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

(11) EP 2 169 174 A2

(12) EUROPEAN PATENT APPLICATION

(43) Date of publication:
31.03.2010 Bulletin 2010/13

(51) Int Cl.:
E06B 11/02 *(2006.01)*

(21) Application number: **09012200.3**

(22) Date of filing: **25.09.2009**

(84) Designated Contracting States:
AT BE BG CH CY CZ DE DK EE ES FI FR GB GR HR HU IE IS IT LI LT LU LV MC MK MT NL NO PL PT RO SE SI SK SM TR
Designated Extension States:
AL BA RS

(30) Priority: **26.09.2008 IT PN20080069**

(71) Applicant: **Vidotto, Angelo**
33082 Tiezzo di Azzano Decimo (PN) (IT)

(72) Inventor: **Vidotto, Angelo**
33082 Tiezzo di Azzano Decimo (PN) (IT)

(54) Gate that lifts while rotating and compacts laterally and its procedure of construction, transport and installation

(57) Disclosed is a gate that lifts while rotating and compacts laterally, with related construction, transport and installation procedure.
Core of the system is the cabinet (1) complete with the gate fixing accessories through the upper and lower hinges and related support sets (3) (5) and (4) (15), the adjustable gates balancing device (7) and the gear motor (6) (see exploded view in fig.4) which together with the whole sub-frame and shafts (26) allows the arrangement of the automation and security system. The above mentioned cabinet, if assembled together with the structural frame, becomes a versatile mono-block easy to be reduced in size **fig.15** or completely disassembled **fig.17** or even directly installed on existing gate posts or finished floor is completed by metal post.

Moreover the gates, if assembled following the described system procedure in specific chapter, can be adjusted on the installation site covering this way a defined range of dimensions.

FIG. 1

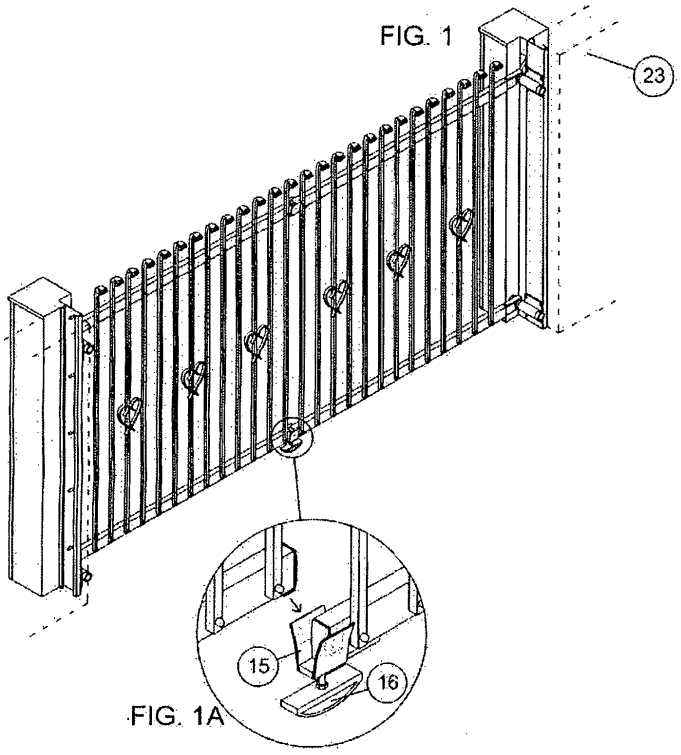


FIG. 1A

EP 2 169 174 A2

Description

[0001] The following invention is related to the technical branch of the gates industry and is submitted by the inventor VIDOTTO ANGELO (Italian SSN: VDT NGL 48B10 H706H), a technician with 35 years of experience in the field of technical closing systems for high end gates and related automation systems in full compliance with practical needs, functionality, aesthetic quality and safety.

[0002] The present invention has been conceived in line with those concepts: it generates vertical movement of the gates with a fully innovative construction, transport and installation process.

[0003] So far no professional knowledge could solve difficult situations like the lack of space to go for traditional closing systems like normal or sliding gates, and cope with all the situations of uneven ground line as in mountain area was even more difficult, moreover the installation was never convenient and precise, and setting up automation right on the construction site was quite troublesome both during the installation of the motors and the positioning of safety and control devices.

[0004] Based on "Prior. Art" the opinion of the inventor is that there is nothing that can be directly compared to the present project subject of application for Patent grant, apart obviously from basic application principles like the horizontal axis as pivot point for rotating elements or the spring as force releasing element due on its precise application, which anyway here can be replaced by other similar commercial device like a simple hydraulic or air piston. Acknowledgment can also be found about common materials and accessories needed for the construction, used to simplify and solve problems up to now unsettled.

[0005] Current solutions that work based on the rotation of the horizontal gate element on the vertical plane bring back to simple road blocks, parking barriers and similar or to outdated design concepts, in the inventors opinion, considered as niche solutions already at their beginning and to be now considered as obsolete based on present day knowledge of functionality, handiness and safety which are requested more and more.

[0006] Those outmoded conceptions covered over aged needs, but based on the writer's opinion can also not be compared to the modern subject of this work, same as the old wood wheel can not be compared to the invention of the more recent ball bearing.

[0007] To the last here above described concept fits the USA 2044 265 (THOMAS GEORGE H) (1936 06 16) as much as the following: USA 2709 862 (LESLIE JR JAMES H) (1955 06 07) general barrier and USA 4 519 164 (PORTER RICHIARD A) (1985 05 29) railway barrier.

[0008] Specific consideration has to be made about FRA 876 140 (EUROPORTE SARL (FR) (2006 04 07) giving credit for the application being used on modern gates, even if limited to swinging gates, but in any case the transport and on site installation easiness claimed by Europorte is related to a different concept and it doesn't include the additional advantages of the system here presented which, as we will later see, makes it possible to be transported by a standard Express courier and to be installed in any condition including uneven ground line, and several others also related to commercial distribution of the product and the system.

[0009] Regarding to the group of invention mentioned here above I suggest a careful consideration about the work identified as USA 4519164 (PORTER RICHARD) (1985 05 28) because the most recent of all and because searching for previous literature it could induce to consider the movement on vertical plane with rotation on horizontal pivot point (hinge) and balance with spring.

[0010] It has to be immediately said that such invention doesn't aim any kind of gates business, but instead also in this case it just brings back to barriers, presenting a triple bar with horizontal elements during closed position which rotate due to one single pivot "improperly called hinge based on the commercial idea of such an accessory part".

[0011] Moreover that pivot is moved by the gear motor and transfers the movement to all the three bars with sophisticated sets of sheaves because the bars are moving on three separate planes and are positioned in three separate housings, and these bars are each separately balanced by a same quantity of springs and also need a post with three shelf to support the end of each bat.

[0012] It's clear that such a complex construction is now of no any practical interest because every advantage in the concept of construction, functionality and safety is here outdated in reference to the common present requirements, even in the proper business sector (railway barriers).

[0013] The invention here presented as application for invention Patent makes it instead possible to manufacture aesthetically high end gates but at the same time if we want to chose a solution with horizontal slats and with number of slats at regular distance as required by present day regulation, the new concept offers the simple solution as represented in **fig.10** also valid for important distances because also manufacturable as double gates because this new concept here described doesn't need supporting posts at the end of the gates having the first gate already a support on the ground thanks to the adjustable accessory component **(16)** while the second gate hooks, rests and center both with the lower and upper beam onto the first one by the accessory **(15).**

[0014] The movement takes place by simple and direct connection to the power take-off **(4a)** of the gear motor **(6)** which is simply plugged in, and the balancing comes directly by a single device **(7).**

PRESENTATION OF THE INVENTION

[0015] The subject of this invention is a device which has integrated in it's whole construction, transport and

installation procedure a safe and convenient solution, under any point of view including the economic one and the nice looking, to all the needs of making use of a beautiful closing or property delimitation in difficult situations like lack of space to operate with normal solutions or uneven ground line at the interested spot.

[0016] The system allows to manufacture any kind of aesthetic need both simple or made of wrought iron, with or without decoration which can also be applied after installation of the full motorized or not motorized device.

[0017] The simplicity of the whole procedure will for sure lead to commercial evaluations finding it convenient to use this invention also in normal conditions and in absence of the problems mentioned above.

[0018] Core of the system is the set of following parts: cabinet assembly **(1),** hinge post **(2),** hinges **(5),** upper connection arm **(3),** spring coupling **(3a)** or equivalent adjustable balancing device, lower connection arm **(4)** with bushing for power take-off **(4a),** balancing device **(7)** and for motorized solutions also the gear motor **(6)** and the electrical control unit **(8)** all represented together in **fig.5** and further detailed in **fig.4.**

[0019] All components here above mentioned are easy to be fixed to the cabinet assembly by screwing them to it and, once the gates are fixed to the upper and lower connection arms, the whole gate is aesthetically and functionally completed as figured in **fig.1.**

[0020] The gates can assume any kind of design and some examples are represented in **figs.7,8,9,10, 13,13A,14A** and more can be added as long as they are manufactured conform to the simple procedure that later will be here described.

