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[54] PADLOCK

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[51] **Int. Cl.** **E05b 67/22,** E05b 67/02

[58] **Field of Search**.....70/51, 52, 38, 38 A, 38 B, 70/38 C; 29/520

[56] **References Cited**

UNITED STATES PATENTS

2,070,012 2/1937 Jacobi.....70/52 X

FOREIGN PATENTS OR APPLICATIONS

28,275 9/1956 Finland.....70/38

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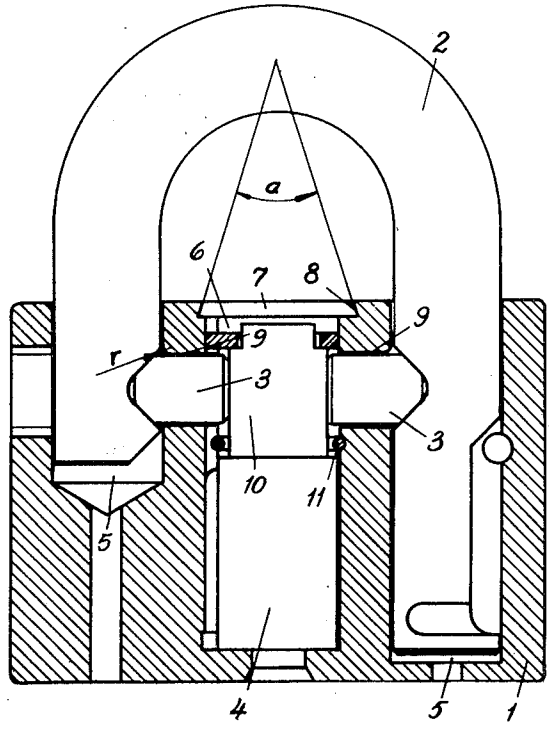
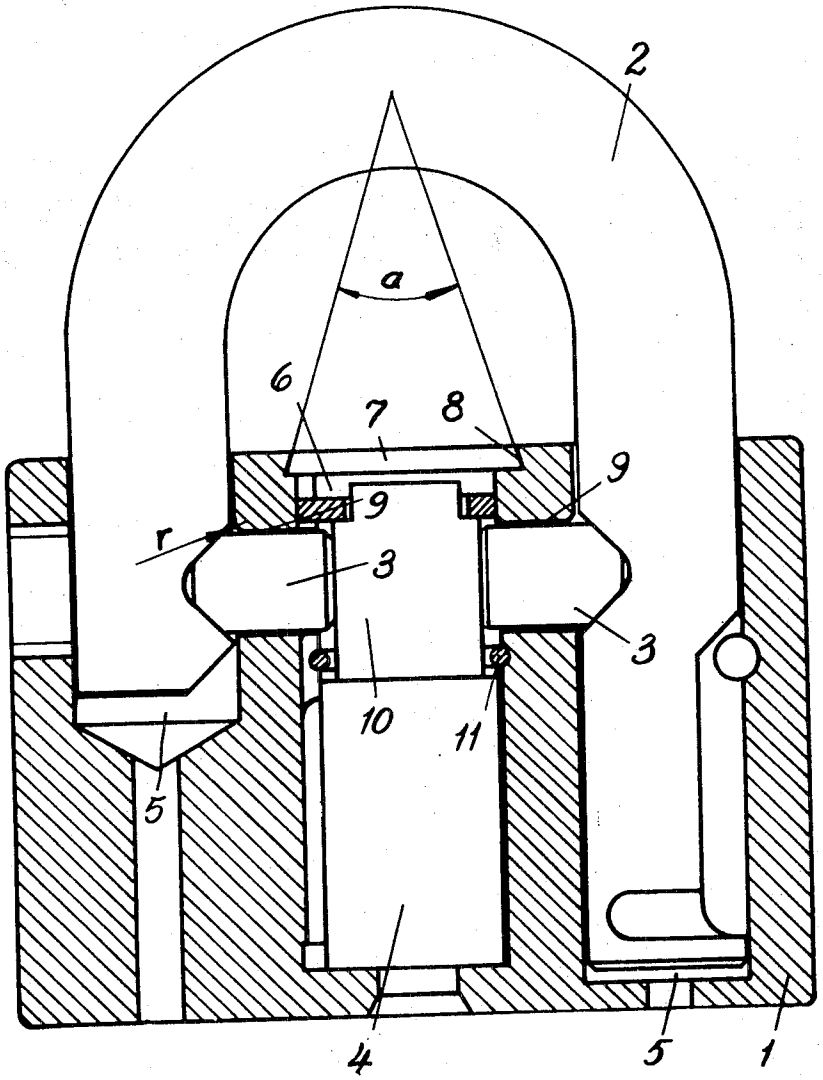
[57] **ABSTRACT**

