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(54) Lock mechanism for a window

(57) A locking mechanism includes: a rack member (10), for attachment to a window frame (1), which has an engagement surface (14) including a number of parallel ribs (12) extending along the surface in a first direction and a lock member (50), for attachment to a window sash (2), including an engagement surface (51) having a number of corresponding ribs (52) adapted to engage with at least some of the ribs (12) on said first engagement surface (14). The mechanism includes means (30,80) for maintaining said engagement surfaces (14,51) of said rack member (10) and lock member (50) in overlying relationship and means (15,70) for disengaging said rack member (10) and said lock member (50) by providing relative movement of said rack member and lock member in a direction substantially parallel to said ribs until said first (12) and second (52) plurality of ribs disengage, so as to open and close the window.

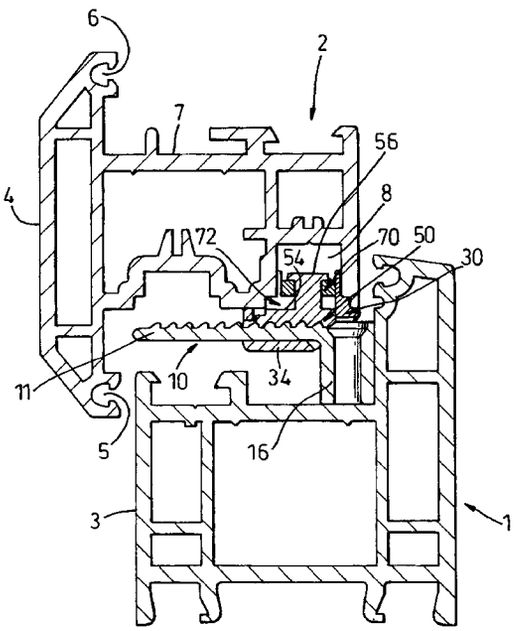

Fig. 1

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Description

[0001] The present invention relates to locking mechanisms for releasably locking two components together, which components are normally in sliding relationship to one another at the time of engagement or disengagement. In particular, though not exclusively so, the invention relates to window and door locking mechanisms.

[0002] In modern window and door manufacture, it is desirable to provide opening windows or doors with locking or latching mechanisms which provide for secure complete closure with high resistance to forced entry, and preferably also to provide for secure partial closure or latching of the window or door in, for example, a so-called "ventilation" position. Partial closure mechanisms are generally particularly vulnerable to attempted forced entry.

[0003] It is also desirable to provide such locking or latching mechanisms such that they can be integrated with a multi-point locking system as commonly found in modern PVC window and door styles, where multiple locking mechanisms around the window sash are connected to actuator drive rods driven by a single actuator handle.

[0004] It is an object of the present invention to provide an improved locking and latching mechanism which gives a high degree of security in both a fully closed and multiple "ventilation" positions, and which can be readily adapted to integrate with multi-point locking mechanisms.

[0005] It is a further object of the present invention to provide an improved locking mechanism which can be easily installed in window sashes incorporating industry standard (eg. "Euro-groove") sash profiles for full compatibility and inter-operability with other actuating mechanisms and window furniture.

[0006] The present invention is applicable to various types of windows and doors, including casement types and tilt-and-turn types.

[0007] According to one aspect, the present invention provides a locking mechanism comprising:

a rack member, for attachment to a first component, the rack member having an engagement surface including a first plurality of substantially parallel ribs extending along the surface in a first direction;
a lock member, for attachment to a second component which is to be releasably secured to the first component by said locking mechanism, the lock member including an engagement surface having a second plurality of substantially parallel ribs adapted to engage with at least some of the first plurality of ribs on said first engagement surface;
means for maintaining said engagement surfaces of said rack member and lock member in overlying relationship to lock together said first and second components; and
means for disengaging said rack member and said lock member by providing relative movement of said rack member and lock member in a direction substantially parallel to said ribs until said first and second plurality of ribs disengage, so as to disengage said first and second components.

[0008] According to a further aspect, the present invention provides a lock component comprising a strip having a leading edge and a trailing edge, a first face of the strip including an engagement surface defined by a plurality of ribs thereon extending transverse to a closure axis of said strip extending between said leading and trailing edges, and a disengagement surface laterally adjacent said engagement surface with respect to said closure axis, the disengagement surface being relatively smooth in a direction parallel to said closure axis.

[0009] Embodiments of the present invention will now be described by way of example and with reference to the accompanying drawings in which:

Figure 1 shows a cross-sectional view through a window sash, window frame and locking device according to the present invention;
Figure 2 shows a rack member according to the invention, in which: figure 2a shows a front perspective view, figure 2b shows a rear perspective view, figure 2c shows a front view, figure 2d shows a rear view, figure 2e shows an end elevation, and figure 2f shows a cross-sectional view on line A-A of figure 2c;
Figure 3 shows detail of the rack member of figure 2 including: tooth orientation in front view (figure 3a), and tooth profile in side view (figures 3b and 3c);
Figure 4 shows a housing member according to the present invention, in which: figure 4a shows a front view, figure 4b shows a cross-sectional view on line B-B of figure 4a, figure 4c shows a receiving end view, and figure 4d shows an opposite end view to figure 4c;
Figure 5 shows a lock member according to the present invention in which: figure 5a shows a front view, figure 5b shows a side view and figure 5c shows a rear view;
Figure 6 shows a leaf spring for use with the lock member of figure 5, in which figure 6 is a front view; figure 6b is a side view; figure 6c is a perspective view and figure 6d is an end view; and
Figure 7 shows the same cross-sectional view of figure 1, but with the window sash and frame in varying positions in relation to one another corresponding to

(a) window open with lock mechanism disengaged,
(b) window in ventilation position with lock mechanism engaged, and
(c) window fully closed.

[0010] Referring now to figure 1, there is shown a presently preferred embodiment of a lock assembly according to the invention, installed as a window lock.

[0011] A window frame 1, of a standard profile adapted to receive various items of window furniture and typically manufactured of PVC, may correspond to the top, bottom or either side of the window, dependent upon hinging arrangements. A window sash 2, also of a standard profile adapted to receive various items of window furniture, is shown in closed position adjacent to the window frame.

