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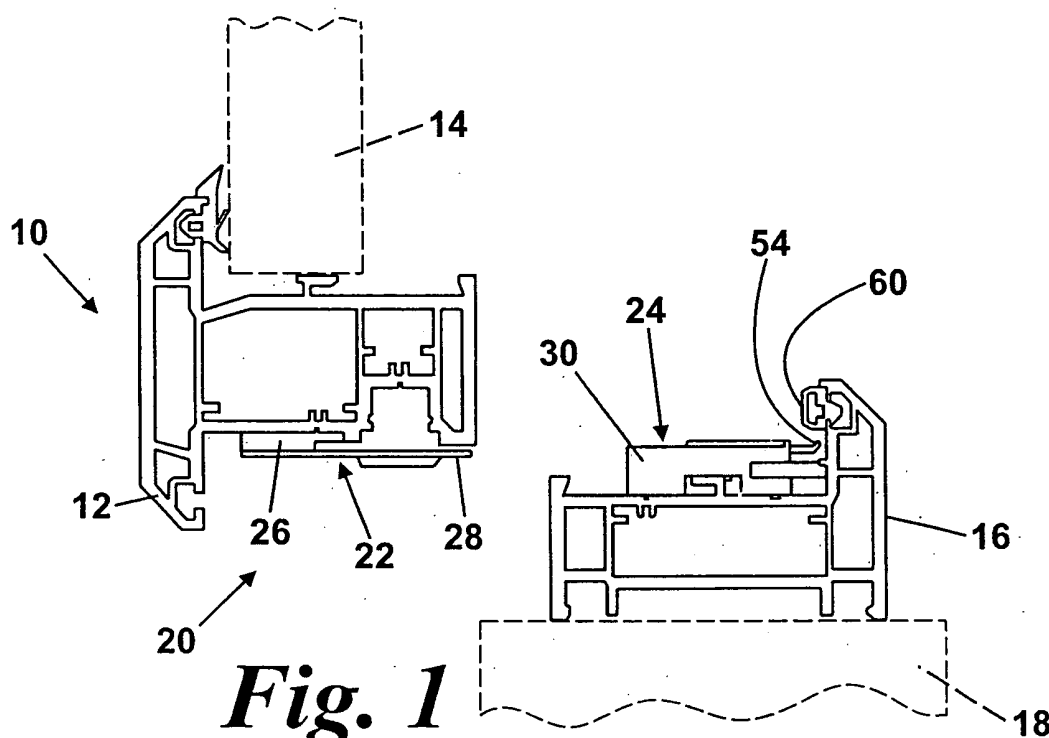
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(54) **Removable fixation of a window sash in an opening by ratchet means**

(57) A panel fixing system is described for rapid and secure fixing of a panel into a matching aperture simply by a push fit. The fixing system comprises male and female portions 22, 24 which engage each other with a ratchet action so that the panel can be pushed home into

the aperture and retained there by the ratchet. A release mechanism is provided whereby the ratchet can be released from one side. A secondary lock out system is provided to secure the panel with respect to the aperture should force be used to overcome the ratchet action.



Description

[0001] This invention relates to a fixing clip and fixing system for fixing together two members to restrict relative movement in at least one direction.

[0002] There are many such instances where it is required to fix two members in edge-to-edge relationship. A typical application is the fitting of windows, but there are many other similar applications.

[0003] Ideal attributes for such fixings are that assembly of the members is quick and easy, the fixing is relatively inexpensive, no screws or the like are visible after fixing, and the fixing provides self alignment. Furthermore, in some circumstances it may be required to remove the window for replacement or maintenance and in these instances it is desirable for the fixing to be releasable.

[0004] A typical example, where such attributes are desirable, is the fitting of a fixed (a so called 'dummy') window sash into an aperture where an opening sash would normally be fitted. In that case a secure fixing is required which is quick and simple and which will securely locate the sash in the frame aperture with no visible screws etc, so that a sash can be push fitted into an opening with a self centring effect. Conventionally a number of different measures are used, including using a hinge fixing and then permanently closing the window by removing the glazed panel and screwing through the sash into the frame. This however is wasteful in terms of window furniture and also time consuming to effect. Furthermore this method is only possible where it is feasible to remove the glazed panel from the sash on site. This means that this method cannot be used for leaded glazed panels because their method of manufacture means they cannot be removed from the sash once assembled. There is, therefore, a need for a fixing system in which the number of costly fixings are reduced and in which the sash can be fitted quickly, ideally by a simple push fit.

[0005] Accordingly, in one aspect this invention provides a fixing system for fixing a panel in an opening framed by one or more frame members, said fixing system comprising a plurality of male fixing means and a plurality of female fixing means, the male means being receivable in or on the female means with a ratchet action therebetween such that in use the panel may be offered up to the opening to effect initial engagement between said male and female fixing means and thereafter urged into place and retained there by said ratchet action.

[0006] Although either alternative is possible, said male fixing means are preferably provided on the panel and said female means are provided on the frame. Conveniently said male fixing means have thereon a row of teeth which cooperate with a latch surface on said female fixing element. Two generally parallel pairs of rows of teeth may be provided each with the teeth at generally the same pitch but the rows of one pair being offset longitudinally relative to those of the other by one half a tooth pitch with respect to each other in the insertion direction,

with there being respective latch surfaces with no longitudinal offset for cooperation therewith.

Conveniently each of said male fixing means comprises a resiliently deformable element biased into engagement with said female fixing means. Said male and female fixing means have complementary engagement surfaces designed to cooperate to prevent removal of the window after installation unless released, thereby to provide lock out. Thus, for example, said complementary engagement surfaces may comprise an edge of an aperture provided on the male fixing means and a cooperating projecting portion on said female fixing means. Said complementary engagement surfaces may cooperate such that a force tending to remove the window urges the male and female means into tighter ratchet action with each other.

Preferably said male and female fixing means are adapted such that during initial engagement of said male and female fixing means, said male fixing means resiliently slides over said projection with said projection thereafter locating within said aperture. Said male fixing means may comprise conveniently two finger elements disposed side by side and adapted to engage corresponding female portions forming part of said female fixing means, in ratchet action. Said female fixing means may comprise a resilient ratchet plate and guide means for guiding said male fixing means into engagement therewith. Said guide means may comprise means defining a passage along which said male fixing means may pass. Said passage may be defined by a moulded plastics base portion for attachment to one of said frame members and a plate attached thereto.

[0007] To allow for maintenance, etc., it is preferred to provide an arrangement whereby following installation, said ratchet action may be disengaged by insertion of a tool between the panel and an adjacent frame member.

[0008] In another aspect this invention provides a fixing assembly for being used to fix a panel in an opening framed by one or more frame members, said fixing system comprising a male fixing means and a female fixing means, the male fixing means being engageable in or on the female fixing means with a ratchet action therebetween such that in use the panel may be offered up to the opening to effect initial engagement between said male and female fixing means and thereafter urged into place and retained there by said ratchet action.

[0009] In yet another aspect this invention provides, a fixing clip for being disposed, in use, at opposing edges of two building members in generally edge-to-edge relationship, the clip providing restriction to relative movement of the two members after they are offered together, the restriction being at least in a direction opposite to the direction of offering together, said clip comprising: a first part attachable to either the first or second building member;

a second part attachable to the other of said members; the first and second parts each having ratchet sections which are engageable to provide a ratchet type action

for providing said restriction;

characterised in that the first and second parts each have guide portions co-operable to provide at least a predetermined minimum spacing between said members, transverse to the direction of offering, when the two parts of the clip are engaged.

[0010] Preferably the guide portions are separate from their respective ratchet sections.

[0011] Preferably the ratchet portion of the first part includes at least one resilient pawl section and preferably the ratchet portion of the second part includes at least one toothed section co operable with the or each resilient pawl section to produce the ratchet action in use.

[0012] Preferably either one or both of the first and second parts are formed from two discrete elements: a resilient element including the pawl or toothed section; and a support element including the first or second guide portion.

[0013] Preferably the two elements are manufactured as discrete pieces but assembled together in use.

[0014] Preferably the resilient element is formed from sheet metal or the like.

[0015] Preferably the support element is formed from a plastics material or the like.

[0016] Preferably said guide portions are each wedge shaped having co-operable planar surfaces, each surface, in use, being in a plane oblique to the direction in which said members are intended to be offered up.

[0017] Preferably two or more pawl sections are provided and preferably two or more toothed sections are provided, each for engagement with a respective pawl section.

[0018] More preferably the two or more toothed sections each have a row of teeth and the two or more rows are staggered so that during offering-up of the first member, only one pawl will operatively engage with one tooth at a time.

[0019] Preferably the first and second parts are releasable after engagement.

[0020] Preferably release of the parts is brought about by insertion of tooling to release the pawl from the toothed section, the insertion being possible in the same direction in which the first member was offered up to the second member.

[0021] It is desirable also that the member or sash mentioned above can be removed from either side.

[0022] In another aspect, this invention provides a two part clip, one part being securable to a first building member and the other part being securable to a building or the like having an inside and an outside, the two parts being engageable to hold the member to the building by means of a ratchet mechanism, the ratchet being disengageable by means of tooling to release the member from the building, the disengagement being possible from the inside and the outside of the building (but not necessarily both at the same time).

