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(54) **A lever for a ring binder mechanism**

Hebel für einen Ringbindungsmechanismus

Levier pour mécanisme de reliure à anneaux

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(56) References cited:
GB-A- 2 275 023 US-A- 1 996 463
US-A- 4 813 803

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Description

BACKGROUND OF THE INVENTION

[0001] This invention relates to a ring binder mechanism for retaining loose-leaf pages, and to an improved ring binder mechanism for opening and closing ring members and for locking closed ring members together.

[0002] A ring binder mechanism retains loose-leaf pages, such as hole-punched pages, in a file or notebook. It has ring members for retaining the pages. The ring members may be selectively opened to add or remove pages or closed to retain pages while allowing the pages to be moved along the ring members. The ring members mount on two adjacent hinge plates that join together about a pivot axis. An elongate housing loosely supports the hinge plates within the housing and holds the hinge plates together so they may pivot relative to the housing.

[0003] The undeformed housing is slightly narrower than the joined hinge plates when the hinge plates are in a coplanar position (180°). So as the hinge plates pivot through this position, they deform the resilient housing and cause a spring force in the housing that urges the hinge plates to pivot away from the coplanar position, either opening or closing the ring members. Thus, when the ring members are closed the spring force resists hinge plate movement and clamps the ring members together. Similarly, when the ring members are open, the spring force holds them apart. An operator may typically overcome this force by manually pulling the ring members apart or pushing them together. Levers may also be provided on one or both ends of the housing for moving the ring members between the open and closed positions. But a drawback to these known ring binder mechanisms is that when the ring members are closed, they do not positively lock together. So if the mechanism is accidentally dropped, the ring members may unintentionally open.

[0004] U.S. Pat. No. 4,813,803 (Gross) discloses a loose-leaf sheet binder mechanism with a case, hinge plates, ring halves and trigger lever to operate the hinge plates for opening and closing the ring halves. The case has first lock means on it in the form of a raised or dimpled member and the trigger lever has complementary second lock means on it. When the trigger lever is in a closed and locked position, the first and second lock means engage one another to help retain the trigger lever in a position in which it is wedged between upper surfaces of the hinge plates and the case to block opening movement of the hinge plates.

[0005] Some ring binder mechanisms have been modified to include locking structure to block the hinge plates from pivoting when the ring members are closed. The blocking structure positively locks the closed ring members together, preventing them from unintentionally opening if the ring mechanism is accidentally dropped. The blocking structure also allows the housing spring force to be reduced because the strong spring force is

not required to clamp the closed ring members together. Thus, less operator force is required to open and close the ring members of these mechanisms than in traditional ring mechanisms.

[0006] Some of these ring mechanisms incorporate the locking structure onto a control slide connected to the lever. The lever moves the control slide (and its locking structure) to either block the pivoting movement of the hinge plates or allow it. But a drawback to these mechanisms is that an operator must positively move the lever after closing the ring members to position the locking structure to block the hinge plates and lock the ring members closed. Failure to do this could allow the hinge plates to inadvertently pivot and open the ring members, especially if the mechanisms are accidentally dropped.

[0007] Some locking ring binder mechanisms use springs to move the locking structure into position blocking the hinge plates when the ring members close. Examples are shown in co-owned U.S. Pat. Appl. Nos. 10/870,801 (Cheng et al.), 10/905,606 (Cheng), and 11/027,550 (Cheng). These mechanisms employ separate springs to help lock the mechanisms.

[0008] Accordingly, there is a need for a simple ring binder mechanism that readily locks ring members together when the mechanism is closed without requiring additional spring components to do so.

SUMMARY OF THE INVENTION

[0009] A ring mechanism for holding loose-leaf pages includes a housing, first and second hinge plates supported by the housing for pivoting motion relative to the housing about a hinge, and rings for holding loose-leaf pages. Each ring has a first ring member and a second ring member. The first ring member is mounted on the first hinge plate and moveable with the pivoting motion of the first hinge plate relative to the second ring member between a closed position and an open position. In the closed position, the two ring members form a substantially continuous, closed loop for allowing loose-leaf pages retained by the rings to be moved along the rings from one ring member to the other. In the open position, the two ring members form a discontinuous, open loop for adding or removing loose-leaf pages from the rings. The ring mechanism also has a lever pivotally mounted on the housing. The lever includes a first portion and a second portion connected to the first portion for engaging the hinge plates and moving the ring members from the closed position to the open position. A locking element is operatively connected to the lever. The hinge plates are supported by the housing so that at least one of the hinge plates is in continuous engagement with the second portion of the lever when the ring members are in the closed position for inhibiting play in the lever. The hinge plate in continuous engagement with the second portion of the lever has an upper surface facing toward the housing and a lower surface facing away from the housing. The lower surface of the hinge plate is in con-

tinuous engagement with the second portion of the lever.

[0010] Other features of the invention will be in part apparent and in part pointed out hereinafter.

BRIEF DESCRIPTION OF THE DRAWINGS

[0011]

FIG. 1 is a perspective of a notebook incorporating a ring binder mechanism according to a first embodiment of the invention;

FIG. 2 is an exploded perspective of the ring mechanism;

FIG. 3 is an enlarged side view of a lever of the mechanism;

FIG. 4 is a top side perspective of the ring mechanism at a closed and locked position with the lever in a first relaxed position;

FIG. 5 is a bottom side perspective thereof;

FIG. 6 is an enlarged fragmentary perspective of the ring mechanism with a portion of a housing broken away and with a ring member removed to show internal construction;

FIG. 7 is a side view thereof with the housing and ring members removed;

FIG. 8 is a top side perspective of the ring mechanism at a closed and unlocked position with the lever in a deformed position;

FIG. 9 is a bottom side perspective thereof;

FIG. 10 is an enlarged fragmentary side view thereof with the housing and ring members removed;

FIG. 11 is a topside perspective of the ring mechanism at an open position with the lever at a second relaxed position;

FIG. 12 is a bottom side perspective thereof;

FIG. 13 is an enlarged fragmentary side view thereof with the housing and ring members removed to show internal construction;

FIG. 14 is a top side perspective of a ring mechanism according to a second embodiment at the closed and locked position;

FIG. 15 is an enlarged top side perspective of a lever thereof;

FIG. 16 is a side view of the ring mechanism;

FIG. 17 is a bottom side perspective of a ring mechanism according to a third embodiment at the closed and locked position;

FIG. 18 is an enlarged side view of a lever thereof;

FIG. 19 is an enlarged fragmentary side view of the ring mechanism with a housing and ring members removed;

FIG. 20 is an enlarged fragmentary side view similar to FIG. 19 with the mechanism at the closed and unlocked position; and

FIG. 21 is an enlarged fragmentary side view similar to FIG. 19 with the mechanism at the open position.

[0012] Corresponding reference numbers indicate cor-

responding parts throughout the views of the drawings.

DETAILED DESCRIPTION

[0013] Referring to the drawings, Figs. 1-13 show a ring binder mechanism according to a first embodiment generally at 1. In Fig. 1, the mechanism 1 is shown mounted on a notebook designated generally at 3. Specifically, the mechanism 1 is shown mounted on a spine 5 of the notebook 3 between a front cover 7 and a back cover 9 hingedly attached to the spine 3. The front and back covers 7, 9 move to selectively cover or expose loose-leaf pages (not shown) retained by the mechanism 1 in the notebook 3. Ring binder mechanisms may be mounted on surfaces other than a notebook, for example, a file.

[0014] As shown in Fig. 1, a housing, designated generally at 11, supports three rings (each designated generally at 13) and a lever (broadly, "actuator," and designated generally at 15). The rings 13 retain loose-leaf pages on the ring mechanism 1 in the notebook 3 while the lever 15 operates to open and close the rings so that pages may be added or removed. Referring now also to Fig. 2, the housing 11 is shaped as an elongated rectangle with a uniform, roughly arch-shaped cross section, having at its center a generally flat plateau 17. A first longitudinal end of the housing 11 (to the left in Fig. 1 and to the right in Fig. 2) is generally open while a second, opposite longitudinal end is generally closed. A pair or mounting arms, each designated 19 (Figs. 2 and 4), extend downward from the housing plateau 17 at the open end, while bent under rims, each designated at 21 (Figs. 2 and 5), extend lengthwise along longitudinal edges of the housing 11 from the first longitudinal end of the housing to the second longitudinal end. Mechanisms may have housing of other shapes, including irregular shapes, or housings that are integral with a file or notebook.

[0015] The three rings 13 of the ring binder mechanism 1 are substantially similar and are each generally circular in shape (Figs 1, 4, and 5). As shown in Figs. 1 and 2, the rings 13 each include two generally semi-circular rings members 23a, 23b formed from a conventional, cylindrical rod of a suitable material (e.g., steel). The ring members 23a, 23b include free ends 25a, 25b, respectively, formed to secure the ring members against transverse misalignment (relative to longitudinal axes of the ring members) when they are together (e.g., Figs 1, 4, and 5). The rings 13 could be D-shaped as is known in the art. Ring binder mechanisms with ring members may be formed of different material or may have different cross-sectional shapes, for example, oval shapes.

[0016] As also shown in Fig. 2, the ring mechanism 1 includes two substantially identical hinge plates, designated generally at 27a, 27b, supporting the ring members 23a, 23b respectively. The hinge plates 27a, 27b are each generally elongate, flat, and rectangular in shape and are each somewhat shorter in length than the housing 11. Four corresponding cutouts 29a-d are formed in each of the hinge plates 27a, 27b along an inner edge

margin of the plate. A bent down finger 31 extends longitudinally away from a first end of each of the hinge plates 27a, 27b (to the right in Fig. 2). The fingers 31 are each narrower in width than the respective hinge plates 27a, 27b and are positioned with their inner longitudinal edges generally aligned with the inner longitudinal edges of the plates. The purpose of the cutouts 29a-d and fingers 31 will be described hereinafter.

[0017] Referring to Figs. 2 and 3, the lever 15 includes a grip 33 with an inverted "L" shape, a body 35 ("first portion") attached to the grip, and a tongue 37 ("second portion") attached to the body. The grip 33 is somewhat broader than both the body 35 and the tongue 37 (Fig. 2) and facilitates grasping the lever 15 and applying force to move the lever. In the illustrated ring mechanism 1, the body 35 is formed as one piece with the grip 33 for substantially conjoint movement with the grip. The body 35 may be formed separate from the grip 33 and attached thereto.

[0018] As shown in Fig. 3, the tongue 37 of the lever 15 is attached to the body 35 by a flexible bridge 39 (or "living hinge") formed as one piece with the body and tongue. A mechanism may have a lever in which a bridge is formed separate from a body and/or tongue for connecting the body and tongue. The bridge 39 is generally arch-shaped and defines an open channel 41 between the tongue 37 and body 35. The tongue 37 extends away from the body 35 at the bridge 39 and channel 41 in general parallel alignment with an upper lip 35a of the body and defines a C-shaped space between the body and tongue (above the bridge). It is envisioned that the lever 15 is formed from a resilient plastic material by, for example, a mold process. But the lever 15 may be formed from other materials or other processes. A ring mechanism may have a lever shaped differently than illustrated and described herein.

[0019] As also shown in Fig. 3, the lever 15 includes a pivot bulb 43 located toward an end of the tongue 37 opposite the bridge 39. The bulb 43 may be separate from the tongue 37 and releasably attached thereto by a tab (not shown) inserted through an opening (not shown) in the tongue. As another example, the bulb 43 may be formed as one piece with the tongue 37.

[0020] Referring again to Fig. 2, the ring mechanism 1 includes an elongated, generally flat, rectangular travel bar designated generally at 45. The travel bar includes a rectangular mounting groove 47 at a first end (to the right in Fig. 2) and three block-shaped locking elements (each designated generally at 49) along a bottom surface. The locking elements 49 are spaced apart longitudinally along the travel bar 45 with one locking element adjacent each longitudinal end of the travel bar, and one located toward a center of the travel bar. The travel bar 45 may have other shapes or greater or fewer than three locking elements 49. The travel bar 45 could be formed without locking elements and instead carry wedges, for example, that move the hinge plates 27a, 27b.

[0021] The locking elements 49 of the illustrated travel

bar 45 are each substantially similar in shape. As best shown in Figs. 7, 10, 12, and 13, each locking element 49 includes a narrow, flat bottom 53 and generally vertical sides 55a-d. The side 55a facing away from the lever 15 is angled and the lateral sides 55b, 55d are converging toward their bottoms to form the narrow, flat bottom 53. In the illustrated embodiment, the locking elements 49 are formed as one piece of material with the travel bar 45 by, for example, a mold process. But the locking elements 49 may be formed separately from the travel bar 45 and attached thereto. Additionally, locking elements may have different shapes, for example, block shapes (e.g., no angled sides or converging sides).

