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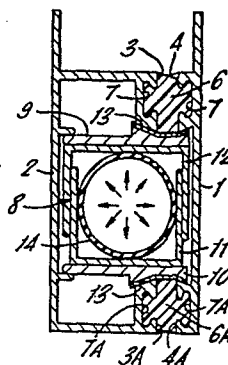
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(54) Method and apparatus for forming a thermal break between two elongate elements of a metal frame.

(57) Surfaces (3, 4 and 3A, 4A) of the inner and outer frame elements (1,2) which when assembled form a box-section member. The gaps are converted into respective mould cavities for resin by the pressure of shoes (9,10) against the elements (1,2) adjacent the respective gaps to close one side thereof, the shoes (9,10) being removed only after the resin has cured to leave the finished thermal break (6,6A). The shoes (9,10) are carried on opposite walls of a laterally expandable tube (8) which is inserted into the box-section and is expanded to press "non-stick" surfaces (13) of the shoes (9,10) against the respective gaps ready for the moulding and curing of resin therein, whilst maintaining the gap dimensions. After curing of the resin, the tube (8) is contracted laterally to disengage the shoes (9,10) and is then withdrawn to leave the finished thermal break (6,6A).

FIG. 5



EP 0 053 642 A1

-1-

"METHOD AND APPARATUS FOR FORMING A
THERMAL BREAK BETWEEN TWO ELONGATE
ELEMENTS OF A METAL FRAME"

5 This invention relates to methods and apparatus
for forming a thermal break between two elongate elements
of a metal frame such as a metal window or door frame.

 Metal extrusions, particularly aluminium
extrusions, are widely used in the construction of door and/
10 or window frames, because of the advantages afforded by
the strength, ease of maintenance etc., of the finished
construction. However, the thermal properties of the
metal tend to result in the formation of condensation
when one part of the frame is subjected to lower
15 temperatures than are experienced by another part of
the frame, e.g. by the side of a door frame exposed
to the exterior of a building which tends to be colder
than the inner side exposed to the building interior.
To combat this, a thermal break is provided between the two
20 parts of the frame, being in the form of a layer of
thermal barrier material, usually a rigid resin,

which connects the two parts of the frame so that there is no direct metal-to-metal contact between them.

One widely used method of constructing a thermal break is illustrated in Figures 1 and 2 of the accompanying drawings, and involves the use of a one-piece aluminium extrusion which comprises the outer element 1 of the frame and the inner element 2 of the frame, the elements 1 and 2 having respective confronting surfaces 3 and 4 which are spaced apart by a thin web 5 which at this stage connects the elements 1 and 2. In other words, there is formed between the elements 1 and 2 a shaped channel of which the walls are defined by the confronting surfaces 3 and 4, and the web 5. The shaped channel is then filled with a resin material, and when this has cured and thus rigidified, the base of the channel constituted by the web 5 is removed by a machining operation to leave the construction shown in Figure 2 where the resin material 6 constitutes the sole connection between the parts 1 and 2. Conveniently the surfaces 3 and 4 are undercut as shown at 7, to provide a secure connection between the resin material 6 and the elements 1 and 2.

Although the method described above is suitable to produce a construction such as that shown in Figure

2, there is a need for a box-like construction such as that shown in Figure 3 of the accompanying drawings, where the elements 1 and 2 are connected by a thermal break comprising two parallel strips of resin 6 and 6A, disposed in opposite side walls of a box-like section. Frequently this box-like construction is required in lengths of up to 5 metres, and it will be readily appreciated therefore that if the method described with reference to Figures 1 and 2 is applied to the box-like construction, the appearance of the construction after the formation of the thermal breaks 6 and 6A would be as is shown in Figure 4 of the accompanying drawings, requiring a difficult if not impossible machining operation to remove the unwanted webs 5 and 5A inside the box section.

The object of the present invention is to provide a method of forming a thermal break which does not require the subsequent removal of unwanted metal webs, and apparatus for performing this method, which is therefore particularly suitable for the production of the box-like construction shown in Figure 3 of the accompanying drawings.

