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(54) **Flood Barrier for a Doorway**

Flutungsbarriere für einen Türgang

Barrière anti-inondation destinée à un encadrement de porte

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US-B1- 7 523 589

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Description

[0001] This invention relates to a flood barrier for a doorway.

[0002] Many buildings are located in areas that are prone to flooding. Climate change is leading to increasing rain fall levels and rising sea levels. This is causing increasing numbers of properties to become at risk from flooding.

[0003] Flooding can lead to severe damage to the contents of a property and to the structure of the building. An increased incidence in flooding in recent years has resulted in increasing insurance premiums and, in areas that are particularly prone to flooding or which have previously been subject of an insurance claim for flood damage, a refusal by insurance companies to offer flood insurance. This can lead to difficulties in selling a property and a severe fall in property values.

[0004] Traditionally the action taken when flooding threatens a property has been to build a barrier of sandbags at each doorway. Even if the materials necessary for building a sandbag barrier are to hand, process of building such a barrier involves a lot of heavy lifting and is particularly time consuming. Often a warning of potential flooding may not be given in sufficient time to enable sufficient sandbags to be obtained and for barriers to be erected. A further disadvantage of traditional sandbag barriers is that sand is porous therefore, whilst it may provide temporary protection from flooding where the flooding lasts only a short time, such barriers are not effective when flooding persists for a long period of time.

[0005] Other attempts to provide a more permanent, reliable and easier to use barrier for preventing flood water from entering a property via a doorway have typically required the permanent fitment of a channels or guides to the doorway for receiving a gate or panel to provide a water tight barrier across at least a lower part of the doorway to provide an adequate seal around the doorway. Examples of such known barriers are shown in GB 2 114 199 and GB 2 254 639. Such permanently fitted channels are prone to damage during normal use of the doorway, may create an undesirable barrier or lip around a lower region of the doorway and may be considered unsightly. Also, it is necessary to fit such channels and other barrier fittings to the doorway before a risk of flooding arises. Therefore the fitment of such barrier requires considerable advance planning. US 2003/102637, WO2004/106692 and US 7523589 show examples of other known flood barriers.

[0006] According to the present invention there is provided a flood barrier for a doorway as claimed in claim 1.

[0007] In a preferred embodiment the barrier includes a pump for inflating said at least one inflatable chamber of the seal. Preferably said pump is mounted on the barrier, preferably to be located behind a front or outer skin of the panel. A pressure gauge may be provided for displaying the pressure of air or liquid contained within the seal.

[0008] In a preferred embodiment said at least one inflatable chamber comprises an inflatable tube or elongate member located within a channel formed around at least the bottom and opposed side edges of the panel whereby inflation of the seal causes the seal to extend from said channel to engage the sides of the doorway within which the barrier is fitted.

[0009] In one embodiment the seal further comprises a layer of conformable material, such as silicone rubber or other suitably malleable material, provided around an outermost side of the at least one inflatable chamber to be located between the at least one inflatable chamber and the doorway, such layer readily conforming to the shape of the sides of the doorway when the at least one inflatable chamber is inflated to provide an enhanced water tight seal, particularly when the barrier is fitted within a doorway having an uneven surface, such as brickwork. Preferably said conformable material comprises a relatively soft elastic material, such material being urged into contact with the sides of a doorway when the at least one inflatable chamber is inflated, said material returning to its original size and shape once the at least one inflatable chamber is deflated.

[0010] Preferably the panel comprises at least two parts adapted to be moved towards and away from each other to vary the overall width of the panel, an actuating means being provided for moving said panel parts towards and away from each other to enable the panel to be expanded in a transverse direction to allow the panel to be fitted to a doorway with the seal in tight contact with the bottom and at least a portion of the sides of the doorway. In a preferred embodiment said panel comprises a central section and first and second side sections extending from opposite sides of the central section. Preferably said central section is defined by front and rear skins, said first and second sections being telescopically mounted between said front and rear skins of the central section. A waterproof seal, such as an elastomeric gasket, may be provided between each of the first and second side sections and the central section to prevent leakage therebetween.

[0011] Where the seal comprises at least one inflatable chamber, movement of the at least two parts of the panel away from one another may cause the side portions of the seal adjacent the sides of the doorway to be compressed, increasing the pressure within the at least one inflatable chamber and causing the lower portion of the seal to expand and/or press against the bottom of the doorway to enhance the seal between the barrier and the doorway. Where the seal comprises more than one inflatable chamber preferably all of the inflatable chambers are linked so that air or fluid can pass between said chambers.

[0012] An embodiment of the present invention will now be described, by way of example only, with reference to the accompanying drawings, in which:-

Figure 1 is a perspective view of a flood barrier ac-

cording to an embodiment of the present invention in a fully retracted configuration;

Figure 2 is a perspective view of the barrier of Figure 1 in a fully extended configuration;

Figure 3 is a perspective view of the barrier of Figure 1 showing the use of the integral pump to expand the inflatable seal thereof;

Figure 4 is a further perspective view of the barrier of Figure 1 in its fully extended configuration;

Figure 5 is a perspective view of the barrier of Figure 1 with a rear skin of the central section of the barrier removed;

Figure 6 is an end view of the barrier of Figure 1;

Figure 7 is a sectional view on line A-A of Figure 6;

Figure 8 is a rear view of the barrier of Figure 1;

Figure 9 is a sectional view on line B-B of Figure 8;

Figure 10 is an end view of the barrier member of Figure 1 in a fully retracted configuration;

Figure 11 is a sectional view on line C-C of Figure 10;

Figure 12 is an exploded view of the barrier of Figure 1 illustrating the inflatable tubular seal;

Figure 13 is a rear view of the barrier of Figure 1 with the tubular seal inflated;

Figure 14 is a sectional view on line H-H of Figure 13;

Figure 15 is a detailed view of one end of the view of Figure 14;

Figure 16 is a perspective view of the barrier of Figure 1 with the tubular seal inflated; and

Figure 17 is a detailed perspective view showing the mounting of the tubular seal on the barrier.

[0013] As illustrated in the drawings, a flood barrier 10 according to an embodiment of the present invention comprises a rectangular panel forming a barrier in the bottom part of a doorway or window to prevent the ingress of floodwater into a building.

[0014] The barrier 10 comprises a central panel section 12 defined by front and rear skins 14,16 and upper and lower side portions 18,20, between which is telescopically mounted first and second side panel sections 22,24 extending from opposite sides of the central panel section 12. The first and second side panel sections 22,24 and the central panel section 12 may be made from plastic, metal or any other suitable material. In a preferred embodiment, the first and second side panel sections and the inner and outer skins of the central panel section are formed from injection moulded plastic material.

[0015] In order to provide a watertight seal between the first and second side panel sections and the central panel section of the barrier, elastomeric gaskets 26,28 (see Figure 5) are provided in recesses formed in the faces of the first and second side panel sections 22,24 to engage respective inner faces of the central panel section 12.

[0016] The lower sides of the central panel section 12 and first and second side panel sections 22,24 of the barrier 10 and the outer sides of the first and second side panel sections 22,24 of the barrier 10 are provided with

a continuous elongate channel within which is received an inflatable tubular seal 30, whereby the tubular seal 30 can be inflated to push the outer surfaces thereof into contact with the sides of a doorway or window opening within which the barrier 10 is located to define a watertight seal between the barrier 10 and the sides of the doorway or window opening.

[0017] As best shown in Figures 12 to 17, distal ends of the tubular seal 30 are secured to respective upper ends of the channels on the outer sides of the first and second panel sections 22,24 via clamping blocks 32,34 secured to an upper end of each channel, each end of the tubular seal 30 being clamped between a respective clamping block 32,34 and the respective channel within which it is located.

[0018] The tubular seal 30 is inflatable by means of a hand pump 36 mounted on the central panel section 12 of the barrier 10. A pressure gauge 38 is provided on a rear skin 16 of the central panel section 12 for displaying the pressure within the tubular seal 30. A handle 40 extends from the upper side 18 of the central panel section 12, whereby the handle 40 can be reciprocally pumped up and down to inflate the tubular seal 30. As shown in Figure 12, a filler pipe 42 is provided at a lower central region of the tubular seal 30 coupled to the pump 36. A pressure release valve 44 is provided alongside the pressure gauge 38 to allow the tubular seal 30 to be deflated when desired.

