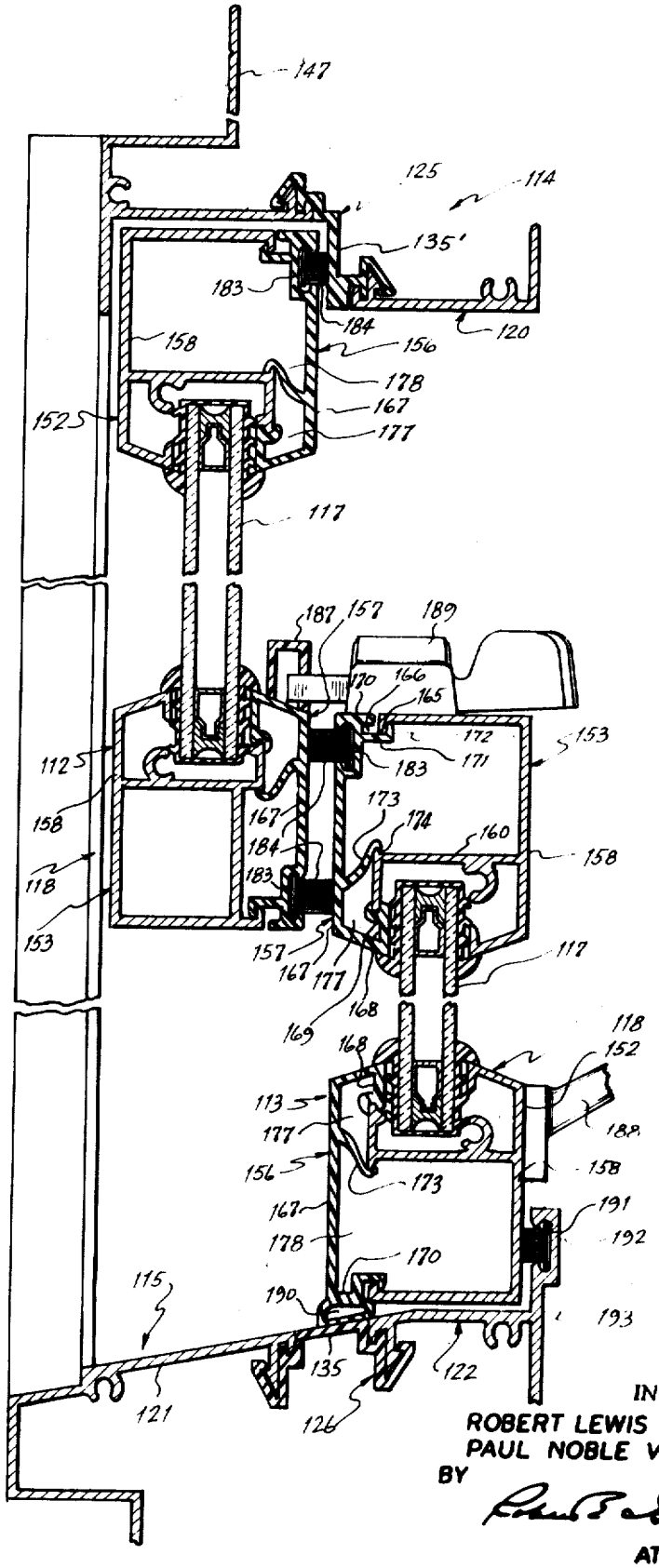


FIG. 4.

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FIG. 5.



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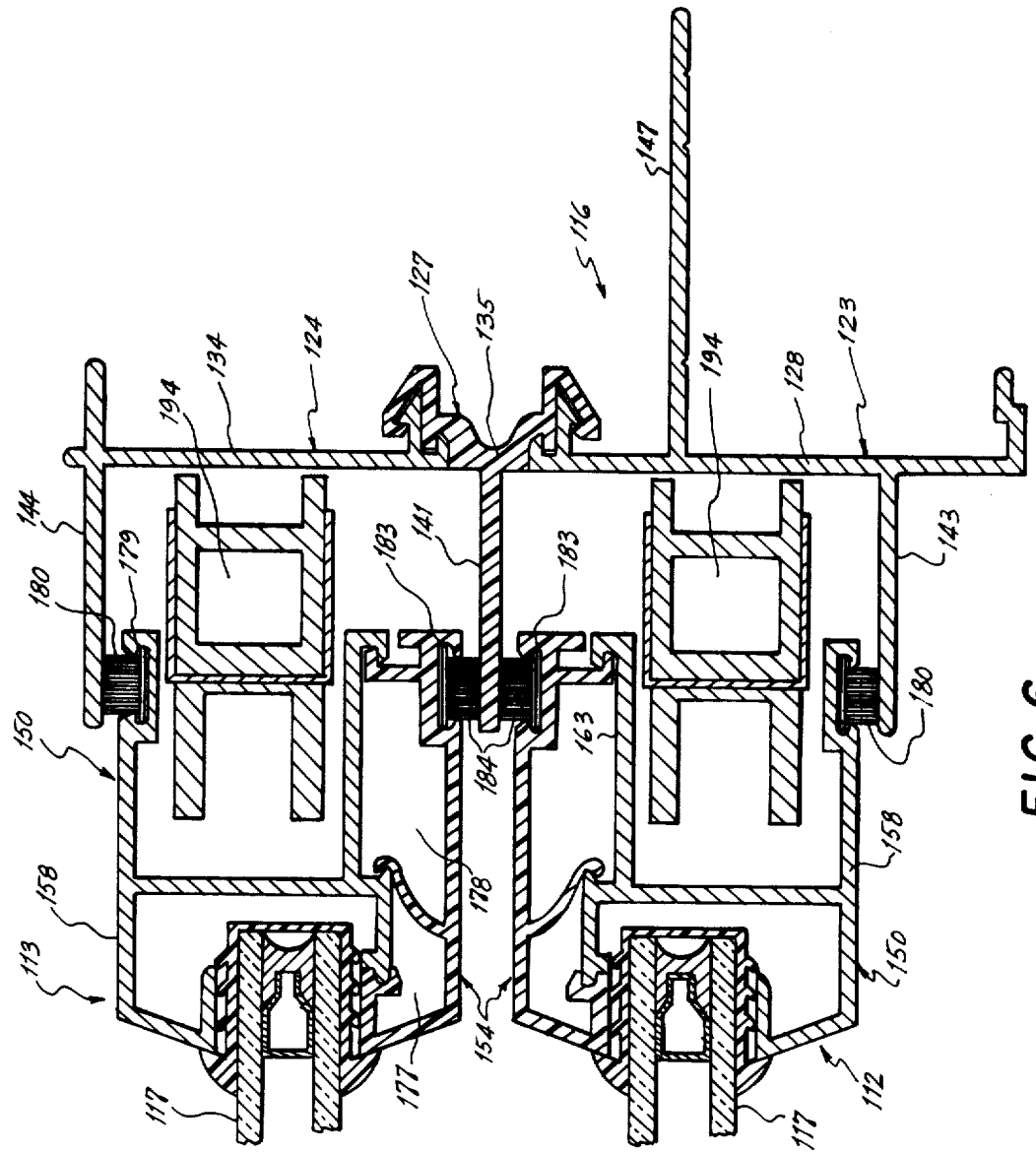


