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

(11) EP 1 705 326 A2

(12) EUROPEAN PATENT APPLICATION

(43) Date of publication:
27.09.2006 Bulletin 2006/39

(51) Int Cl.:
E05D 15/06 *(2006.01)*

(21) Application number: **06075648.3**

(22) Date of filing: **21.03.2006**

(84) Designated Contracting States:
AT BE BG CH CY CZ DE DK EE ES FI FR GB GR HU IE IS IT LI LT LU LV MC NL PL PT RO SE SI SK TR
Designated Extension States:
AL BA HR MK YU

(30) Priority: **21.03.2005 NL 1028583**

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(54) Floating door construction making use of a magnetic field

(57) The present invention relates to a device for opening and closing a passage in a wall, comprising:
-a frame with a groove arranged therein;
-a door element arranged slidably in the frame;
-permanent magnets arranged on or close to the upper edge of the door element;
-one or more wheels which are mounted on the door element and which run in the groove during sliding of the door element; and
-a ferromagnetic member arranged between the magnets and the upper edge of the door element.

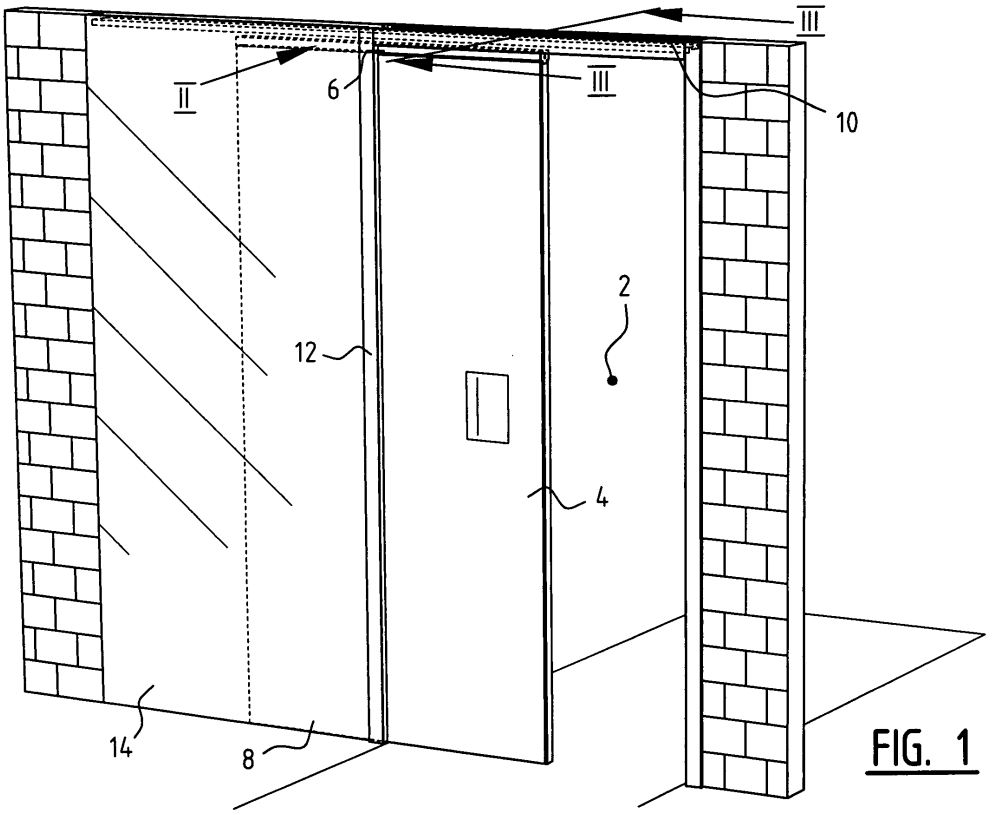

FIG. 1

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Description

[0001] The invention relates to a device with a sliding door for opening and closing a passage.

[0002] The sliding door can be accommodated with a complete frame in a finished wall or partition wall, wherein the so-called cavity part, together with the wall or partition wall, is finished such that it is concealed from view, wherein the passage opening is framed by a lintel and door posts.