[0021] The gate this way manufactured as assembly of cabinet **(1)** and accessories, can be installed close to conerete/masonry gate posts **(23)** or metal prefabricated ones **(28),** both on flat floors as shown in **fig.1** and **fig. 13**, as well as on uneven ground line as highlighted in **fig.13A** and more detailed in **fig.14** and **fig.14A.**

[0022] The system has been developed also to be assembled as a whole single unit, which we will call here mono-block, as represented in **figs.15,15A** obtaining this way a much easier usage as highlighted in **fig.16** and **fig.16A** and where we can value that the three elements of the beam. **(24)** not only join the whole into a monoblock but also make totally safe the handling and installation of the whole structure without any deformation. Moreover the beam **(14)** will also function as reinforcement cage during the concrete casting for the foundation and fixing to the ground resulting this way in a more simple work with clear money saving.

[0023] The invention has been conceived for a gate dual maneuvering method option, both manually and motorized as an adjustable balancing system based on the weight of the gate is foreseen which allows the manual balanced handling during normal use as well as for emergency operation.

[0024] It's natural that the commercial demand will focus on the motorized solution therefore the system comes with control and safety devices for an efficient automation with present operator and at distance.

[0025] Therefore the gear motor spline shaft **(6)** is expected to be simply directly plugged into the power take-off bushing **(4a)** and fixed by the metal plate **(6a,6b,6e)** to the cabinet side **(1)** under friction.

[0026] Inside the cabinet (only in one for single gate solutions) finds also place the electrical control unit.

[0027] Furthermore the system comes cable ready for the whole electrical connection and the installation of control and safety devices, therefore the hinge support assembly visible in **fig.15B** is also including a junction at the bottom **(2a)** for a horizontal telescopic tube and the shaft for passage and inspection of the cables. The opposite hinge support is exactly the specular same therefore joining the two supports will result in a. simple operation by using the tubes **(27,27a)** which based on different sections will fit one to another as a telescopic tube obtaining this way the correct junction length.

[0028] The left and right hinge supports and the shafts, once joined by the telescopic tube **(27 and 27a),** set up a kind of sub-frame mounting for the gates and the motorization.

[0029] The needed cables pass all through the sub-frame and the shafts. The telescopic tube is just needed to join the parts and to create a passage from side to side so it can be laid underground. The vertical supports will be fixed to the existing concrete/masonry gate posts **(23)** or metal prefabricated ones **(28)** and as already mentioned will hold the hinges **(5),** connection arms for gates fixing **(3)** and **(4)** in **fig.15B,** and at the same time will function as support to the fixing of the external security photocells **(20)** using the U shaped protection **(19)** and the shimming beam **(18).** The internal security barrier will be fixed directly to the cabinet.

[0030] Not to go unnoticed the inventor wants to highlight that the same way as the cabinet with all the accessories contained therein, also the whole sub-frame as above described becomes important and integral part of the whole system here presented as it provides immediate reference during installation for the correct height positioning: the finished floor level coincides with the height of the shaft **(26)** and the position of the gate is already predetermined by the position of the hinges **(5)** already appropriately set during the production phase of the vertical supports **(2).** Moreover it works as useful structure design to carry out the electrical automation system and to fix control and safety accessories like the security photocells and finally supports the hinges **(5)** and therefore the whole gate through the upper and lower connection arms **(3)** and **(4).**

[0031] It's called sub-frame because it has the whole electrical automation system and also the gate support and connection on it, but alone it can not boast the feature of supporting the gate itself: this function is expected to be taken by the whole sub-frame and gate post once the vertical supports are firmly fixed to the gate posts by screwing if it is a metal one or by rawlplugs if it's a con-

crete/masonry post.

OPERATION OF THE GATE

[0032] The invention aiming to solve difficult and unresolved situations has also looked for qualified production to achieve a reliable and easy to work product for a safe use.

[0033] Having to make a real gate that moves on a vertical plane and not a simple barrier it was necessary to use two pivot points of rotation with appropriate and special hinges as important parts of the two different rotation groups: the lower one related to connection arm **(4)** whose function is direct power take-off from the gear motor, and the upper one related to connection arm **(3)** whose function: is to get the balancing force from the spring **(7)** (or other equivalent device) through the spring coupling **(3a).**

[0034] This way we obtain a linear and balanced motion both for the motorized operation and a possibly manual one.

[0035] Considering the behavior during automatic function, by activating the gear motor **(6)** in the opening cycle the gate's lower and upper beams will rotate and lift and this makes compacting the vertical poles which become close and closer white keeping a perfect parallel vertical position. The opening cycle will be competed when all poles will touch one each other (**fig.19**) which causes on the top end a reduction of the free gateway, equal to the size of the poles multiply by the number of the same poles (for a 160cm, large gate the reduction of the free gateway will be about 20cm, but only on the top end).

[0036] During the closing cycle the beams will push down the poles which also in this case will always maintain a vertical position until the closing is completed (**figs. 1,7,8,9**).

[0037] The travel span of the movement can be defined by limit switch or encoder or by operation of the current switch on the electrical unit at floor impact during closing cycle or arrest impact during opening cycle.

[0038] The closing position is given by the adjustable half-moon shaped support **(16)** and the centering and coupling accessory **(15)** see **fig.1A**.

[0039] Any kind of safety for people, objects and animals during the gates operating cycles is assured not only by the adjusted moving torque but mainly by the multi-radius radius security photocells **(20) figs.4. 11.12.13.13A** which activate immediately if rays are interrupted at any detection of potential obstacles: this is intended for the whole movement of the gates, both inside and outside of the same.

SYSTEM TRANSPORT

[0040] The system allows more than one transport method, satisfying this way the most different needs.

1) One possible way of shipment is to move the whole system as a single piece, a mono-block which is already including the ready to use motorization: by doing so, once installed the system in the prearranged excavation, for it's first start it just needs to plug the already pre-assembled connector into the power supply, like any other home appliance.
4 pieces lifting hooks **(25)** are arranged as to make it possible to lift the whole mono-block with any crane or forklift or other lifting device by using the appropriate lifting slings as made in **fig.16A**,
This simple method is economically convenient only for local short range deliveries because the needed crane truck or similar big vehicle can result into a very expensive transport.

2) Another possible way is to reduce the mono-block size to the situation showed in **fig.15**, easy to be done through the sub-frame telescopic junction of the tubes **(27,27a)** and by removing the central part of the support frame (**24**): this operation has to be done without gates which wilt be shipped with a separate packaging. Following this way even long distance shipping can be done using normal couriers which can offer extremely convenient rates especially after subscription. Once delivered at the installation site the whole system can be set up again at the correct dimension as represented in **fig.15A** by simply reassembling the support frame **(24)** and reassembling the gates. Even following this method the system can be transported including motorization and safety devices, because the shafts connection cables are stored inside the shafts during all the time of reduced framework.

3) Finally, another important opportunity has been graphically summarized in **figs.17,17A and 17B:** all components manufactured conform to all needed processes for the installation can be placed on a standard pallet, thereby resulting in minimal encumbrance with the advantage of getting the lowest shipping rates for any destination by normal and even express courier. The detailed instructions of the manufacturer will allow easy reassembly and installation on site.

[0041] All this can be seen also as a convenient business solution where the manufacturer can rely on a properly trained distributor network which can perform a perfect assembly, installation and start up for a qualified, economic and convenient end user service.

[0042] As already highlighted in the description the product, in his essentiality of complete cabinets with gate supports for any requested type, gear motors and all accessories related to the automation already connected, can be also used in situations where other rearrangement or gate posts already exist: in that case the system keeps unchanged it's simple installation procedure with direct

fixing to the existing post. Beside this, **fig.18** also highlights the opportunity to fix the cabinets and the prefabricated gate post directly on the floor. In both this situations the support frame **(24)** is not needed and the whole installation and transportation activity may result in a more simple solution which based on point (**3**) will also be cheaper due to the weight cut.

SYSTEM PROCEDURE FOR THE GATES AS COMPLETION OF THE WHOLE

[0043] The gates are an integral part of the system: they are fixed to the cabinets through the connection arms (**3 and 4**), can be manufactured in many types, plain iron, hammered with spears (**11**) of Many types (**see figs.7,9, etc...**), different types of tops (**see figs.8, 11,13A**) or in any other shape with several different central decorations (**see figs.1,3,7,8,9,13A**) and any other as desired or even with a more simple design without spears, tops or decorations.

The core of each gate includes::

[0044] 1pc upper and lower beam appropriately drilled. Each single vertical pole will be assembled to the upper and lower beam with a mobile, free to rotate and vibration free coupling: this is obtained by the system illustrated in **fig.4** which includes screw (**12**), brass or bronze washer (**12b**), bushing for correct coupling (**12c**). Any decorations are rigidly fixed to the poles, but slightly spaced from related poles as represented in **fig.4A**. The gates assembled as described will be completed by fixing the accessory components (**13,14,14a,15,15a**) to the opposite end of the one with the connection arms: a finishing cap, a support and a centering device. This gates can be added and fixed to the whole by specific fastening with screws (**9a**). In addition gates assembled this way can be shortened and customized, within a certain range, to fit existing gateway dimension.

INSTALLATION

[0045] Simplification of the installation is to be considered already highlighted in the context of all descriptions, however, it will be here briefly summarized by points:

1) for the mono-block solution it's enough to position it into the prearranged excavation without any other foundation frame for the concrete casting, because this function is already covered by the beam (**24**) as part of the system (**see fig.16,16A**).

