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404 28 Göteborg (SE)****(54) Improvements in sliding doors**

(57) In a fire-resistant sliding door (1) comprising a frame (2) and two door leaves (3, 4) the frame and the door leaves comprise vertical interconnected steel profile sections (5) framed by fire-retardant sheets of glass (6). The door leaves (3, 4) are suspended in aligned relationship from the door frame (2) and are displaceable forwards and backwards in the door-frame plane between a closed position ©, wherein the confronting front edges (13, 14) of the door leaves abut against one another via a gasket (15) in order to close a through-passage opening (16) in said frame (2), and an open position allowing passage-through by way of said opening (16). The gasket (15) comprises a vertical strip seal (17)

of U-shaped configuration the web portion (18) of which is connected to the front edge (13) of one (3) of the door leaves while the two flanges (19) of said seal are arranged, upon closing of the door, to be moved into fire-resisting and sealing abutment against the front edge of the other door leaf (4), and also a vertical U-shaped steel profile section (24) the two flanges (25) of which are connected to the front edge (14) of the opposite door leaf (4) opposite the strip seal (17) and the web portion (27) of which is arranged, upon closing of the door, to be moved together with the flanges (25) into fire-resisting and sealing abutment against the side walls of the U-shaped channel (29) of the strip seal (17).

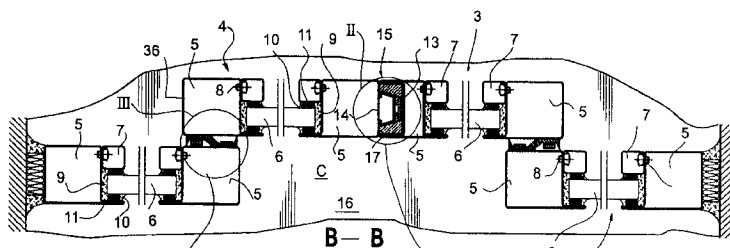


Fig. 4

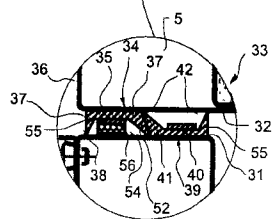


Fig. 4B

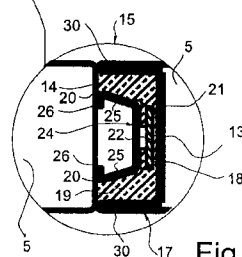


Fig. 4A

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Description

The present invention refers to improvements in sliding doors comprising a door frame and at least two door leaves, each one of said frame and said door leaves comprising essentially vertical and horizontal interconnected metal profile sections and surface elements framed by said profile sections, said door leaves being suspended in aligned relationship from the door frame and being displaceable forwards and backwards in the door-frame plane between a closed position, wherein the confronting, essentially vertical front edges of said door leaves abut against one another via a gasket in order to close a through-passage opening in said frame, and an open position allowing passage-through by way of said opening.

Sliding doors of the general type outlined above are used in many different applications in and on buildings and premises of the most varied nature, their purpose being to form entrances to and exits from for instance shopping markets and commercial centres, shops, offices, stair openings and the like and/or to serve as passages-through in e.g. corridors, underground walkways, and the like. In addition to serving, in their closed and locked position, as a protection against unauthorised entrance sliding doors also serve as a lock for reducing air draught and inflow/outflow of cold/warm air.

An increasingly common requirement nowadays on doors of various kind, including sliding doors serving in the positions outlined above, is that it should be possible to close them in case of fire and that at the same time they should be capable of withstanding the effects of such fire for a predetermined length of time while maintaining their separating function and in doing so prevent the fire and the smoke and hot gases generated thereby from spreading.

The main object of the present invention is to provide a sliding door of the kind defined in the introduction, which door is sufficiently fire-resistant to be classified as being of fire resistance class.

This main object is achieved in accordance with the invention in that the gasket comprises on the one hand at least one essentially vertical strip seal of an essentially U-shaped configuration, the web portion of which is connected to the front edge of one of the door leaves while the two flanges of the seal are directed outwards, towards the front edge of the opposite door leaf, the free ends of said flanges arranged, upon closing of the door to be moved into fire-resisting and sealing abutment against the front edge of said opposite door leaf, and on the other at least one essentially vertical metal profile section of an essentially U-shaped configuration, the two flanges of which are connected, by means of their two free ends, to the front edge of the other door leaf opposite the strip seal and the web portion of which is arranged, upon closing of the door, to be moved together with the flanges into fire-resisting and sealing abutment against the side walls of the outwardly open, es-

entially U-shaped channel of the strip seal, which channel is delimited by the strip seal web portion and flanges.

