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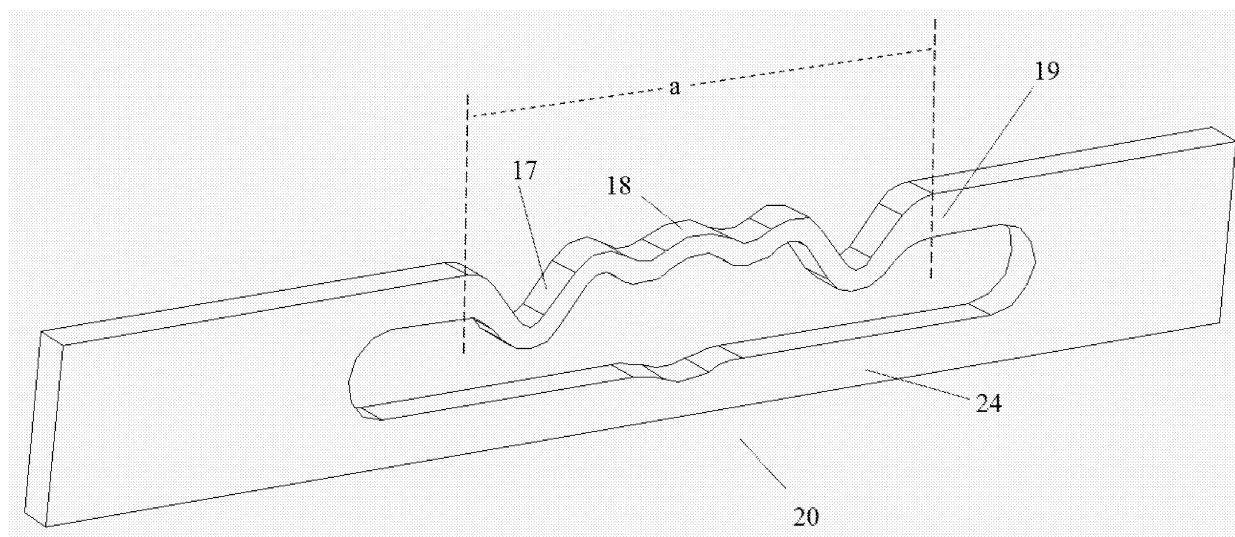
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(54) **Inseparable lock cylinder**

(57) The objects of the invention are achieved through use of a reinforcing system comprising a reinforcing member in the form of a two-arm closed-line longitudinal element, the two arms longitudinally extending along lines above and below said fixing hole. The upper arm of said reinforcing member is aimed at resisting ex-

panding forces by means of an extensible and high tensile strength structure provided. The reinforcement member according to the present invention is provided with smooth-curve zigzag lines of different lengths, delaying a rupture at the vertical line of the main rotation axis during extension.



**Fig. 2**

## Description

### Technical Field of the Invention

**[0001]** The present invention relates to a lock cylinder designed to be more reliable against breaking attempts where the improvement proposed by the invention prevents complete separation of the two cylinder parts in case of an unauthorized attempt to release the door lock or break the lock into pieces.

### Background of the Invention

**[0002]** In a standard locking assembly, a lock cylinder accommodates the most basic yet the most crucial elements of the system, to ensure reliability against burglary. In a lock case, typically two mutually located cylinder parts, between which a notch and a rotatable lock pawl are situated on a bridge-like region with a screw hole in the center, are present. Said bridge-like region exists in almost every lock assembly due to manufacturing standards set to enable a given lock to fit into a given door assembly. To this end, in an attempt to break the cylinder case, the small region, in the center of which a fixing screw is located on said bridge-like portion, constitute the weakest line of the case.

