(19) Europäisches Patentamt
European Patent Office
Office européen des brevets

(11) **EP 2 615 237 A2**

(12) **EUROPEAN PATENT APPLICATION**

(43) Date of publication:
17.07.2013 Bulletin 2013/29

(51) Int Cl.:
E06B 7/23 *(2006.01)*

(21) Application number: **13150288.2**

(22) Date of filing: **04.01.2013**

(84) Designated Contracting States:
AL AT BE BG CH CY CZ DE DK EE ES FI FR GB GR HR HU IE IS IT LI LT LU LV MC MK MT NL NO PL PT RO RS SE SI SK SM TR
Designated Extension States:
BA ME

(30) Priority: **16.01.2012 FI 20125047**

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(54) **Door of a building with a seal**

(57) A door of a building comprises a frame (10) and a door leaf attached with hinges to the frame. The frame has an outer side surface (12) and an inner side surface (14), which are at different levels. The door leaf has an edge surface (22), which settles beside the outer side surface of the frame when the door is closed. A seal (30) is attached to the frame, which seal has a sealing surface (32) settling against the edge surface of the closed door leaf. The sealing surface has a first edge, which is substantially at the same level as the outer side surface of the frame, and a second edge, which is substantially at the same level as the inner side surface of the frame. The first edge and second edge are arranged to remain substantially unmoving in relation to the side surfaces of the frame when the door is opened and closed. The seal can be a flexible band-like part, which is attached by the first edge of the sealing surface to the outer side surface of the frame and by the second edge to the inner side surface of the frame, so that a substantially closed edge cavity (42) remains between the sealing surface and the frame surface. The seal can also be a flexible and compressible, substantially solid seal or a so-called cavity seal, inside which there is a cavity in the longitudinal direction of the seal.

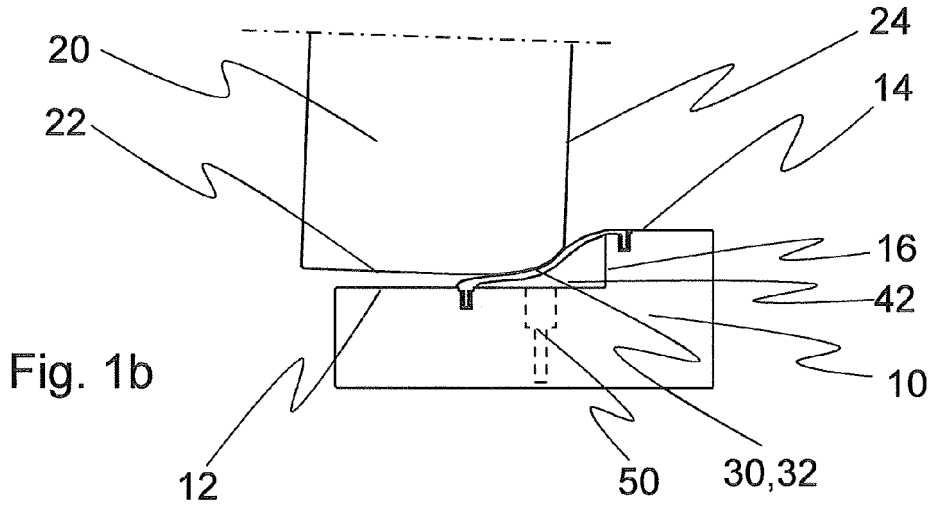

Fig. 1b

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Description

[0001] The invention relates to a door of a building, which door comprises a frame, which has an outer side surface and an inner side surface, which outer and inner side surface are at different levels, a door leaf attached with hinges to the frame, which door leaf has an edge surface, and a seal attached to the frame, which seal has a sealing surface settling against the edge surface of the closed door leaf, which sealing surface has a first edge, which is substantially at the same level as the outer side surface of the frame, and a second edge, which is substantially at the same level as the inner side surface of the frame.

[0002] Continuously tightening regulations regarding thermal insulation of buildings demand a good sealing of the outer shell of a building. For the sealing of the outer shell the most challenging points are the structural parts in the outer shell which can be opened, such as outer doors. Outer doors are traditionally sealed with two cellular rubber seals placed between the edge of the door leaf and the frame, one of which seals is attached to the frame and one to the door leaf. For the sealing of outer doors it is important that the seals between the door leaf and frame fill the gap between the door leaf and the frame as planned. Outer doors with a plate structure can, after they have been installed, curve somewhat due to the effect of moisture and temperature differences, whereby the width of the gap between the edge of the door leaf and the frame changes, especially on the lock side edge of the door. Deterioration of the sealing of the outer door can also be caused by installation errors of the door. A typical installation error is that the lock side door frame is attached in a precisely vertical position, even if the edge of the door leaf of the door in a closed position is in a position, which slightly deviates from the vertical.

[0003] Deterioration of the sealing of the door caused by curving of the door leaf increases energy costs and causes a feeling of draft, which diminishes the living comfort. Additionally the curving of the door can make closing the door more difficult, whereby more force must be used for closing the door. Due to problems caused by curving of the door leaf, door manufacturers must within the warranty period yearly exchange hundreds of outer doors for new ones, which causes significant additional costs for the door manufacturers. The doors to be exchanged usually do not have any other faults than a deterioration of the sealing caused by curving of the door leaf.

[0004] Reference publications DE2608499 A1 and N068098 disclose a door of a building, which door comprises a frame and a door leaf attached to the frame with hinges. The frame has an outer side surface and an inner side surface, which are at different levels. A tape-like seal is attached to the frame, so that the first edge of the seal is at the same level as the outer side surface of the frame and the second edge is at the same level as the inner side surface of the frame. In the above-mentioned reference publication the tape-like seals are attached to the frame by only one edge, whereby the second edge of the seal can move freely along the surface of the frame. Irregularities in the frame surface and impurities and snow and ice passing between the frame and the door leaf can impede the movement of the free edge of the seal, whereby the seal does not function in the desired manner. Such seals are thus not suitable for use in the doors of buildings, especially outer doors, which are opened and closed several times a day.

[0005] An object of the invention is to provide a door of a building, by which the problems relating to the prior art can be significantly reduced.

[0006] The objects of the invention are obtained with a door, which is characterised in what is presented in the independent claim. Some advantageous embodiments of the invention are presented in the dependent claims.

[0007] The invention relates to a door of a building, which door comprises a frame and a door leaf attached to the frame with hinges. The door is advantageously an outer door of the building, of which door a good airtightness is required. The frame has an outer side surface and an inner side surface, which are at different levels, so that the opening of the frame delimited by the outer side surface is larger than the opening delimited by the inner side surface. The door leaf has an edge surface, which settles beside the outer side surface of the frame when the door is closed. When the door is closed the outer side surface thus remains hidden from view under the door leaf. The inner side surface of the frame means the part of the frame surface, which remains visible when the door is closed. A seal is attached to the door frame, which seal has a sealing surface settling against the edge surface of the closed door leaf. The sealing surface has a first edge, which is substantially at the same level as the outer side surface of the frame, and a second edge, which is substantially at the same level as the inner side surface of the frame. The height of the seal is thus not constant viewed in the direction of the normal of the outer side surface, but it changes when moving from the first edge of the sealing surface to the second edge of the sealing surface. The first edge of the sealing surface is practically at the same level as the outer side surface of the frame, and the second edge of the sealing surface is clearly higher than the first edge when seen in the direction of the normal of the outer side surface. In the area between the first and second edge the shape of the sealing surface can be even, convex, concave or shaped in a desired manner. Due to the shape of the sealing surface a contact surface is formed between the edge surface of the door leaf and the sealing surface, even if the edge of the face surface of the door leaf settling against the frame is somewhat curved. The door according to the invention is **characterised in that** said first edge and second edge are arranged to remain substantially unmoving in relation to the side surfaces of the frame when the door is opened and closed. The pressing of the edge surface of the door leaf against the sealing surface thus does not cause substantial movement of either edge of the sealing surface

in relation to the frame, but only pressing of the sealing surface toward the outer side surface of the frame.

