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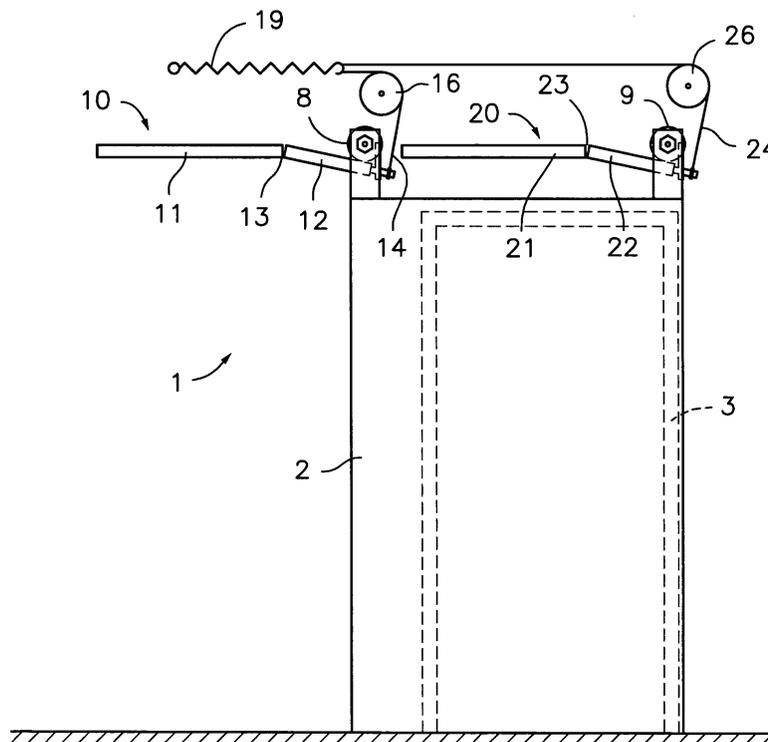
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(54) **Sliding door**

(57) It comprises a leaf (2) which can be moved by two supporting and guiding rails (10, 20) linked to a stationary structure between a first position in which the leaf (2) is at least partly open and separate from a frame (3) of the door and a second position in which the leaf (2) is closed, leaning against the said frame (3) and supported on the floor. Each rail (10, 20) comprises a stationary length (11, 21) and a moving length (12, 22) tilt-

ing between a first position corresponding to the said first position of the leaf (2) in which the said moving length (12, 22) remains aligned with the stationary length (11, 21) and a second position corresponding to the said second position of the leaf (2) in which the moving length (12, 22) remains inclined with respect to the stationary length (11, 21) and with its free end located at a lesser distance and height with respect to the stationary structure.



**Fig.2**

## Description

### Field of the invention

**[0001]** The invention relates to a sliding door comprising a leaf which is moving with respect to a stationary structure and at least two rails for supporting the leaf and guiding it to move between one first position, in which the leaf (2) is at least partly open and separate from the door frame (3) and a second position in which the leaf (2) is closed and leaning against such frame (3) and supported on the floor.

### Background of the invention

**[0002]** In the state of the art sliding doors are known of the kind in which the doorleaf is moving in a direction parallel to its main plane.

**[0003]** One of the drawbacks shown by the said sliding doors is their sealing that is to say the level of the closed door and its frame sealing and the door and the floor sealing. Usually in order the said doors operate correctly it is required to leave a clearance between the door and the frame and between the door and the floor.

**[0004]** In the case of the sliding doors which require a significantly tight closing, for example for hospital white rooms or operating rooms, the said lack of tightness means a serious problem of hygiene. In addition, the said doors usually have great sizes and are very heavy which makes that any improvement it is wished to apply to their moving mechanisms is even more complicated.

**[0005]** To overcome the said drawback different systems have been developed allowing to place the leaf closer to the frame and to lower it down the floor to achieve a tight contact. However, the said systems due to the weight of the leaf usually produce that the leaf briskly falls down at the end of the closing travel and require a significant effort from the user to start opening the door. The said drawbacks still exist when the door is motor-operated.

**[0006]** ES-2156440-T3 discloses a sliding door in which the effort for opening and closing the door has been reduced. It includes spring or weight loaded stops which dampen the door blow when closing it and assist to start opening it. It also includes rolling rails which can be tilted towards one end or the other depending on whether the door is being opened or closed. But the said system still does not overcome the problem of fitting the closed door with the frame and with the floor.

