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(54) **WINDOW LOCKING DEVICE**

EINE VERRIEGELNORRICHTUNG FÜR FENSTER

DISPOSITIF DE VERROUILLAGE DE FENETRE

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**EP 1 537 285 B1**

**Description**

**[0001]** The present invention relates to a pivot or bottom window, having a sash provided with a latch for locking engagement with the window frame according to the preamble of claim 1.

BACKGROUND ART

**[0002]** Conventional windows of this type are provided with a locking mechanism operated by a handle for locking the sash in a closed position. Often, the possibility to lock the sash in a ventilation position is also provided. Hereto, the window frame comprises a recess for receiving a latch mounted on the sash and extending parallel to the pivot axis. The latch engages the recess to lock the sash in a ventilation position.

**[0003]** It is though sometimes possible to reach the latch from the outside when the sash is in the ventilation position. For easily accessible facades, such a construction presents a burglary risk.

**[0004]** Therefore, there are commercially available additional locking means that can be mounted after the installation of the window in an easily accessible facade. DE-43 28 330 discloses such a locking device for a pivot or bottom hung window which corresponds to the preamble of claim 1. The locking device comprises a bushing mounted in the window frame and an axially movable cylindrical locking member received in the bushing having an extended active position and a retracted inactive position. The cylindrical locking member is formed by a key operates locking cylinder. In its active position the locking cylinder obstructs the opening movement of the sash, typically limiting the movement of the sash between a closed position to a ventilation position engaging the latch. This type of lock provides excellent burglar resistance, but is cumbersome to use as the user needs to have the key available for locking and unlocking. Further, it is not possible to lock the window in a ventilation position using the latch when this type of cylinder lock is mounted in the window frame.

**[0005]** Cylinder locks are also relatively expensive. Not all customers desire the additional locking feature. Factory fitting all windows of this type with a cylinder lock would increase product cost beyond competitive levels. Cylinder locks are therefore typically retrofitted, which further increases the costs, since skilled technician are needed to fit the cylinder locks in situ.

**[0006]** US 6 366 245 discloses a door stopper of a construction such that a door contacting member fitted into a guide cylinder sunk vertically into the floor is allowed to be set in two positions, in a door contacting state in which it protrudes from the floor and in a housed state in which the top is substantially level with the floor. According to this construction, the floor is able to be substantially flat when the door stopper is not in use so that it does not become an obstruction to floor polishers and wheelchairs.

DISCLOSURE OF THE INVENTION

**[0007]** On this background, it is an object of the present invention to provide an inexpensive user friendly and versatile locking device of the kind referred to above. This object is achieved in accordance with claim 1 by providing a locking device for pivot or bottom hung windows comprising a bushing for mounting in a window frame, an axially movable locking member received in, the bushing having an extended active position and a retracted inactive position and being resiliently biased towards the extended position, and means for retaining the locking member in the retracted position, wherein the locking member is provided with an axially opening recess for receiving a latch extending from a sash of the window.

**[0008]** Thus, the sash can be blocked from opening further than a ventilation position when the locking member is in the active position and the sash can also be locked in a ventilation position using the latch when the locking member is in the retracted position. The locking device is inexpensive, so it can be factory fitted as a standard feature whilst maintaining competitive manufacturing costs.

**[0009]** Preferably, the means for retaining the locking member in the retracted position is key-less.

**[0010]** Advantageously, the locking member is provided with an radially outwardly extending pin that engages a substantially L-shaped groove in the bushing for retaining the locking member in the retracted position. This construction enables the locking member to be selectively retained in the retracted position.

**[0011]** Alternatively, the bushing may be provided with an radially inwardly extending pin that engages a substantially L-shaped groove in the locking member for retaining the locking member in the retracted position.

**[0012]** To retain the locking member in the extended position, the locking member may be provided with a radially outwardly extending pin that engages a substantially U- or z-shaped groove in the bushing for retaining the locking member in the retracted position and in the extended position. This construction enables the locking member to be selectively retained in the retracted position and in the extended position.

**[0013]** Alternatively, the bushing may be provided with a radially inwardly extending pin that engages a substantially U- or Z-shaped groove in the locking member for retaining the locking member in the retracted position and in the extended position.

**[0014]** On the above background, it is a further object of the present invention to provide a more user friendly and versatile pivot or bottom hung window of the kind referred to above. This object is achieved in accordance with claim 7 by providing a pivot or bottom hung window comprising a window frame and a sash provided with a latch for locking engagement with the window frame, a bushing mounted in the window frame, an axially movable locking member received in the bushing having an extended active position in which it obstructs the sash

and a retracted inactive position in which it does not obstruct the sash, the locking member being resiliently biased towards the extended position, and means for retaining the locking member in the retracted position, the bushing being mounted in the frame so that it faces the latch when the sash is in an open position and the locking member being provided with an axially opening recess for receiving the latch.