[0012] In an outward opening window, surface 3 corresponds to the outside of the window frame, and surface 4 corresponds to the outside of the window sash, with channel 5 carrying a rubber seal (not shown) for compressing against outer surface 3 of the frame profile to form a weather-tight seal, and channel 6 carrying a rubber seal (not shown) for compressing against a glazing unit (not shown) installed against inner wall 7.

[0013] The locking mechanism comprises a rack member 10, a lock housing member 30 and a lock member 50 which are shown in more detail in figures 2, 4 and 5 respectively.

[0014] With reference to figures 1 and 2, the rack member comprises a strip 11 which includes, on a front surface thereof, a plurality of parallel ribs 12 which extend across a part of the front surface hereinafter referred to as the engagement surface 14. The remainder of the front surface is relatively smooth and provides what is hereinafter referred to as the disengagement surface 15.

[0015] The strip 11 is supported adjacent the window frame profile 1 by a support post 16 which, as best viewed in figure 2f, extends upwards from a fixing plate 17 to a proximal end of the strip 11. The support post 16 is affixed to the window frame 1 using known techniques. Throughout the present specification, the free end (distal end) 18 of the strip 11 will be referred to as the leading end, and the end 19 proximal to the support post will be referred to as the trailing end.

[0016] The ribs 12 comprise a series of teeth 20, best viewed in figure 3, which teeth have a leading edge profile 21 which is preferably moderately inclined with respect to the plane of the engagement surface 14. In a preferred embodiment, the angle between the plane of the engagement surface 14 and the tooth leading edge 21 is approximately 40°. The teeth 20 preferably have a trailing edge profile 22 which is perpendicular or near perpendicular to the plane of the engagement surface 14. In a preferred embodiment, particularly as shown in figure 3c, the trailing edge profile is re-entrant. In other words, the top corner of the tooth 20 overhangs an edge of the base of the tooth, and preferably the angle between the trailing edge profile 22 and the plane of the engagement surface 14 is approximately 94°, ie. 4° from orthogonal.

[0017] It will be understood that the trailing edge profile may include a re-entrant profile only over a part of the height of the tooth.

[0018] Preferably, the teeth 20 have rounded corners as exhibited in figure 3c, tooth 20a, rather than angular corners as exhibited in figure 3c, tooth 20b.

[0019] The teeth 20 each have a longitudinal axis which is transverse to the axis of the strip (ie. the strip axis which extends between the leading end 18 and the trailing end 19). In a preferred embodiment as shown in figure 3a, the teeth axes are slightly off-perpendicular to the strip axis, preferably approximately 6° off perpendicular.

[0020] Preferably, the strip 11 is formed from a resilient plastics material, such as Nylon 6,6, with or without glass or spring steel reinforcement, or from Kevlar™. Many alternative materials may be used, such as spring steel, stainless steel or high strength zinc alloy.

[0021] Referring now to figures 1 and 4, the lock housing member 30 will be described in detail. The housing 30 comprises a framework 31 in which the strip 11 is received through aperture 32 and in which the lock member is received in aperture 33. The framework 31 provides an arm 34 which restrains the reverse face 23 of the strip when it is engaged in the housing. The leading edge 35 of the restraining arm 34 (ie. the edge facing the direction of insertion of the leading edge 18 of the strip 11, indicated by arrow A) is preferably bevelled to guide the strip into the housing, allowing for any slight misalignment thereof.

[0022] The housing 30 is secured to the window sash 2 by suitable bolts or screws (not shown) through fixing holes 36 at the top and bottom of the housing. Preferably, the housing 30 partly resides in an industry standard sized groove 8 (figure 1) in the sash frame, which also carries an actuator drive rod mechanism to be described hereinafter.

[0023] Preferably, the housing 30 is formed from an appropriate material such as high strength zinc alloy, stainless steel, GRP or Kevlar™.

[0024] Referring now to figures 1 and 5, the lock member 50 will now be described in detail. Lock member 50 comprises a plate 54 whose front surface defines an engagement surface 51 which includes a plurality of parallel ribs 52 extending across the front surface in similar manner to that described in relation to strip 11. The ribs comprise a series of teeth 60 of corresponding pitch to those of the strip 11. Preferably, therefore, the teeth 60 have a leading edge profile 61 which is preferably moderately inclined with respect to the plane of the engagement surface 51. In a preferred embodiment, the angle between the plane of the engagement surface 51 and the tooth leading edge 61 is approximately 40°. The teeth 60 preferably have a trailing edge profile 62 which is perpendicular or near perpendicular to the plane of the engagement surface 51. In a preferred embodiment, the trailing edge profile is re-entrant. In other words, the top corner of the tooth overhangs the edge of the base of the tooth, and preferably the angle between the trailing edge profile 62 and the plane of the engagement

surface 51 is approximately 94°, ie. 4° from orthogonal.

[0025] The teeth 60 each have a longitudinal axis which is transverse to the axis of the lock member 50 (ie. the lock member axis which extends between a leading end 64 and a trailing end 65, in which the leading end is the first end to meet the strip 11 when closing the window sash 2). In a preferred embodiment, the teeth 60 axes are slightly off-perpendicular to the lock member axis, and preferably approximately 6° off-perpendicular as particularly shown in figure 5.

[0026] Preferably, the lock member 50 is formed from a high strength zinc alloy, stainless steel, GRP or Kevlar™.

[0027] The lock member 50 further includes a shaft 55 extending from the rear face of the plate 54 defining the engagement surface 51. Shaft 55 is adapted to pass through a hole in an actuator drive rod 70 (seen in cross-section in figure 1), being retained therein by suitable means such as swaging the shaft 55 over the drive rod 70, or providing a nut 56 at the end of the shaft 55. The actuator drive rod 70 extends longitudinally along the channel or groove 8 in the sash 2, according to well known mechanisms.

[0028] The width w_l (figure 5a) of the lock member 50 is preferably approximately equal to, or slightly less than, half the width w_s (figure 3a) of the strip 11, and the width w_e of the engagement surface 14 of the strip is preferably approximately equal to the width w_l. The width w_l of the lock member is preferably also approximately equal to the width w_d of the disengagement surface 15 of the strip 11.