### Short explanation of the invention

**[0007]** An object of this invention is to provide a good tightness to a sliding door when it is closed, that is to say, to provide a good fitting between the closed door leaf and its frame and between the said door and the floor.

**[0008]** Another object of this invention is to facilitate a sliding door opening and closing so that no great effort is necessary for the user to open or close it.

**[0009]** According to the invention, each of the said guided supporting rails which are at least two comprises a stationary length integral with the said stationary structure and a moving length which can be tilted between a first at least partly open door position in which the said moving length remains aligned with the stationary length and a second closed door position in which the moving length remains inclined with respect to the stationary length so that its free end remains located at a lesser distance from the door stationary structure and at a lesser height than the stationary length. Preferably, at each rail the moving length is coupled to the stationary length by a link selected from a group including an hinge with respect to a shaft, a flexible joining element and an elastic joining means and the free end of the said moving length is guided in the motion between the door opening and closing positions by an inclined slide integral with the door stationary structure. This solution for the moving length motion is mechanically simple and reliable. Preferably the door leaf is hanging from the said at least two supporting and guiding rails through the rolling or sliding elements located at distances from each other equivalent to the distances between the moving lengths of the supporting and guiding rails.

**[0010]** Thanks to this supporting and guiding rail structure in the closing motion, the doorleaf is guided so that it simultaneously moves on a vertical plane, bringing the leaf close to the floor until it is resting on it, and in a horizontal plane, bringing the leaf close to the frame until achieving to fully apply it against it. The leaf and/or the frame include sealing elements for example elastic door strips which improve the tightness closing as well on the floor as on the frame.

**[0011]** In addition, bringing the leaf close to the frame and the floor can only be done at the end of the travel thanks to the supporting and guiding rail division into a fixed horizontal length which can be longer and a moving length which can be shorter, providing thus most of the travel on the said stationary horizontal length which facilitates the motion without prejudice of an optimum closing end position.

**[0012]** According to an embodiment, the sliding door comprises means to assist the doorleaf motion between the open door position and the closed door position and vice versa; this way, starting the opening operation can be achieved with less effort and the end of the closing operation is smoother.

**[0013]** Preferably, the said means assisting the leaf motion comprise means for storing the potential energy which absorb energy during the leaf closing motion and deliver the energy stored during the opening motion thereof, and they are connected to the moving length of the supporting and guiding rail to help to tilt it between the said second position and the said first position, cooperating in the leaf weight lifting and between the first

position and the second position, dampening the leaf fall. This characteristic secures an easier door opening and help to achieve a smooth closing.

**[0014]** In an embodiment, the said means assisting to the leaf motion comprise for each supporting and guiding rail, a spring which has a first end fixed on the door stationary structure and a second end linked to the free end of the moving length. Advantageously, according to another example of embodiment, there is a single spring the second end of which is linked to the free ends of the said moving lengths through respective return cables and pulleys. The fact that there is a single spring for the two rails assist to balance the doorleaf preventing thus lengthwise pitch motions. It is also possible to incorporate several springs, each being connected to its corresponding moving length through a respective return cable and pulley.

**[0015]** In an advantageous embodiment, the sliding door comprises a stop device designed to prevent that the rolling or sliding elements leave their respective supporting and guiding rails, so that the door safety and reliability improve, Preferably, the said stop device comprises a stop element integral with the door stationary structure and a maintaining wheel integral with the doorleaf. Each stop element is located with respect to one of the moving lengths and each maintaining wheel is located with respect to one of the rolling or sliding elements mounted on the leaf so that each rolling or sliding element remains facing its corresponding stop element at a given moment of the leaf motion between its first and second positions.

**[0016]** In an embodiment, the door comprises two rolling elements, each associated to one of the said supporting and guiding rails composed of a stationary length and a moving length.

#### Short description of the drawings

**[0017]** To best understand above explained, drawings are attached in which, schematically and for a not limiting example purpose an embodiment is shown.

**[0018]** In the drawings:

Fig. 1 is a schematic elevation view of a sliding door according to the invention in open position;

Fig. 2 is a schematic elevation view of a sliding door according to the invention in closed position;

Fig. 3 and 4 are plan views showing respectively the sliding door supporting rails installed on a wall according to two different arrangements;

Fig. 5 is a view in perspective showing in an enlarged detail the slide for the free end of the moving length of each rail; and

Fig. 6 and 7 are side elevation views showing the operation of a stop device designed to prevent that the rolling or sliding elements leave their respective supporting and sliding rails.

