

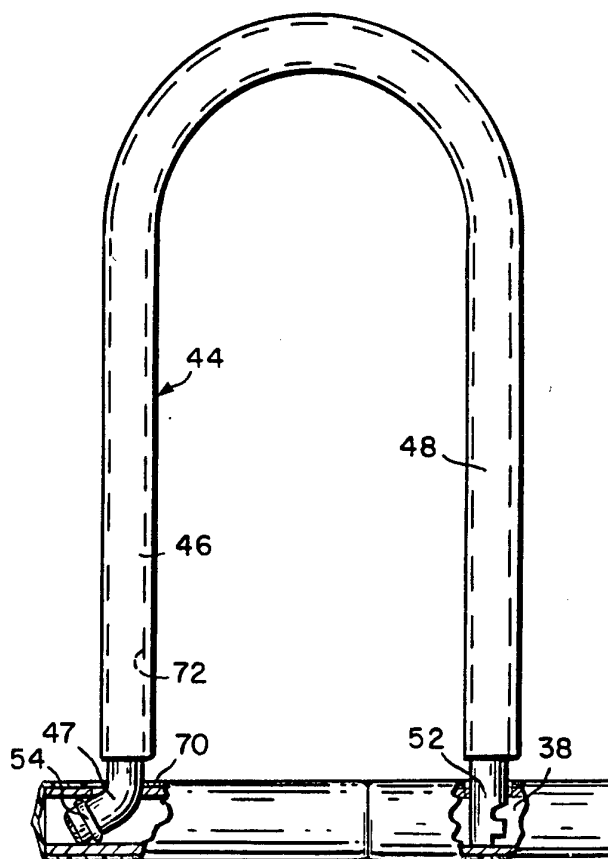


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(54) Title: U-LOCK WITH SECURE WIDE ANGLE PIVOT**(57) Abstract:**

A lock comprises a tubular body (32) having a pair of longitudinally aligned spaced openings (34, 36); a security mechanism (38) having a movable catch (40) inside the body and a security control (42) accessible from outside the body; a shackle (44) having a pair of opposed legs (46, 48); one of the legs having a bent foot (47); the bent foot being free for swivelling and rocking in one of the openings when the lock is open; a retainer (50) on the bent foot that normally prevents removal of the bent foot from the opening; the other of the legs having a shaped foot (52) which projects through the other of the openings and is engaged by the catch when the lock is closed.



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U-LOCK WITH SECURE WIDE ANGLE PIVOT

BACKGROUND OF THE INVENTION

1. Field of the Invention

The present invention relates to portable locks, and, more particularly, to locks characterized by (1) a body having a security mechanism and (2) a shackle having a pair of legs that are secured to the body when the lock is closed and movable with respect to the body when the lock is opened. More particularly, the present invention relates to heavy-duty portable U-locks that are highly resistant to physical assault by bolt cutters, crowbars, hack saws and the like.

2. The Prior Art

In one form of prior art U-lock, one leg of the shackle is pivotally connected to the body for rocking between open and closed conditions. In another form, both legs of the shackle are separable from the body. In the former case, the pivotal connection has been a weak point that, for example, could be ruptured by the tremendous leverage applicable by a crow-bar. In the latter case, the separability has enabled particular interactions between the legs of the shackle and the body to obviate the weakness of the pivotal connection.

One example of a separable U-lock is illustrated in U.S. patent No. 4,155,231, issued May 22, 1979, in the names of Michael S. Zane and Peter L. Zane, for Bicycle Lock and Bracket. In this configuration: (1) the body is a cross-bar

that is formed from hardened steel tube, with a pair of aligned openings and an interior locking mechanism; and (2) the shackle is formed from hardened steel rod, with one of its legs terminated by a bent foot and the other of its legs terminated by a particularly shaped foot.

When joining the cross-bar and the shackle, the bent foot of one leg is introduced into one of the openings and acts as a fulcrum while the shaped foot of the other leg is swivelled transversely of the longitudinal axis of the cross-bar, and rocked along the plane of the longitudinal axis of the cross-bar toward and into the other of the openings for engagement by the locking mechanism. This configuration has been highly successful in bicycle and motorcycle locks, whereby the shackle is fitted simultaneously about a wheel spoke and a stationary post, and the cross-bar is secured to the free ends of the shackle's legs to anchor the bicycle or motorcycle against theft. Although this configuration has been highly successful in resisting mechanical assault, the separability in use of its shackle and cross-bar sometimes is an inconvenience. This inconvenience can take the form of misplacing one of the separable components, or of requiring unduly complex manipulation by two hands.