FIG. 6.

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INSULATED WINDOW ASSEMBLY WITH MOVABLE SASH

This invention relates generally to thermally insulated window and similar panel assemblies for installation in a rough opening of an enclosing wall exposed to different temperature conditions at the opposite sides thereof.

The relatively high thermal conductivity of metals, such as aluminum, is probably the most undesirable property limiting their substitution for wood and other less conductive nonmetallic structural materials. The effects of the foregoing characteristic are best seen in window and other panel assemblies employing metal framing in direct conductive relationship with air at interior and exterior ambient temperatures giving rise to the generation and presence of frost and condensation on the interior surfaces of the framing, particularly in northern climates where extreme interior and exterior temperature differentials may prevail. Of course, where the window assembly has a metal outer frame fixed in the rough opening of the wall and also a sash or sashes movably mounted in such fixed outer frame and each having a metal frame peripherally embracing the glass or other panel, the described problem exists with respect to the metal sash frame as well as the metal outer or fixed frame.

Some relief from the deleterious high thermal conductivity of metal framing for windows and similar panels has been achieved, particularly with respect to fixed metal window frames, by constituting the latter of separate interior and exterior metal parts respectively exposed to the air at interior and exterior ambient temperatures and being connected to each other by an intermediate member of plastic or other nonmetallic material having thermal insulating properties and intended to act as a thermal break or barrier between the metal frame parts, for example, as taught in U.S. Pat. No. 3,289,377, issued Dec. 6, 1966. Further, in window assemblies having movable sash, it has been proposed to form the fixed frame and the frame of the movable sash partly of metal members and partly of plastic members, for example, as taught in U.S. Pat. No. 3,302,354, issued Feb. 7, 1967, in which the metal and plastic frame members are particularly provided for the purpose of facilitating the assembly and disassembly of the various components. Although the structures as disclosed in the foregoing patents inherently alleviate the conditions resulting from the thermal conductivity of the metal frame members, such structures do not fully solve the mentioned problems as they do not incorporate relationships for maximum avoidance of heat transfer between surfaces of the window frames exposed to relatively warm and cold air. Further, the identified patents and other proposals for providing thermal breaks or barriers in metal window frames do not disclose arrangements by which truly efficient thermal breaks or barriers may be incorporated in metal-framed window assemblies of the type in which a fixed outer frame supports two lapping sashes having respective inner frames that are movable vertically as in a double-hung window, or horizontally as in a sliding or rolling window.

Accordingly, it is an object of this invention to provide a window having a glass or other panel with a frame extending along and embracing the panel periphery and constituted by metal and nonmetallic thermal insulating members which are constructed and arranged for maximum avoidance of heat transfer between the lateral surfaces of the frame exposed to disparate ambient air temperatures.

Another object is to obtain the maximum avoidance of heat transfer between the lateral surfaces of the frame exposed to disparate ambient air temperatures with metal and nonmetallic frame members that are capable of easy and economical production and assembly and result in a window frame of pleasing appearance and adequate rigidity and strength.

A further object of the invention is to provide a window assembly having an outer frame to be fixed in a rough opening and lapping sashes movable in parallel planes in the outer frame and each having an inner frame supporting the respective glass or other panel, with the outer frame and the inner frames being formed largely of metal and having efficient thermal breaks or barriers incorporated therein for maximum avoidance of heat transfer between the surfaces of the frames exposed to disparate air temperatures.

Still another object is to obtain effective sealing of a window assembly having the foregoing characteristics.

In accordance with a feature of this invention, the frame extending around the periphery of a glass or other panel of a window comprises a metal frame member and a rigid nonmetallic thermal insulating frame member respectively constituting the entire opposite lateral surfaces of the frame for exposure to disparate ambient air temperatures, and the insulating frame member includes a relatively thin web or webs defining the respective lateral surface of the frame and relatively thin flanges extending from the web or webs toward the metal frame member and effecting interlocking engagement with the latter at free marginal portions of the flanges, so that the web or webs and the metal frame member are substantially spaced from each other and cooperate with the flanges in defining a cavity or cavities therebetween, whereby to minimize the possibility of conduction of heat between the metal and nonmetallic insulating frame members.

In accordance with another feature of this invention, a window assembly comprises an outer frame to be installed in a rough wall opening and including interior and exterior metal frame members for exposure to the interior and exterior ambient air temperatures and a rigid nonmetallic thermal barrier member disposed intermediate, and rigidly assembling together the interior and exterior metal frame members while thermally insulating the latter from each other, and two lapping sashes within the outer frame respectively disposed generally at the inboard and outboard sides of the median of the thermal barrier member with at least one of the sashes being movable in the respective plane for opening and closing the window, each of the sashes having a glass or other panel and an inner frame embracing the periphery thereof, with each inner frame including a metal frame member and a rigid nonmetallic thermal insulating frame member preferably as aforesaid, respectively constituting the entire opposite lateral surfaces of the inner frame, and with the inboard and outboard sashes having their thermal insulating frame members respectively facing toward the exterior and interior so as to be disposed adjacent the thermal barrier member of the outer frame for cooperation therewith in providing an efficient thermal break or barrier between all metal frame members of the assembly which are exposed to disparate ambient temperatures.