[0022] The ring binder mechanism 1 in assembled form will now be described with reference to Figs. 4-7 in which the mechanism is illustrated with the ring members 23a, 23b in the closed position and the lever 15 in an upright position. The lever 15 pivotally mounts on the first, open end of the housing 11 at the mounting arms 19 of the housing (Figs. 4-6). A mounting opening 57 (Fig. 2) in each mounting arm 19 aligns with the channel 41 of the lever 15. A hinge pin 59 passes through the aligned openings 57 and channel 41 to pivotally mount the lever on the housing 11. It is envisioned that the mounting arms 19 are one piece with the housing 11, but they may be formed separately from the housing and attached thereto.

[0023] As shown in Fig. 6, the travel bar 45 is disposed within the housing 11 behind the housing's plateau 17. It extends lengthwise of the housing 11, in generally parallel orientation with a longitudinal axis LA (Fig. 2) of the housing, with the locking elements 49 extending away from the housing. Two elongate openings, each designated 61 (only one is shown in Fig. 6; see *also*, Fig. 2), through the travel bar 45 align with two rivet openings, each designated 63 (only one is shown in Fig. 6; see *also*, Fig. 2) of the housing plateau 17. Grooved rivets, each designated 65 (only one is shown in Fig. 6; see *also*, Fig. 2), secure to the housing 11 at the rivet openings 63 and extend through the respective elongate opening 61 of the travel bar 45 to vertically support the travel bar within the housing. The travel bar 45 fits within the grooves of the rivets 65, allowing it to slide in translation lengthwise of the housing 11 relative to the rivets.

[0024] Referring to Figs. 6 and 7, the travel bar 45 is operatively connected to the lever 15 by an intermediate connector, designated generally at 67. In the illustrated embodiment, the intermediate connector 67 is a wire bent into an elongate, roughly rectangular form (Fig. 2). The intermediate connector 67 may have other shapes or be formed from other material. A first end of the intermediate connector 67 is open and includes two free ends 69a, 69b (Fig. 2) that fit within openings 71a, 71b (Fig. 3, only opening 71b is visible) in the body 35 of the lever 15 to form a pivoting connection. A second, closed end of the intermediate connector 67 is narrowed and includes a bent end 73 (Fig. 2) that fits within the mounting groove 47 of the travel bar 45. The bent end 73 secures the

intermediate connector 67 to the travel bar 45 at mounting groove 47 to either push against the travel bar or pull on the travel bar. The bent end 73 allows the intermediate connector 67 to pivot relative to the travel bar 45 to accommodate small vertical movements of the intermediate connector that occur when the lever 15 pivots. A ring binder mechanism may lack an intermediate connector (e.g., in which a travel bar is pivotally connected directly to a lever).

[0025] As shown in Figs. 5 and 6, the hinge plates 27a 27b are interconnected in parallel arrangement along their inner longitudinal edge margins, forming a central hinge 75 having a pivot axis. This is done in a conventional manner known in the art. As will be described, the hinge plates 27a, 27b can pivot about the hinge 75 upward and downward. The four cutouts 29a-d in each of the two individual hinge plates 27a, 27b (Fig. 2) align to form four openings also designated 29a-d in the interconnected plates (Fig. 5). The housing 11 supports the interconnected hinge plates 27a, 27b within the housing below the travel bar 45. The outer longitudinal edge margins of the hinge plates 27a, 27b loosely fit behind the bent under rims 21 of the housing 11 for allowing them to move within the rims when the hinge plates pivot. As shown in Fig. 7, the fingers 31 of the hinge plates 27a, 27b (only one hinge plate 27a is shown) extend into the C-shaped space of the lever 15 between the tongue 37 and the upper lip 35a of the body 35 so that lower surfaces of the hinge plates engage the lever bulb 43.

[0026] The ring members 23a, 23b are each mounted on upper surfaces of respective ones of the hinge plates 27a, 27b in generally opposed fashion, with the free ends 25a, 25b facing (see also, Fig. 2). The ring members 23a, 23b extend through respective openings, each designated 77, along sides of the housing 11 so that the free ends 25a, 25b of the ring members can engage above the housing (e.g., Fig. 4). The ring members 23a, 23b are rigidly connected to the hinge plates 27a, 27b as is known in the art and move with the hinge plates when they pivot. Although in the illustrated ring binder mechanism 1 both ring members 23a, 23b of each ring 13 are each mounted on one of the two hinge plates 27a, 27b and move with the pivoting movement of the hinge plates, there is a mechanism in which each ring has one movable ring member and one fixed ring member (e.g., a mechanism in which only one of the ring members of each ring is mounted on a hinge plate with the other ring member mounted, for example, on a housing).

[0027] As shown in Fig. 5, two mounting posts 79a, 79b (see also, Fig. 2) are secured to the illustrated ring mechanism 1 to mount the mechanism on, for example, a notebook 3 (e.g., Fig. 1) in any suitable manner. The posts 79a, 79b attach to the housing 11 at mounting post openings 81a, 81b (Fig. 2) of the plateau 17 located toward the longitudinal ends of the housing. A first mounting post 79a (toward the left in Fig. 5) extends through the intermediate connector 67 and through mounting post opening 29d of the interconnected hinge plates 27a, 27b.

[0028] Operation of the ring mechanism 1 will be described with reference to Figs. 4-13. As is known, the hinge plates 27a, 27b pivot downward and upward relative to the housing 11 and move the ring members 23a, 23b mounted thereon between a closed position (Figs. 1, 4-10) and an open position (Figs. 11-13). The hinge plates 27a, 27b are wider than the housing 11 when in a co-planar position (180D), so as they pivot through the co-planar position, they deform the housing and create a small spring force in the housing. The housing spring force biases the hinge plates 27a, 27b to pivot away from the co-planar position, either downward or upward. The ring members 23a, 23b close when the hinge plates 27a, 27b pivot downward (i.e., the hinge 75 moves away from the housing 11 (e.g., Fig. 5)). The ring members 23a, 23b open when the hinge plates 27a, 27b pivot upward (i.e., the hinge 75 moves toward the housing 11 (e.g., Fig. 12)).

[0029] In Figs. 4-7, the ring mechanism 1 is in a closed and locked position. The hinge plates 27a, 27b are hinged downward, away from housing 11, so that the ring members 23a, 23b of each ring 13 are together in a continuous, circular loop, capable of retaining loose-leaf pages. The lever 15 is vertical relative to the housing 11 and in a first relaxed position (the lever is shown in this position in Fig. 3 also) with the lever bulb 43 engaging the lower surfaces of the hinge plates 27a, 27b. The locking elements 49 of the travel bar 45 are above the hinge plates 27a, 27b generally aligned with the hinge 75 with their narrow, flat bottoms 53 contacting the upper surfaces of the hinge plates. As shown in Fig. 5, the locking elements 49 are adjacent respective locking element openings 29a-c, but are substantially out of registration with the openings. Together, the travel bar 45 (vertically supported by the grooved rivets 65) and locking elements 49 oppose any force tending to pivot the hinge plates 27a, 27b upward to open the ring members 23a, 23b (i.e., they lock the ring members closed)

[0030] To unlock the ring mechanism 1 and open the ring members 23a, 23b, an operator applies force to the grip 33 of the lever 15 and pivots it counterclockwise (as viewed in Figs. 4, 6, and 7). As shown in Figs. 8-10, the grip 33 and body 35 of the lever 15 move relative to the tongue 37, which is held stationary by the hinge plates 27a, 27b under the spring force of the housing 11. The intermediate connector 67 simultaneously moves with the body 35 and transfers the pivoting movement of the lever 15 around the mounting post 79a to the travel bar 45. The travel bar slides toward the lever 15 and moves the locking elements 49 into registration with the respective locking element openings 29a-c of the hinge plates 27a, 27b. The bridge 39 between the lever body 35 and lever tongue 37 flexes and tensions as the open channel 41 closes and the body moves into engagement with the tongue (Fig. 10). If the lever 15 is released before the hinge plates 27a, 27b pivot upward through their co-planar position (i.e., before the ring members 23a, 23b open), the tension in the bridge 39 will automatically recoil (and push) the grip 33 and body 35 back to the vertical

position, moving the travel bar 45 and locking elements 49 to the locked position.

[0031] The lever channel 41, now closed, no longer shields the tongue 37 from the pivoting movement of the grip 33 and body 35. Continued opening movement of the lever 15 causes the body 35 to conjointly pivot the tongue 37. The lever bulb 43 causes the interconnected hinge plates 27a, 27b to pivot upward over the locking elements 49 at the locking element openings 29a-c and relative to the mounting post 79a at the mounting post opening 29d. Once the hinge plates 27a, 27b pass just through the co-planar position, the housing spring force pushes them upward, opening the ring members 23a, 23b (Figs. 11-13). The lever 15 can be released. The tension in the bridge 39 recoils (and pushes) the grip 33 and body 35 away from the tongue 37, which is held stationary against the hinge plates 27a, 27b via the lever bulb 43 engaging the lower surfaces of the hinge plates. The channel 41 opens and the travel bar 45 moves slightly away from the lever 15. The lever is again relaxed, in a second relaxed position substantially identical to the first relaxed position (e.g., Fig. 3), and the locking elements 49 are at rest within the respective hinge plate openings 29a-c free of any forces tending to move them relative to the housing 11.

[0032] To close the ring members 23a, 23b and return the mechanism 1 to the locked position, an operator manually pushes the free ends 25a, 25b of the ring members together. The hinge plates 27a, 27b pivot downward, and rotate the lever tongue 37 clockwise (as viewed in Figs. 11 and 13). The tongue 37 initially moves the grip 33 and body 35 to seat the locking elements 49 against tangs 83 at the edges of the locking element openings 29a-c of the hinge plates 27a, 27b (the tangs are ramped to assist the locking elements 49 in moving out of the openings). The tongue 37 then moves relative to the grip 33 and body 35, which are held stationary by the locking elements 49 against tangs 83 (Fig. 13). The lever channel 41 closes (and the lever bridge 39 flexes) allowing the hinge plates 27a, 27b to pivot to and through the co-planar position and past the narrow bottoms 53 of the locking elements 49. The angled sides 55a of the locking elements 49 allow the locking elements to move incrementally away from the lever 15 and out of the respective opening 29a-c as the hinge plates 27a, 27b move down. This allows the lever 15 to pivot slightly with the tongue 37 as the tongue channel 41 closes. The angled sides of the locking elements are not necessary for operation though.

[0033] Once the hinge plates 27a, 27b clear the bottoms 53 of the locking elements 49, the tongue 37 pushes the body 35 and grip 33 to the vertical position and the travel bar 45 and locking elements move to the locked position. The ring members 23a, 23b of the ring mechanism 1 could be closed by a modified lever capable of engaging the hinge plates 27a, 27b and pivoting them downward.

[0034] It should now be apparent that the flexibility of

the lever bridge 39 allows the grip 33 and body 35 of the lever 15 to move relative to the tongue 37. This moves the lever 15 between the relaxed position (Figs. 3-7 and 11-13) and a deformed (broadly, "reconfigured") position (Figs. 8-10). The deformed position of the lever 15 is an unstable, intermediate position in which the bridge 39 is tensioned to always move the grip 33, body 35, and tongue 37 to the relaxed position (i.e., reconfigure the lever).

[0035] When the lever 15 pivots to open the ring members 23a, 23b, the travel bar 45 and locking elements 49 move immediately and prior to the tongue 37 and bulb 43 pivoting the hinge plates 27a, 27b upward. This lost motion caused by the open channel 41 allows the locking elements 49 to move into registration with the locking element openings 29a-c of the hinge plates 27a, 27b before the hinge plates pivot. They do not interfere with the desirable pivoting movement of the hinge plates 27a, 27b. After the locking elements 49 move into registration with the respective openings 29a-c, the channel 41 closes and the grip 33, body 35, and tongue 37 conjointly pivot to move the hinge plates 27a, 27b upward.

[0036] In addition when the ring members 23a, 23b are open and the lever 15 is relaxed, the locking elements 49 and travel bar 45 are free of forces tending to move them to the locked position. Thus, there is no tendency for the open ring members 23a, 23b to inadvertently close under the influence of the lever 15, locking elements 49, or travel bar 45 as an operator loads or removes pages from the ring members 23a, 23b.