The invention will be described in closer detail in the following with reference to the accompanying drawings showing a presently particularly preferred embodiment. In the drawings:

Fig. 1 is a front view of a sliding door in accordance with the preferred embodiment of the invention,

Fig. 2 is a view as seen from above of the sliding door of Fig. 1,

Fig. 3 is a cross-sectional view taken on line A-A of Fig. 1,

Fig. 3A is an enlarged view of the encircled area I of Fig. 3,

Fig. 4 is a cross-sectional view taken on line B-B of Fig. 1,

Figs 4A and 4B are enlarged views of the encircled areas II and III, respectively, of Fig. 4,

Fig. 5 is a sectional view similar to that of Fig. 4 but showing the door leaf of the sliding door in an open position, and

Fig. 5A is an enlarged view of the encircled area IV of Fig. 5.

The principal components of the sliding door in accordance with the invention, generally designated by reference 1 in the drawing figures, are a door frame 2 and two door leaves 3 and 4. Each of the frame 2 and the door leaves 3, 4 comprises essentially vertical and horizontal interconnected metal profile sections 5 of steel or other fire-resistant material, and surface elements 6 enclosed/framed by said metal sections 5. In accordance with the embodiment shown and described herein the surface elements 6 consist of fire-retardant sheets of glass having a thickness of 21 mm, for instance PYROSTOP® glass. The fire-retardant glass sheets could of course be thicker or thinner than 21 mm, as required or requested. As an alternative or a supplement to the fire-retardant glass sheets forming the surface elements 6 at least some of them could consist of sheet metal plates or panels of other fire-resistant material.

When fire-retardant glass sheets are used as the surface elements 6 they are mounted in the frame 2 and the respective door leaves 3 and 4 by means of glazing beads 7 which are secured to their associated metal profile section 5 by means of fasteners, such as fastening screws 8. It should be appreciated that the glazing beads 7 could be mounted on the metal profile sections 5 in other ways than by means of fasteners, such as by welding, glueing or the like. The fire-retardant glass sheets 6 are also secured with the aid of bottom and top seals 9 and 10 of a fire-resistant material, preferably a sealing compound of silicone or the like which is difficult to ignite, such as Pyrosil B. Intermediate the bottom and top seals 9 and 10 glazing strips 11 are provided, also of a fire-resistant material, such as Fiberfrax.

As appears most clearly from Figs 4 and 5, the door leaves 3 and 4 are suspended in alignment from the door frame 2 in such a manner as to be displaceable forwards and backwards by means of a sliding door opener, for example of type BESAM EMD 3000, generally designated by numeral reference 12 and not described in closer detail herein. More precisely, the door leaves 3, 4 are displaceable forwards and backwards between a closed position C, see Fig. 4, wherein their essentially vertical opposed front edges 13 and 14 abut against each other via a gasket generally designated by 15 to be described in more detail in the following, serving to seal a through-traffic opening 16 in the frame 2, and an open position D, see Fig. 5, to allow passage-through through the opening 16.

According to the preferred embodiment described and shown herein the gasket 15, see Figs 4 and 4A, comprises at least one essentially vertical strip seal 17 of essentially U-shaped configuration, the web portion 18 of which is connected to the front edge 13 of one 3 of the door leaves while the two flanges 19 of the seal are directed outwards, towards the front edge 14 of the opposite door leaf 4, the free ends 20 of said flanges arranged, upon closing of the door leaves 3 and 4; to be moved into fire-resisting and sealing abutment against the front edge 14 of said opposite one 4 of the door leaves. The strip seal 17 is made from a material which is well adapted for its purpose, such as e.g. chloroprene rubber or the like. A longitudinal groove 21 is formed in the web portion 18 of the strip seal 17 for reception therein of at least one elongate support 22, in this case preferably in the shape of a flat bar of steel, and fasteners, not shown, such as e.g. screws, pop rivets or the like, may be inserted through holes, not either shown, formed in the support 22 and through the part of the web portion 18 that is turned towards the associated front edge 13 so as to be secured to said front edge in order to fasten the strip thereto.

In addition to the strip seal 17 the gasket 15 also comprises at least one metal profile section 24, see Figs 4, 4A and 5, preferably made from steel or other fire-resistant material. The metal profile section 24 has an essentially U-shaped configuration, the two flanges 25 of which are connected, by means of their two free ends 26, to the front edge 14 of the other door leaf 4 opposite the strip seal 17 and the web portion of which 27 is arranged, upon closing of the door leaves, to be moved together with the flanges 25 into fire-resisting and sealing abutment against the side walls 28 of the outwardly open, essentially U-shaped channel 29 of the strip seal 17, which channel 29 is delimited by the web portion 18 and the flanges 19 of the seal 17. The free ends 26 of the flanges 25 of the metal profile section 24 are connected to the front edge 14 of the associate door leaf 4, e.g. by tack welding or the like or by means of suitable fasteners, not shown.