[0008] In an advantageous embodiment of the door according to the invention the distance between the first edge and second edge of the sealing surface in the direction of the level of the outer side surface is at least twice, advantageously at least 2.5 times, most advantageously at least three times as large as the distance between the first edge and second edge of the sealing surface in the direction of the normal of the outer side surface. The seal thus extends clearly deeper than what is common into the gap between the edge surface of the door leaf and the outer side surface of the frame, as a result of which the width of the contact surface between the sealing surface and the edge surface is large. A wide contact surface improves the airtightness of the door.

[0009] In a second advantageous embodiment of the door according to the invention the seal is a flexible band-like part, which is attached by the first edge of the sealing surface to the outer side surface of the frame and by the second edge to the inner side surface of the frame, so that a substantially closed edge cavity remains between the sealing surface and the frame surface. Advantageously the first edge of the sealing surface has a first attaching edge, which is fitted into a first attaching groove in the outer side surface of the frame, and the second edge of the sealing surface as a second attaching edge, which is fitted into a second attaching groove in the inner side surface of the frame.

[0010] In a third advantageous embodiment of the door according to the invention the frame has a detent surface connecting the outer side surface and inner side surface. The frame can to its cross-sectional shape be a common door frame, where the inner and outer are substantially parallel surfaces and the detent surface is in a substantially right angle in relation to the above-mentioned surfaces. The seal has a first wall settling against the outer side surface and a second wall settling against the detent surface of the frame. The first edge of the sealing surface is connected to the second edge of the first wall and the second edge of the sealing surface is connected to the second edge of the second wall. The first and second wall and the sealing surface thus form the outer surface of the seal. The first wall of the seal supports the first edge of the sealing surface and prevents its substantial movement on the outer side surface of the frame, and the second wall of the seal supports the second edge of the sealing surface and prevents its substantial movement in relation to the inner side surface of the frame when the door leaf is opened and closed. The seal can be a flexible and compressible, substantially solid seal.

[0011] In still another advantageous embodiment of the door according to the invention the seal is a so-called cavity seal, which has a cavity in the longitudinal direction of the seal, delimited by the sealing surface, the first wall and the second wall. Advantageously the first wall of the seal has at least one tongue in the longitudinal direction of the seal, directed into the cavity, which tongue is arranged to press against the cavity side surface of the sealing surface, when the edge surface of the door leaf is pressed against the sealing surface. The tongue thus divides the cavity inside the seal into at least two partial cavities. The sealing surface can have a first flank and a second flank, which first and second flank are apart from each other but the edges of which overlap with each other in a substantially airtight manner. The sealing surface does thus not necessarily need to be a uniform part, but it can be constructed from two separate flanks settled to overlap by their edges.

[0012] In still another advantageous embodiment of the door according to the invention the first wall of the seal has an attaching edge, which is fitted into an attaching groove in the outer side surface of the frame. The frame can have drillings for installing attaching screws, so that the drillings are in the frame in the area covered by the seal. No separate frame plugs are thus needed for covering the drillings, but the drillings always remain invisible under the seal. The drillings are advantageously in the frame in an area, which is covered by the part of the seal between the first edge of the sealing surface and the attaching edge in the first wall of the seal. In connection with installation of the door the edge of the seal can thus be lifted temporarily off the drilling without detaching the seal from the door frame.

[0013] Still another advantageous embodiment of the door according to the invention has a frame surrounding the door leaf and a ring-like seal in the shape of the frame, inside which seal there is an airtight cavity. The ring-like seal is formed from a sealing strip, the ends of which are joined together by vulcanising. Straight angles are formed in the part of the seal ending up in the corners of the frame by cutting the corner of the seal in a mitre and joining the contact surfaces together by vulcanising. In known doors particularly the corners are the weakest points in the door with regard to airtightness. A uniform ring-like seal minimises the air leaks of the door also in the corners of the frame.

[0014] In still another advantageous embodiment of the door according to the invention the door leaf has, in a known manner, a face surface, and the part of the edge surface of the door leaf settling against the sealing surface is bevelled. Additionally the corner between the edge surface and the face surface is rounded. Bevelling the edge surface and rounding the corner between the face surface and the edge surface makes possible the use of a seal with a clearly larger cross-section than commonly in the door.

[0015] An advantage of the invention is that the door retains a sealing according to regulations, even if some curving occurs in the door leaf. Installation errors occurring while installing the door also do not have a significant effect on the sealing of the door. The invention thus saves energy, improves the living comfort and especially significantly decreases the need for exchanging a door caused by curving and installation errors of the door leaf.

[0016] An advantage of the invention is additionally

that the door retains its air and water tightness also when the pressure difference working on different sides of the door is larger than commonly. Such a situation dominates for example in windy and rainy weather. Large pressure differences can be generated also in spaces equipped with automatic ventilation, when doors and/or windows are opened.

[0017] An advantage of the invention is further that the contact surface between the edge surface of the door leaf and the seal becomes wide. A wide contact surface increases the sealing of the door and reduces heat conduction occurring via the seal, whereby the energy efficiency of the door is improved.

[0018] An advantage of the invention is still that the closing force needed for closing the door decreases. This is beneficial especially for physically weaker building residents, such as children and the elderly. A decrease in the closing force also increases the safety of the residents, as the risk of the door unintentionally remaining open decreases.

[0019] In the following, the invention will be described in detail. In the description, reference is made to the enclosed drawings, in which

Figures 1a, 1b and 1c show as an example a door of a building according to the invention as cross-sectional views from the lock side of the door,

Figure 1d shows as an example an advantageous embodiment of a door of a building according to the invention as a cross-sectional view from the lock side of the door,

Figure 1e shows as an example a second advantageous embodiment of a door of a building according to the invention as a cross-sectional view from the lock side of the door,

Figures 2a, 2b and 2c show as an example a third advantageous embodiment of a door of a building according to the invention as cross-sectional views from the lock side of the door,

Figures 3a, 3b and 3c show as an example a fourth advantageous embodiment of a door of a building according to the invention as cross-sectional views from the lock side of the door and

Figures 4a, 4b and 4c show as an example still some advantageous embodiments of a door of a building according to the invention as cross-sectional views from the lock side of the door.

[0020] Figures 1a, 1b and 1c show as an example a door of a building according to the invention from the lock side of the door, i.e. from the side opposite to the hinge side of the door. A door of a building here means such a door, which one can pass through, which is attached to a door opening in the wall of the building. The door shown in the figures is a plate-structured, heat-insulated outer door of a building. The door according to the invention has a door leaf 20 and a frame 10 surrounding the door leaf on all sides. The figures show the door frame and the frame side edge of the door leaf as cross-sectional views. In Figures 1a, 1b and 1c only the frame on the lock side of the door is shown. The door leaf is attached by its other edge to the frame with hinges (the hinges are not shown in the figure).