According to one aspect of the present invention, there is provided a method of forming a thermal break between two elongate elements of a metal frame,

comprising the steps of assembling said two elements
so that two parallel, laterally spaced elongate surfaces
on one of the elements respectively confront two
corresponding parallel, laterally spaced elongate
5 surfaces on the other element to define therebetween two
parallel elongate gaps of predetermined dimensions, the
assembled elements forming a box-section elongate member
with said elongate gaps disposed in opposite elongate
side walls thereof; closing off one open elongate side
10 of each of the gaps to form a respective elongate mould
cavity by disposing within the box-section member a pair of
elongate shoes which are each aligned with the inner
open elongate side of a respective one of said elongate
gaps, and moving the shoes simultaneously apart in an
15 outward lateral direction thereby to press each shoe into
engagement with said elements adjacent the respective

gap to form said respective mould cavity; filling the
mould cavities thus formed with a thermal barrier material;
to join the parallel elongate surfaces rigidly together with
thermal barrier material between them and disengaging said
5 shoes from said elements by moving the shoes relatively
laterally towards each other before withdrawing them from
the box-section member.

For convenience, before their insertion in the
box-section member, the shoes are preferably mounted on
10 opposite exterior sides of an elongate tube, the tube
being expansible, in a single lateral direction such that
when the tube and the shoes are disposed within the box-
section member with the shoes aligned with said gaps as
aforesaid, lateral expansion of the tube in said single
15 lateral direction presses the shoes against said elements
to close off said inner open sides of the gaps, lateral

contraction of the tube serving to disengage said shoes from said elements.

The expansion of the tube and its contraction may be accomplished in any suitable manner, for example, using pneumatic or hydraulic pressure operated means; for example, an elongate flexible bag may be disposed inside the tube, means being provided for varying the pressure inside the bag as required.

An embodiment of the invention will now be described, by way of example, with reference to the accompanying drawings, of which:

Figures 1 and 2 show various stages in the construction of a thermal break according to a known method, as described hereinabove;

Figure 3 shows a cross-sectional view of a typical box-section member incorporating a thermal break;

Figure 4 shows an intermediate stage in the construction of a box-section member such as that shown in Figure 3, using a similar method to that used in Figures 1 and 2;

Figure 5 shows an embodiment of apparatus according to the invention at an intermediate stage during the construction of a box-section member incorporating a thermal break such as that shown in Figure 3;

Figure 6 shows a perspective view of the

expansible tube and pressure bag used in the apparatus shown in Figure 5,

... Figure 7 of the drawings shows an alternative construction of expansible tube;

5 Figure 8 of the accompanying drawings shows a modified pair of sections to be assembled with the thermal break therebetween; and

Figure 9 is a "Blown-up" view of part of one of the sections shown in Figure 8.

10 It should be noted that throughout the Figures of the drawings, like parts are indicated by like reference numerals, for easy identification.

 The known method of forming a thermal break comprising a single strip of resin material, as shown
15 in Figures 1 and 2, has already been described herein, as well as the difficulties in adapting this method in producing a thermal break in a box-section member requiring two closely spaced parallel strips of resin material, as shown in Figure 3.

20 Considering Figures 5 and 6, according to a preferred embodiment of the present invention, an elongate box-section member is formed by assembling two independent metal extrusions, here shown as
elements 1 and 2, alongside one another, with respective
25 pairs of confronting surfaces 3,4 and 3A,4A defining respective elongate gaps between the elements 1 and

2, the gaps being located in the side walls of the box-section member. Each surface 3, 3A, 4 and 4A is preferably undercut as before as shown at 7. An expansible tube 8 is inserted between the elements 1 and 2, so that respective shaped shoes 9 and 10 carried
5 on opposite sides of the tube 8 are aligned with the inner open sides of the gaps between the pairs of surfaces 3,4 and 3A,4A.

The tube is constructed from two elongate channel members 11 and 12, which are nested together in the
10 manner illustrated in Figures 5 and 6, to form the tube which is open at both ends, and which is expansible in one lateral direction only by relative lateral sliding movement of channel member 11 into and out of channel member 12. The shoes 9,10 are
15 mounted on the sides of the tube formed by the base walls of the respective channel members 12 and 11. It will be seen that with this construction of the tube 8, the exterior dimension of the tube in a lateral direction perpendicular to the direction of the
20 relative sliding movement between the channel members 11 and 12 remains substantially constant during expansion and contraction of the tube, so that the tube 8 can be used to maintain the desired gap width once it is inserted within the box-section member.

