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(54) Method and apparatus for constructing insulating glass units.

(57) A method for producing a double sealed insulating glass unit which comprises moving a spacer frame member longitudinally through first and second sealant application stations, applying a first sealant (26) continuously to at least opposite facing spacer frame member sides, applying a second sealant (28) continuously to a third side of the spacer frame member, placing the resulting spacer frame member between peripherial regions of panes of glass (12, 14) with the first sealant (26) between the glass and spacer frame member and the second sealant (28) between the glass along the third side of the spacer frame member, and pressing the panes of glass (12, 14) toward each other to sealingly engage the glass with the first and second sealant.

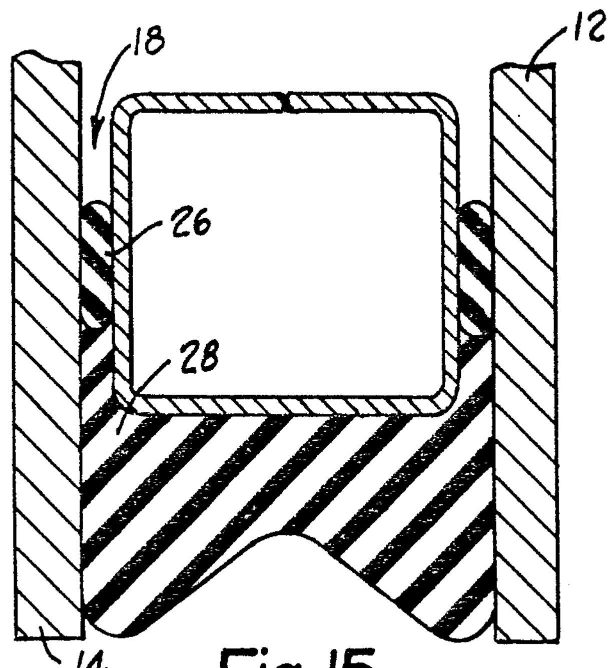

Fig. 15

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Method and Apparatus for Constructing Insulating Glass Units

Technical Field

The present invention relates to double-sealed insulated glass units and more particularly relates to a method and apparatus for constructing such units.

Background of the Invention

Typical insulating glass units are constructed from two rectangular panes of glass interconnected by a rectangular spacer frame assembly. The spacer frame assembly is disposed between and extends about the margins of the panes so that a dead air space is formed between the panes within the spacer frame. An insulating glass unit of the sort referred to is generally placed in a supporting framework of a door or a window or building facade in such a way that the spacer frame and marginal areas of the panes are not visible.

The typical spacer frame assembly includes four thin elongated tubular spacer frame members, sometimes called spacer bars, connected at their ends to form a rectangular shape. Various devices and structures can be used to connect the spacer frame members together. For example, the spacer frame assemblies can be formed from a single length of tubular bar stock which is notched at the locations of the frame corners so that the bar stock can be readily bent at its corner locations and the opposite ends can be secured together to form a closed rectangular frame. This approach to forming spacer frame assemblies is illustrated and described in U.S. Patent No. 3,280,523 to Stroud, et al.

Another approach is to bend a single length of spacer bar into a rectangular shape and weld or solder the free ends together.

Alternatively, the spacer frame assemblies can be formed from separate, individual spacer frame members connected at their ends by folding, locking corner connectors (referred to as folding locking corner "keys") which allow the spacer bar members to be formed into a rectangular shape at which time the corner keys lock in place to produce a relatively stable rectangular frame construction. Spacer frames constructed in this manner are illustrated and described in U.S. Patent No. 4,530,195 to Leopold.

Still another approach to the construction of spacer frames is to connect the spacer frame members by yieldably bendable corner keys so that the spacer frame members can be manipulated into a rectangular shape by bending the corner keys which, after having been bent, permit the spacer frame members to be maintained generally in the rectangular configuration. Yet another manner of constructing the spacer frame assembly is to provide separate individual spacer frame members which are connected together by rigid fixed angle corner keys.

In all these constructions the spacer frame assembly also includes sealant material by which the glass panes and the spacer frame assembly are hermetically attached together to produce the dead air space in the insulating glass unit. It is essential that the sealant material provide an effective vapor barrier in sealing the insulating glass units. If a leakage path forms between the atmospheric air and the dead air space, atmospheric water vapor enters the dead air space and eventually condenses on the interior faces of the panes leaving permanent stains in the unit. Two kinds of sealing approaches have become commonplace in the construction of insulating glass units. One approach produces "single seal" units; the other produces "double seal" units.

Single seal units are produced by providing a vapor barrier formed by a single sealant material. In their simplest form, single seal units are made by applying sealant peripherally about the outside of the spacer frame assembly once it is positioned between two lites of glass. In single seal units, the sealant material functions to both seal the units and to structurally interconnect the panes and spacer bars.

This approach to sealing insulating glass units is generally termed "single seal" because a single kind of sealant material forms a single barrier to the entry of vapor into the units while structurally connecting the spacer bars and glass panes.

In some single seal units the sealant is applied along the spacer frame member sides and continuously along the external peripheral faces of the members as a single body of material. By still another method sealant is applied as in U.S. Patent No. 4,546,723. The sealant body has a generally U-shaped cross sectional configuration and extends completely around the periphery of the insulating glass unit. This sealant body configuration maximizes the extent of the vapor barrier and because hot melt butyl is used as the sealant material the structural strength of the insulating glass unit is quite great.

When the sealant material has been applied to the spacer frame members the resultant spacer frame assembly is sandwiched between glass panes with the sealant material adhered to the glass and the spacer frame. It is preferable to pass the assemblage through an oven to heat the sealant for facilitating bonding. The unit is then moved through a press where rollers compress the units while the sealant is at temperature. The combination of heat and pressure firmly affixes the glass panes to the spacer frame assembly and seals the unit.

"Double sealed" units are also employed in residential environments as well as in installations where insulating glass units form architectural features of buildings and are composed of large area, relatively thick glass panes. This kind of unit is generally produced utilizing a method of production in which two sealant materials are used one forming a distinct vapor barrier, the other forming a structural interconnection.

Double sealed insulating glass units have always been manufactured by first applying a primary seal to the spacer frame and then applying the secondary seal completely around the periphery of the insulating glass unit. A typical construction employs a spacer frame assembly having a small body of polyisobutylene (PIB) forming the primary sealant. Polyisobutylene is a commonly used insulating glass unit sealant material which provides a highly effective vapor seal but does not afford significant structural strength to the units. The polyisobutylene is applied in narrow beads to opposite sides of the spacer bars. Where the spacer frame members are joined by corner keys the PIB is also applied in the form of thin coatings on the frame corners as in U.S. Patent No. 4,546,723. The units are run through a press to fix the PIB in place and seal the dead air space.

The double sealed units are completed by applying a body of structurally strong sealant material completely around the unit periphery to form a second seal while assuring the structural integrity of the unit. The second material may be a hot melt butyl but is more frequently a two component material which requires "curing" by placement in an oven or the like for a pre determined period. Silicones, polysulfides and urethanes are frequently used for such purposes.

Application of the second sealant material is normally accomplished by use of a hand held sealant "gun" connected to a sealant supply and pumping system. After the gunning is complete the sealant is hand trowled into place. Application of the second sealant is a slow, labor intensive procedure which reduces the production rate of double sealed insulating glass units and markedly increases their cost. Furthermore, the secondary sealant must be carefully applied to the unit because if air is entrapped between the primary and secondary sealants the entrapped air becomes a weak point with the potential for destroying the vapor barrier and thus ruining the unit.

Summary of the Invention

The present invention provides a new and improved method and apparatus for constructing double sealed insulating glass units wherein both sealants form part of a spacer frame assembly so that the double sealed units are produced by sandwiching dual sealant spacer frame assemblies between glass panes.