[0015] Thus, the sash can be blocked from opening further than a ventilation position when the locking member is in the active position and the sash can also be locked in a ventilation position using the latch when the locking member is in the retracted position. The locking device is inexpensive, so it can be factory fitted as a standard feature whilst maintaining competitive manufacturing costs.

[0016] Preferably, the means for retaining the locking member in the retracted position is key-less.

[0017] Advantageously, the locking member is provided with a radially outwardly extending pin that engages a substantially L-shaped groove in the bushing for retaining the locking member in the retracted position. This construction enables the locking member be selectively retained in the retracted position.

[0018] Alternatively, the bushing may be provided with a radially inwardly extending pin that engages a substantially L-shaped groove in the locking member for retaining the locking member in the retracted position.

[0019] To retain the locking member in the extended position, the locking member may be provided with a radially outwardly extending pin that engages a substantially U- or Z-shaped groove in the bushing for retaining the locking member in the retracted position and in the extended position. This construction enables the locking member to be selectively retained in the retracted position and in the extended position.

[0020] Alternatively, the bushing may be provided with a radially inwardly extending pin that engages a substantially U- or Z-shaped groove in the locking member for retaining the locking member in the retracted position and in the extended position.

[0021] Preferably, the bushing is mounted such that the sash can only be opened to a ventilation position when the locking member is in its active position.

[0022] At the same time it is possible that the bushing is mounted such that the sash can be locked in a ventilation position with the latch engaging the recess in the locking member when the latter is in the retracted position.

[0023] Further objects, features, advantages and properties of the pivot or bottom hung window and the locking device according to the invention will become apparent from the detailed description.

#### BRIEF DESCRIPTION OF THE DRAWINGS

[0024] In the following detailed portion of the present description, the invention will be explained in more detail

with reference to the preferred embodiments shown in the drawings, in which

Fig. 1 shows a closed and a ventilation position of the sash,

Fig. 2 is a sectional view through a locking device in a first preferred embodiment of the invention,

Fig. 3 is a top view on the locking device shown in Fig. 2,

Fig. 4 is a side view of the locking device shown in Fig. 2,

Fig. 5 shows the sash in another ventilation position,

Fig. 6 is a top view on the window frame and sash with a detail showing the engagement of a latch with the locking device with the sash in a ventilation position,

Fig. 7 is a sectional view through a second preferred embodiment of the locking device according to the invention, and

Fig. 8 is a top view of a third preferred embodiment of the locking device according to the invention.

#### DETAILED DESCRIPTION

[0025] With reference to Figs. 1 to 3 a pivot roof window according to the invention is an openable window with a window frame 2 and an openable sash 1. It is understood that the invention can be equally applied also to bottom hung windows in a substantially vertical facade.

[0026] The sash structure is pivotally journaled in the frame structure with an axis of rotation parallel with the top and bottom members by means of pivotal hinges 3, known per se, between the frame 2 and sash 1.

[0027] Preferably, the frame and sash structures are for the major part built up by wood, although it is also possible to use metal or plastic. The sash 1 carries a window pane 15.

[0028] In a closed position, the sash 1 is oriented substantially parallel with the window frame 2. In the closed position a locking mechanism (not shown) engages a recess 16 in the window frame to lock the window. The locking mechanism is operated by a handle 4. Such locking mechanisms are well known in the art and are therefore not shown in detail here.

[0029] A ventilation position of the sash 1 at which it forms an acute angle with the window frame 2 is shown in broken lines in Fig. 1. Opening the sash 1 further is prevented by a locking device 5 which is described in more detail below.

[0030] As best shown in Figs. 2 and 3, the locking device 5 comprises a metal or plastic bushing 7 provided with a closed bottom and an annular rim 12 at its open end. The bushing is to be mounted in a bore in frame 2.

[0031] A metal or plastic cylindrical locking member 8 is slidably received in the bushing 7. A spring 9, arranged between the bottom of the bushing 7 and the inner end of the locking member 8 urges the locking member 8 to an extended position, in which it obstructs the sash 1.

The locking member is provided with a bore 14 in which the latch 6 can be received when the locking member 8 is in a retracted position.

**[0032]** A radially outwardly protruding pin 10 is fixed to the locking member 8. The pin extends into an L-shaped groove 11 arranged in the bushing 7. In the retracted position the pin 10 is located at the end of the tangentially extending arm 11b of the L-shape groove 11, thus retaining the locking member 8 in the retracted position.