[0003] GB-A-1.089.605 described a construction in which a door element is embodied slidably in a frame by applying magnets.

[0004] NL-192997 describes a sliding door assembly with a small number of magnets.

[0005] A problem of the known sliding door constructions is the strength of the magnetic field.

[0006] An associated problem in known sliding door constructions is that components of the construction have a disruptive effect on the magnetic field.

[0007] The present invention has for its object to obviate the above stated problems by providing a device and method comprising:

- a frame and a door element slidable therein;
- permanently arranged magnets on one side of this door element such that this door element is slidable in the frame due to the permanent magnetic field, wherein a magnetic field is strengthened by arranging a ferromagnetic member embodied as steel plate between the magnets and the upper edge of the door element directly below the magnets.

[0008] The magnetic field strength is strengthened on the upper side of the magnet, with an improvement of for instance 100%. The ferromagnetic member is preferably a metal strip with a thickness of 4 mm.

[0009] Wheels or rollers are arranged on the top of the door on either side of the row of magnets for the purpose of guiding the door. In the present invention these wheels are arranged in a plastic housing into which these wheels can be placed with a clicking movement. These wheels can thus be readily exchanged when they are broken or become jammed and/or fouled; they are easy to clean and it is also possible to arrange, adjacently of the plastic housing of the wheels, extra magnets which on the one hand fill up the space and on the other enhance the magnetic action.

[0010] The magnetic elements are preferably block-shaped and of sintered, permanently paramagnetically polarized material, preferably ferrite, samarium cobalt or Neodymium iron alloy, or of other alloys of lanthanides, cobalt and/or iron.

[0011] In the device according to the present invention the magnets are preferably arranged on the top of the door. This has the advantage that wide magnets can be used, so that weaker magnets can be used, preferably not very expensive ferrite magnets. Assembly is moreover not very labour-intensive, nor is the changing of magnets, which is likewise of importance for maintenance of the row of magnets.

[0012] In the present invention the magnets are arranged in a plastic housing which is T-shaped and arranged upside down, i.e. with the broad part of the T directed downward. This makes it possible to arrange the magnets one by one in an aluminium profile, this profile being arranged on the top side of the door. This aluminium profile has on either side two upright edges between which the magnets are arranged. The edges are further provided with a protrusion which is arranged along the whole length thereof and under which the T-shaped housing of the magnets is secured. The further advantage relates to the space present between the plastic casing of the magnet and the aluminium profile. In this space can be arranged a strip of a material which foams when heated. Such material has for instance fire-resistant properties, so that in the case of fire the space between the door and the door jamb is automatically filled by the foaming material, thus preventing an airflow from supplying fresh oxygen and preventing the spread of the fire.

[0013] A spring-back mechanism is preferably arranged on the rear end surface of the door panel. This means that, when opened, the door with the mechanism disappears completely into the frame and is eventually pressed against an end post. In order to reclose the door the door must be pressed slightly inward into the frame, wherein the spring mechanism clicks loose and begins to press against the end post so as to push the door shut.

[0014] According to the present invention the length of the magnet is short in the direction parallel to the door, whereby more groups of alternately oriented magnets (north/south) can be arranged adjacently of each other so that the magnetic field is continuous, which results in an improvement in the attractive force.

[0015] The above-mentioned aluminium profile according to the preferred embodiment is non-magnetizable, so that the magnetic field does not change direction and/or is not conducted.

[0016] In the case of doors wherein magnets are used which are manufactured from the material neodymium, a casing is preferably applied to prevent oxidizing of such magnets. It is also possible to provide the magnets with a protective coating. The additional advantage of the casing is that the magnets can be fixed in simple manner in the profile and can also be exchanged in simple manner for stronger or weaker magnets.