[0023] Preferably, to effect said disengagement, the tooling is insertable into a complementary aperture in the

clip.

[0024] Preferably the complementary aperture comprises two discrete apertures and the tooling comprises two discrete elongate release tines for insertion into the apertures at the same time.

[0025] The invention further extends to a release tool for use in conjunction with a clip mentioned above, the tool comprising a pair of elongate release tines.

[0026] The invention extends to a fixing system comprising a plurality of clips as defined in any one or more of the statements above, spaced around a building member within a building aperture and providing a substantially uniform gap or overlap between said member and said aperture.

[0027] The invention extends yet further to a fixing clip, system, or release tool substantially as herein described with reference to the Figures.

[0028] Whilst various aspects of the invention have been set out above, the invention extends to any inventive combination of the features mentioned above or in the following description and/or drawings.

[0029] Various illustrative embodiments of the invention will now be described by way of example only, with reference being made to the accompanying drawings, wherein:

Figure 1 is a side section view of a first embodiment of fixing system of this invention, showing the sash prior to attachment to the frame;

Figure 2 is a view similar to Figure 1 but showing the sash fully fitted into the frame;

Figure 3 is a view of the male and female components of the clip assembly prior to engagement;

Figures 4A to C show a view of the male and female components of the assembly when fully engaged, and with various components removed to show the underlying components;

Figure 5 is an exploded view of the male and female components;

Figure 6 is a plan view of the components of Figure 5; and

Figures 7A and B are respectively side and underneath perspective views of the male clip portion.

Figure 8 shows a perspective view of a second embodiment of the clip of the invention in use;

Figures 9 & 10 show further perspective views of two halves of the clip shown in Figure 8, in a ready for use condition;

Figure 11A shows an end view of an element of the clip shown in Figure 8;

Figure 11B shows a side view of the element shown in Figure 11A;

Figure 11C shows a section on the line A-A of Figure 11A;

Figure 11D shows a section on the line B-B (see Figure 10) of the element shown in Figures 11A, B & C and a section on line C-C of a further element of the clip;

Figure 12 shows a side view of the clip of Figure 8 in a ready to use condition;

Figure 13 shows a side view of the clip of Figure 8 in use;

Figure 14 shows a release tool;

Figure 15 shows further details of the release tool shown in Figure 14; and

Figure 16 shows the clip of Figure 8 used in a different application.

[0030] Referring initially to the embodiment of Figures 1 to 7, there is described a fixing system for fixing a dummy sash into a window frame. The dummy sash is sized to fit with clearance within the window frame and the window frame is provided with the usual run up locks of tapered form so that as the dummy sash is pushed home into the frame, it is centralised. The fixing system shown in Figures 1 to 7 is designed securely and semi-permanently to retain the dummy sash in the window frame in a manner which allows the dummy sash simply to be offered up to the window frame and pushed home without requiring any special tooling.

[0031] Referring now specifically to Figures 1 and 2, the dummy sash 10 comprises a sash frame 12 and a double glazed unit 14. The window frame 16, defining the opening into which the dummy sash is inserted, is secured to the adjacent building structure 18 by suitable means. The dummy sash will typically be rectangular in form and there will be several clip assemblies 20 disposed along each side.

[0032] The clip assemblies 20 comprise a male portion 22 which is secured to the sash frame 12 and a female portion 24 which is secured to the window frame 16. In order to secure the dummy sash in place, the sash is offered up so that the male portions 22 engage the female portions 24 and then the dummy sash is pushed home (as seen in Figure 2) and retained there by the ratchet action.

[0033] Referring now to Figures 3 to 6, the male portion 22 is made up of a sash packer element 26 and pressed metal male clip 28. The sash packing element may be made of moulded plastics material and various different sash packing elements may be produced for each of a wide range of different sash frames. The female portion 24 comprises a window frame packer element 30 of moulded plastics form and two pressed metal components, namely a top plate 32 and a female pawl clip element 34. Again, the window frame packer element may be designed with different configurations to allow it to interface with different window frames.

[0034] The male clip 28 has an anchorage edge 36 which is securely attached, e.g. by screws, to the sash frame 12 through the packer element 26. Cantilevered from the anchorage edge 36 are two generally rectangular spaced flat fingers 38 of identical form. Each finger 38 has a central rectangular aperture 40, the longer sides of each being bordered by a row of downwardly projecting teeth 41 (in the sense viewed in Figures 1 and 2). The

pitch of the teeth is uniform and, on each finger 38 the teeth are aligned with each other but the teeth on one finger are offset relative to the other by one half the pitch of the teeth. This can be seen in Figures 7A and B where the pitch of the teeth is shown as X and the offset between the two fingers is shown as X/2.

[0035] The female portion 24 is made up of the top plate 32 and the female pawl clip 34 which are secured to the window frame 16 by screws passed through the top plate and the pawl clips and the window plate packer element 30. When assembled, as seen for example in Figure 3, the female portion defines two locking passages 42 for receiving the respective flat fingers 38. The female pawl clips comprise an anchorage edge 44 from which extend two pawl regions 46. Each pawl region comprises a pawl wall 48 inclined upwardly from the plane of the anchorage edge 44 and defining two pawl surfaces 50 designed in use to be in registration with the teeth 41 of the flat fingers 38. The nature and construction of the male portion 22 and the female portion 24 are such that the teeth 41 can ratchet resiliently over the pawl surfaces 50 as the sash is pushed home. Half way along each pawl wall 48 is an upstanding lock out tab 52. When the male portion 22 is introduced into the locking passages, the leading ends of the flat fingers 38 initially contact the lock out tabs 52 and, due to the angle of inclination, the leading ends of the flat fingers 38 ride over the lock out tabs 52 in non-return fashion, whereafter the lock out tabs are located in the rectangular apertures 40. Extending beyond each pawl wall 48 is release portion 54 which, as described below, can be accessed by a flat blade on the interior side of the dummy sash, to deflect the pawl wall 48 and the lock out tabs 52 downwardly so that they allow withdrawal of the male clip from the locking passages 42. The top plate 32 is of pressed metal and has downwardly projecting tabs 56 which provide a degree of lateral constraint for the male portion 22 as it enters the locking passages. The locking plate also has two apertures 58 which receive the tips of the lock out tabs 52 and provide restraint to prevent them bending and releasing the flat fingers 38 if an attempt is made to prise the dummy sash out of the window frame using force.

[0036] The dummy sash is installed by offering it up the opening as previously described. The flat fingers 38 enter the locking passages 42 and the leading ends of the flat fingers 38 push past the locking tabs 52 in non-return fashion and shortly thereafter the teeth 41 engage and ratchet over the pawl wall 48. The dummy sash is then pushed home so that it compresses the seal 60 on the window frame. At this stage, the window is securely fixed and the ratchet nature of the teeth and the offset between the teeth on the fingers means that the clip effectively ratchets in increments of about 1 mm thereby allowing a fair degree of tolerance around the periphery of the frame. An attempt to prise the dummy sash out of the frame will initially be resisted by the action of the teeth 41 acting on the pawl surface 50. If however this ratchet force is overcome, then the sash will withdraw slightly

until the forward inner edges of the apertures 40 engage the lock out tabs 52. The combined action of the lock out tabs and their support by the edges of the apertures 58 in the top plate 32 mean that the flat fingers 58 are trapped in the female fitting, and withdrawal is not possible.

[0037] Referring to Figure 2, for authorised withdrawal of the window, a pallet knife or the like is slid between the seal 60 and the sash frame 12 to engage the release portions 54 and to push them downwardly. This disengages the pawl surface 50 from the teeth 41 and moves the lock out tab 52 downwardly clear of the path of the flat fingers so that the window can be withdrawn. It will be noted that the components are designed such that, when installed, the release portion 54 projects beyond the end of the flat fingers 38.

[0038] Referring now to the second embodiment illustrated in Figures 8 to 16, Figure 8 shows a typical application of the two part clip assembly 120, 122 of this embodiment. The clip 120, 122 is holding a dummy sash window frame 10 in place within an opening of window frame 112. The sash 110 is restricted from moving in the direction of arrow F by a ratchet mechanism and a generally uniform gap G is obtained around the sash when it is fixed in place.

[0039] Figure 9 shows a first part 122 of the clip assembly in place. This part of the clip comprises two discrete elements: a pawl section 116; and a guide portion 118. The pawl section 116 is manufactured from pressed and resilient sheet metal, for example carbon steel sheet and the guide portion is manufactured from moulded plastics for example polypropylene. The two elements are held to the window frame 112 by means of screw fixings or the like within the holes shown in both elements. The screw heads have been omitted in the drawings. The pawl section includes two pawls 111, which are simply cut ends of the sheet metal. Areas 111 and 115 aid release and are described below. Apertures 117 and 119 are provided for a release tool and their function is described in more detail below. A ramped section 114 provides a guide for its complementary part (127 Figure 10) as described below.

[0040] Figure 10 shows a second part 120 of the clip assembly, in place. This part of the clip too comprises two discrete elements: a toothed section 126; and a second guide portion 128. The toothed section 126 includes two rows of teeth 121 and 121' which co-operate with the pawls 111, in a manner described more fully below. A second guide ramp 127 is illustrated which co-operates with the complementary ramp part 114 shown in Figure 9 as described below. The two elements are manufactured in a similar manner to the a pawl section 116 and the guide portion 118 mentioned above, and are held in place on the sash 110 in the same way as the first part of the clip.