[0029] The lock member 50 is able to slide, within the lock-receiving aperture 33 of the housing 30, under the control of the actuator drive rod 70, so that it opposes and makes contact with either the engagement surface 14 of the strip 11, or the disengagement surface 15 of the strip, or a part of both. In figure 1, this movement will be understood to be into and out of the plane of the drawing.

[0030] In the preferred embodiment illustrated in figure 1, a small gap 72 is preferably provided between the rear face of the plate 54 and the actuator drive rod 70 to allow the lock member 50 a degree of freedom in a direction parallel to the axis of the shaft 56, ie. orthogonal to the plane of the engagement surfaces 51 and 14. Into this gap 72 is installed a leaf spring 80 as shown in figure 6. This leaf spring urges the engagement surface 51 of the lock member 50 into locking engagement with the engagement surface 14 of the strip 11, but enables the lock member 50 to ride up and over the inclined leading edges 21 of the teeth 20 when the lock member is sliding over the strip in one direction only.

[0031] With reference now to figures 1 and 7, the operation of the locking mechanism will now be described.

[0032] In an open condition of the window sash (as shown in figure 7a), the sash 2 and the window frame 1 and corresponding parts of the locking mechanism (ie. rack and lock members) are separated.

[0033] As the window is closed, the sash 2 is brought into position along side window frame 1, at which point the leading end 18 of the rack member 10 enters the aperture 32 of housing 30.

[0034] There are two modes of operation in the embodiment described above. The first of these is an "autolocking" mode, in which the engagement surface 51 of the lock member 50 is already in line with the engagement surface 14 of the strip 11 during the closing operation. The second mode is a manual locking mode where the engagement surface 51 of the lock member 50 is not in line with the engagement surface 14, but fully in line with the disengagement surface 15 of the strip 11 during the closing operation.

[0035] In the first mode, the leading edge of the first tooth 20 of the leading end 18 of the strip 11 collides with the lock member 50 which is biassed toward the restraining arm 34. However, the leading edge profile 21 of each tooth 20 forces the lock member to recede into the groove 8 against the bias of the leaf spring 80 in a ratchet-and-pawl type action, allowing strip 11 to pass through the housing 30, but only in the closing direction. The trailing edge profile 22 of the teeth 20 prevents reversal of this closing action. It will be understood that the closing action can be halted at any desired point, at which the window will be secured in a partly open, "ventilation" position (figure 7b). The fully closed position is shown in figure 7c and figure 1.

[0036] In the second mode, the window sash 2 is brought into the closure position while the lock member 50 is displaced along the channel 8 by the actuator drive rod 70, so that engagement surface 51 of the lock member 50 is in line with the disengagement surface 15 of the strip. In this case, the sash 2 can move freely in the opening and closing directions as the teeth 60 of the lock member pass easily over the disengagement surface 15 of the strip in either direction.

[0037] In the second mode, to secure the window in a fully closed or partially closed (ventilation) position (figures 7b and 7c), the actuator drive rod is used to drive the lock member longitudinally within the channel 8 (ie. into or out of the plane of the drawing), in the housing 30, until the parallel sets of teeth 20 and 60 interlock with one another. In the preferred embodiment, in which the ribs 12 are pitched at, for example, 6° to the axis perpendicular to the closure direction "A" (figure 4), as the actuator drive rod 70 moves the lock member 50 to its engaged position, a further slight displacement of the sash frame occurs in the closure direction caused by the pitched ribs, thereby tightening the closure of the window. In the fully closed position, this serves to compress the seal in channel 5 (figure 1).

[0038] To re-open the window, the actuator drive rod 70 is deployed in the reverse direction to drive the lock member 50 so that it slides across the strip 11, off the engagement surface 14 and onto the disengagement surface 15. The window sash 2 is then free to open and close.

[0039] It will be understood that in the second mode of operation, the leaf spring 74 and gap 72 could, in fact, be omitted from the mechanism (making allowances for any required clearances), as a ratchet-and-pawl type closure operation is not required.

[0040] In this case, the inclined leading edge profile 21 of the teeth 20 is also not required. The teeth can then have any suitable profile.

[0041] The locking mechanism as described above can readily be used in any orientation around a window casement, and is ideally suited for multipoint locking with each lock member 50 being driven by a common actuating mechanism linked through the actuator drive rod or a series of actuator drive rods linked around the window sash.

[0042] The mechanism is highly resistant to being forced or jemmied. Any attempt to bend the strip 11 toward the window frame 1 to attempt to disengage corresponding teeth 20, 60 is prevented in the preferred embodiment by the restraining arm 34 and by the action of the re-entrant trailing edge tooth profiles 22,62 which provide a further clamping force. Any attempt to distort the sash 2 to move the lock member 50 so as to prise it away from the strip 11 is defeated because the restraining arm 34 will pull the resilient strip 11 in the same direction as the distortion of the sash 2, preventing the teeth 20, 60 from disengaging. Only movement substantially parallel to the ribs, in the correct direction of the actuator drive rod 70, will allow the teeth 20, 60 to disengage.

[0043] The length of the ribs, ie. approximately the width w_l and w_s can be made as long as required for a given degree of security. Slightly re-entrant teeth 20, 60 are preferred so that any attempt to force the window open merely results in tighter engagement of the engaged teeth. High locking strength is assured by a large total surface area of engaged teeth, ie. the cumulative trailing edges of all engaged teeth.

[0044] It will be understood that the locking mechanism described above is readily adaptable to lock together any first component bearing the rack member 10 and any second component bearing the lock member 50 and housing 30.

[0045] The window sash and frame could be reversed with respect to the members attached thereto. The first and second components need not be window and door components. The principle can be applied to, *inter alia,* reusable cable ties, luggage straps, child safety locks for cupboards, bicycle locks, car steering wheel locks, padlocks, other lock out devices, and reusable label tabs.

[0046] It will also be understood that features of the rack member and lock member are interchangeable in the sense that the disengagement surface 15 could be provided on the lock member 50 rather than on the rack member 10.