A padlock of hardened steel having a lock mechanism inserted through an opening in the lock casing, which opening is covered by a cover plate with a very shallow surface hardening. The cover plate is initially curved and is pressed flat to fill a conical attachment recess in the lock casing.

13 Claims, 1 Drawing Figure

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PADLOCK

The present invention relates to a padlock comprising a lock casing, a lock shackle to be locked in the lock casing, and a lock bolt providing a locking action and being movable inside the lock casing and operable by a lock mechanism.

Various attempts have been made to produce unbreakable padlocks by attaching protecting plates or bars of hardened steel or other hard material to the lock casing, but in spite of these efforts, no one has so far succeeded in making an unbreakable lock. Not even the making of a completely hardened lock casing has met with success for the reason that the lock mechanism has to be inserted into the lock casing and thereafter the lock casing has to be closed in such a way that it cannot be reopened. The closing of the lock casing is usually made by pressing a cover plate into an attachment recess so that it undergoes a plastic deformation and fills the attachment recess, after which the outer surface of the lock casing is ground even, so that the cover plate cannot be grabbed by any tool. As this way of closing the lock casing presupposes plastic deformation of the cover plate, a hardened cover plate cannot be used, and hence, there will be a weak spot just in front of the lock mechanism even if the other parts of the lock casing are hardened.

The object of the invention is to provide a very strong, practically unbreakable lock, which cannot be broken by means of sawing, boring or heavy overloading, for instance by means of an iron bar. The invention is characterized in that the outside surface of the lock casing is completely hardened and that in the lock casing, preferably in one of its ends, there is an opening for the insertion of the lock mechanism into the lock casing, which opening is covered by a cover plate which has a shallow surface hardening so that its attachment into an attachment groove or slot by means of bending is possible. The invention is based on the observation that a plate having a shallow surface hardening can be bent somewhat without damaging the hardened surface, and that such a slight bending is sufficient for the attachment of the plate in a lock casing. It has also been found that even a shallow surface hardening effectively prevents boring and sawing with ordinary tools. Accordingly the invention makes it possible to create a lock casing with a completely hardened outer surface.

Usually the best results are obtained if the hardness penetration in the cover plate is a maximum of 0.1 mm., preferably 0.07 mm. at a maximum. The hardness penetration on the inner surface of the cover plate may be the same. The inner surface may also be left unhardened, but this causes higher production costs.

The cover plate is most suitably attached in a conical recess into which the initially convex cover plate can be inserted, and thereafter by pressing the cover plate flat it can be made to completely fill said recess. The opening covered by the cover plate is preferably made in the shackle end of the lock casing, because this part is protected by the shackle and by the attachment irons of the lock.

The complete surface hardening of the lock casing prevents breaking the lock by means of boring or sawing. In order that the lock also withstands breaking attempts by means of overloading, the strength of the lock can be improved by rounding the shackle facing edges of the guide borings for the lock bolts at least above the lock bolt. It has been found that the strength of the lock may be increased by more than 10 percent if the radius of the rounding is 0.4 to 1.2 mm.

The strength and general durability of the lock can be further improved by making the lock casing of substantially rectangular bar stock which is provided with two borings for the shackle and one boring for the lock mechanism which preferably is a cylinder lock. In this way also the production costs of the lock are substantially reduced.

A lock according to the invention should of course be designed to withstand all kinds of known destroying methods, otherwise its strength in some respects is useless. One known method to break a padlock by force is to load the lock mechanism axially through the key hold with a very great force in order to press out the cover plate in the opposite end of the lock from the inside. The durability of the lock against breaking attempts of this kind can be very much improved by locking the lock mechanism axially by means of a locking ring or the like. This ring should be situated in such a way that it resists at least a part of the axial load which may be applied to the lock mechanism through the keyhole. In this way the strength of the lock can be made up to four times greater.