**[0033]** In the extended position the pin 10 is located in the axially extending arm 11a of the L-shaped groove 11, and thus prevents the locking member 8 from being ejected from the bushing 7, as shown by the broken lines in Fig. 3.

**[0034]** The locking member 8 can be moved from the retracted position to the extended position by turning the locking member 8 anti-clockwise and releasing it. The locking member 8 can be moved from the extended position by pressing it into the bushing 7 and turning it clockwise.

**[0035]** As best shown in Fig. 4, the locking member 8 is at its axial periphery provided with a serrated or grooved surface for improving frictional contact with an operator's fingers.

**[0036]** As the locking member 8 cannot be reached from the outside it offers proper burglar protection.

**[0037]** Relatively broad types of windows may be provided with two locking devices 5, one at each side of the window frame 2, to improve structural stability.

**[0038]** As best shown in Figs. 5 and 6, the sash 1 can also be locked in a ventilation position by engaging the latch 6 with bore 14 in the locking member 7 when the latter is in the retracted position.

**[0039]** With reference to Fig. 7, another preferred embodiment of the locking device is shown. In this embodiment a radially inwardly protruding pin 10 is fixed to the bushing 7. The pin 10 is received in an L-shaped groove 11' provided in the locking member 6. The operation of moving the locking member between the retracted position and the extended position is the same as for the embodiment described above.

**[0040]** With reference to Fig. 8 yet another preferred embodiment of the locking device is shown. An additional tangentially extending arm 11c has been added to the L-shaped groove 11, thus forming a U-shaped groove. In the extended position, shown with broken lines in Fig. 8, the pin 10 is located at the end of the arm 11c and prevents the locking member from being pushed into the bushing 7. For moving the locking member 8 from the extended position to the retracted position, it is thus required to first turn the locking member 8 anticlockwise, press it into the bushing 7 and then turn it clockwise so that the pin 10 arrives at the end of the tangentially extending arm 11b. Arm 11c may also extend in the opposite direction so that the L-shaped groove 11 becomes Z-shaped. A U- or Z-shaped groove can also be used when the groove is provided in the locking member 8 as

described above.

**[0041]** The locking member may in another preferred embodiment (not shown) be provided with a key operated locking mechanism, such as a locking cylinder, to lock the locking member in the extended position and eventually also the retracted position.

**[0042]** Although the present invention has been described in detail for purpose of illustration, it is understood that such detail is solely for that purpose, and variations and combination can be made therein by those skilled in the art without departing from the scope of the appended claims.

## 15 Claims

### 1. A pivot or bottom hung window comprising:

- a window frame (2),
- a sash (1) provided with a latch (6) for locking engagement with the window frame (2),
- a bushing (7) mounted in the window frame (2),
- an axially movable locking member (8) received in the bushing (7) having an extended active position in which it obstructs the sash (1) and a retracted inactive position in which it does not obstruct the sash (1), said locking member (8) being resiliently biased towards the extended position, and
- means for retaining the locking member (8) in the retracted position,

**characterized in that** the locking member (8) is provided with an axially opening recess (14) for receiving the latch (6) extending from the sash (1) when the locking member (8) is in the retracted position.

### 2. A pivot or bottom hung window according to claim 1, **characterized in that** the means for retaining the locking member (8) in the retracted position is keyless.

### 3. A pivot or bottom hung window according to claim 1 or 2, **characterized in that** the locking member (8) is provided with an radially outwardly extending pin (10) that engages a substantially L-shaped groove (11) in the bushing (7) for retaining the locking member (8) in the retracted position.

### 4. A pivot or bottom hung window according to claim 1 or 2, **characterized in that** the locking member (8) is provided with an radially outwardly extending pin (10) that engages a substantially U- or Z-shaped groove (11) in the bushing (7) for retaining the locking member (8) in the retracted position and in the extended position.

### 5. A pivot or bottom hung window according to claim 1

or 2, **characterized in that** the bushing (7) is provided with a radially inwardly extending pin (10) that engages a substantially L-shaped groove (11') in the locking member (8) for retaining the locking member (8) in the retracted position.

6. A pivot or bottom hung window according to claim 1 or 2, **characterized in that** the bushing (7) is provided with a radially inwardly extending pin (10) that engages a substantially U- or Z-shaped groove (11') in the locking member for retaining the locking member (8) in the retracted position and in the extended position.
7. A pivot or bottom hung window according to any of claims 1 to 6, **characterized in that** the bushing (7) is mounted in the frame (2) so that it faces the latch (6) when the sash (1) is in an open position.
8. A pivot or bottom hung window according to any of claims 1 to 7, **characterized in that** said bushing (7) is provided with a radially inwardly extending pin (10) that engages a substantially U- or Z-shaped groove (11') in said locking member (8) for retaining said locking member (8) in said retracted position and in said extended position.
9. A pivot or bottom hung window according to any of claims 1 to 8, **characterized in that** said bushing (7) is mounted such that the sash (1) can only be opened to a ventilation position when the locking member (8) is in its active position.
10. A pivot or bottom hung window according to any of claims 1 to 9, **characterized in that** said bushing (7) is mounted such that the sash (1) can be locked in a ventilation position with the latch engaging the axially opening recess (14) in the locking member (8).