25 Once the tube is inserted in the box-section member with the shoes aligned as illustrated in Figure 5, the tube is expanded in a manner described in detail below, to press the shoes into engagement

with the elements 1 and 2 adjacent the inner sides of the respective gaps, so that each shoe closes off one side of the respective gap, and converts it into a mould cavity into which the thermal barrier resin material can be injected. Because the resin is introduced into the mould cavities as a fluid (i.e. in uncured condition), the elements 1, 2 are first arranged so that one of the mould cavities is uppermost, and the resin is poured into this mould cavity. After a few minutes, when the resin has hardened sufficiently, the elements 1,2 are turned over so that the other mould cavity can be filled with resin also. The resin 6, 6A in each mould cavity is allowed to set i.e. cure, after which the shoes are retracted from the elements, 1, 2 by contraction of the tube 8, after which the tube 8 and the shoes 9, 10 are removed from the now completed box-section.

Preferably the surfaces 13 of the shoes 9, 10 which engage the elements 1 and 2 and which constitute the respective mould cavities are hollow, each surface having a flat base with very shallow inclined side walls rising therefrom. The surfaces of the elements 1 and 2 which the inclined side walls engage are correspondingly under-cut to facilitate the correct relative locations of the elements 1 and 2 during filling and curing of the resin 6, 6A

within the mould cavities. To facilitate the ready removal of the shoes 9,10 from the cured resin material, the surfaces 13 are preferably "non-stick", being for example treated with a coating of PTFE or silicone.

The relative movement produced between the shoes 9 and 10 during their engagement with and disengagement from the elements 1 and 2 during the method described above, can be achieved in any suitable way. In the embodiment illustrated in Figures 5 and 6, where the shoes are mounted on the expansible tube, expansion and contraction of the tube may be performed by for example a mechanical linkage, or a series of opposed inclined planes, or, as in the illustrated embodiment, using hydraulic or pneumatic pressure operated means, preferably the latter. In the illustrated embodiment, an elongate pressure bag 14, having a closed end 15 and a valve 16 located in its opposite end is disposed within the tube 8. The pressure inside the bag is suitably varied to produce the desired contraction and expansion of the tube 8, whether using positive or negative air pressure inside the bag to produce expansion of the tube.

Figure 7 shows an alternative expansible tube construction in which the shoes 9, 10 are formed integrally with the channel members 11 and 12 respectively. Also the inner sides of the bases of the channel members are formed with part cylindrical seats 17, 18 to support the elongate pressure bag (not shown).

The elements are otherwise substantially the same as the elements previously described. The method of use of the expansible tube is likewise similar to the method used for the tube described earlier except that since the shoes 9, 10 are formed integrally with the channels, the tube as a whole is inserted in and extracted from the sections being assembled.

Figure 8 of the drawing shows an alternative pair of sections to be assembled with a thermal break between the sections. The sections are generally similar to the elements 1 and 2 previously described and like parts have been allotted the same reference numerals. As previously described, the sections have confronting surfaces 3, 4 and 3A, 4A defining respectively the elongate gaps between the elements 1 and 2 to be filled with a resin to bond the two elements together whilst providing a thermal break between the elements. The expansible tube 8 to be inserted between the elements is intended to be a close

sliding fit between the elements and the wall of the element 1 between the surfaces 4 is formed on the inner side thereof with raised lands 1A immediately adjacent the surfaces (see Figure 9) against which the outer ends of the integral shoes on the channel members 11, 12 engage whilst holding the elements 1 and 2 for the filling of the gaps 4, 4A. As best seen in the enlarged view 9A of the drawings, the land 1A merges with the rest of the wall of the section through a shallow inclined ramp. When the resin in the gaps 4, 4A has set and it is desired to remove the expansible tube and shoes, the inflatable bag is de-flated and the sections 11, 12 of the tube are pressed towards each other. Once the outer ends of the tube are thus retracted from the lands 1A the tube should then be sufficiently loose between the sections 1 and 2 to be readily extracted. The provision of the lands enables the tube to be loosened between the sections even though the sections may have been drawn towards each other slightly by the setting of the resin in the gaps 4, 4A which may contract slightly on setting. The provision of the ramps leading up the lands assists in guiding the corners of the expandible tube into engagement with the lands immediately adjacent the surfaces 4, 4A when the tube is expanded to hold the sections for filling of the gaps. The arrangement is otherwise similar to that previously described.