[0041] Guide portions 118 and 128 support the pawl and toothed sections in use. It is intended that different size guide portions 118 & 128 can be used to suit different applications, it being necessary then only to change the

plastic guide portions, the pawl/toothed metal parts remaining unchanged. This reduces the number of parts required for different applications.

[0042] Figures 11 A,B&C show details of the clip element 126 and Figure 11D shows details of clip element 116 and 126. The clip element 126 includes two upstanding rows of teeth 121 and 121'. The Figures illustrate that the two rows of teeth have the same pitch (x in Figure 11C) but that the pitch of the two rows is off-set by x/2, so the teeth are staggered. Clip element 116 has two pawls 111 one of which engages with the teeth 121 and one of which engages with the teeth 121' to cause a ratchet effect in the direction of arrow H, as illustrated in Figure 11D. As a result of the staggering of the teeth rows, the ratchet will engage a tooth every x/2 units of movement, so e.g. where x is 2 mm the ratchet can be moved in increments of just 1 mm. It has been found that teeth of 2 mm pitch can be punched from sheet metal and the punch will have a reasonable life expectancy, whereas teeth of less than 2 mm (e.g. 1 mm) require a more detailed punch and this results in premature wear of the punch. So staggering the teeth in two sets results in a fine ratchet, the tooling for which has a good useable life.

[0043] Figure 12 shows a side view of the clip halves 120, 122 in place on the sash 10 and frame 112. The sash 110 is offered to the frame 112 in the direction of arrow H. Guide ramps 114 and 127 guide the sash into place. In practice a number of clips will be in place around the sash making assembly of the sash much easier. During fitting the pawls 111 engage with teeth 121 and 121' to provide the ratchet effect as described above.

[0044] Figure 13 shows the clip in use. The clip restricts movement in the direction of arrow F and the guide ramps 114 and 127 have guided the sash into place so that a uniform gap G is maintained. This provides a predetermined minimum spacing between the sash and the frame. As shown in Figure 13 it is not necessary for the guide ramps 114 and 127 to touch when the sash is fitted, although where multiple clips are used, some may touch after fitting. Their function is to guide the sash during fitting so that e.g. the ratchet mechanism will operate correctly and the minimum spacing is maintained to avoid overloading the ratchet mechanism and to centralise (in a direction transverse to the direction of fitting H) the sash 110 as it is pushed into the frame 112. The seal 140 now acts to inhibit draughts through the window.

[0045] Generally a plurality of like clips will be employed to form a fixing system which keeps the sash in place in the window frame. Since the ratchet mechanism is resilient there will be a tendency for the sash to be pushed from all directions where a clip is fitted and this will centralise the sash also.

[0046] It may be necessary to remove the sash e.g. for maintenance or replacement of any glass. The clip may be used in many applications e.g. used for fixing various profiles of wood, metal plastics or the like, or combinations of materials, and so a distinct commercial advantage obtains if disengagement of the clip can be ef-

fectured from either inside or outside (or both), depending on the application of the clip.

[0047] Disengagement of the clip from the outside is shown in Figures 14 & 15. Tooling 240 is inserted through gap G into U shaped receiving apertures 117 in clip part 122. Exit apertures 119 are arranged so that tooling 240 is caused to resiliently deflect release tags 115. In so doing, the pawls 111 are released from teeth 121, 121' and the clip is disengaged. Further clips can be disengaged in the same manner and, by keeping pressure on the sash 110 in the direction of arrow F, as each clip is released, the sash 110 can be freed from the frame 112.

[0048] In practice the two release tines of tool 240 will be joined by a handle and more than one tool may be employed. Using two (or more) unusually shaped apertures 117 makes it difficult for unauthorised removal of the sash. In this particular embodiment, the shape of sash 110 makes disengagement of the ratchet difficult from the inside (the side with the seal 140) and so disengaging the clip from the outside is necessary.

[0049] Figure 16 shows a differently shaped sash 200 fixed using the clip of the invention. The shape of the different sash 200 makes disengagement of the clip difficult or impossible from the outside because gap G is replaced by an overlap O in this configuration. So the clip is designed so that it can be disengaged from the inside also, for use with sash 200. Disengagement from the inside involves forcing a flat tool 230 past seal 140. This clip is brought into engagement with inner release tags 113 (shown in Figure 9) and the tags are moved. This action causes disengagement of the pawls and teeth to enable removal of the sash 200.

[0050] Various specific embodiments have been described above, but it will be readily apparent to the skilled addressee that various alternatives, variants, modifications, adaptations, substitutes, replacements etc are possible within the scope of the invention set out herein. For example, any suitable materials can be used other than those described above. The fixing of a dummy sash window has been described but any similar building member could be fixed using the clip system described. The pawl element 22 is shown attached to a window panel and the toothed element 20 is shown attached to the sash. This arrangement could be the other way round. A pawl and teeth are described as a ratchet mechanism, however other ratchet type devices could be employed, e.g. two co operating teeth formations, a sprung cam or other mechanical one-way movement mechanism (in this description 'ratchet' includes any one way movement mechanism). Means for disengagement of such alternative ratchet mechanisms will be apparent to the skilled addressee.

Claims

1. A fixing system for fixing a panel in an opening framed by one or more frame members, said fixing

system comprising a plurality of male fixing means and a plurality of female fixing means, the male means being receivable in or on the female means with a ratchet action therebetween such that in use the panel may be offered up to the opening to effect initial engagement between said male and female fixing means and thereafter urged into place and retained there by said ratchet action.

2. A fixing system according to Claim 1, wherein said male fixing means have thereon a row of teeth which cooperate with a latch surface on said female fixing element.

3. A fixing system according to Claim 2, wherein two generally parallel rows of teeth are provided each with teeth at generally the same pitch but the rows being offset longitudinally by one half a tooth pitch with respect to each other in the insertion direction, with there being respective latch surfaces with no longitudinal offset for cooperation therewith.

4. A fixing system according to any of the preceding Claims, wherein each of said male fixing means comprises a resiliently deformable element biased into engagement with said female fixing means.

5. A fixing system according to any of the preceding Claims, wherein said male and female fixing means have complementary engagement surfaces designed to cooperate to prevent removal of the window after installation unless released, thereby to provide lock out.

6. A fixing system according to Claim 5, wherein said complementary engagement surfaces comprise an edge of an aperture provided on the male fixing means and a cooperating projecting portion on said female fixing means.

7. A fixing system according to any of Claims 1 to 6, wherein, following installation, said ratchet action may be disengaged by insertion of a tool between the panel and an adjacent frame member.

8. A fixing assembly for being used to fix a panel in an opening framed by one or more frame members, said fixing system comprising a male fixing means and a female fixing means, the male fixing means being engageable in or on the female fixing means with a ratchet action therebetween such that in use the panel may be offered up to the opening to effect initial engagement between said male and female fixing means and thereafter urged into place and retained there by said ratchet action.

9. A fixing clip for being disposed, in use, at opposing edges of two building members in generally edge-

to-edge relationship, the clip providing restriction to relative movement of the two members after they are offered together, the restriction being at least in a direction opposite to the direction of offering together, said clip comprising:

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a first part attachable to either the first or second building member;

a second part attachable to the other of said members;

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the first and second parts each having ratchet sections which are engageable to provide a ratchet type action for providing said restriction;

characterised in that the first and second parts each have guide portions co-operable to provide at least a predetermined minimum spacing between said members, transverse to the direction of offering, when the two parts of the clip are engaged.

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10. A clip as claimed in Claim 9 wherein the guide portions are separate from their respective ratchet sections.

11. A clip as claimed in Claim 9 or 10 wherein the ratchet portion of the first part includes at least one resilient pawl section and the ratchet portion of the second part includes at least one toothed section co-operable with the or each resilient pawl section to produce the ratchet action in use.

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12. A clip as claimed in Claim 9 to 11 wherein either one or both of the first and second parts are formed from two discrete elements: a resilient element including the pawl or toothed section; and a support element including the first or second guide portion.

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13. A clip as claimed in any of Claims 9 to 12, wherein two or more pawl sections are provided and two or more toothed sections are provided, each for engagement with a respective pawl section.