[0047] It will also be understood that multiple parallel engagement surfaces 14 separated by one or more disengagement surfaces 15 on the rack member 10 (with corresponding surfaces on the lock member 50) could be provided as alternating rows, each having a width w_e and each adapted to engage with an appropriate portion of the lock member 50.

[0048] The strip 11 could also be surface mounted onto the window frame 1 or other component, in which case the lock housing member 30 does not require the restraining arm 34 providing aperture 32.

[0049] The locking mechanism herein described is highly resistant to being forced, as most forces which can be applied will generate opposing forces thereto. The operating forces required for normal opening and closing are, however, very low. The number of ventilation positions available is high, owing to the small pitch (spacing) of the teeth 20 and their extent is simply determined by the length of rack member 10. The ratchet-and-pawl facility (optional) allows a partially opened window to be closed regardless of whether the operator possesses a key to the actuator drive mechanism, thereby offering greater security. All parts can be readily fabricated from a wide variety of corrosion resistant materials and the design allows for quick and easy assembly and full compatibility with known industry standard window sash and frame profiles.

Claims

1. A locking mechanism comprising:

a rack member (10), for attachment to a first component (1), the rack member having an engagement surface (14) including a first plurality of substantially parallel ribs (12) extending along the surface in a first direction;

a lock member (50), for attachment to a second component (2) which is to be releasably secured to the first component by said locking mechanism, the lock member including an engagement surface (51) having a second plurality of substantially parallel ribs (52) adapted to engage with at least some of the first plurality of ribs on said first engagement surface;

means (30,80) for maintaining said engagement surfaces (14,51) of said rack member (10) and lock member (50) in overlying relationship to lock together said first and second components; and

means (15,70) for disengaging said rack member and said lock member by providing relative movement of said rack member and lock member in a direction substantially parallel to said ribs until said first and second plurality of ribs (12,52) disengage, so as to disengage said first and second components.

2. A locking mechanism according to claim 1 wherein

said first and second components (1,2) are adapted to separate and come together along a closure axis transverse to said first direction.

3. A locking mechanism according to claim 2 wherein said closure axis is substantially orthogonal to said first direction.

4. A locking mechanism according to claim 1 wherein said rack member (10) or said lock member (50) includes a disengagement surface (15), substantially co-planar with said engagement surface (14), which allows smooth travel of said corresponding lock or rack member thereover, the boundary between said engagement and disengagement surfaces being parallel to a closure axis of the first and second components, the plurality of ribs (12,52) being transverse to said closure axis.

5. A locking mechanism according to claim 4 in which each of the plurality of ribs is at an angle of between 90 and 75° to the closure axis.

6. A locking mechanism according to claim 5 in which each of the plurality of ribs is at an angle of approximately 84° to the closure axis.

7. A locking mechanism according to 1 in which said rack member (10) comprises a strip (11) having a front face bearing said engagement and disengagement surfaces (14,15), and a support portion (16) at one end thereof for mounting onto a surface of said first component (1) so as to hold the strip spaced apart from the surface of said first component.

8. A locking mechanism according to claim 1 in which each of said ribs (12,52) comprises an elongate tooth (20,60) having an inclined profile on a leading edge (21,61) and a near perpendicular profile on the trailing edge (22,62).

9. A locking mechanism according to claim 8 in which each of the ribs has a slightly re-entrant profile for said trailing edge.

10. A locking mechanism according to any preceding claim in which said rack member (10) is formed from resilient plastics or composite material combined with a sprung steel reinforcement.

11. A locking mechanism according to any one of claims 7 to 10 further including a housing (30) for attachment to said second component (2), said housing defining an elongate aperture (32) adapted to receive the cross-sectional profile of said strip and provide a restraining arm (34) for a reverse face of said strip when said rack member and said lock member are in engaged positions.

12. A locking mechanism according to any preceding claim in which said lock member (50) includes a shaft (55), extending from a reverse face to said engagement surface, adapted to engage with an actuator drive rod (70) for driving said lock member in a direction substantially parallel to the ribs (52) thereon.

13. A locking mechanism according to claim 12 further including bias means (80) for resiliently biasing said lock member towards said rack member.

14. A locking mechanism according to claim 12 when dependent from claim 11 in which said lock member (50) resides in said housing (30), further including bias means (80) for resiliently biasing said lock member toward said restraining arm (34) and allowing said strip (11) to pass therebetween.

15. A lock component (10) comprising a strip (11) having a leading edge (18) and a trailing edge (19), a first face of the strip including an engagement surface (14) defined by a plurality of ribs (12) thereon extending transverse to a closure axis of said strip extending between said leading and trailing edges, and a disengagement surface (15) laterally adjacent said engagement surface with respect to said closure axis, the disengagement surface being relatively smooth in a direction parallel to said closure axis.

16. A lock component according to claim 15 further including a support portion (16) at the trailing end (19) of said strip (11) for affixing said lock component (10) to a substrate surface such that the strip is held spaced apart from said substrate surface.

17. A lock component according to claim 15 in which each of the plurality of ribs (12) is at an angle of between 90 and 75° to the closure axis.

18. A lock component according to claim 17 in which each of the plurality of ribs (12) is at an angle of approximately 84° to said closure axis.

19. A lock component according to claim 15 in which each of the ribs (12) comprises an elongate tooth (20) having an inclined profile on a leading edge (21) and a near perpendicular profile on the trailing edge (22).

20. A lock component according to claim 19 in which each rib (12) has a slightly re-entrant profile for said trailing edge.

21. A lock component according to any one of claims

15 to 20 in which said component (10) is formed from resilient plastics or composite material combined with a spring steel reinforcement.

22. A multipoint locking device for a window comprising at least one locking mechanism according to claim 1 in which said means for disengaging said rack member and said lock member comprises an actuator drive rod (70) adapted to displace each said lock member or each said rack member in a direction substantially parallel to said ribs thereon.