#### Patentansprüche

1. Drehflügel- oder Kippfenster, das umfasst:

- einen Fensterrahmen (2),
- einen Fensterflügel (1), der mit einem Riegel (6) für einen Verriegelungseingriff mit dem Fensterrahmen (2) versehen ist,
- eine Buchse (7), die in dem Fensterrahmen (2) montiert ist,
- ein in der Buchse (7) aufgenommenes axial bewegliches Verriegelungselement (8) mit einer ausgefahrenen aktiven Stellung, in welcher es den Fensterflügel (1) blockiert, und einer eingezogenen inaktiven Stellung, in welcher es den Fensterflügel (1) nicht blockiert, wobei das Verriegelungselement (8) in Richtung der ausge-

fahrenen Stellung elastisch vorgespannt ist, und  
- ein Mittel zum Festhalten des Verriegelungselements (8) in der eingezogenen Stellung,

- 5 **dadurch gekennzeichnet, dass**  
das Verriegelungselement (8) mit einer axialen Öffnungsausnehmung (14) versehen ist, um den Riegel (6) aufzunehmen, der sich von dem Fensterflügel (1) weg erstreckt, wenn sich das Verriegelungselement (8) in der eingezogenen Stellung befindet.
- 10 **2.** Drehflügel- oder Kippfenster nach Anspruch 1, **dadurch gekennzeichnet, dass**  
das Mittel zum Festhalten des Verriegelungselements (8) in der eingezogenen Stellung ohne einen Schlüssel auskommt.
- 15 **3.** Drehflügel- oder Kippfenster nach Anspruch 1 oder 2, **dadurch gekennzeichnet, dass**  
das Verriegelungselement (8) mit einem sich radial nach außen erstreckenden Stift (10) versehen ist, der mit einer im Wesentlichen L-förmigen Nut (11) in der Buchse (7) in Eingriff steht, um das Verriegelungselement (8) in der eingezogenen Stellung festzuhalten.
- 20 **4.** Drehflügel- oder Kippfenster nach Anspruch 1 oder 2, **dadurch gekennzeichnet, dass**  
das Verriegelungselement (8) mit einem sich radial nach außen erstreckenden Stift (10) versehen ist, der mit einer im Wesentlichen U- oder Z-förmigen Nut (11) in der Buchse (7) in Eingriff steht, um das Verriegelungselement (8) in der eingezogenen Stellung und in der ausgefahrenen Stellung festzuhalten.
- 25 **5.** Drehflügel- oder Kippfenster nach Anspruch 1 oder 2, **dadurch gekennzeichnet, dass**  
die Buchse (7) mit einem sich radial nach innen erstreckenden Stift (10) versehen ist, der mit einer im Wesentlichen L-förmigen Nut (11') in dem Verriegelungselement (8) in Eingriff steht, um das Verriegelungselement (8) in der eingezogenen Stellung festzuhalten.
- 30 **6.** Drehflügel- oder Kippfenster nach Anspruch 1 oder 2, **dadurch gekennzeichnet, dass**  
die Buchse (7) mit einem sich radial nach innen erstreckenden Stift (10) versehen ist, der mit einer im Wesentlichen U- oder Z-förmigen Nut (11') in dem Verriegelungselement in Eingriff steht, um das Verriegelungselement (8) in der eingezogenen Stellung und in der ausgefahrenen Stellung festzuhalten.
- 35 **5.** Drehflügel- oder Kippfenster nach Anspruch 1 oder 2, **dadurch gekennzeichnet, dass**  
die Buchse (7) mit einem sich radial nach innen erstreckenden Stift (10) versehen ist, der mit einer im Wesentlichen L-förmigen Nut (11') in dem Verriegelungselement (8) in Eingriff steht, um das Verriegelungselement (8) in der eingezogenen Stellung festzuhalten.
- 40 **6.** Drehflügel- oder Kippfenster nach Anspruch 1 oder 2, **dadurch gekennzeichnet, dass**  
die Buchse (7) mit einem sich radial nach innen erstreckenden Stift (10) versehen ist, der mit einer im Wesentlichen U- oder Z-förmigen Nut (11') in dem Verriegelungselement in Eingriff steht, um das Verriegelungselement (8) in der eingezogenen Stellung und in der ausgefahrenen Stellung festzuhalten.
- 45 **5.** Drehflügel- oder Kippfenster nach Anspruch 1 oder 2, **dadurch gekennzeichnet, dass**  
die Buchse (7) mit einem sich radial nach innen erstreckenden Stift (10) versehen ist, der mit einer im Wesentlichen L-förmigen Nut (11') in dem Verriegelungselement (8) in Eingriff steht, um das Verriegelungselement (8) in der eingezogenen Stellung festzuhalten.
- 50 **6.** Drehflügel- oder Kippfenster nach Anspruch 1 oder 2, **dadurch gekennzeichnet, dass**  