2) for the reduced mono-block solution, once reassembled the central part of the support frame, it's possible to follow the same procedure as at previous point 1): the gates can be fixed to the connection arms before the positioning into the excavation or even after the concrete foundation (**see fig.15 and fig. 14** for horizontal floor with height difference).

3) If gate posts are already existing on the spot it's enough to fix with screws or rawlplugs the complete cabinets which already include the accessories. The cabinets can be handled with or without pre-assembled gates based on their size (**see figs.1,5, 11,12,13,13A**).

4) In case of already finished floor with no gate posts the cabinet, with his hinges support and metal post, has to be fixed directly to the floor with the angle support and the rawlplugs **(29)** in **fig.18**.

BRIEF REFERENCE TO THE DRAWINGS

[0046]

Fig.1, perspective view of closed gate with two wrought iron gates completed with pole beads, central decoration, cabinets and hinges support.

Fig.1A: detailed view of central ground stopper with adjustable height (**16**) and of the gates alignment with the centering accessory (**15**).

Fig.2: representation of gate as in **fig.1** but during opening phase and with other type of decoration.

Figs.3 and 4: exploded view of the gate with all components, construction and assembly of both the gate and the hinges support, the hinges with upper and lower connection arms and the motor cabinet with all his accessories.

Fig.5: perspective view of the motor cabinet assembly **(1)** with the motor itself **(6)** and related fixing plates **(6a) (6b) (6c)**, spring with tensioner **(7) (7a),** control unit **(8),** hinges support **(2)**; hinges **(5)** with accessories and connection arms **(3) (4)** and the assembly of one gate. The connection of the two parts is also highlighted.

Fig.5A: detailed view of the motor positioning **(6)** into the cabinet **(1)** and connection between motor and rotation power take-off bushing **(4a).**

Fig.6: exploded view of the multi-radius photoelectric safety barriers **(20)**, their specific protections **(19)** and fastening to the profiles **(17) (18)** and the sheet metal **(21)** to assure the protection of the safety barriers themselves (rules compliance). This accessories are required for remote control motorization.

Fig.7: example of wrought iron double gate, here with vertical poles in square tubes (also hammered), pole heads and central decorations.

Fig.8: example of wrought iron double gate, here with vertical poles in square tubes (also hammered), top, central decorations and greek at the base.

Fig.9: example of double gate, here with vertical poles in round tubes, top finishing with pegs and set of decorations.

Fig.10: example of double gate with slats, here with Vertical and horizontal poles in rectangular tubes and central decoration.

Figs.11 and 12: installation example of the product in a situation with already existing gate posts and finished paving. In **fig.11** is represented the correct positioning of the inner corner of the cabinet **(1)** and related accessories, hinges support **(2)** and accessories, multi-radius photoelectric safety barriers **(20)** and accessories (all this already connected to the control unit) and the gate (for an easier handling big gates can be also mounted later through the special connection arms **(3)** and **(4)),** the fastening will be done with simple rawlplugs into the gate post or into the floor or in both based on the possible options. **Fig.12** represents the work once finished.

Fig.13: view of previous gate with gate posts on the same level

Fig.13A: as above, but with gate posts on different levels.

Fig.14: installation example of the product in a situation of new construction directly on the ground. Compared to previous situation (**figs.11,12**) in this case will be added one iron post **(28)** and a section of structural frame **(24)** that will be incorporated in the plinth. In this case the gates will be added once the foundation is completed.

Fig.14A: view that highlights the uneven ground line.

Fig.14B: example of view of a convenient parking solution made in a situation with lack of space and where it's absolutely impossible to install a sliding or swinging gate.

Fig.15: perspective that highlights that for the mono-block solution (already having all connections and test made by the manufacturer) it's easy to reduce the volume by removing the central part of the support frame **(24)** compacting the telescopic tubes **(27)** and **(27a)** and placing the cables back into the shaft **(26),** with a big advantage during the transport.

Fig.15A: view that highlights the easiness of changing back from the reduced length solution (for the transport) to the installation ready solution (also right at the construction site) by adding the central support element **(24)** and the gates,

Figs.15B and **15C:** view that highlights that component **(26)** and **(2a)** can be alone standing **(fig.15C)** or directly welded to the hinges support **(2) (fig.15B).**

Fig.16: view of a complete mono-block and its details.

Fig.16A: installation example of the mono-block with a simple excavation. Connections and structural frame are highlighted,

Fig.17: mono-block exploded view.

Fig.17A: view that highlights the easiness of changing from open gate (dashed) to completely closed gate, with considerable saving of space for a passible transport by courier.

Fig.17B: example of pallet with the whole components of **fig.17**, including the gates, ready for shipment by courier, In case of long gates their shipment will be done with a separate package for economic convenience.

Fig.18: installation example of the product directly on the floor using rawlplugs **(29).**

Fig.19: front view of open gate with highlighted encumbrance.

Claims

1. Complete system for gates of good aesthetic quality, for driveway closing where situations of lack of space or uneven ground line make it impossible to install normal gates. Its mainly composed of a cabinet **(1)** with inner and outer fixed accessories for the manual or motorized functioning **(see fig.4)** whose characteristic is represented by the rotating group with power take-off **(4a)** in correspondence to the lower gate connection a **(4)** and the balancing group with drilled spring coupling **(3a)** and **(7)** in correspondence to the upper gate connection arm **(3).**
Characteristic of the system is also the sub-frame including the hinges support as the assembly in **fig. 15b.** composed of a vertical element **(2),** cables shaft **(26),** telescopic tube junction **(2a)** and the telescopic tube itself **(27)** and **(27a)** to connect to opposite hinges support completing this way the the whole sub-frame which will be screwed to the cabinet **(1)** or to the metal post **(29)** or, if already existing, to the concrete/masonry post,
Characteristic of the system specification is also the swivel fitting in all junctions between the beams

(9,10) and vertical poles **(11)** of the gates, which allows this way to reduce the encumbrance during the gateway opening by compacting the vertical elements to the cabinet side.
Characteristic of the system specification is also the fitting of the gates through the connection arms which allow to handle separately the gates from the cabinets with an evident advantage during transport and installation operations.
Due to the construction method of the gates another characteristic of the system is also the feasibility to reduce the length of the beams during installation for a perfect fitting to the real situation on the spot.

2. Construction method **characterized by** the cabinet **(1)** and sub-frame as upper and lower rotation groups support **(2)** which extends the product versatility to any kind of possible situation, in example:

a) for use with structural frame **(24)** as complete mono-block solution **(see fig.16A)**
b) for use directly on already existing gate posts with fastening by screws or rawlplugs on site **(see fig.11 and fig.12)**
c) for use on floor with fastening by rawlplugs on the corner **(1b)** in **fig.18**
d) for use on uneven ground line by compensation of dismountable beam ends during new installation.
e) for use on uneven ground line also by direct fastening to the gate posts, if existing, or otherwise also to the floor

3. Method of procedure that makes possible any kind of transport for any kind of need and that can satisfy:

a) the possibility to transport the product as a whole mono-block thanks to the structural frame **(24)** and the dedicated hooks **(25)**
b) the possibility to transport the product as a size reduced mono-block thanks to the option to disassemble the central part of the structural frame **(24)** in **fig.15**
c) the possibility to transport each single element disassembled and placed on a pallet as graphically represented in **figs.17,17A and 17B**

4. We claim that the connection between the beams **(9)** and connection arms **(3,4)** can be replaced by a single element,

5. We claim that the hinge can be not only fixed by screws but also welded to the hinges support **(2).**

6. We claim that the whole sub-fratne can be not only disassemblable but also a single welded piece.

7. We claim that the connection between cabinet **(1)** and hinges support can be done not only with screws but also by welding.

8. We claim that the gear motor coupling can be done not only by direct plugging into the bushing **(4a)** but also in any other possible way as for example with gearing or chain and sprocket.