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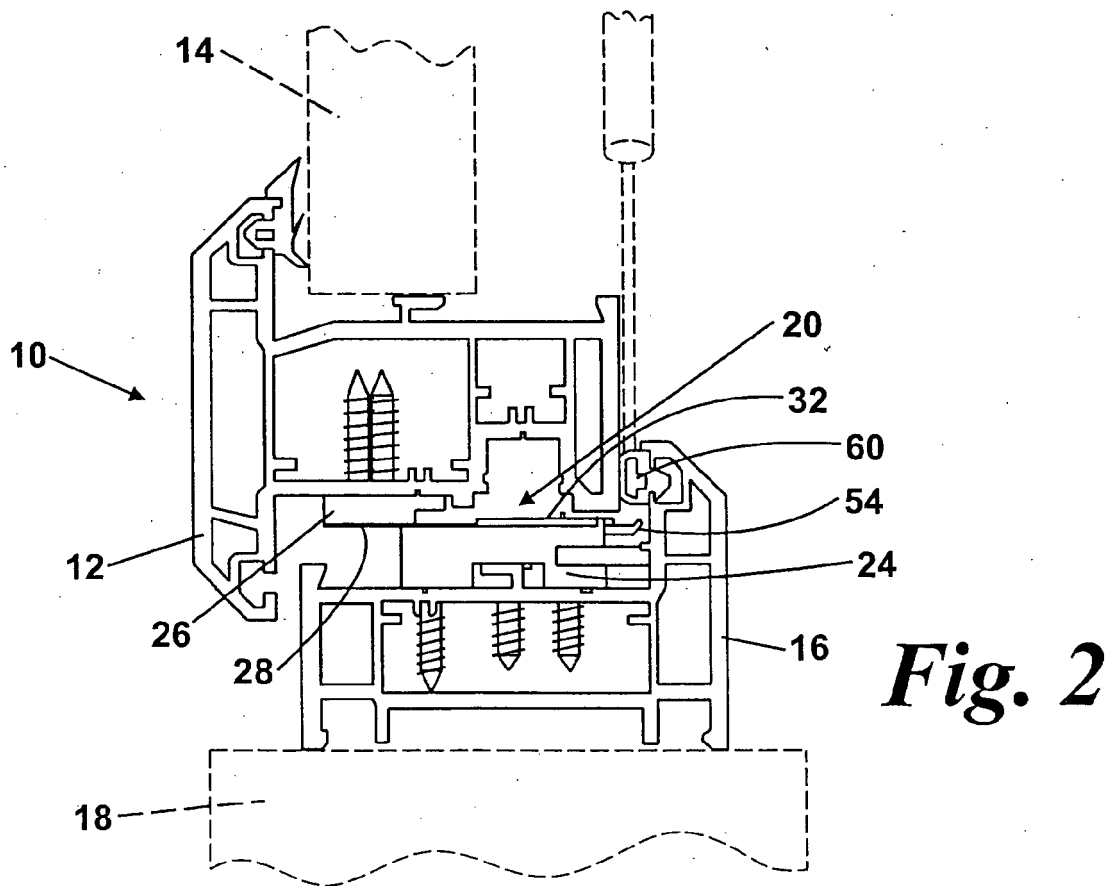
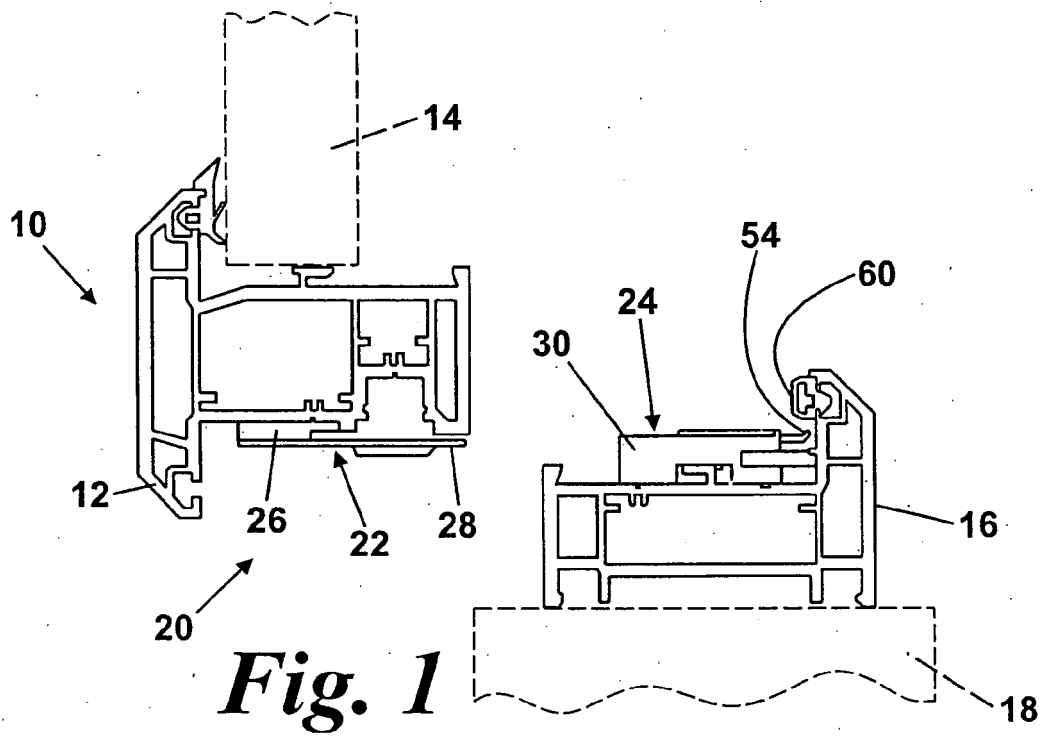
14. A clip as claimed in Claim 13 wherein the two or more toothed sections each have a row of teeth and the two or more rows are staggered so that during offering-up of the first member, only one pawl will operatively engage with one tooth at a time.

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15. A two part clip, one part being securable to a first building member and the other part being securable to a building or the like having an inside and an outside, the two parts being engageable to hold the member to the building by means of a ratchet mechanism, the ratchet being disengageable by means of tooling to release the member from the building, the disengagement being possible from the inside and the outside of the building but not necessarily both at the same time.

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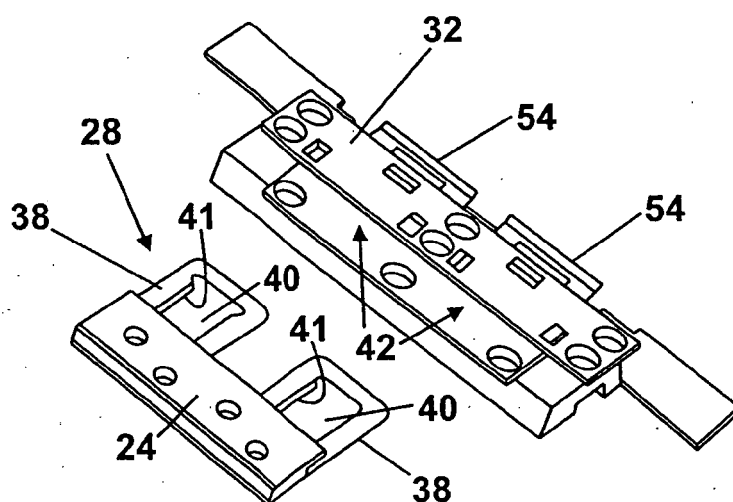