On the front edge 13 of the door leaf 3 to which the web portion 18 of the strip seal 17 is secured in the man-

ner described in the foregoing, at least two protective flanges 30 are provided, said protective flanges projecting towards the front edge 14 of the opposite door leaf 4 and preferably they are made from steel and suitably formed integrally with the associated metal profile section 5. The strip seal 17 is placed between these protective flanges 30, said protective flanges 30, as appears from Figs 4 and 5, resting on the external faces of the outwardly directed flanges 19 of the strip seal 17 in order to protect as far as possible the strip seal 17 against the effects of fire. To maximize the protection the protective flanges 30 preferably are arranged to project from the associated front edge 13 by a distance E which is only slightly shorter, say by about 1 mm, than the height F of the strip seal 17.

In addition to the above-described gasket 15 disposed between the front edges 13, 14 of the door leaves 3, 4, a gap sealing member 33 is provided in the gap G between the facing sides 31, 32 of the frame 2 and the door leaves 3, 4, respectively, see Figs 3, 3A, 4 4B, said member sealing the gap G in the closed position C in a fire-resisting manner to be described in closer detail below.

In accordance with the embodiment described and shown herein the gap sealing member 33 comprises at least one vertical strip seal 34, see Figs 4 and 4B, which like the strip seal 17 of the gasket 15 could be made from chloropene rubber or a similar material. As appears from the drawing figures, the strip seal 34 has a generally U-shaped configuration, and in a manner to be described in more detail in the following the web portion 35 of the U-shaped seal is joined to the side 32 of the respective door leaf 3, 4 that is turned towards the frame 2, in the area adjacent the rear edge 36 of the respective door leaf, whereas the two flanges 37 of the seal are directed towards the frame, their free ends 38 sealingly abutting against the frame 2 in the closed position C of the door leaves 3, 4. In combination with the vertical strip seal 34 the gap seal 33 comprises at least one further vertical strip seal 39, see Fig. 4B, which like the strip seals 17 and 34 may be made from chloropene rubber or a similar material. Like strip seal 34, strip seal 39 has an essentially U-shaped configuration the web portion 40 of which is connected to the side 31 of the frame 2 that is turned towards the respective door leaf 3, 4, in the area of the opening 16 in the frame 2, whereas the two flanges 41 of the seal are directed towards the corresponding door leaf 3, 4, their free ends 42, in the closed position of the door leaves 3, 4, sealingly abutting against the corresponding door leaf in the area adjacent the rear edge thereof and interiorly of the strip seal 34 of the corresponding door leaf 3, 4 as seen in the closing direction.

As a supplement to the strip seals 34 and 39 above the gap seal 33 also comprises, in accordance with the shown and described embodiment, a horizontal strip seal 43, see Figs 3 and 3A, also preferably made from chloropene rubber. The strip seal 43 essentially is of U-

shaped configuration including a web portion 44 which is connected to the side 32 of the respective door leaf 3, 4 that is turned towards the frame 2, in the area adjacent the upper edge 45 of the respective door leaf, whereas the two flanges 46 of the seal are directed towards the frame, their the free ends 47 sealingly abutting against the frame 2 in the closed position C of the door leaves 3, 4. To complete the gap seal member 33, finally, also a horizontal strip seal 48, likewise preferably of chloroprene rubber, is provided. Also this strip seal has an essentially U-shaped configuration, its web portion 49 being connected to the side 31 of the frame 2 that is turned towards the respective door leaf 3, 4 in the area adjacent and above the opening 16 in the frame 2, whereas its two flanges 50 are directed towards the respective door leaf 3, 4, the free ends 51 of the flanges, in the closed position C of the door leaves 3, 4, sealingly abutting against the corresponding door leaf 3, 4 in the area adjacent the upper edge 45 thereof and below the strip seal 43 connected to the respective door leaf.

In accordance with the preferred embodiment the above-described gap strip seals 34, 39, 43 and 48 mounted on respectively the door leaves 3, 4 and the frame 2 are in abutting relationship in the closed position C of the door leaves, by means of the external faces 52 of their oppositely directed, facing flanges 37, 41, 46 and 50. As appears from Figs 3-5, an elongate support 55 is provided in accordance with the referred embodiment on the bottom of the outwardly open, essentially U-shaped channel 54 delimited by the web portions 35, 40, 44, 49 and the flanges 37, 41, 46, 50 of the respective strip seals 34, 39, 43, and 48, said support 55 preferably being in the form of a fire-resistant flat metal bar, preferably of steel. Fasteners, not shown in the drawings, such as e.g. screws, pop rivets or the like, may be inserted through holes, not either shown, formed in the supports and the web portions 35, 40, 44, 49, respectively, for secure attachment to the respective door leaf 3, 4 and to the frame 2.