#### Description of examples of embodiment

**[0019]** Referring first to Fig. 1 and 2, an example of embodiment of a sliding door 1 is shown according to the invention comprising a stationary structure, fixed on a wall in which the doorway of the door provided with a frame 3 is open and a doorleaf 2 including two top supports 6 and 7. Wheels 8 and 9 are mounted on the said supports 6 and 7 and the said wheels are rolling respectively on a first supporting and guiding rail 10 and a second supporting and guiding rail 20 in the door opening and closing motions and each rail 10, 20 comprises two lengths. Thus, the first rail 10 is divided into a stationary length 11 and a moving length 12; both lengths are linked by a hinge or elastic junction 13 allowing that the moving length 12 tilts with respect to the stationary length 11 in a direction having a vertical component and a horizontal component. In a similar way, the second rail 20 is divided into a stationary length 21 and a moving length 22; in same way, both lengths are joined by means of a hinge 23 allowing that the moving length 22 tilts with respect to the stationary length 21 in a direction having a vertical component and a horizontal component. The fixed length 11, 21 of each rail is horizontal and is fixed on the stationary structure by means of conventional supports (not shown).

**[0020]** The guided supporting rails 10, 20 can be arranged in different ways. In the example shown in Fig. 3, an embodiment is shown in which the supporting and guiding rails 10,20 are aligned to each other as a single rail, although each comprises its respective moving length 22. In the example shown in Fig. 4 an embodiment is shown in which such rails are at same height not aligned to each other but moved the one with respect to the other on an horizontal plane and partly overlapping each other. Other embodiments not shown would also be possible such as for example the two rails superposed on a same vertical plane and moved or partly overlapping each other as required.

**[0021]** As it can be seen in more details in Fig. 5, the free end of each moving length 12, 22 ends in a stem 18, 28 which can be moved on a respective inclined slide which is here constituted by a slider 31, 41 pierced on a vertical plate 30,40 which is perpendicularly fixed on the stationary structure. The top end of such slide 31, 41 is more separate from the wall than its lower end.

**[0022]** The stem 18, 28 has a cable 14, 24 coupled which at its other end (Fig. 1 and 2) is joined to a spring 19. A pulley 16, 26, arranged above such second length 12, 22, is guiding the cable 14, 24 to the spring 19 and as well the pulley as the spring are fixed on the stationary structure. This mechanism of cable, pulley and spring cooperates lifting the weight of the leaf 2 when starting to open the leaf 2 and dampening the leaf 2 fall at the end of the closing operation and it constitutes therefore means for assisting to the leaf 2 motion.

**[0023]** Fig. 1 shows the sliding door 1 in open position. To close the door 1, the wheels 8,9 rolling has to be start-

ed on the stationary lengths 11, 21 of the rails 10, 20. When the wheels 8, 9 enter on the respective moving lengths 12, 22 of the rails 10, 20, such moving lengths still remain in horizontal position by virtue of the spring 19 traction. But as the wheels 8, 9 are going closer to the end of the respective moving lengths 12, 22, the door 1 weight overcomes the spring 19 traction and the stems 18, 28 smoothly slide on their respective slides 31, 41 allowing and guiding the moving lengths 12, 22 slope of the rails 10, 20. The end position inclined towards the wall and downwards the floor of each moving length 12, 22 leaves the leaf 2 at a closed position in which it is supported perfectly fit as well against the frame 3 of the door associated to the stationary structure as against the floor. This closed position is shown in Fig. 2.

**[0024]** To open the sliding door 1 the leaf 2 has to be lifted along the inclined moving lengths 12, 22 of the rails 10, 20. This operation does not mean a great effort because the spring 19 tension which remains loaded when the door 1 is closed, strongly contributes to lift the stem 18, 28 of each moving length 12, 22, assisting it to go up on its inclined slide 31, 41 and therefore to lift the leaf 2 until the wheels 8, 9 remain supported on the respective horizontal stationary lengths 11, 21 of the rails 10, 20 with which the moving lengths 12, 22 free of the leaf weight also remain horizontal.

**[0025]** In order to prevent that during the door opening or closing the wheels 8 and 9 can be lifted from their respective rails 10 and 20 when passing from the moving length 12, 22 to the stationary length 11, 21 due to the drawing effect from the spring 19 or vice versa, it has been provided to incorporate a stop device 50 which is shown in details in Fig. 6 and 7.