An important feature of the invention resides in the substantially simultaneous application of first and second sealants to spacer frame members prior to the spacer frame assembly being sandwiched between glass panes. This enables the manufacture of double sealed insulating glass units without any need to apply sealant material after the glass and spacer frame assembly are assembled.

In accordance with a preferred embodiment of the invention each frame member of an assemblage of spacer frame members is moved past a sealant application station where a body of primary sealant material is applied. As each member continues its movement past the sealant application station a second body of sealant material is applied so that the first and second bodies of sealant material are contiguous and deposited at locations enabling two distinct vapor barriers to form when the insulating glass unit is assembled.

An important feature of the invention is the provision of a new and improved sealant application machine having a sealant application station for serially applying first and second sealant bodies to spacer members being fed past the station. The new machine employs first and second sealant supply systems for continuously delivering sealant to the application stations. The new sealant machine is so constructed and arranged that bodies of the sealant materials are applied to the frame members contiguously and in relative positions that the sealant bodies form the double seals of a double sealed insulating glass unit when glass panes are assembled to the spacer frame assembly.

Other features and advantages of the invention will become apparent from the following description of a preferred embodiment made with reference to the accompanying drawings.

Brief Description of the Drawings

Figure 1 is a perspective view of an insulating glass unit constructed according to the present invention;

Figure 2 is a cross-sectional fragmentary view seen approximately from the plane indicated by the line 2-2 of Figure 1;

Figure 3 is a fragmentary cross-sectional view seen approximately from the plane indicated by the line 3-3 of Figure 1;

Figure 4 is a top plan schematic view of equipment constituting an assembly line for insulating glass units of the character illustrated by Figure 1;

Figure 5 is a top plan view of a portion of the insulating glass assembly line of Figure 4;

Figure 6 is a front elevational view of the equipment illustrated by Figure 5;

Figure 7 and 8 are a fragmentary cross-sectional views of the sealant extrusion heads utilized in the apparatus of Figures 5 and 6;

Figure 9 is a front elevational view of the drive assembly portion of the equipment illustrated by Figure 6;

Figure 10 is a fragmentary cross-sectional view of an insulating glass unit spacer frame at a stage in production where it passes over bottom nozzles of the sealant extrusion heads illustrated in Figures 7 and 8;

Figures 11 and 12 illustrate portions of insulating glass unit spacer frames at different stages in their production;

Figure 13 is a cross-sectional view seen approximately from the plane indicated by line 13-13 of Figure 11;

Figure 14 is a cross-sectional view seen approximately from the plane indicated by the line 14-14 of Figure 12;

Figure 15 is an enlarged cross-sectional view seen approximately from the plane indicated by the line 15-15 of Figure 1;

Figure 16 is an enlarged cross-sectional view seen approximately from the plane indicated by the line 16-16 of Figure 11;

Figure 17 is an enlarged cross-sectional view seen approximately from the plane indicated by the line 17-17 of Figure 12; and

Figure 18 is an enlarged cross-sectional view of a portion of an insulating glass unit similar to that illustrated in Figure 2.

Best Mode for Carrying Out the Invention

An insulating glass unit 10 constructed according to the present invention is illustrated by Figures 1 and 2 of the drawings and includes rectangular glass panes, or lites, 12, 14 with a spacer frame assembly 16 sandwiched between the panes extending about their peripheries to produce a hermetic air space 18 between the lites 12, 14 and within the spacer frame assembly 16.

The spacer frame assembly 16 is constructed and arranged to space the panes 12, 14 a predetermined distance apart while securing the panes together and sealing their perimeters to assure that the dead air space 18 remains sealed from the surrounding atmospheric air. In the preferred and illustrated embodiment of the invention the spacer frame assembly 16 comprises four spacer frame members 20 (also known as "spacer bars") which are arranged in a rectangular configuration with their adjacent ends connected together by corner connectors 22 which serve both to connect the spacer bars together and to plug the ends of the spacer frame members to prevent of loss of desiccant 24 from the interior of the frame members. The spacer frame assembly 16 further includes sealant bodies 26, 28 which serve to secure the spacer frame assembly and panes together while sealing the dead air space 18 within the unit 10.

The spacer frame members 20 may be of any suitable or conventional construction and for the purpose of this description have been illustrated as formed by relatively thin-walled tubular members, which can be roll-formed aluminum for example, constructed so that the interior of the frame member is in communication with the air space 18 through a perforate seam 29. The desiccant material 24 inside the frame members is particulate material with the particles being sufficiently large to prevent desiccant loss through the seam 29. The desiccant material 24 being in communication with the air space 18 is effective to absorb any moisture trapped within the space 18 at the time the insulating glass unit 10 is constructed.

The corner connectors 22 can be of any suitable or conventional construction. For example, the connectors might be rigid fixed angle corner keys, or folding non-locking corner keys. In the preferred and illustrated embodiment the connectors are folding locking corner keys. The preferred keys are illustrated as formed of plastic material defining body portions 30, 32 which are attached to respective spacer frame members. A hinge structure 34 allows the body portions to be flexed relative to each other, and a latching mechanism 36 enables the body portions 30, 32 to be secured together in a flexed condition. The corner connector 22 is illustrated and described in greater detail in U.S. Patent No. 4,530,195 to Leopold.

While corner connectors have been illustrated and described, or adverted to, frame corner constructions devoid of corner connectors could be employed without departing from the invention. In such a construction a long spacer frame member 20 could simply be bent at right angles to form four corners and the free adjacent frame ends connected together by welding or by a suitable straight connector element. Another type of construction employs spacer frame members which are welded together or soldered at the corners. Alternatively, the frame members could be formed by a single length of tubular spacer bar which is provided with V-shaped notches so that the corners are formed by simply bending a thin wall of the frame member material.

The insulating glass unit 10, because of the presence of the sealant material bodies 26, 28, is what is known as a double-sealed insulating glass unit. Double-sealed insulating glass units are so called because the air space 18 is separated from the sur rounding atmosphere by two sealant barriers formed, respectively, by the sealants 26, 28. The sealant bodies 26, 28 individually function both to secure the spacer frame members and glass panes together and to produce a vapor barrier.

Figure 4 illustrates a system 40 for constructing double-sealed insulating glass units according to the present invention. The system 40 includes a spacer frame assembly production line 42 and a glass pane conveyor table 44 which respectively deliver spacer frame assemblies and glass to an insulating glass unit assembly location. There the spacer frame assemblies are sandwiched between glass panes and the sandwiches are delivered to an oven 50. The heated units pass through a roller press 52 which forces the panes against the spacer frame assemblies. A discharge conveyor 54 delivers the completed insulating glass units from the roller press.

Individual spacer frame assemblies 16 are mated with pairs of conforming glass panes 12, 14 at the insulating glass unit assembly location. The conveyor table 44 preferably delivers panes to the assembly location from a glass washer (not illustrated). When relatively small units are assembled they are built on the table 44. Alternatively, when large units are built the panes are fed onto a tilting caster table 60, where an assembly line worker aligns and applies the spacer frame assembly to one pane on the table 60. When the table is tilted the worker places the second pane lightly against the spacer frame assembly and first pane so that the panes are both lightly adhered to the spacer frame assembly.

The partially assembled insulating glass units are then fed onto a driven conveyor 62 into the oven 50 and the roller press 52 so that the units pass through the press roll nips and the panes are urged into firm engagement with the spacer frame assembly while the sealant bodies remain at elevated temperatures.

The completed insulating glass units are delivered from the roller press onto a feed out conveyor 54 from which the units are manually off-loaded by assembly line workers.

According to the present invention spacer frame assembly production line 42 is constructed and arranged so that the spacer assemblies are delivered to the insulating glass unit assembly location with two sealant bodies already attached to the spacer frame members and positioned for making a double seal unit, with glass panes also delivered to the assembly location. For this purpose the spacer frame assembly production line 42 comprises a sealant application machine 80 for affixing two distinct sealant bodies to the spacer frame members passing through it and a delivery conveyor 82 for transporting the completed spacer frame assemblies to the assembly location.