At least one of the gap strip seals 34, 39, 43, 48 on the respective door leaf 3, 4 and the frame 2 - in accordance with the shown and described embodiment the vertical gap strip seals 34 on the door leaves 3, 4, see Fig. 4B - has a fire strip 56 associated therewith, for example of type INTUMEX® L which is a fire-expandable silicone strip seal. The fire strip seal or seals 56 expand (s) when exposed to fire after closing of the door leaves 3, 4 in response to the sounding of a fire alarm, in order to prevent fire, smoke and hot gases from spreading by way of the gap G. For the same reason, a fire strip 59 corresponding to strip 56 may be provided along the lower edges of each door leaves 3, 4, see Fig. 3, laterally of the associated floor guides 58 controlling the door leaves 3, 4 in a manner known per se by means of the lower door-leaf edges 57. Accordingly, also this fire strip 56 is arranged to expand upon fire exposure of the closed doors 3, 4 in order to prevent fire smoke and hot gases from spreading by way of the bottom gap I be-

tween the support or floor 60 and the respective lower edges 57.

It should be appreciated that the invention must not be regarded as limited to the above described embodiments illustrated in the drawing figures but that it may be modified in a variety of different ways-within the scope of the claimed protection. The number of door leaves 3, 4 obviously could be increased or lowered and for example amount to four door leaves interconnected in pairs, in case the opening 16 in the frame 2 is very large. In addition, an arrangement comprising two pairs of door leaves positioned in parallel juxtaposed relationship and opening and closing in synchrony or with some delay with respect to one pair, is likewise conceivable. Also, the number of strip seals may vary, as may also their positions and shapes, which is, of course, equally true as regards the fire-expandable fire strips 56 and 59.

20 Claims

1. An improvement in sliding doors (1) comprising a door frame (2) and at least two door leaves (3,4), each one of said frame and said door leaves comprising essentially vertical and horizontal interconnected metal profile sections (5) and surface elements (6) framed by said profile sections, said door leaves (3,4) being suspended in aligned relationship from the door frame (2) and being displaceable forwards and backwards in the door-frame plane between a closed position (C), wherein the confronting, essentially vertical front edges (13, 14) of said door leaves abut against one another via a gasket (15) in order to close a through-passage opening (16) in said frame (2), and an open position (D) allowing passage-through by way of said opening (16), **characterised** in that the gasket (15) comprises on the one hand at least one essentially vertical strip seal (17) of an essentially U-shaped configuration, the web portion (18) of which is connected to the front edge (13) of one (3) of the door leaves while the two flanges (19) of the seal are directed outwards, towards the front edge (14) of the opposite door leaf (4), the free ends (20) of said flanges (19) arranged, upon closing of the door, to be moved into fire-resisting and sealing abutment against the front edge (14) of said opposite door leaf (4), and on the other at least one essentially vertical metal profile section (24) of an essentially U-shaped configuration, the two flanges (25) of which are connected, by means of their two free ends (26), to the front edge (14) of the other door leaf (4) opposite the strip seal and the web portion (27) of which is arranged, upon closing of the door, to be moved together with the flanges (25) into fire-resisting and sealing abutment against the side walls (28) of the outwardly open, essentially U-shaped channel (29) of the strip seal (17), which channel (29) is delimited

by the strip seal web portion (18) and flanges (19).