[0019] The first and second side panel sections 22,24 of the barrier 10 are slidably mounted within the central panel section 12 to be telescopically movable towards and away from each other to vary the width of the barrier 10 to allow the barrier 10 to be fitted to doorways of different width and to press the inflated tubular seal 30 into close contact with the sides of the doorway. A jacking mechanism is mounted on the central panel section 12 between the first and second side panel sections 22,24 of the barrier 10 for telescopically extending the first and second side panel sections 22,24 out of the central panel section 12 and each other to fit the barrier into a doorway or window opening.

[0020] In the illustrated embodiment, the jacking mechanism comprises a bar 46 extending between the first and second side panel sections 22,24 of the barrier 10 and through an aperture in a central region of the central panel section 12, the bar 46 having oppositely handed threaded ends. Each threaded end of the bar 48 is received in a correspondingly threaded aperture 48,50 in the respective side panel section 22,24. A ratchet handle 52 is mounted on a central portion of the bar 46. The ratchet handle 52 is adapted so that reciprocating movement of the handle 52 is converted into rotational movement of the bar 42 in a desired direction to move the first and second side panel sections 22,24 towards and away from each other to vary the width of the barrier.

[0021] The elasticity of the tubular seal 30 allows the seal 30 to stretch as the first and second side panel sections 22,24 are extended from the central panel section

12.

[0022] In use, the barrier 10 is located in a doorway or window opening and the ratchet handle 52 is operated to rotate the bar 46 and extend the first and second panel sections 22,24 from the central panel section 12 and into contact with the sides of the doorway. The barrier 10 is oriented within the doorway or window opening such that the ratchet handle 52 and pressure gauge 38 are located on a inner side of the barrier 10. As such, the ratchet handle 52 and release valve 44 can be operated from behind the barrier 10 and are protected from tampering once the barrier 10 has been installed due to their location behind the barrier 10.

[0023] The hand pump 36 is then operated to inflate the tubular seal 30 to compress the seal 30 into contact with the sides and bottom of the doorway such that the soft rubber sealing seal 30 conforms to the shape of the doorway or window opening's surfaces to form a watertight seal around the barrier 10.

[0024] Once the flooding has subsided the air can be released from the tubular seal 30 by opening the release valve 44 and ratchet handle 52 can be operated to rotate the bar 46 and retract the first and second side panel sections 22,24 to enable the barrier 10 to be removed from the doorway or window opening.

[0025] The barrier 10 may be constructed in any suitable dimensions to suit the dimensions of the doorway or window opening in which it is to be fitted. Due to the ability of the width of the barrier 10 to be adjusted, the barrier 10 may fit a range of different sized doorways or window openings. For example, in one version the barrier 10 may be constructed to vary in width between approximately 800mm and 1200mm. Other versions may be made to suit doorways or window openings having a width falling within a smaller or larger range of sizes.

[0026] The invention is not limited to the embodiment(s) described herein but can be amended or modified without departing from the scope of the present invention. For example, the ratchet handle 52 for rotating the bar 46 of the jacking mechanism may be replaced by an electric motor. Alternatively the jacking mechanism may be replaced by a hydraulic or pneumatic ram for extending and retracting the first and second panel sections 22,24 with respect to the central panel section 12.

Claims

1. A flood barrier (10) for a doorway comprising a panel (12) for blocking at least a portion of a doorway when the panel is mounted therein, a compressible resilient seal (30) being provided on at least a portion of the periphery of the panel (12) to extend at least along the bottom edge and opposed side edges of the panel to engage at least a lower portion of a doorway when the panel is fitted therein, and wherein the panel (12) comprises at least two parts (22,24) adapted to be moved towards and away from each

other to vary the overall width of the panel, an actuating means being provided for moving said panel parts (22,24) towards and away from each other to enable the panel (12) to be expanded in a transverse direction to allow the panel to be fitted to a doorway with the seal (30) in tight contact with the bottom and at least a portion of the sides of the doorway, the actuating means comprising a jacking mechanism for moving the first and second parts (22,24) of the panel with respect to one another, **characterised in that** said seal (30) comprises at least one inflatable chamber whereby the seal may be inflated with air or another fluid to form a watertight seal against the doorway in which the barrier is fitted, the jacking mechanism comprising a ratchet and pawl or a scissor jack or similar manually operable linear actuator, said jacking mechanism having an operating handle (52) located on a rear side of the barrier behind a front skin of the panel (12), or wherein the actuating means comprises a hydraulic or pneumatic actuator or an electrically driven actuating mechanism.

2. A flood barrier as claimed in claim 1, wherein the barrier includes a pump (36) for inflating said at least one inflatable chamber of the seal (30).
3. A flood barrier as claimed in any preceding claim, wherein said at least one inflatable chamber comprises an inflatable tube or elongate member located within a channel formed around at least the bottom and opposed side edges of the panel (12), whereby inflation of the seal (30) causes the seal to extend from said channel to engage the sides of the doorway within which the barrier is fitted.
4. A flood barrier as claimed in claim 3, wherein the seal (30) further comprises a layer of conformable material provided around an outermost side of the at least one inflatable chamber to be located between the at least one inflatable chamber and the doorway, such layer readily conforming to the shape of the sides of the doorway when the at least one inflatable chamber is inflated to provide an enhanced water tight seal.
5. A flood barrier as claimed in any preceding claim, wherein said panel (12) comprises a central section (12) and first and second side sections (22,24) extending from opposite sides of the central section (12).
6. A flood barrier as claimed in claim 5, wherein said central section (12) is defined by front and rear skins (14,16), said first and second sections (22,24) being telescopically mounted between said front and rear skins (14,16) of the central section.
7. A flood barrier as claimed in claim 6, wherein a wa-

terproof seal (26,28) is provided between each of the first and second side sections (22,24) and the central section (12) to prevent leakage therebetween.

8. A flood barrier as claimed in any preceding claim, wherein the seal (30) comprises at least one inflatable chamber, movement of the at least two parts of the panel away from one another causing the side portions of the seal (30) adjacent the sides of the doorway to be compressed, increasing the pressure within the at least one inflatable chamber and causing the lower portion of the seal to expand and/or press against the bottom of the doorway to enhance the seal between the barrier and the doorway.

Patentansprüche

1. Hochwasserbarriere (10) für eine Türöffnung, wobei die Hochwasserbarriere Folgendes umfasst: eine Platte (12) zum Blockieren von mindestens einem Teil einer Türöffnung, wenn die Platte darin angebracht ist, eine komprimierbare elastische Dichtung (30), die mindestens an einem Teil des Umfangs der Platte (12) vorgesehen ist, um sich mindestens entlang der Unterkante und gegenüberliegender Seitenkanten der Platte zu erstrecken, um mindestens in einen unteren Abschnitt einer Türöffnung einzugreifen, wenn die Platte darin angebracht ist, und wobei die Platte (12) mindestens zwei Teile (22, 24) umfasst, die dafür ausgelegt sind, zueinander hin und voneinander weg bewegt zu werden, um die Gesamtbreite der Platte zu variieren, wobei ein Betätigungsmittel zum Bewegen der Plattenteile (22, 24) zueinander hin und voneinander weg vorgesehen ist, damit die Platte (12) in einer Querrichtung erweitert werden kann, damit die Platte an einer Türöffnung mit der Dichtung (30) in engen Kontakt mit dem Boden und mindestens einem Teil der Seiten der Türöffnung angebracht werden kann, wobei das Betätigungsmittel einen Hebemechanismus zum Bewegen der ersten und zweiten Teile (22, 24) der Platte in Bezug zueinander umfasst, **dadurch gekennzeichnet, dass** die Dichtung (30) mindestens eine aufblasbare Kammer umfasst, wodurch die Dichtung mit Luft oder einem anderen Fluid aufgeblasen werden kann, um eine wasserdichte Abdichtung an der Türöffnung zu bilden, in der die Barriere angebracht ist, wobei der Hebemechanismus einen Sperrklinken- oder Scherenheber oder eine ähnliche manuell bedienbare Linearbetätigung umfasst, wobei der Hebemechanismus einen Betätigungsgriff (52) aufweist, der auf einer Rückseite der Barriere hinter einer vorderen Haut der Platte (12) angeordnet ist, oder wobei das Betätigungsmittel eine hydraulische oder pneumatische Betätigung oder einen elektrisch angetriebenen Betätigungsmechanismus umfasst.