CLAIMS:

1. A method of forming a thermal break between two elongate elements of a metal frame, comprising the steps of assembling said two elements so that two parallel, laterally spaced elongate surfaces on one of the elements respectively confront two corresponding parallel, laterally spaced elongate surfaces on the other element to define therebetween two parallel elongate gaps the assembled elements forming a box-section elongate member with said elongate gaps disposed in opposite elongate side walls thereof; closing off one open elongate side of each of the gaps to form a respective elongate mould cavity by disposing within the box-section member a pair of elongate shoes which are each aligned with the inner open elongate side of a respective one of said elongate gaps, and moving the shoes simultaneously apart in an outward lateral direction thereby to press each shoe into engagement with said elements adjacent the respective gap to form said respective mould cavity with a predetermined gap width between said parallel elongate surfaces filling the mould cavities thus formed with a thermal barrier material; to join the parallel elongate surfaces rigidly together with the thermal barrier material between them;

and disengaging said shoes from said elements by moving the shoes relatively laterally towards each other before withdrawing them from the box-section member.

5

2. A method as claimed in claim 1, in which said shoes are moved laterally relative to each other as aforesaid by pneumatic or hydraulic pressure.

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3. A method as claimed in claim 1, in which before their insertion in said box-section member, the shoes are mounted on opposite exterior sides of an elongate tube, the tube being expansible in a single lateral direction such that when the tube and the shoes are disposed within the box-section member with the shoes aligned with said gaps as aforesaid, lateral expansion of the tube in said single lateral direction presses the shoes against said elements to close off said inner open sides of the gaps, lateral contraction of the tube serving to disengage said shoes from said elements.

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4. A method as claimed in claim 3, in which the tube is expanded and contracted as aforesaid by corresponding variation of the internal pressure of an elongate bag disposed in the tube.

5. A method as claimed in claim 3 or claim 4,
in which the spacing of each pair of confronting
surfaces is maintained during the filling of the mould
cavities with said thermal barrier material, and during
5 the subsequent curing thereof, by the lateral external
dimension of the tube which is maintained constant in a
lateral direction perpendicular to said single lateral
direction and by complementary concave and convex
surfaces provided respectively on each shoe and on said
10 two elements which are matingly engaged with the shoes
are pressed against said elements upon expansion of the
tube.

6. A method as claimed in any of the
15 preceding claims wherein the thermal barrier material is a
curable material, the gaps are filled with the material
in the uncured condition and the material is allowed to cure
prior to disengagement and withdrawal of the shoes.

20 7. Apparatus for forming a thermal break
between two elongate elements of a metal frame having
two parallel elongate surfaces one element confronting
two corresponding parallel elongate surfaces on the other
element to define therewith two parallel elongate gaps
25 respectively in opposite side walls of an elongate box-

-16-

section member formed by the elements thus held;
comprising a pair of elongate shoes (9,10) which are
insertable into the box-section member (1,2) so as to
be each aligned with the inner open side of a respective
5 one of said gaps; means (14) for moving the shoes
laterally apart so as to press the shoes into engagement
with the two elements (1,2) adjacent the respective
gaps and thereby close off said inner sides of said
gaps and form two elongate mould cavities; and
10 means for filling said mould cavities with thermal
barrier material (6, 6A), said shoes being readily
removable from said elements by lateral movement
relatively towards each other after a rigid joint has been
formed by the material between the parallel surfaces of
15 the elements, the thermal barrier material providing a
thermal break connecting said confronting surfaces of
said elements.

8. Apparatus as claimed in claim 7, in which
said shoes (9,10) are carried on opposite exterior sides
20 of an elongate tube (11,12) which is disposable, in use,
in said box-section member with the shoes aligned with
said respective gaps as aforesaid, an which is expansible
in one lateral direction when it is, in use, disposed
in said box-like member to move the shoes simultaneously
25 laterally outwardly of the tube thereby to press the
shoes as aforesaid against said elements, the shoes

being removable from said elements after curing of said thermal barrier material by lateral contraction of said tube.

5 9. Apparatus as claimed in claim 8, in which the exterior dimension of said tube (11,12) in a lateral direction perpendicular to said one lateral direction is substantially constant during lateral expansion and contraction of the tube thereby, when inserted, in use,
10 in said box-section member, to maintain the gaps between said elements during the formation of the thermal break therebetween.