9. We claim that the transmission and balancing concept can be reversed between the upper and lower beam.

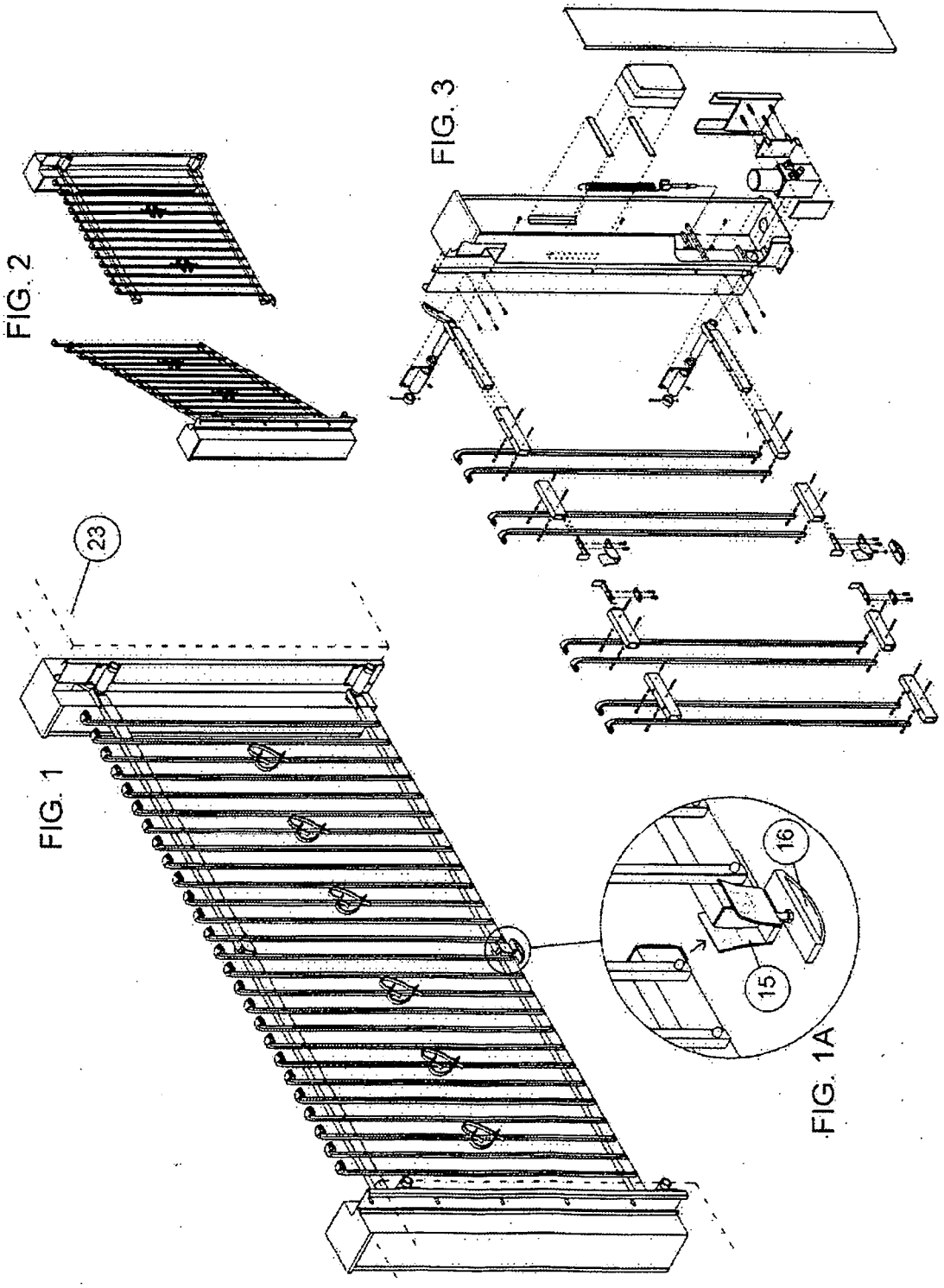


FIG. 2
FIG. 3
23
FIG. 1
16
15
FIG. 1A

FIG. 4

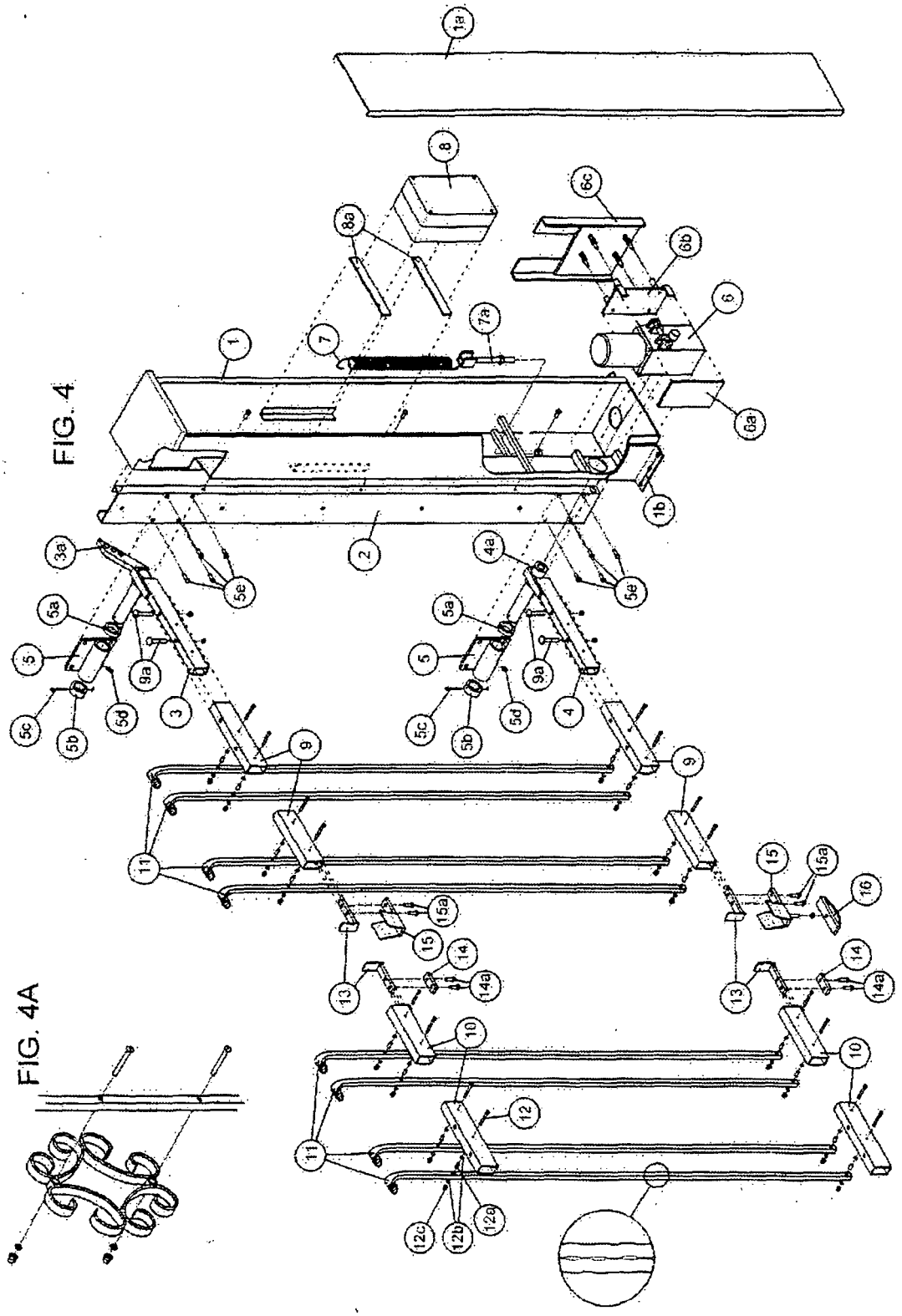

1a
8
8a
6c
6b
6
7
7a
1
9a
1b
2
3a
4a
5e
5a
5
5c
5b
5d
3
4
9
11
15
15a
16
14
14a
13
10
12
12a
12b
12c