[0037] Similarly when the ring members 23a, 23b are moved to the closed position, the lever channel 41 allows the hinge plates 27a, 27b to pivot downward over the locking elements 49 before the grip 33 and body 35 of the lever 15 push the travel bar 45 and locking elements 49 to the locked position. Here, the lost motion caused by the open channel 41 maintains a continuous engagement between the lever tongue 37 and the hinge plates 27a, 27b (via the lever bulb 43) without risk of the mechanism jamming in the open position (e.g., as may occur if the lever tongue is unable to move downward with the hinge plates because the locking elements 49 wedge against edges of the locking element openings 29a-c of the hinge plates, holding the hinge plates from further pivoting downward). The continuous engagement between the lever tongue 37 and the lower surfaces of the hinge plates 27a, 27b (via lever bulb 43) ensures that the body 35 and grip 33 of the lever 15 move fully to their vertical position when the hinge plates 27a, 27b are pivoted downward (and the ring members 23a, 23b are closed), moving the travel bar 45 and locking elements 49 fully to the locked position.

[0038] Thus, the ring binder mechanism 1 effectively retains loose-leaf pages when ring members 23a, 23b are closed, and readily prevents the closed ring members 23a, 23b from unintentionally opening. The lever 15 positions the travel bar 45 and its locking elements 49 in the locked position when the ring members 23a, 23b

close, eliminating the need to manually move the lever 15 to positively lock the mechanism 1. The ring mechanism 1 incorporating the locking lever 15 requires no additional biasing components (e.g., springs) to perform the locking operation, and requires no specially formed parts to accommodate such biasing components.

[0039] Figures 14-16 show a second embodiment of the ring binder mechanism generally at 101. The ring mechanism 101 is substantially the same as the ring mechanism 1 of the first embodiment previously described and illustrated in Figs. 1-13, and parts of this ring mechanism 101 corresponding to parts of the prior ring mechanism 1 are designated by the same reference numerals, plus "100". In this ring mechanism 101, however, the lever 115 has a low profile in that it includes a substantially flat grip 133. The lever 115 mounts on the housing 111 (Figs. 14 and 16) as previously described for the ring mechanism 1 of Figs. 1-13, and the flat grip 133 is positioned in general alignment (i.e., is generally co-planar) with the plateau 117 of the housing. In all other aspects, including operation, the ring mechanism 101 is the same as the ring mechanism 1 of Figs. 1-13.

[0040] Figures 17-21 show a third embodiment of the ring binder mechanism generally at 201. Parts of this ring mechanism corresponding to parts of the ring mechanism 1 of the first embodiment of Figs. 1-13 are designated by the same reference numerals, plus "200". This mechanism 201 is substantially the same as the ring mechanism 1 of Figs. 1-13, with the exception that the lever 215 is formed without a bridge and without a channel between the body 235 and the tongue 237. Other components of the ring mechanism 201, as well as assembly of the components, are substantially the same as those of the mechanism 1 of Figs. 1-13.

[0041] Operation of the ring mechanism 201 will be described with reference to the enlarged fragmentary views of Figs. 19-21. In Fig. 19, the ring mechanism 201 is in the closed and locked position (similar to the closed position of the ring mechanism 1 of Figs. 1-13). To unlock the ring mechanism 201 and open the ring members 223a, 223b, an operator pivots the lever 215 outward and downward (counter-clockwise as viewed in Fig. 19). The lever body 235 pulls the travel bar 245 and locking elements 249 toward the lever 215, while the lever bulb 243 simultaneously pushes upward on the hinge plates 227a, 227b (only one hinge plate 227a is shown). But the locking elements 249, still behind the hinge plates 227a, 227b, block their upward movement. So as the lever 215 continues to pivot, the lever bulb 243 flexes (and tensions) the hinge plates 227a, 227b adjacent the fingers 231 (Fig. 20). Once the locking elements 249 (only one is shown) move into registration with the locking element openings 229a-c (only opening 229c is shown) of the hinge plates 227a, 227b, the tensioned hinge plates immediately pivot upward, through the co-planar position (Fig. 21) to open the ring members 223a, 223b (the ring members are not shown). If the lever 215 is released before the hinge plates 227a, 227b pivot through the co-

planar position, the tensioned hinge plates will push down on the lever bulb 243 and pivot the lever 215 back to the vertical position, moving the travel bar 245 and locking elements 249 to the locked position. The tension in the hinge plates 227a, 227b dissipates and the lever 215 can be released. The bulb 243 of the tongue 237 remains in engagement with the lower surfaces of the hinge plates 227a, 227b, and the spring force of the housing 211 holds the hinge plates hinged upward. The locking elements 249 are at rest within the respective hinge plate cutout openings 229a-c free of any forces tending to move them to the locked position.

[0042] As in the ring mechanism 1 of Figs. 1-13, to close the ring members 223a, 223b of this mechanism 201 and return the mechanism to the locked position (Fig. 19), an operator manually pushes the free ends 225a, 225b of the ring members together. In this ring mechanism 201, the hinge plates 227a, 227b pivot downward and cause the lever bulb 243 and tongue 237 to rotate clockwise (as viewed in Fig. 21). The tongue 237 pushes the grip 233 and body 235 to seat the locking elements 249 against the tangs 281 at the edges of the locking element openings 229a-c of the hinge plates 227a, 227b (this engagement is not necessary for operation). The locking elements 249 instantaneously resist movement of the lever 215, and thus downward movement of the hinge plates 227a, 227b, causing the hinge plates 227a, 227b to slightly flex adjacent their fingers 231. The hinge plates 227a, 227b bend down while the lever 215 and finger 231 remain relatively stationary. The angled sides 255a of the locking elements 249 allow the locking elements to move small amounts away from the lever 215 as the hinge plates 227a, 227b bend, allowing the lever to pivot slightly. Once the hinge plates 227a, 227b clear the narrow bottoms 253 of the locking elements 249, the tension in the flexed hinge plates immediately pivots the lever 215 to its vertical position, pushing the travel bar 245 and locking elements 249 to the locked position.

[0043] In this ring mechanism 201, the unique cooperation between the lever 215, the hinge plates 227a, 227b, and the locking elements 249 allows the mechanism to operate between the closed and locked position and the open position. When opening the ring members 223a, 223b, the hinge plates 227a, 227b briefly flex upward to allow the lever 215 to pivot to move the locking elements 249 into registration with the locking element openings 229a-c of the hinge plates. The lever 215, together with the tension from the flexed hinge plates 227a, 227b and the spring force of the housing 211, then pivot the hinge plates over the locking elements 249 to open the ring members 223a, 223b. When closing the ring members 223a, 223b, the hinge plates 227a, 227b again flex to allow the plates to pivot downward over the locking elements 249 (the angled sides 255a of the locking elements 249 also aid in this operation, but are not necessary for this operation).

[0044] Components of ring binder, mechanisms of the embodiments described and illustrated herein are made

of a suitable rigid material, such as a metal (e.g. steel). But mechanisms may have components made of a non-metallic material, specifically including a plastic.

[0045] When introducing elements of the ring binder mechanisms herein, the articles "a", "an", "the" and "said" are intended to mean that there are one or more of the elements. The terms "comprising", "including" and "having" are intended to be inclusive and mean that there may be additional elements other than the listed elements. Moreover, the use of "up" and "down" and variations of these terms is made for convenience, but does not require any particular orientation of the components.

Claims

1. A ring mechanism (1) for holding loose-leaf pages, the mechanism comprising:

a housing (11);
 first and second hinge plates (27a, 27b) supported by the housing (11) for pivoting motion relative to the housing about a hinge (75);
 rings (13) for holding loose-leaf pages, each ring including a first ring member (23a) and a second ring member (23b), the first ring member (23a) being mounted on the first hinge plate (27a) and moveable with the pivoting motion of the first hinge plate relative to the second ring member (23b) between a closed position and an open position, in the closed position the two ring members (23a, 23b) forming a substantially continuous, closed loop for allowing loose-leaf pages retained by the rings (13) to be moved along the rings from one ring member (23a) to the other (23b), and in the open position the two ring members (23a, 23b) forming a discontinuous, open loop for adding or removing loose-leaf pages from the rings (13);
 a lever (15) pivotally mounted on the housing (11), the lever (15) comprising a first portion (35) and a second portion (37) connected to the first portion (35) for engaging the hinge plates (27a, 27b) and moving the ring members (23a, 23b) from the closed position to the open position;
 a locking element (49) operatively connected to the lever (15);
characterized in that the hinge plates (27a, 27b) being supported by the housing (11) so that at least one of the hinge plates (27a, 27b) is in continuous engagement with the second portion (37) of the lever (15) when the ring members (23a, 23b) are in the closed position for inhibiting play in the lever (15), said at least one hinge plate (27a, 27b) having an upper surface facing toward the housing (11) and a lower surface facing away from the housing, the lower surface being in continuous engagement with the sec-

ond portion (37) of the lever (15).

2. A ring mechanism (1) as set forth in claim 1 wherein at least one of said hinge plates (27a, 27b) includes a cutout (29), the locking element (49) positioning in registration with said cutout (29) and engaging said hinge plate (27a, 27b) at the cutout when the ring members (23a, 23b) are in the open position.
3. A ring mechanism (1) as set forth in claim 2 wherein the cutout (29) includes an edge (83), the locking element (49) engaging said hinge plate (27a, 27b) at the cutout edge (83).
4. A ring mechanism (1) as set forth in claim 3 wherein the hinge plate cutout (29) is formed with a first portion in the first hinge plate (27a) and a second portion in the second hinge plate (27b), the cutout (29) being oriented symmetrically along the hinge (75) of the hinge plates (27a, 27b).
5. A ring mechanism (1) as set forth in claim 4 wherein the locking element (49) is positioned out of registration with said cutout (29) when the ring members (23a, 23b) are in the closed position for blocking pivoting movement of the hinge plates (27a, 27b).
6. A ring mechanism (1) as set forth in claim 5 further comprising a travel bar (45) operatively connected to the lever (15) and disposed between the housing (11) and the hinge plates (27a, 27b) in substantial alignment with the hinge (75) of the hinge plates (27a, 27b), the locking element (49) being mounted on the travel bar (45).
7. A ring mechanism (1) as set forth in claim 6 wherein the locking element (49) is formed as one piece with the travel bar (45).
8. A ring mechanism (1) as set forth in claim 6 comprising three locking elements (49), and wherein the hinge plates (27a, 27b) comprise three cutouts (29a, 29b, 29c) corresponding to each locking element (49).
9. A ring mechanism (1) as set forth in claim 1 wherein the first portion (35) of the lever (15) is formed as one piece with the second portion (37).
10. A ring mechanism (1) as set forth in claim 9 wherein the second portion (37) of the lever (15) comprises a bulb (43) engaging the hinge plates (27a, 27b).
11. A ring mechanism (1) as set forth in claim 1 wherein the hinge plates (27a, 27b) are hinged downward when the ring members (23a, 23b) are in the closed position holding the first portion (35) of the lever (15) in a substantially vertical position.

12. A ring mechanism (1) as set forth in claim 11 wherein the hinge plates (27a, 27b) are hinged upward when the ring members (23a, 23b) are in the open position, the locking element (49) holding the lever (15) in a relatively fixed position rotated away from the vertical position.
13. A ring mechanism (1) as set forth in any one of claims 1 to 12 in combination with a cover (3), the ring mechanism (1) being mounted on the cover (3), the cover being hinged for movement to selectively cover and expose loose-leaf pages when retained on the ring mechanism (1).

Patentansprüche

1. Ringmechanismus (1) zum Halten loser Blattseiten, der Mechanismus umfassend:

ein Gehäuse (11);
 erste und zweite Scharnierplatten (27a, 27b), die von dem Gehäuse (11) getragen werden für eine Schwenkbewegung relativ zu dem Gehäuse über ein Gelenk (75);
 Ringe (13) zum Halten der losen Blattseiten, wobei jeder Ring ein erstes Ringglied (23a) und ein zweites Ringglied (23b) hat, das erste Ringglied (23a) angebracht auf der ersten Scharnierplatte (27a) und beweglich mit der Schwenkbewegung der ersten Scharnierplatte relativ zu dem zweiten Ringglied (23b) zwischen einer geschlossenen Stellung und einer offenen Stellung, wobei in der geschlossenen Stellung die beiden Ringglieder (23a, 23b) einen im Wesentlichen ununterbrochenen, geschlossenen Bügel bilden, um durch die Ringe (13) gehaltene lose Blattseiten entlang der Ringe von einem Ringglied (23a) zu dem anderen (23b) bewegen zu können, und damit die beiden Ringglieder (23a, 23b) in der offenen Stellung einen unterbrochenen, offenen Bügel bilden, um lose Blattseiten einzulegen oder aus den Ringen (13) zu entnehmen;
 einen Hebel (15), der schwenkbar an dem Gehäuse (11) angebracht ist, wobei der Hebel (15) einen ersten Teil (35) und einen zweiten Teil (37) umfasst, der mit dem ersten Teil (35) verbunden ist zur Betätigung der Scharnierplatten (27a, 27b) und um die Ringglieder (23a, 23b) von der geschlossenen Stellung in die offene Stellung bewegen zu können;
 ein Schließelement (49) betriebsmäßig verbunden mit dem Hebel (15);
dadurch gekennzeichnet, dass die Scharnierplatten (27a, 27b), die von dem Gehäuse (11) derart getragen werden, dass zumindest eine der Scharnierplatten (27a, 27b) sich in kontinuierlicher Verbindung mit dem zweiten Teil (37)

des Hebels (15) steht wenn die Ringglieder (23a, 23b) sich in der geschlossenen Stellung befinden, um zu verhindern, dass der Hebel (15) Spiel hat, wobei die zumindest eine Scharnierplatte (27a, 27b) eine obere Fläche aufweist, zugewandt dem Gehäuse (11) und eine untere Fläche, abgewandt von dem Gehäuse, wobei die untere Fläche in kontinuierlicher Verbindung mit dem zweiten Teil (37) des Hebels (15) steht.