The above, and other objects, features and advantages of this invention will be apparent in the following detailed description of illustrative embodiments which is to be read in connection with the accompanying drawings, wherein:

FIG. 1 is an elevational view of the exterior side of a window assembly embodying this invention;

FIG. 2 is an enlarged vertical sectional view taken along the line 2—2 on FIG. 1, but with the sashes relatively moved so as to be coextensive;

FIG. 3 is an enlarged horizontal sectional view taken along the line 3—3 on FIG. 1;

FIG. 4 is an elevational view of the exterior side of a window assembly according to another embodiment of this invention;

FIG. 5 is an enlarged vertical sectional view taken along the line 5—5 on FIG. 4; and

FIG. 6 is an enlarged horizontal sectional view taken along the line 6—6 on FIG. 4, but with the sashes being relatively moved so as to be vertically coextensive.

Referring to the drawings in detail, and initially to FIG. 1 thereof, it will be seen that the invention is there shown applied to a window assembly 10 of the horizontal sliding or rolling type that generally comprises an outer frame 11 and relatively movable sashes 12 and 13 mounted within the outer frame in parallel closely spaced planes. The outer frame 11,

which is intended to be fixed in the usual rough opening provided in an enclosing wall, includes a header **14** and sill **15** at the top and bottom and side jambs **16** secured at their ends in any convenient manner to the header and sill. Further, each of sashes **12** and **13** includes a panel or pane **17** of glass or other suitable material and a frame **18** extending around and embracing the periphery of the respective panel **17**.

In the following description, the terms "exterior" and "interior" are intended to refer to the directions toward the outside and toward the inside, respectively, of the window assembly **10** in planes normal to the planes of panels **17**, and the terms "inner" and "outer" refer to the directions toward and away from, respectively, the middle of the window assembly in the planes of panels **17**. Thus, the fixed frame **11** is outward from the relatively inner frames **18** of sashes **12** and **13**, and the planes of sashes **12** and **13** can be spoken of as being relatively exterior and interior planes.

Referring in detail to FIGS. **2** and **3**, it will be seen that, in the outer frame **11** according to this invention, header **14** includes exterior and interior metal framing members **19** and **20**, sill **15** includes exterior and interior metal framing members **21** and **22** and each jamb **16** includes exterior and interior metal framing members **23** and **24**, all of which metal framing members are preferably aluminum extrusions. The header **14**, sill **15** and jambs **16** further include nonmetallic framing members **25**, **26** and **27**, respectively, of rigid thermal insulating material, for example, of extruded rigid vinyl or the like, which are disposed between the respective metal framing members **19** and **20**, **21** and **22**, and **23** and **24**, and in interlocking engagement therewith, as hereinafter described in detail, so as to rigidly assemble together the associated metal framing members and thermally insulate the latter from each other. The exterior framing members **19**, **21** and **23** are suitably connected to each other at their ends to constitute an exterior metal frame member, and the interior framing members **20**, **22** and **24** are similarly connected to each other at their ends to constitute an interior metal frame member, with such exterior and interior metal frame members of outer frame **11** being rigidly assembled together and thermally insulated from each other by the nonmetallic framing members **25**, **26** and **27** which constitute a thermal barrier member of outer frame **11**.

As shown, each of exterior metal framing members **19**, **21** and **23** includes an interiorly extending wall **28** having an outwardly directed rim **29** along its free interior edge and an outwardly directed flange **30** spaced in the exterior direction from rim **29** to define a groove **31** therebetween. Flange **30** has an inclined face **32** at its exterior side and is undercut adjacent wall **28** to define a shoulder **33** between face **32** and wall **28**. Similarly, each of interior metal framing members **20**, **22** and **24** includes an exteriorly extending wall **34** which is generally coplanar with the wall **28** of the associated exterior metal framing member and which, along its free exterior edge portion, is provided with an outwardly directed rim **29***a* and an outwardly directed flange **30***a* formed as substantial mirror images of rim **29** and flange **30**, respectively.

Each of the nonmetallic framing members **25**, **26** and **27** is shown to include a relatively thin web **35** extending between the confronting free edges of walls **28** and **34** and having L-shaped flanges **36** and **36***a* extending outwardly from its opposite margins and then exteriorly and interiorly, respectively. Parallel walls **37** and **37***a* extend inwardly and outwardly from flange **36** and from flange **36***a*, respectively, to cooperate therewith in defining inwardly opening grooves **38** and **38***a* for receiving the rims **29** and **29***a*, respectively, of the associated exterior and interior metal framing members. Inclined walls **39** and **39***a* diverge inwardly from the outer margins of walls **37** and **37***a* and, at their inner edges, are formed with flanges **40** and **40***a* which extend toward walls **37** and **37***a*, respectively, to define restricted slots therebetween.

In assembling an exterior metal framing member **19**, **21** or **23** with the associated nonmetallic framing member **25**, **26** or **27**, the flange **30** of the metal framing member is pushed outwardly into the restricted slot between flange **40** and wall **37** and, by reason of the inclined face **32**, flange **39** is angularly flexed away from the adjacent wall **37** until flange **40** snaps into place inwardly of shoulder **33**. Upon such engagement of flange **40** with shoulder **33**, rim **29** is engaged and securely retained in groove **38** and the inner edge portion of wall **37** is similarly engaged and retained in groove **31**. The assembling of each interior metal framing member **20**, **22** or **24** with the respective nonmetallic framing member **25**, **26** or **27** is effected in a similar manner so that members **25**, **26** and **27** finally rigidly assemble together the respective metal framing members **19** and **20**, **21** and **22**, and **23** and **24**, to constitute the thermal barrier member of outer frame **11**.