The delivery conveyor 82 may be of any suitable or conventional construction and for the purposes of this description is formed by an overhead chain or belt carrying suspension hooks on which spacer frame assemblies are hung and moved from the sealant application machine 80 to the assembly location.

In the preferred and illustrated embodiment of the invention the sealant application machine 80 is in the form of a sealant extruder (see Figures 5-9) comprising a machine body 84 defining a sealant application station 86; a sealant supply system 90 for delivering both sealants to the application station 86 and a frame conveyor system 92 by which spacer frame members are fed to the station 86 and delivered from the station 86 with the sealants applied.

The machine body 84 is formed by a floor engaging base 94 supporing a structural framework 96 extending upwardly from the base. The framework 96 supports an electrical control system 98 and a fluid control system 99 in suitable enclosures.

The sealant application station 86 is located so that spacer frame members are fed to and delivered from it on a path of travel extending along the conveyor system 92. The preferred station 86 comprises two sealant extrusion heads 100A, 100B positioned immediately adjacent each other along the path of travel of the spacer frame members on the conveyor system. The head 100A applies the primary sealant material to the spacer frame members while the head 100B applies the secondary sealant material immediately after the primary sealant is applied.

Referring to Figure 7, the head 100A includes a heated sealant directing manifold 101 supporting sealant extruding nozzle assemblies 102 and sealant flow controlling valves 103. Nozzle assemblies 102A, 102B are disposed at opposite sides of the path of travel and a nozzle assemblies 102C lies adjacent the bottom wall of a spacer frame member passing the station 86.

The sealant manifold 101 is supported by the machine frame and contains internal passages for communicating the nozzles 102 to the sealant supply system. The manifold 101 is provided with electrical heating elements and a suitable thermostatic control to assure that the manifold temperature remains at a level to promote flow of the primary sealant.

The nozzle assemblies 102A, 102B are each communicated to the sealant supply system 90 by a respective on-off control valve 103A, 103B. When the leading end of a spacer frame member moves into the station 86 the control valves 103A, 103B are opened and beads of primary sealant material (such as PIB) are forcefully extruded onto the opposite sides of the spacer frame member via small nozzle openings in the nozzle assemblies 102A, 102B. The beads are applied so long as a spacer frame is passing through the station 86.

The nozzle assembly 102C is connected to the sealant supply system 90 by an on-off control valve 103C which is actuated whenever a corner section of spacer frame assemblage approaches the head 100. The nozzle assembly 102C defines a nozzle opening which is narrow and elongated, extending transversely across the path of travel. As shown in Figure 11, sealant extruded through the nozzle assembly 100A flows in a generally U-shaped configuration along the bottom wall of the spacer frame member and up the side walls continuously with the beads applied by the nozzle assemblies 102A, 102B. Thus, a U-shaped body of primary sealant is disposed on the spacer frame member assemblage at positions bridging the corner forming parts and extruded along the opposite ends of the assemblage. The intermittent application of the primary sealant body along the bottom wall of the assembly corner parts and spacer frame segments is accomplished by the control system described in U.S. Patent No. 4,546,723, or other conventional means.

As shown in Figure 10, the nozzle assembly 102C further includes a spacer member guide disposed "upstream" from the nozzle opening for maintaining a predetermined spacing between the nozzle opening and the confronting lower side of the spacer frame member. This helps assure that the desired thickness of primary sealant is applied by the nozzle assembly 102C. In the preferred embodiment the spacer member guide is formed by a cylindrical dowell-like pin 102D.

The nozzle assemblies 102A, 102B and their respective control valves 103A, 103B are attached to the manifold 101 so that the nozzle and valve positions can be adjusted towards and away from the spacer frame member path of travel. This permits differing width spacer frame members to be accommodated. The side nozzle assemblies are constructed so that when their positions are adjusted along the top surface of the manifold 101 the width of the opening of the lower nozzle assembly 102C is adjusted correspondingly. This adjustment assures that the primary sealant body is always appropriately configured for the size of the spacer member passing through the station 86.

The nozzle control valves 103A, 103B, 103C are illustrated as pneumatically actuated between their fully open and fully closed positions under control of the electrical control system 98. The control system 98 may be constructed like the system disclosed in U.S. Patent No. 4,546,723 or may take other conventional forms.

The head 100B is located adjacent the head 100A so that spacer frame members which are having the primary sealant body applied to them by the head 100A immediately receive a body of secondary sealant at the head 100B. The head 100B is constructed and arranged to affix a body of secondary sealant to the spacer frame members which is shaped to extend contiguously with the primary sealant body. The secondary sealant is forcibly directed onto spacer frame members in a generally U-shaped cross-sectional configuration as illustrated in Figures 14 and 17. The body of secondary sealant affixed to each spacer member smoothly joins the primary sealant body placed by the head 100A and thus both the primary and secondary sealants individually extend between the glass panes and the spacer frame members to form a dual atmospheric air vapor barrier as well as individually acting to secure the panes and spacer frame members together as shown in Figures 15 and 18.

Referring to Figure 8, the head 100B is illustrated as comprising a heated sealant manifold 104, a nozzle assembly 105 supported by the manifold 104, and a sealant flow control valve 106. The manifold 104 is supported by the machine framework adjacent the manifold 101 and communicates heated secondary sealant from the source 90 to the nozzle 105 through suitable sealant passages. The manifold 104 is electrically heated to maintain the proper fluency of the secondary sealant. The manifolds 101, 104 are preferably separated by a good heat insulator, such as an air space, or a body of heat insulating material, so that the manifolds can be efficiently maintained at substantially different temperatures depending upon the sealants selected for use.

As shown in Figure 10, the preferred nozzle assembly comprises a nozzle plate 105A defining a narrow extrusion nozzle opening 105B extending transversely of the path of travel along the lower face of a spacer frame member passing through the station 86. Flow adjusting slides 105C, 105D are disposed on the nozzle plate at opposite sides of the spacer member path of travel. The slides are adjustably positioned towards and away from the path of travel axis to adjust the width of the nozzle opening 105B and to control the application of secondary sealant along the spacer frame side wall. The slides are adjusted so that the spacer frame members, with the beads of primary sealant already applied, just clear the slides. The nozzle assembly 105 includes a spacer member guide like that of assembly 102 is disposed upstream from the nozzle opening 105B. The spacer member guide is formed by a cylindrical dowell-like pin 105E, of a slightly larger diameter than that of 102D. The secondary sealant supplied from the nozzle opening 105B is adhered to the lower face of the spacer member and also flows upwardly between the spacer member sides and the slides 105C, 105D to the primary sealant beads as shown in Figure 12. The flow of the sealant is variable to accommodate the skip sealant application of the type disclosed in U.S. Patent No. 4,546,723. The sealant flow control valve 106 connects the nozzle assembly 105 to the sealant supply system 90. The flow control valve 106 may be hydraulically or pneumatically actuated between open, closed and intermediate reduced flow condition positions based on control signals received by and responded to by the electrical control system 98.

The sealant supply system 90 operates to continuously deliver individual supplies of the primary and secondary sealants to the extrusion heads 100A, 100B. The system 90 comprises a primary sealant supply unit 110 and a secondary sealant supply unit 112. The primary supply unit 110 includes a sealant source 114 for producing a supply of heated, fluent sealant material and a sealant extrusion unit 116 supplied with sealant from the source 114 for delivering the sealant at high pressure to the extrusion head 100A.

The preferred sealant source 114 is formed by a storage reservoir 120 (which is typically a 55-gallon drums of primary sealant material) a sealant heater 122 including a heated plate structure seated on top of the sealant in the reservoir 120, and a supply pump 124 associated with the heater 122 for pumping heated sealant from the reservoir 120 to the extrusion unit 116.