[0021] The door leaf has two face surfaces 24 and an edge surface 22 surrounding the door leaf. The face surfaces of the door leaf in this description mean the visible remaining surfaces of a closed door leaf, of which one is the inner surface remaining on the inside of the door and the other is the outer surface remaining on the outside of the door. The face surfaces of the door leaf are substantially even surfaces. The door frame 10 has an outer side surface 12, an inner side surface 14 and a detent surface 16 connecting the side surfaces. The outer side surface in this description means the surface of the frame, beside which the edge surface of the closed door leaf settles. When the door leaf is closed the outer side surface thus remains hidden from view under the closed door leaf. The inner side surface of the frame in this description means the part of the frame surface, which remains visible when the door leaf is closed. The inner and outer side surface are substantially parallel, but they are at different levels, so that the opening of the frame delimited by the inner side surface is smaller than the opening of the frame delimited by the outer side surface. The inner and outer side surface are connected by a detent surface 16, which forms a right angle with the inner and outer side surface. The distance between the levels of the inner and outer side surface, i.e. the height of the detent surface, is typically 12-14 mm.

[0022] A band-like seal 30 is attached to the frame, which seal has a sealing surface 32 meant to settle against the edge surface of the door leaf 20. The first edge of the sealing surface has a first attaching edge 34a in the direction of the first edge and pointing toward the outer side surface 12 of the frame, which attaching edge is fitted into a first attaching groove 18a in the outer side surface. In a corresponding manner the second edge of the sealing surface has a second attaching edge 34b, which is fitted into a second attaching groove 18b in the inner side surface of the frame. The outer surface of the attaching edge has flexible, protruding bristles, which press against the walls of the attaching groove and keep the attaching protrusions in the attaching grooves. The sealing surface thus attaches by its first edge to the outer side surface of the frame and by its second edge to the inner side surface of the frame. The inner side surface has by the seal an indentation of the thickness of the sealing surface, due to which indentation the surface of the sealing surface settles substantially at the same level as the inner side surface of the frame. The distance of the first edge of the sealing surface from the detent sur-

face is about three times as large as the distance of the second edge of the sealing surface from the outer side surface of the frame. The first edge of the sealing surface can extend to a distance of 38-62 mm from the detent surface. The seal thus extends substantially farther from the corner between the outer side surface and the detent surface than in known doors. The distance of the sealing surface from the outer side surface of the frame decreases when moving toward the first edge surface of the sealing surface. In the first edge of the sealing surface the height of the seal in the direction of the normal of the outer side surface of the frame is clearly smaller than the gap between the edge surface of the closed door leaf and the outer side surface of the frame. The sealing surface and the attaching edges therein are made of some flexible material suitable as sealing material, such as silicone, foam plastic, thermoplastic elastomer (TPE), polyurethane or cellular rubber, which is manufactured into a one-piece band-like seal 30 for example with extrusion technique.

[0023] The outer side surface of the frame has drillings 50 extending almost through the frame, for installing attaching screws for the frame. These drillings are placed in the part of the outer side surface, which remains covered by the seal. The seal can be detached from the frame in the door installation stage by lifting either attaching edge out of the attaching groove, whereby screwing the attaching screw into place is possible. After the attaching screws are attached, the attaching edge of the seal is pressed back into the attaching groove, whereafter the seal again remains reliably in place in the frame.

[0024] The seal is installed in the frame to circulate the entire frame. The door seal is a uniform, continuous part manufactured precisely according to the shape and dimensions of the door frame, which part is attached in place in the frame so that a uniform, substantially airtight edge cavity 42 is formed between the sealing surface 32 of the seal and the frame. The seal is manufactured from a long sealing strip by cutting mitre joints in the sealing strip, which joints end up in the corners of the frame, and by joining the cutting surfaces together by vulcanising. The end surfaces of the seal, which settle opposite each other, are also joined together by vulcanising. The mitre cut corners of the seal and the joining together of the ends of the seal can be done also as butt joints without vulcanisation.

[0025] Figure 1a shows a door according to the invention, which is slightly ajar, i.e. the door has not yet closed completely. In Figure 1a the seal 30 is in a free, unburdened state, where its sealing surface has a slightly gutter-like cross-sectional shape. Figures 1b and 1c show doors according to the invention in a closed position. Figure 1c shows a door, the lock side edge of the door leaf of which is substantially straight. The edge of the face surface 24 of the door leaf thus settles very close to the detent surface 16 of the frame, i.e. a gap, which is only slightly larger than the thickness of the sealing surface 32, remains between the face surface and the detent surface. The width of the contact surface between the edge surface 22 of the door leaf 20 and the sealing surface is almost the width of the entire sealing surface, i.e. in practice several centimetres. The width of the contact surface is thus significantly larger than in known door sealing solutions. The part of the edge surface 22 of the door leaf which settles against the sealing surface is bevelled and the corner between the edge surface and the face surface is rounded, so that there is no right angle between the edge surface and the face surface. The rounding radius of the corner can be in the magnitude of 40-50 mm or even 50-60 mm, i.e. it is substantially larger than the small rounding used in known door leafs for removing the sharp edge between the edge surface and the face surface. Due to the rounding and the bevelling of the edge surface, no large deformations are generated in the sealing surface when the door leaf is pressed against the frame. Instead of the rounding, the corner between the edge surface and the face surface can also be bevelled, so that there is no corner pressing into the seal in the juncture between the edge surface and the face surface.

[0026] Figure 1b shows a door according to the invention, the upper and lower edges of the door leaf of which are curved outwards. When the door is closed, the face surfaces 24 of the door leaf 20 in the upper and lower edges of the door leaf thus remain at a distance from the detent surface 16 of the frame, in the manner shown in Figure 1b. A clear, wide contact surface is however generated between the edge surface 22 of the door leaf and the sealing surface 32 of the seal, i.e. the seal seals the gap between the edge surface of the door leaf and the frame 10 in a substantially airtight manner.

[0027] Figure 1d shows as a cross-sectional view an advantageous embodiment of a door according to the invention in a situation, where the door is slightly ajar, i.e. it has not yet closed completely. In the embodiment shown in the figure the sealing surface 32 is completely even in the part which covers the outer face surface of the frame. Otherwise the seal is to its structure as the seal described in Figures 1a, 1b and 1c and it behaves in the same way when the door is closed.

[0028] Figure 1e shows as a cross-sectional view a second advantageous embodiment of a door according to the invention in a situation, where the door is slightly ajar, i.e. it has not yet closed completely. In the embodiment shown in the figure the sealing surface 32 is outwards convex in the part which covers the outer face surface of the frame. In this embodiment a contact surface is generated between the edge surface 22 of the door leaf 20 and the sealing surface 32, even if the gap between the face surface 24 of the door leaf and the detent surface 16 is larger than in the doors shown in Figures 1a, 1b, 1c and 1d. Otherwise the seal is to its structure as the seal described in Figures 1a, 1b and 1c and it behaves in the same way when the door is closed.

[0029] Figures 2a, 2b and 2c show as an example a third advantageous embodiment of a door of a building

according to the invention as cross-sectional views. The embodiment shown in the figures differs from the above-described doors only with regards to the structure of the seal. Other than that the door is to its structure mainly as described above, and the same reference numbers as above are used in the description for the parts of the door. In this embodiment the seal 130 is a so-called solid seal, which is manufactured from a flexible and compressible material, such as cellular rubber or silicone. The seal has a first wall 136a settling against the outer side surface 12 of the frame and a second wall 136b settling against the detent surface 16 of the frame. The first and second walls are joined together at their first edges in the corner formed by the outer side surface and the detent surface. The shape of the sealing surface 132 of the seal is substantially the same as in the doors shown in Figures 1a, 1b and 1c. The first edge of the sealing surface is connected to the second edge of the first wall and the second edge of the sealing surface is connected to the second edge of the second wall. The first and second wall and the sealing surface thus form the outer surface of the seal. The first wall of the seal has an attaching edge 134, which is fitted into an attaching groove 18a in the outer side surface of the frame. The drillings 50 in the outer side surface of the frame are in this embodiment placed in the area between the attaching edge of the seal and the first edge of the seal. When installing the door in place the first edge of the seal can be lifted up from the surface of the frame, whereby an attaching screw can be screwed into place in the drilling.