2. Ringmechanismus (1) nach Anspruch 1, wobei zumindest eine der Scharnierplatten (27a, 27b) eine Aussparung (29) hat, das Schließelement (49) passgenau mit der Aussparung (29) positionierend und die Scharnierplatte (27a, 27b) in die Aussparung greifend, wenn die Ringglieder (23a, 23b) sich in der offenen Stellung befinden.
3. Ringmechanismus (1) nach Anspruch 2, wobei die Aussparung (29) eine Kante (83) aufweist, das Schließelement (49) die Scharnierplatte (27a, 27b) an der Kante (83) der Aussparung greifend.
4. Ringmechanismus (1) nach Anspruch 3, wobei die Scharnierplattenaussparung (29) ausgestaltet ist mit einem ersten Teil in der ersten Scharnierplatte (27a) und einem zweiten Teil in der zweiten Scharnierplatten (27b), die Aussparung (29) dabei symmetrisch entlang des Gelenks (75) der Scharnierplatten (27a, 27b) ausgerichtet.
5. Ringmechanismus (1) nach Anspruch 4, wobei das Schließelement (49) aus der Ausrichtung mit der Aussparung (29) heraus ausgerichtet ist, wenn die Ringglieder (23a, 23b) sich in der geschlossenen Stellung befinden, um eine Schwenkbewegung der Scharnierplatten (27a, 27b) zu verhindern.
6. Ringmechanismus (1) nach Anspruch 5, ferner umfassend eine Verschiebeschiene (45), die betriebsmäßig verbunden ist mit dem Hebel (15) und angeordnet zwischen dem Gehäuse (11) und den Scharnierplatten (27a, 27b), im Wesentlichen ausgerichtet mit dem Gelenk (75) der Scharnierplatten (27a, 27b), wobei das Schließelement (49) auf der Verschiebeschiene (45) angebracht ist.
7. Ringmechanismus (1) nach Anspruch 6, wobei das Schließelement (49) einteilig mit der Verschiebeschiene (45) ausgestaltet ist.
8. Ringmechanismus (1) nach Anspruch 6 umfassend drei Schließelemente (49) und wobei die Scharnierplatten (27a, 27b) drei Aussparungen (29a, 29b, 29c) umfassen, korrespondierend zu jedem Schließelement (49).
9. Ringmechanismus (1) nach Anspruch 1, wobei der

erste Teil (35) des Hebels (15) einteilig mit dem zweiten Teil (37) ausgestaltet ist.

10. Ringmechanismus (1) nach Anspruch 9, wobei der zweite Teil (37) des Hebels (15) eine Kugel (43) umfaßt, die die Scharnierplatten (27a, 27b) betätigt. 5
11. Ringmechanismus (1) nach Anspruch 1, wobei die Scharnierplatten (27a, 27b) nach unten geklappt sind, wenn die Ringglieder (23a, 23b) sich in der geschlossenen Stellung befinden, den ersten Teil (35) des Hebels (15) in einer im Wesentlichen vertikalen Stellung haltend. 10
12. Ringmechanismus (1) nach Anspruch 11, wobei die Scharnierplatten (27a, 27b) nach oben geklappt sind, wenn die Ringglieder (23a, 23b) sich in der offenen Stellung befinden, das Schließelement (49) den Hebel (15) in einer relativ fixierten Stellung haltend, weggedreht von der vertikalen Stellung. 20
13. Ringmechanismus (1) nach einem der Ansprüche 1 bis 12 in Verbindung mit einem Deckel (3), wobei der Ringmechanismus (1) auf dem Deckel (3) angebracht ist, und der Deckel beweglich angelenkt ist, um wahlweise lose Blattseiten abzudecken und freizulegen, wenn diese auf dem Ringmechanismus (1) gehalten werden. 25

Revendications

1. Mécanisme à anneaux (1) pour maintenir des pages volantes, le mécanisme comprenant:

un logement (11);
des première et seconde plaques de charnière (27a, 27b) supportées par le logement (11) pour le mouvement pivotant par rapport au logement autour d'une charnière (75);
des anneaux (13) pour maintenir des pages volantes, chaque anneau comprenant un premier élément d'anneau (23a) et un second élément d'anneau (23b), le premier élément d'anneau (23a) étant monté sur la première plaque de charnière (27a) et mobile avec le mouvement de pivotement de la première plaque de charnière par rapport au second élément d'anneau (23b) entre une position fermée et une position ouverte, dans la position fermée, les deux éléments d'anneau (23a, 23b) formant une boucle fermée sensiblement continue pour permettre aux pages volantes retenues par les anneaux (13) d'être déplacées le long des anneaux, d'un élément d'anneau (23a) à l'autre (23b), et dans la position ouverte, les deux éléments d'anneau (23a, 23b) formant une boucle ouverte discontinue pour ajouter ou retirer des pages volantes 50

des anneaux (13);
un levier (15) monté de manière pivotante sur le logement (11), le levier (15) comprenant une première partie (35) et une seconde partie (37) raccordée à la première partie (35) pour mettre en prise les plaques de charnière (27a, 27b) et déplacer les éléments d'anneau (23a, 23b) de la position fermée à la position ouverte;
un élément de verrouillage (49) raccordé de manière opérationnelle au levier (15);
caractérisé en ce que:

les plaques de charnière (27a, 27b) sont supportées par le logement (11), de sorte qu'au moins l'une des plaques de charnière (27a, 27b) est en mise en prise continue avec la seconde partie (37) du levier (15) lorsque les éléments d'anneau (23a, 23b) sont dans la position fermée pour empêcher le jeu dans le levier (15), ladite au moins une plaque de charnière (27a, 27b) ayant une surface supérieure orientée vers le logement (11) et une surface inférieure opposée au logement, la surface inférieure étant en mise en prise continue avec la seconde partie (37) du levier (15).

2. Mécanisme à anneaux (1) selon la revendication 1, dans lequel au moins l'une desdites plaques de charnière (27a, 27b) comprend une découpe (29), l'élément de verrouillage (49) se positionnant en alignement avec ladite découpe (29) et mettant en prise ladite plaque de charnière (27a, 27b) au niveau de la découpe lorsque les éléments d'anneau (23a, 23b) sont dans la position ouverte. 30
3. Mécanisme à anneaux (1) selon la revendication 2, dans lequel la découpe (29) comprend un bord (83), l'élément de verrouillage (49) mettant en prise ladite plaque de charnière (27a, 27b) au niveau du bord découpé (83). 40
4. Mécanisme à anneaux (1) selon la revendication 3, dans lequel la découpe (29) de plaque de charnière est formée avec une première partie dans la première plaque de charnière (27a) et une seconde partie dans la seconde plaque de charnière (27b), la découpe (29) étant orientée de manière symétrique le long de la charnière (75) des plaques de charnières (27a, 27b). 45
5. Mécanisme à anneaux (1) selon la revendication 4, dans lequel l'élément de verrouillage (49) est positionné en dehors de l'alignement avec ladite découpe (29) lorsque les éléments d'anneau (23a, 23b) sont dans la position fermée pour empêcher le mouvement de pivotement des plaques de charnière (27a, 27b). 55

6. Mécanisme à anneaux (1) selon la revendication 5, comprenant en outre une barre de déplacement (45) raccordée de manière opérationnelle au levier (15) et disposée entre le logement (11) et les plaques de charnière (27a, 27b) en alignement sensible avec la charnière (75) des plaques de charnière (27a, 27b), l'élément de verrouillage (49) étant monté sur la barre de déplacement (45). 5
7. Mécanisme à anneaux (1) selon la revendication 6, dans lequel l'élément de verrouillage (49) est formé d'un seul tenant avec la barre de déplacement (45). 10
8. Mécanisme à anneaux (1) selon la revendication 6, comprenant trois éléments de verrouillage (49), et dans lequel les plaques de charnière (27a, 27b) comprennent trois découpes (29a, 29b, 29c) correspondant à chaque élément de verrouillage (49). 15
9. Mécanisme à anneaux (1) selon la revendication 1, dans lequel la première partie (35) du levier (15) est formée d'un seul tenant avec la seconde partie (37). 20
10. Mécanisme à anneaux (1) selon la revendication 9, dans lequel la seconde partie (37) du levier (15) comprend un bourrelet (43) mettant en prise les plaques de charnière (27a, 27b). 25
11. Mécanisme à anneaux (1) selon la revendication 1, dans lequel les plaques de charnière (27a, 27b) sont articulées vers le bas lorsque les éléments d'anneau (23a, 23b) sont dans la position fermée maintenant la première partie (35) du levier (15) dans une position sensiblement verticale. 30
- 35
12. Mécanisme à anneaux (1) selon la revendication 11, dans lequel les plaques de charnière (27a, 27b) sont articulées vers le haut lorsque les éléments d'anneau (23a, 23b) sont dans la position ouverte, l'élément de verrouillage (49) maintenant le levier (15) dans une position relativement fixe entraînée en rotation à distance de la position verticale. 40
13. Mécanisme à anneaux (1) selon l'une quelconque des revendications 1 à 12, en combinaison avec une couverture (3), le mécanisme à anneaux (1) étant monté sur la couverture (3), la couverture étant articulée pour le déplacement afin de recouvrir et d'exposer sélectivement les pages volantes lorsqu'elles sont retenues sur le mécanisme à anneaux (1). 45
- 50