It will be apparent that, in such outer frame **11**, the only path for heat transfer by conduction through framing members **25**, **26** and **27** between the interior and exterior metal framing members is by way of the webs **35** which, by reason of their relatively small thickness and the thermal insulating material of members **25**, **26** and **27**, effectively resist such heat transfer by conduction.

Each of the nonmetallic framing members **25**, **26** and **27** is also seen to have, as an integral part thereof, an inwardly directed median flange **41** extending centrally along its web **35**. In the case of the sill **15**, its nonmetallic framing member **26** further includes an integral shelf **42** extending along flange **41** inwardly of web **35** and being directed interiorly and exteriorly from flange **41** to constitute a support surface for sashes **12** and **13**.

The exterior metal framing members **19**, **21** and **23** are further shown to have flanges **43** directed inwardly from the exterior margins of their walls **28** to cooperate with the median flange **41** in defining a guide channel therebetween for the exterior sash **12** which is disposed outboard with respect to median flange **41**. Similarly each of interior metal framing members **20**, **22** and **24** is shown to have a flange **44** directed inwardly from the interior margin of wall **34** to cooperate with the median flange **41** in defining a guide channel therebetween for the interior sash **13** which is disposed inboard of the median flange **41**. In the case of the sill **15**, its metal framing members **21** and **22** have ledges **45** and **46** formed on flanges **43** and **44** to carry the exterior and interior margins of the shelf **42** for supporting the sashes (FIG. **2**).

As shown, the exterior metal framing members **19**, **21** and **23** further may have mounting fins **47** extending outwardly from their walls **28** for suitable attachment to the building structure around the rough opening for the window assembly. The exterior metal framing members **19** and **21** of header **14** and sill **15** may also have L-shaped flanges **48** (FIG. **2**) extending from flanges **43** at the exterior of the latter to define downwardly and upwardly opening channels, respectively, for the reception and mounting of screens or storm sashes. A stay bar **49** (FIG. **3**) may extend vertically between flanges **48** and be suitably connected to the latter at the ends of bar **49** for bracing the outer frame **11** of the window assembly at the middle thereof.

In accordance with this invention, the inner frame **18** of each of sashes **12** and **13** is shown to comprise metal framing members **50**, **51**, **52** and **53**, preferably of extruded aluminum, which respectively extend along the top, bottom and opposite sides of panel **17** and are suitably joined to each other preferably with mitered joints at the corners of frame **18** to constitute a metal frame member of the latter. Each inner frame **18** further comprises nonmetallic framing members **54**, **55**, **56** and **57** of rigid thermal insulating material, for example, of extruded rigid vinyl or the like, which are in interlocking engagement with metal framing members **50**, **51**, **52** and **53**, respectively, as hereinafter described in detail, and also joined at mitered corners to constitute a thermal insulating frame member of inner frame **18**.

As shown, the top and bottom metal framing members **50** and **51** of each frame **18** are identical, but inverted with respect to each other, and each includes a web **58** having an angled inner marginal portion **58'** from which a flange **59** is

directed outwardly to define a seating surface for one side of panel 17. A wall 60 is directed at right angles to web 58 and extends substantially beyond the plane of flange 59 to a flange 61 which is directed inwardly from wall 60. The edge of flange 61 is at a distance from wall 60 that is approximately equal to the spacing between wall 60 and the edge of flange 59. A flange 63 is directed outwardly from wall 60 and is parallel to, and spaced from web 58. In the case of bottom metal framing member 51, rollers 64 may be rotatably mounted in molded corner-joining keys 62 and project downwardly from the latter for rolling engagement with shelf 42. Further, as shown on FIG. 2, the flange 63 of each of members 50 and 51 has a reverted rim 65 to define an inwardly opening groove 66 at the side of flange 63 that faces away from web 58.

The top and bottom nonmetallic framing members 54 and 55 are also identical, but inverted with respect to each other, and each includes a web 67 having an angled inner marginal portion 67' from which a flange 68 is directed outwardly to define a seating surface for the side of panel 17 which is opposed to that seating against flange 59. The edge of flange 68 is thickened and has an outwardly opening groove 69 therealong to receive the inner edge of flange 61. The outer margin of web 67 has a flange 70 extended therefrom to bear, at its edge, against rim 65, and a flange 71 is also extended from the outer portion of web 67 and spaced inwardly from flange 70, with the edge of flange 71 angled outwardly, as at 72, to engage in groove 66. Further, at a location intermediate angled marginal portion 67' of web 67 and flange 71, a septum 73 of arcuate cross section extends from web 58 to bear upon an edge 74 provided on wall 60 outwardly with respect to flange 61.

In assembling together framing members 50 and 54 and framing members 51 and 55, the angled edge 72 of flange 71 and the groove 69 of flange 68 at one end of member 54 or 55 may be aligned with the groove 66 and the edge of flange 61 of member 50 or 51, respectively, and then the members 50 and 54 or 51 and 55 may be displaced longitudinally relative to each other so as to be longitudinally coextensive with edge 72 in groove 66 and the edge of flange 61 in groove 69, as shown. Alternatively, framing members 50 and 54 and framing members 51 and 55 may be assembled by a snapping action to engage edge 72 in groove 66 and the edge of flange 61 in groove 69.

The side metal framing members 52 and 53 and the side nonmetal framing members 56 and 57 for each inner frame 18 are generally similar to the above-described members 50 and 51 and members 54 and 55, respectively, and have their corresponding parts identified by the same reference numerals, but with the letter "*a*" appended thereto (FIG. 3). However, as shown, in side metal framing members 52 and 53, a wall 75 parallel to wall 60*a* extends from the outer margin of web 58*a* to the outer margin of flange 63*a* to form a boxlike structure.

When the various-described framing members of each inner frame 18 are assembled together, as indicated above, an inwardly opening peripheral gap is defined between flanges 59 and 68 and between flanges 59*a* and 68*a* to receive the peripheral portion of the respective panel 17 which is preferably provided with a continuous sealing strip 76 of thermal insulating material wrapped over the edge of the panel. When the panel 17 is of glass, insulating glass is preferably employed therefor, that is, the panel 17 is constituted by an assembly of two parallel, spaced glass sheets with a peripheral seal therebetween, as shown.