[0017] In the device according to the present invention a means for limiting the drop height is preferably arranged. Such a limiting means is arranged on the upper edge on the magnet carriage and on the underside as door guide. Because the operation of the floating door is based on magnetic attraction, the door can be pulled downward whereby the door can fall out of the frame. The limiting means on the underside of the door consists of a profile piece, wherein the profile preferably corre-

sponds to the shape of the door, so that the door cannot be pulled any further downward than is allowed. When the door is pulled downward, this is not possible any further than the distance defined by the limiting means, wherein after the door is released the door will return to its original position. This limiting means on the underside of the door is fastened by means of one or more screws to the frame or the wall, and will first have to be removed before the door can be taken out of the frame.

[0018] Further advantages, features and details of the present invention will be elucidated on the basis of the following description with reference to the accompanying drawings, in which:

- figure 1 shows a view of a sliding door construction according to the present invention;
- figure 2 shows a view of the upper edge of the sliding door element of figure 1;
- figures 3A, B and C show a view of the cross-section of figure 1;
- figures 4A and B show an assembly drawing of the wheels in the upper edge of the door element as according to a preferred embodiment.

[0019] A passage 2 (figure 1) can be opened or closed with a sliding door element 4 which has an upper edge 6 and a lower edge 8. Sliding door element 4 moves along side posts 12 connected to the fixed wall. In the opened position the sliding door element 4 is situated along a wall or, preferably, in a wall cavity 14.

[0020] Magnets 22 are placed on the upper edge 6 (figure 2). In the preferred embodiment there are placed on the outer ends of the upper edge a number of wheels 24 which provide for guiding of sliding door element 4. Magnets 22 are placed in a U-profile 26 which holds these magnets. Situated under the magnets is a ferromagnetic member 23 embodied as a metal strip for the purpose of strengthening the magnetic field (figure 3A). The U-profile is closed at the outer ends with an end guard 28 which also functions as means for limiting the drop height on the top side of the door.

[0021] Opposite the upper edge 6 of sliding door element 4 a wooden adjusting lath 32 is arranged against wall 34 using a screw 36 (figure 3A). In the preferred embodiment a clamping strip 40 is fixed on either side of metal strip 32 using a screw 38, with which strip the profiles or finishing trims 10 are held in place. Held fixedly with the same screw 38 is a suspension bracket 42 on which the guide 44 for wheels 24 is placed. Wheels 24 are situated in a housing 46 forming part of door element 4. In a further preferred embodiment the fastening of the clamping strip 40 is such that a suspension bracket 42 and the guide/support 44 are also fixed using the same fastening (figure 3B). Sliding door element 4 is guided on the underside by a guide profile 35 which also serves as drop height limiting means on the underside of the door element (figure 3C).

[0022] Situated on the outer end of the upper edge (figures 4A and B) are wheels 24 in their housing 46 which is fixed in the door element 4 by means of a screw 48. The end guard 28, also drop height limiting means on the top side of the door, is fixed by means of a screw 50 to the upper edge/magnet carriage. In the preferred embodiment magnets 22 can be pushed into the profile 52 specially manufactured for this purpose, such that simple placing of magnets 22 is possible.

[0023] Assembly of the sliding door construction can be carried out in a short time according to the present invention since the entire frame can be set in place, built in and finished during the structural work and completion of a building without danger of fouling the running mechanism.

[0024] The sliding door itself can be installed during finishing of the building, by first inserting it diagonally into the wall cavity and then lifting it until the strip moves within the attractive force of the magnets. The drop height limiting means is then placed.

[0025] The construction can be further supplemented by an automatic control, driven for instance by an electric motor.

[0026] Weights of commercial doors with dimensions 201 x 83 cm are:

light poplar wood door:	16 to 18.5 kg
chipboard door:	45 kg
fireproof door:	50 kg
sound-insulating door:	50 kg
x-ray insulating door:	64 kg
bullet-proof door:	80 kg

[0027] The attractive force of the magnet will have to be 100 to 150 N higher than the door weight. An element of 1 kg Neodymium iron has a coercive force such that an attractive force is achieved of about 1200 N. This means that for a door of 18.5 kg an attractive force is required of 330 N, and therefore a magnet of 0.27 kg. For a door of 45 kg this is respectively 60 kg and 0.50 kg.