The heater plate 122 is circular to fit within and closely conform to the surrounding circular wall of the reservoir 120 and heats the sealant adjacent the heater plate 122 to a temperature where the sealant has a sufficiently low viscosity to enable it to be pumped. The supply pump 124 is supported by the heater plate 122 and is positioned to extract the low viscosity heated sealant from the reservoir and deliver it to the extrusion unit. The sealant heater and pump thus "sink" into the reservoir as sealant is pumped out.

A heated sealant conduit 126 is preferably connected between the pump 124 and the extrusion unit 116 to assure the sealant remains in a flowable state as it is pumped to its destination. The heater 122, sealant pump 124 and conduit 126 may be of any suitable or conventional constructions and are therefore not described in further detail.

The extrusion unit 116 comprises piston-cylinder type hydraulically powered extrusion pumps 130, 132 supported by the machine framework near the nozzle head 100A and a change over valving system 134 which enables sealant to be delivered into one of the pumps 130, 132 from the storage reservoir 120 while the other pump is delivering sealant to the extrusion head 100A. The extrusion pumps 130, 132 are each constructed utilizing a piston sealingly mounted in its respective cylinder 131. A double or single acting hydraulic ram 131A controls the piston/cylinder by introducing fluid into the bottom region of the cylinder to drive the piston upward. Sealant above the piston is thus forced upwardly into contact with the change-over valve structure where it is delivered from the cylinder to the extrusion head 100A. When hydraulic fluid is exhausted from the cylinder the piston can move downwardly from the change-over valve as sealant is introduced into the cylinder from the reservoir 120. The change-over valving system in the preferred embodiment is formed by a heated manifold plate 133 which closes and seals the tops of both extrusion pump cylinders and a fluid actuated four-way valve assembly 135 which provides for the alternative operation of the extrusion pumps and thus permits continuous operation of the extrusion head 100A.

The heated manifold plate 133 defines flow passages extending, respectively, from the reservoir conduit to the valve assembly 135 and from the valve assembly to the extrusion head 100A. Likewise the manifold plate 133 defines passages between the valve assembly 135 and both of the extrusion pump cylinders 130, 132.

The secondary sealant supply 112 is constructed and arranged substantially like the system 110 and thus includes a secondary sealant source 140 and a double barrelled extrusion pump unit 142 associated with the source 140. The source 140 is illustrated as comprising a storage reservoir 144, a sealant heating system 146, a supply pump 148 and a conduit system 150 by which the sealant from the reservoir 144 is delivered from the pump 148 to the extrusion pump unit 142.

The extrusion pump unit 142 is formed by hydraulic piston and cylinder extrusion pumps 152, 154 like the pumps 130, 132 which are interconnected with the source 140 by a change over valving system 156. The valving system 156 is a fluid actuated assembly which, like the valving system 134, enables one of the extrusion pump cylinders to be filled from the reservoir 144 while the other extrusion pump cylinder is delivering secondary sealant to the extrusion head 100B. The valving system 156 includes a heated manifold plate 153 which closes and seals the tops of both extrusion pumps and a fluid actuated four-way valve assembly 155, which like valve 135, provides for continuous operation of head 100B. The heated plate 153 defines flow passages extending between the reservoir conduit 150 and valving assembly 155, valve assembly to head 100B, and the valve assembly 155 and the extrusion pumps 152, 154. The heated plates 133, 153 are preferrably separated by an insulator 153A, which is illustrated in Figure 5 as air.

The frame conveyor system 92 operates to move the spacer frame assembly past the extrusion heads 100A, 100B at a constant speed which is related to the rate of extrusion of sealant through the nozzle assemblies 103, 105 so that uniform layers of sealant are applied. The system comprises a conveyor 93, a conveyor 93A, a common drive mechanism 180, and a hold down assembly 190 for maintaining the assemblies in contact with the heads. The conveyor 93 has an endless belt 160, trained around rollers 162, 164 supported at opposite ends of a conveyor system supporting frame 166. The belt defines an upper reach 168 for supporting the frame segments while they are fed to the heads 100A, 100B. The conveyor 93A is formed by an endless belt 170 trained around rollers 172, 174 on opposite ends of conveyor support frame 176. The belt defines an upper reach 178 for supporting the spacer frame assemblies as they are delivered from the heads 100A, 100B.

The belts 160, 170 are driven by a common drive mechanism 180, illustrated in Figure 9, connected to the rollers 162, 172 adjacent the extrusion heads. The preferred conveyor drive mechanism includes an electric drive motor 182 whose output shaft is connected to the rollers via drive chains and appropriate sprockets.

The aligned frame segments of the spacer frame assemblies are moved along the conveyor belts 160, 170 between an opposed pair of guide plates 185 fixed to the supporting frame 166. The guide plates are disposed immediately adjacent the lateral sides of the frame segments and thus accurately position the frame segments for movement past the heads at predetermined distances from the nozzle assemblies 103, 105.

The hold down assembly 190 maintains the spacer assemblies with the belts and heads and comprises a mounting bracket 194 above the belts, and hold down wheels 192 supported by the bracket. As shown in Figure 6, the hold down assembly 190 is disposed above the belts to maintain the spacer assemblies in positive driving contact with the belts between the guide plate 185.

The hold down wheels 192 each having a resilient roller 193, are preferrably rotatably supported upon an axle projecting from the mounting bracket 194 extended above the belts and fixed to the conveyor frames 166, 176.

To assure that the spacer assemblies 16 are properly positioned with respect to the nozzle assemblies 103, 105 as they pass the heads 100A, 100B, pneumatic hold down wheels 196, 197 are disposed above nozzle openings 103C, 105B. The wheels 196, 197 bias the assemblages in the direction of the nozzle openings, without inhibiting the continuous travel of the assembly past the extrusion heads.

The sealant coated spacer frame assemblies exit the extrusion head 100B supported on the conveyor 93A. Upon reaching the end of the conveyor the assemblages are received by workers who manipulate the assemblages to rectangular configuration and transport them to the delivery conveyor 82 for transport to the insulating glass unit assembly location.

Referring to Figures 14 and 17 of the drawings a fragmentary spacer frame assemblage is illustrated in its condition when it is delivered from the sealant applying station 86 with the body of secondary sealant material illustrated extending contiguously with the primary sealant body along the spacer frame assemblage. The control valve 106 which governs the flow of the secondary sealant onto the spacer frame assemblage is constructed and arranged so that the flow of secondary sealant from the nozzle 105 is initiated and terminated when the leading and trailing edge ends, respectively, of the spacer frame assemblage pass through the station 86. In the preferred and illustrated embodiment of the invention the valve 106 initiates, terminates and varies the flow rate of the secondary sealant through the nozzle 105. The valve 106 is effective to provide a full flow rate and a restricted flow rate of the secondary sealant. The valve is preferably step actuatable between flow and restricted flow rates by the same control system which governs the continuous bead and intermittant corner application of primary sealant (shown in Figures 11, 13 and 16 respectively) through the extrusion head 100A. The thickness of the primary and secondary sealant bodies applied to the spacer frame assemblages is thus substantially constant along the length of the spacer frame assemblage including the regions at which the corners are located as illustrated by the thicknesses of sealant in Figures 12, 14 and 17. Upon exiting from the oven and roller press the hermitic air space 18 of the completed insulating glass unit is spaced from the atmosphere by the primary and secondary sealant barriers 26, 28 as in Figures 15 and 18.

While a preferred embodiment, of the invention has been illustrated and described in detail, the present invention is not to be considered limited to the precise construction disclosed. Various adaptations, modifications and uses of the invention may occur to those skilled in the art to which the invention relates and the invention is to cover all such adaptations, modifications and uses falling within the spirit or scope of the appended claims.

Claims

1. A method of producing a double sealed insulating glass unit comprising:

a) moving an elongated spacer frame member in the direction of its longitudinal axis along a generally linear path of travel extending through first and second sealant application stations;

b) applying a first sealant material to said spacer frame member continuously along its length at least on oppositely facing spacer frame member sides as said member moves through one sealant application station;

c) applying a second sealant material to a third side of said spacer frame member continuously along its length as said spacer frame member moves through the other sealant application station;

d) thereafter placing said spacer frame member between peripheral regions of panes of glass with the first sealant material disposed between the glass panes and the spacer frame member and with the second sealant material disposed between the glass panes along said third side; and

e) pressing the glass panes toward each other to sealingly engage the panes with said first and second sealant materials.