 10. Apparatus as claimed in claim 8 or claim 9
15 including means (14) for expanding said tube (11,12) laterally, said means comprising an elongate inflatable bag disposed within said tube, inflation of the bag expanding the tube laterally.

20 11. Apparatus as claimed in any of claims 8 to 10, in which said tube comprises two elongate U-shaped channel members (11,12) which are assembled with the side walls of one channel member extending into the other channel member to constitute said tube, whereby said
25 lateral expansion and contraction of said tube is effected by relative lateral sliding movement of said

one channel member respectively out of and into said
other channel member, each of said elongate shoes (9,10)
being carried on the outer wall of the tube constituted
by the base wall of a respective one of said channel
5 members.

12. Apparatus as claimed in any of claims
7 to 10, in which the shoes (9,10) are readily detachable
from said tube when said tube is removed from said box-
10 section member.

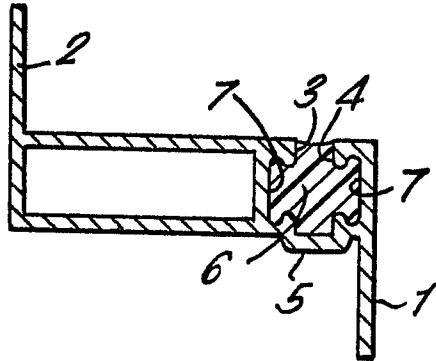
13. Apparatus as claimed in any of claims 6 to 9,
in which the surface of each of the shoes (9,10) which is
arranged to engage the elements (1,2) adjacent said
15 respective gap and to constitute a part of the
associated mould cavity is coated with a 'non-stick'
material.

14. Apparatus as claimed in any of claims
20 7 to 13 in which each shoe (9,10) has a base the width
of which corresponds to the width of the desired gap
between the elements and has shallow inclined side walls
rising on each side of the base to engage corresponding
sides of the spaced elements on either side of the gap to
25 support the elements spaced apart with the required gap
therebetween.

15. An apparatus as claimed in any of claims 7 to 14 wherein the shoes (9,10) are formed integrally with the U-shaped channel members (11,12).

5 16. An apparatus as claimed in any of claims 7 to 15 and in the case where the means to locate the shoes comprises a tube (11,12) consisting of two elongate interfitting U-shaped channel section members and an elongate inflatable bag (14) disposed within the
10 channel section members to expand the latter laterally, wherein the base of each channel section member (11,12) has a part cylindrical surface (18) formed thereon to support the inflatable bag on either side thereof.

FIG. 1.
PRIOR ART



1/2

FIG. 2.
PRIOR ART

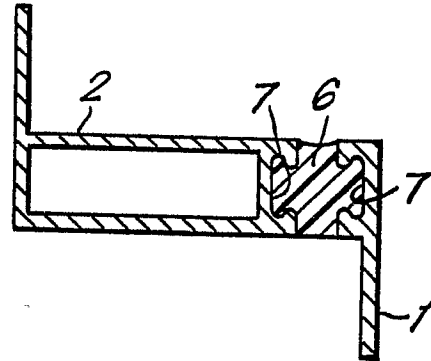


FIG. 3.