BRIEF SUMMARY OF THE INVENTION

The primary object of the present invention is to provide a novel portable lock which combines advantages that heretofore have been found only either where (1) body and shackle have been separable or (2) where body and shackle have been

pivotally connected. In a sense, the present invention is an improvement over separable U-locks and involves providing the bent foot of a separable shackle with a retainer that permits the shackle to swivel and rock, but inhibits or prevents its manual removal from the cross-bar. More specifically, the object of the present invention is to provide a novel heavy-duty U-lock comprising: a body having a hardened steel tubular construction with a pair of longitudinally aligned spaced openings; a security mechanism having a movable catch inside the body and a key or combination control accessible from outside the body; a shackle having a hardened steel rod construction with a pair of opposed legs; one of the legs having a bent foot which is free for swivelling and rocking in one of the openings when the U-lock is open and which carries a retainer that normally prevents removal of the bent foot from that opening; the other of the legs having a shaped foot which projects through the other of the openings and is engaged by the catch when the U-lock is closed. In one form, the retainer is rigid so that the bent foot is not manually separable from the body. In another form, the retainer is deformable so that it may be forced through the opening under manual pressure or tension between the body and the shackle. Preferably both the body and the shackle are encased in plastic sleeves.

Other objects of the present invention will in part be obvious and will in part appear hereinafter.

BRIEF DESCRIPTION OF THE DRAWINGS

For a fuller understanding of the nature and objects of the present invention, reference is made to the following specification, which is to be taken in connection with the accompanying drawings, wherein:

Fig. 1 is a broken-away side view illustrating operative principles of a heavy-duty U-lock in accordance with the present invention;

Fig. 2 is an enlarged broken-away view of the U-lock of Fig. 1 illustrating relationships between components thereof;

Fig. 3 is an end view of the U-lock of Fig. 2, taken along the lines 3-3 of Fig.2;

Fig. 4 is an enlarged view illustrating the pivot of one embodiment of the U-lock of Fig. 1, partly broken-away and partly in cross-section;

Fig. 5 is a front plan view of a part of the pivot of Fig. 4;

Fig. 6 is a cross-sectional view of the part of Fig. 5, taken along the line 6-6;

Fig. 7 is an enlarged view illustrating the pivot of a modification of the U-lock of Fig. 1, partly broken-away and partly in cross-section;

Fig. 8 is a front plan view of a part of the pivot of Fig. 7;

Fig. 9 is an enlarged view illustrating the pivot of another modification of the U-lock of Fig. 1, partly broken-away and partly in cross-section;

Fig. 10 is a side view of a part of the pivot of Fig. 9;

Fig. 11 is a front view of the part of Fig. 10, taken along the line 11-11;

Fig. 12 is a side view of the locking mechanism of the embodiment of the U-lock of Figs. 1 and 2, partly broken-away and partly in cross-section;

Fig. 13 is an interior view of the locking mechanism of Fig. 12, taken along the line 13-13;

Fig. 14 is an exterior end view of the locking mechanism of Fig. 13, taken along the line 14-14;

Fig. 15 is a side view of a key of the type that is used in connection with the locking mechanism of Fig. 12;

Fig. 16 is an exploded view illustrating relationships among certain parts of the locking mechanism of Fig. 13;

Fig. 17 is a front view of another embodiment in the form a heavy-duty motorcycle brake disc U-lock incorporating the present invention;

Fig. 18 is a broken-away view of the embodiment of Fig. 17, partly in cross-section;

Fig. 19 is a bottom plan view of the embodiment of Fig. 17;

Fig. 20 is an exploded perspective view of components of the locking mechanism of the embodiment of Fig. 17; and

Fig. 21 is an exploded front plan view of components of the locking mechanism of the embodiment of Fig. 17.

DETAILED DESCRIPTION OF THE PREFERRED EMBODIMENTS

The Embodiment and Modifications of Figs. 1-16.

Generally, the embodiment and each of the modifications illustrated in Figs. 1 to 16 relate to a heavy-duty U-lock of the type used to anchor a bicycle or motorcycle to a fixed post. This U-lock, which is shown generally at 30 comprises: a body 32 having a hardened steel tubular construction with a pair of longitudinally aligned spaced openings 34, 36; a security mechanism 38 having a movable catch 40 inside the body and a control 42 accessible from outside the body; a shackle 44 having a hardened steel rod construction with a pair of opposed legs 46, 48; one of the legs having a bent foot 47 which is free for swivelling and rocking in one of the openings when the U-lock is open and which carries a retainer 50 that normally prevents removal of the bent foot from that opening; the other of the legs having a shaped foot 52 which projects through the other of the openings and is engaged by the catch when the U-lock is closed. Preferably, the body and the shackle are encased in vinyl sleeves 70, 72.

One form of retainer 50 is shown in Figs. 4, 5 and 6 as an elastomeric O-ring 54 which is snugly seated in a peripheral groove 56 that is in contiguity with the free end of bent foot 47. The normal diameter of O-ring 54 is greater than the diameter of opening 34. In normal usage, O-ring 54 retains the end of foot 47 within body 32 despite any swivelling or rocking motion to which shackle 44 may be subjected when the U-lock is in use. However, when the user so determines, he may exert a force between the body and the shackle to squeeze the O-ring

through opening 34 into or out of the body interior.

Another form of retainer is shown as a spring clip 58 which is snugly seated in a peripheral groove 60 in contiguity with the free end of the bent foot. The normal diameter of spring clip 58 is greater than the diameter of opening 34. In normal usage, spring clip 58 retains the end of the bent foot within the body despite any swivelling or rocking motion to which the shackle may be subjected when the U-lock is in use. However, when the user so determines, he may exert a force between the body and the shackle to crimp the spring clip through opening 34 into or out of the body interior.