die Buchse (7) mit einem sich radial nach innen erstreckenden Stift (10) versehen ist, der mit einer im Wesentlichen U- oder Z-förmigen Nut (11') in dem Verriegelungselement in Eingriff steht, um das Verriegelungselement (8) in der eingezogenen Stellung und in der ausgefahrenen Stellung festzuhalten.
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7. Drehflügel- oder Kippfenster nach einem oder mehreren der Ansprüche 1 bis 6,  
**dadurch gekennzeichnet, dass**  
die Buchse (7) in dem Rahmen (2) so montiert ist, dass sie dem Riegel (6) zugewandt ist, wenn sich der Fensterflügel (1) in einer geöffneten Stellung befindet. 5
8. Drehflügel- oder Kippfenster nach einem oder mehreren der Ansprüche 1 bis 7,  
**dadurch gekennzeichnet, dass**  
die Buchse (7) mit einem sich radial nach innen erstreckenden Stift (10) versehen ist, der mit einer im Wesentlichen U- oder Z-förmigen Nut (11') in dem Verriegelungselement (8) in Eingriff steht, um das Verriegelungselement (8) in der eingezogenen Stellung und in der ausgefahrenen Stellung festzuhalten. 10
9. Drehflügel- oder Kippfenster nach einem oder mehreren der Ansprüche 1 bis 8,  
**dadurch gekennzeichnet, dass**  
die Buchse (7) derart montiert ist, dass der Fensterflügel (1) nur in eine Lüftungsstellung geöffnet werden kann, wenn sich das Verriegelungselement (8) in seiner aktiven Stellung befindet. 15
10. Drehflügel- oder Kippfenster nach einem oder mehreren der Ansprüche 1 bis 9,  
**dadurch gekennzeichnet, dass**  
die Buchse (7) derart montiert ist, dass der Fensterflügel (1) in einer Lüftungsstellung verriegelt werden kann, wobei der Riegel in die axiale Öffnungsaufnahme (14) in dem Verriegelungselement (8) eingreift. 20
- (8) comprend un évidement s'ouvrant axialement (14) pour recevoir le loquet (6) s'étendant du châssis (1) lorsque l'élément de verrouillage (8) est dans la position escamotée.
2. Fenêtre à pivot ou à soufflet selon la revendication 1, **caractérisée en ce que** les moyens pour retenir l'élément de verrouillage (8) dans la position escamotée sont sans clé. 25
3. Fenêtre à pivot ou à soufflet selon la revendication 1 ou 2, **caractérisée en ce que** l'élément de verrouillage (8) comprend un axe s'étendant radialement vers l'extérieur (10) qui s'engage dans une gorge substantiellement en forme de L (11) dans la douille (7) pour retenir l'élément de verrouillage (8) dans la position escamotée. 30
4. Fenêtre à pivot ou à soufflet selon la revendication 1 ou 2, **caractérisée en ce que** l'élément de verrouillage (8) comprend un axe s'étendant radialement vers l'extérieur (10) qui s'engage dans une gorge substantiellement en forme de U ou de Z (11) dans la douille (7) pour retenir l'élément de verrouillage (8) dans la position escamotée et dans la position allongée. 35
5. Fenêtre à pivot ou à soufflet selon la revendication 1 ou 2, **caractérisée en ce que** la douille (7) comprend un axe s'étendant radialement vers l'intérieur (10) qui s'engage dans une gorge substantiellement en forme de L (11') dans l'élément de verrouillage (8) pour retenir l'élément de verrouillage (8) dans la position escamotée. 40
6. Fenêtre à pivot ou à soufflet selon la revendication 1 ou 2, **caractérisée en ce que** la douille (7) comprend un axe s'étendant radialement vers l'intérieur (10) qui s'engage dans une gorge substantiellement en forme de U ou de Z (11') dans l'élément de verrouillage pour retenir l'élément de verrouillage (8) dans la position escamotée et dans la position allongée. 45
7. Fenêtre à pivot ou à soufflet selon l'une quelconque des revendications 1 à 6, **caractérisée en ce que** la douille (7) est montée dans le cadre (2) de telle sorte qu'elle se trouve en regard du loquet (6) lorsque le châssis (1) est en position ouverte. 50
8. Fenêtre à pivot ou à soufflet selon l'une quelconque des revendications 1 à 7, **caractérisée en ce que** la douille (7) comprend un axe s'étendant radialement vers l'intérieur (10) qui s'engage dans une gorge substantiellement en forme de U ou de Z (11') dans l'élément de verrouillage (8) pour retenir l'élément de verrouillage (8) dans la position escamotée et dans la position allongée. 55