**[0003]** Someone who is involved in an unauthorized attempt to open a locked door may be able to destruct the lock cylinder and break the same into pieces for acting freely around the locking pawl or the bolt. In the event that he/she could be able to do so, the lock assembly becomes practically non-functional since the slot into which the pawl engages is accessible by simple means. Provided he/she is able to separate cylinder halves, he/she could then easily drop the far cylinder half into the interior of house and by pulling the front half out of its base, insert a cylinder of his/her own with a proper key to operate the lock or use any sharp tool, such as a screwdriver or a strong wire for instance to reach the slot in which the pawl resides.

**[0004]** On the other hand, in the event that the two half cylinders are broken from around the lock mounting hole in the middle, but not yet separated from each other due to any reinforcing structure, effecting rotation of the pawl will still prove to be difficult since the pawl slot is not directly accessible and since pin profiles in the cylinder are still functional in the manner to prevent a false key or any other sharp object to enable rotation of the pawl so as to catch lock actuation slot.

**[0005]** In a locking system, beside all security measures taken to prevent a burglary, one of the key factors determining whether a lock will perform its duty or not, is the length of the duration a thief has to struggle to unlock a door. Experiences in the circles of lock manufacturers and surveys from different sources show that the time elapsed to pull a lock out of its base is inversely proportional to the number of thieves insisting on the same lock. In other words, it is widely suggested in the country of

the applicant that lesser number of thieves continues their efforts as time elapses and that they do not attend to break into if they think that the door can not be unlocked or the lock can not be destructed in less than 10 seconds.

**[0006]** There are several patents/patent applications in the technical field of the present invention. One of those is EP 1 583 878. According to the disclosure provided therein, a reinforcement member in the form of a closed line body composed of a plurality of laminations occupying a receptacle volume arranged around both sides of the bridge-like portion and extending longitudinally along both cylindrical half-housings is present. Said lamination packs hence longitudinally surround said lock fixing hole from both side in a manner to resist flexural forces.

**[0007]** The most apparent drawback of this arrangement lies in that it simply further weakens the bridge-like portion as longitudinal arms of said reinforcement member further thin brass body portions above and below the fixing hole. In this respect, it eases a rupture in the region at which said reinforcing elements surround the fixing hole.

**[0008]** To further elucidate this situation, response of a lock assembly of the present type to a breaking force during an unauthorized attempt should be considered. When an unauthorized attempt takes place, force components exerting on the protruding front face of the lock cylinder typically try to advance the cylinder's lower part to an inner downward position and the upper part to an outer downward position. This flexural resultant force achieved by a suitable wrench is therefore effecting rotation around said bridge-like portion since the inner half-cylinder is fixed.

**[0009]** When such a force is applied on the protruding outer face of the cylinder, the two thin brass portions above and below said fixing hole forming the bridge-like portion, are not subject to the same force vectors. While the reinforcement material along the thin brass line below the fixing hole is subject to a compressing force, the material in the line above the hole is subject to an expanding force. This is due to the fact that it is not possible to effect rotation by wrenching upwardly since the lock pawl body in between two half-housings physically restricts a compressing force to act on this region. Although upward wrenching would possibly be helpful in order for weakening the bridge-like portion, final stroke should yet be imparted in a downward direction.

**[0010]** Referring back to EP 1 583 878, the reinforcing element in the form of a two-arm closed-line body made of laminations is not suitable for preventing a flexural rupture at the bridge-like portion. Rather, this rupture is eased by weakening said bridge-like portion. Further, as the two lines above and below the fixing hole are not subject to the same force vector as explained above, a rupture of the reinforcement member of EP 1 583 878 at the upper line is very likely considering that tensile strength of any used material will be greater than its compressive strength. To this end, a solution as is proposed by EP 1 583 878 is deficient in that the upper arm of the

reinforcement material is not suitable for resisting against expanding force components and the lower arm against compressing force components when upper arm rupture already occurred.