A further form of retainer is shown as a steel annulus 62, which receives and is anchored to the end of the bent foot by a washer 64. The outer surface of annulus 62 is developed spherically about a center. The connection between the annulus and the bent foot must be fabricated before the open end of the body is enclosed by the vinyl sheath. First, the inner periphery of the washer is forced over the bent foot onto and into a peripheral groove adjacent to the free end of the foot. Then, while the U-lock is closed and with the free end of the bent foot adjacent to the open end of the body, the annulus is hammered over the washer until the outer periphery of the washer snaps into a groove in the interior surface of the annulus. This construction precludes manual separation of the shackle from the body. In a modification, the annulus is internally threaded and is turned onto the an external thread on the bent foot.

Plastic, e.g. vinyl, sheaths 70, 72 preferably enclose the cross-bar and the shackle. Preferably, the sheath for the cross-bar is formed from two parts that are slidably fitted over the opposite ends of cross-bar and that mate at a convenient location along the cross-bar. At their junction the two parts can be secured to each other, inter alia, by welding or gluing the abutting parts.

Preferably, body 32 and shackle 44 are fabricated from a heat treated high grade hardened steel, and both are sufficiently sturdy and thick to present effective resistance to a action of a bolt cutter, hack saw or crowbar. Body 32 preferably is of hollow tubular construction while shackle 44 preferably is of solid cylindrical rod stock construction. Alternatively, the body can be formed of hollow tubular constructions that, in cross-section are rectangular, oval, pentagonal, hexagonal, octogonal, etc. The vinyl sheaths to protect the finished surfaces of the bicycle and motorcycle from scratching when the locking device is applied.

Security mechanism 38 is shown in Figs. 12 to 16 as including a barrel 74 which is press fitted into the end of body 32, an inner bushing and sleeve assembly 76 which is rotatable within the barrel, a standard cam 78 which constitutes the catch that engages with and disengages from shaped foot 52, a stop cam 80 that limits rotation of assembly 76 within the barrel, a socket head cap screw 82 by which the entire assembly is united, and a key 84 with coded serrations that correspond to coded serrations on assembly 76.

The Embodiment and Modifications of Figs. 17-21.

Generally, the embodiment and each of the modifications illustrated in Figs. 17 to 21 relate to a heavy-duty U-lock of the type used to secure the brake disc of a motorcycle. When the lock is in place on the brake disc, the motorcycle is disabled. This U-lock, which is shown generally at 90 comprises: a body 92 having a hardened steel tubular construction with a pair of longitudinally aligned spaced openings 94, 96; a security mechanism 98 having a movable cam 100 inside the body and a control 102 accessible from outside the body; a shackle 104 having a hardened steel rod construction with a pair of opposed legs 106, 108; one of the legs having a bent foot 110 which is free for swivelling and rocking in one of the openings when the U-lock is open and which carries a retainer 112 that normally prevents removal of the bent foot from that opening; the other of the legs having a shaped foot 114 which projects through the other of the openings and is engaged by the catch when the U-lock is closed. Various modifications of retainer 112 correspond identically to the various modifications shown in Figs. 4 to 11, namely, the deformable O-ring sub-assembly of Figs. 4 to 6, the deformable retaining ring sub-assembly of Figs. 7 and 8, and the steel annulus sub-assembly of Figs. 9 to 11.

Preferably, the body and the shackle are encased in vinyl sleeves 116, 118. In one form, the sheath for the cross-bar is formed from two parts that are slidably fitted over the opposite ends of cross-bar and that mate at a convenient

location along the cross-bar. At their junction the two parts are secured to each other, inter alia, by welding or gluing the abutting edges.

Security mechanism 98 is shown in Figs 19, 20 and 21 as including a cylinder 120 that is friction fitted into an opening 122 in body 92, a cam 124 that is eccentrically journaled for rotation about the axis of cylinder 120 under the control of a key of the type shown in Fig. 15, a housing 126 that is fixed within body 92, and a bolt 128 that rides in a channel provided by housing 126. Bolt 128 is reciprocable under the control of cam 122 which rides in a channel 130 at the underside of bolt 128.

OPERATION

In operation, the embodiments of Figs. 1 to 16 and 17 to 21 are similar. When the security mechanism is unlocked, the shaped leg of the shackle can be withdrawn from the body and the shackle is free for swivelling and rocking throughout a very wide solid angle. Ordinarily, the bent foot of the other leg is retained within the body by the O-ring, washer or annulus that it carries, no matter how the swivelling and rocking of the shackle occurs. In this open condition, the cross-bar and then the shaped foot of the shackle can be inserted through a bicycle or motorcycle wheel and about a post or the like, and the cross-bar can be rocked and swivelled until it is united with the shackle and the security mechanism is locked. Removal of the U-lock from the bicycle or motorcycle simply involves reversing the above steps.