## Revendications

### 1. Fenêtre à pivot ou à soufflet comprenant :

- un encadrement de fenêtre (2),
- un châssis (1) comprenant un loquet (6) pour verrouiller le couplage avec l'encadrement de fenêtre (2),
- une douille (7) montée dans l'encadrement de fenêtre (2),
- un élément de verrouillage axialement déplaçable (8) reçu par la douille (7) et présentant une position active allongée dans laquelle il obstrue le châssis (1) et une position inactive escamotée dans laquelle il n'obstrue pas le châssis (1), l'élément de verrouillage (8) étant sollicité élastiquement vers la position allongée, et
- des moyens pour retenir l'élément de verrouillage (8) dans la position escamotée,

**caractérisée en ce que** l'élément de verrouillage

9. Fenêtre à pivot ou à soufflet selon l'une quelconque des revendications 1 à 8, **caractérisée en ce que** la douille (7) est montée de telle sorte que le châssis (1) ne peut être ouvert que dans une position de ventilation lorsque l'élément de verrouillage (8) est dans sa position active. 5

10. Fenêtre à pivot ou à soufflet selon l'une quelconque des revendications 1 à 9, **caractérisée en ce que** la douille (7) est montée de telle sorte que le châssis (1) peut être verrouillé dans une position de ventilation lorsque le loquet s'engage dans l'évidement s'ouvrant axialement (14) dans l'élément de verrouillage (8). 10