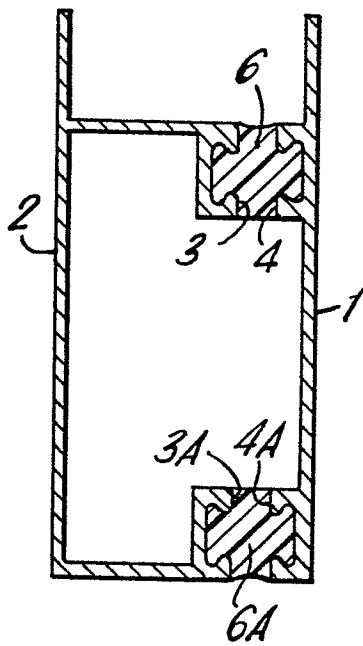


FIG. 4.
PRIOR ART

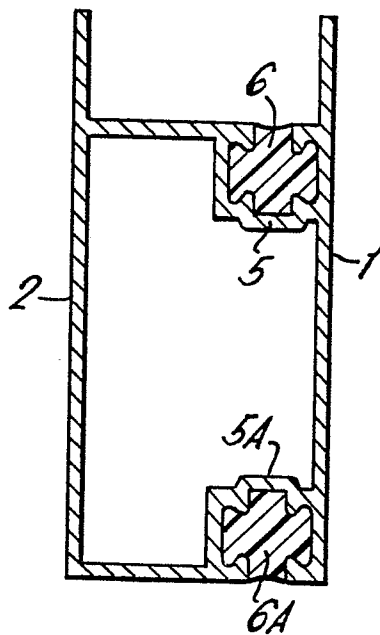
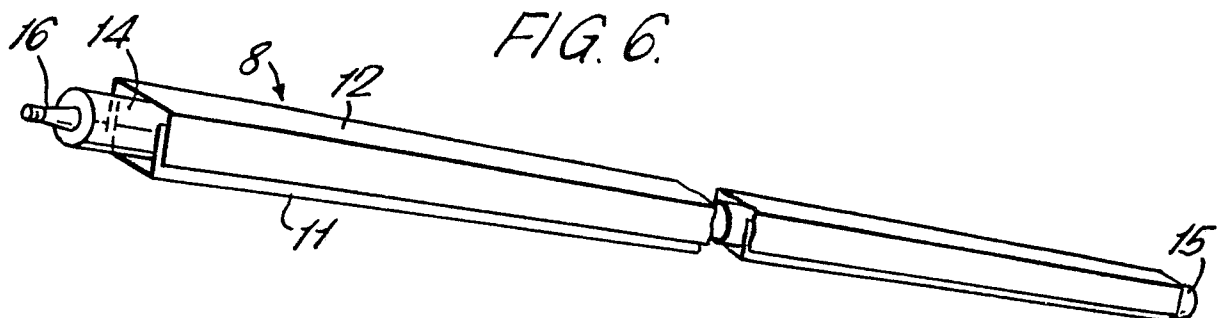
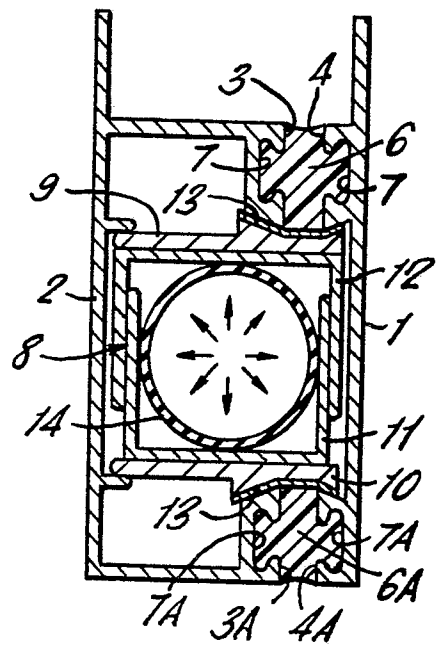


FIG. 5.



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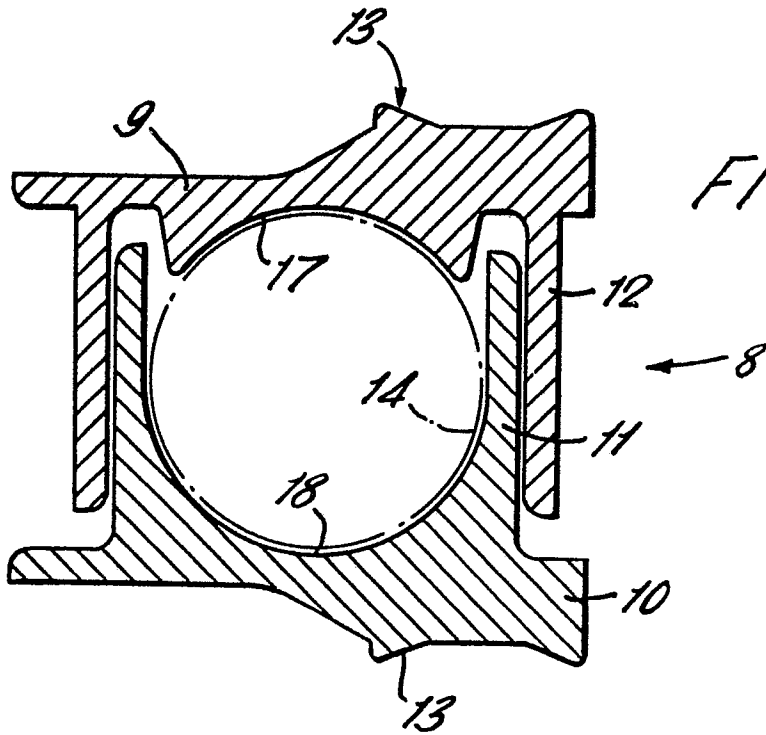


FIG. 8.