It will be seen that, in accordance with this invention, sashes 12 and 13 are oppositely mounted in outer frame 11. That is, outboard sash 12 which is at the exterior side of median flanges 41 is arranged with its thermal insulating frame member constituted by nonmetallic framing members 54, 55, 56 and 57 at the interior side of sash 12, while inboard sash 13 which is at the interior side of median flanges 41 is arranged with its thermal insulating frame member at the exterior side of sash 13. By reason of the foregoing arrangement of sashes 12 and 13, the nonmetallic framing members 54, 55 and 56 of the thermal insulating frame members of both sashes are disposed closely adjacent the flanges 41 of the nonmetallic framing members 25, 26 and 27 which constitute the thermal barrier member of outer frame 11. Further, when sashes 12 and 13 are closed, as shown on FIG. 3, the meeting or lapping nonmetallic framing members 57 of the sashes are also in closely adjacent, facing relation (FIG. 3).

It will also be seen that, in the described window assembly 10, the entire opposite lateral surfaces of the inner frame 18 of each of sashes 12 and 13 are respectively constituted by the webs 58, 58', 58*a* and 58'*a* of the metal framing members and by the webs 67, 67', 67*a* and 67'*a* of the nonmetallic framing members. Further, in each sash frame 18, the webs 67 and 67' or 67*a* and 67'*a* of the nonmetallic framing members constituting one of the lateral surfaces of the inner or sash frame are connected with the metal framing members constituting the other lateral surface of frame 18 only by way of the relatively thin flanges 68, 70, 71 and 73 or 68*a*, 70*a*, 71*a* and 73*a* which engage the metal framing members only at their respective free marginal portions, for example, at the edge of flange 68 receiving the edge of flange 61 in its groove 69, at the edge of flange 70 abutting rim 65, at the edge 72 of flange 71 engaged in groove 66 and at the edge 74 engaging flange or septum 73. Thus, heat transfer by conduction between the opposite lateral surfaces of each sash frame 18 exposed to disparate ambient air temperatures can occur only through the mentioned thin flanges of the nonmetallic framing members, whereby such heat transfer is efficiently resisted. Further, the mentioned thin flanges of the nonmetallic framing members, the webs of the latter and the respective metal framing members 50, 51, 52 and 53 cooperate to define cavities 77 and 78 therebetween in which the contained air enhances the insulating effect.

Accordingly, in the window assembly 10 as shown, heat transfer from the interior lateral surface to the exterior lateral surface of frame 18 of sash 12, which lateral surfaces are respectively constituted by the framing members 54, 55, 56 and 57 and by the framing members 50, 51, 52 and 53, is efficiently resisted to prevent cooling of the interior surface and condensation of moisture thereon from the warm, relatively moist interior air to which such interior surface is exposed. Similarly, in the case of sash 13, where the interior and exterior lateral surfaces of the sash frame 18 are respectively constituted by the metal framing members 50, 51, 52 and 53 and by the nonmetallic framing members 54, 55, 56 and 57, the heat transfer from the interior to the exterior lateral surface is efficiently resisted to again prevent such cooling of the interior surface as would result in condensing of moisture thereon from the warm interior air to which it is exposed. In each instance, the webs 67, 67' or 67*a*, 67'*a* constituting an entire lateral surface of the sash frame are spaced a substantial distance, preferably at least one-fourth inch, from the nearest portion of the associated metal framing member 50, 51, 52 or 53, as by the flanges 68, 70, 71 and 73 of the nonmetallic framing members.

In order to seal window assembly 10 when its sashes 12 and 13 are in their closed positions, the webs 58, 58*a* of metal framing members 50, 51 and 52 have undercut grooves 79 extending along their outer portions and receiving pile sealing strips 80 engageable with flanges 43 of outer frame 11 in the case of sash 12 and with flanges 44 of outer frame 11 in the case of sash 13. The stay bar 49 (FIG. 3) may also have an undercut groove 81 extending along its interior side and receiving a pile sealing strip 82 engaging web 58*a* of the metal framing member 53 of sash 12 when the latter is in its closed position. Further, each of the nonmetallic framing members has an undercut groove 83 extending along the outer portion of its web 67 or 67*a* and receiving a pile sealing strip 84. The sealing strips 84 thus carried by framing members 54, 55 and 56 of outboard sash 12 engage the exterior sides of flanges 41 of the thermal barrier member in outer frame 11, while the sealing strips 84 carried by framing members 54, 55 and 56 of inboard sash 13 engage the interior sides of flanges 41. The pile sealing

strips **84** carried by framing members **57** of sashes **12** and **13** which meet or overlap at the center of the window assembly **10** each engage the web **67***a* of the other framing member **57** (FIG. 3). Thus, it will be seen that the sealing strips **80**, **82** and **84** all extend between and engage either two nonmetallic framing members or two metal framing members which are, with the exception of the pile sealing strips **84** extending between framing members **57**, exposed to substantially the same ambient air temperature to discourage heat transfer by way of the sealing strips. The pile sealing strips **84** carried by members **57** provide two parallel seals between the latter. Similarly, the other pile sealing strips provide two parallel seals between each sash frame and the outer frame **11**.

The window assembly **10** may be provided with a handle **85** which may be formed integrally with framing member **56** of sash **12** (FIG. 3) and a similar handle (not shown) formed integrally with framing member **52** of sash **13**. Further, a latch **89** may be pivoted on framing member **53** of inboard sash **13** and engageable in a keeper recess provided in a keeper **88** on framing member **57** of outboard sash **12**. Since framing members **53** and **57** of sashes **13** and **12**, respectively, are both exposed to the relatively warm interior ambient air, no heat transfer can occur through the latch **89**.