**[0026]** In the said Fig. 6 and 7 and to best clarify the drawing, a significant part of the door stationary structure has been omitted to visualize elements which could remain concealed by them. The mechanism 50 includes a pair of stop sets 51, 55, fixed separate on the stationary structure in positions adapted to guide respective maintaining wheels 52 mounted on the leaf 2 ends above respectively the wheels 8, 9. Both stop sets 51, 55 and their respective maintaining wheels 52 are analogous therefore in Fig. 6 and 7 only one of them is shown corresponding to an end of the leaf 2.

**[0027]** Each stop set 51, 55 comprises a first stop 51 having the shape of a top rolling surface located with relation to the position of the maintaining wheel 52 when it is located at the highest point (Fig. 6) corresponding to the open position of the leaf 2 and to the bigger part of transition between the open position and the closed position, that is to say, while the wheels 8, 9 roll on the stationary lengths 11, 21 of the rails 10, 20. At the end of each stop 51 there is a second stop 55 located at a position related to the position of the maintaining wheel 52 when this later is located at the lowest point at the closed position of the leaf 2 (Fig. 7), that is to say, when the wheels 8, 9 arrived to the final ends of the moving lengths 12, 22 of the rails 10, 20 these later being in-

clined. In order to prevent that the wheel 52 can briskly knock the second stop 55, this later has transition inclined planes 43 and 54 at its ends.

**[0028]** Obviously, the sliding door of this invention can include an electric engine or some other one which provides the closing and opening motion of the leaf 2.

**[0029]** The invention has been disclosed with reference to a concrete embodiment, but a man of the art can easily imagine variations and modifications of concrete features of the invention which would also be comprised within the scope of the protection defined in the claims appended.

**[0030]** For example, the spring can be replaced by any device storing potential energy.

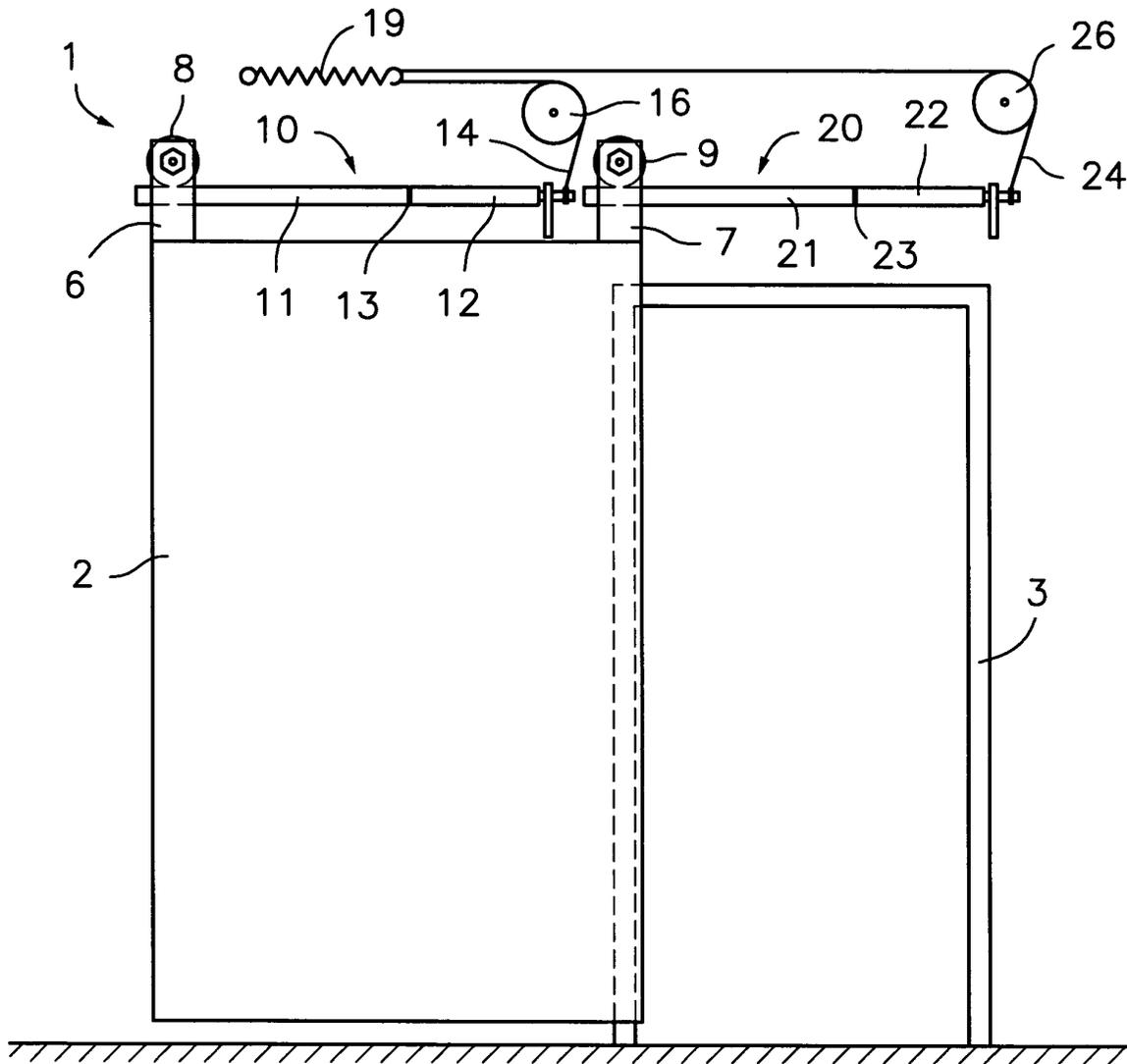
**[0031]** On the other hand, the sliding door can have two leaves instead of one, with corresponding constructive modifications.