2. Hochwasserbarriere nach Anspruch 1, wobei die Barriere eine Pumpe (36) zum Aufblasen der mindestens einen aufblasbaren Kammer der Dichtung (30) umfasst.

3. Hochwasserbarriere nach einem der vorhergehenden Ansprüche, wobei die mindestens eine aufblasbare Kammer einen aufblasbaren Schlauch oder ein längliches Element umfasst, das innerhalb eines Kanals angeordnet ist, der um mindestens die unteren und gegenüberliegenden Seitenkanten der Platte (12) gebildet ist, wodurch das Aufblasen der Dichtung (30) bewirkt, dass sich die Dichtung von dem Kanal erstreckt und in die Seiten der Türöffnung eingreift, in der die Barriere angebracht ist.

4. Hochwasserbarriere nach Anspruch 3, wobei die Dichtung (30) ferner Folgendes umfasst: eine Schicht aus anpassbarem Material, die um eine äußerste Seite der mindestens einen aufblasbaren Kammer vorgesehen ist, um zwischen der mindestens einen aufblasbaren Kammer und der Türöffnung angeordnet zu werden, wobei sich eine derartige Schicht leicht an die Form der Seiten der Türöffnung anpasst, wenn die mindestens eine aufblasbare Kammer aufgeblasen ist, um eine verbesserte wasserdichte Abdichtung bereitzustellen.

5. Hochwasserbarriere nach einem der vorhergehenden Ansprüche, wobei die Platte (12) einen zentralen Abschnitt (12) und erste und zweite Seitenabschnitte (22, 24) umfasst, die sich von gegenüberliegenden Seiten des zentralen Abschnitts (12) erstrecken.

6. Hochwasserbarriere nach Anspruch 5, wobei der zentrale Abschnitt (12) durch vordere und hintere Häute (14, 16) definiert ist, wobei die ersten und zweiten Abschnitte (22, 24) zwischen den vorderen und hinteren Häuten (14, 16) des mittleren Abschnitts teleskopartig angebracht sind.

7. Hochwasserbarriere nach Anspruch 6, wobei eine wasserdichte Abdichtung (26, 28) zwischen jedem der ersten und zweiten Seitenabschnitte (22, 24) und dem zentralen Abschnitt (12) vorgesehen ist, um eine Leckage zwischen diesen zu verhindern.

8. Hochwasserbarriere nach einem der vorhergehenden Ansprüche, wobei die Dichtung (30) mindestens eine aufblasbare Kammer aufweist, wobei eine Bewegung der mindestens zwei Teile der Platte voneinander weg bewirkt, dass die Seitenteile der Dichtung (30) benachbart zu den Seiten der Türöffnung zusammengedrückt werden, wodurch der Druck innerhalb der mindestens einen aufblasbaren Kammer zunimmt und wodurch der untere Teil der Dichtung erweitert wird und/oder gegen den Boden der Türöffnung drückt, um die Abdichtung zwischen der

Barriere und der Türöffnung zu verbessern.

Revendications

1. Barrière anti-inondation (10) destinée à un encadrement de porte comportant un panneau (12) permettant de bloquer au moins une partie d'un encadrement de porte quand le panneau est monté dans celui-ci, un joint d'étanchéité élastique compressible (30) étant mis en oeuvre sur au moins une partie de la périphérie du panneau (12) à des fins d'extension au moins le long du bord inférieur et des bords latéraux opposés du panneau à des fins de mise en prise avec au moins une partie inférieure d'un encadrement de porte quand le panneau est installé dans celui-ci, et dans laquelle le panneau (12) comporte au moins deux pièces (22, 24) installées à des fins de déplacement l'une vers l'autre et à l'opposé l'une de l'autre pour faire varier la largeur hors tout du panneau, un moyen d'actionnement étant mis en oeuvre à des fins de déplacement desdites pièces (22, 24) du panneau l'une vers l'autre et à l'opposé l'une de l'autre pour permettre au panneau (12) d'être étendu dans une direction transversale pour permettre au panneau d'être installé dans un encadrement de porte avec le joint d'étanchéité (30) en contact serré avec la partie inférieure et au moins une partie des côtés de l'encadrement de porte, le moyen d'actionnement comportant un mécanisme de levage par vérin à des fins de déplacement des première et seconde pièces (22, 24) du panneau l'une par rapport à l'autre, **caractérisée en ce que** ledit joint d'étanchéité (30) comporte au moins une chambre gonflable ce par quoi le joint d'étanchéité peut être gonflé au moyen d'air ou d'un autre fluide afin de former un joint d'étanchéité étanche à l'eau contre l'encadrement de porte dans lequel la barrière est installée, le mécanisme de levage par vérin comportant un dispositif à rochet ou un cric à losanges articulés ou un actionneur linéaire similaire à commande manuelle, ledit mécanisme de levage par vérin ayant une poignée de manoeuvre (52) se trouvant sur un côté arrière de la barrière derrière une enveloppe avant du panneau (12), ou dans laquelle le moyen d'actionnement comporte un actionneur hydraulique ou pneumatique ou un mécanisme d'actionnement à commande électrique.
2. Barrière anti-inondation selon la revendication 1, dans laquelle la barrière comprend une pompe (36) destinée à gonfler ladite au moins une chambre gonflable du joint d'étanchéité (30).
3. Barrière anti-inondation selon l'une quelconque des revendications précédentes, dans laquelle ladite au moins une chambre gonflable comporte un élément allongé ou tube gonflable se trouvant à l'intérieur d'un profilé en U formé autour d'au moins la partie inférieure et les bords latéraux opposés du panneau (12), ce par quoi le gonflement du joint d'étanchéité (30) amène le joint d'étanchéité à s'étendre en provenance dudit profilé en U à des fins de mise en prise avec les côtés de l'encadrement de porte à l'intérieur duquel la barrière est installée.
4. Barrière anti-inondation selon la revendication 3, dans laquelle le joint d'étanchéité (30) comporte par ailleurs une couche de matière adaptable en forme mise en oeuvre autour d'un côté le plus à l'extérieur de ladite au moins une chambre gonflable à des fins de positionnement entre ladite au moins une chambre gonflable et l'encadrement de porte, une telle couche étant facilement adaptable en forme par rapport à la forme des côtés de l'encadrement de porte quand ladite au moins une chambre gonflable est gonflée à des fins de mise en oeuvre d'un joint d'étanchéité perfectionné étanche à l'eau.
5. Barrière anti-inondation selon l'une quelconque des revendications précédentes, dans laquelle ledit panneau (12) comporte une section centrale (12) et des première et seconde sections latérales (22, 24) s'étendant en provenance de côtés opposés de la section centrale (12).
6. Barrière anti-inondation selon la revendication 5, dans laquelle ladite section centrale (12) est définie par des enveloppes avant et arrière (14, 16), lesdites première et seconde sections (22, 24) étant montées de manière télescopique entre lesdites enveloppes avant et arrière (14, 16) de la section centrale.
7. Barrière anti-inondation selon la revendication 6, dans laquelle un joint d'étanchéité étanche à l'eau (26, 28) est mis en oeuvre entre chacune des première et seconde sections latérales (22, 24) et la section centrale (12) pour empêcher toute fuite entre elles.
8. Barrière anti-inondation selon l'une quelconque des revendications précédentes, dans laquelle le joint d'étanchéité (30) comporte au moins une chambre gonflable, le mouvement desdites au moins deux pièces du panneau à l'opposé l'une de l'autre amenant les parties latérales du joint d'étanchéité (30) adjacentes par rapport aux côtés de l'encadrement de porte à se comprimer, augmentant la pression à l'intérieur de ladite au moins une chambre gonflable et amenant la partie inférieure du joint d'étanchéité à s'étendre et/ou à venir s'appuyer contre la partie inférieure de l'encadrement de porte à des fins de perfectionnement du joint d'étanchéité entre la barrière et l'encadrement de porte.