An important feature of the window assembly **10** as described above is that, in all instances, a barrier of nonmetallic, thermal insulating material, preferably measuring at least one-fourth inch thereacross, is provided between each aluminum or other metal part of the outer frame **11** and of the inner frame **18** of each sash and the nearest incompatible air, that is, the nearest air at a temperature substantially different from that of the air to which the aluminum part in question is exposed. Thus, in the case of the outer frame **11**, web **35** preferably has a lateral width of at least one-fourth inch, and, in the case of sash frames **18**, flanges **68**, **70**, **71** and **73** or flanges **68***a*, **70***a*, **71***a* and **73***a* preferably have a width (measured at right angles to their thicknesses) of at least one-fourth inch. Further, the pile sealing strips **80** and **84** ensure that there will be no leakage or flow of warm interior air to the exterior, or drafts of cold exterior air to the interior, past the peripheries of the sash frames **18** as would chill the framing members of outer frame **11** or of sash frames **18** exposed to the warm interior air. Accordingly, condensation and frosting on the interior parts of the window assembly are prevented.

Although the window assembly **10** described above with reference to FIGS. **1–3** is of the type having horizontally rolling or sliding sashes, it will be appreciated that the described features of this invention may be similarly applied to a window assembly **110** of the double-hung type (FIG. **4**), that is, a window assembly in which lapping sashes **112** and **113** are vertically slidable within a fixed outer frame.

In the window assembly **110**, the various parts of outer frame **111** and of sashes **112** and **113** are identified by the same reference numerals used to identify the corresponding parts of window assembly **10**, but with the digit "1" preceding such numerals. Thus, outer frame **111** is shown to include a header **114**, sill **115** and side jambs **116**, while each of sashes **112** and **113** includes a panel **117**, preferably of insulating glass, and an inner or sash frame **118** extending around and embracing the periphery of the respective panel.

In the outer frame **111** according to this invention, as shown particularly on FIGS. **5** and **6**, exterior and interior metal framing members **119** and **120** are rigidly connected by a nonmetallic framing member **125** therebetween to form header **114**, exterior and interior metal framing members **121** and **122** are rigidly connected by a nonmetallic framing member **126** therebetween to form sill **115**, and exterior and interior metal framing members **123** and **124** are rigidly connected by a nonmetallic framing member **127** therebetween to form each side jamb **116**. As before, framing members **119**, **121** and **123** are suitably connected to each other, at their ends, to constitute an exterior metal frame member, and framing members **120**, **122** and **124** are similarly connected to each other, at their ends, to constitute an interior metal frame member, with such exterior and interior metal frame members of outer frame **111** being rigidly assembled together and thermally insulated from each other by the nonmetallic framing members **125**, **126** and **127** which constitute a thermal barrier member of outer frame **111**.

As shown, the structures by which metal framing members **119**, **121** and **123** and metal framing members **120**, **122** and **124** are respectively joined to nonmetallic framing members **125**, **126** and **127** may be similar to the structures described for that purpose in connection with window assembly **10** so that the connected metal framing members of sill **115** and side jambs **116** are separated by a web **135** of the respective nonmetallic framing member **126** or **127** while the connected metal framing members of header **114** are separated by a web **135'** of framing member **125** which web, in this case, extends vertically between the vertically offset metal framing members **119** and **120**. Further, it will be seen that nonmetallic framing members **127** of jambs **116** have median flanges **141** extending inwardly from their webs **135** and that such flanges may be omitted from members **125** and **126** of the header and sill.

It will be apparent that, in outer frame **111**, the only path for heat transfer by conduction between the exterior and interior metal framing members thereof is by way of the webs **135** and **135'** of the nonmetallic framing members, and by reason of the relatively small thickness of such webs and the thermal insulating material of members **125**, **126** and **127** such heat transfer is efficiently resisted.

The exterior metal framing members **123** of jambs **116** are further shown to have flanges **143** directed inwardly from the exterior margins of their walls **128** (FIG. **6**) to cooperate with median flanges **141** in defining guide channels therebetween for the exterior sash **112** which is disposed outboard with respect to median flanges **141**. Similarly, the interior metal framing members **124** of jambs **116** have flanges **144** directed inwardly from the interior margins of their walls **134** to cooperate with median flanges **141** in defining guide channels therebetween for the interior sash **113** which is disposed inboard of median flanges **141**. The exterior metal framing members **119**, **121** and **123** also have mounting fins **147** extending outwardly from their walls **128** for suitable attachment to the building structure around the rough opening for the window assembly.

In accordance with this invention, the inner frame **118** of each of sashes **112** and **113** is shown to comprise metal framing members **150**, **151**, **152** and **153**, preferably of extruded aluminum, which respectively extend along the opposed sides and the opposed horizontally extending edges of the respective panel **117** and are suitably joined to each other, preferably with mitered joints, at the corners of frame **118** to constitute a metal frame member of the latter. Each inner frame **118** further comprises nonmetallic framing members **154**, **155**, **156** and **157** of rigid thermal insulating material, for example, of extruded rigid vinyl or the like, which are in interlocking engagement with metal framing members **150**, **151**, **152** and **153**, respectively, and also joined to each other at mitered corners to constitute a thermal insulating frame member of inner frame **118**.

As shown, the metal framing members **150**, **151**, **152** and **153** and the nonmetallic framing members **154**, **155**, **156** and **157** of each sash or inner frame **118** may be generally similar, in configuration and interengagement, to the similarly numbered framing members **50**, **51**, **52** and **53**, and **54**, **55**, **56** and **57**, respectively, of each sash frame **18**, which have been described in detail above.

It will be seen that, in accordance with this invention, sashes **112** and **113** are oppositely mounted in outer frame **111**. That is, outboard sash **112** which is at the exterior side of median flanges **141** is arranged with its thermal insulating frame member constituted by nonmetallic framing members **154**, **155**, **156** and **157** at the interior of sash **112**, while inboard sash **113** at the interior sides of flanges **141** is arranged with its similarly constituted thermal insulating frame member at the exterior side of sash **113**. By reason of the foregoing arrange-

ment of sashes **112** and **113**, the nonmetallic framing members **154** and **155** of both sashes are closely adjacent flanges **141** of framing members **127** of jambs **116** (FIG. 6), and the nonmetallic framing members **156** of sashes **112** and **113** are also closely adjacent to framing members **125** and **126**, respectively of header **114** and sill **115** when the sashes are in their closed positions (FIG. 5). Further, when the sashes are closed, the meeting or lapping nonmetallic framing members **157** are also in closely adjacent, facing relation.