[0011] The reinforcing system, which comprises a reinforcing member according to the present invention, is advantageous in that said member is suitable for tolerating upper line expanding forces. The extensible arrangement of the reinforcing member according to the present invention will be effectual in preventing a burglary attempt by sufficiently extending so as to tolerate gaps in between half-housings. Conducted experiments reveal that reinforcement member lower arm withstands compressing force vectors as long as the upper arm does not break off. Since a rupture along the upper line of the fixing hole is more likely, arrangement of an extensible, high tensile strength structure prevents upper line rupture. On the other hand, the reinforcement member provided with smooth-curve zigzag lines of different lengths will additionally delay a rupture at the vertical line of the main rotation axis during extension according to the present invention.

### Objects of the Invention

[0012] In view of the problems with regard to the prior art disclosed above, one of the objects of the present invention is to prevent separation of the two half-housings of the cylinder assembly.

[0013] Another object of the present invention is to provide a cylinder assembly comprising a reinforcing system with a reinforcing member which can not be separated from the half-housings.

[0014] Further an object of the present invention is to provide a cylinder assembly comprising a reinforcing system for tolerating fixing hole upper line expanding forces as well as fixing hole lower line compressing forces.

[0015] Further an object of the present invention is to provide a cylinder assembly comprising a reinforcing system which can extend in the manner to tolerate gaps in between half-housings.

[0016] Further an object of the present invention is to provide a cylinder assembly comprising a reinforcing system which can additionally delay a rupture at the vertical line of the main rotation axis during extension.

### Summary of the Invention

[0017] The objects of the invention are achieved through use of a reinforcing system comprising a reinforcing member in the form of a two-arm closed-line longitudinal element, the two arms longitudinally extending along lines above and below said fixing hole. The upper arm of said reinforcing member is aimed at resisting expanding forces by means of an extensible and high tensile strength structure provided. The reinforcement member according to the present invention is provided with smooth-curve zigzag lines of different lengths, delaying

a rupture at the vertical line of the main rotation axis during extension.

### Brief Description of the Figures

[0018] Accompanying drawings are given solely for the purpose of exemplifying a cylinder assembly whose advantages over prior art were outlined above and will be explained in detail hereinafter:

Fig. 1 demonstrates a perspective view of the lock cylinder according to the present invention.

Fig. 2 demonstrates the reinforcement member according to the present invention.

Fig 3 demonstrates the upper arm of the reinforcement member according to the present invention

Fig. 4 also demonstrates the upper arm of the reinforcement member according to the present invention

### Detailed Description of the Invention

[0019] Referring now to the figures outlined above, the lock assembly (11) typically comprises a longitudinally extending cylindrical portion (12) in the form of two divisions or cylindrical half-housings (22), to receive keys from the inside and the outside of a door and a flat portion (13) extending parallel to the upper cylindrical portion with a notch (14) in the middle, through which a pawl is rotatably movable between said divisions, to operate the lock. Said cylindrical portion (12) contains the cylindrical core in which a series of ciphering pins extend in the conventional manner.

[0020] A standard lock is conventionally secured to a door assembly by a screw that is fixed at a hole (15) which is located in a bridge-like portion (16) under said notch (14) and which is perpendicular to the key axis of the cylinder lock. This region constitutes both vertically and horizontally the weakest line across the entire length of the lock assembly (11) and is potentially to be the first portion to be broken in case a burglar exerts a flexural and torsional force e.g. via a lever rod to break the lock into pieces. It is known in the art that the bodies of these locks are generally made of brass. Separation of the two half-housings (22) will simply permit a burglar to pull one of those out of the lock hole and reach the slot into which the pawl engages to unlock the door. To avoid further weakening of the weakest line and to effect this region inadvertently as least as possible, the reinforcing structure according to the present invention takes advantage of an improved design and provides a reinforcement member (20) in the form of a two-arm closed-loop steel body. The upper arm (19) of the reinforcement member (20) is provided with a plurality of non-horizontal smooth-turn segment lines in the form of zigzag lines extending

along at least an upper arm portion. Linear length (distance -a- in Fig. 2) of said zigzag form is arranged suitable for circumferentially surrounding said fixing hole (15).