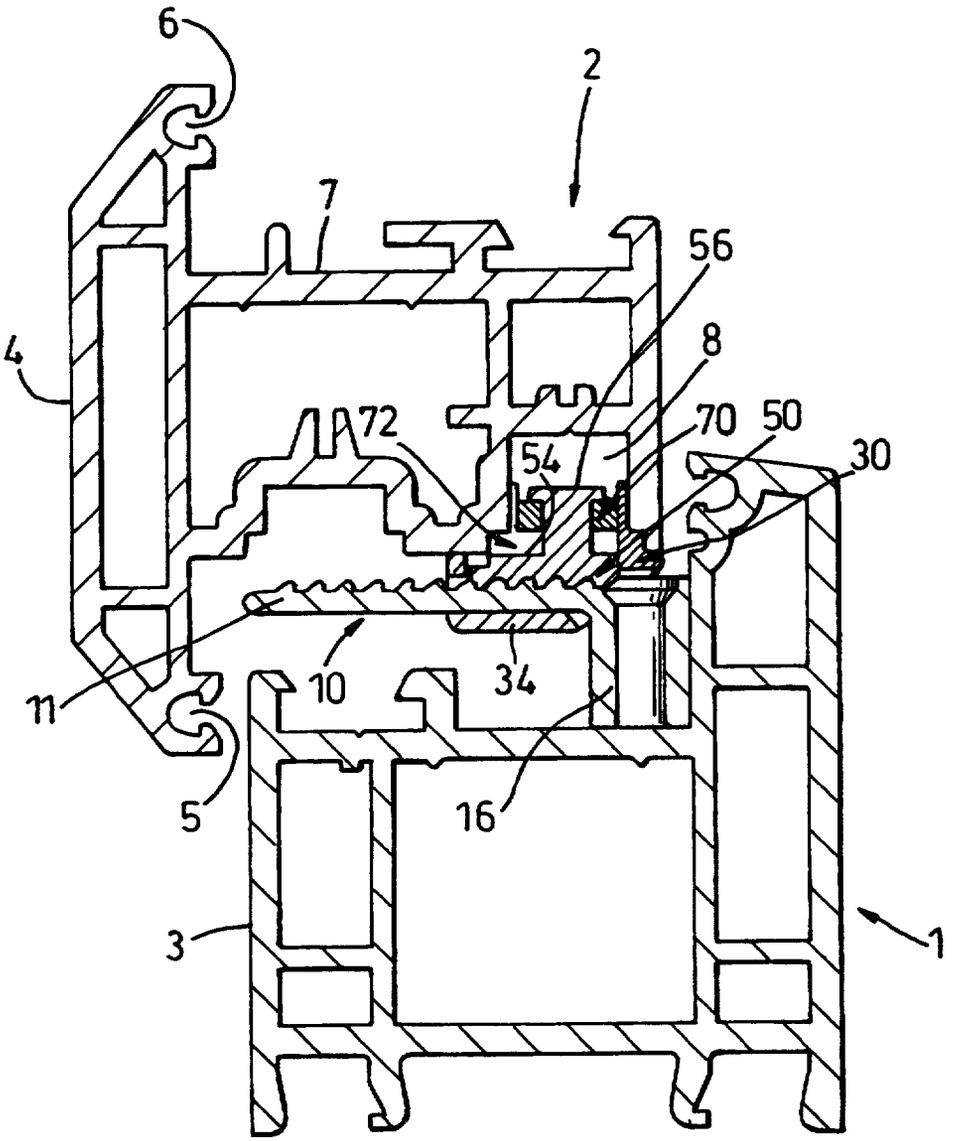

Fig. 1

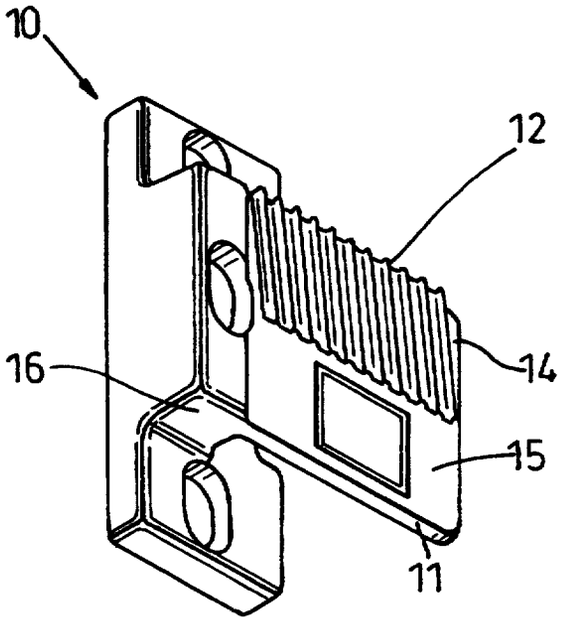

Fig. 2a

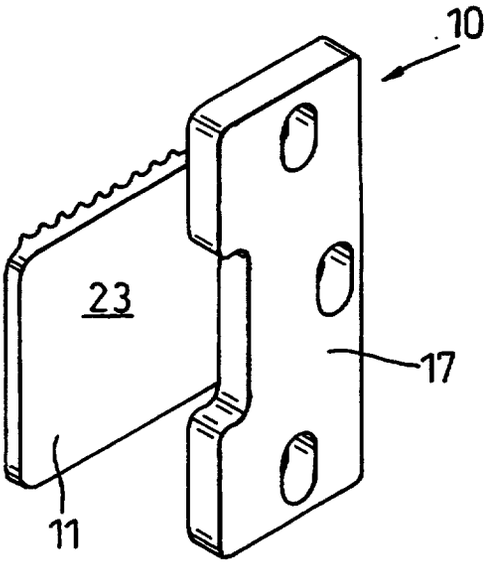

Fig. 2b

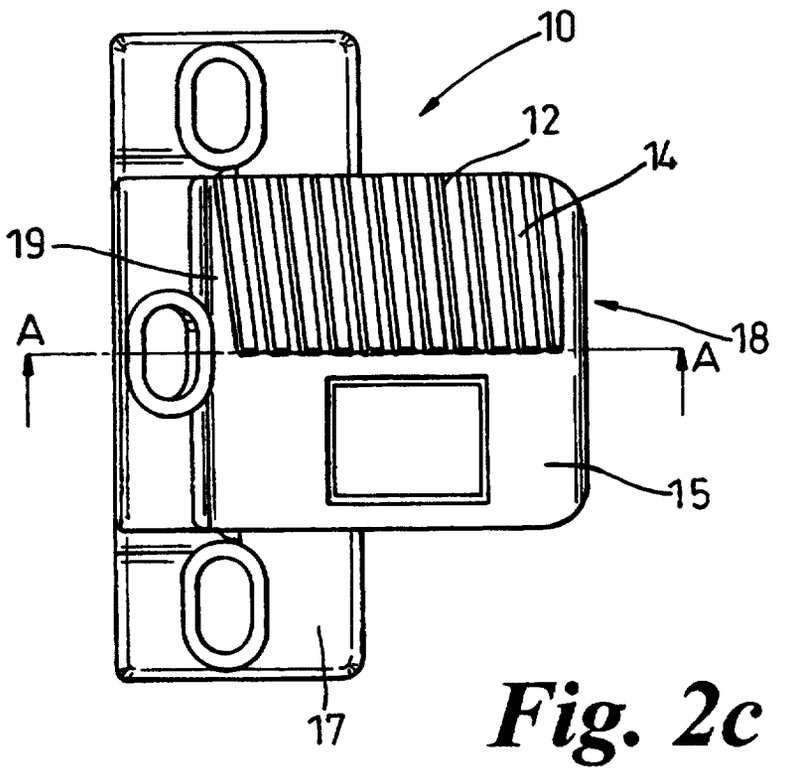

Fig. 2c

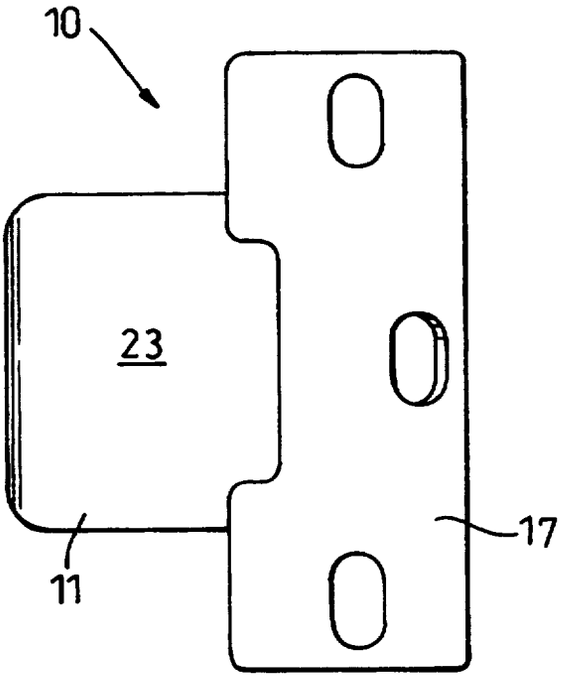

Fig. 2d

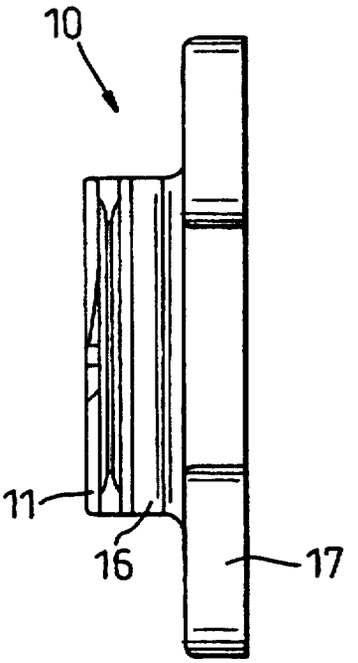