2. An improvement as claimed in claim 1, **characterised** in that a recess (21) is formed in the web portion (18) of the strip seal (17) for reception therein of at least one elongate support (22), and in that fasteners are arranged for insertion through holes formed in the support and through the part of the web portion (18) that is turned towards the associated front edge (13) so as to be secured to said front edge in order to fasten the strip thereto. 5
3. An improvement as claimed in claim 1 or 2, **characterised** in that at least two protective flanges (30) are provided on the front edge (13) of the door leaf (3) to which the web portion (18) of the strip seal (17) is secured, said protective flanges projecting from said web portion towards the front edge (14) of the opposite door leaf (4), said strip seal (17) being disposed between said protective flanges (30), the latter resting on the external faces of the outwardly directed flanges (19) of the strip seal (17) in order to protect as far as possible the strip seal (17) against the effects of fire. 10 15 20 25
4. An improvement as claimed in claim 3, **characterised** in that said protective flanges (30) project from the associated front edge (13) by a distance (E) which is only slightly shorter than the height (H) of the strip seal (17). 30
5. An improvement as claimed in any one of the preceding claims, **characterised** in that a sealing member (33) is provided in the gap (G) between the facing sides (31, 32) of the frame (2) and the door leaves (3, 4, respectively), said member sealing the gap (G) in the closed position (C) in a fire-resisting manner. 35
6. An improvement as claimed in claim 5, **characterised** in that the gap sealing member (33) comprises on the one hand at least one vertical strip seal (34) having a generally U-shaped configuration, the web portion (35) of which is joined to the side (32) of the respective door leaf (3, 4) that is turned towards the frame (2), in the area adjacent the rear edge (36) of the respective door leaf, whereas the two flanges (37) of the seal (34) are directed towards the frame (2), their free ends (38) sealingly abutting against the frame (2) in the closed position (C) of the door leaves (3, 4), and on the other at least one vertical strip seal (39) having an essentially U-shaped configuration, the web portion (40) of which is connected to the side (31) of the frame (2) that is turned towards the respective door leaf (3, 4), in the area of the opening (16) in the frame (2), whereas the two flanges (41) of the seal (39) are directed towards the corresponding door leaf (3, 4), their free ends (42), in the closed position of the door leaves (3, 4), sealingly abutting against the corresponding door leaf in the area adjacent the rear edge (36) thereof and interiorly of the strip seal (34) of the corresponding door leaf (3, 4) as seen in the closing direction. 40 45 50 55
7. An improvement as claimed in claim 6, **characterised** in that the gap seal (33) also comprises on the one hand at least one horizontal strip seal (43) of an essentially U-shaped configuration the web portion (44) of which is connected to the side (32) of the respective door leaf (3, 4) that is turned towards the frame (2), in the area adjacent the upper edge (45) of the respective door leaf, whereas the two flanges (46) of the seal (43) are directed towards the frame, their free ends (47) sealingly abutting against the frame (2) in the closed position (C) of the door leaves (3, 4), and on the other at least one horizontal strip seal (48) having an essentially U-shaped configuration, the web portion (49) of said seal (48) being connected to the side (31) of the frame (2) that is turned towards the respective door leaf (3, 4), in the area adjacent and above the opening (16) in the frame (2), whereas its two flanges (50) are directed towards the respective door leaf (3, 4), the free ends (51) of said flanges, in the closed position (C) of the door leaves (3, 4), sealingly abutting against the corresponding door leaf (3, 4) in the area adjacent the upper edge (45) thereof and below the strip seal (43) connected to the respective door leaf. 5
8. An improvement as claimed in claim 6 or 7, **characterised** in that the gap strip seals (34, 39, 43 and 48) connected to the door leaves (3, 4) and the frame (2) are in abutting relationship in the closed position (C) of the door leaves, by means of the external faces (52) of their oppositely directed, facing flanges (37, 41, 46, 50). 35
9. An improvement as claimed in any one of claims 6 - 8, **characterised** in that an elongate support (55) is provided on the bottom (53) of the outwardly open, essentially U-shaped channel (54) delimited by the web portions (35, 40, 44, 49) and the flanges (37, 41, 46, 50) of the respective strip seals (34, 39, 43, 48), and in that fasteners are arranged for insertion through holes formed in the supports and the web portions (35, 40, 44, 49), respectively, for secure attachment to the respective door leaf (3, 4) and to the frame (2). 40 45 50 55
10. An improvement as claimed in any one of claims 6 - 9, **characterised** in that a fire strip (56) is associated with at least one of the gap strip seals (34, 39, 43, 48) on the respective door leaf (3, 4) and the frame (2), said fire strip(s) (56) expanding when ex-

posed to fire after closing of the door leaves (3, 4) in response to the sounding of a fire alarm, in order to prevent fire, smoke and hot gases from spreading by way of the gap (G).

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11. An improvement as claimed in any one of the preceding claims, **characterised** in that at their lower edges (57) the door leaves (3, 4) are guided by one floor guide (58) each, and in that along the lower edge of each door leaf, laterally of the associated floor guides (58) guiding the door leaves 3, 4, a fire strip (59) is provided which upon closed door leaves (3, 4) and exposure to fire expands to prevent fire, smoke and hot gases from spreading by way of the bottom gap (I) between the floor (60) and the respective lower edges (57).