## 20 Claims

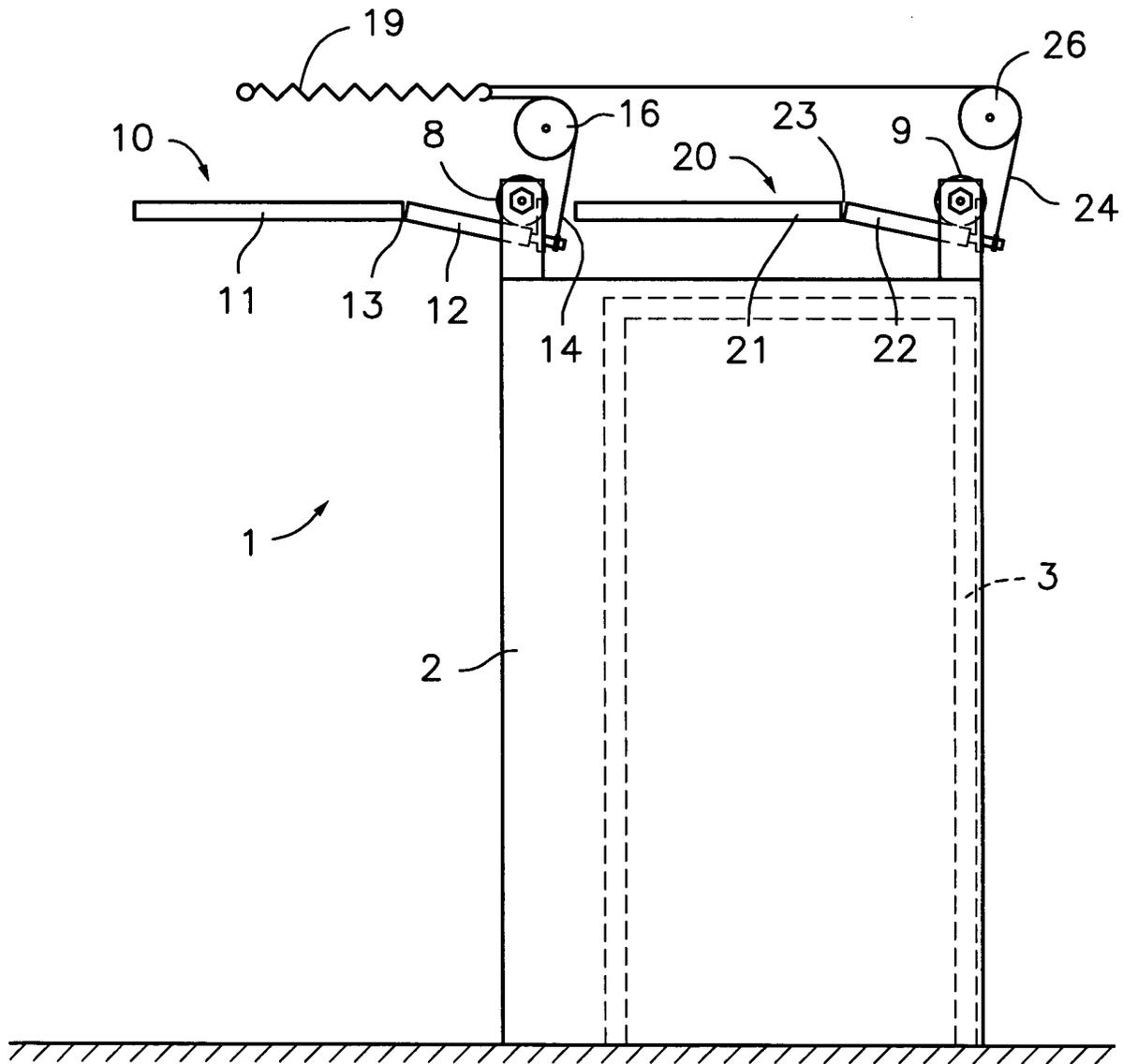
1. Sliding door comprising a leaf (2) which is moving with respect to a stationary structure and at least two rails (10, 20) for supporting the leaf (2) and guiding the travel thereof between one first position, in which the leaf (2) is at least partly open and separate from the door frame (3) and a second position in which the leaf (2) is closed and leaning against such frame (3) and supported on the floor, **characterized in that** it includes at least two supporting and guiding rails (10, 20) each comprising a stationary length (11, 21) integral with the said stationary structure and a moving length (12, 22) associated by one end to the said stationary length (11, 21) so that it can tilt between a first position corresponding to the said first position of the leaf (2) in which the said moving length (12, 22) remains aligned with the stationary length (11, 21) and a second position corresponding to the said second position of the leaf (2) in which the moving length (12, 22) remains inclined with respect to the stationary length (11, 21) and with its free end located at a lesser distance from the stationary structure of the door and a lesser height than the stationary length (11, 21).
2. Sliding door according to claim 1, **characterized in that** the leaf (2) of the door is hanging from the said at least two supporting and guiding rails (10, 20) by means of at least as many respective rolling or sliding elements (8, 9).
3. Sliding door according to claim 2, **characterized in that** the said free end of the said moving length (12, 22) is guided in its travels between the said first and second positions by an inclined slide (31, 41) integral with the stationary structure of the door.
4. Sliding door according to claim 3, **characterized in**