Fig. 3

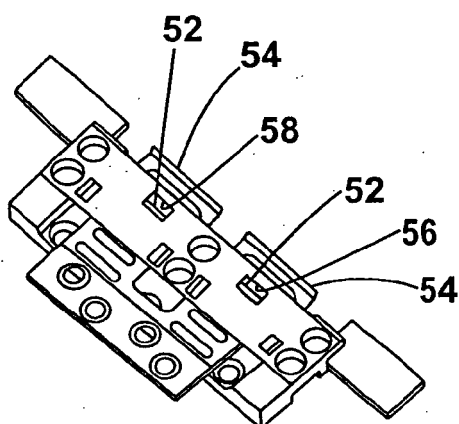


Fig. 4A

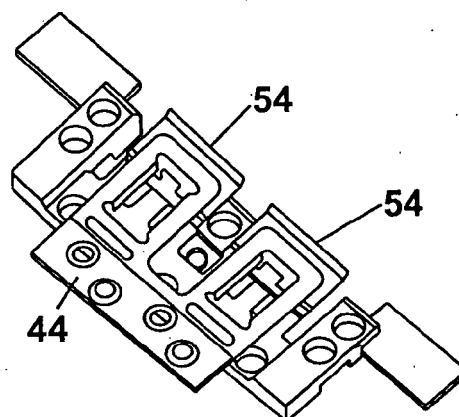


Fig. 4B

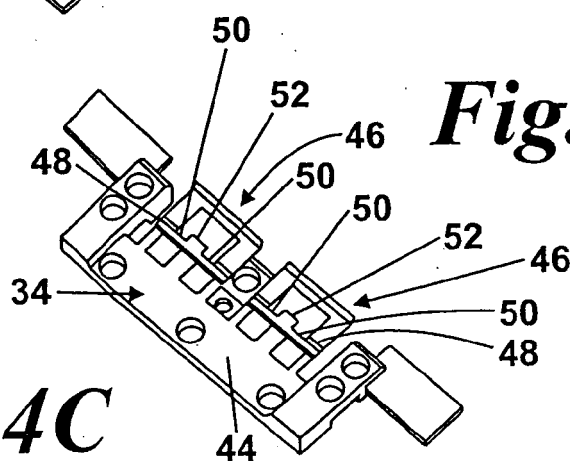


Fig. 4C

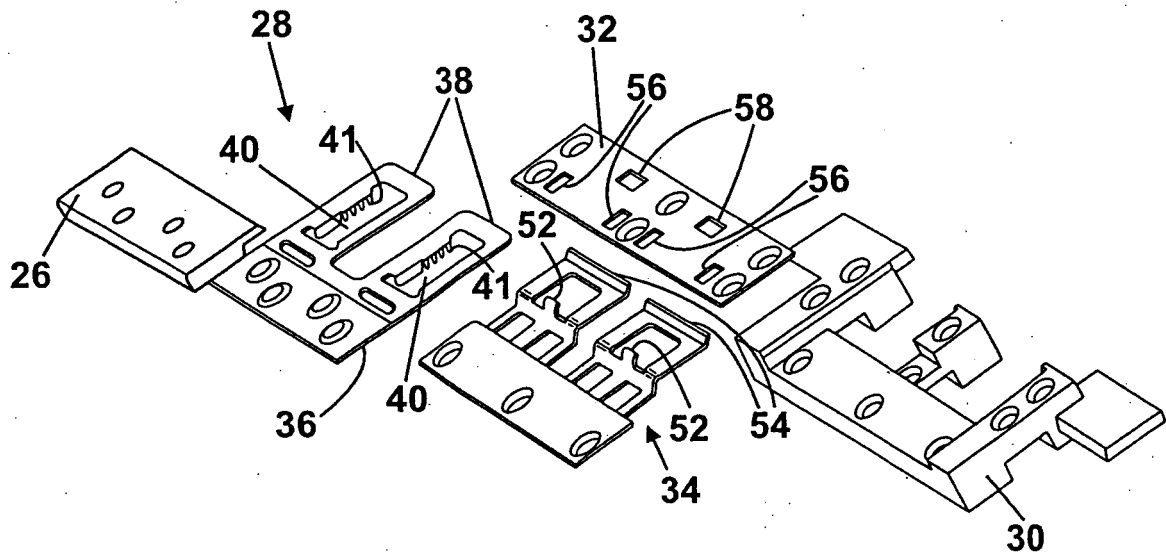


Fig. 5

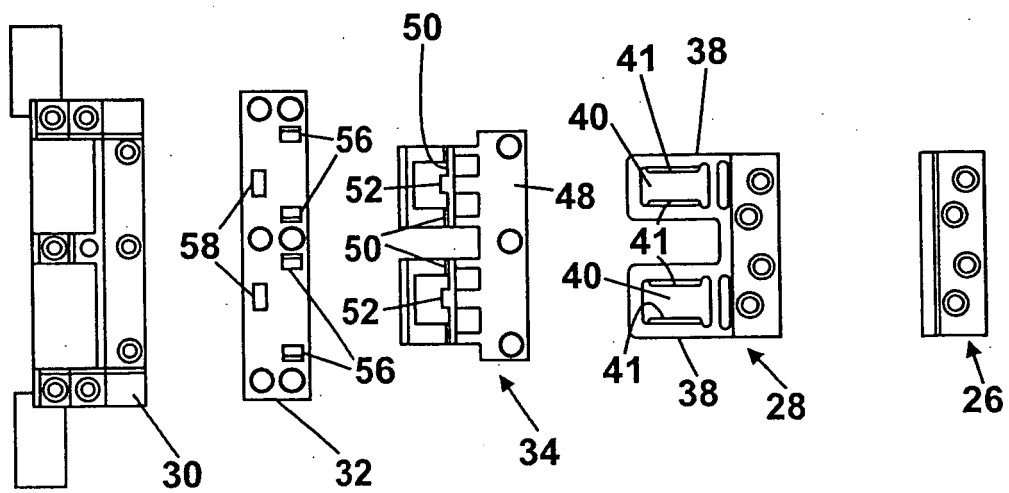