[0030] Figure 2b shows a closed door according to Figure 2a, the lock side edge of the door leaf of which is curved outwards at its corners. Thus a wide gap is left between the edge of the face surface of the door leaf and the detent surface of the frame in the upper and lower corners of the frame. Regardless of the width of the gap the seal 130 still covers the gap in an airtight manner and even so that a wide contact surface is generated between the edge surface of the door and the sealing surface 132 of the seal.

[0031] Figure 2c shows a closed door according to Figure 2a, the lock side edge of the door leaf of which is substantially straight. Only a narrow, substantially evenly wide gap is thus left between the face surface 24 of the door leaf 20 and the detent surface 16 of the frame. The seal 130 is thus compressed somewhat more than in the case of Figure 2b, and a slightly wider contact surface than the last is generated between the edge surface of the door and the sealing surface 132. The flexibility and compressibility of the seal ensure the airtightness of the sealing.

[0032] Even though in the embodiments of the invention shown in Figures 2a-2c the edges 132 of the sealing surface do not actually attach to the side surfaces of the frame, the first and second edge of the sealing surface remain substantially immovably in place in relation to the frame, especially in relation to the side surfaces of the frame, when the door leaf is opened and closed. The immobility of the edges of the sealing surface is obtained with a cross-sectional shape of the seal, where the first wall 136a of the seal supports the first edge of the sealing surface and prevents its substantial movement on the outer side surface of the frame, and the second wall 136b of the seal supports the second edge of the sealing surface and prevents its substantial movement in relation to the inner side surface of the frame.

[0033] Figures 3a, 3b and 3c show as an example a fourth advantageous embodiment of a door of a building according to the invention as cross-sectional views. The embodiment shown in the figures differs from the above-described doors only with regards to the structure of the seal. Other than that the door is as described above, and the same reference numbers as above are used in the description for the parts of the door. In this embodiment the seal 230 is a so-called cavity seal, which is manufactured from a flexible and compressible material, such as cellular rubber or silicone. The seal has a first wall 236a settling against the outer side surface 12 of the frame and a second wall 236b settling against the detent surface 16 of the frame. The shape of the sealing surface 232 of the seal is substantially the same as in the doors shown in Figures 1a, 1b and 1c. The first edge of the sealing surface is connected to the second edge of the first wall, and the second edge of the sealing surface is connected to the second edge of the second wall. The first and second wall and the sealing surface thus form the outer surface of the seal. Inside the seal there is a cavity 238 in the longitudinal direction of the seal, delimited by the first wall, second wall and sealing surface. The seal is formed to be a ring-like one-piece part, which has the shape and size of the edge surfaces of the frame, the corners and end surfaces of which part are vulcanised to be airtight.

[0034] The first wall of the seal has an attaching edge 234, which is fitted into an attaching groove 18a in the outer side surface of the frame. The drillings 50 in the outer side surface of the frame are in this embodiment placed in the area between the attaching edge of the seal and the first edge of the seal. When installing the door in place the first edge of the seal can be lifted up from the surface of the frame, whereby an attaching screw can be screwed into place in the drilling.

[0035] Figure 3b shows a closed door according to Figure 3a, the lock side edge of the door leaf of which is curved outwards at its corners. Thus a wide gap is left between the face surface 24 of the door leaf and the detent surface 16 of the frame in the upper and lower corners of the frame, which gap the seal 230 however covers in an airtight manner. Figure 3c shows a closed door according to Figure 3a, the lock side edge of the door leaf of which is substantially straight. Only a narrow, substantially evenly wide gap is thus left between the face surface 24 of the door leaf and the detent surface 16 of the frame. The seal 230 is thus compressed somewhat more than in the case of Figure 3b, and a slightly wider contact surface than the last is generated between

the edge surface of the door and the sealing surface 232. Due to the air-filled cavity inside the seal the seal is compressed with a smaller force than in the embodiments shown in Figures 2a, 2b and 2c.

[0036] Also in the embodiment of the invention shown in Figures 3a-3c the first and second edge of the sealing surface remain substantially immovably in place in relation to the frame, especially in relation to the side surfaces of the frame, when the door leaf is opened and closed, even though the edges of the sealing surface 232 do not actually attach to the side surfaces of the frame. The immobility of the edges of the sealing surface is the result of a cross-sectional shape of the seal, where the first wall 236a of the seal supports the first edge of the sealing surface and prevents its substantial movement on the outer side surface 12 of the frame, and the second wall 236b of the seal supports the second edge of the sealing surface and prevents its substantial movement in relation to the inner side surface 14 of the frame.

[0037] Figure 4a shows as an example a fifth advantageous embodiment of a door of a building according to the invention as a cross-sectional view. The embodiment shown in the figure differs from the above-described doors only with regards to the structure of the seal. Other than that the door is as described above, and the same reference numbers as above are used in the description for the parts of the door. Also in this embodiment the seal 330 is a so-called cavity seal, which is manufactured from a flexible and compressible material, such as cellular rubber or silicone. The seal has a first wall 336a settling against the outer side surface 12 of the frame and a second wall 336b settling against the detent surface 16 of the frame. The shape of the sealing surface 332 of the seal is substantially the same as in the doors shown in Figures 1a, 1b and 1c. The first edge of the sealing surface is connected to the second edge of the first wall and the second edge of the sealing surface is connected to the second edge of the second wall. The first and second wall and the sealing surface thus form the outer surface of the seal. Inside the seal there is a cavity 338 in the longitudinal direction of the seal, delimited by the first wall, second wall and sealing surface. The seal is formed to be a ring-like one-piece part, which has the shape and size of the edge surfaces of the frame, the corners and end surfaces of which part are vulcanised to be airtight.

[0038] In this embodiment the sealing surface has two separate flanks, a first flank 332a and a second flank 332b. These flanks are apart from each other but still substantially overlapping in an airtight manner when in an unburdened state. When the edge surface 22 of the door leaf 20 hits it, the sealing surface 332 behaves in the above-described manner, i.e. the sealing surface is shaped according to the edge surface of the door, sealing the gap between the edge surface and the frame. When the edge surface presses against the sealing surface, sliding occurs in the overlapping surfaces of the flanks, so that the total width of the sealing surface grows. Due to the structure of the sealing surface the width of the sealing surface in the direction of the level of the sealing surface can thus grow significantly, without significant tensile stresses being generated in the seal. This embodiment reduces tensile stresses generated in the seal and makes possible the use of a sealing material, the deformation ability, i.e. stretching ability, of which is substantially lower than in the above-described doors.

[0039] Figure 4b shows as an example a sixth advantageous embodiment of a door of a building according to the invention as a cross-sectional view. The embodiment shown in the figure differs from the embodiment shown in Figure 4a in that there is inside the cavity 438 of the seal 430, on the inner surface of the first wall 436a of the cavity, a tongue 440 in the longitudinal direction of the cavity, the free edge of which tongue points toward the first flank 432a of the sealing surface. When the edge surface 22 of the door leaf 20 presses against the sealing surface 432 of the seal 430, the sealing surface is pressed toward the first wall. In the closed position of the door the sealing surface has moved so much that the free edge of the tongue 440 comes into contact with the first flank 432a of the sealing surface. Two substantially airtight cavities are thus generated inside the seal, which improves the thermal insulation ability of the seal.