2. The method claimed in Claim 1 further including hingedly securing four spacer frame members together at adjacent ends thereof, to form an assemblage of longitudinally aligned spacer frame members and moving the assemblage along said path of travel, said first sealant material applied continuously along oppositely facing sides of said assemblage and said second sealant material applied continuously along a third side of said assemblage.

3. The method claimed in Claim 2 further including applying said first sealant material to said assemblage along said third side at least in the vicinity of each juncture of the spacer frame members with the first sealant material bridging the junctures.

4. The method claimed in Claim 1 wherein applying said first sealant comprises extruding a thin bead of said first sealant material continuously along each said oppositely facing side and applying said second sealant material comprises extruding said second sealant material continuously along said third side.

5. The method claimed in Claim 4 further including extruding said second sealant material continuously along said oppositely facing sides of said spacer frame member adjacent said beads of said first sealant material.

6. The method claimed in Claim 1 further including applying said second sealant material continuously along said oppositely facing spacer frame member sides adjacent the first sealant material thereon.

7. A method of making a double sealed insulating glass unit comprising the steps of:

a) fabricating a rectangular spacer assembly including forming a primary sealant material to provide first and second faces extending continuously about opposite lateral sides of the assembly and forming a secondary sealant material to define a sealant body disposed continuously about the outer periphery of the spacer frame assembly and extending into contiguity with said first and second primary faces;

b) placing the spacer frame assembly between glass lites so that said first and second primary sealant faces and the contiguous secondary sealant body portions are in engagement with the respective lites; and

c) urging said lites into intimate contact with said primary and secondary sealants to adhere said lites to both sealants for forming a double sealant vapor barrier about said insulating glass unit.

8. Method of making a double sealed insulating glass unit comprising:

a) providing a plurality of spacer frame members connected together at their ends;

b) moving said members individually through a primary sealant application station along a path of travel;

c) applying primary sealant at predetermined locations extending continuously along opposite sides of each member facing laterally of the path of travel;

d) applying primary sealant along at least predetermined locations of each member on a member side extending between said opposite sides;

e) applying secondary sealant along said member sides, and locating said secondary sealant material contiguously with said primary sealant material on said opposite sides;

f) locating said spacer frame assembly between glass lites to that said primary and secondary sealants along said opposite sides engage said lites; and

g) adhering said lites to said primary and secondary sealant bodies.

9. Method of making a double seal insulating glass unit comprising:

a) assembling a structural spacer member, a body of primary sealant and a desiccant to form a substantially straight spacer frame assemblage;

b) moving said assemblage along a linear path of travel extending through a secondary sealant application stations;

c) extruding a body of a secondary sealant material onto said assemblage, said body of secondary sealant material located on said spacer assemblage contiguous the primary sealant;

d) folding said spacer frame assemblage into a generally polygonal shape;

e) placing said folded assemblage between glass panes; and

f) heating the sealant materials while pressing the panes into engagement with the sealant to form a double sealed insulating glass unit.

10. A machine for use in manufacturing double seal insulating glass panels wherein a polygonal spacer frame assembly is sealed in place between glass panes by first and second sealants to establish a hermetic space between the panes, said machine comprising:

a) a conveyor for feeding a spacer frame member along a generally linear path of travel;

b) a sealant application station comprising:

i) reservoir structure for a supply of a sealant material;

ii) extruder nozzle means supported adjacent said path of travel so that said conveyor feeds said spacer bar along said path adjacent said nozzle means, said nozzle means comprising at least first and second nozzle apertures disposed adjacent respective opposite sides of said path of travel for directing separate beads of said sealant material onto a spacer frame member moving along said path;

iii) sealant pumping means for forcing sealant out of said reservoir structure to said nozzle means; and

iv) sealant flow control means governing the flow of sealant to said nozzle apertures; and,

c) a second sealant application station comprising:

i) second reservoir structure for a supply of a second sealant material;

ii) second sealant extrusion nozzle means disposed along said path of travel adjacent said first extrusion nozzle means, said second extrusion nozzle means comprising nozzle aperture forming structure positioned for directing second sealant material onto the opposite sides of a spacer frame member adjacent the location of the first sealant material thereon;

iii) second sealant pumping means for forcing a flow of the second sealant from said second reservoir structure to said second nozzle means.