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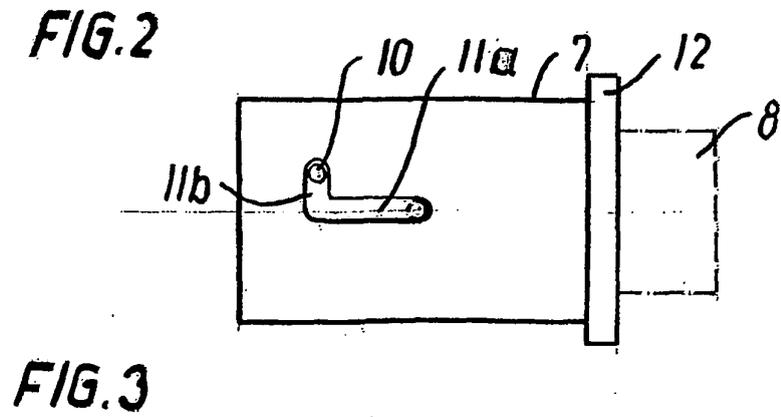
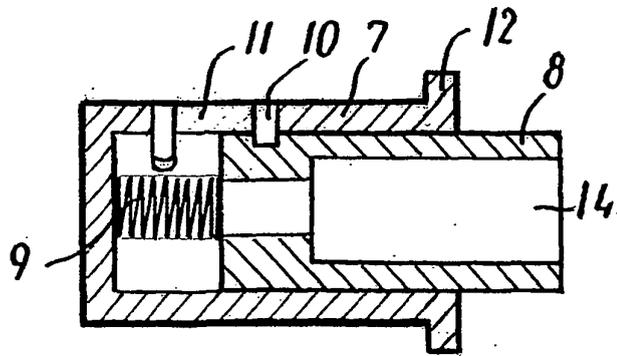
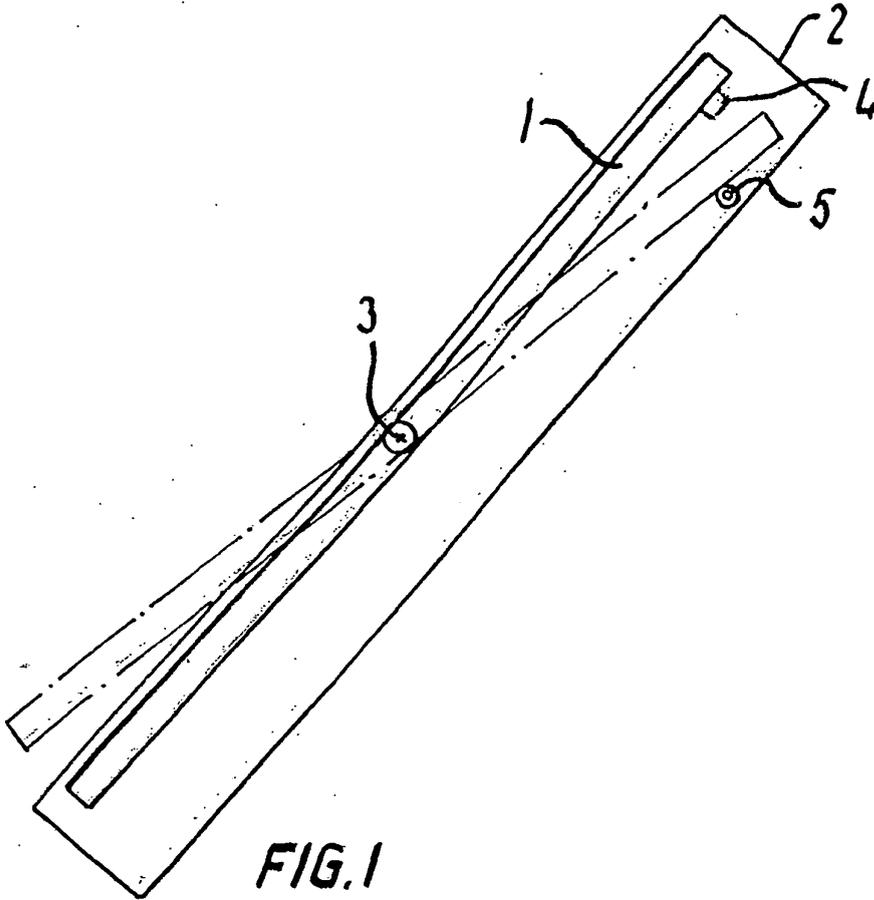
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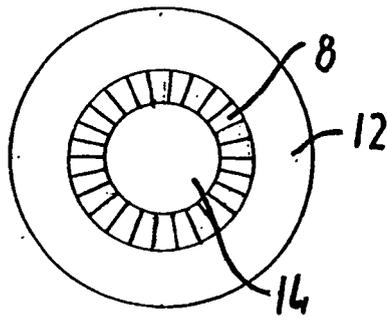
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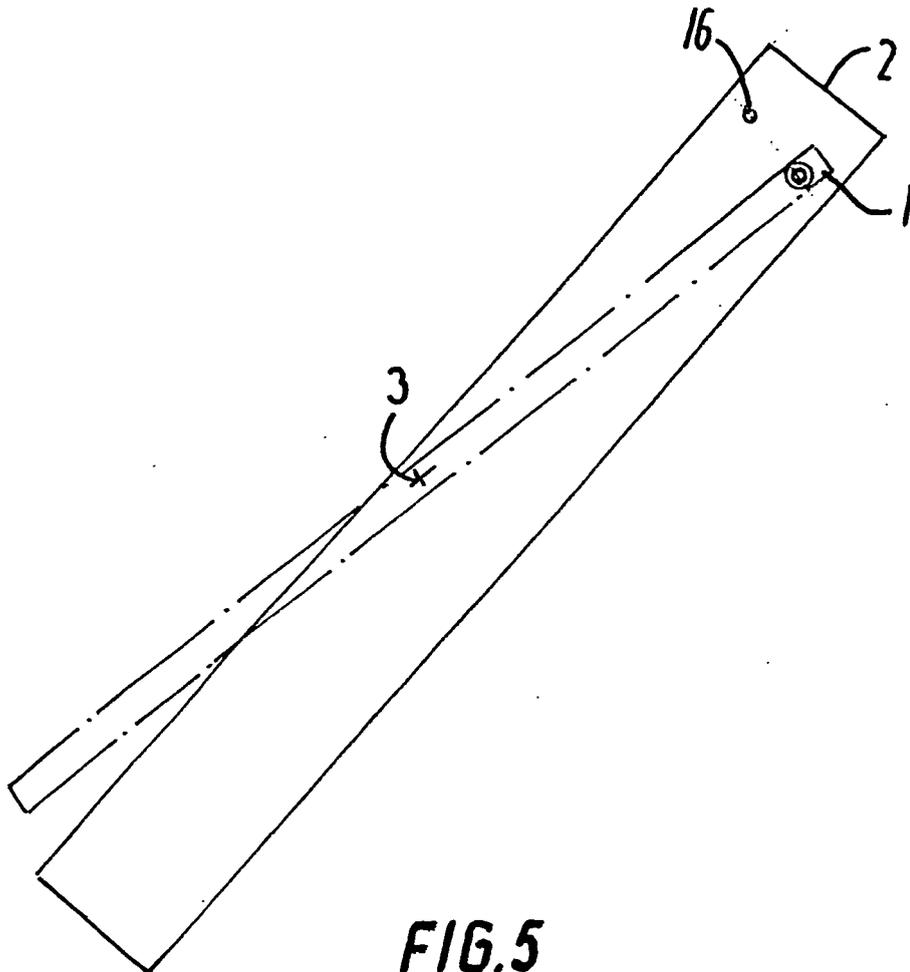
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**FIG. 4**