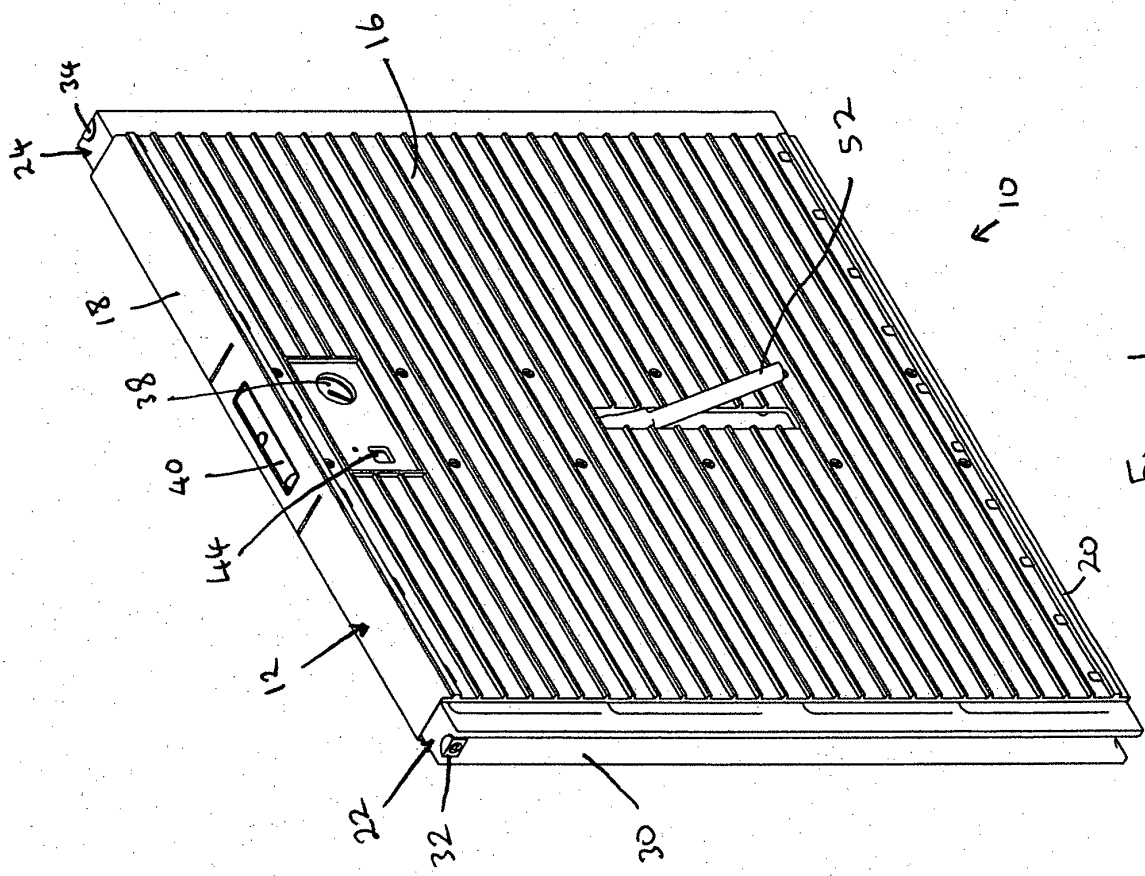


Figure 1

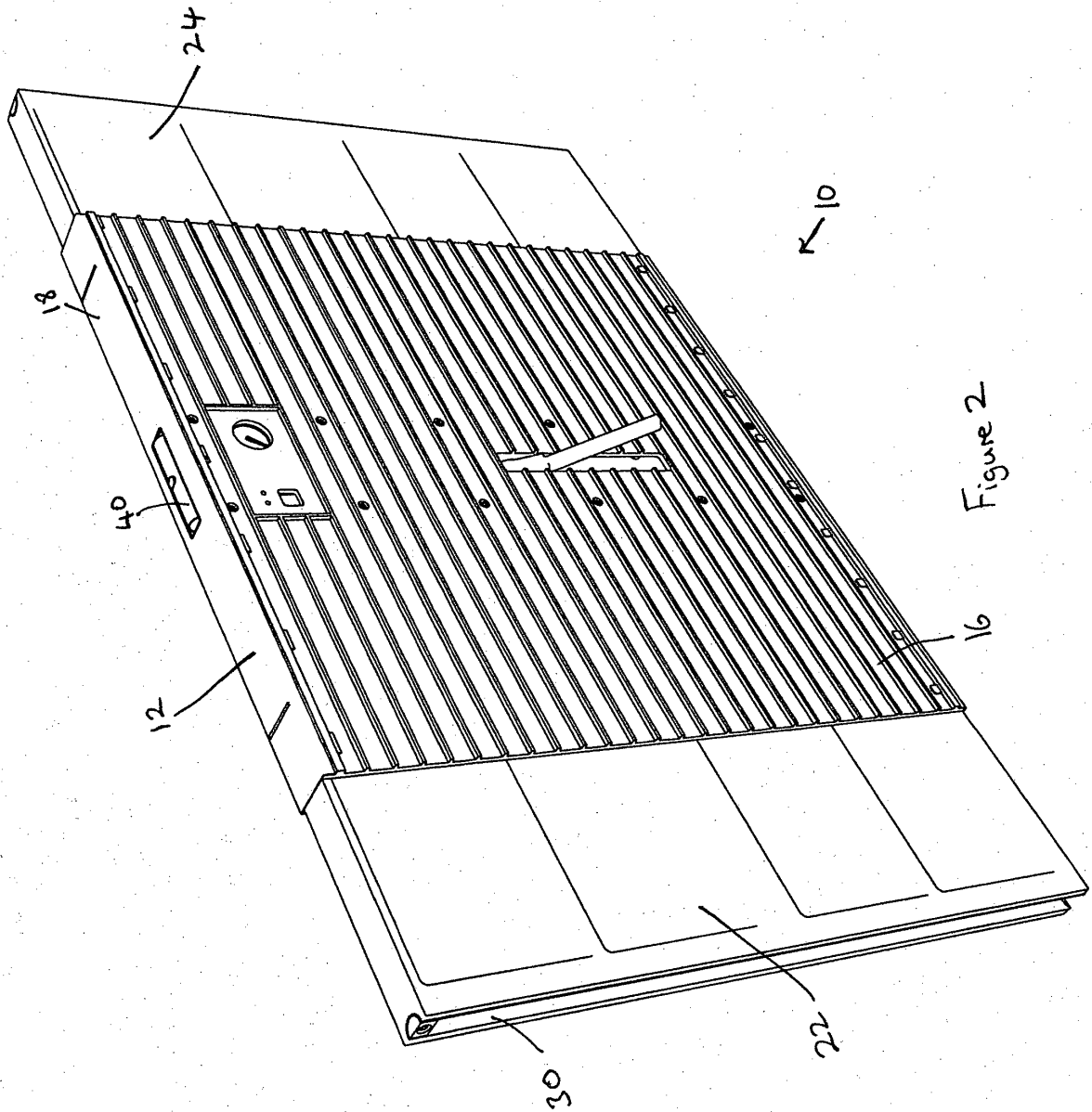