**that** it comprises means for assisting the leaf (2) travel between its first and second positions.

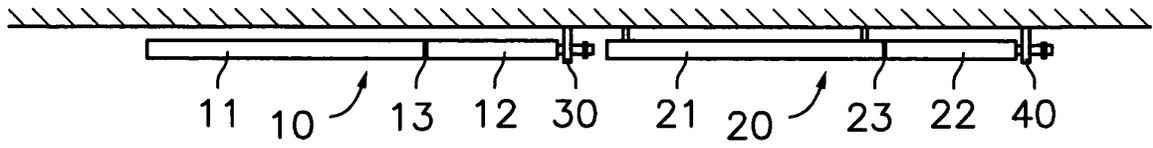
5. Sliding door according to claim 4, **characterized in that** the said means for assisting the leaf (2) travel comprise means for storing the potential energy (19) which absorb energy during the leaf (2) closing motion and deliver the energy stored during the opening motion thereof, the said means storing the potential energy (19) being connected to the moving length (12, 22) of the supporting and guiding rail (10, 20) to help its tilting from the second position to the first position cooperating to lift the door weight and from the first position to the second position dampening the door weight fall. 5 10 15
6. Sliding door according to claim 5, **characterized in that** the said means assisting the leaf (2) motion comprise for each moving length (12, 22) of each supporting and guiding rail (10, 20) a spring having a first end fixed on the door stationary structure and a second end linked to the free end of the respective moving length (12, 22). 20
7. Sliding door according to claim 5, **characterized in that** the said means assisting the leaf (2) motion comprise a spring (19) which has a first end fixed on the door stationary structure and a second end linked to the free ends of the moving lengths (12, 22) of the supporting and guiding rails (10, 20) which are at least two, through as many respective return cables (14,24) and pulleys (16, 26). 25 30
8. Sliding door according to claim 1, **characterized in that** each moving length (12, 22) is coupled to the respective stationary length (11, 21) by means of a hinge or elastic junction (13, 23). 35
9. Sliding door according to claim 2, **characterized in that** it comprises a stop device (50) designed to prevent that the said rolling or sliding elements (8, 9) leave their corresponding supporting and guiding rails (10, 20). 40
10. Sliding door according to the claim 9, **characterized in that** the said stop device (50) comprises a pair of stop sets (51, 55) fixed separate on the stationary structure in positions adapted to guide respective maintaining wheels (52) mounted on the leaf (2) with relation to the wheels (8, 9) at a higher level than them. 45 50
11. Sliding door according to claim 10, **characterized in that** each stop set (51, 55) comprises a first stop (51) located above corresponding rail (10, 20) and with relation to the higher position of the maintaining wheel (52) and a second stop (55) located above the final end of corresponding stationary length (12, 22) at a position related with the lower position of the maintaining wheel (52) at least one inclined transition plane (54) existing between each first and second stops (51, 55). 55
12. Sliding door according to claim 1, **characterized in that** the supporting and guiding rails (10, 20) are aligned to each other.
13. Sliding door according to claim 1, **characterized in that** the supporting and guiding rails (10, 20) are moved on a same horizontal or vertical plane and partly overlapping each other.