[0028] The present invention is not limited to the above described preferred embodiments thereof; the rights sought are defined by the following claims, within the scope of which many modifications can be envisaged.

Claims

1. Device for opening and closing a passage in a wall, comprising:

- a frame with a groove arranged therein;
- a door element arranged slidably in the frame;
- permanent magnets arranged on or close to the upper edge of the door element;
- one or more wheels which are mounted on the door element and which run in the groove during sliding of the door element; and

- a ferromagnetic member arranged between the magnets and the upper edge of the door element.

2. Device as claimed in claim 1, wherein one or more wheels are arranged on either side of magnets.

3. Device as claimed in claim 2, provided with a housing in which the wheels are arranged rotatably.

4. Device as claimed in claim 1, 2 or 3, wherein the magnets are placed with the ferromagnetic member directly onto the upper edge of the door element in a non-magnetic housing.

5. Device as claimed in claim 4, wherein the magnets are provided with a casing and/or a coating.

6. Device as claimed in one or more of the foregoing claims, wherein the magnets are of ferrite material.

7. Device as claimed in one or more of the foregoing claims, wherein the steel plate has a thickness of 2-10 mm, preferably about 4 mm.

8. Device as claimed in one or more of the foregoing claims, wherein two or more magnets are alternately oriented.

9. Device as claimed in one or more of the foregoing claims, wherein the housing is embodied in a non-magnetizable material such as aluminium.

10. Device as claimed in one or more of the foregoing claims, wherein a drop height limiting means is arranged to hold the door element in the magnetic field.

11. Device as claimed in claim 10, wherein the drop height limiting means comprises a member which is arranged removably in or on the frame.

12. Method for opening and closing a passage wherein a device as claimed in one or more of the foregoing claims is applied.