WHAT IS CLAIMED IS:

1. A lock comprising:
 - (a) a tubular body having a pair of longitudinally aligned spaced openings;
 - (b) a security mechanism having a movable catch inside said body and a security control accessible from outside the body;
 - (c) a shackle having a pair of opposed legs;
 - (d) one of said legs having a bent foot:
 - (e) said bent foot being free for swivelling and rocking in one of said openings when said lock is open;
 - (f) a retainer on said bent foot that normally prevents removal of said bent foot from said opening;
 - (g) the other of said legs having a shaped foot which projects through the other of the openings and is engaged by said catch when said lock is closed.
2. The lock of claim 1 wherein said retainer is rigid so that said bent foot is not manually separable from said body.
3. The lock of claim 1 wherein said retainer is deformable so that it may be forced through the opening under manual pressure or tension between the body and the shackle.
4. The lock of claim 1 wherein said body and said shackle are composed of hardened steel.
5. The lock of claim 1 wherein said body and said shackle are encompassed by plastic sheaths.
6. The lock of claim 1 wherein said catch projects inwardly and is engageable by said shaped foot.

7. The lock of claim 1 wherein said catch projects outwardly and is engageable by said shaped foot.

8. The lock of claim 1 wherein, when said bent foot is retained in said body and said shaped foot is removed from said body, said shackle is free for swivelling motion transversely of the axis of said body and for rocking motion along the axis of said body.

9. The lock of claim 1 wherein said retainer is an elastomeric O-ring.

10. The lock of claim wherein said retainer is composed of spring steel.

11. A U-lock comprising:

- (a) a tubular body having a pair of longitudinally aligned spaced openings;
- (b) a security mechanism having a movable catch inside said body and a security control accessible from outside the body;
- (c) a shackle having a pair of opposed legs;
- (d) one of said legs having a bent foot:
- (e) said bent foot being free for swivelling and rocking in one of said openings when said lock is open;
- (f) a retainer on said bent foot that normally prevents removal of said bent foot from said opening;
- (g) the other of said legs having a shaped foot which projects through the other of the openings and is engaged by said catch when said lock is closed.
- (h) said retainer being sufficiently rigid to retain

said bent foot in said body while said shackle is being moved.

- (i) said retainer being deformable so that it may be forced through the opening under manual pressure or tension between the body and the shackle.
- (j) said body and said shackle being composed of hardened steel.
- (k) said body and said shackle being encompassed by plastic sheaths.

12. The lock of claim 11 wherein said catch projects inwardly and is engageable by said shaped foot.

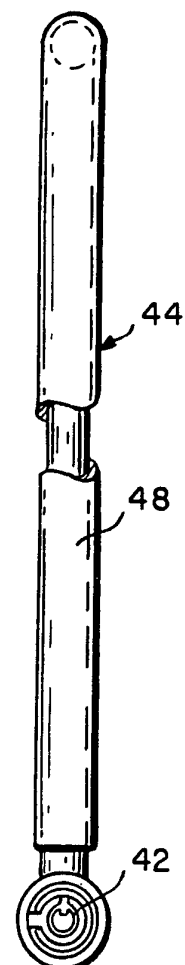
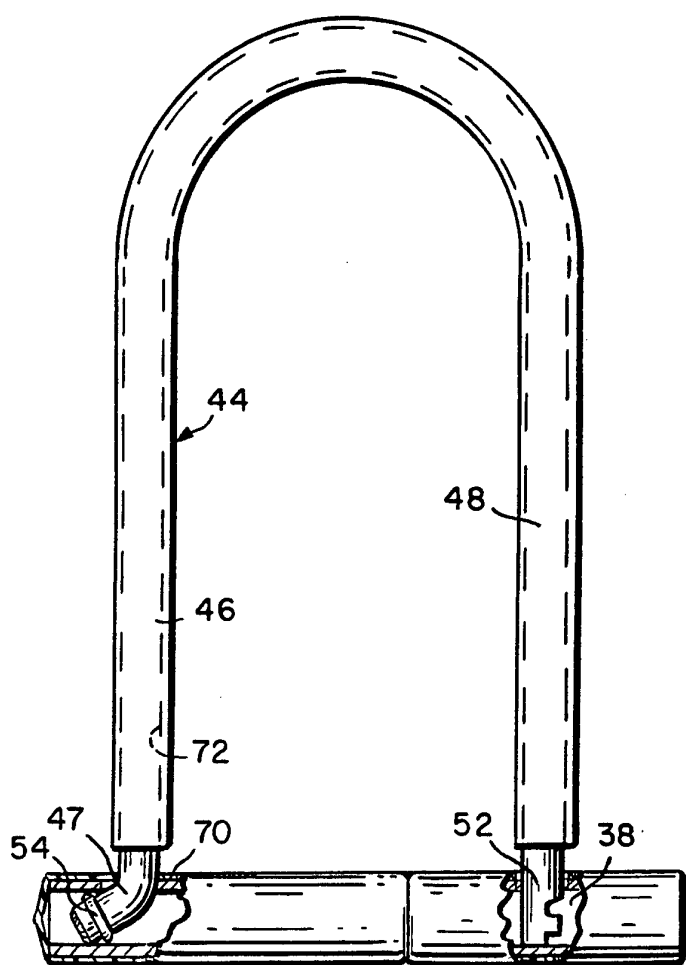
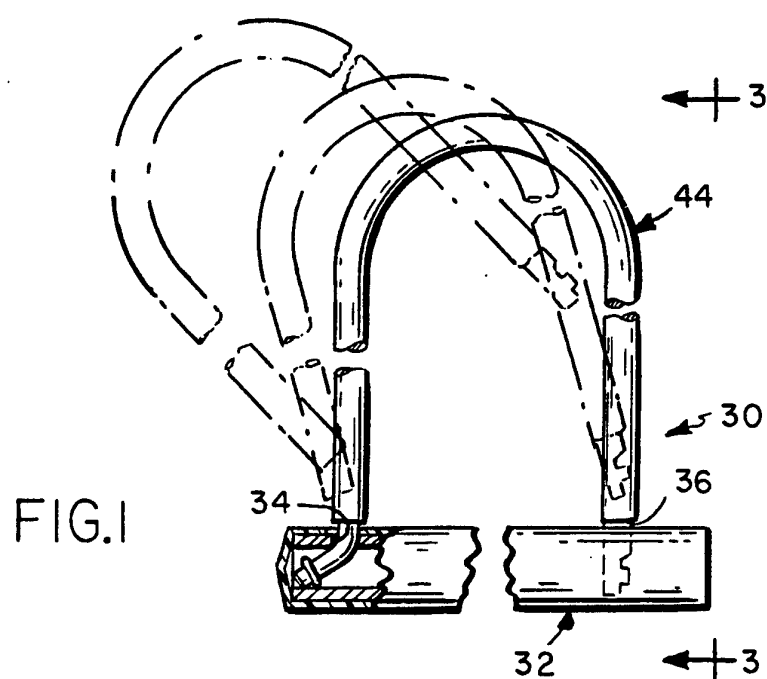
13. The lock of claim 11 wherein said catch projects outwardly and is engageable by said shaped foot.