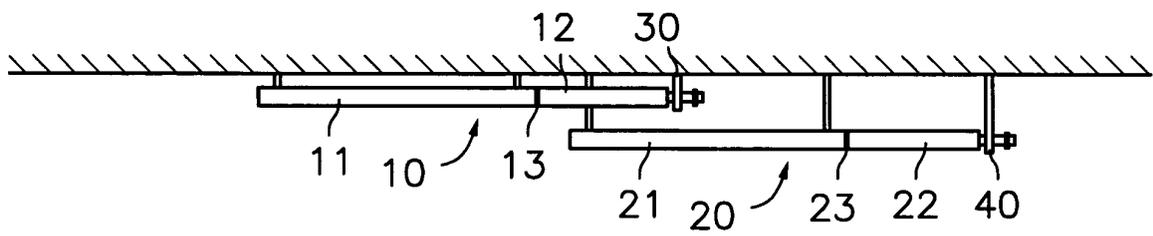
**Fig. 1**



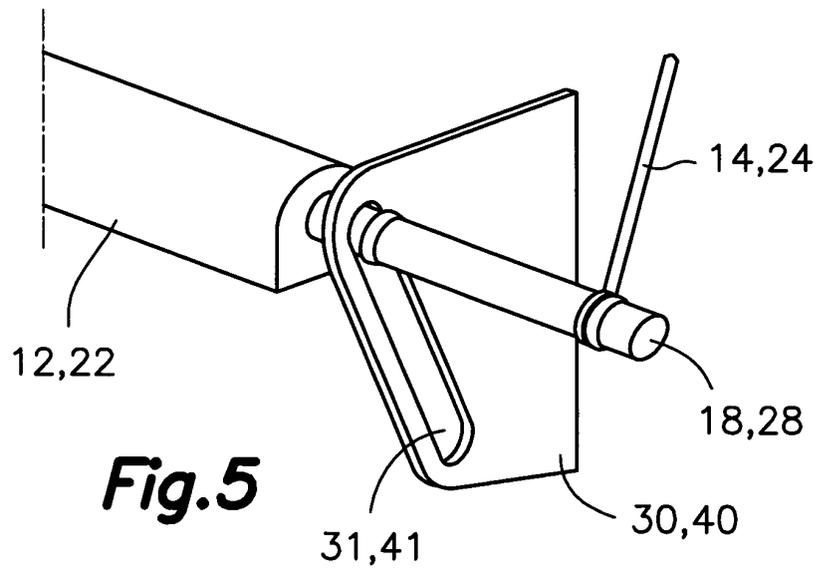
**Fig.2**



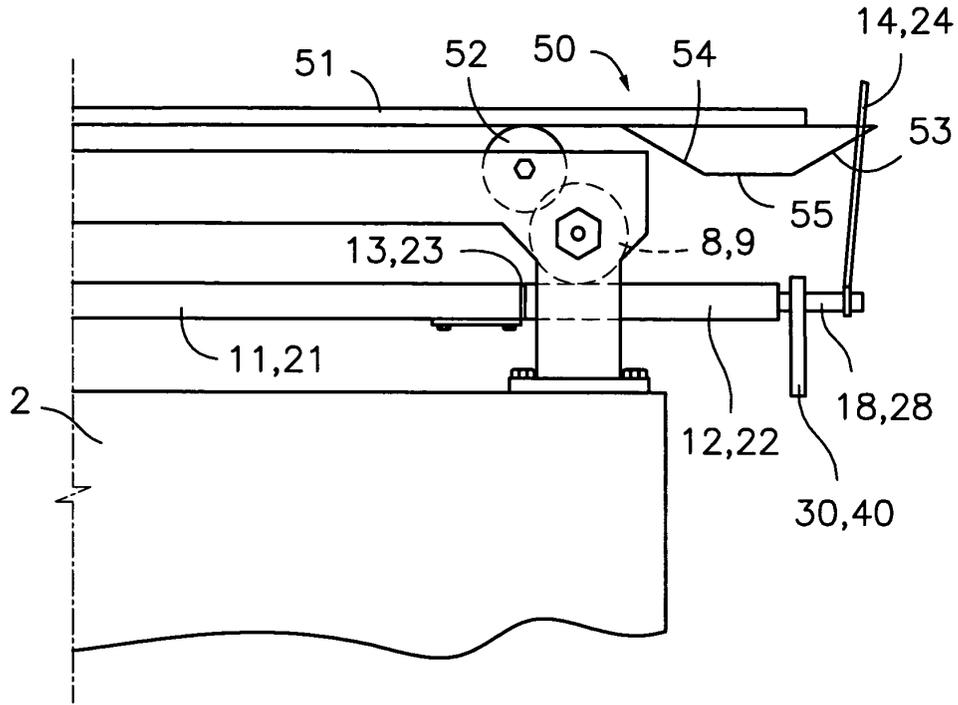
**Fig. 3**



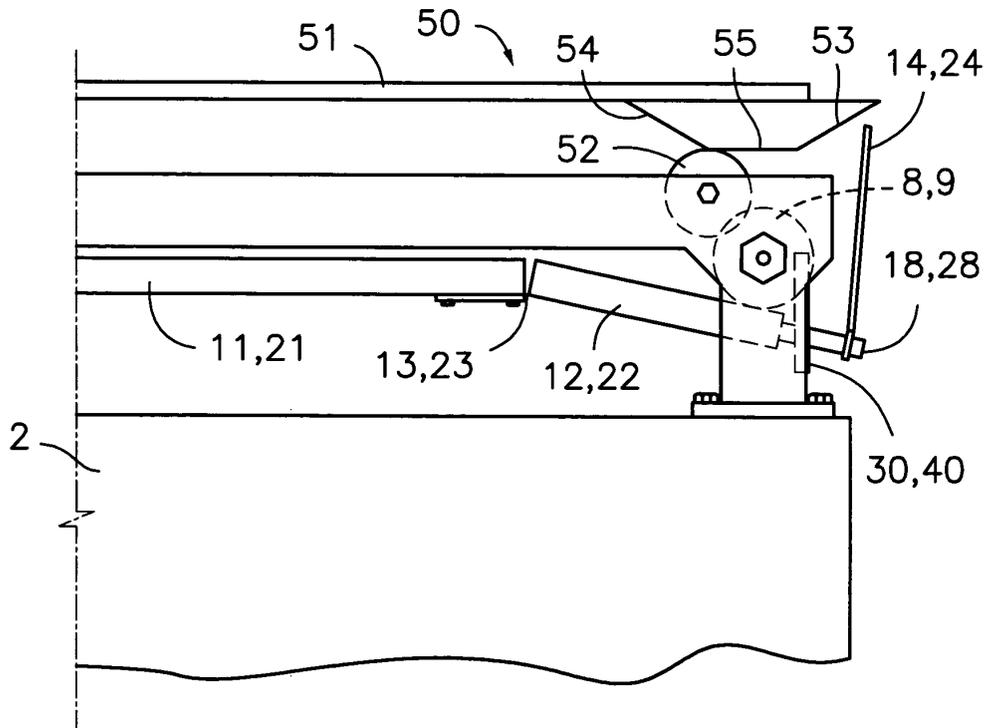
**Fig. 4**



**Fig. 5**



**Fig.6**



**Fig.7**



DOCUMENTS CONSIDERED TO BE RELEVANT			
Category	Citation of document with indication, where appropriate, of relevant passages	Relevant to claim	CLASSIFICATION OF THE APPLICATION (Int.Cl.7)
D,A	WO 98/51895 A (WOESS FRANZ) 19 November 1998 (1998-11-19) * abstract; figure 7 *	1	E05F1/04
A	--- PATENT ABSTRACTS OF JAPAN vol. 2000, no. 15, 6 April 2001 (2001-04-06) & JP 2000 345761 A (SHIBUTANI:KK), 12 December 2000 (2000-12-12) * abstract *	1	
The present search report has been drawn up for all claims			TECHNICAL FIELDS SEARCHED (Int.Cl.7)
			E05F
Place of search		Date of completion of the search	Examiner
THE HAGUE		3 June 2004	Witasse-Moreau, C
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**ANNEX TO THE EUROPEAN SEARCH REPORT  
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