55

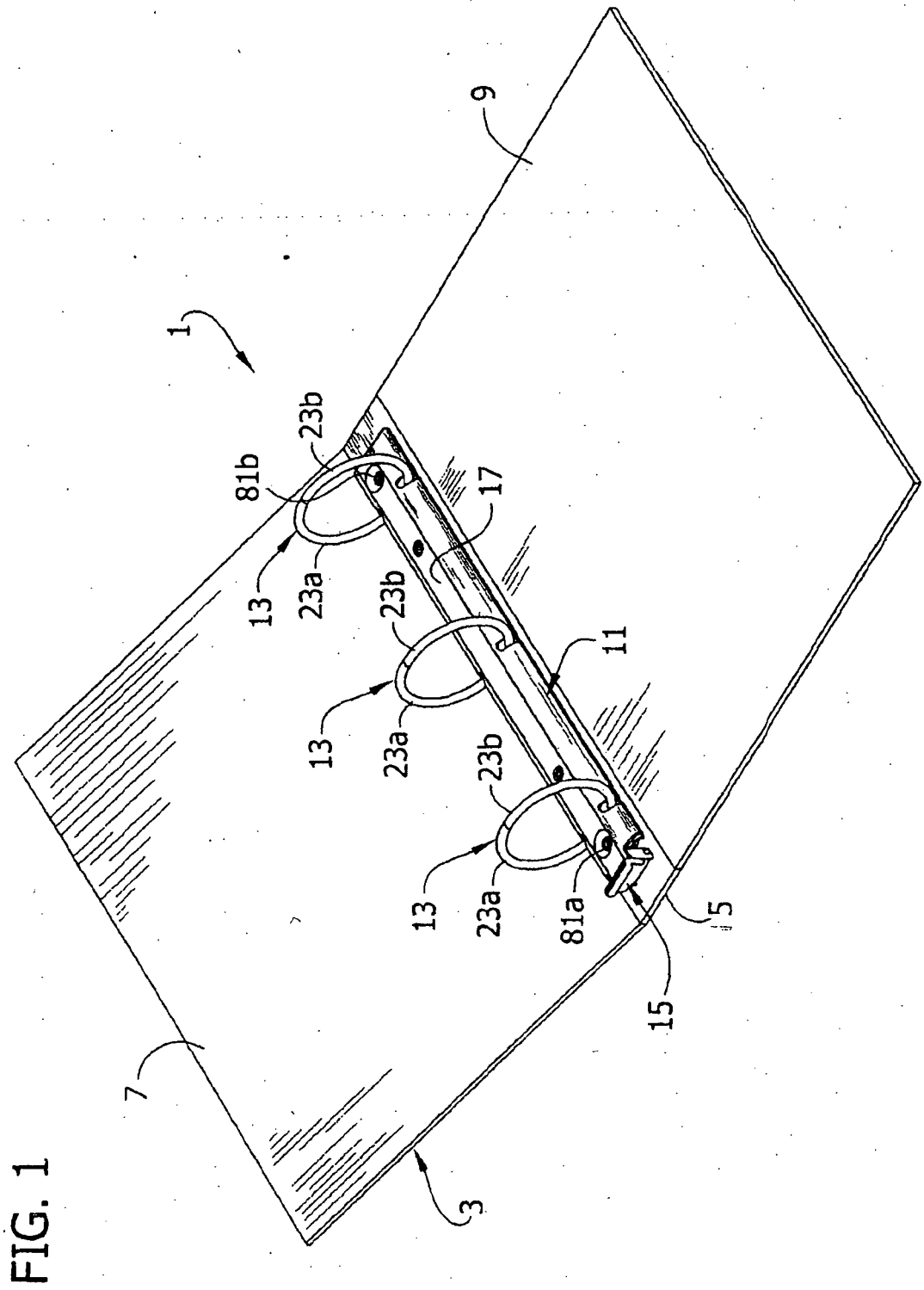


FIG. 3

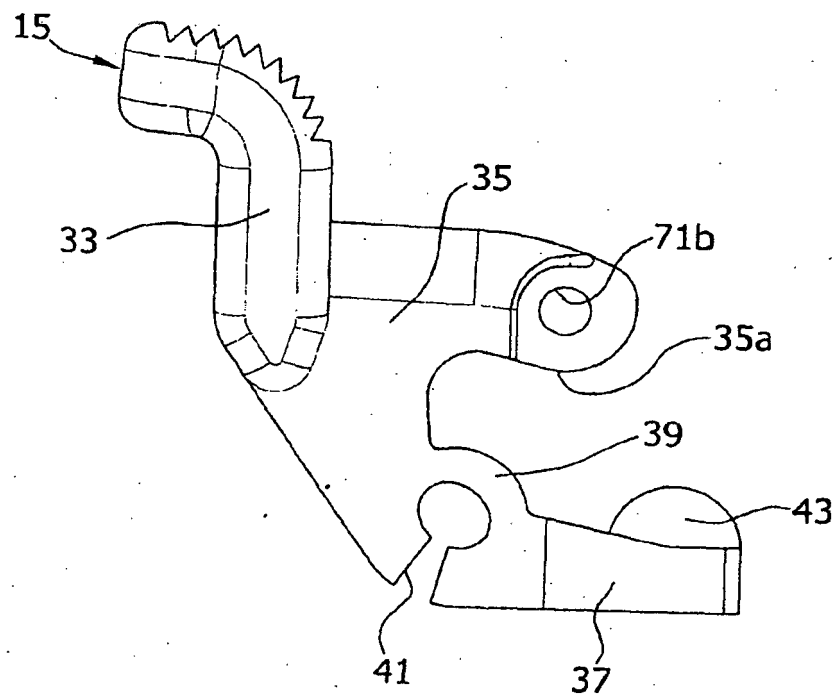
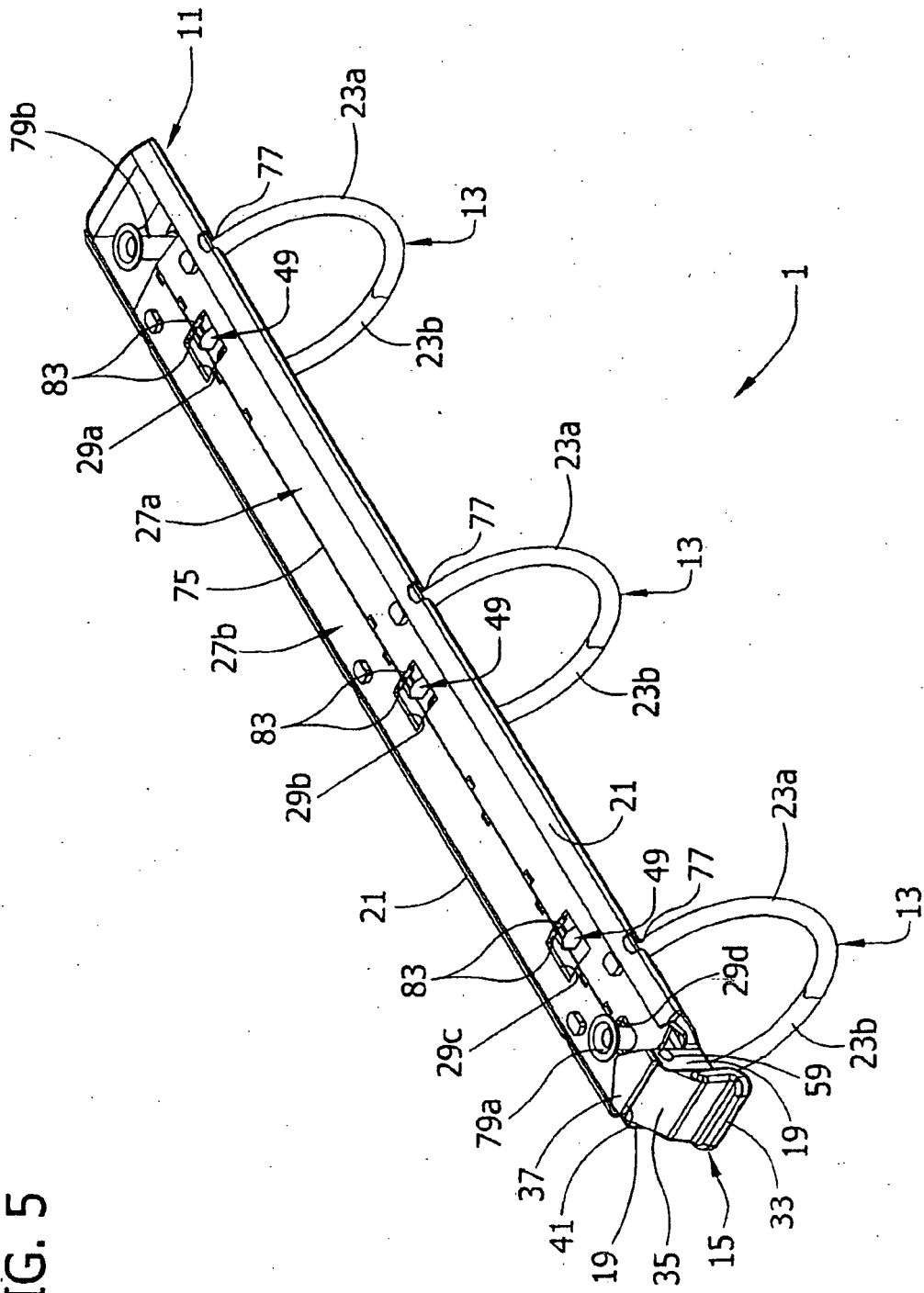