As in the first-described embodiment, the entire opposite lateral surfaces of the inner or sash frame **118** of each of sashes **112** and **113** are respectively constituted by the webs **158** of the metal framing members and by the webs **167** of the nonmetallic framing members. Further, in each sash frame **118**, the webs **167** of the nonmetallic framing members constituting one of the lateral surfaces of the sash frame are connected with the metal framing members constituting the other lateral surface of the sash frame only by way of the relatively thin flanges **168**, **170**, **171** and **173** which engage the metal framing members only at their respective free marginal portions, for example, as shown on FIG. 5 with respect to framing members **153** and **157**, at the edge of flange **168** receiving the edge of flange **161** in its groove **169**, at the edge or rim **165** engaging in groove **166** defined between the edge of flange **170** and the margin **172** of flange **171**, and at the edge **174** engaging flange or septum **173**. Thus, there are no relatively large areas of face-to-face contact between the interengaged metal and nonmetallic framing members, and heat transfer by conduction between the opposite lateral surfaces of each sash frame **118** exposed to disparate ambient air temperatures can occur only through the mentioned thin flanges **168**, **170**, **171** and **173** of the nonmetallic framing members, whereby such heat transfer is efficiently resisted. Further, the mentioned thin flanges of the nonmetallic framing members, the webs **167** of the latter and the respective metal framing members **150**, **151**, **152** and **153** cooperate to define cavities **177** and **178** therebetween in which the contained air enhances the insulating effect.

In the window assembly **110** as shown, heat transfer from the interior lateral surface to the exterior lateral surface of frame **118** of each of sashes **112** and **113** is efficiently resisted, thereby to prevent such cooling of the interior surface as would result in condensing of moisture thereon from the warm interior air to which it is exposed. In each instance, the webs **167** constituting an entire lateral surface of the sash frame **118** are spaced a substantial distance, preferably, at least one-fourth inch, from the nearest portion of the associated metal framing member **150**, **151**, **152** or **153**, as by the flanges **168**, **170**, **171** and **173** of the nonmetallic framing members.

In order to seal window assembly **110** when its sashes **112** and **113** are in their closed positions shown on FIG. 5, the webs **158** of metal framing members **150** and **151** may have undercut grooves **179** extending along their outer portions and receiving pile sealing strips **180** engageable with flanges **143** of outer frame jambs **116** in the case of sash **112** and with flanges **144** of jambs **116** in the case of sash **113** (FIG. 6). Further, each of nonmetallic framing members **154** and **155** has an undercut groove **183** extending along the outer portion of its web **167** and receiving a pile sealing strip **184** engageable with the confronting surfaces of median flanges **141**. The nonmetallic framing members **157** may also have undercut grooves **183** in their webs **167** receiving pile sealing strips **184** each of which is engageable with the web **167** of the other member **157** in the closed positions of the sashes (FIG. 5).

The seal at the top or header of window assembly **110** may be provided by a pile sealing strip **184** received in an undercut groove **183** in web **167** of framing member **156** of sash **112** and which is engageable, in the closed position of such sash, with web **135'** of the framing member **125** of header **114**. The seal at the bottom or sill **115** may be provided by a combined bumper and sealing strip **190** (FIG. 5), preferably of an elastic plastic material, which is either permanently secured, as shown, or removably mounted, as in a groove (not shown), along the lower margin of the nonmetallic framing member **156** of sash **113** for engagement with the web **135** of outer framing member **126**. The seal at the sill **115** may be complemented, as shown, by a pile sealing strip **191** receivable in an undercut groove **192** formed along a flange **193** along the interior margin of interior metal framing member **122** of sill **115** and being engageable with web **158** of the metal framing member **152** of sash **113**.

The window assembly **110** may be provided with a handle or handles **188** (FIG. 5) suitably secured to framing member **152** of sash **113** and also with a latch **189** pivoted on framing member **153** of sash **113** and engageable in a suitable keeper slot or recess provided in a keeper **187** attached to framing member **157** of sash **112**. As is shown on FIG. 6, the metal framing members **154** at one side of sashes **112** and **113**, and similarly the metal framing members **155** at the other side of the sashes, define outwardly opening channels between their webs **158** and flanges **163** to receive sash balances, as indicated at **194**.

As described in connection with the window assembly **10**, it is also an important feature of the window assembly **110** that, in all instances, a barrier of nonmetallic, thermal insulating material, preferably having a width of at least one-fourth inch, is provided between each aluminum or other metal part of outer frame **111** and of each inner or sash frame **118** and the nearest incompatible air, that is, the nearest air at a temperature substantially different from that of the air to which the aluminum part in question is exposed. Further, the pile sealing strips **180**, **184** and **191** and the bumper and thermal sealing strip **190** provide effective seals against drafts or exchanges of cold exterior air and warm interior air between the peripheries of sash frames **118** and exterior frame **111**.

In both described embodiments of the invention, the arrangement of the outboard and inboard sashes **12** and **13**, or **112** and **113**, with their nonmetallic framing members facing toward the interior and exterior, respectively so as to be closely adjacent to the intermediate or median nonmetallic thermal barrier members of outer frame **11** or **111**, and the provision of the described seals between the nonmetallic framing members of the sashes where the latter meet or overlap and between such nonmetallic framing members of the sashes and the nonmetallic thermal barrier members of the outer frame, results in their being a continuous thermal break around the entire periphery of each sash and of the outer frame of the window assembly.

In each of the window assemblies **10** and **110**, both sashes **12** and **13** or **112** and **113** have been movable relative to the outer fixed frame **11** or **111**, but it will be apparent that the invention can be similarly applied to window assemblies in which only one sash is movable and the other is fixed within the outer frame.

Although illustrative embodiments of this invention have been described in detail herein with reference to the accompanying drawings, it is to be understood that the invention is not limited to those precise embodiments and that various changes and modifications may be effected therein by one skilled in the art without departing from the scope or spirit of the invention.