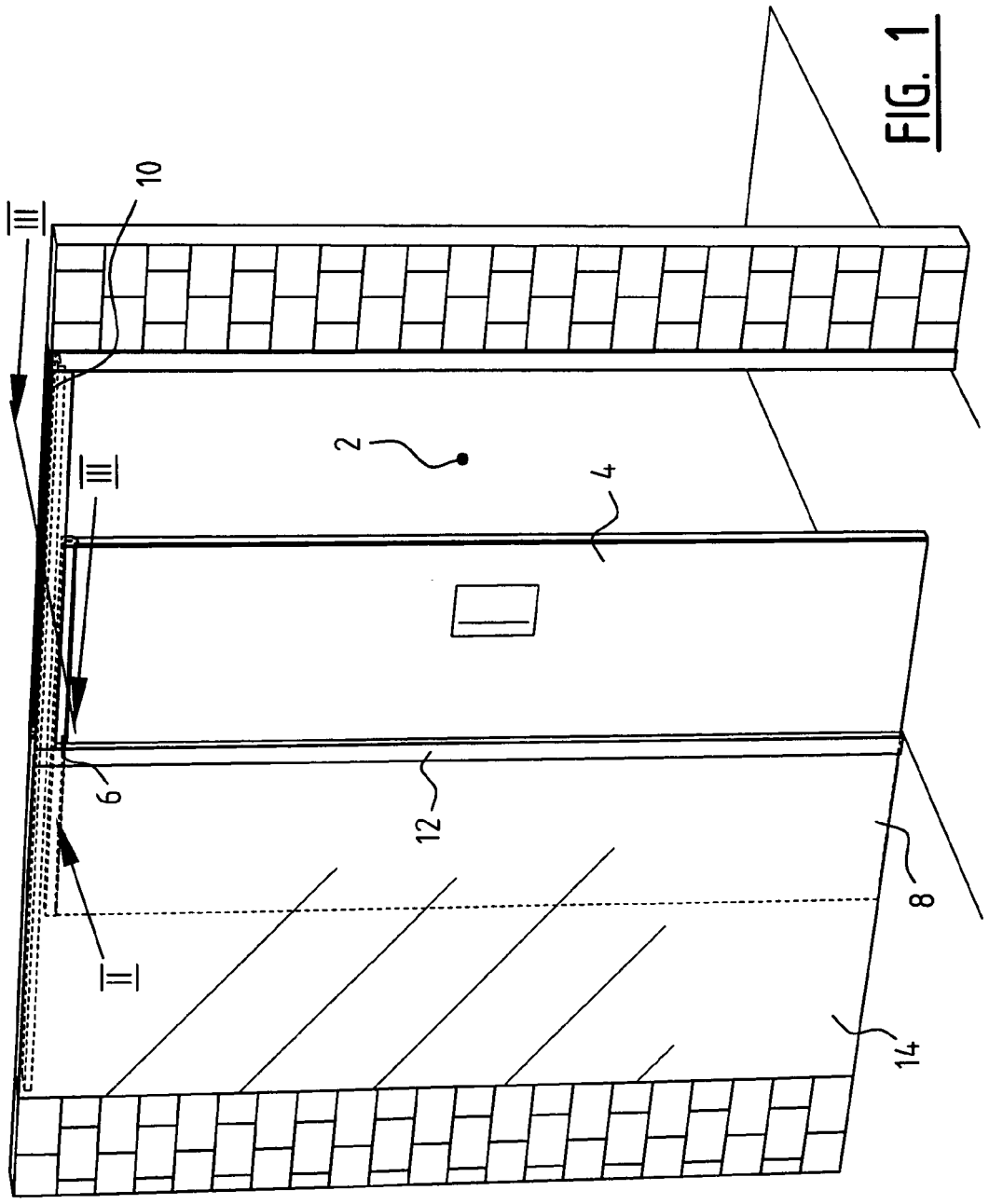

FIG. 1

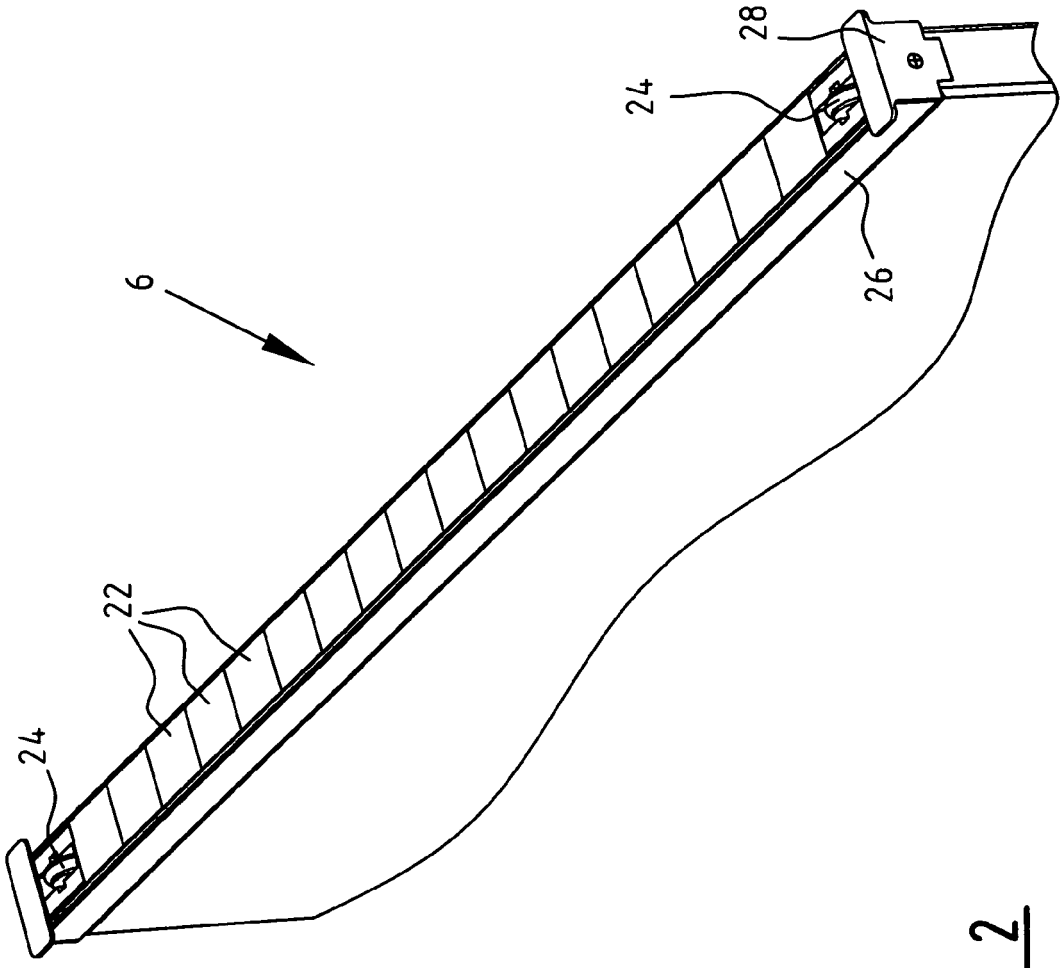

FIG. 2

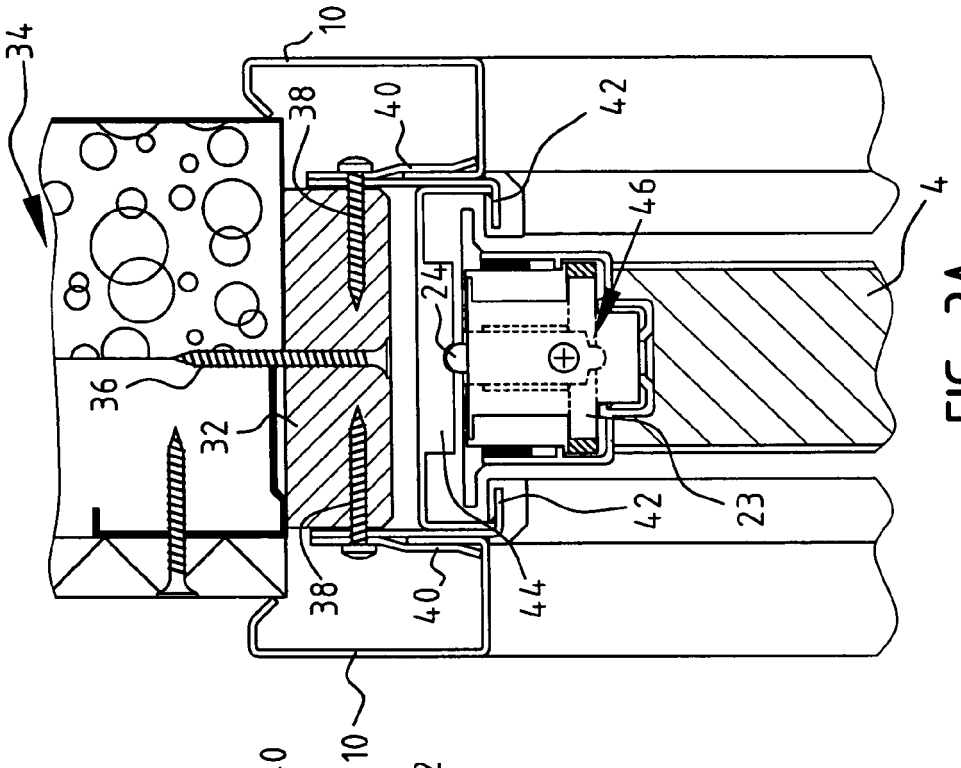