FIG. 5



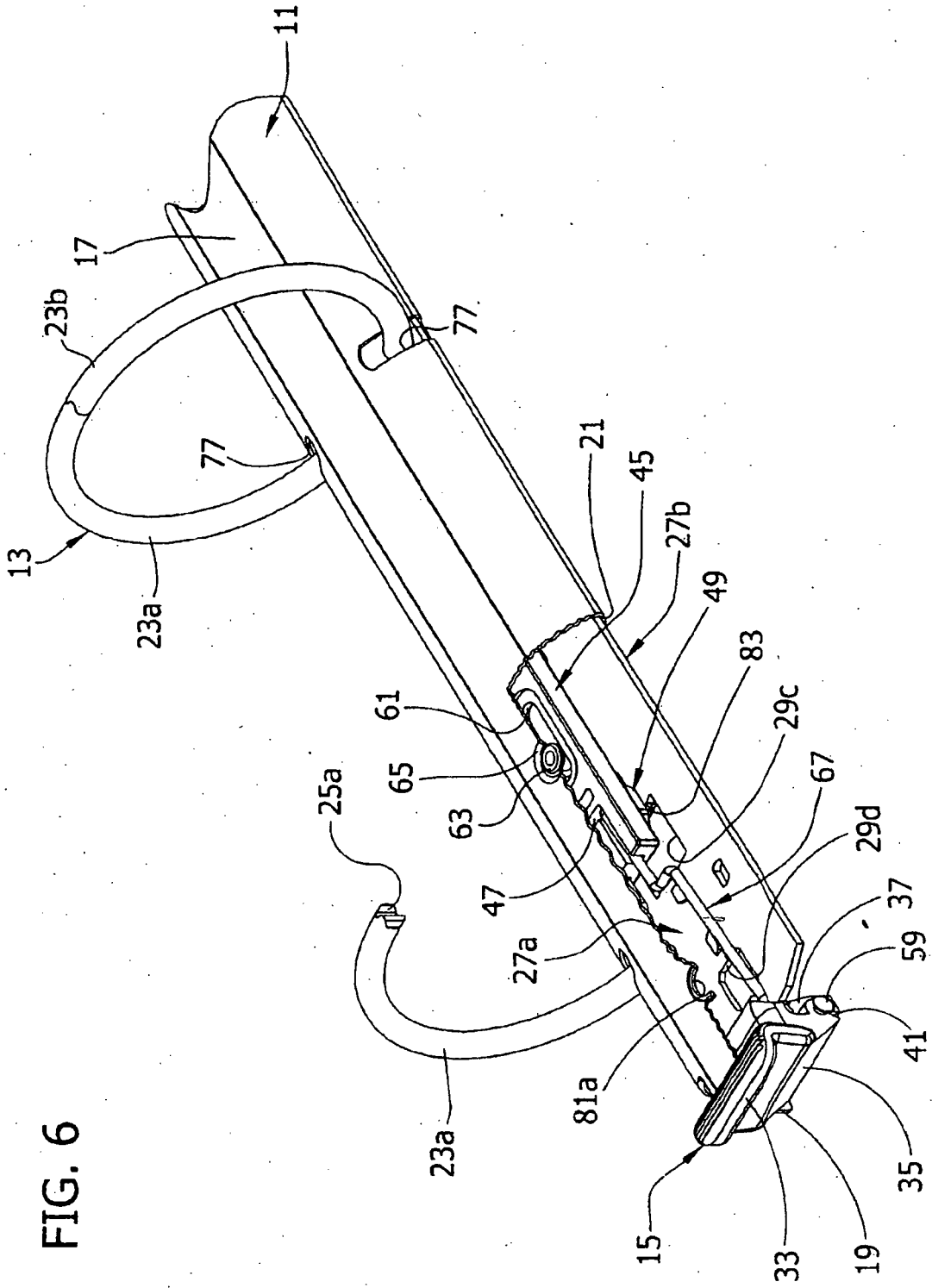


FIG. 6

FIG. 7

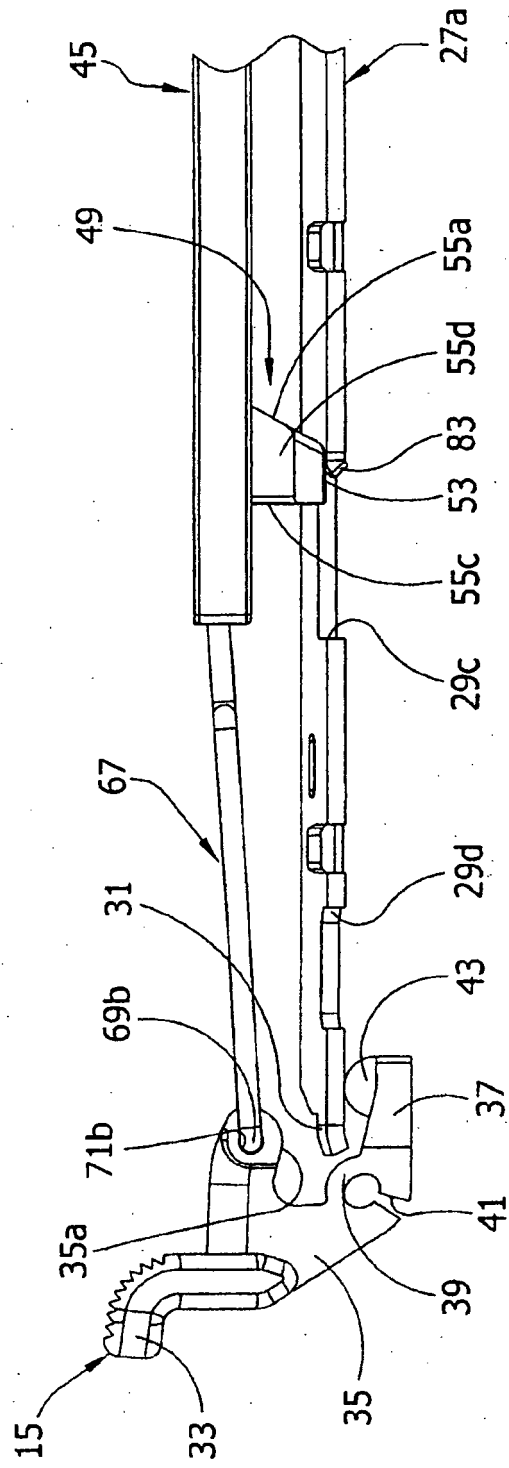


FIG. 9

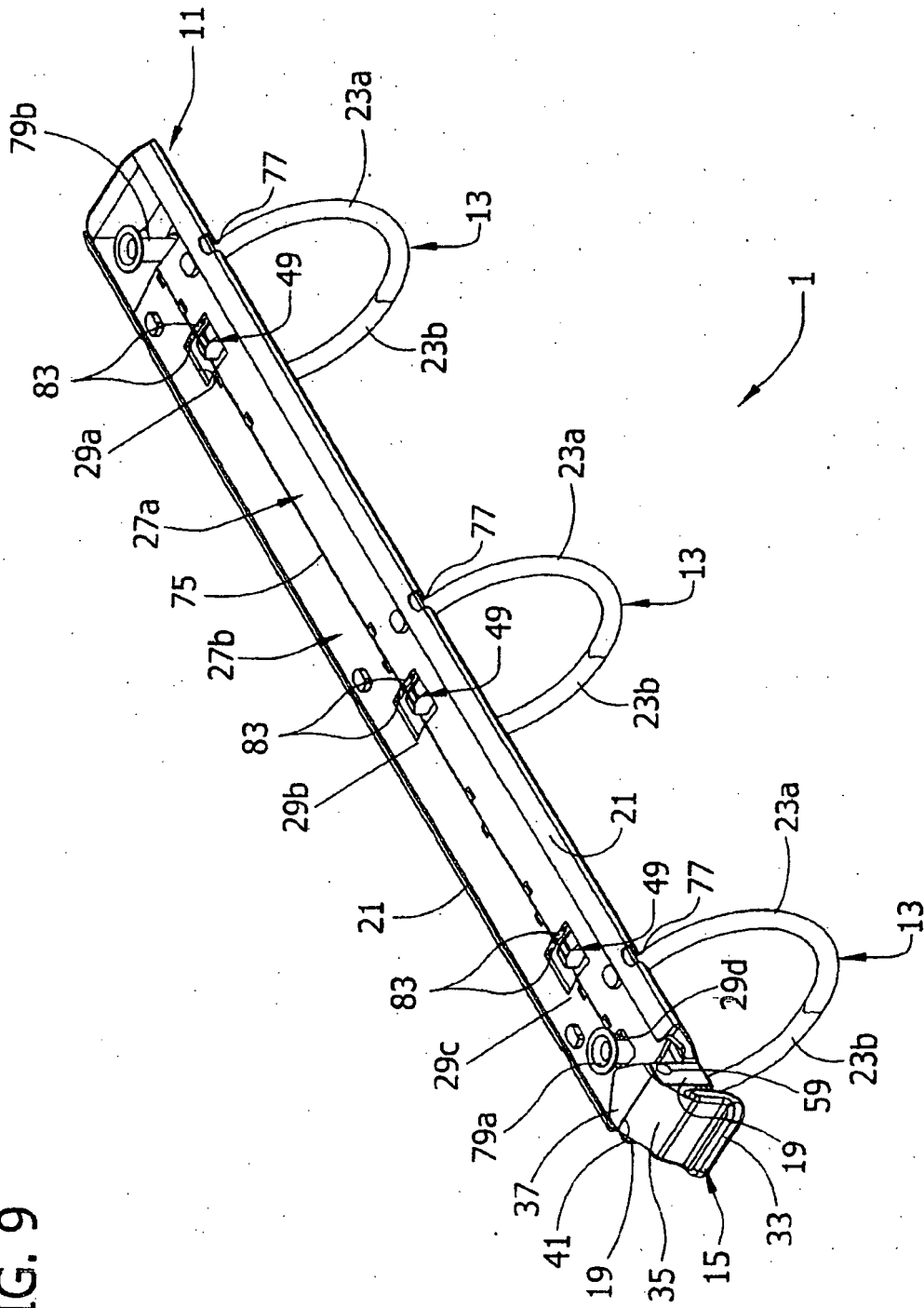
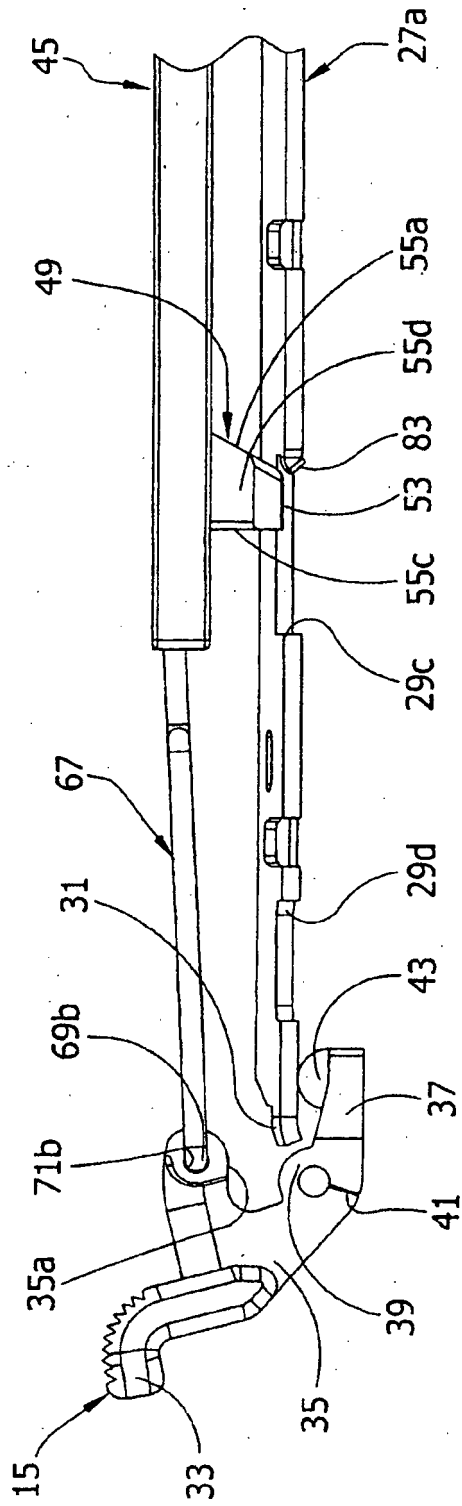