14. The lock of claim 11 wherein said retainer is an elastomeric O-ring.

15. The lock of claim 11 wherein said retainer is composed of spring steel.

16. The lock of claim 11 wherein said catch projects inwardly and is engageable by said shaped foot.

17. The lock of claim 11 wherein said catch projects outwardly and is engageable by said shaped foot.



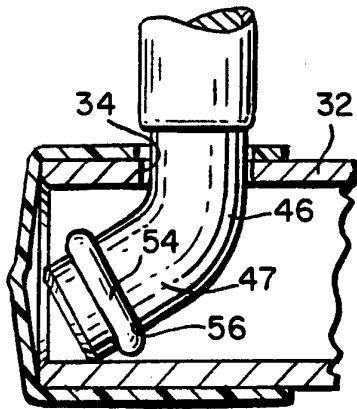


FIG. 4

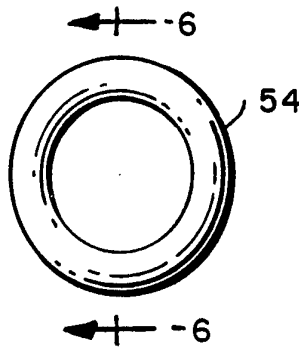


FIG. 5

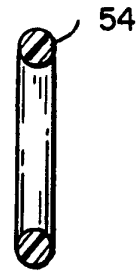


FIG. 6

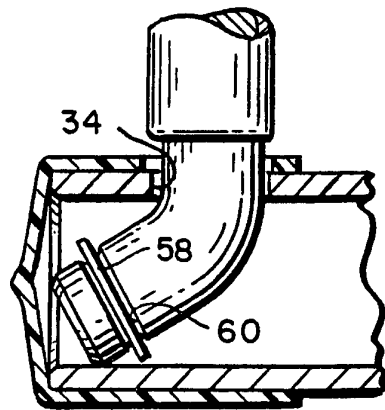


FIG. 7

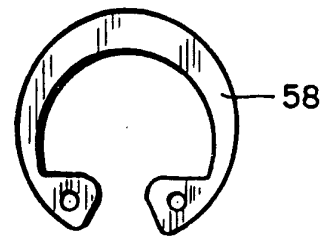


FIG. 8

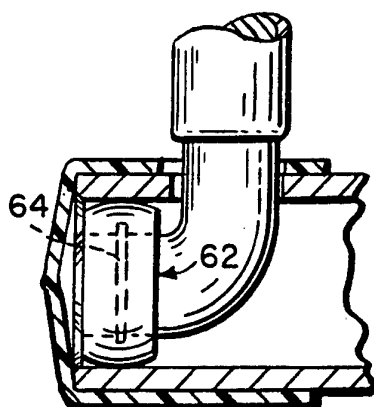


FIG. 9

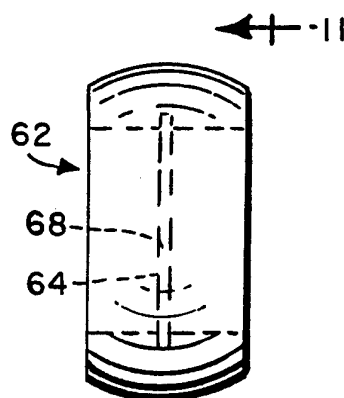


FIG. 10

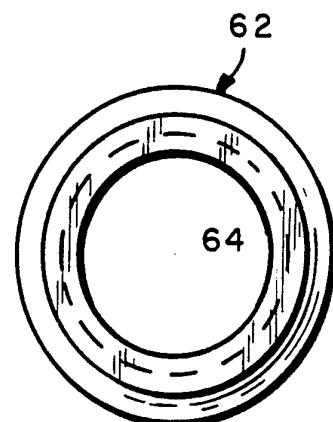


FIG. 11

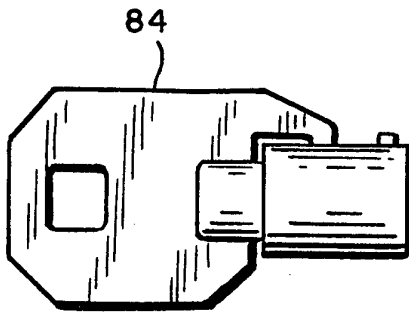