In the following, one embodiment of the invention will be described more fully with reference to the attached drawing showing an axial section of a padlock according to the invention.

In the drawing, **1** indicates the lock casing having a completely hardened outer surface, **2** the shackle, **3** the lock bolts and **4** a cylinder lock mechanism. In the lock casing **1** there are two borings **5** for the shackle **2** and a third boring **6** for the cylinder lock **4**. The boring **6** is closed by a cover plate **7** which is attached in a conical recess **8**. In the illustrated embodiment, the cone angle is about 40° which has been found suitable. The cone angle should be **20** to 60°, preferably 30° to 50° in order to obtain a reliable attachment of the cover plate **7**. The cover plate **7** is initially somewhat convex, so that its edge surface is more or less cylindrical. When the convex plate is pressed flat, its edge surface becomes conical and is pressed against the corresponding conical side surface of the recess **8**. The deformation of the cover plate **7** is so small, that the cover plate can be surface hardened if the hardness penetration is a maximum 0.1 mm. In practice a hardness penetration of 0.05 to 0.06 mm. gives the best results.

The lock bolts **3** are movable in borings **9**. The movement is obtained by turning the cylinder of the lock mechanism **4**, whereby a plate **10** at the end of the cylinder pushes the lock bolts **3** outwards. In the opposite direction, the bolts **3** move by being pushed by the inclined surfaces of the shackle **2**. The edges of the borings **9** facing the shackle **2** are at least on the upper side, rounded with a radius *r*, of about 0.4 to 1.2 mm. It has been found, that a radius of 0.5 mm. can increase the strength of the lock by more than 10 percent. This is due to the fact, that part of the shearing stress of the lock bolts is transformed into bending stress. If the rounding radius *r* is made too large, the strength of the lock decreases. The plate **10** should be of such a hard material that it is not deformed by the load of the lock bolts when the shackle is pulled outwards with a great force.

In the boring **6** there is a locking ring **11** above the lock cylinder of the lock mechanism. If the lock cylinder is loaded axially through the key hole, the lock cylinder will reach the locking ring **11** at the same time that the plate **10** reaches the cover **7**. The cover **7** and the locking ring **11** will then both take up the axial load and in this case the lock may withstand a load of the order discussed of more than 5,000 kp.

The invention is not limited to the embodiment shown, but several different modifications of the invention are feasible within the scope of the following claims.

What is claimed is:

1. A padlock comprising a lock casing, a shackle to be locked in said lock casing and at least one lock bolt providing a locking action and being movable in said lock casing and operable by a lock mechanism; an improvement wherein the outside surface of said lock casing is completely hardened and said lock casing is provided with an opening for the insertion of the lock mechanism into said lock casing, a cover plate for closing said opening, said cover plate having a shallow surface hardening to allow said cover plate to be attached into an attachment groove at said opening by means of a slight bending.

2. A lock according to claim **1** wherein a conical recess for said cover plate is provided in said lock casing, said cover plate being initially curved and inserted into said recess by being pressed flat.

3. A lock according to claim **2** wherein said recess has a cone angle of 20° to 60°.

4. A lock according to claim **2** wherein said recess has a cone angle of 30° to 50°.

5. A lock according to claim 1 wherein said casing has a guiding bore for movement of said lock bolt, said guiding bore having a rounded edge adjacent said shackle.

6. A lock according to claim 5 wherein said rounded edge has a radius of 0.4 to 1.2 mm.

7. A lock according to claim 2 wherein said cover plate is initially convex with a cylindrical edge, the latter edge being locked in said conical recess when the cover plate is pressed flat and permanently deformed in said recess.

8. A lock according to claim 1, wherein the hardness penetration in said cover plate is a maximum of 0.1 mm.

9. A lock according to claim 8, wherein said hardness penetration is a maximum of 0.07 mm.

10. A lock according to claim 1, wherein said opening is situated in the part of said lock casing facing said shackle.

11. A lock according to claim 1, comprising a locking ring arranged to resist at least part of an axial load applied to aid lock mechanism through the keyhole of said padlock.

12. A lock according to claim 1, wherein said lock casing is made of substantially rectangular bar stock and is provided with two borings for said shackle and one boring for said lock mechanism.

13. A lock according to claim 1, wherein said lock mechanism is a cylinder lock mechanism.

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