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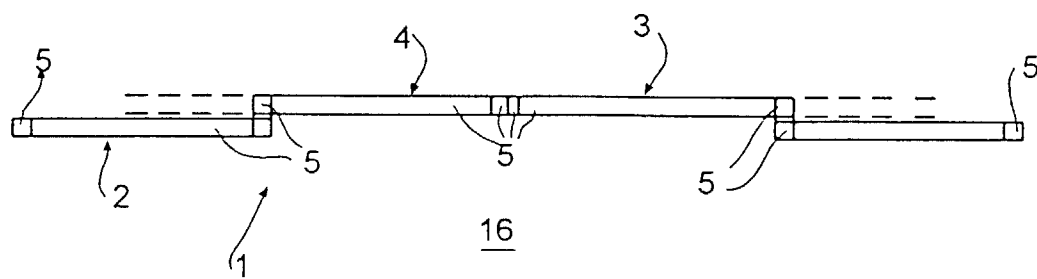
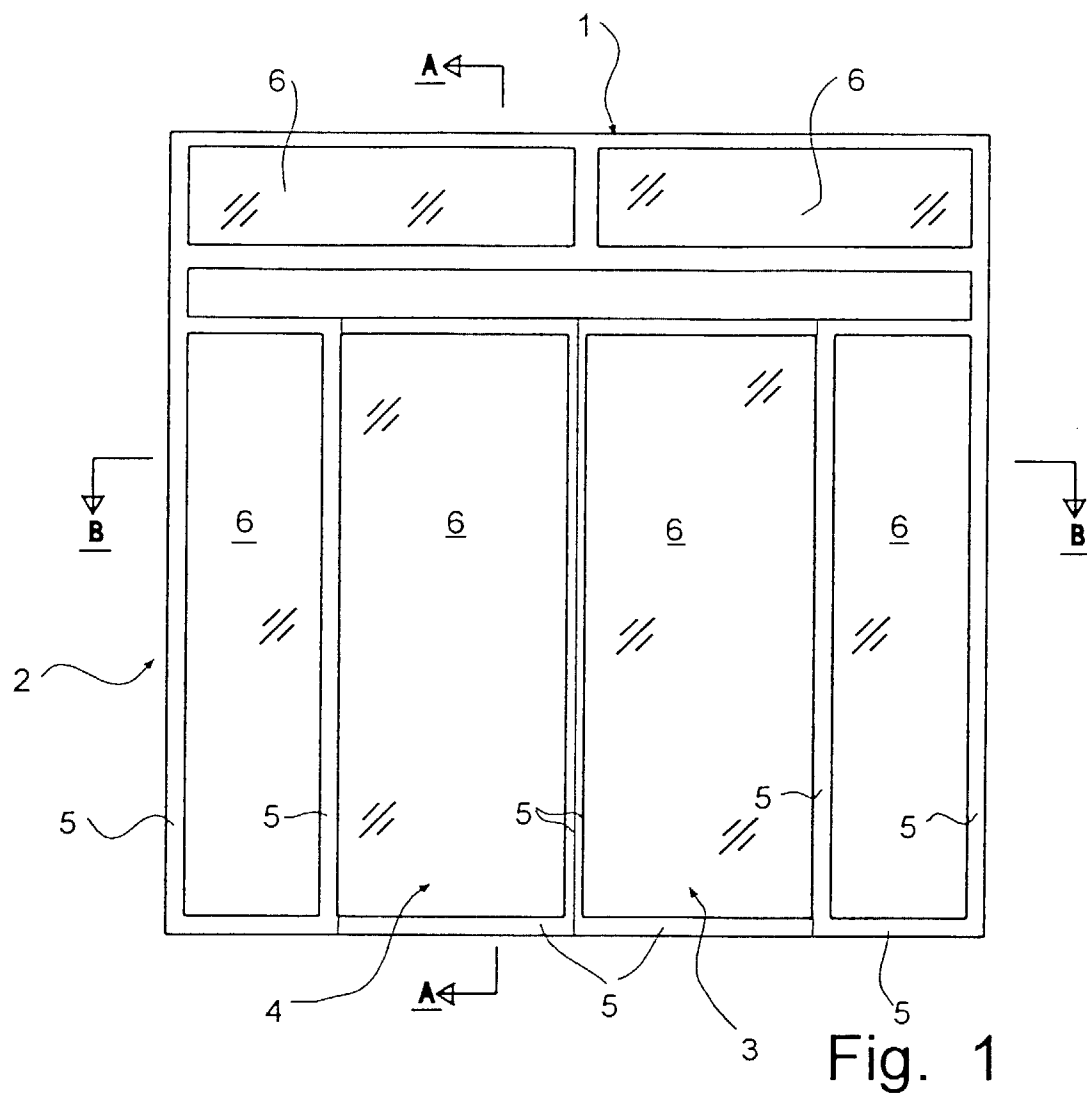
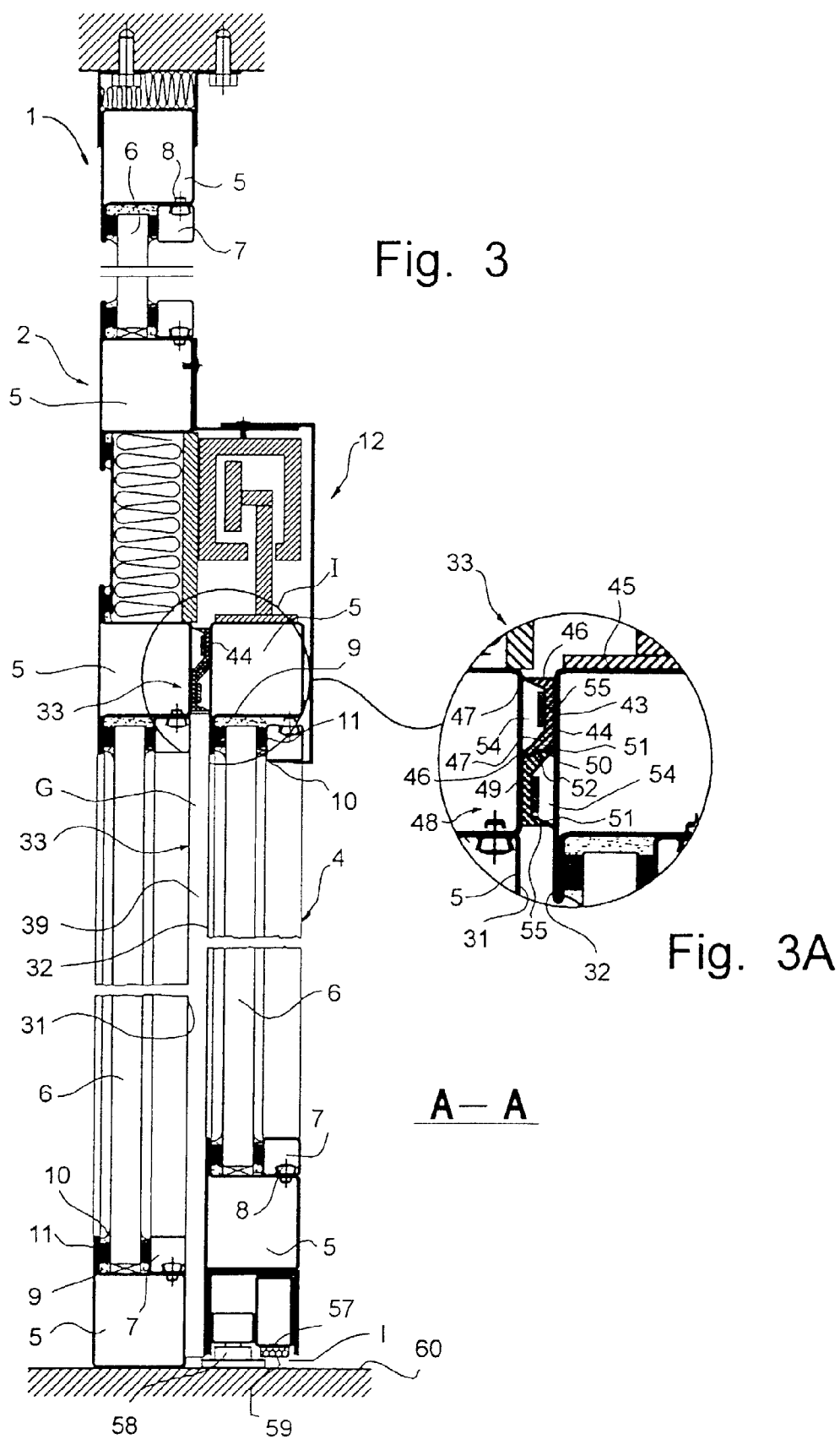