FIG. 10



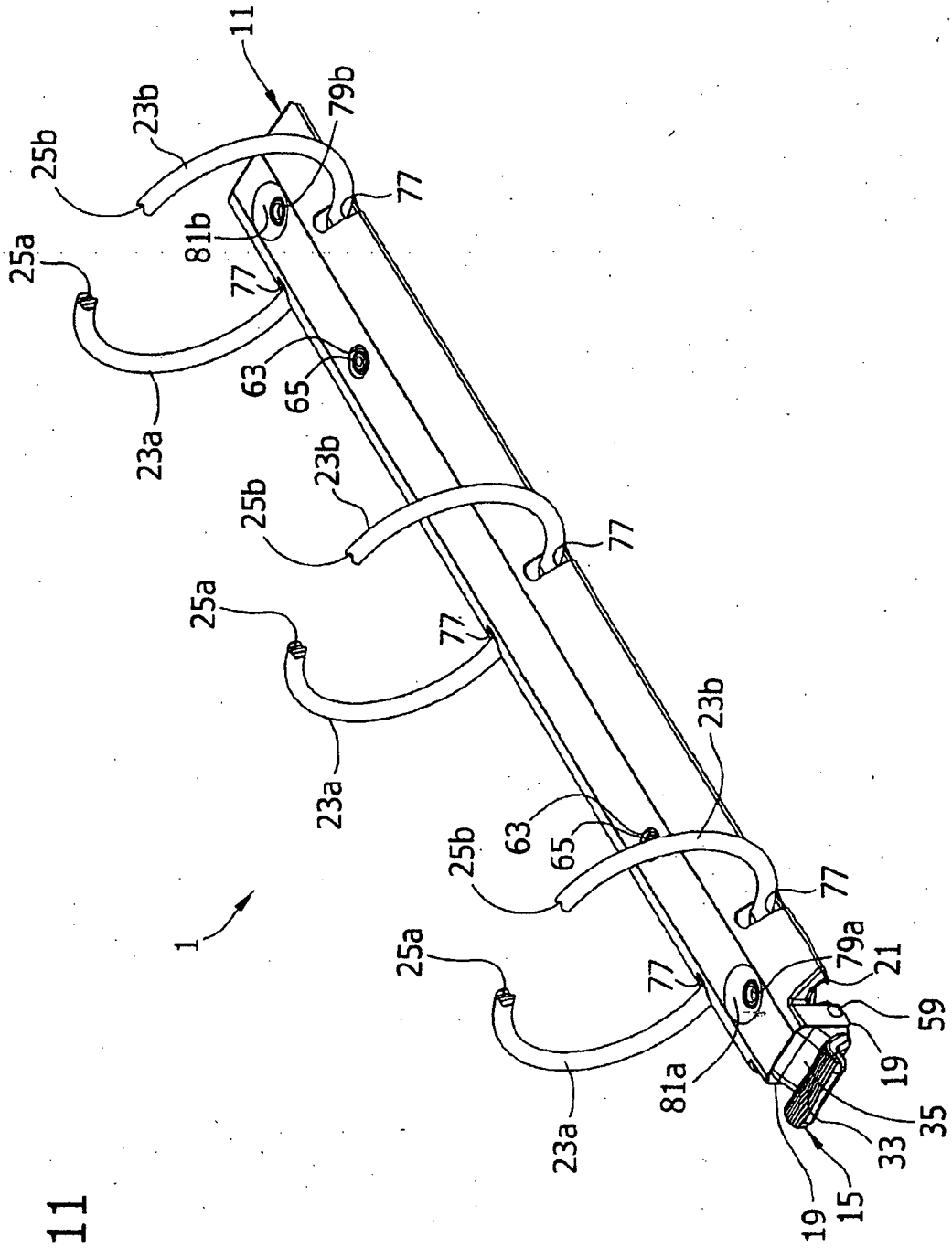


FIG. 11

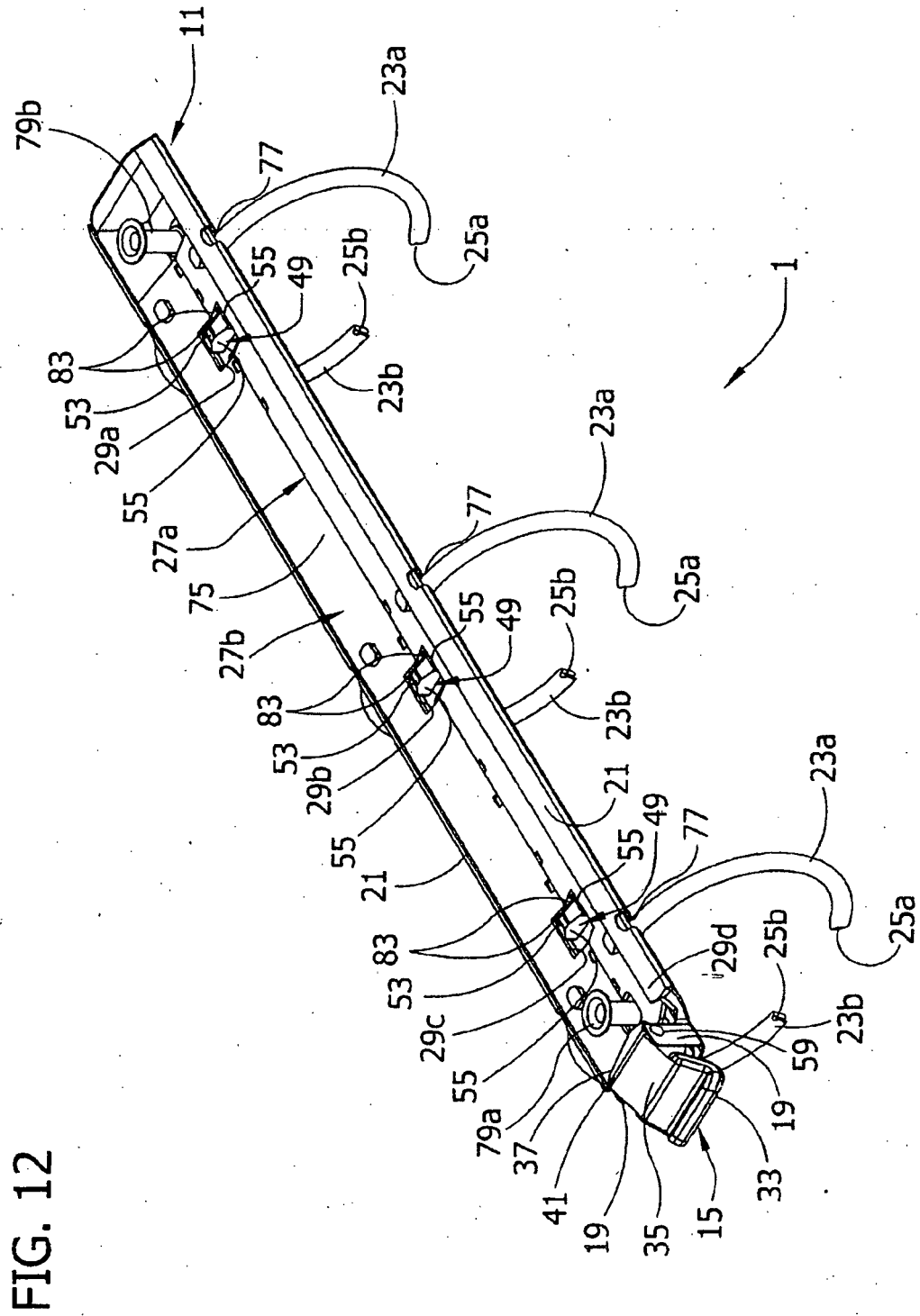
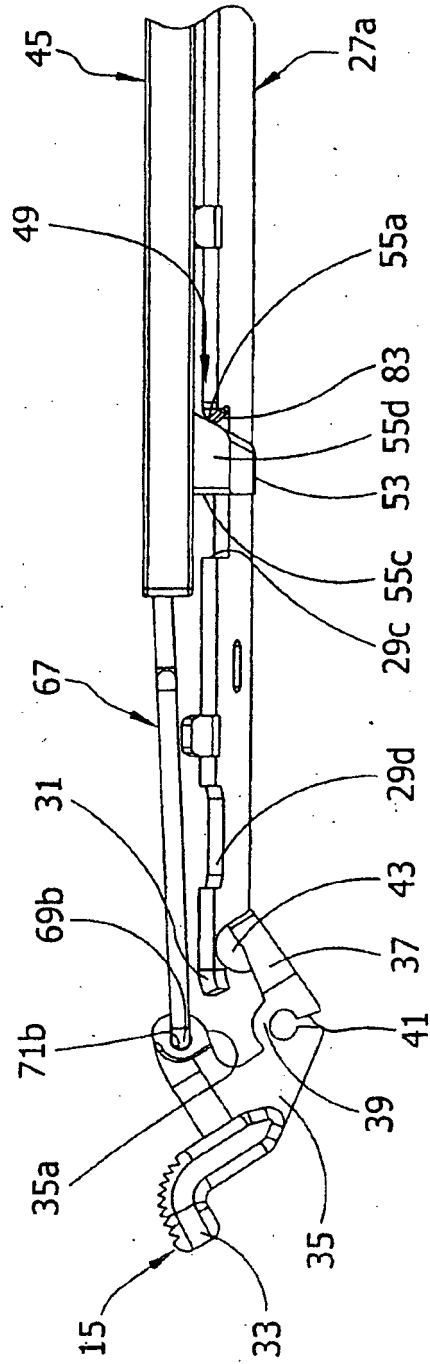