FIG. 3A

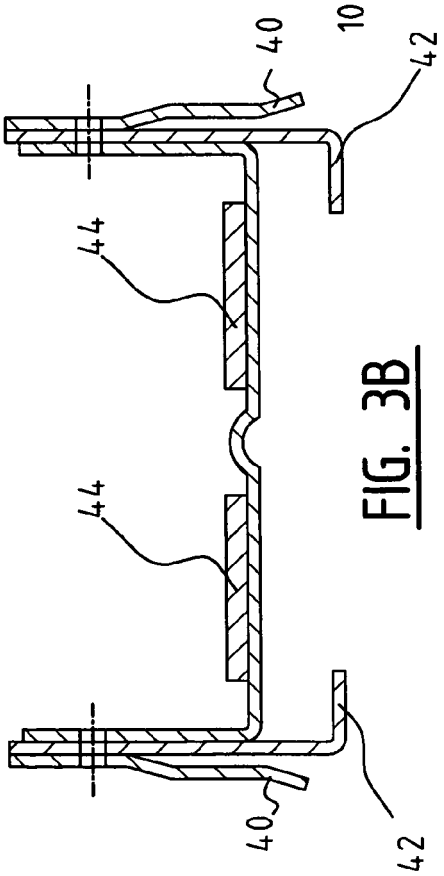

FIG. 3B

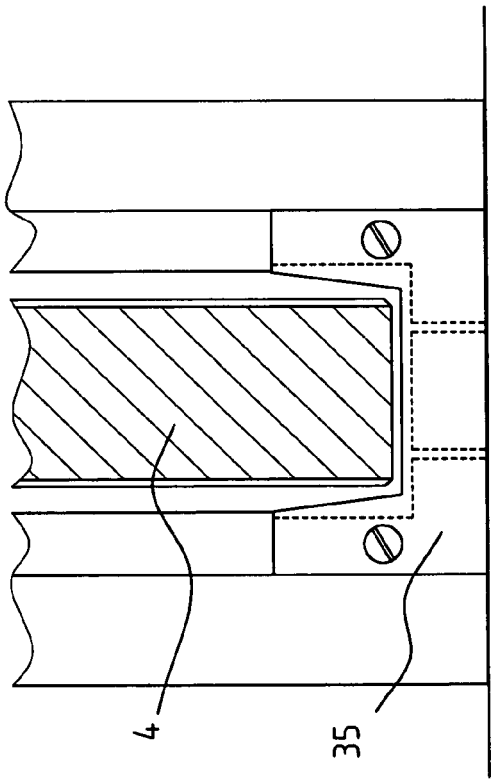

FIG. 3C