**[0021]** The reinforcement member (20) according to the present invention is designed as a two different sets line corrugation upper arm (19). In other words, the upper arm (19) comprises two separate regions along which inclined lines with different horizontal and vertical projections extend. To this end, the upper arm (19) along the bridge-like region (16), that is, within the space defined by the projection lines of the vertical borders of said notch (14), is designed to comprise shorter length (distance -c- in Fig. 3) line segments compared to the line segments (distance -e- in Fig. 4) outside the bridge space (16). More particularly, while design of the upper part of said screw hole (15) on the upper arm (19) is similar to a sine wave, remaining side portions (17) of the arm (19) are designed in the form of a larger magnitude sine wave.

**[0022]** The upper arm (19) outer portions (17) at both sides with longer line segments (e) in between zigzag turns are the first parts that are extending toward the sides to tolerate the distance opening in between the half-housings (22) following rupture at the screw hole upper brass body (21). In case a burglar exerts e.g. laterally using a charging rod, a force sufficient to break said screw hole upper brass body (21), it is apparent that the cylinders (22) will move in opposite directions and since the inner one is fixed, the outer cylinder will tend to rotate downward around a point on the screw hole (15) lower brass body (21), on which a rupture will also eventually occur due to compressing forces. As stated above, upon rupture at both upper and lower brass bodies (21, 23), the security of the system will solely rely on the reinforcement member (20).

**[0023]** In case such a double rupture takes place in the bridge-like region (16), upper arm (19) longer segment zigzag lines (17) of said reinforcement member (20) will extend faster to compensate outward advancement of the outer housing (22). Longer segment lines (17) are shaped such that, when fully extended, at least a 90 degrees rotation of the outer cylinder (22) around the screw hole lower brass body (23) is compensated. Said smooth-curve zigzag segment lines in different lengths are especially advantageous in that they are extensible in sequence so as to tolerate upper line expanding forces. In other words, extension of shorter length line segments (18) takes place when longer length line segments (17) are substantially extended, delaying rupture at the vertical line of the main rotation axis (Fig. 1).

**[0024]** Considering the fact that tensile strength of steel is greater than its compressive strength and that total rupture of the lower arm (24) is very unlikely before a rupture on the upper arm (19) takes place, the extensible arrangement of the upper arm will be effectual in preventing a burglary attempt. On the other hand, smooth-curve segment lines in different lengths will additionally delay a rupture at the vertical line of the main rotation axis.

**[0025]** The reinforcement member (20) is fixed within the flat portion (13) of the lock cylinder by means of any suitable fixing means. Suitable bearings in holes (15) can be used for this purpose.

**[0026]** It is clear that the reinforcement member (20) according to the present invention is made out of a high tensile material. Any high tensile material will resist an expanding force before completely breaking off, depending on the magnitude of the force vectors. The arrangement of the present invention, however, although making use of a high tensile material, benefits from the special design allowing displacement of line segments (17, 18) during extension. This can be explained by referring to a "V" letter. When a "V" shape structure is subject to a horizontal expanding force from both extremities, the angle between two line segments of "V" will expand to tolerate the displacement caused. However, it is worthy of note that smooth turns of the line segments according to the present invention, although getting deformed during expansion of the angle in between, elastic limit / yield strength of the material is not reached before the line segments (17, 18) are substantially extended to take a linear alignment. This will substantially delay rupture of the reinforcement member (20), therefore discouraging burglars.

**[0027]** The present invention in a nutshell provides a lock cylinder (11) comprising a longitudinally extending cylindrical portion (12) in the form of two cylindrical half-housings (22), a flat portion (13) extending parallel to the upper cylindrical portion with a notch (14) above a bridge-like region (16) accommodating a screw hole (15) for fixing said lock cylinder (11) and a reinforcement member (20) fixed at both sides of said bridge-like region (16) so as to extend at least partially along said flat portion (13) in a longitudinal manner. Said reinforcement member (20) further comprises at least two non-horizontal line segments the angle between which is suitable for expanding in response to expanding forces.