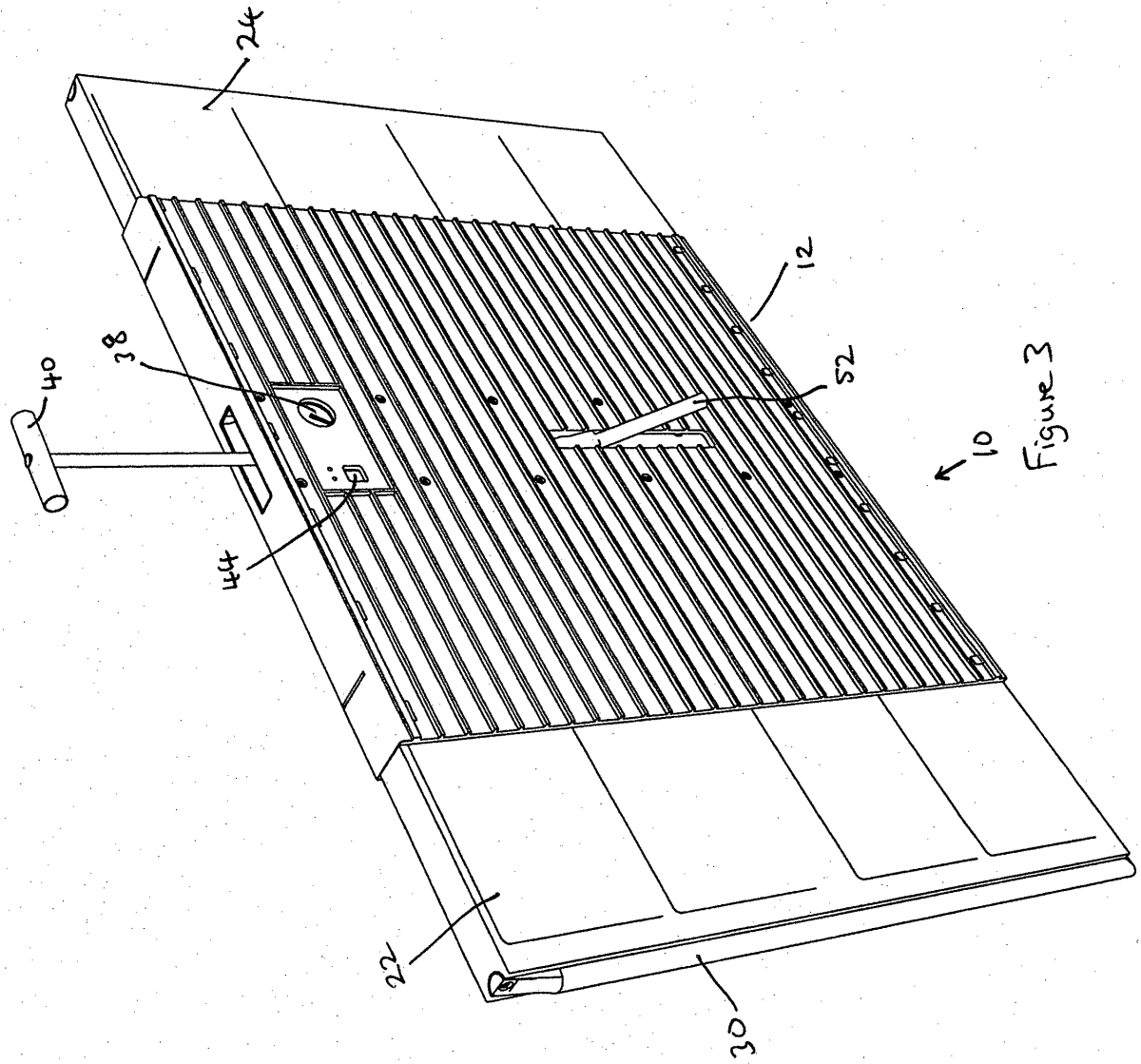
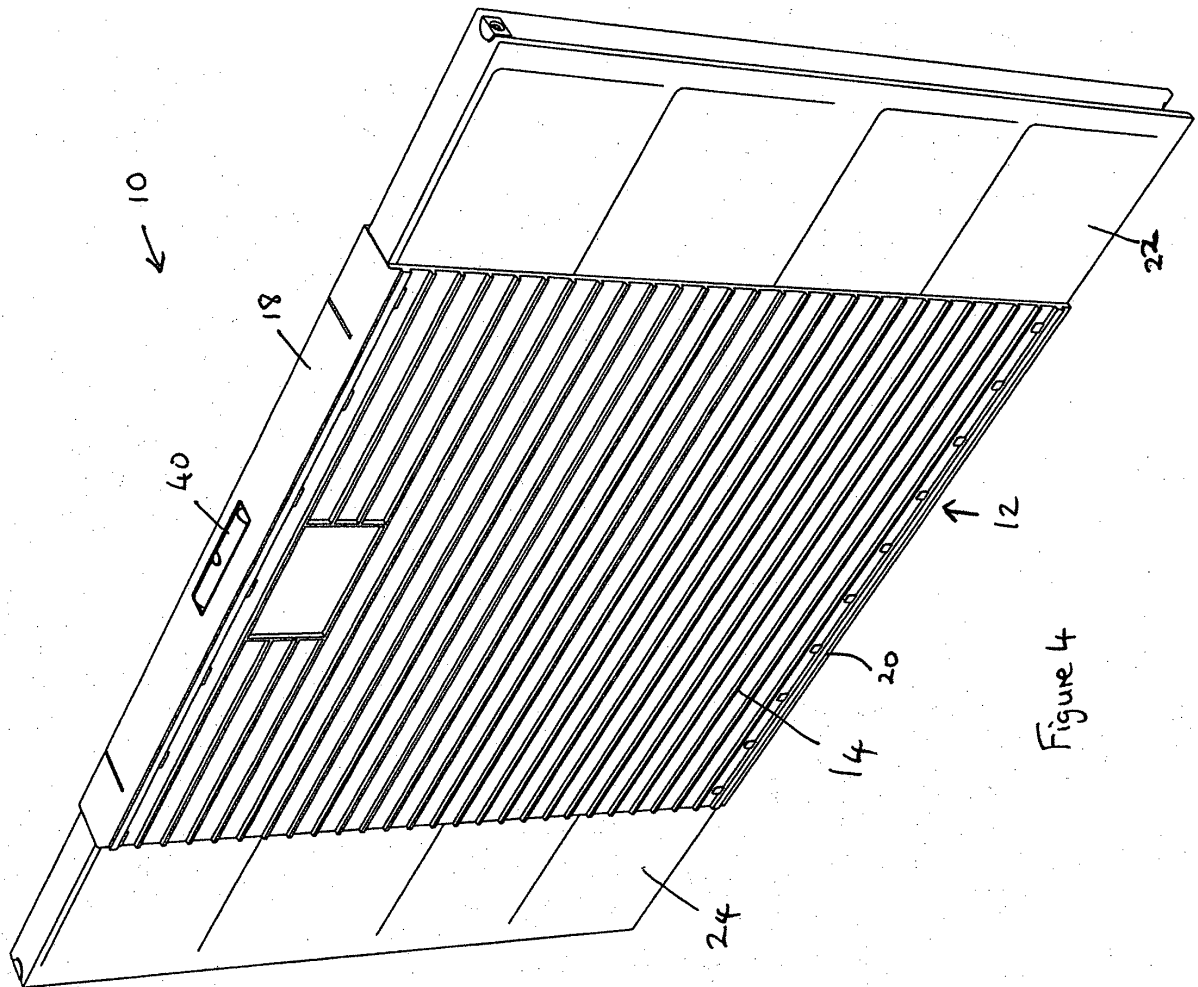