[0040] Figure 4c shows as an example a seventh advantageous embodiment of a door of a building according to the invention as a cross-sectional view. The embodiment shown in the figure differs from the embodiment shown in Figures 3a, 3b and 3c in that inside the cavity 538 of the seal 530, on the inner surface of the first wall 536a of the cavity, there are two tongues 540 in the longitudinal direction of the cavity, the free edge of which tongues points toward the sealing surface 532. When the edge surface 22 of the door leaf 20 presses against the sealing surface 532 of the seal 530, the sealing surface is pressed toward the first wall 536a. In the closed position of the door the sealing surface has moved so much that the free edges of both tongues 540 come into contact with the cavity side surface of the sealing surface. Three parallel, substantially airtight cavities are thus generated inside the seal, which improves the thermal insulation ability of the seal.

[0041] Also in the embodiments of the invention shown in Figures 4a-4c the first and second edge of the sealing surface remain substantially immovably in place in relation to the frame, especially in relation to the side surfaces of the frame, when the door leaf is opened and closed, even though the edges of the sealing surface do not actually attach to the side surfaces of the frame. The immobility of the edges of the sealing surface is the result of a cross-sectional shape of the seal, where the first wall of the seal supports the first edge of the sealing surface and prevents its substantial movement on the outer side surface of the frame, and the second wall of the seal supports the second edge of the sealing surface and prevents its substantial movement in relation to the inner side surface of the frame.

[0042] The description shown above describes cases,

where the corners of the lock side edge of a door leaf of a door according to the invention have curved outwards. The corners of a door leaf can sometimes also curve inwards. In known outer doors the gap between the face surface of the door leaf and the detent surface of the frame is in a closed door usually 4-6 mm. Thus even a small inwards curving of the corners of the door leaf significantly impedes the closing of the door. In the door according to the invention the gap between the edge of the face surface of the door leaf and the detent surface of the frame can in a closed door be as much as 9-11 mm. The door according to the invention thus also makes possible a clearly larger inwards curving of the corners of the door leaf than in known doors.

[0043] Some advantageous embodiments of the door according to the invention have been described above. The invention is not limited to the solutions described above, but the inventive idea can be applied in different ways within the scope of the claims.

Claims

1. A door of a building, which door comprises a frame (10), which has an outer side surface (12) and an inner side surface (14), which outer and inner side surface are at different levels, a door leaf (20) attached with hinges to the frame, which door leaf has an edge surface (22), and a seal (30, 130, 230, 330, 430, 530) attached to the frame, which seal has a sealing surface (32, 132, 232, 332, 432, 532) settling against the edge surface of a closed door leaf, which sealing surface has a first edge, which is substantially at the same level as the outer side surface of the frame, and a second edge, which is substantially at the same level as the inner side surface of the frame, **characterised in that** said first edge and second edge are arranged to remain substantially unmoving in relation to the side surfaces of the frame when the door is opened and closed.

2. The door according to claim 1, **characterised in that** the distance between the first edge and second edge of the sealing surface (32, 132, 232, 332, 432, 532) in the direction of the level of the outer side surface (12) is at least twice, advantageously at least 2.5 times, most advantageously at least three times as large as the distance between the first edge and second edge of the sealing surface in the direction of the normal of the outer side surface.

3. The door according to claim 1 or 2, **characterised in that** the seal (30) is a flexible band-like part, which is attached by the first edge of the sealing surface (32) to the outer side surface (12) of the frame (10) and by the second edge to the inner side surface (14) of the frame, so that a substantially closed edge cavity (42) remains between the sealing surface and the frame surface.

4. The door according to claim 3, **characterised in that** the first edge of the sealing surface (32) has a first attaching edge (34a), which is fitted into a first attaching groove (18a) in the outer side surface (12) of the frame (10), and the second edge of the sealing surface (32) as a second attaching edge (34b), which is fitted into a second attaching groove (18b) in the inner side surface (14) of the frame.

5. The door according to claim 1 or 2, **characterised in that** the frame (10) has a detent surface (16) connecting the outer side surface (12) and the inner side surface (14), and the seal (130, 230, 330, 430, 530) has a first wall (136a, 236a, 336a, 436a, 536a) settling against the outer side surface (12) and a second wall (136b, 236b, 336b, 436b, 536b) settling against the detent surface (16) of the frame.

6. The door according to claim 5, **characterised in that** the seal (130) is a flexible and compressible, substantially solid seal.

7. The door according to claim 5, **characterised in that** the seal (230, 330, 430, 530) is a so-called cavity seal, which has a cavity (238, 338, 438, 538) in the longitudinal direction of the seal, delimited by the sealing surface (232, 332, 432, 532), the first wall (236a, 336a, 436a, 536a) and the second wall (236b, 336b, 436b, 536b).

8. The door according to claim 7, **characterised in that** the sealing surface (332, 432) has a first flank (332a, 432a) and a second flank (332b, 432b), which first and second flank are apart from each other and the edges of which first and second flank overlap with each other in a substantially airtight manner.

9. The door according to claim 7 or 8, **characterised in that** the first wall (436a, 536a) of the seal (430, 530) has at least one tongue (440, 540) in the longitudinal direction of the seal and directed into the cavity (438, 538), which tongue is arranged to press against the cavity side surface of the sealing surface (432, 532) and to divide the cavity into at least two partial cavities when the edge surface (22) of a door leaf (20) is pressed against the sealing surface.

10. The door according to any of the claims 5-9, **characterised in that** the first wall (136a, 236a, 336a, 436a, 536a) of the seal (130, 230, 330, 430, 530) has an attaching edge (134, 234, 334, 434), which is fitted into an attaching groove (18) in the outer side surface (12) of the frame.

11. The door according to any of the claims 1-10, **characterised in that** the frame (10) has drillings (50)

for installing attaching screws, which drillings are in the frame in the area covered by the seal (30, 130, 230, 330, 430, 530).

12. The door according to claim 11, **characterised in that** the drillings (50) are in the frame (10) in the area covered by the part of the seal between the first edge of the sealing surface (132, 232, 332, 432, 532) of the seal (130, 230, 330, 430, 530) and the attaching edge (34, 134, 234) in the first wall (136a, 236a, 336a, 436a, 536a) of the seal.

13. The door according to any of the claims 1-12, **characterised in that** it has a frame (10) surrounding the door leaf (20) and a ring-like seal (230, 330, 430, 530) shaped like the frame, inside which seal there is an airtight cavity (238, 338, 438, 538).

14. The door according to any of the claims 1-13, **characterised in that** the door leaf (20) has a face surface (24) and the part of the edge surface (22) of the door leaf settling against the sealing surface (32, 132, 232, 332, 432, 532) is bevelled and/or the corner between the edge surface and the face surface is rounded.