Fig. 2e

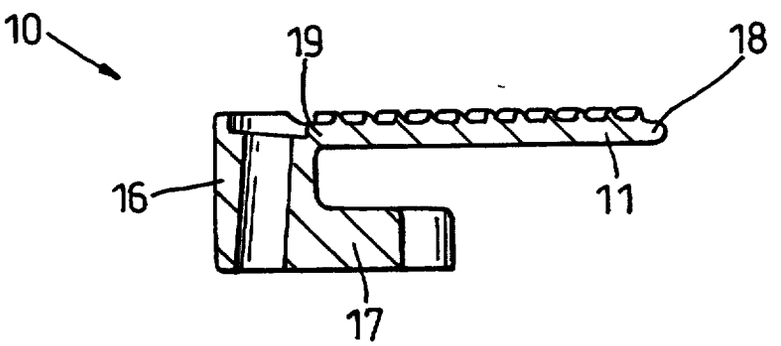

Fig. 2f

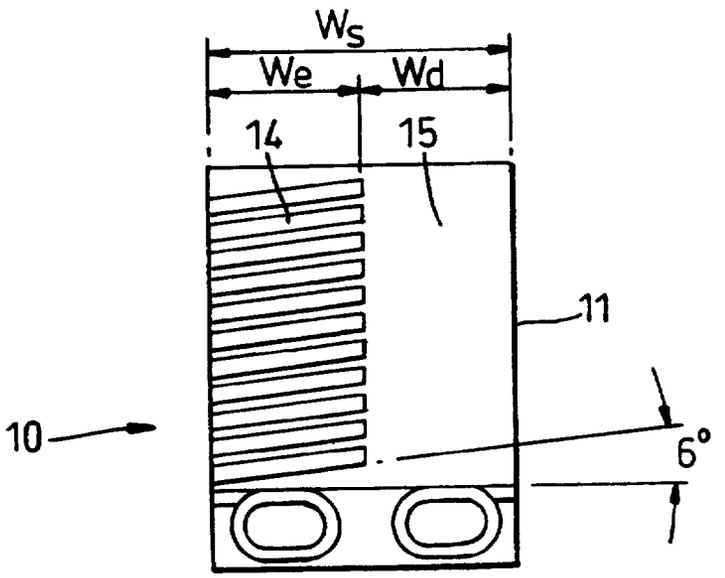

Fig. 3a

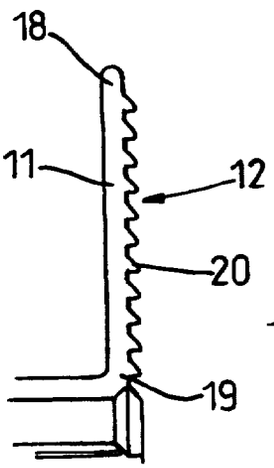

Fig. 3b

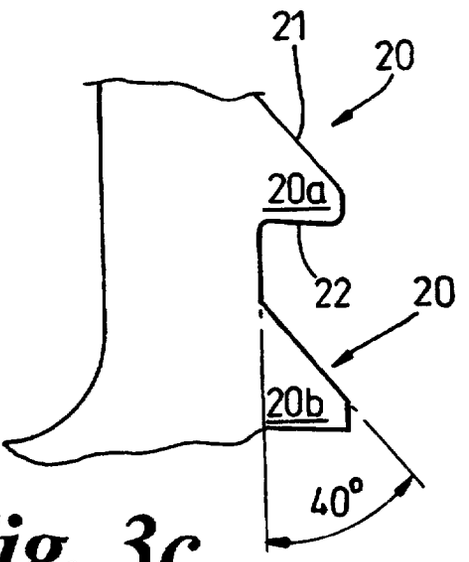

Fig. 3c

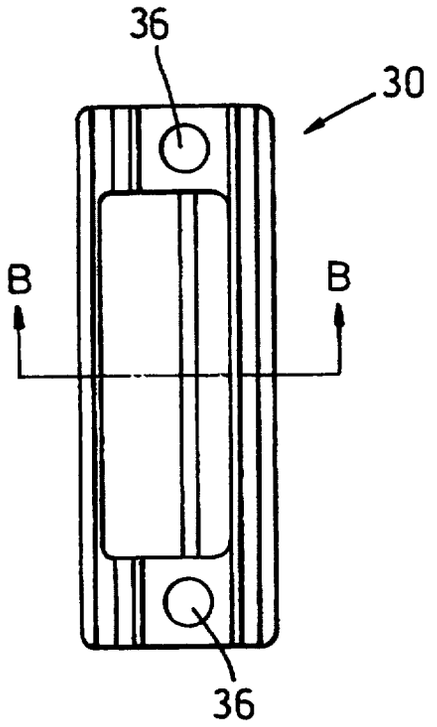

Fig. 4a

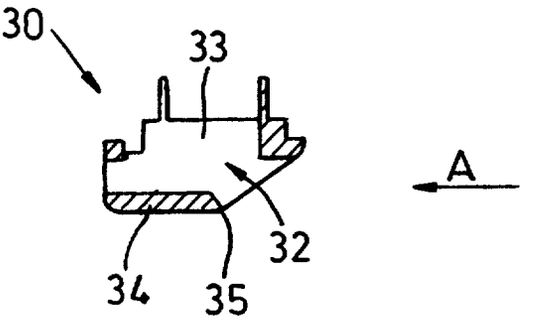