FIG. 15

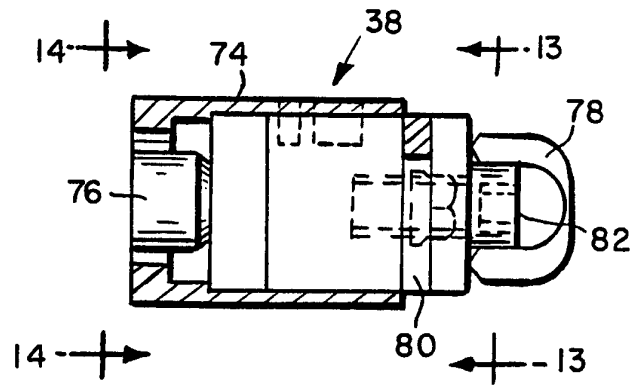


FIG. 12

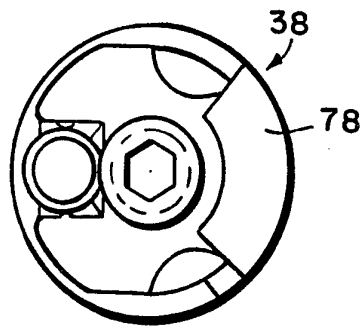


FIG. 13

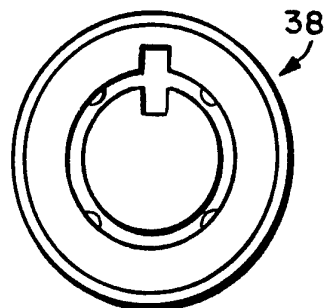


FIG. 14

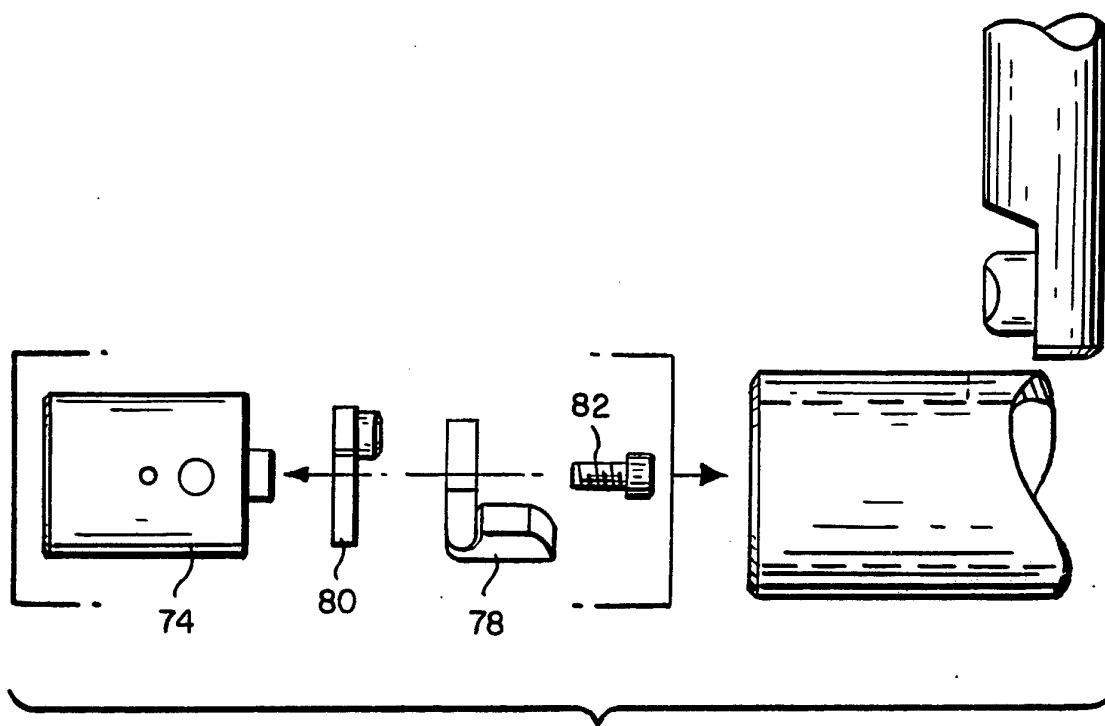


FIG. 16

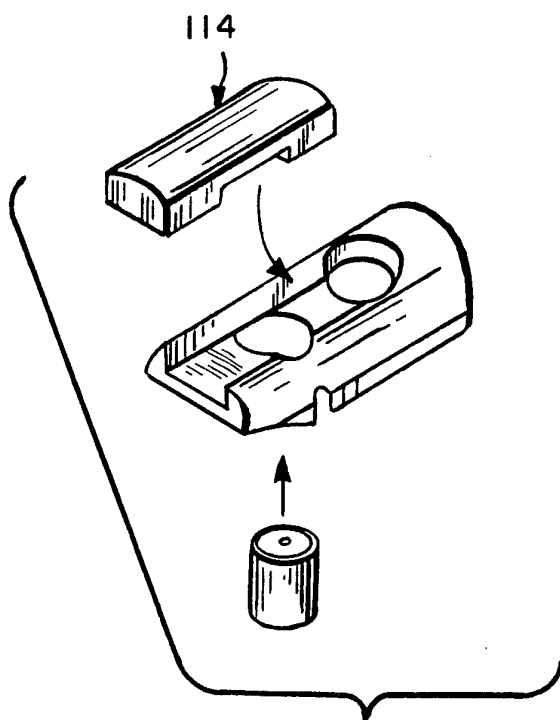


FIG. 20

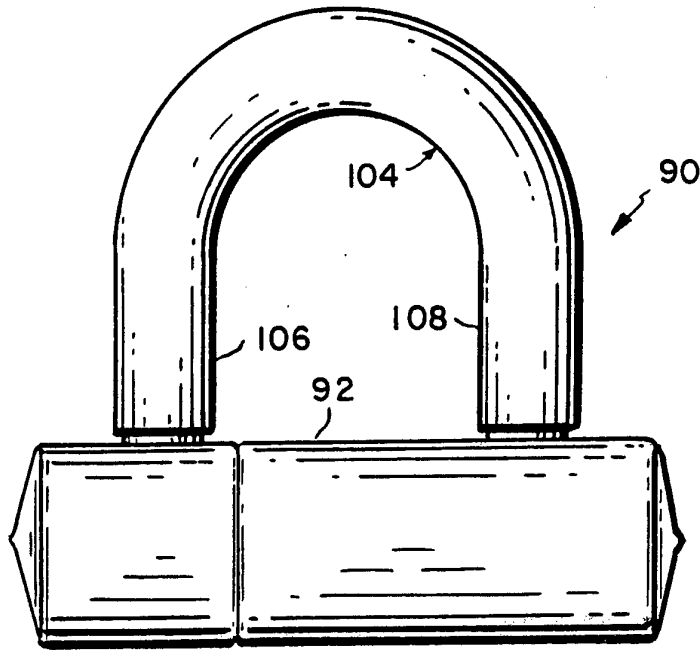


FIG. 17

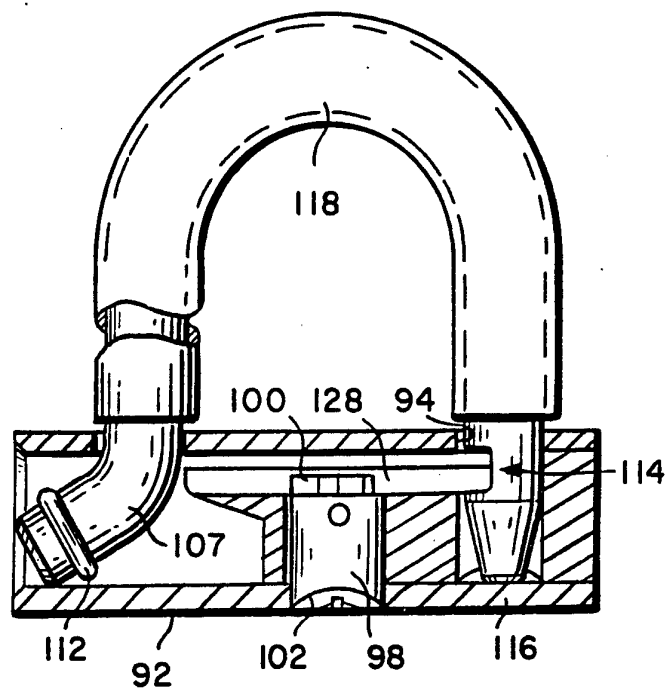
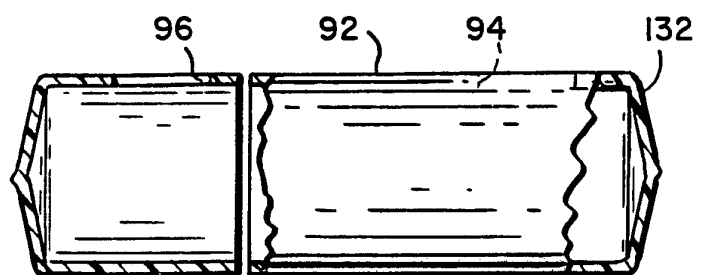