FIG. 4A

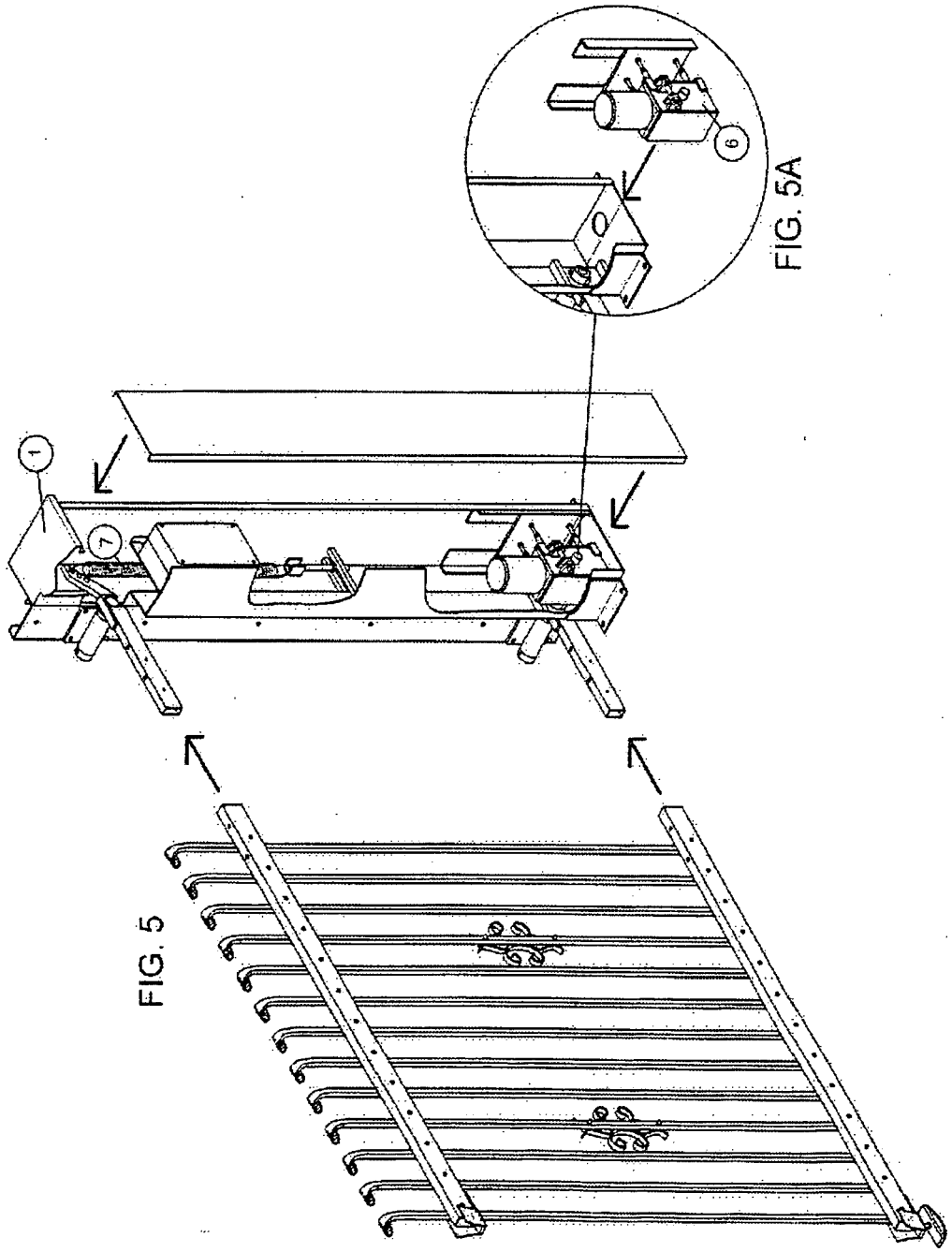


FIG. 5A

FIG. 5

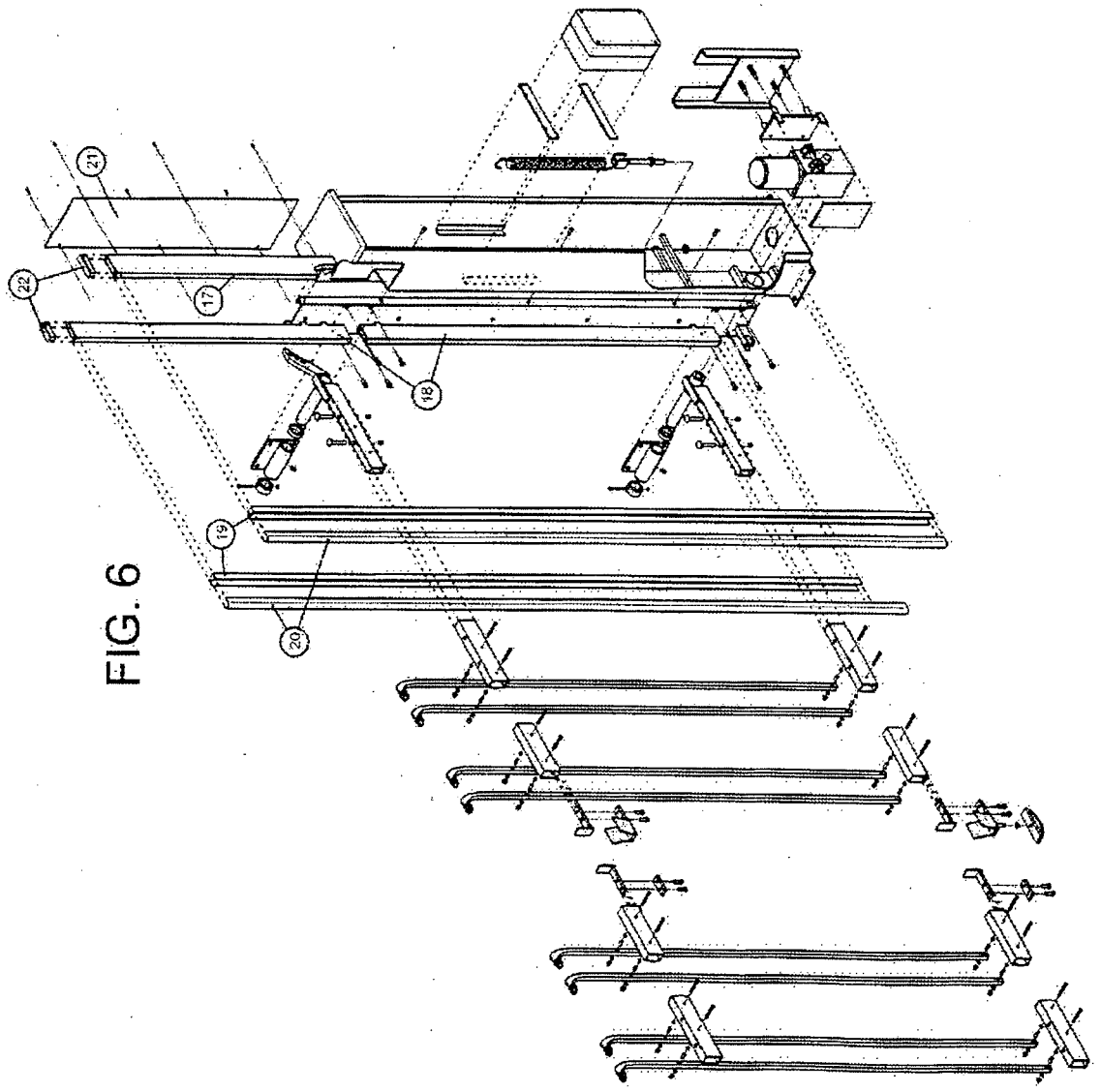


FIG. 6

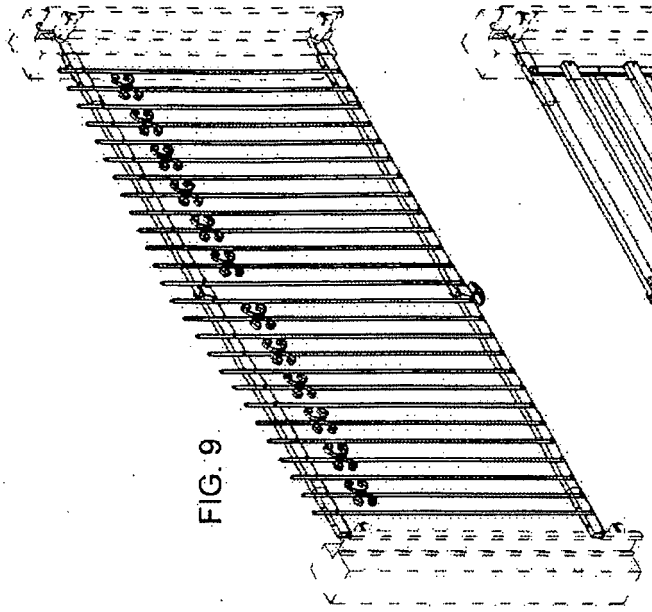


FIG. 9

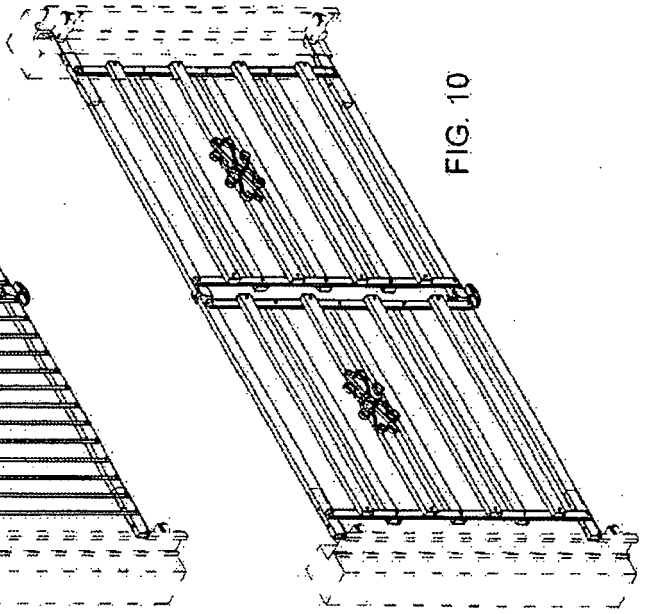


FIG. 10

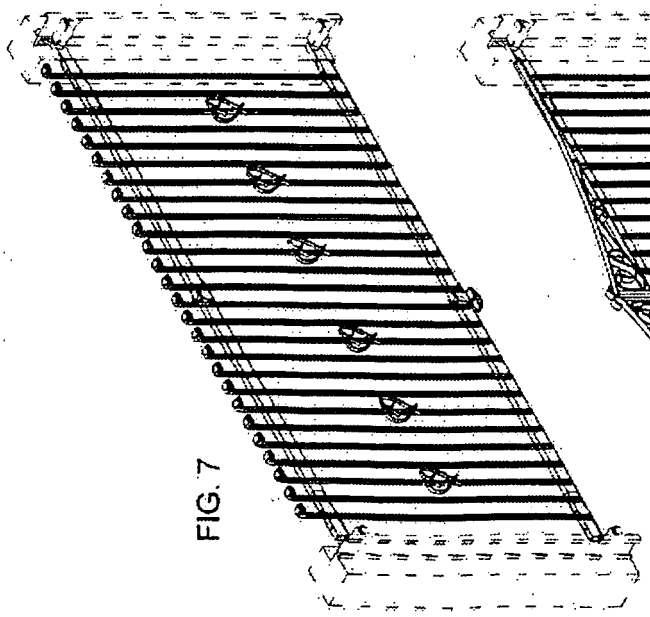


FIG. 7

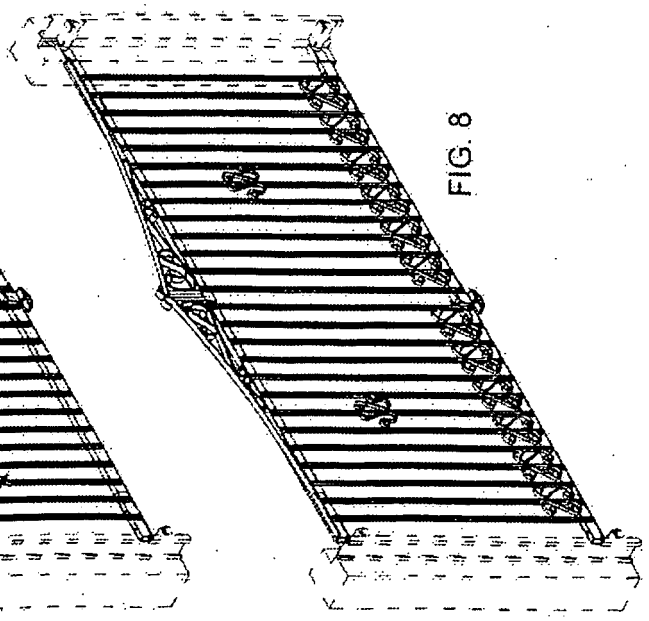


FIG. 8