Fig. 4b

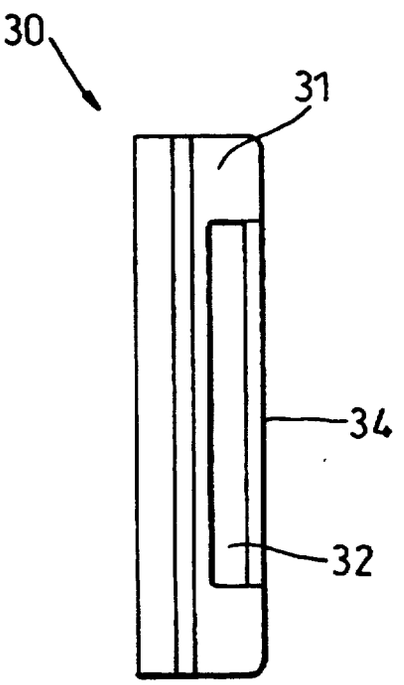

Fig. 4c

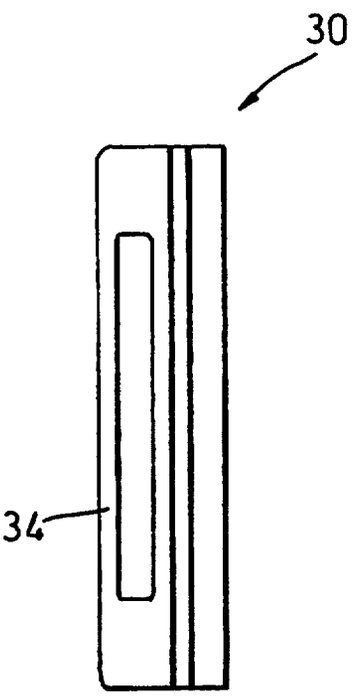

Fig. 4d

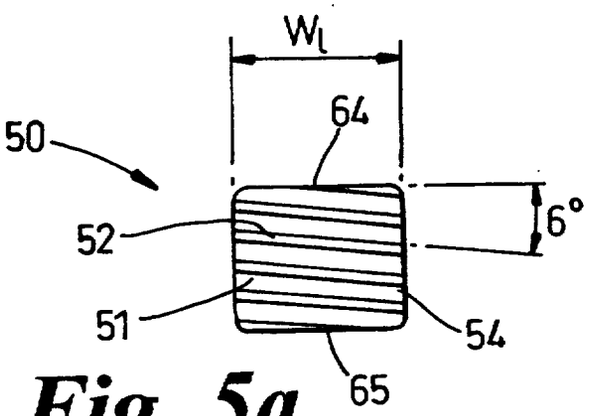

Fig. 5a

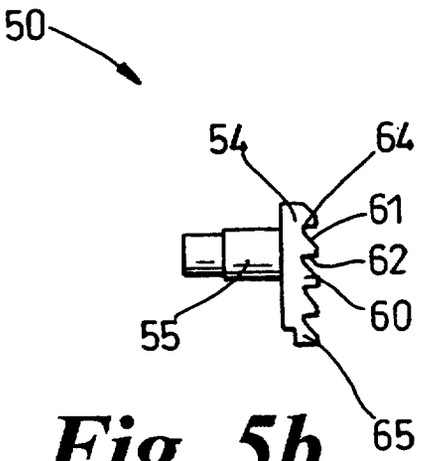

Fig. 5b

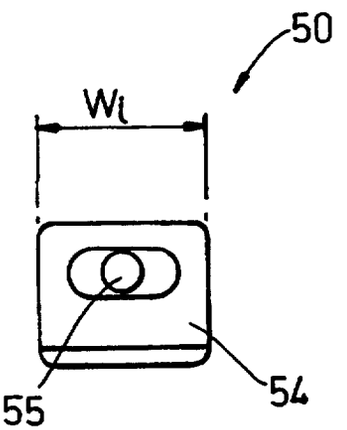

Fig. 5c