What is claimed is:

1. A window assembly comprising an outer frame to be installed in a rough opening in an enclosing wall and including interior and exterior metal frame members for respective exposure to air at interior and exterior ambient temperatures, and a rigid nonmetallic thermal barrier member interlockingly engaged with said interior and exterior metal frame members and disposed therebetween for rigidly assembling together said metal frame members and thermally insulating the latter from each other; and first and second sashes in lapping relation within said frame and being disposed in inboard and outboard relation to the median of said thermal barrier member, at least one of said sashes being movable in parallel relation to the other sash for opening and closing the window, each of said sashes including a panel and an inner frame extending

along and embracing the periphery of said panel, each of said inner frames including a metal frame member and a rigid nonmetallic thermal insulating frame member secured to each other and respectively constituting the entire opposite lateral surfaces of said inner frame, said sashes being arranged in said outer frame with said thermal insulating frame member of the inboard sash facing toward the exterior and with said thermal insulating frame member of the outboard sash facing toward the interior for providing an efficient thermal break between all metal frame members of the assembly which are exposed to the interior environment and all metal frame members which are exposed to the exterior environment.

2. A window assembly according to claim 1, wherein said thermal barrier member of the outer frame is adjacent said thermal insulating frame members, and sealing means are provided between said thermal insulating frame members of said sashes at the portions of said inner frames which are in lapping relation when the window is closed, and between said thermal barrier member of the outer frame and said thermal insulating frame members which are adjacent thereto whereby all heat transfer paths across the framing assembly from the interior surface to the exterior surface thereof will be broken.

3. A window assembly according to claim 1, in which said thermal barrier member has inwardly directed flanges at said median thereof so as to extend between said inboard and outboard sashes, and sealing means are provided between said thermal insulating frame members of the sashes and the confronting surfaces of said flanges of the thermal barrier member.

4. A window assembly according to claim 3, in which sealing means are also provided between said thermal insulating frame members of the sashes at the portions of said inner frames which meet when the window is closed.

5. A window assembly according to claim 4, in which said interior and exterior metal frame members of the outer frame have inwardly directed flanges parallel to, and spaced from said flanges of the thermal barrier member to cooperate therewith in defining guide channels for said sashes therebetween, and sealing means are also provided between said metal frame members of said inboard and outboard sashes and said flanges of the interior and exterior metal frame members, respectively, of the outer frame.

6. A window assembly according to claim 1, in which said thermal insulating frame member of each of said sashes includes web means defining the respective lateral surface of the inner frame and flanges extending from said web means at substantial angles to the latter and having free marginal portions at which interlocking engagement with the respective metal frame member exclusively occurs to secure together said metal and thermal insulating frame members, said flanges substantially spacing said web means from said respective frame member and cooperating with said web means and said respective frame member to define at least one cavity therebetween.

7. A window assembly according to claim 6, in which each of said flanges has an extent of at least one-fourth inch in the direction from said web means to its marginal portion engaged with said respective metal frame member.

8. A window assembly according to claim 6, in which said thermal insulating frame member and said metal frame member of the inner frame of each sash are constituted by respective framing elements extending along the top, bottom and sides of the respective panel, and in which said flanges of each framing element included in said thermal insulating frame member effects said interlocking engagement with the associated framing element of the respective metal frame member at grooves therealong opening inwardly and outwardly, respectively, and receiving oppositely directed edges, whereby to prevent relative lateral or inward and outward movements of the framing elements thus interlockingly engaged.

9. A window assembly according to claim 6, in which said thermal barrier member has inwardly directed flanges at said median thereof so as to extend between said inboard and outboard sashes, and sealing means are provided between said web means of said thermal insulating frame members of the sashes and the confronting surfaces of said flanges of the thermal barrier member.

10. A window assembly according to claim 9, in which sealing means are also provided between said web means of the thermal insulating frame members of the sashes at the portions of the inner frames which meet when the window is closed.

11. A window assembly according to claim 10, in which said sealing means between the portions of the inner frames which meet when the window is closed includes pile strips extending along the respective web means of the thermal insulating frame means, and each engaging the web means of the other thermal insulating frame means.

12. A window assembly according to claim 6, in which said thermal barrier member of the outer frame includes a web interposed between said interior and exterior metal frame members of the outer frame and having a lateral extent of at least one-fourth inch.

13. A window assembly according to claim 1, in which said sashes are horizontally movable relative to each other within said outer frame, and said outer frame includes a sill portion at which said thermal barrier member thereof has a shelf portion extending to the exterior and interior of said median and on which said outboard and inboard sashes are movably supported.

14. A window assembly according to claim 1, in which said sashes are vertically movable relative to each other within said outer frame, and the inboard sash has an elastic bumper and thermal sealing strip extending along the lower margin of its thermal insulating frame member engageable with said thermal barrier member of the outer frame when said inboard sash is in its lowermost closed position.

15. In a window having a panel and a frame extending along and embracing the periphery of said panel, said frame comprising a metal frame member and a rigid nonmetallic thermal insulating frame member respectively constituting the entire opposite lateral surfaces of said frame for exposure to disparate ambient air temperatures, said insulating frame member including web means defining the lateral surface of said frame constituted by said insulating frame member and flanges extending from said web means at substantial angles to the latter and having free marginal portions in interlocking engagement with said metal frame member, said flanges substantially spacing said web means from the metal frame member and said web means and flanges cooperating with said metal frame member to define at least one cavity therebetween.

16. A window according to claim 15, in which each of said flanges has an extent of at least one-fourth inch in the direction from said web means to its marginal portion engaged with said metal frame member.

17. A window according to claim 15, in which said thermal insulating frame member and said metal frame member are constituted by respective framing elements extending along straight edges of said panel, and in which said flanges of each framing element included in said thermal insulating frame member and the associated framing element of the metal frame member have cooperative grooves therealong opening inwardly and outwardly and oppositely directed edges received in said grooves for said interlocking engagement, whereby to prevent lateral or inward and outward movements of the framing elements thus engaged.