Figure 2





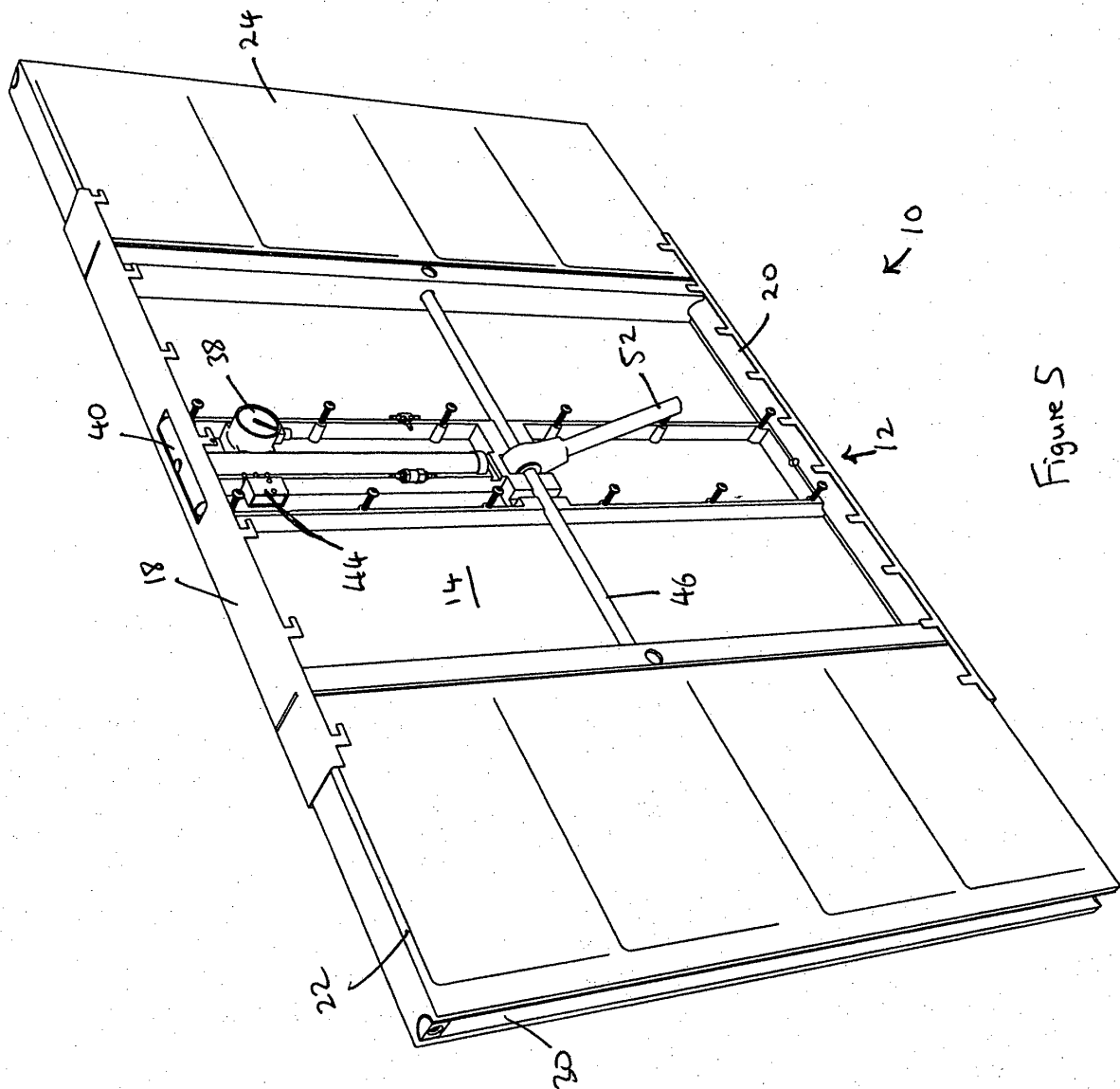


Figure 5

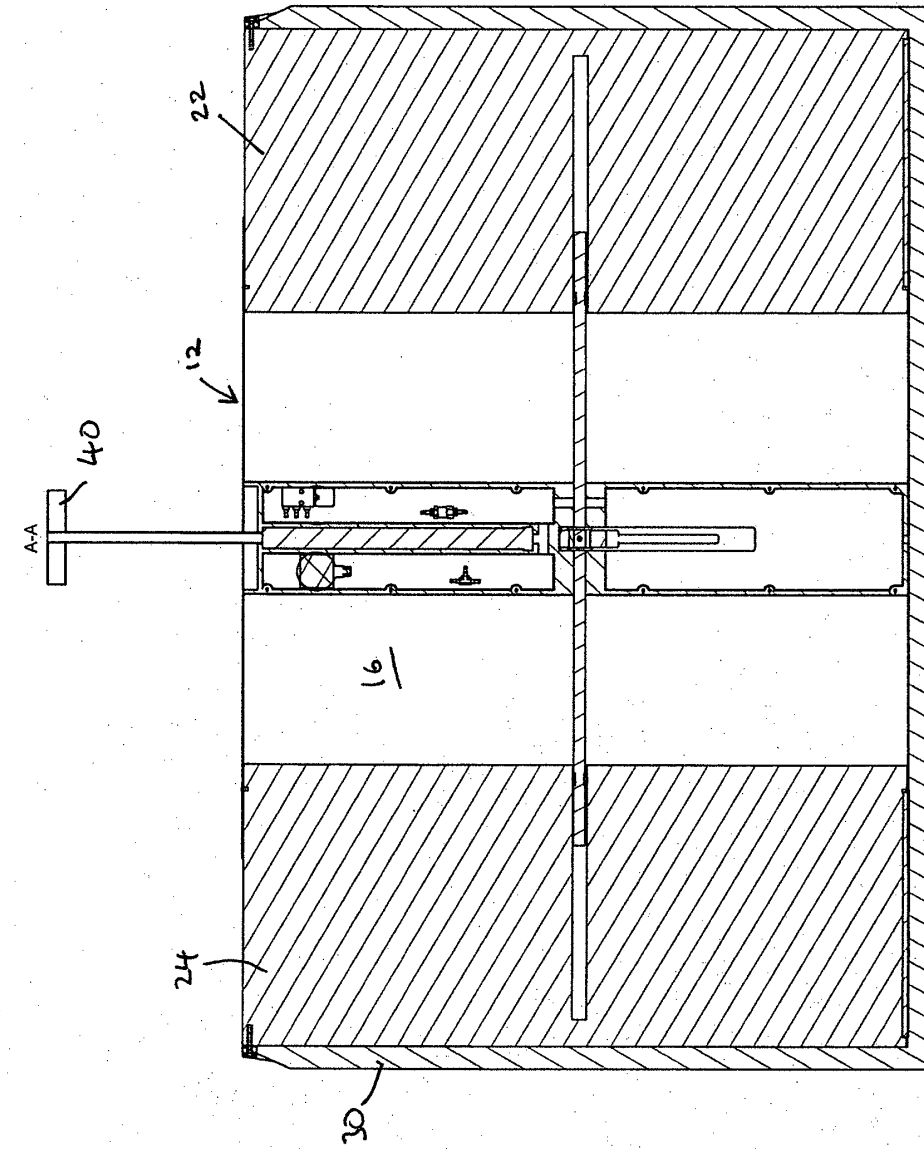


Figure 6

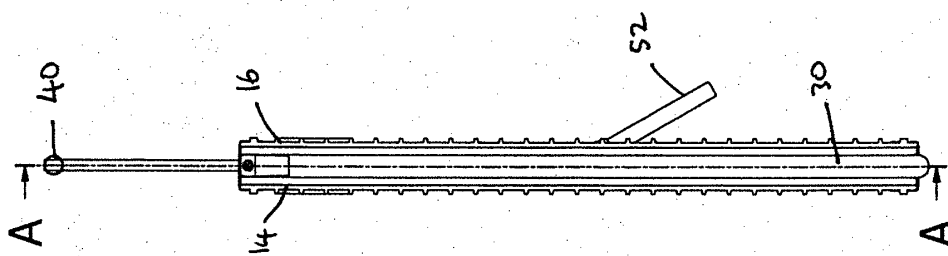


Figure 7

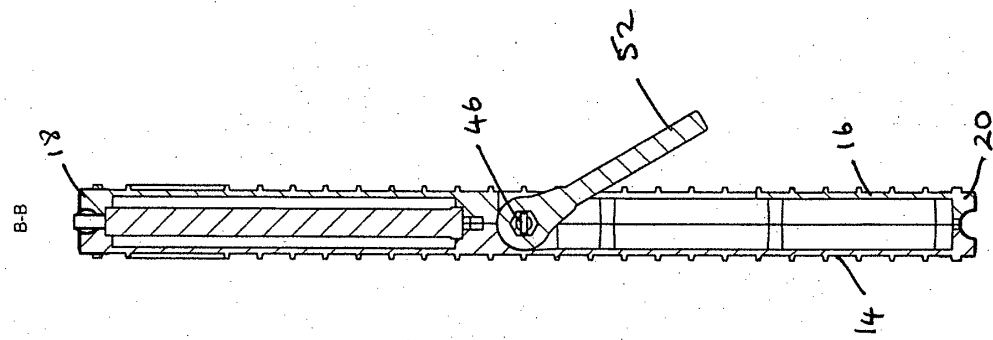


Figure 9

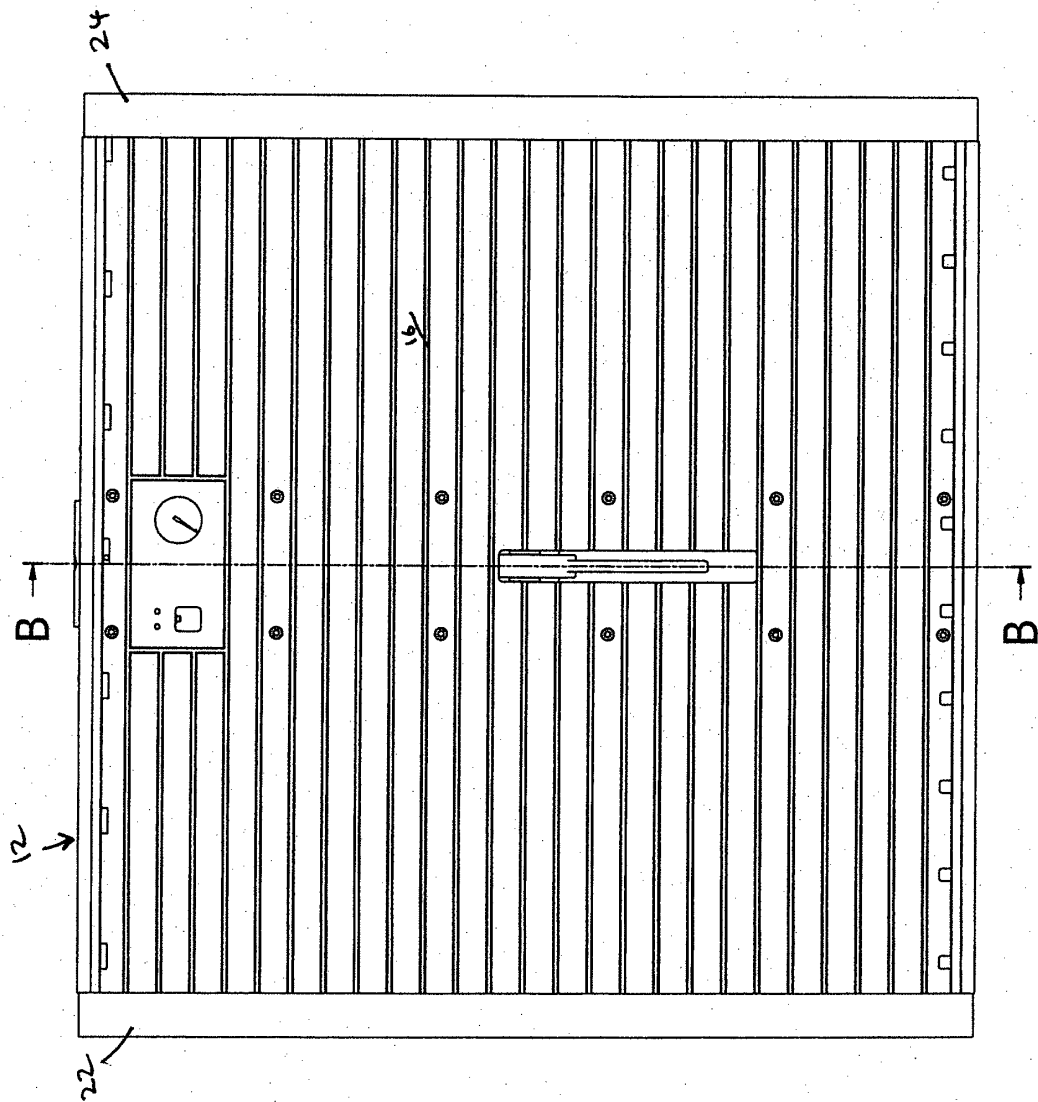