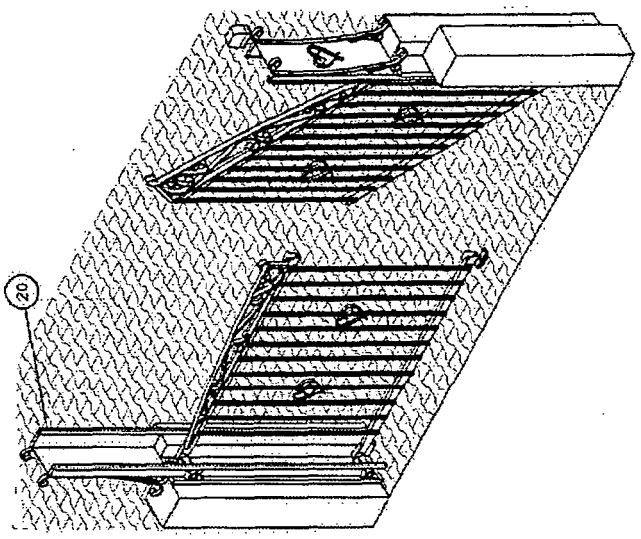


FIG. 12

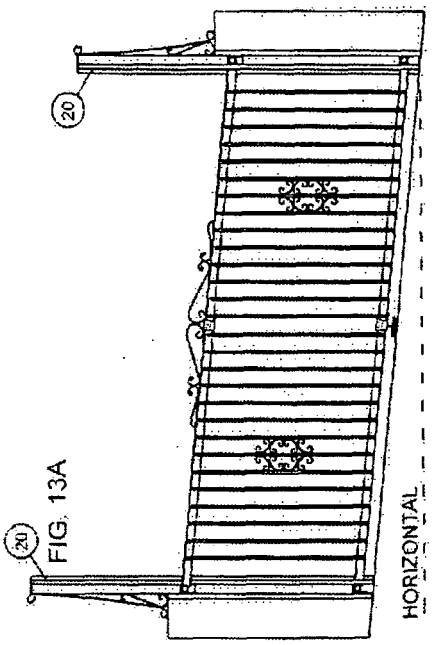


FIG. 13A

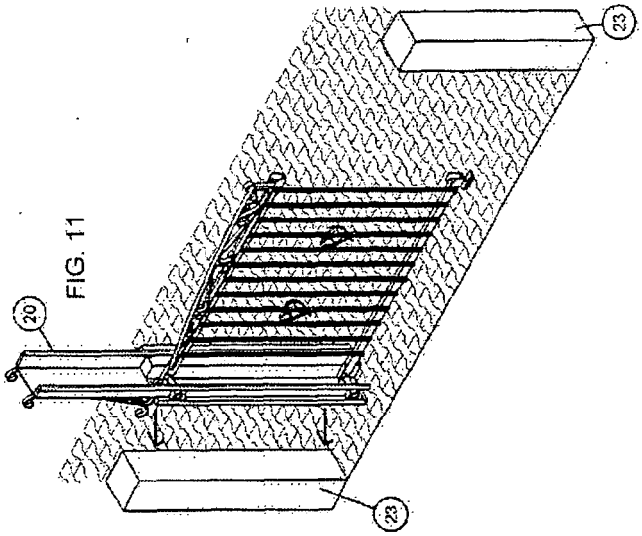


FIG. 11

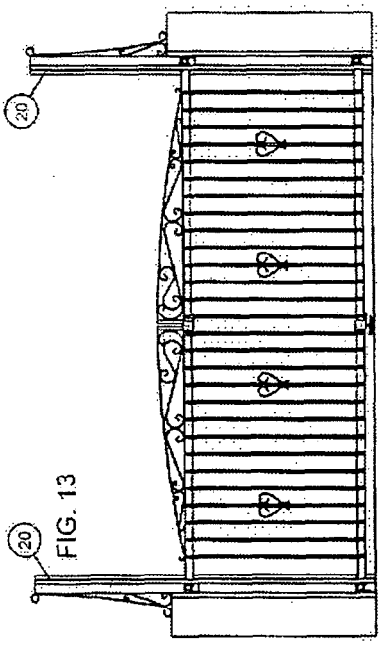


FIG. 13

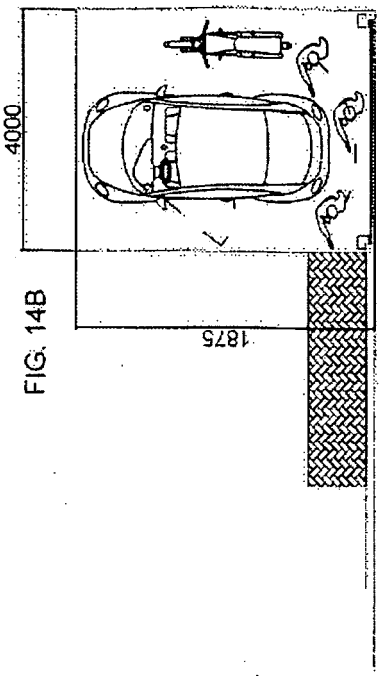


FIG. 14B

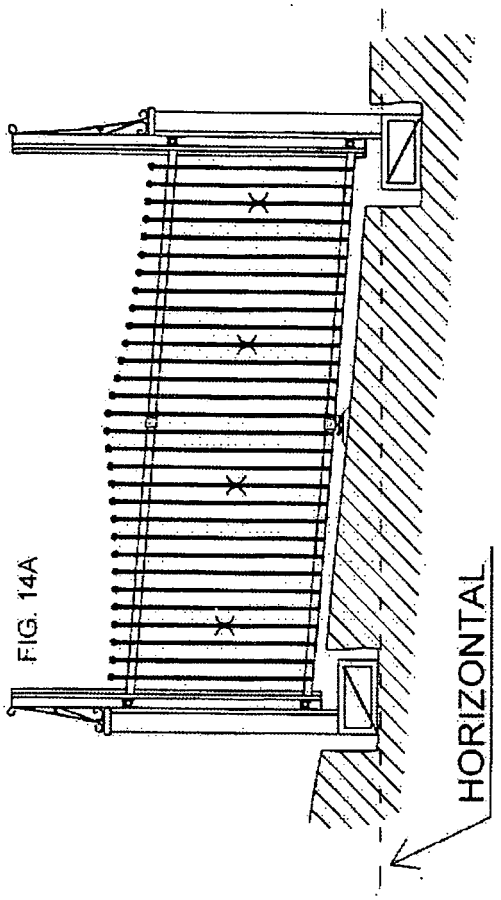


FIG. 14A

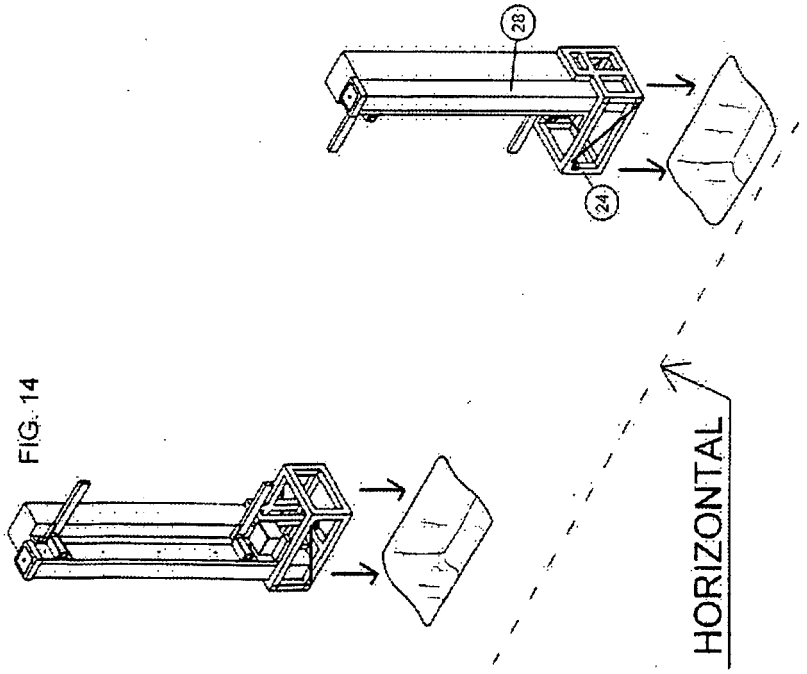