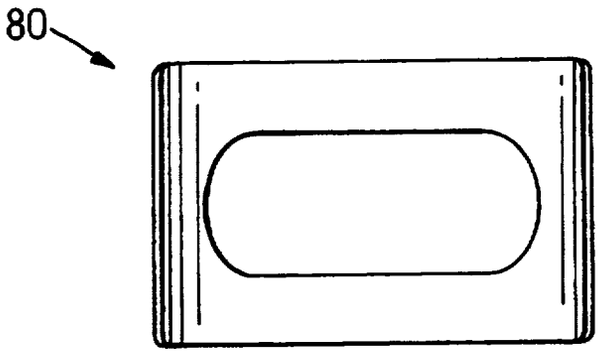

Fig. 6a

Fig. 6b

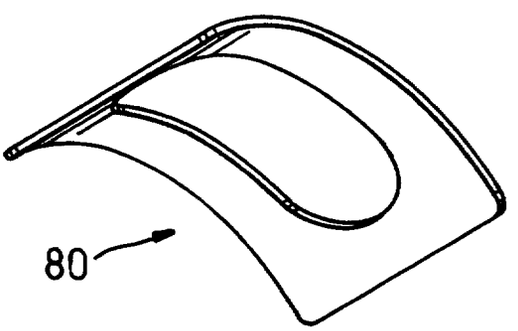

Fig. 6c

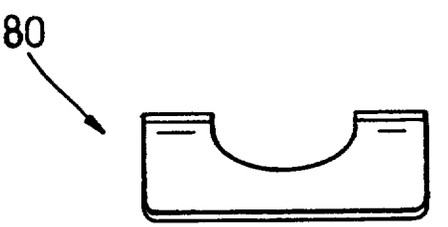

Fig. 6d

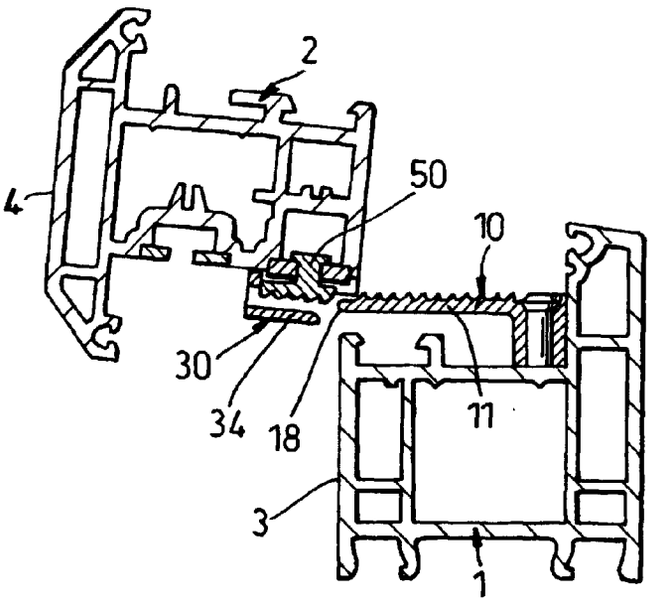

Fig. 7a

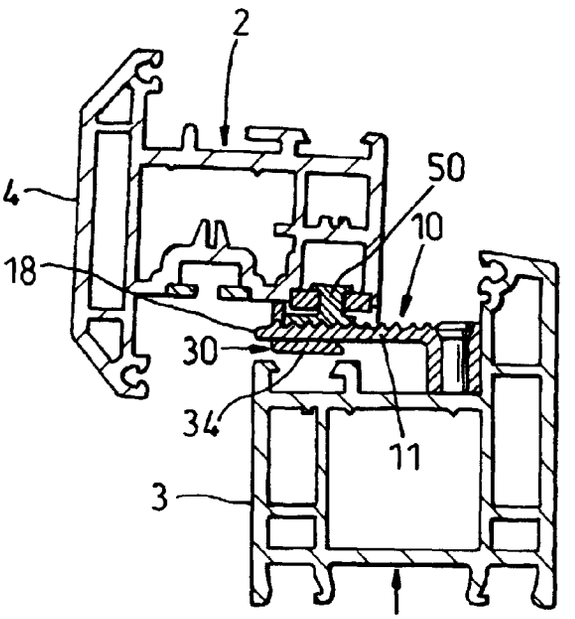

Fig. 7b

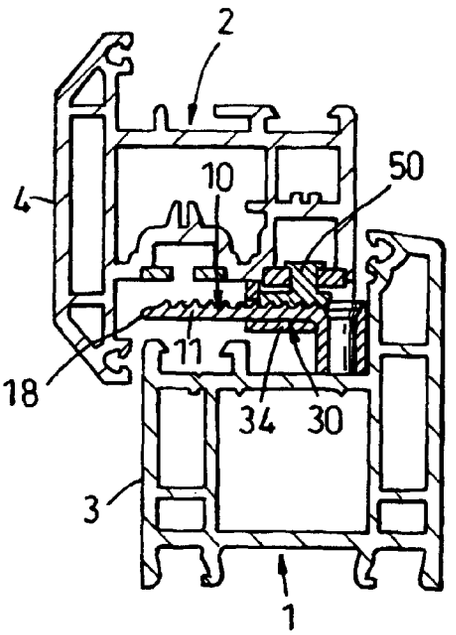

Fig. 7c