Figure 8

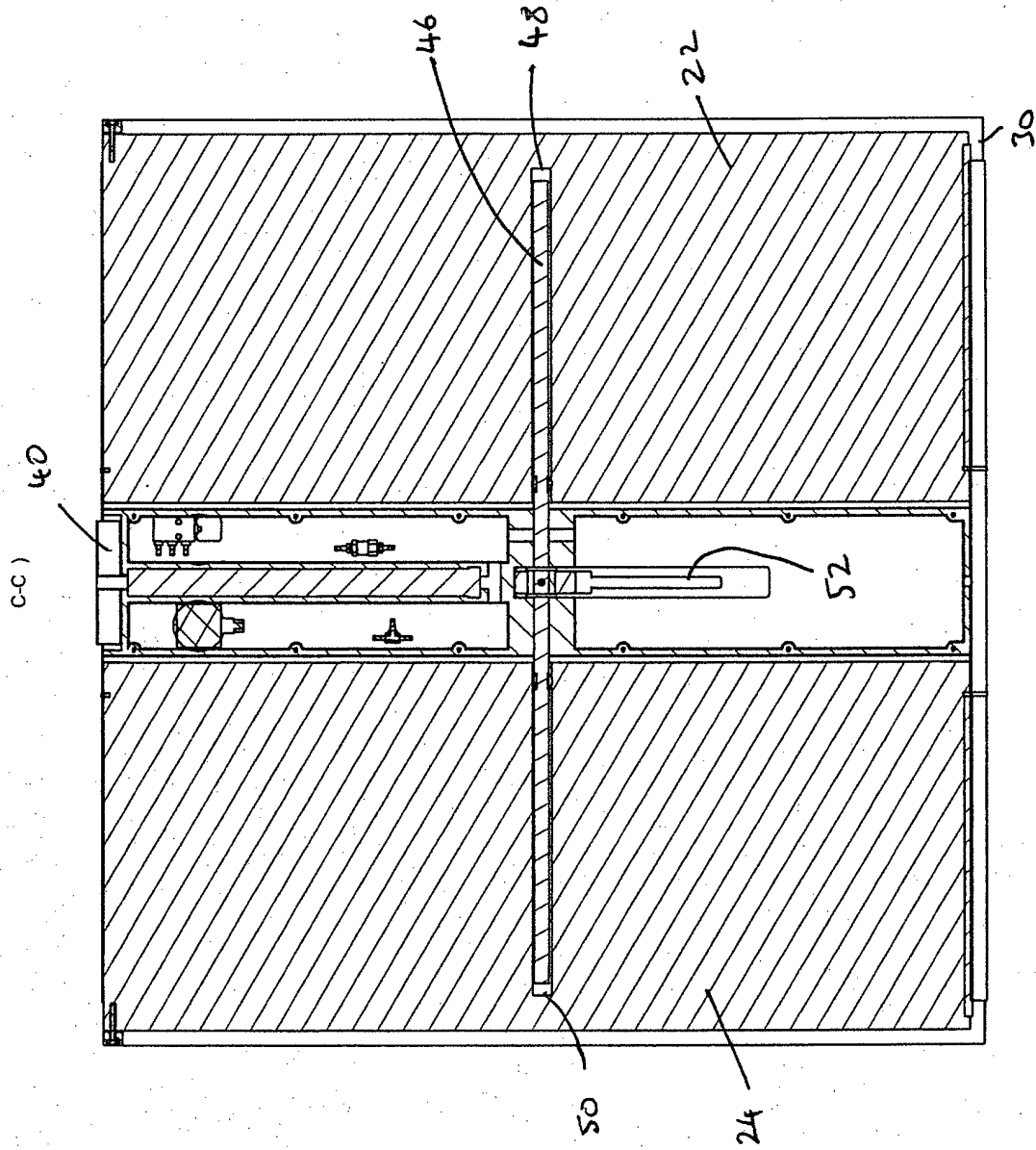


Figure 11

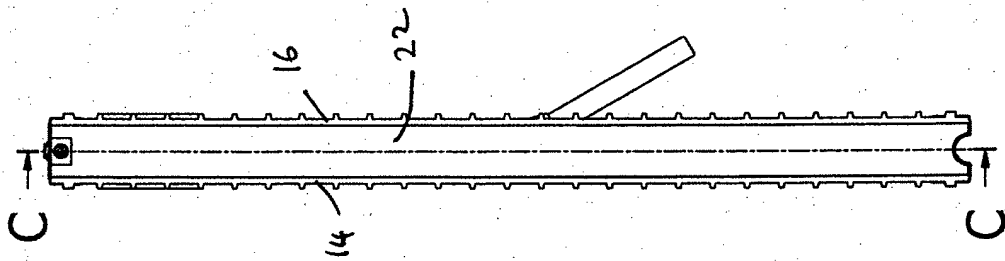


Figure 10

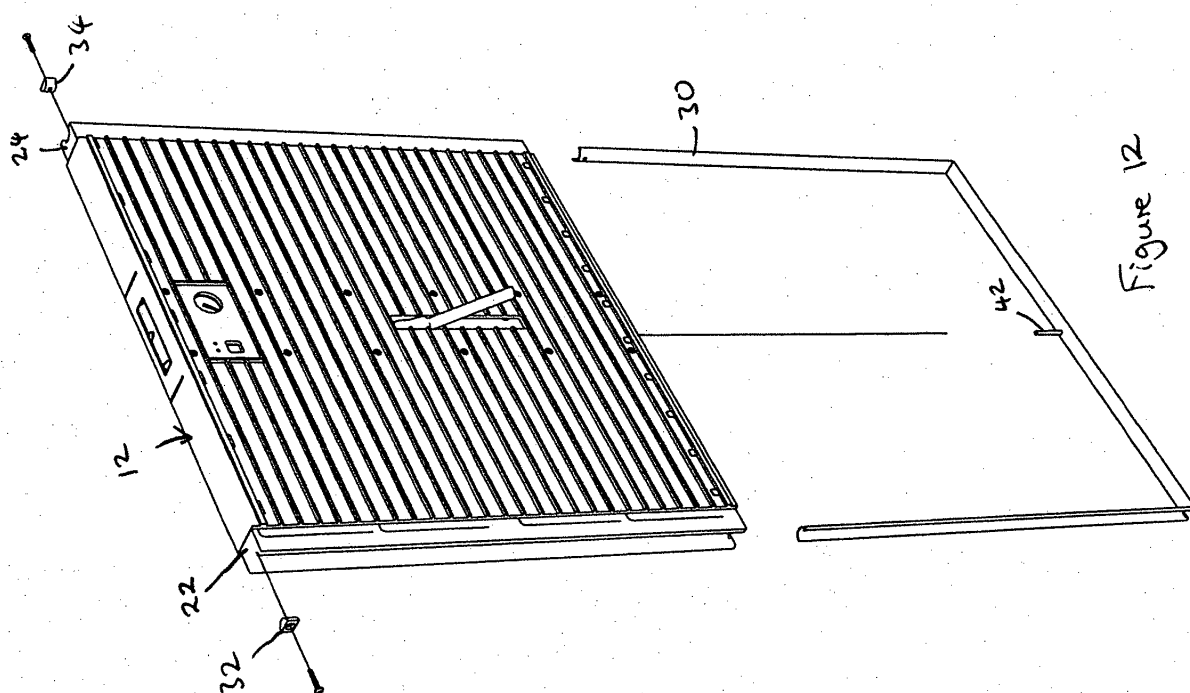


Figure 12

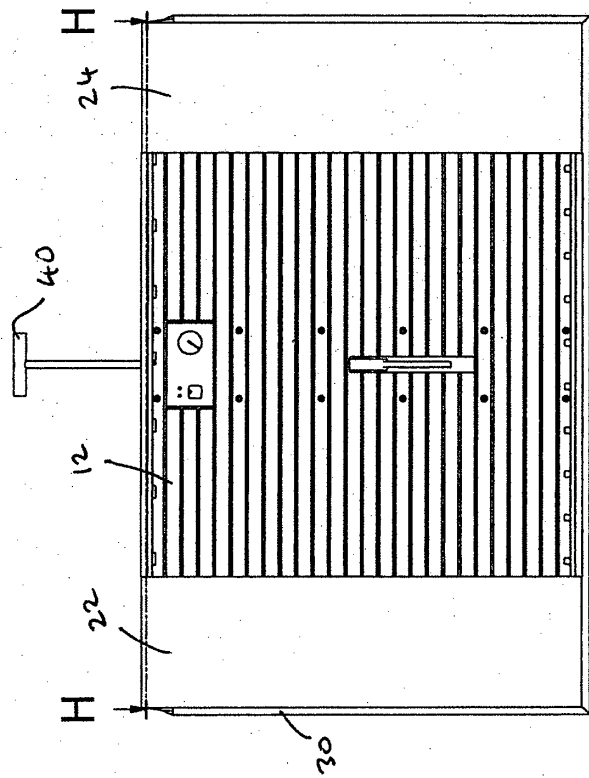


Figure 13

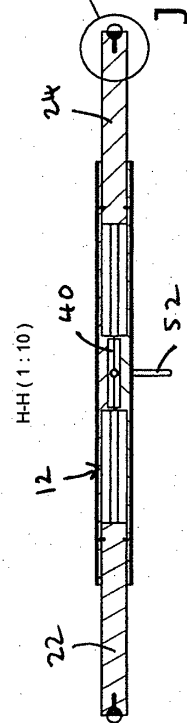