Fig. 6

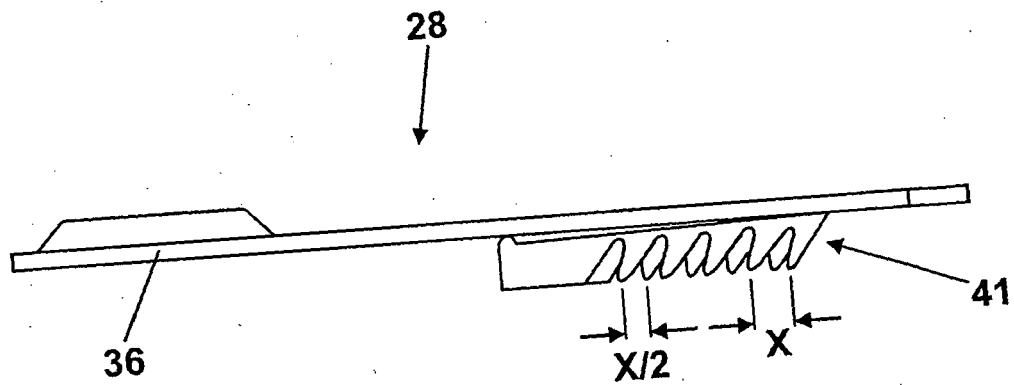


Fig. 7A

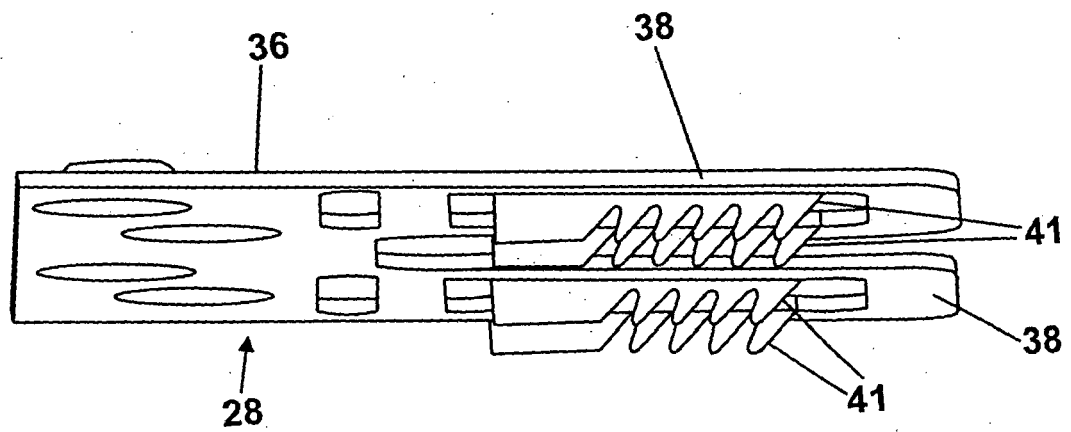


Fig. 7B

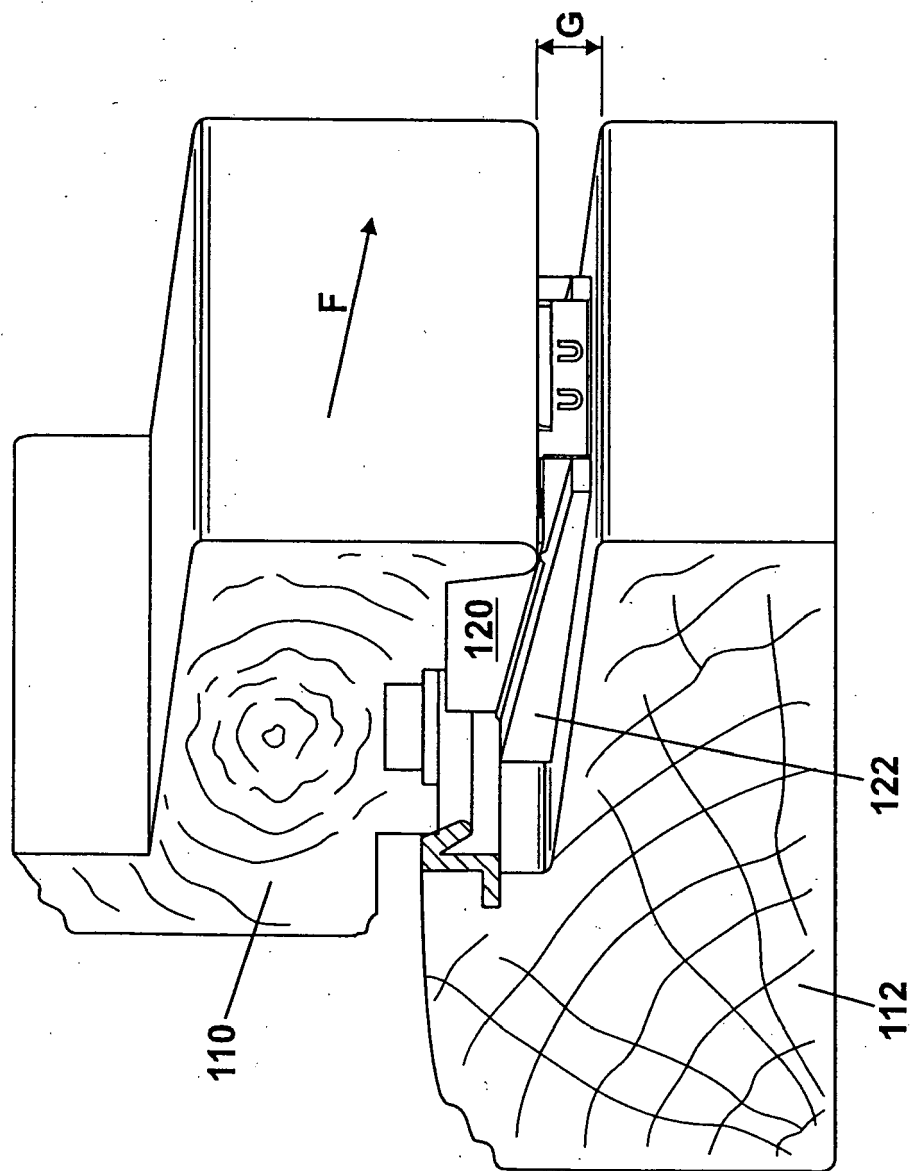


Fig. 8

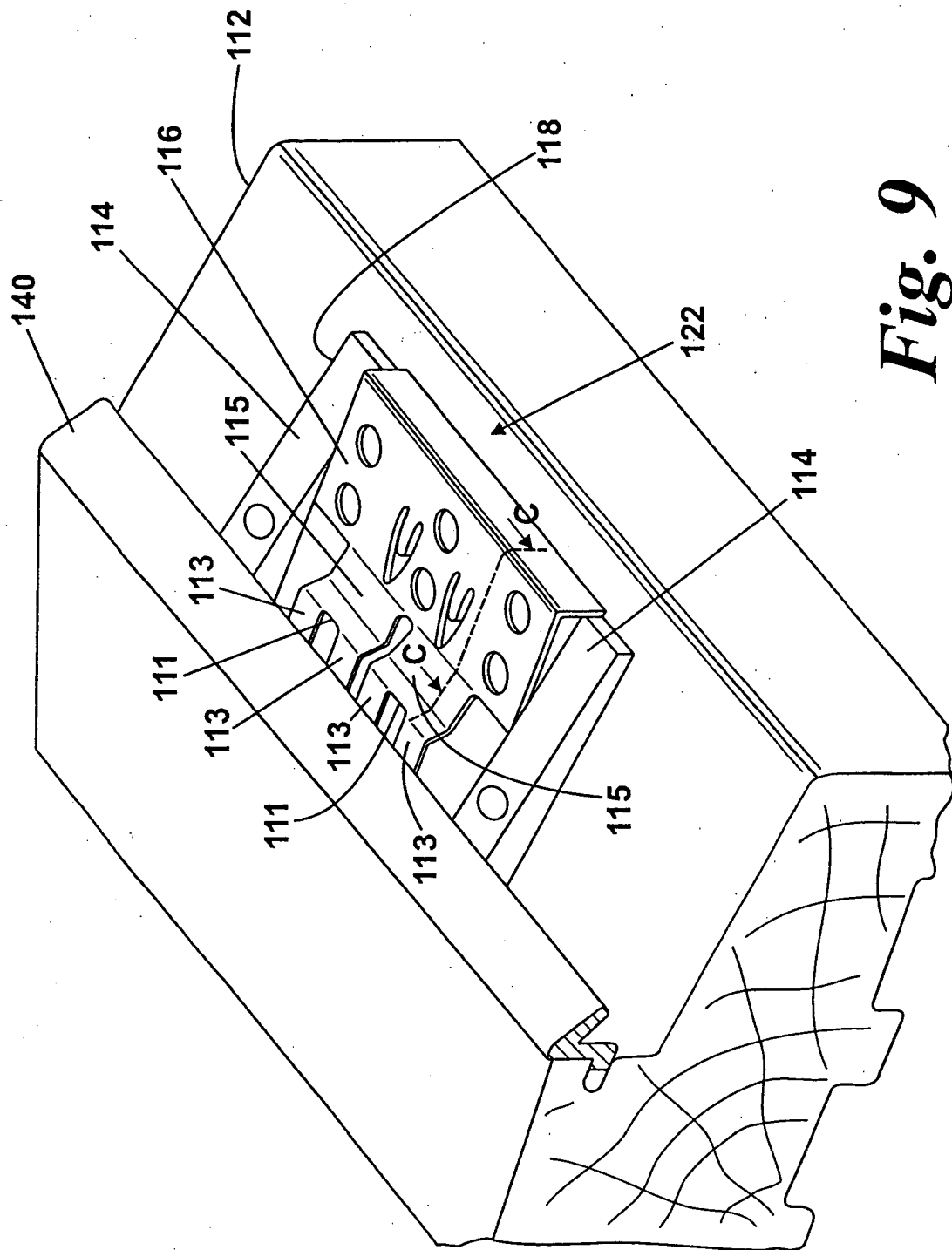


Fig. 9

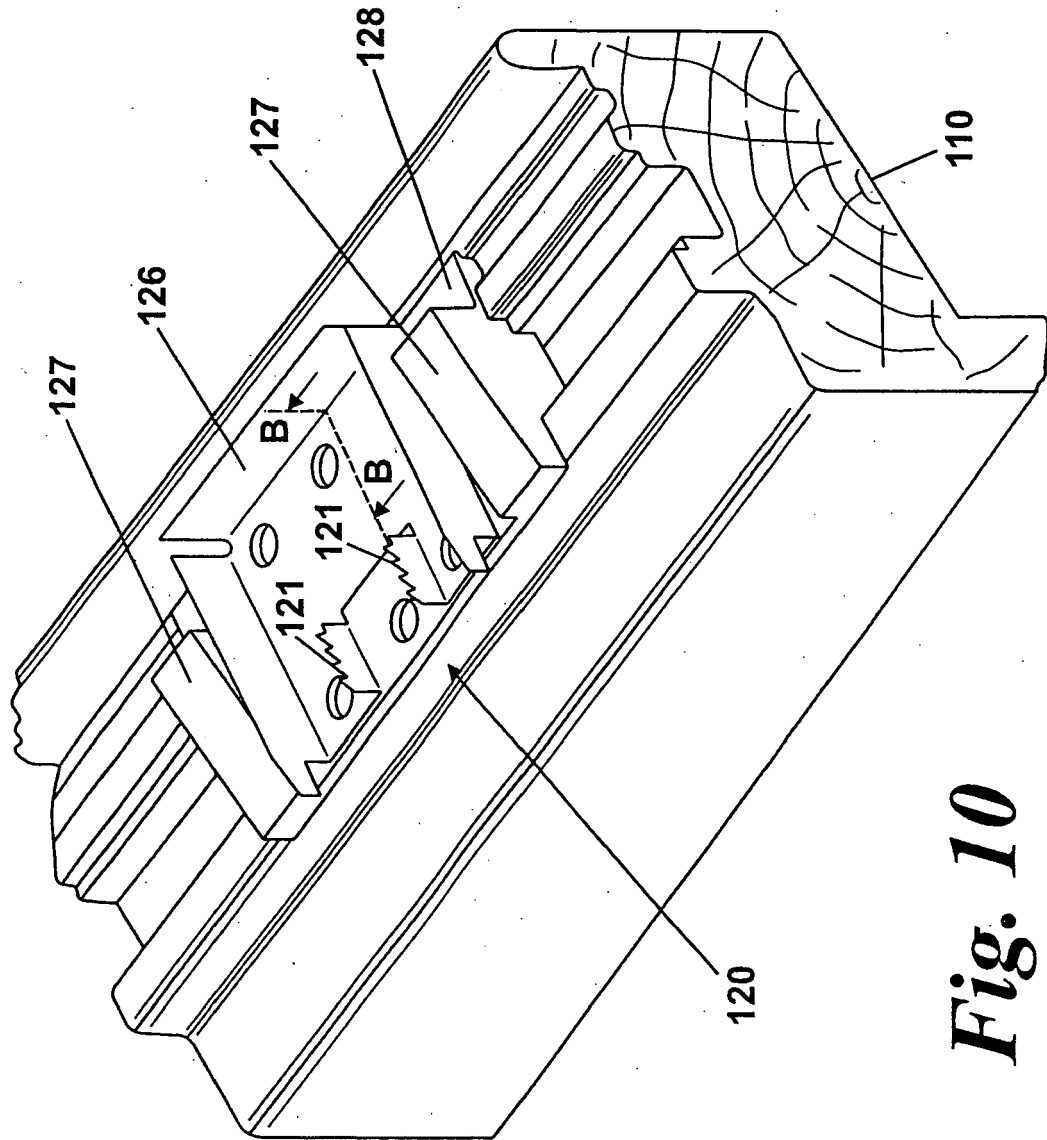