15. The door according to any of the claims 1-14, **characterised in that** it is an outer door of a building.

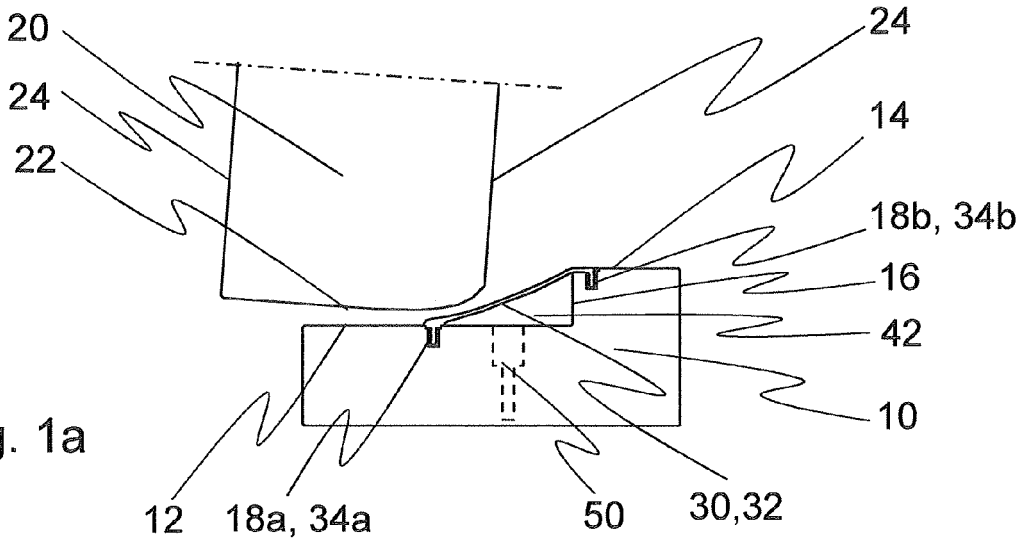

Fig. 1a

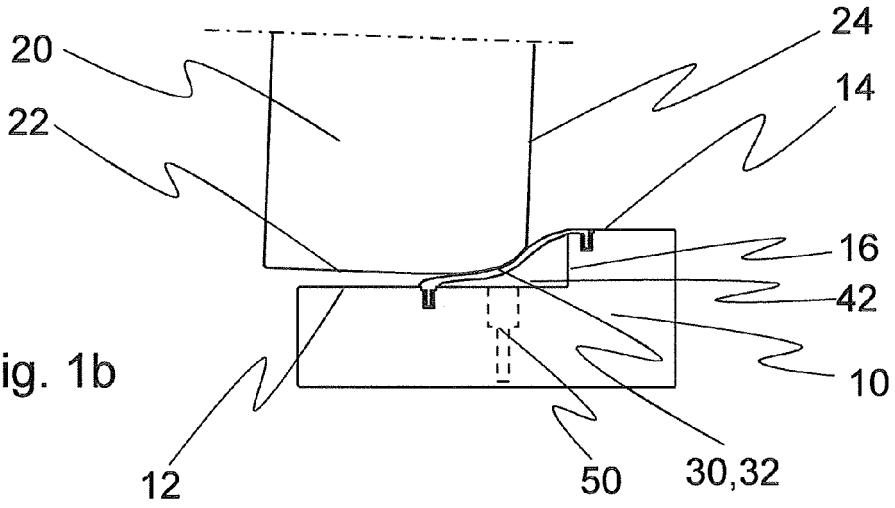

Fig. 1b

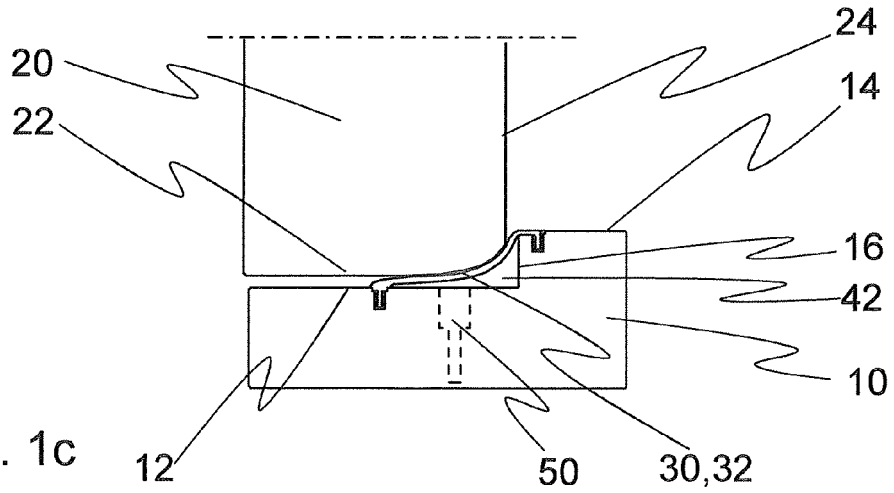

Fig. 1c

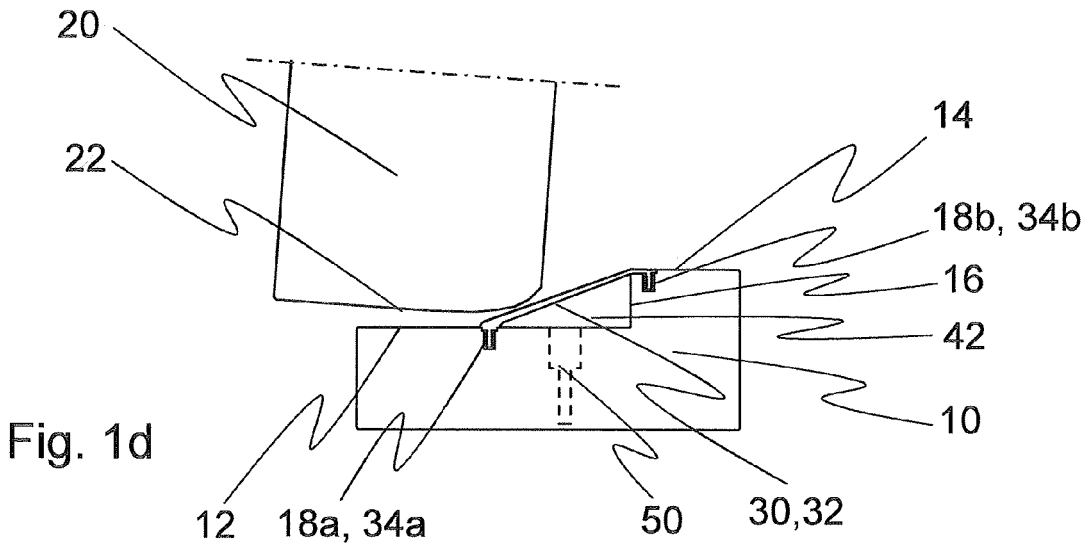
20
22
14
18b, 34b
16
42
10
12
18a, 34a
50
30,32

Fig. 1d

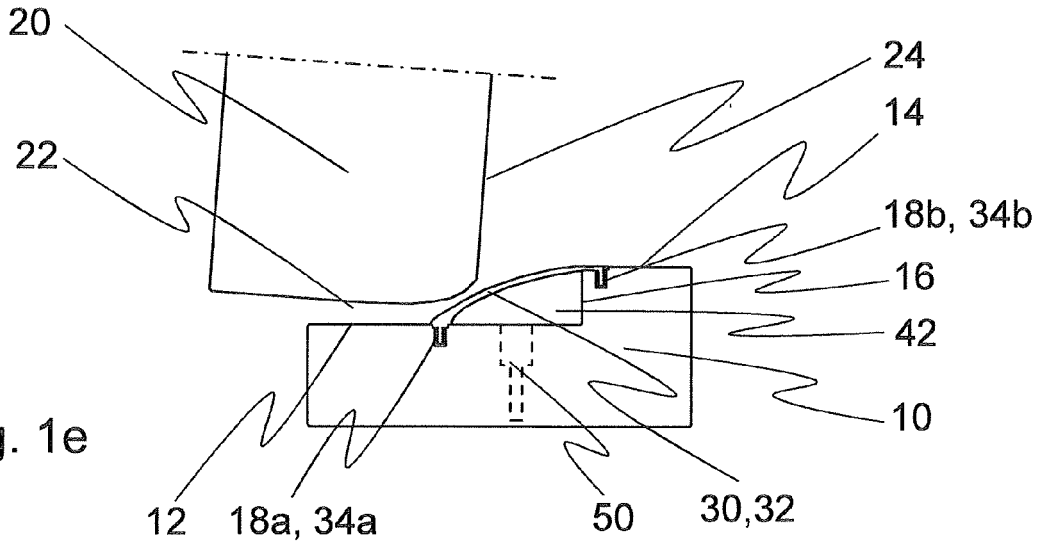
20
22
24
14
18b, 34b
16
42
10
12
18a, 34a
50
30,32