FIG. 14

FIG. 15A

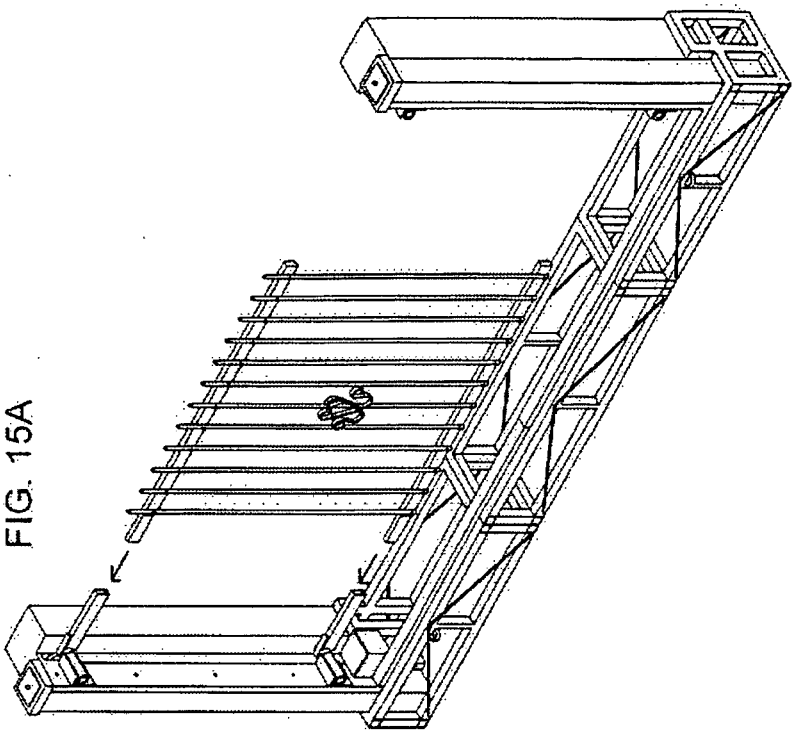


FIG. 15C

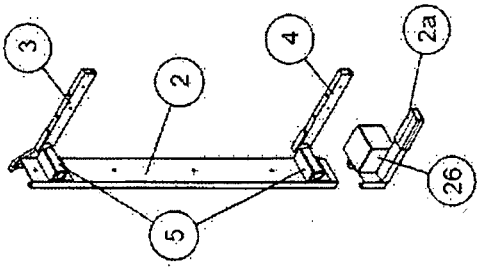


FIG. 15B

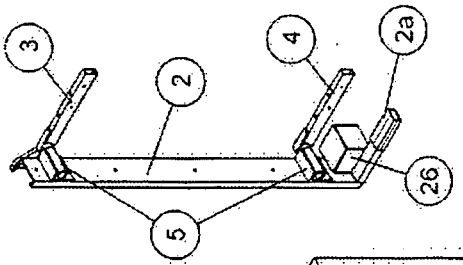


FIG. 15

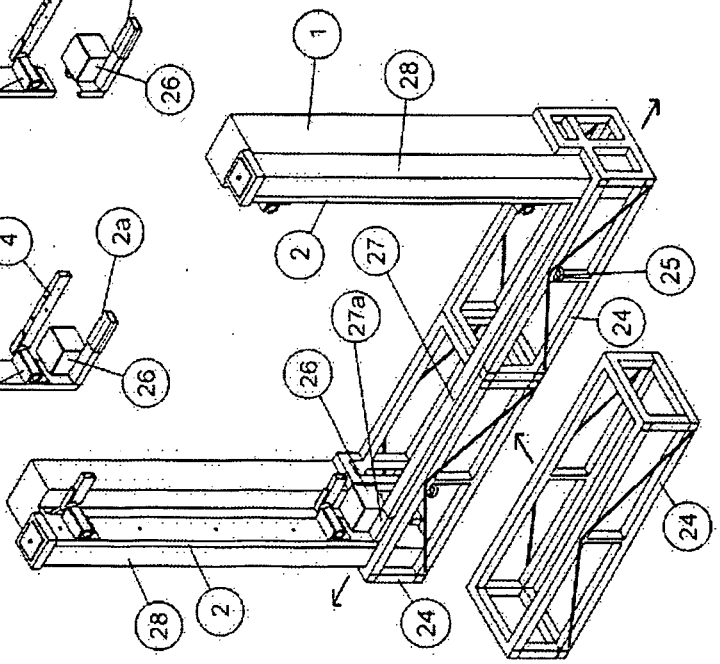


FIG. 16A

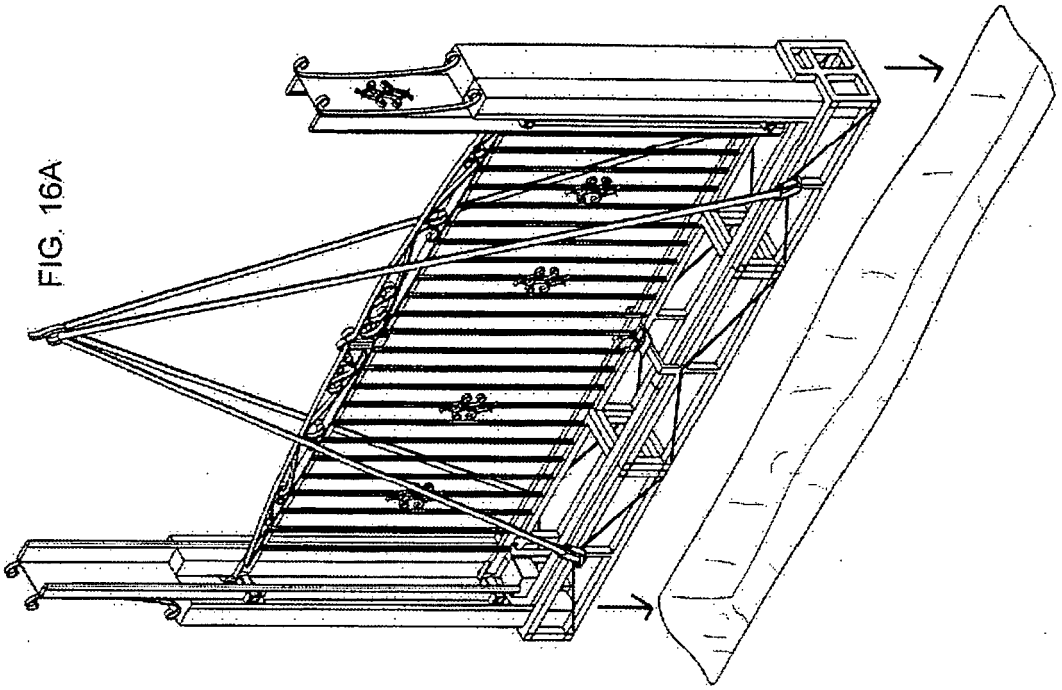
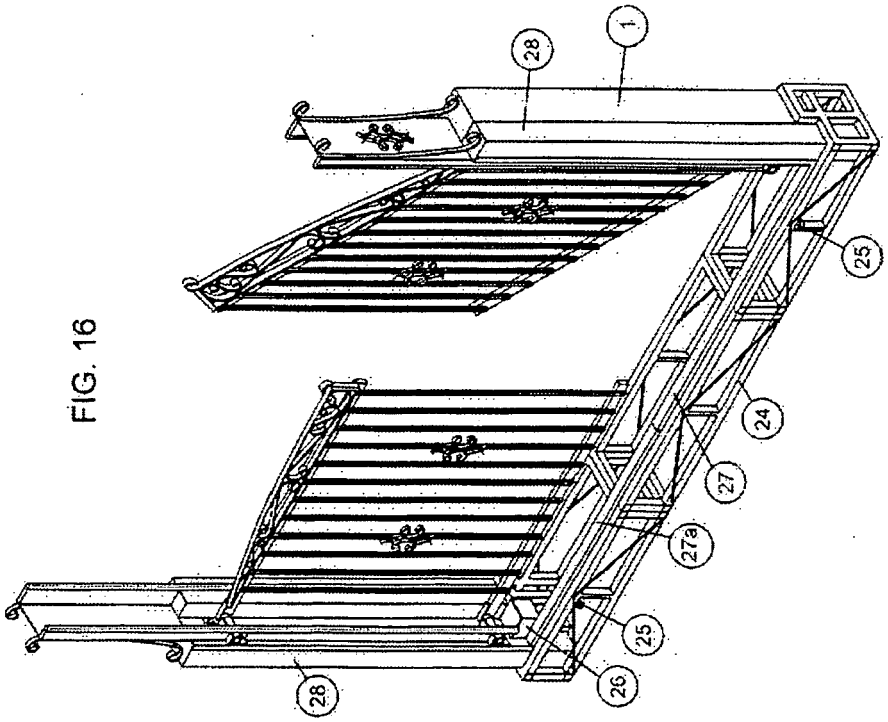