Figure 14

J(1:1)

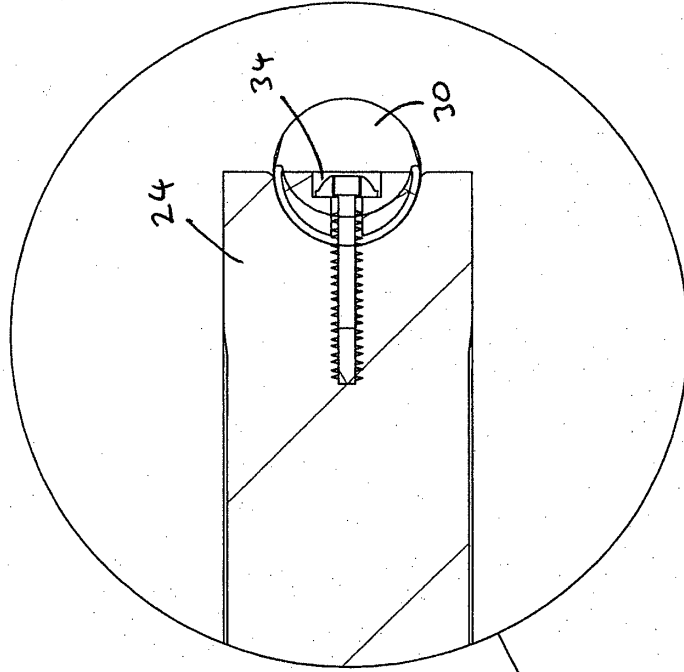
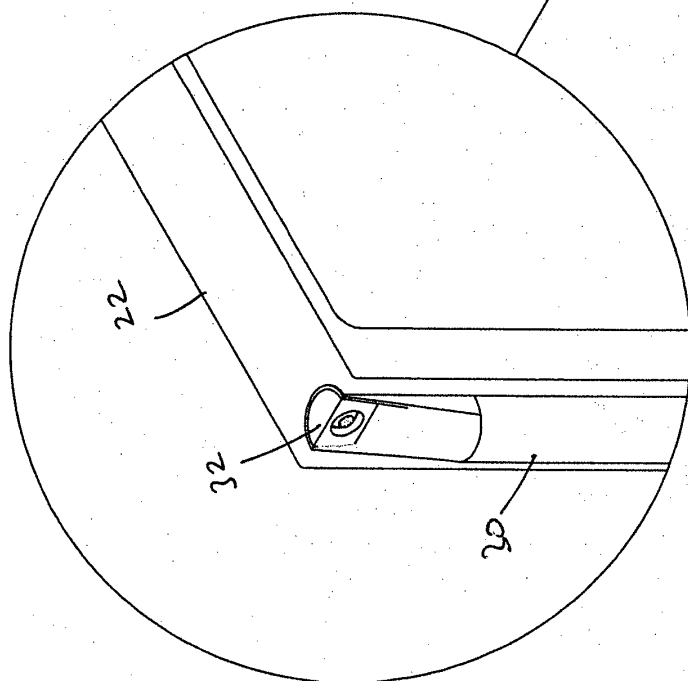
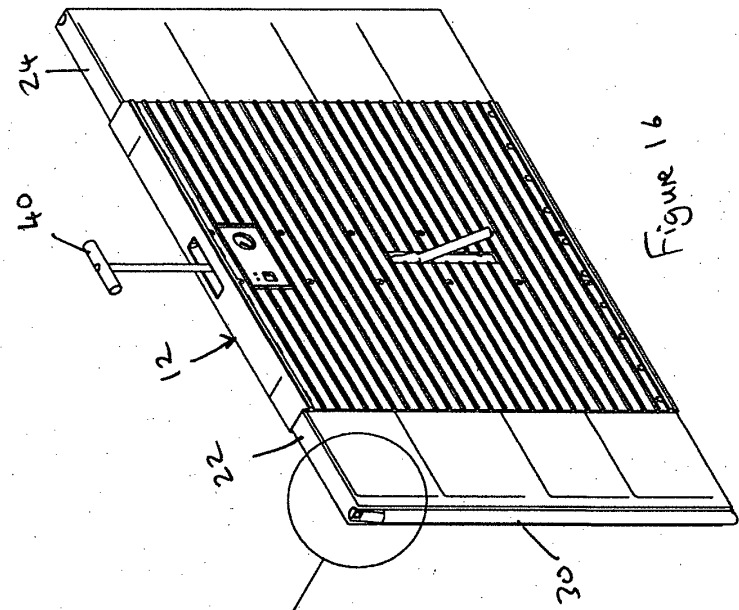


Figure 15



REFERENCES CITED IN THE DESCRIPTION

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