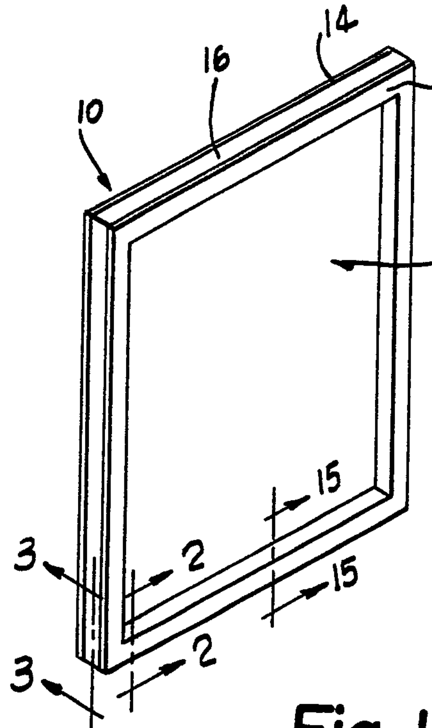


Fig. 1

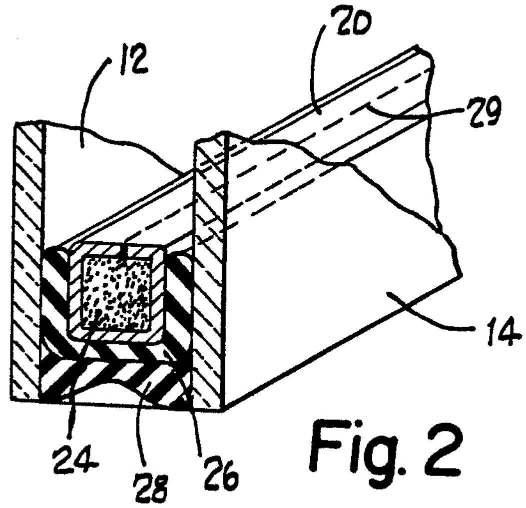


Fig. 2

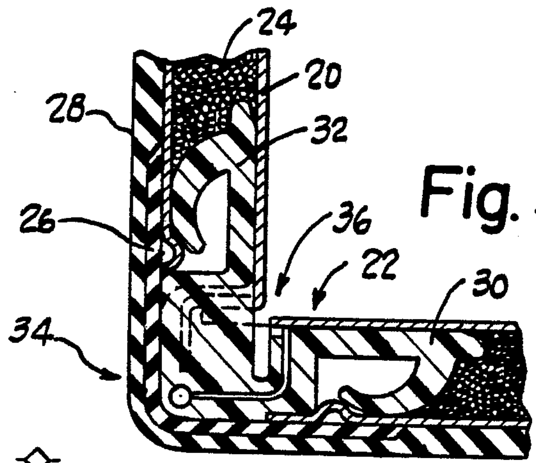
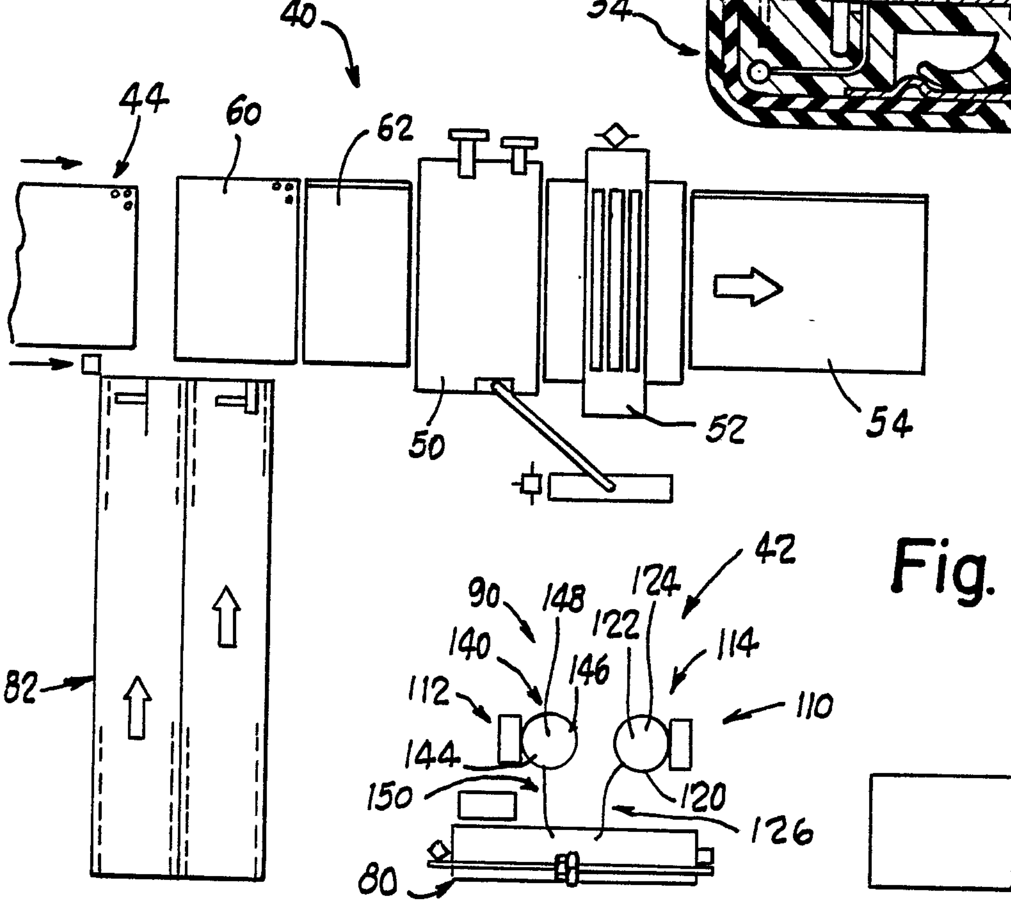


Fig. 3



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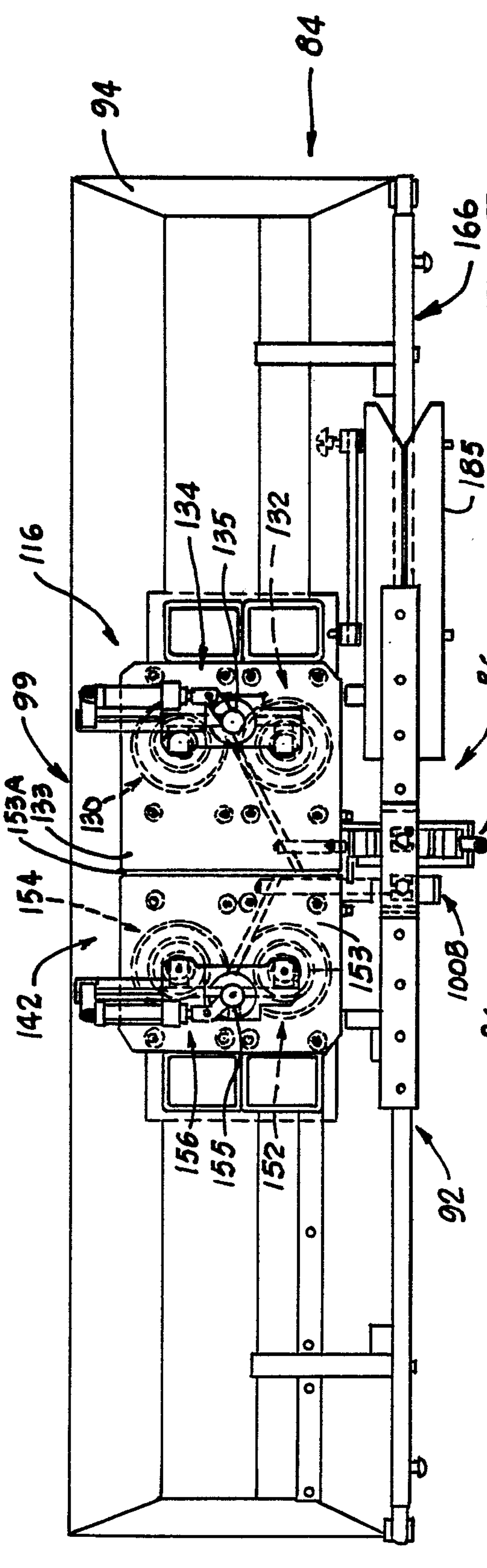
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Fig.5

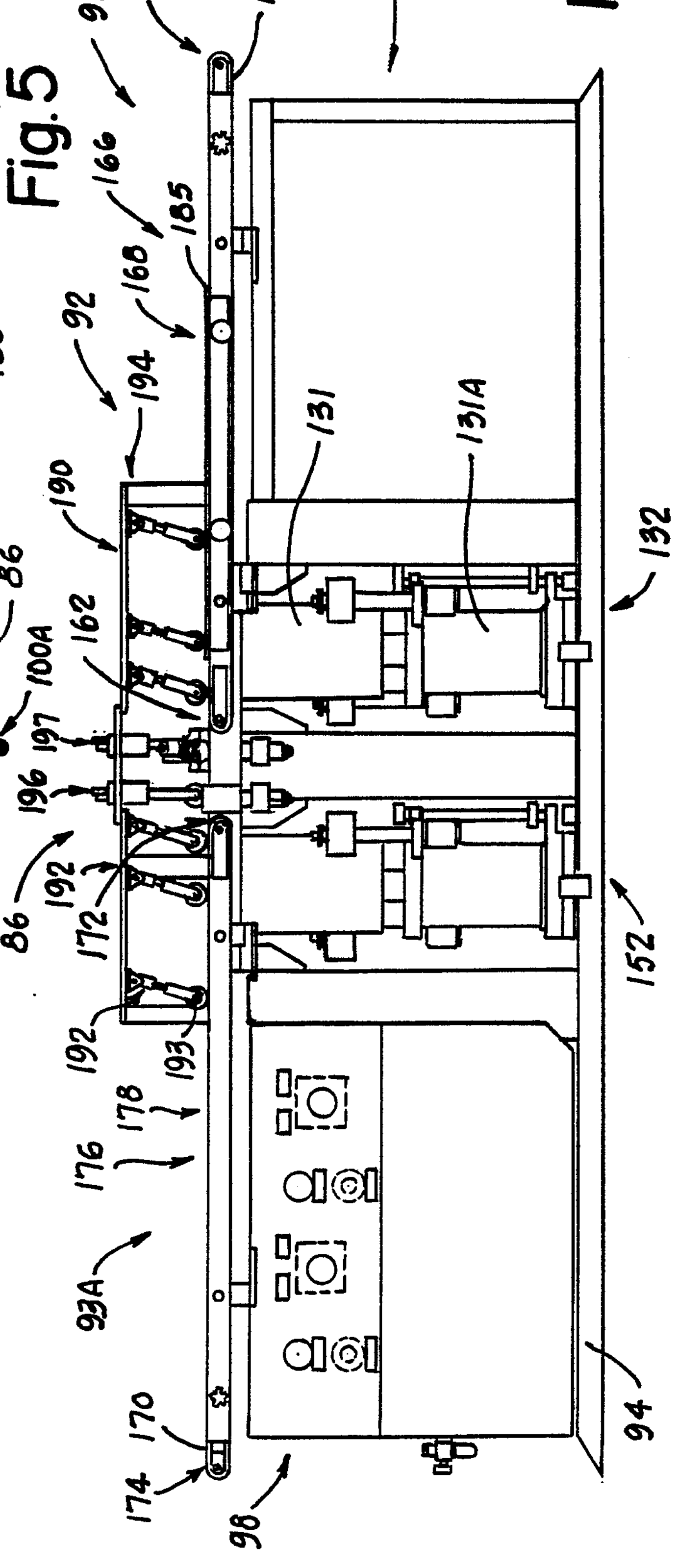
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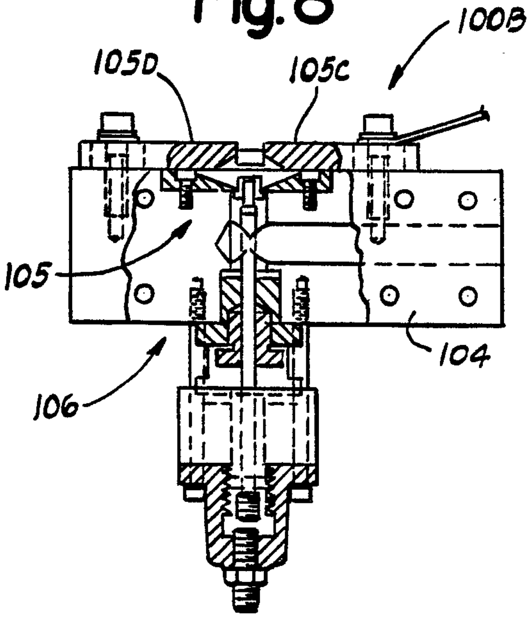
Fig.6