## Claims

1. A lock cylinder (11) comprising a longitudinally extending cylindrical portion (12) in the form of two cylindrical half-housings (22), a flat portion (13) extending parallel to the upper cylindrical portion with a notch (14) above a bridge-like region (16) accommodating a screw hole (15) for fixing said lock cylinder (11) and a reinforcement member (20) fixed at both sides of said bridge-like region (16) so as to extend at least partially along said flat portion (13) in a longitudinal manner  
**characterized in that**  
said reinforcement member (20) comprises at least two non-horizontal line segments the angle between which is suitable for expanding in response to expanding forces.

2. A lock cylinder (11) as explained in Claim 1 wherein said reinforcement member (20) is a two-arm closed-loop steel body, both arms (19, 24) extending longitudinally along said flat portion (13).  
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3. A lock cylinder (11) as explained in Claim 1 and 2 wherein said non-horizontal line segments are provided in the form of smooth-turn zigzag lines extending along at least an upper arm (19) portion.  
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4. A lock cylinder (11) as explained in Claim 3 wherein the upper arm (19) of said reinforcement member (20) is arranged in the form of two separate regions along which non-horizontal line segments in different lengths extend.  
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5. A lock cylinder (11) as explained in Claim 4 wherein linear length (a) along said separate regions is arranged suitable for circumferentially surrounding said fixing hole (15).  
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6. A lock cylinder (11) as explained in Claim 4 wherein line segments (18) within the space defined by the projection lines of the vertical borders of said notch (14) are shorter than line segments (17) outside the bridge-like region (16) whereby extension of shorter length line segments (18) takes place when longer length line segments (17) are substantially extended, delaying rupture at the vertical line of the main rotation axis.  
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7. A lock cylinder (11) as explained in Claim 6 wherein said line segments (17) are shaped such that, when fully extended, at least a 90 degrees rotation of an outer cylinder (22) around a screw hole lower brass body (23) is compensated.  
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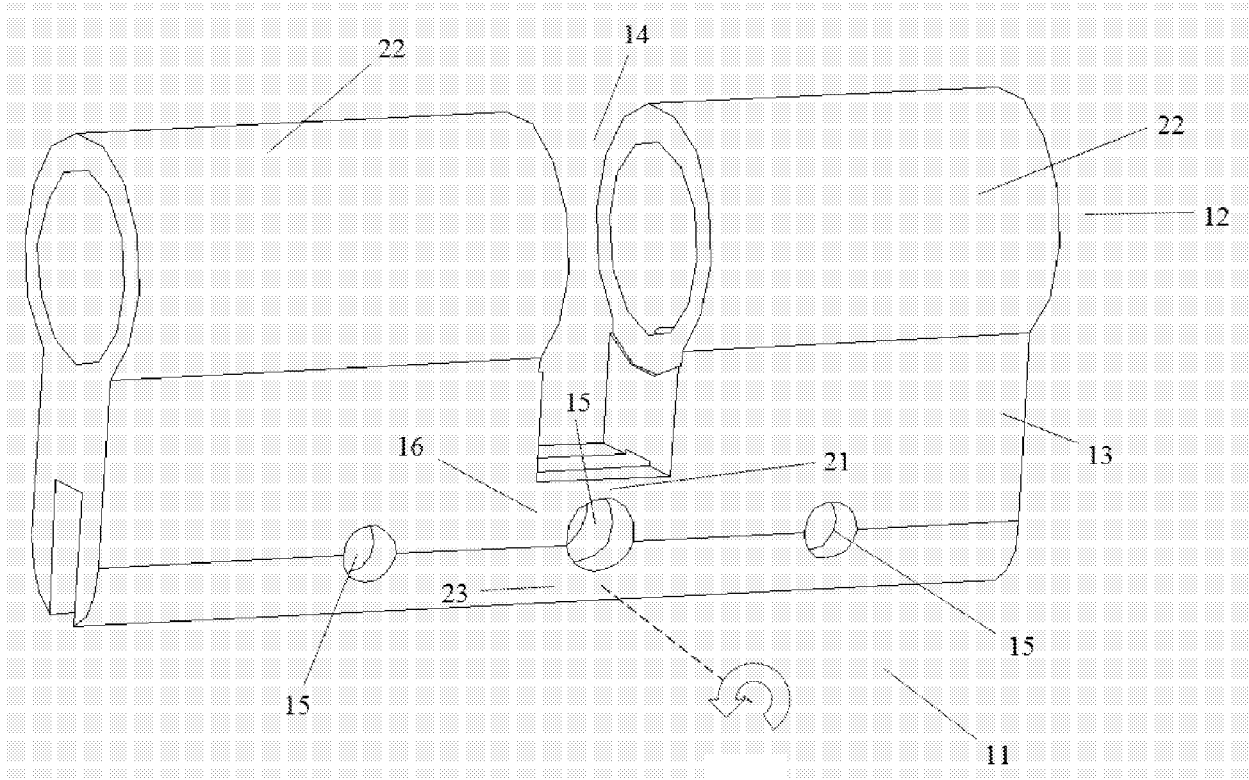