FIG. 13



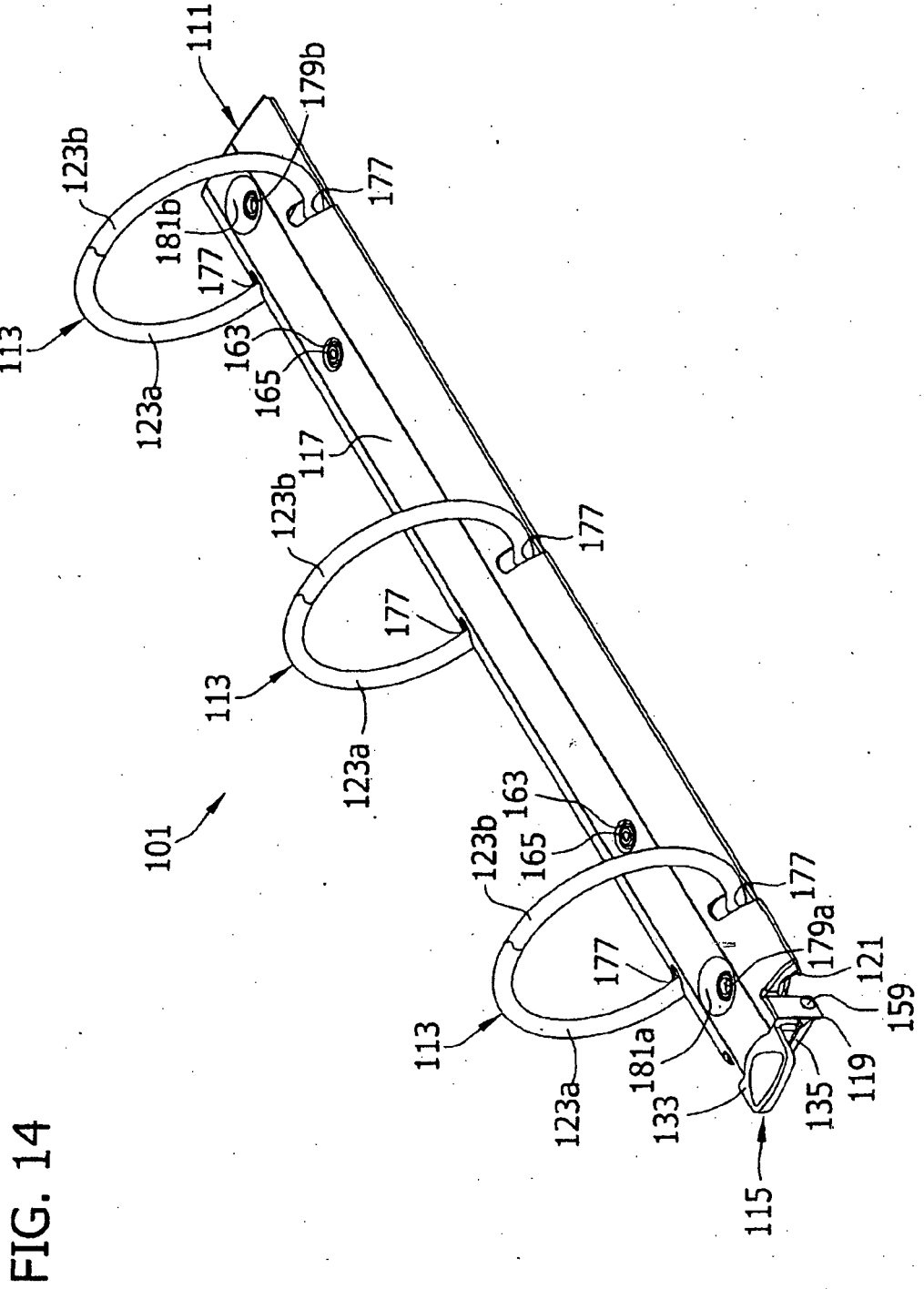


FIG. 14

FIG. 15

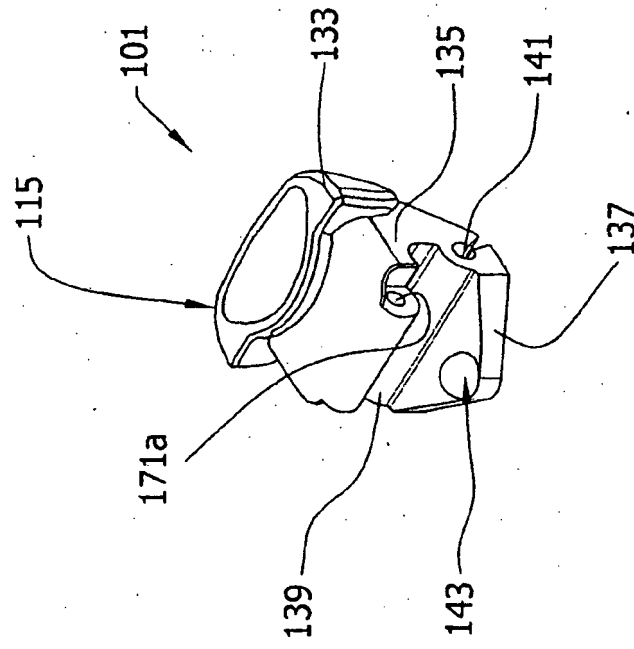


FIG. 16

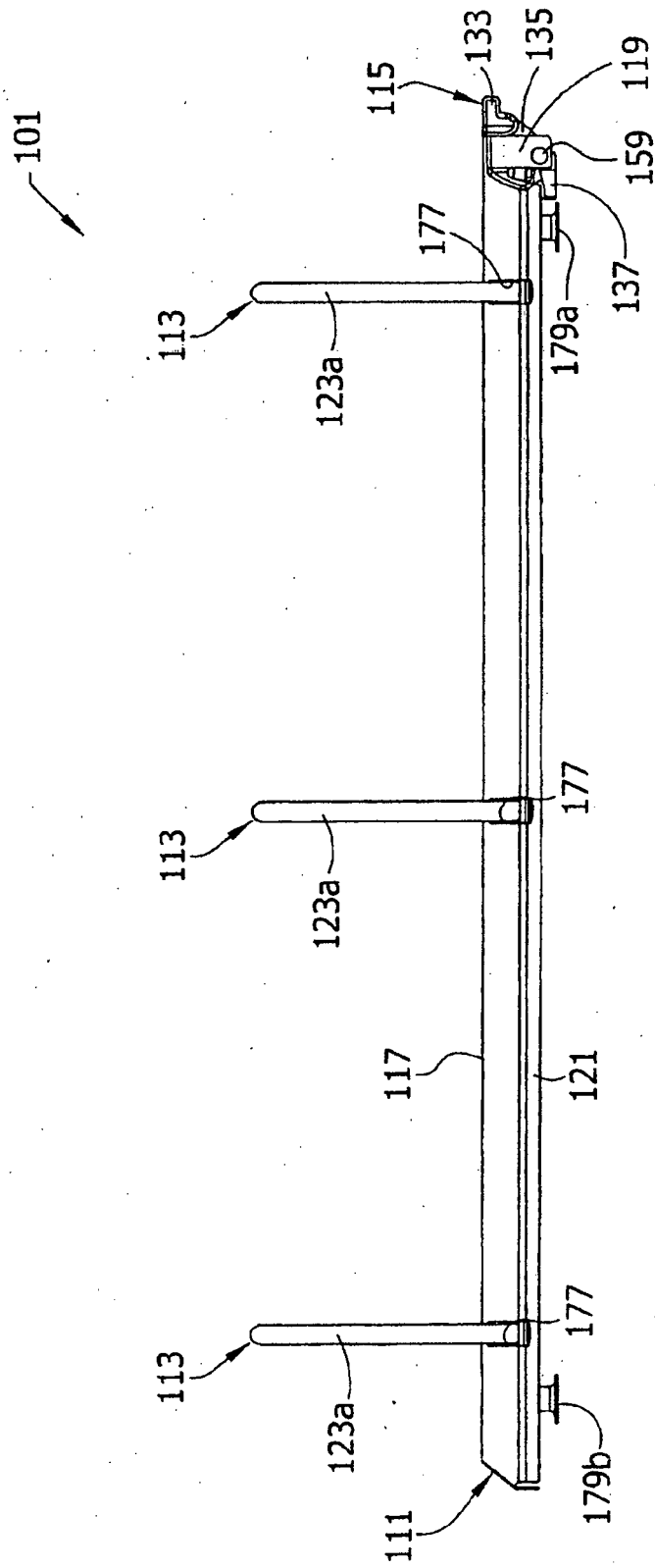


FIG. 17

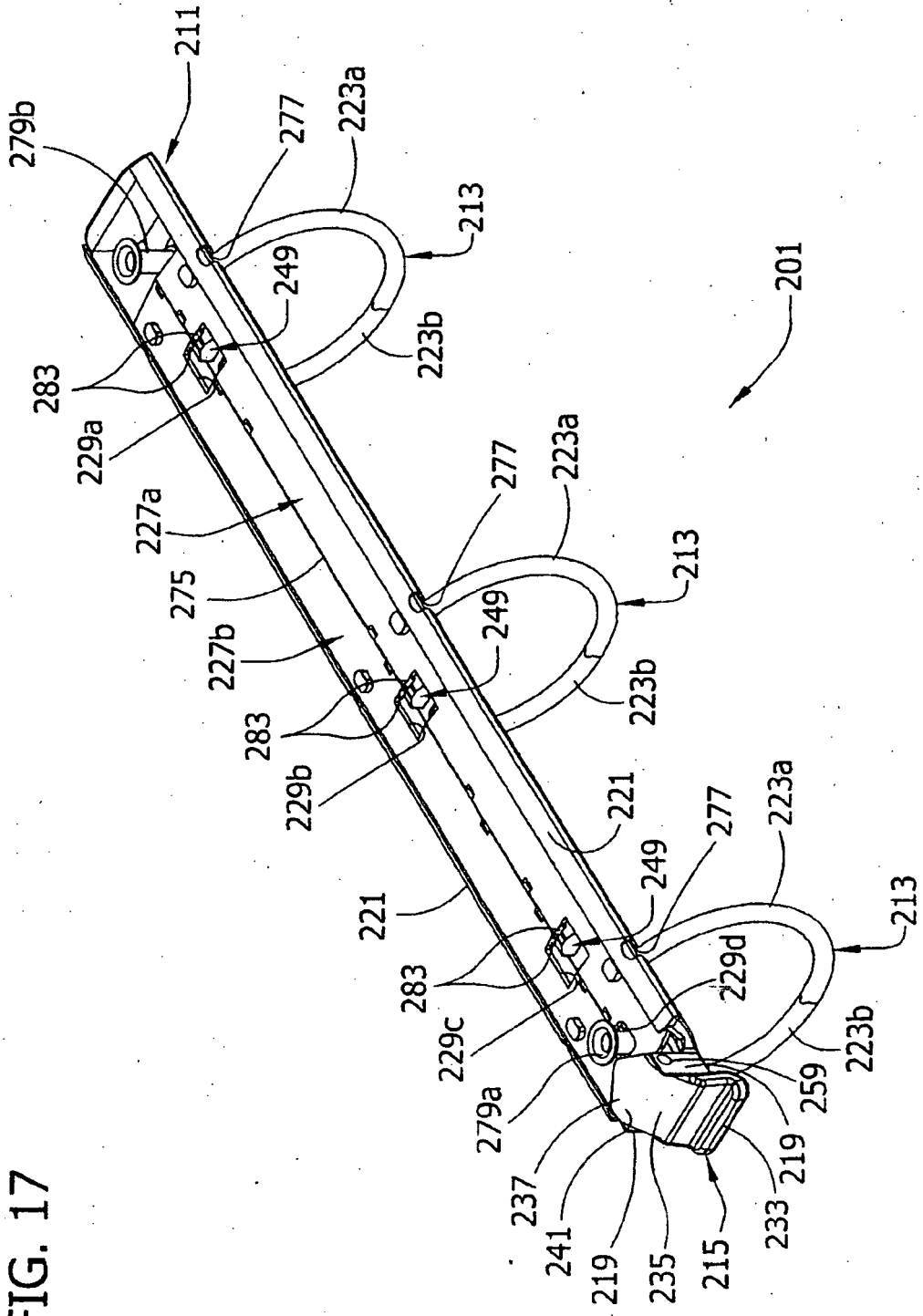


FIG. 18

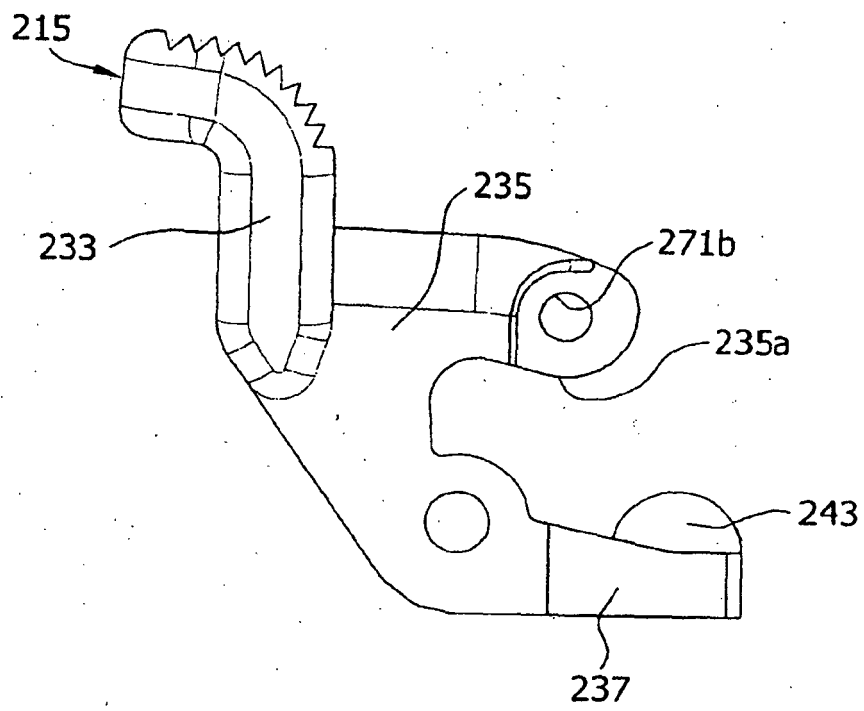


FIG. 19

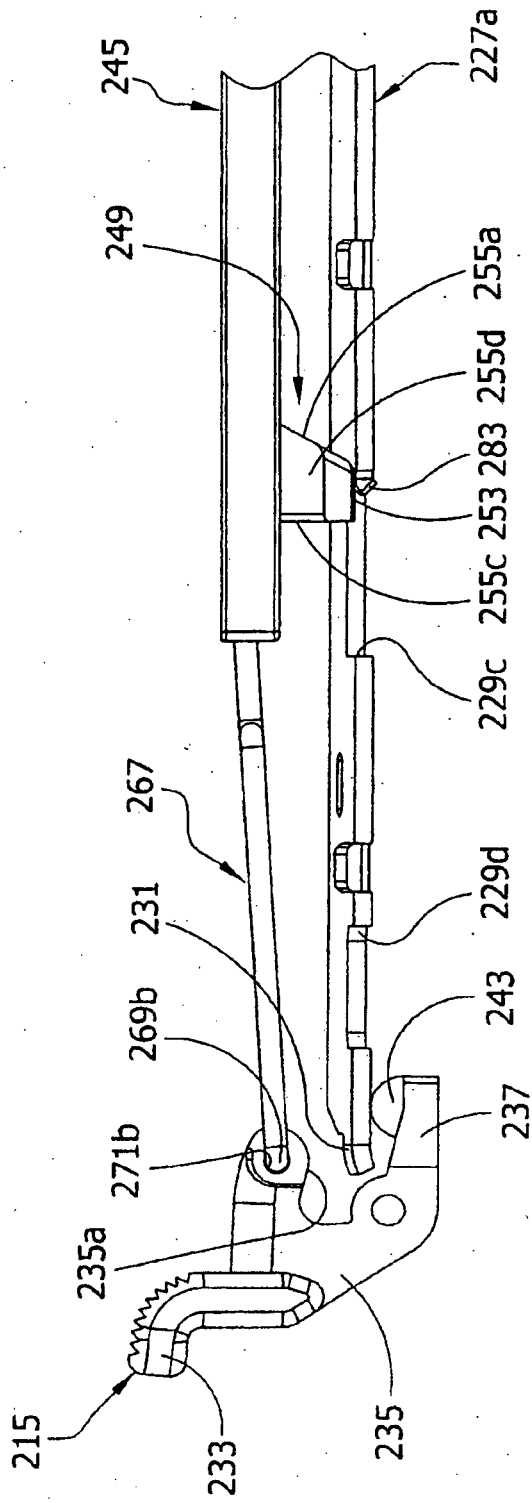


FIG. 20

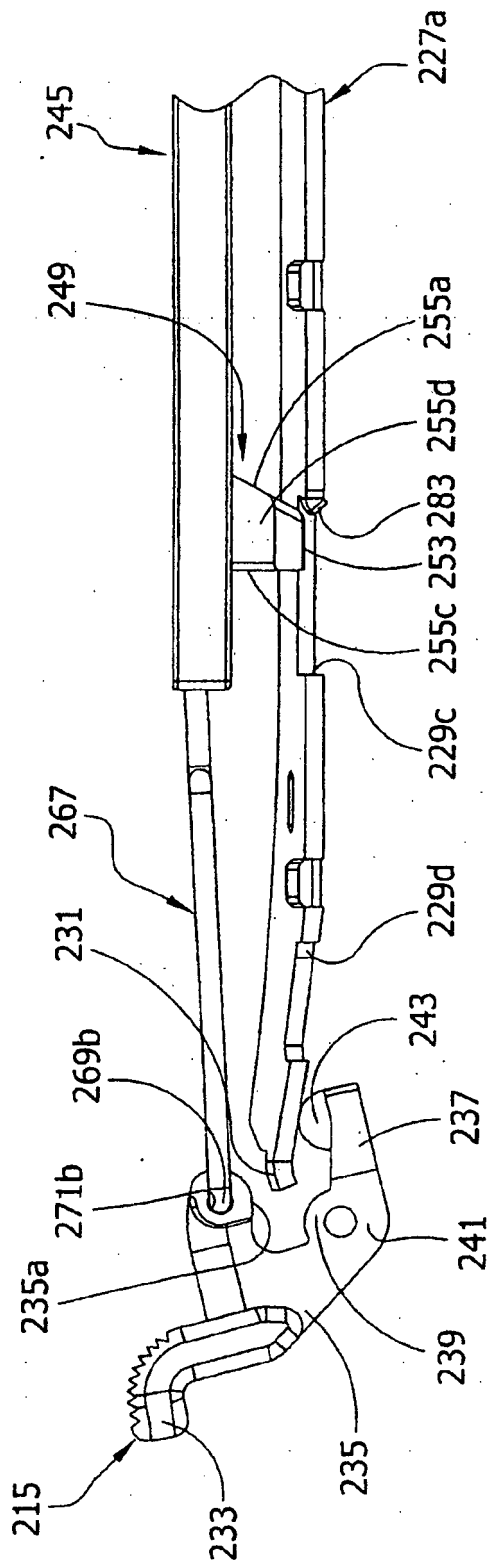
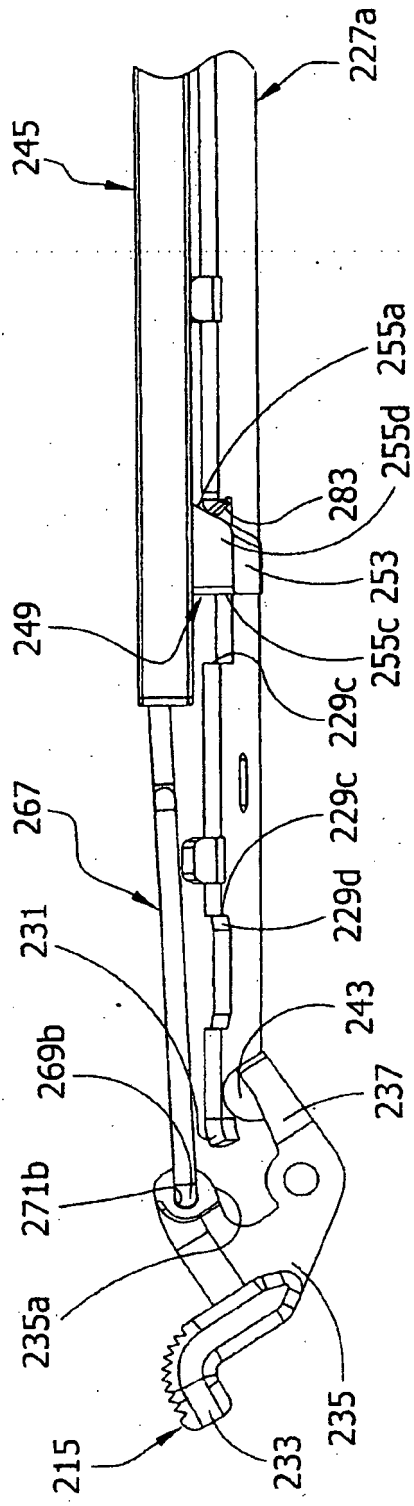


FIG. 21



REFERENCES CITED IN THE DESCRIPTION

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Patent documents cited in the description

- US 4813803 A, Gross **[0004]**
- US 870801 A, Cheng **[0007]**
- US 10905606 A, Cheng **[0007]**
- US 11027550 A, Cheng **[0007]**