Fig. 2



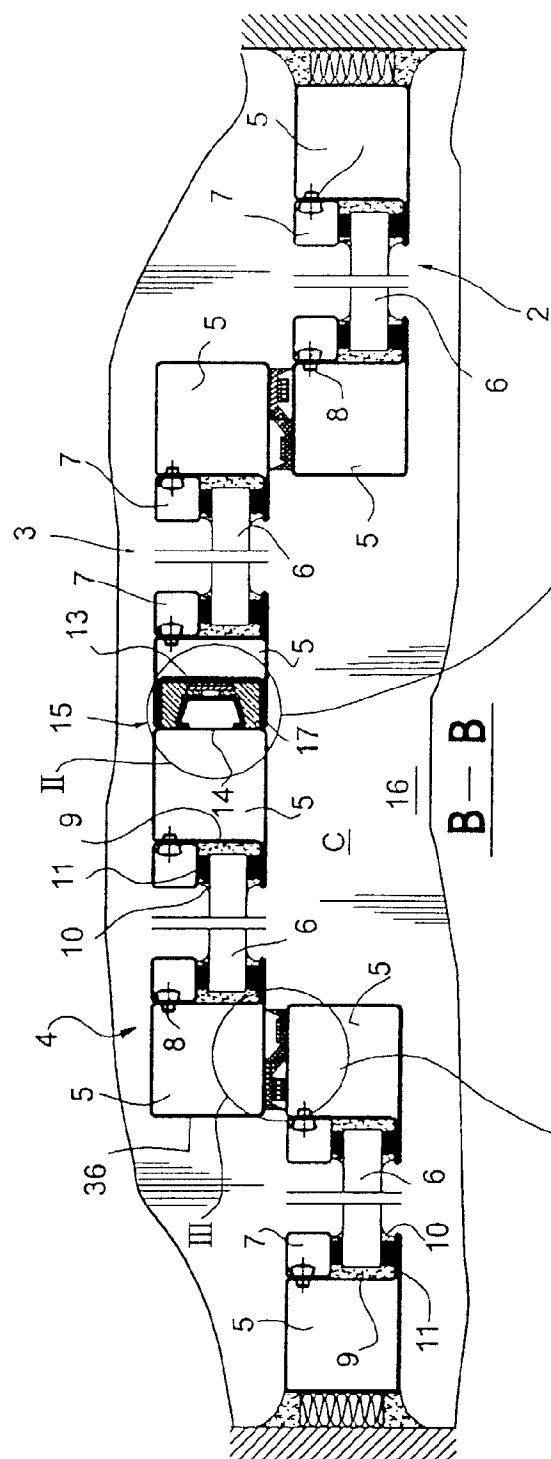


Fig. 4

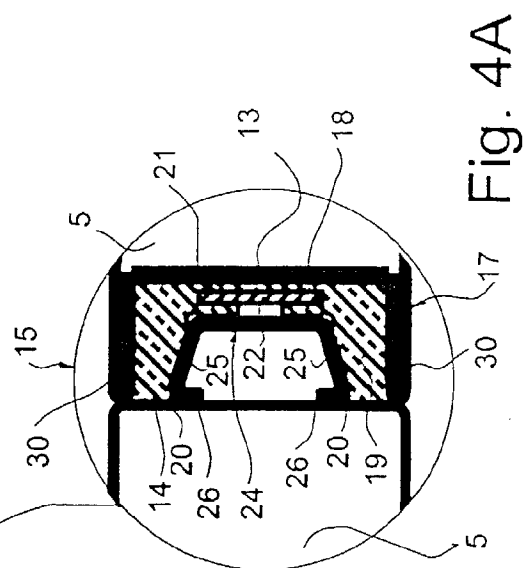


Fig. 4A

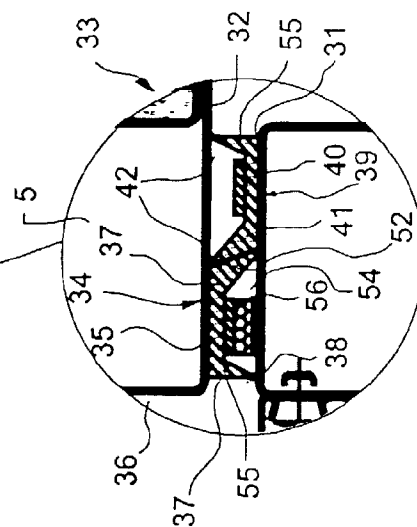


Fig. 4B

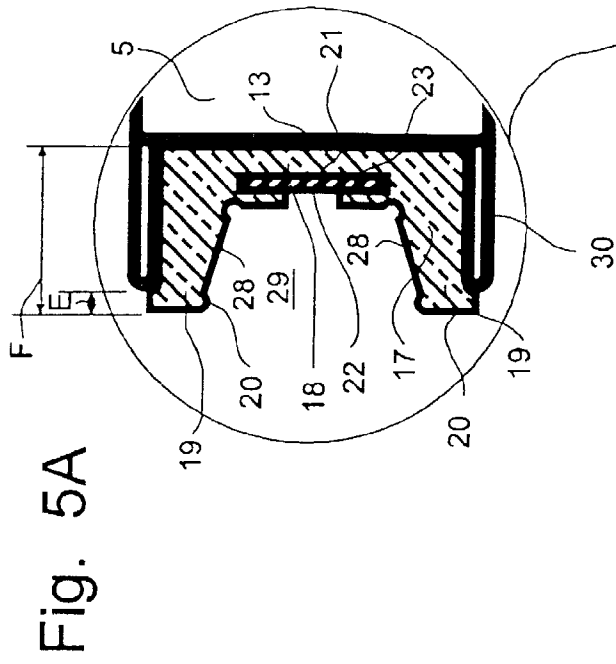


Fig. 5