Fig. 1

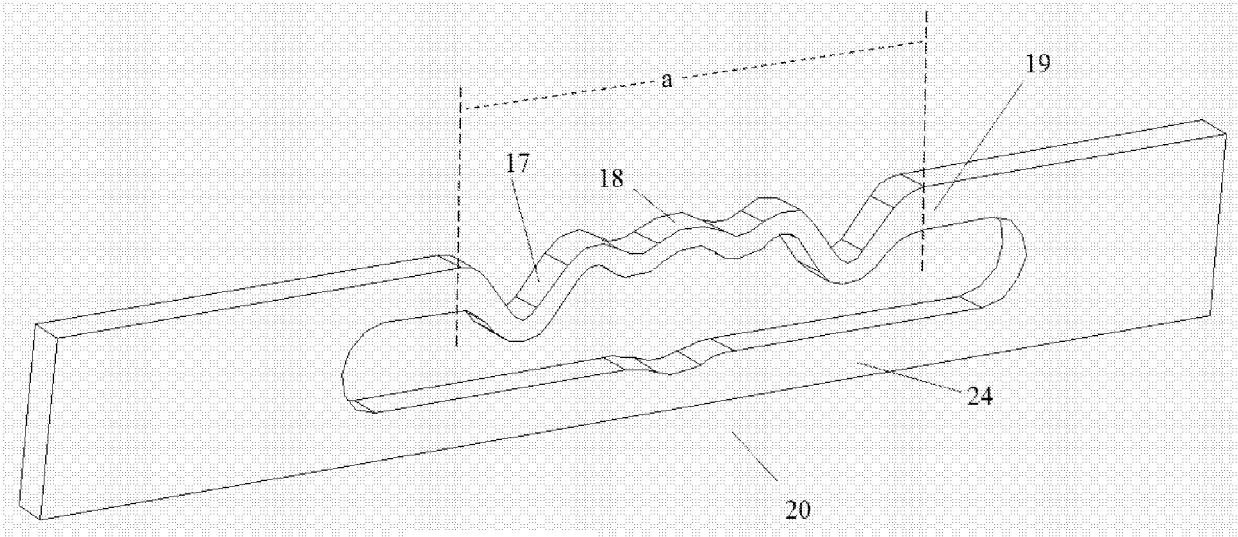


Fig. 2

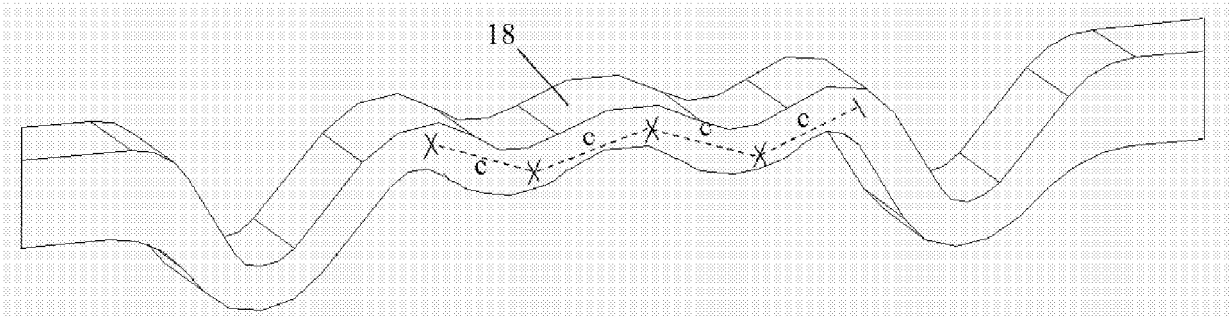


Fig. 3

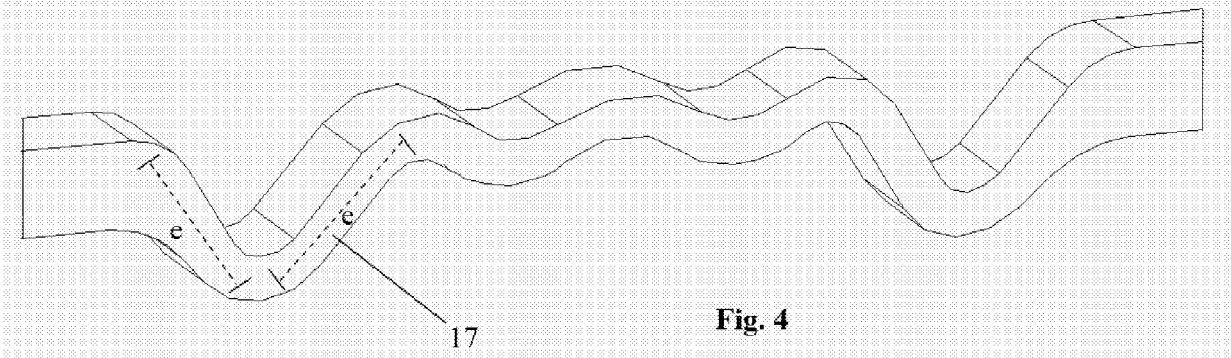


Fig. 4





European Patent  
Office

# EUROPEAN SEARCH REPORT

Application Number  
EP 07 10 0304

| DOCUMENTS CONSIDERED TO BE RELEVANT  |  |   |   |
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| The present search report has been drawn up for all claims   |  |   | TECHNICAL FIELDS SEARCHED (IPC)<br><br>E05B |
| Place of search<br><b>The Hague</b>  |  | Date of completion of the search<br><b>22 May 2007</b>  | Examiner<br><b>Westin, Kenneth</b>          |
| CATEGORY OF CITED DOCUMENTS<br>X : particularly relevant if taken alone<br>Y : particularly relevant if combined with another document of the same category<br>A : technological background<br>O : non-written disclosure<br>P : intermediate document |  | T : theory or principle underlying the invention<br>E : earlier patent document, but published on, or after the filing date<br>D : document cited in the application<br>L : document cited for other reasons<br>.....<br>& : member of the same patent family, corresponding document |   |

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EPO FORM 1503 03.82 (P04C01)

**ANNEX TO THE EUROPEAN SEARCH REPORT  
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EP 07 10 0304

This annex lists the patent family members relating to the patent documents cited in the above-mentioned European search report.  
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22-05-2007

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**REFERENCES CITED IN THE DESCRIPTION**

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