Fig. 1e

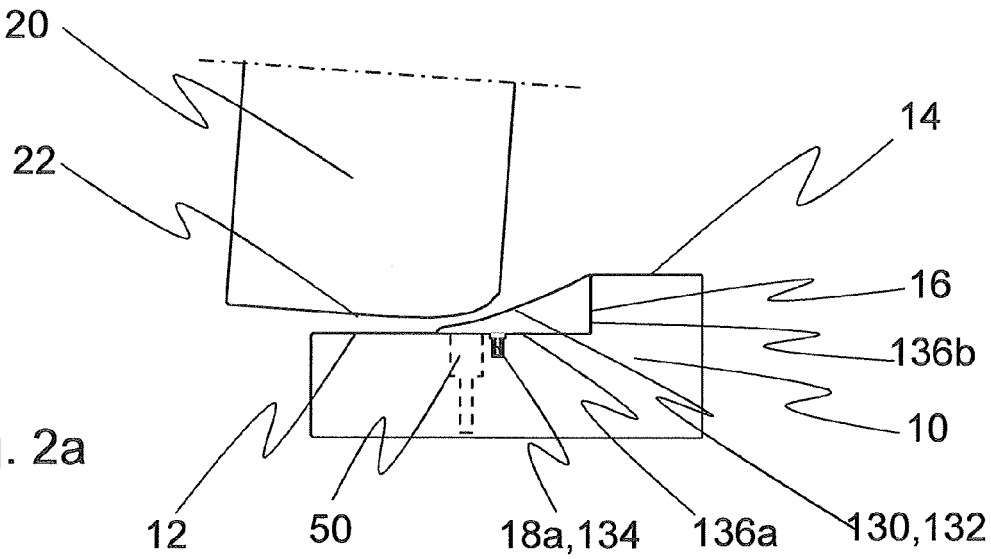

Fig. 2a

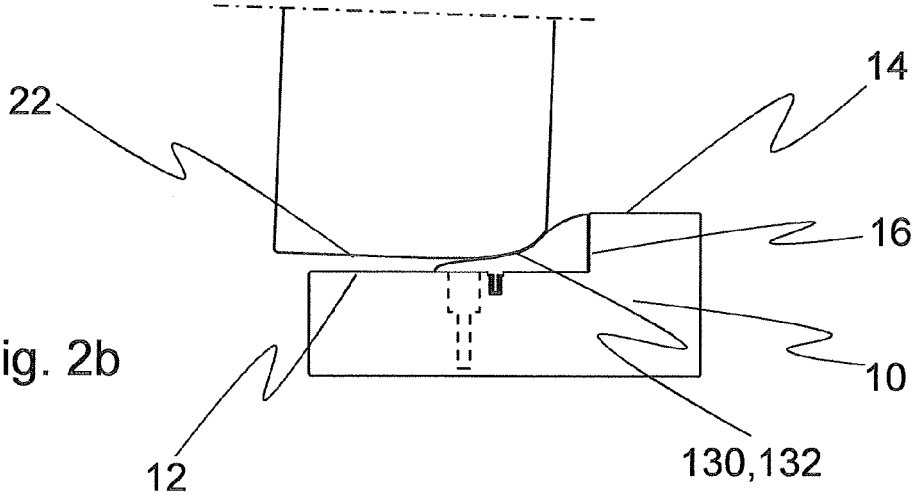

Fig. 2b

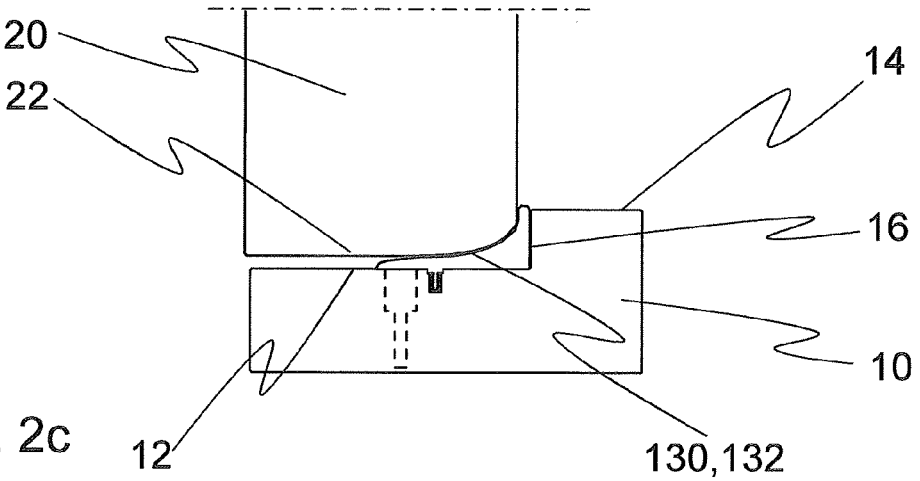

Fig. 2c

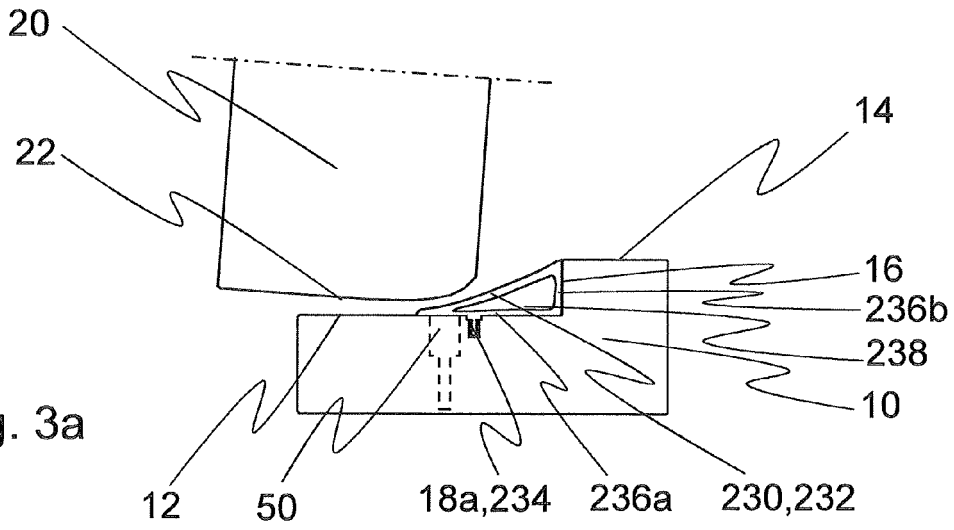

Fig. 3a

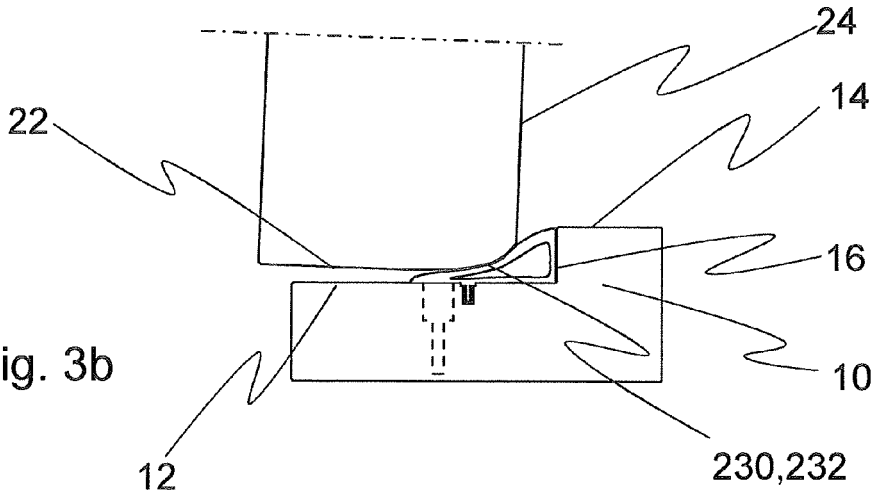

Fig. 3b

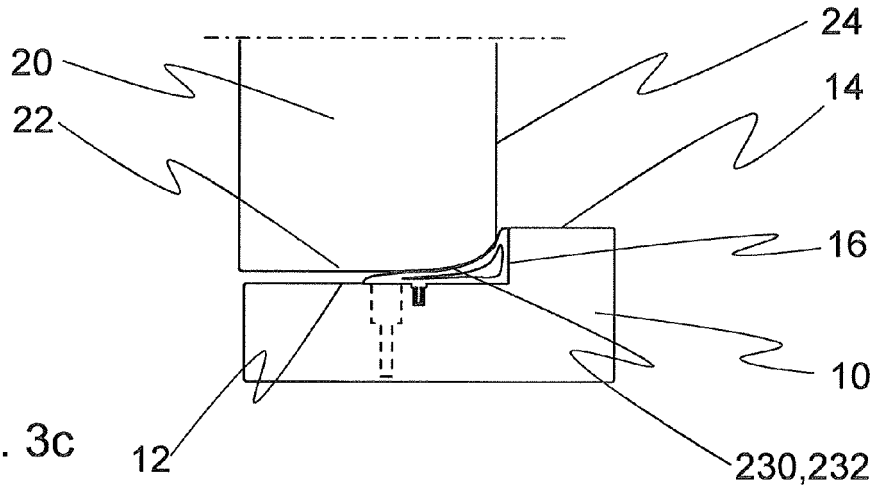