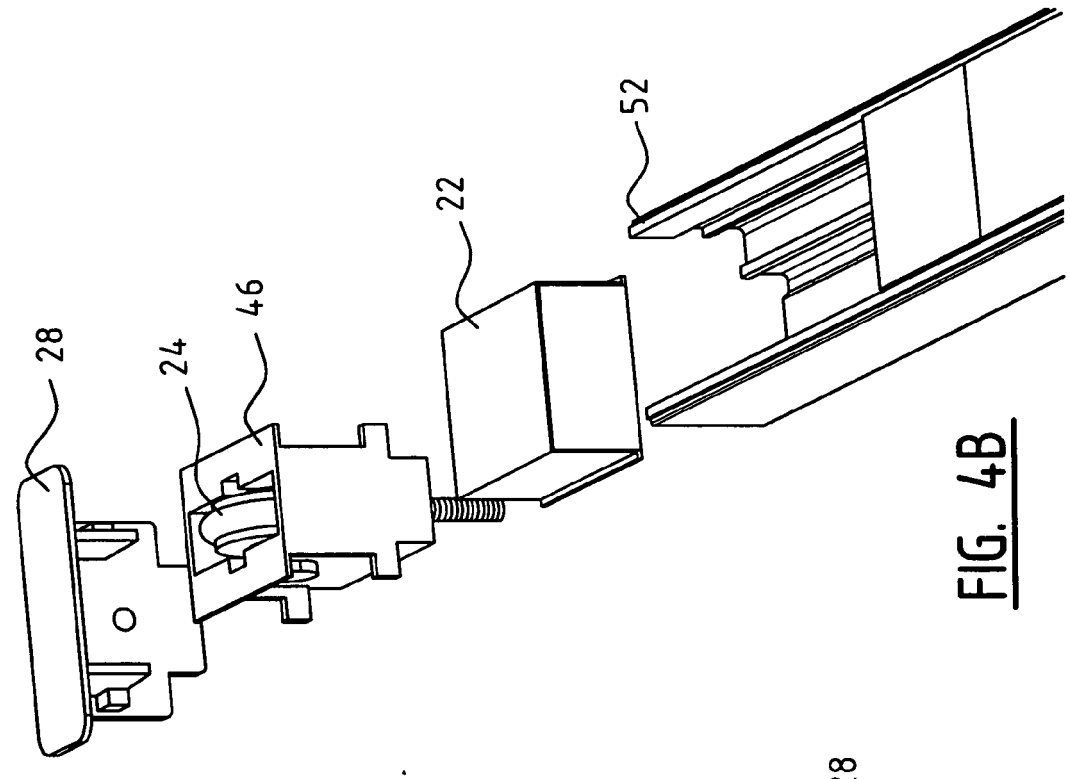

FIG. 4B

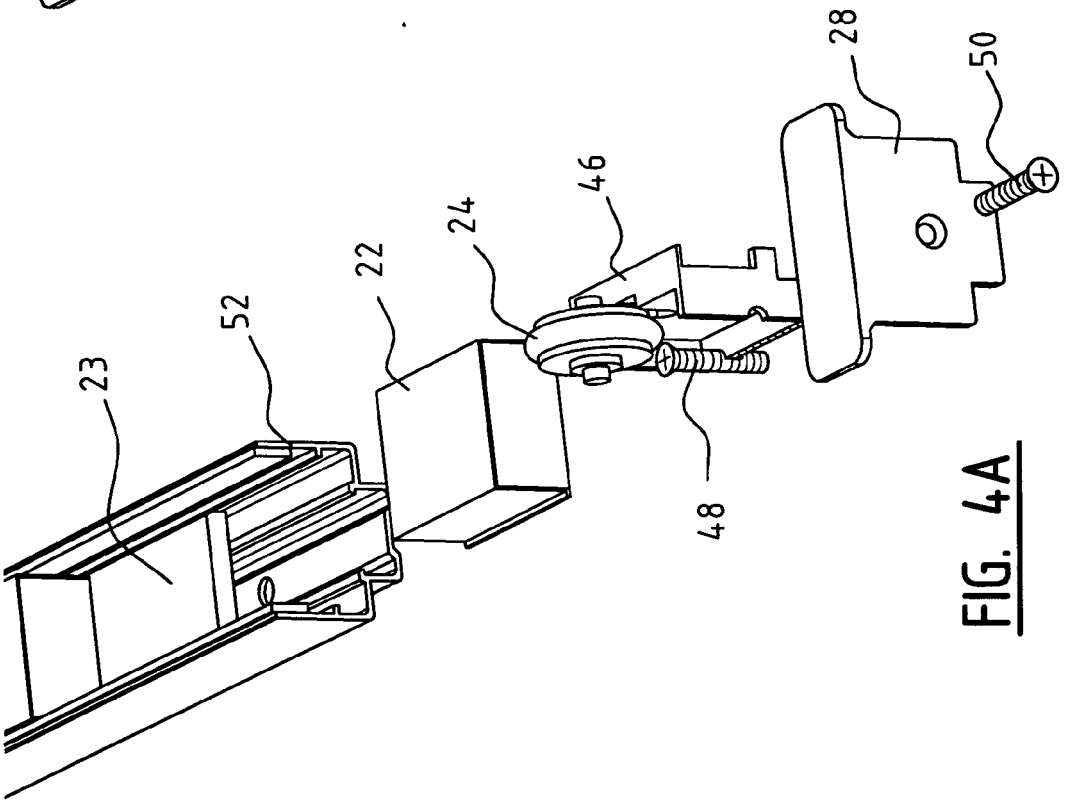

FIG. 4A

REFERENCES CITED IN THE DESCRIPTION

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Patent documents cited in the description

- GB 1089605 A **[0003]**
- NL 192997 **[0004]**