Fig. 10

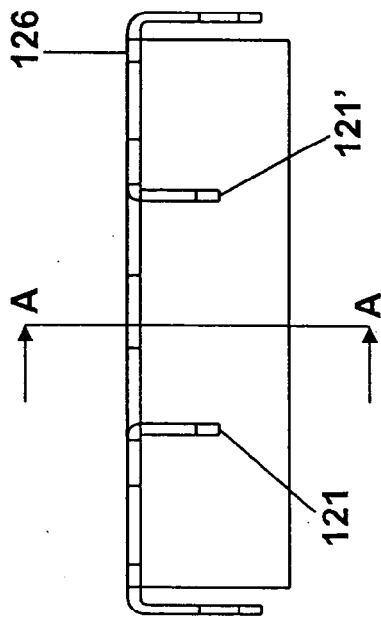


Fig. 11A

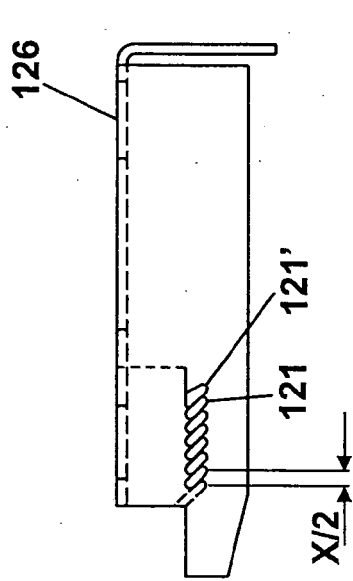


Fig. 11B

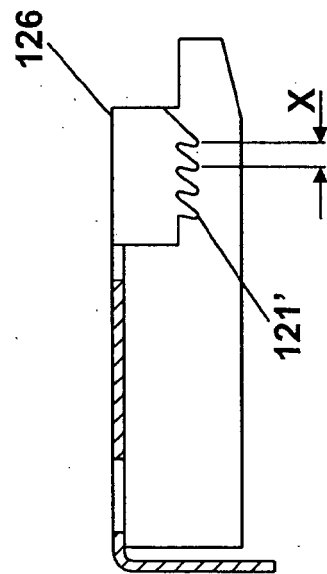


Fig. 11C

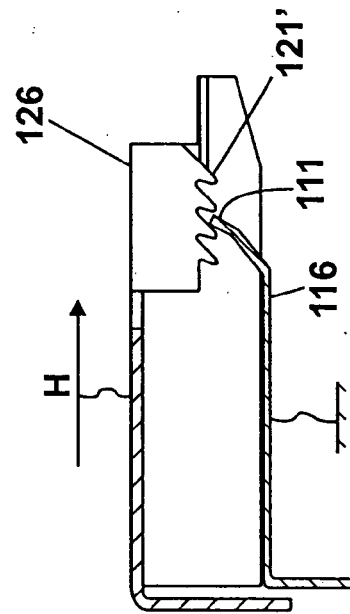


Fig. 11D