**FIG. 5**

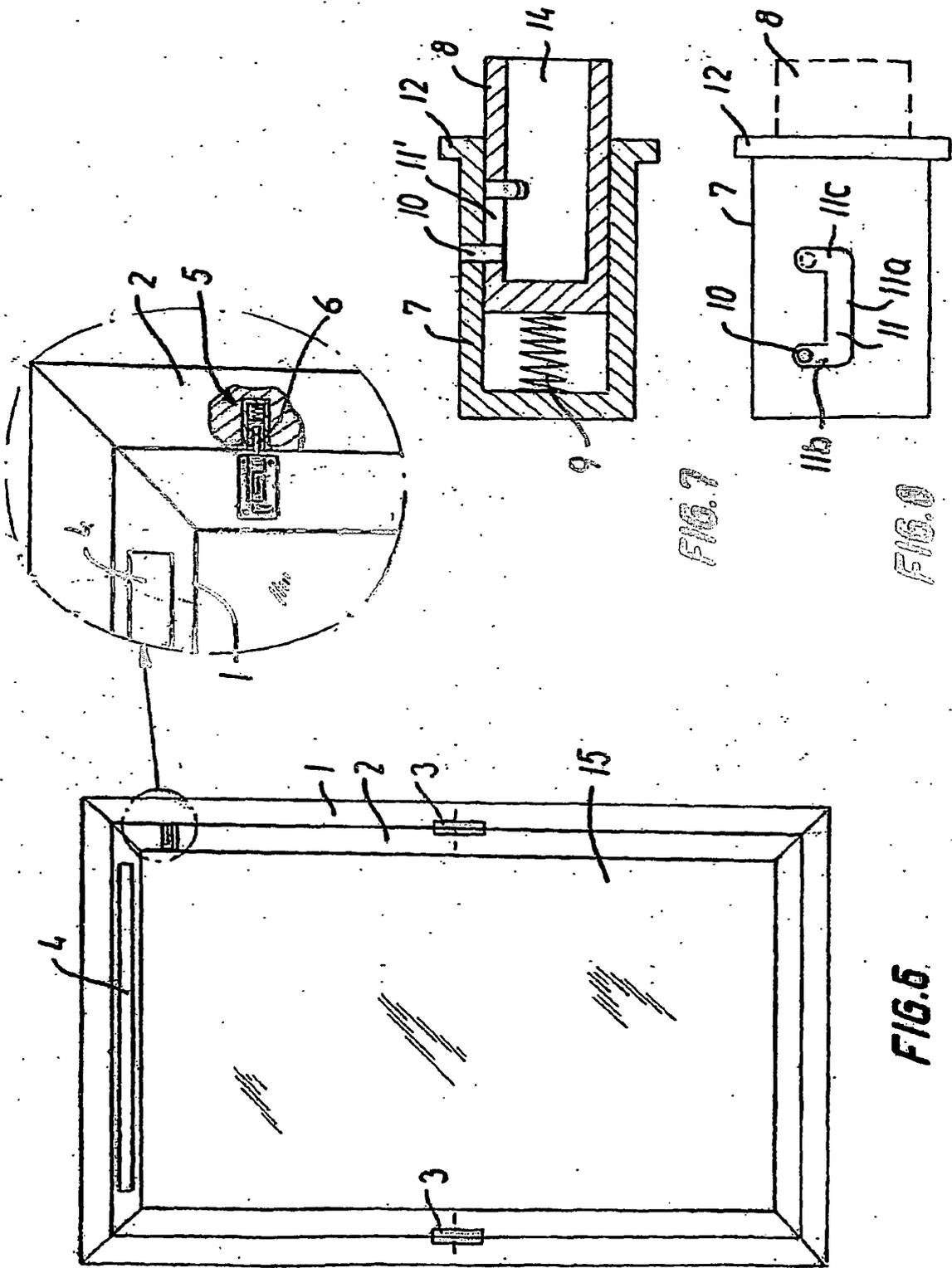


FIG. 7

FIG. 8

FIG. 6

**REFERENCES CITED IN THE DESCRIPTION**

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**Patent documents cited in the description**

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