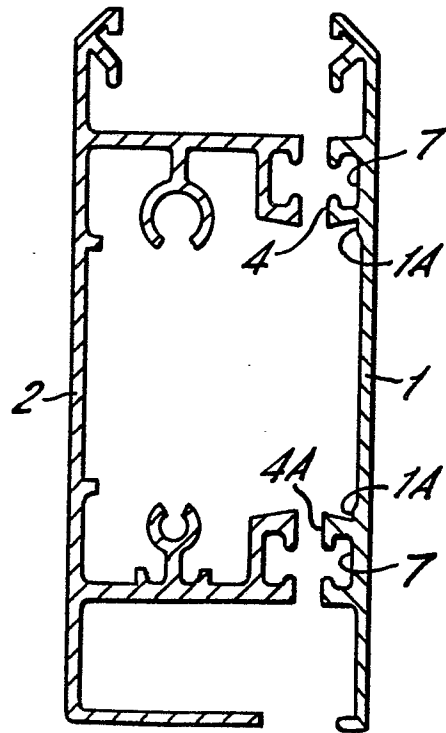
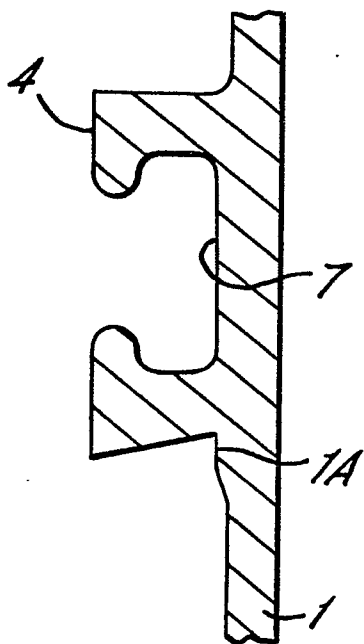


FIG. 9.





European Patent
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EUROPEAN SEARCH REPORT

0053642

Application number

EP 80 30 4443.7

DOCUMENTS CONSIDERED TO BE RELEVANT			CLASSIFICATION OF THE APPLICATION (Int. Cl. ³)
Category	Citation of document with indication, where appropriate, of relevant passages	Relevant to claim	
X	DE - A - 2 254 762 (FA. E. HUECK) * claims; fig. * -- DE - A - 1 650 952 (J. & A. ERBSLÖH) * complete document * -- DE - A1 - 2 531 267 (W.P. KRÜGER) * page 2, lines 1 to 15; fig. * -- DE - A1 - 2 633 580 (J. & A. ERBSLÖH) * claims 1 to 8; fig. 9, 10 * -- AT - B - 281 384 (J. SOMMER STAHL- U. METALLBAU KG) * complete document * --	1-8,10, 12,14 1 1-3,5, 6 1,2,5, 6 1,2,5, 6	E 06 B 3/26 B 29 C 27/00 F 16 S 3/02
A	DE - A - 1 953 718 (ELEKTRODENFABRIK OERLIKON BÜHRLE et al.) * fig. * --	1-6,10	TECHNICAL FIELDS SEARCHED (Int. Cl.³) B 23 K 9/00 B 29 C 27/00 E 06 B 3/00 F 16 S 3/00
A	DD - A - 114 918 (E. WITZEL et al.) * fig. * --	1-6,10	CATEGORY OF CITED DOCUMENTS X: particularly relevant A: technological background O: non-written disclosure P: intermediate document T: theory or principle underlying the invention E: conflicting application D: document cited in the application L: citation for other reasons
A	GB - A - 949 969 (WOODALL-DUCKHAM CONSTRUCTION CO. LTD.) * fig. 4 * ----	1-10, 12-16	
☒ The present search report has been drawn up for all claims			&: member of the same patent family, corresponding document
Place of search		Date of completion of the search	Examiner
Berlin		09-07-1981	WUNDERLICH