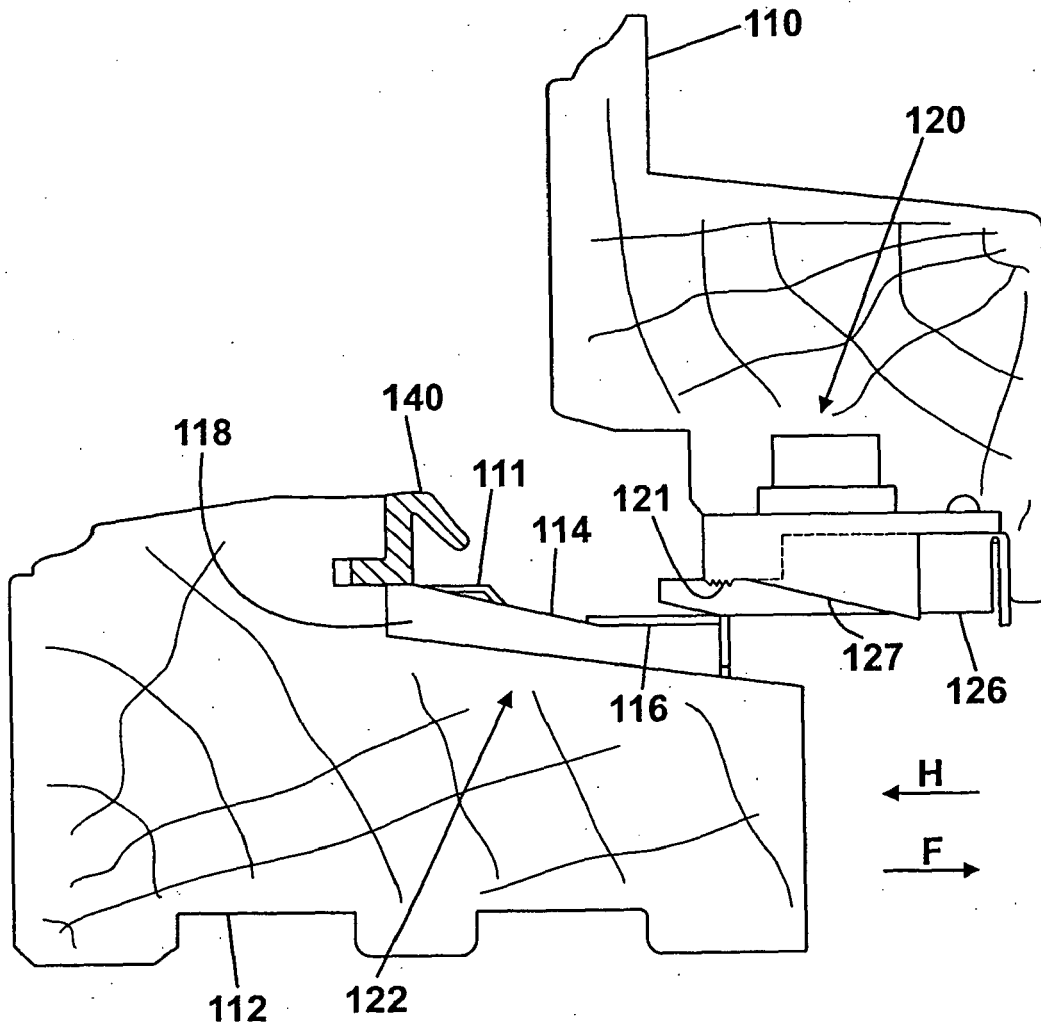


Fig. 12

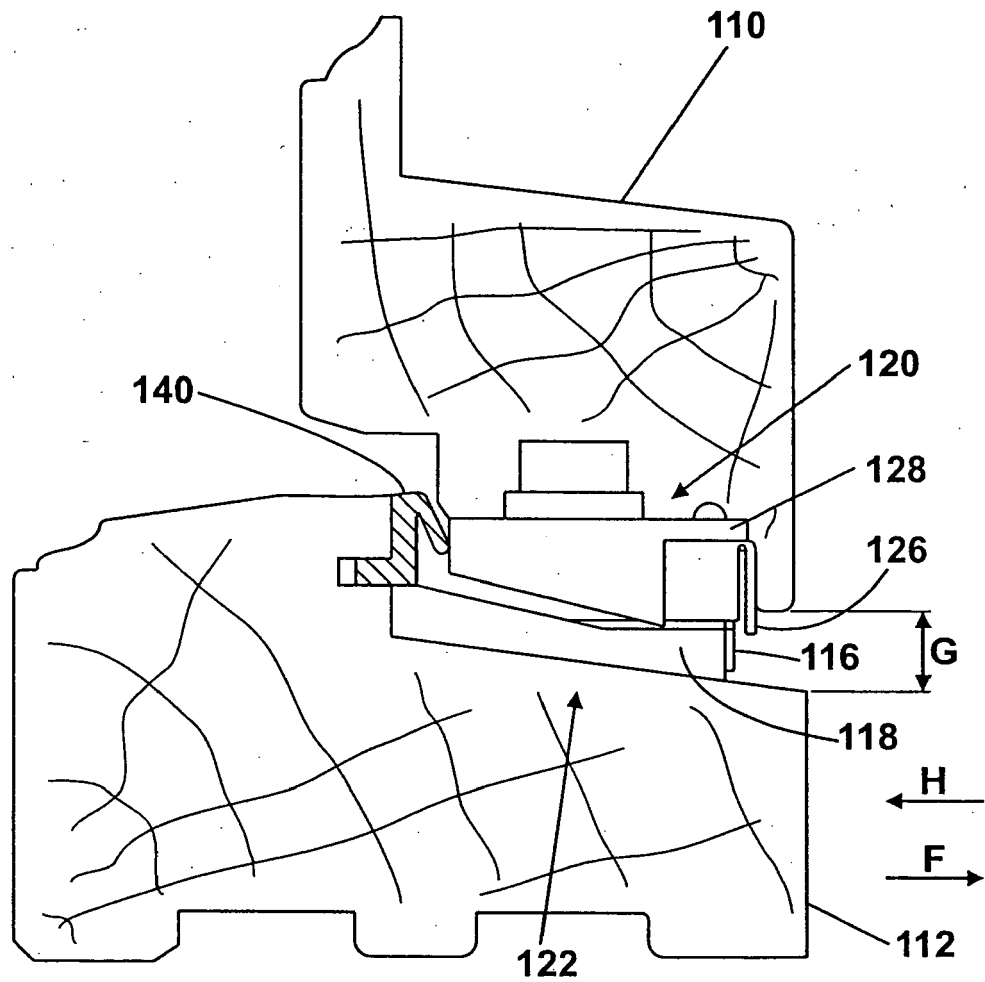


Fig. 13

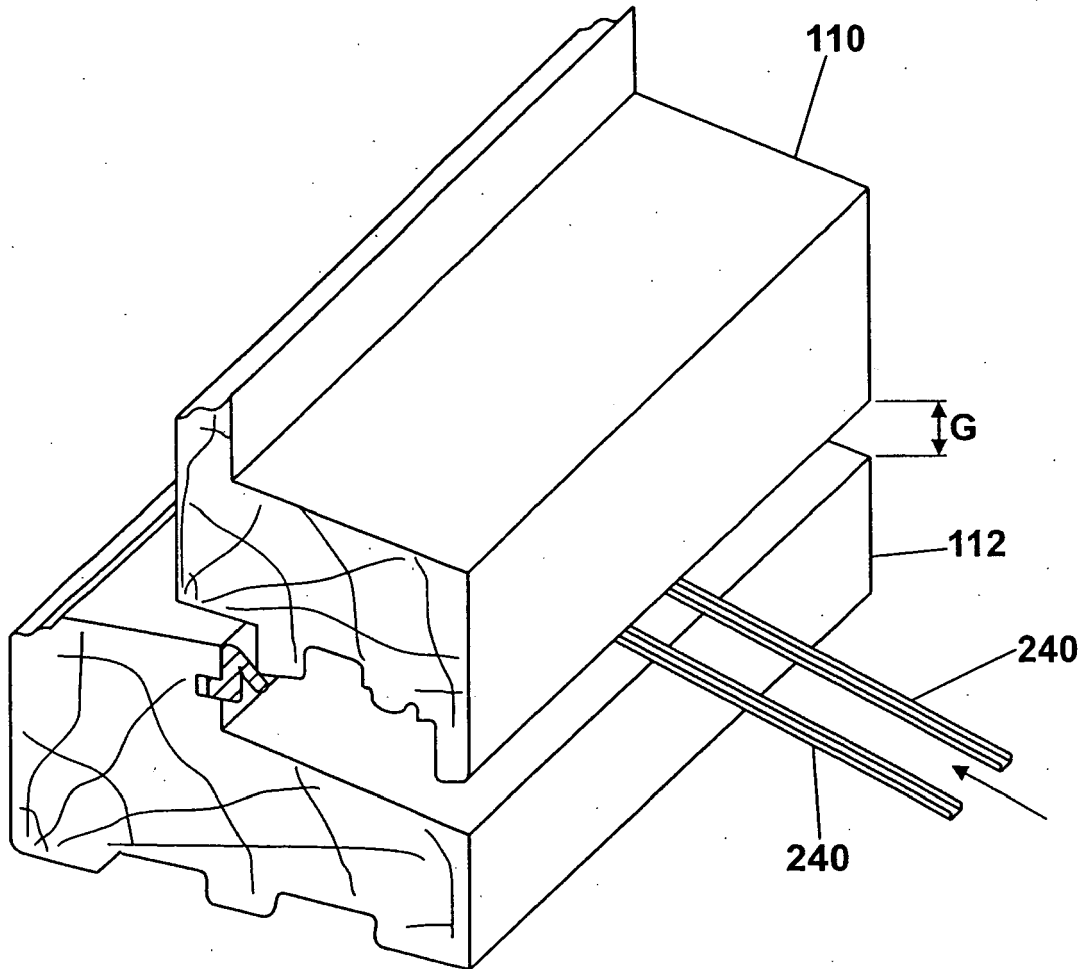


Fig. 14

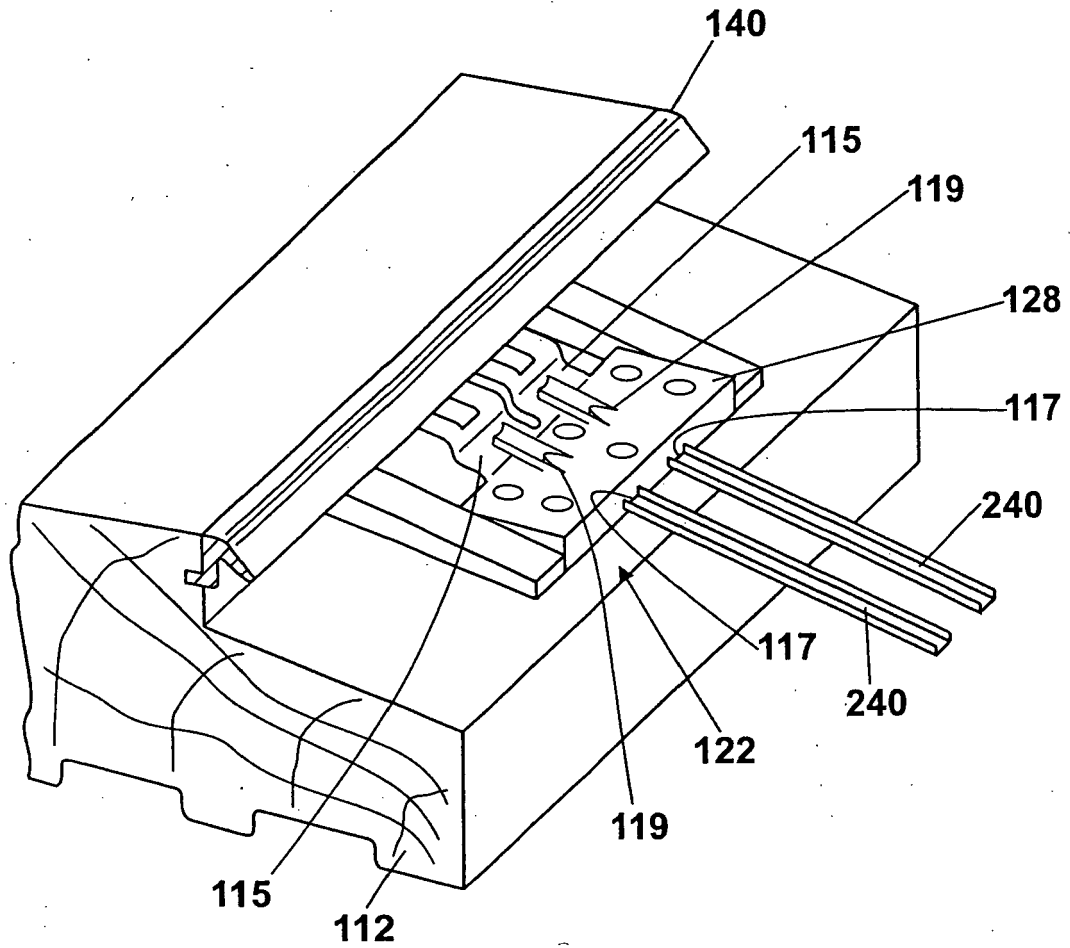


Fig. 15

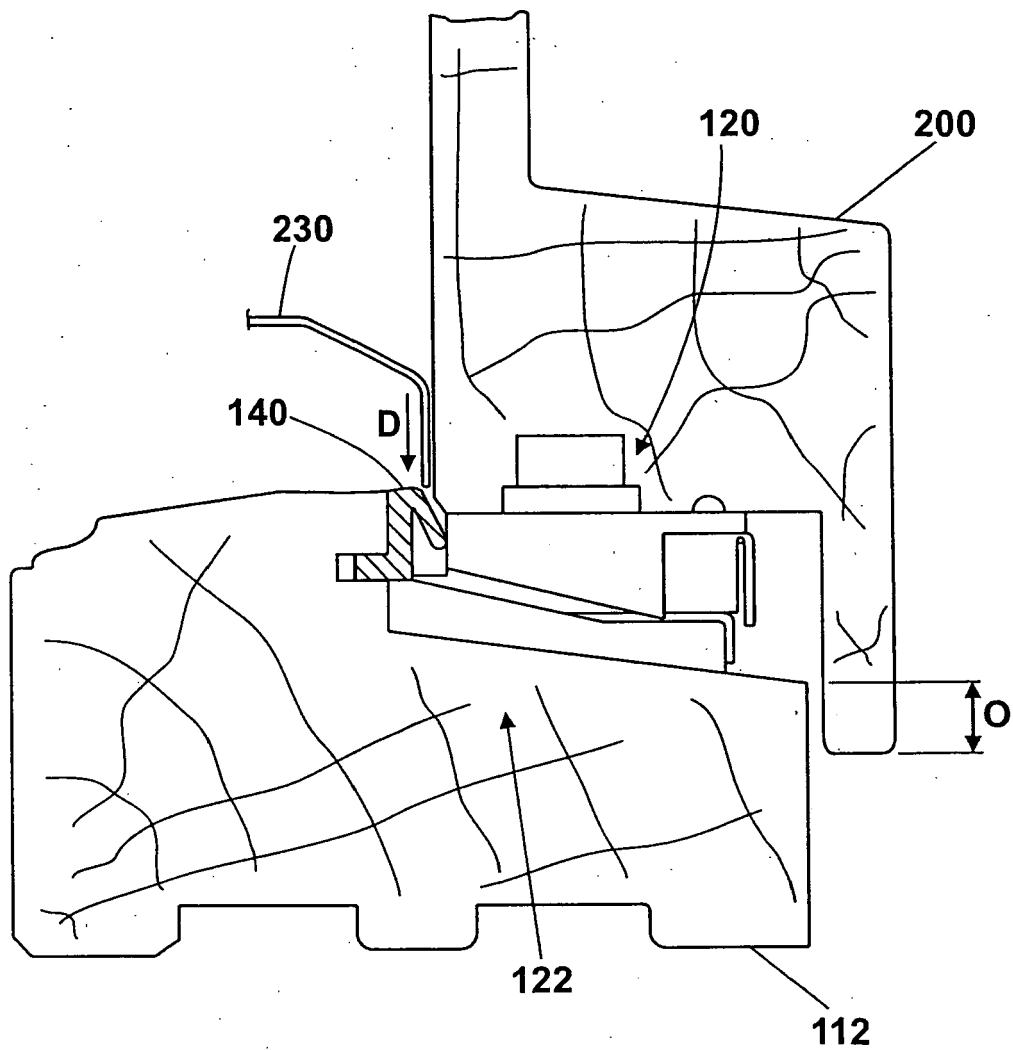


Fig. 16