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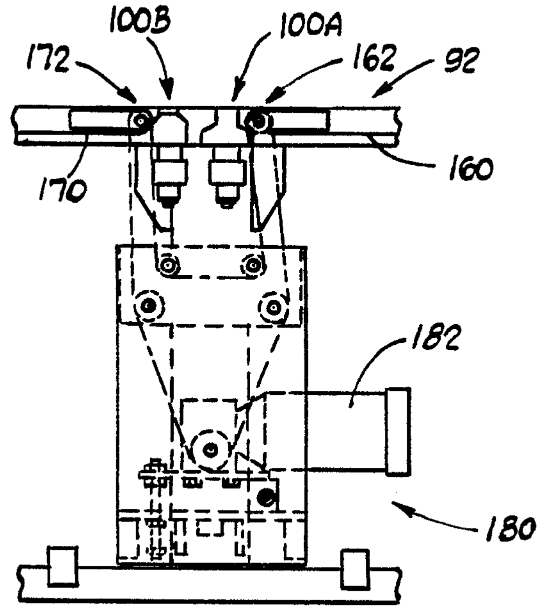

Fig. 9

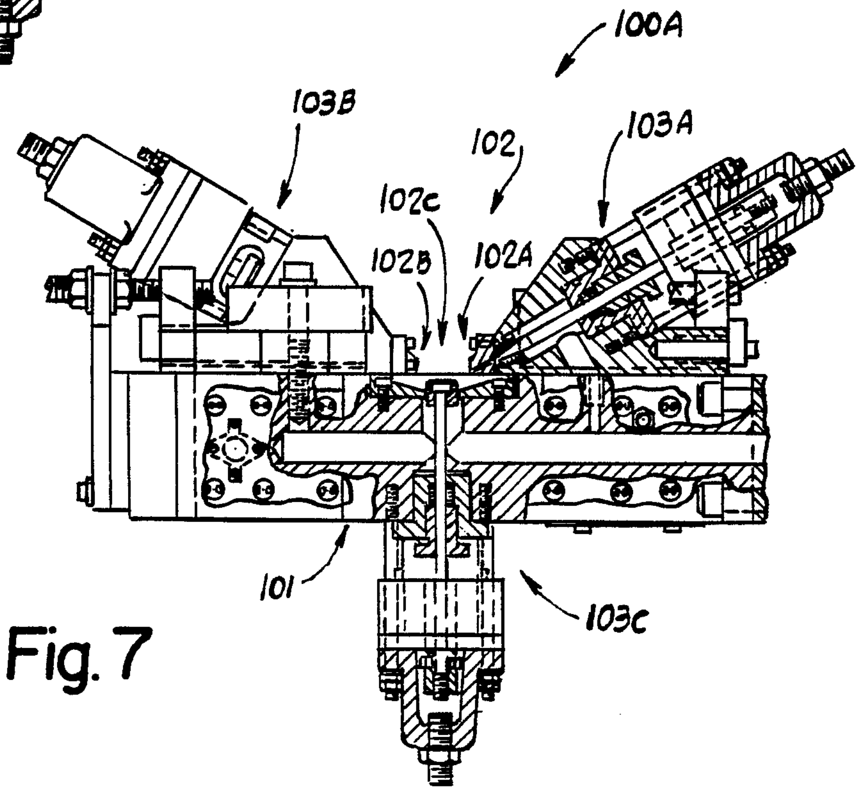

Fig. 7

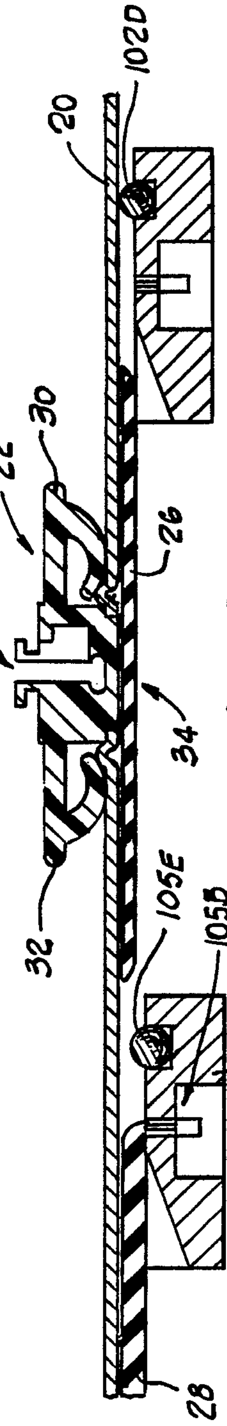

Fig. 10

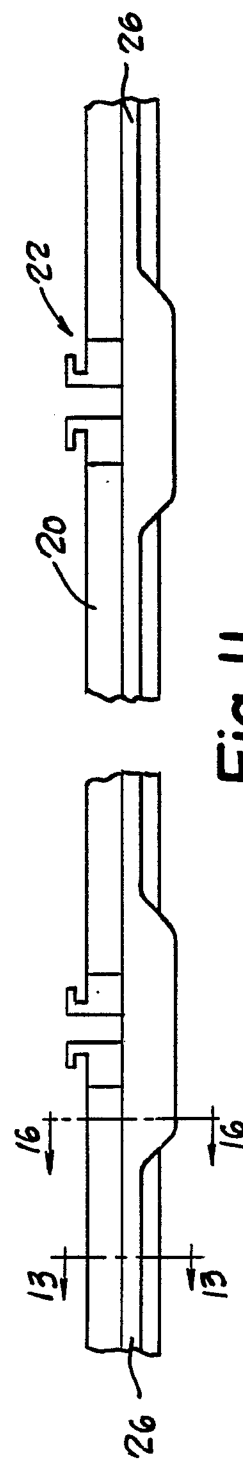

Fig. 11

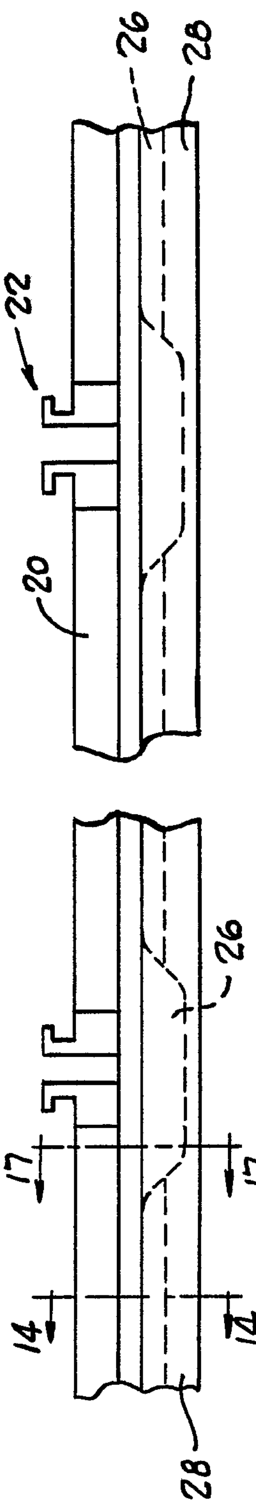

Fig. 12

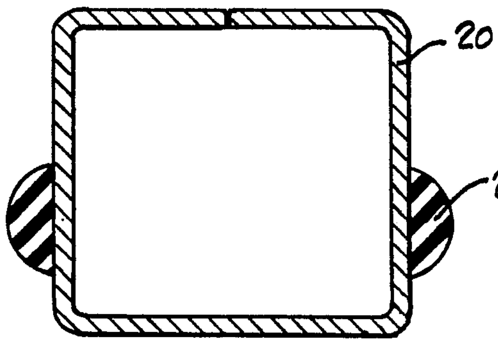

Fig. 13

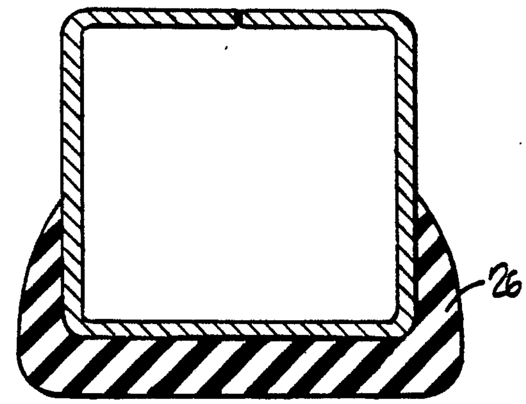

Fig. 16

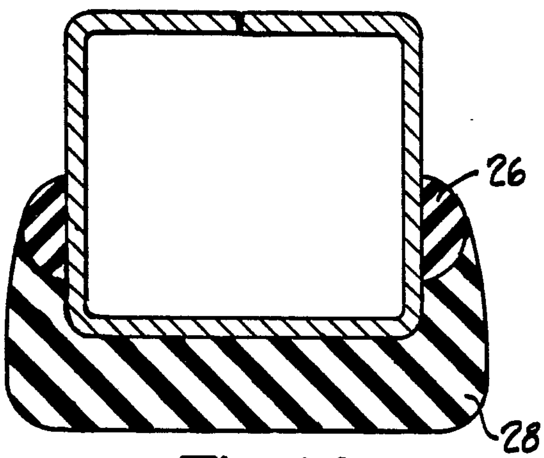

Fig. 14

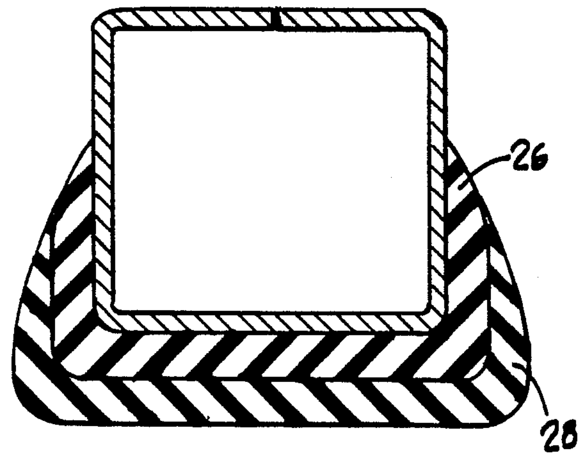

Fig. 17

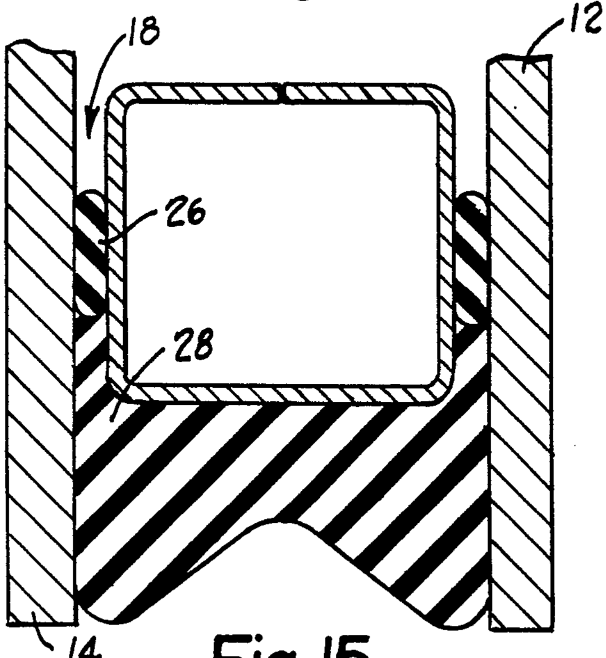

Fig. 15

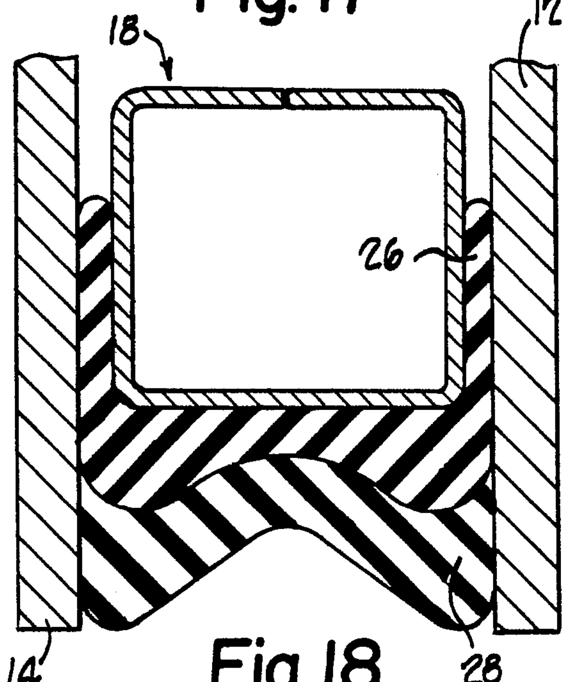

Fig. 18

European Patent Office

EUROPEAN SEARCH REPORT

Application Number

EP 88 10 5664

DOCUMENTS CONSIDERED TO BE RELEVANT

Category	Citation of document with indication, where appropriate, of relevant passages	Relevant to claim	CLASSIFICATION OF THE APPLICATION (Int. Cl.4)
D,Y	US-A-4 546 723 (LEOPOLD) * Column 3, line 43 - column 4, line 3; column 4, line 49 - column 6, line 65; column 7, line 58 - column 8, line 2; figures 1-8 *	1-10	E 06 B 3/66
Y	EP-A-0 192 363 (BOSTIK) * Page 3, line 7 - page 8, line 29; figures 1-3 *	1-10	
A	FR-A-2 449 222 (KAUFERLE) * Page 16, line 4 - page 17, line 14; page 20, line 26 - page 22, line 8; page 24, line 3 - page 25, line 29; figures 1-13 *	1,4,7,8,9,10	
A	US-A-4 411 115 (MARZOUKI)		

TECHNICAL FIELDS SEARCHED (Int. Cl.4)

E 06 B

The present search report has been drawn up for all claims

Place of search	Date of completion of the search	Examiner
THE HAGUE	08-07-1988	DEPOORTER F.

CATEGORY OF CITED DOCUMENTS

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