FIG. 18



5/6 FIG. 19

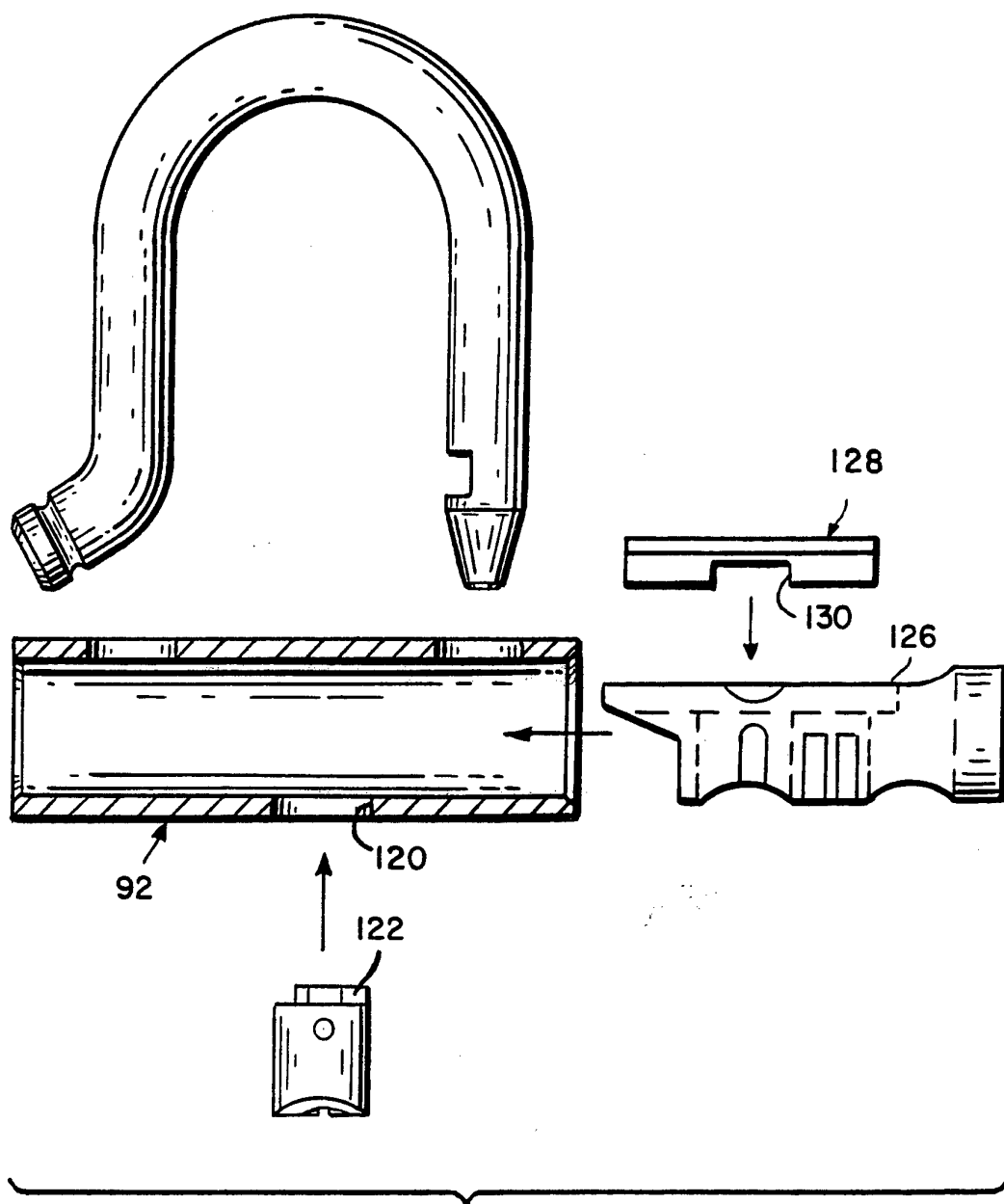


FIG. 21

INTERNATIONAL SEARCH REPORT

International application No.

PCT/US93/09063

A. CLASSIFICATION OF SUBJECT MATTER

IPC(5) :E05B 9/04

US CL : 70/39

According to International Patent Classification (IPC) or to both national classification and IPC

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)

U.S. : 70/38-47, 51-56, 233, 238

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

Electronic data base consulted during the international search (name of data base and, where practicable, search terms used)

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
Y	US, A, 5,010,746 (Zane et al) 30 April 1991, entire document	1-8,10-13, 15-17
Y	US, A, 4,545,224 (Zane) 08 OCTOBER 1985, entire document	1-8, 10-13, 15-17
Y	US, A, 4,730,470 (Zane et al) 15 March 1988, entire document	1-8, 10-13, 15-17
A	US, A, 4,986,095 (Chou et al) 22 January 1991, entire document	1-8, 10-13, 15-17
A	US, A, 4,987,753 (Kuo) 29 January 1991, entire document	1-8, 10-13, 15-17



Further documents are listed in the continuation of Box C.



See patent family annex.

* Special categories of cited documents:	"T" later document published after the international filing date or priority date and not in conflict with the application but cited to understand the principle or theory underlying the invention
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Date of the actual completion of the international search

16 December 1993

Date of mailing of the international search report

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