Fig. 3c

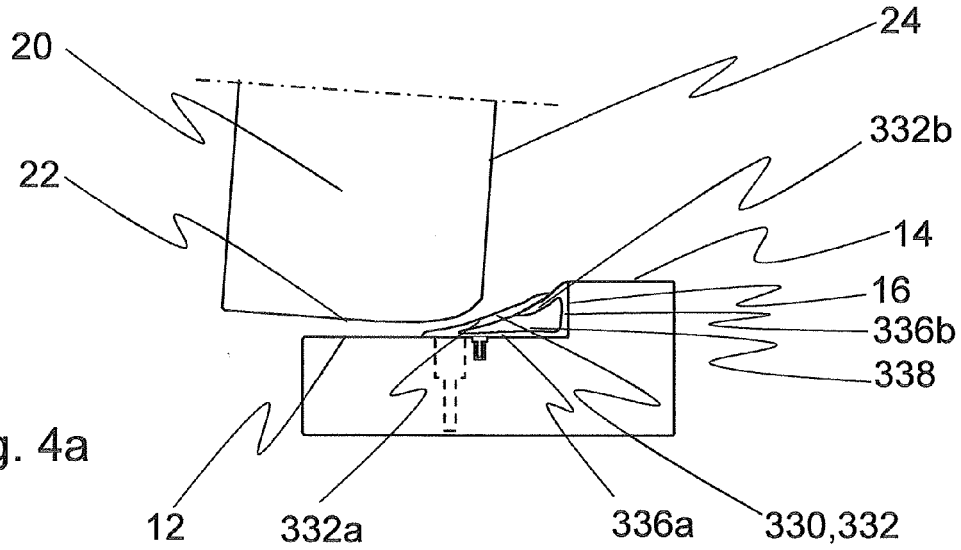

Fig. 4a

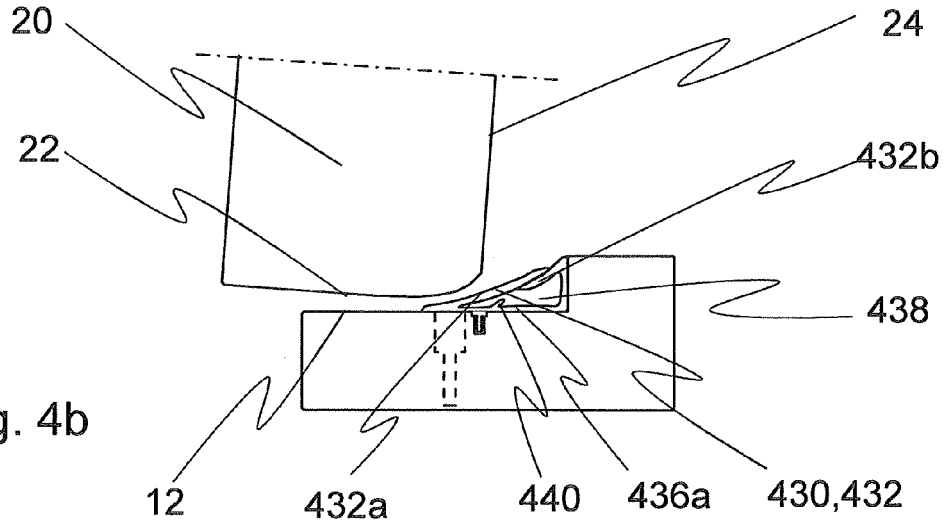

Fig. 4b

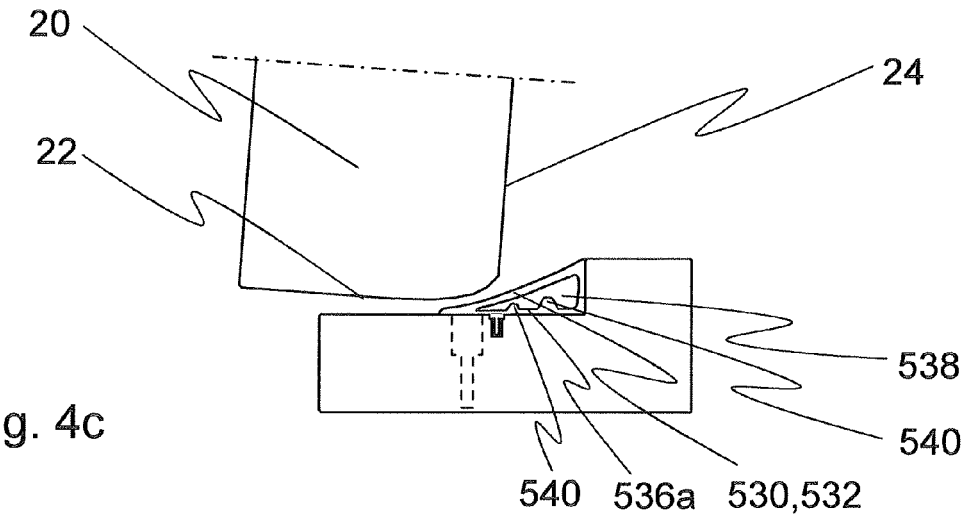

Fig. 4c

REFERENCES CITED IN THE DESCRIPTION

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- DE 2608499 A1 **[0004]**
- DE N068098 A1 **[0004]**