FIG. 16



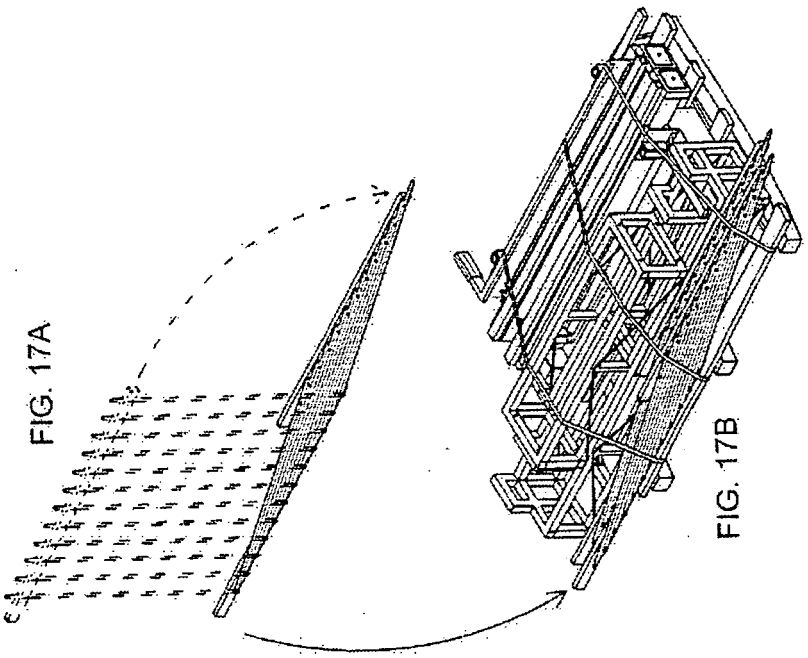


FIG. 17A

FIG. 17B

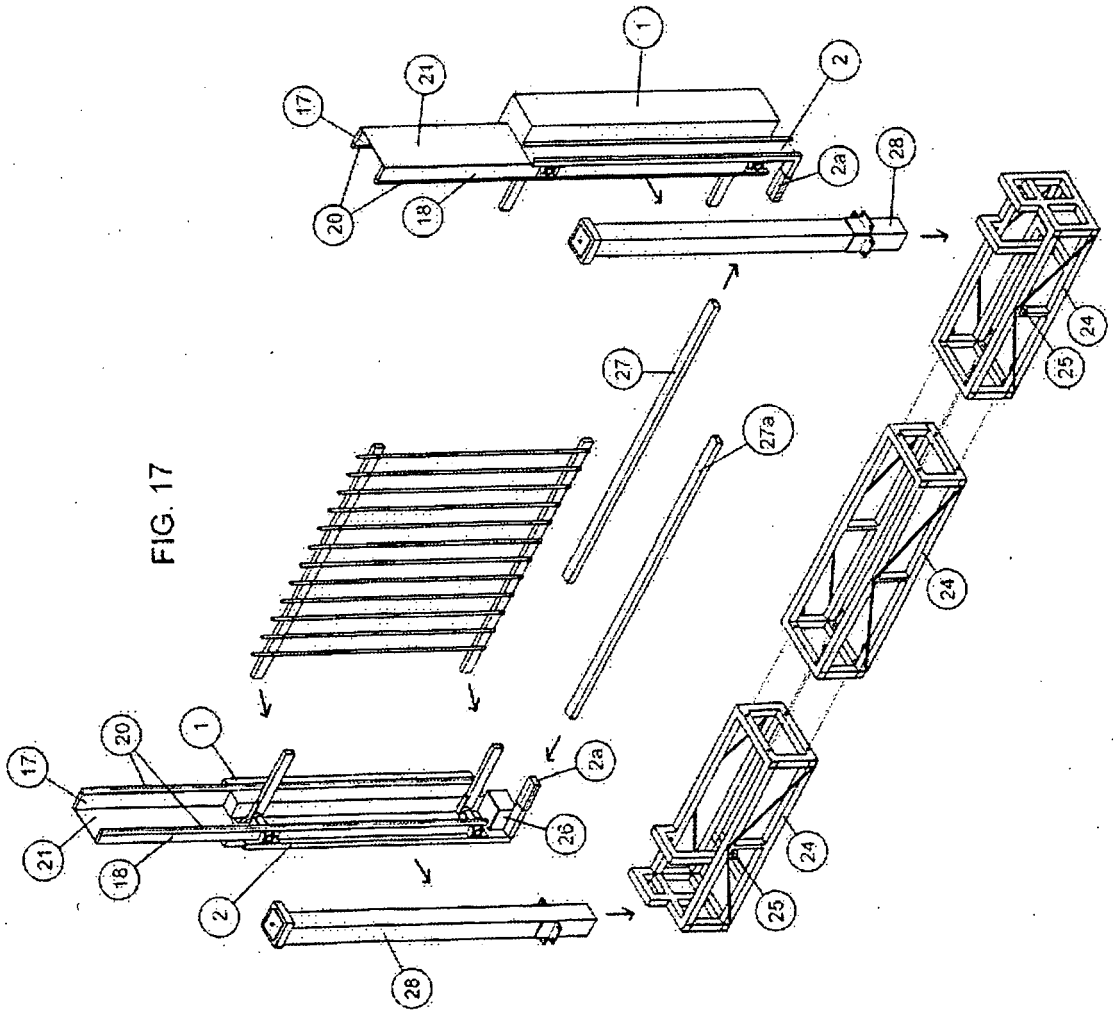
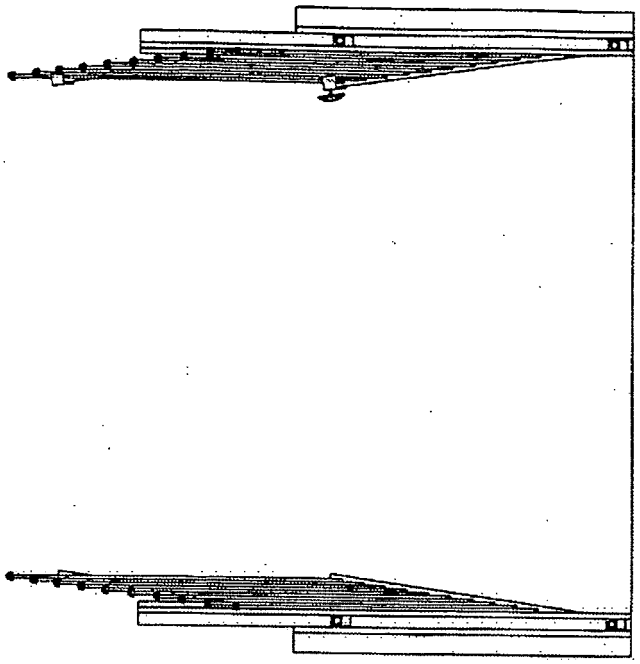
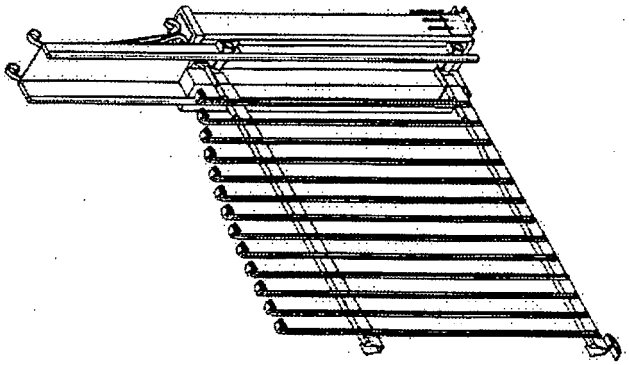


FIG. 17

FIG. 19





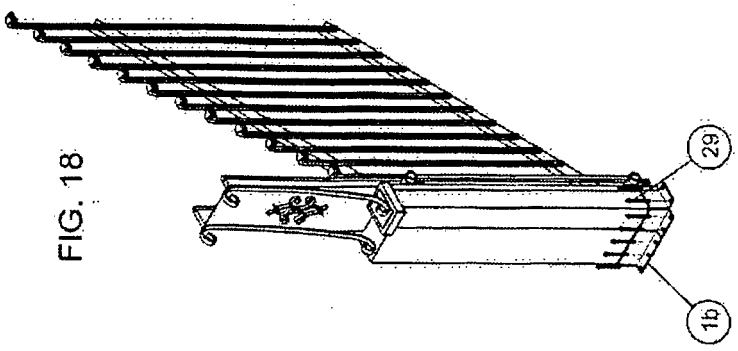


FIG. 18

REFERENCES CITED IN THE DESCRIPTION

This list of references cited by the applicant is for the reader's convenience only. It does not form part of the European patent document. Even though great care has been taken in compiling the references, errors or omissions cannot be excluded and the EPO disclaims all liability in this regard.

Patent documents cited in the description

- US 2044265 A, THOMAS GEORGE H **[0007]**
- US 2709862 A, LESLIE JR JAMES H **[0007]**
- US 4519164 A, PORTER RICHIARD A **[0007] [0009]**