

(19)



Europäisches Patentamt
European Patent Office
Office européen des brevets

(11)

Publication number:

0 298 681
A1

(12)

EUROPEAN PATENT APPLICATION

(21)

Application number: **88306072.5**

(51)

Int. Cl.4: **E05B 27/00**

(22)

Date of filing: **04.07.88**

(30)

Priority: **08.07.87 GB 8716028**

(43)

Date of publication of application:
11.01.89 Bulletin 89/02

(84)

Designated Contracting States:
AT BE CH DE ES FR GB GR IT LI LU NL SE

(71)

Applicant: **DIFFUSION ALLOYS LIMITED**
Birchwood Industrial Estate
Hatfield Hertfordshire AL9 5JW(GB)

(72)

Inventor: **Harmer, Stephen Harry**
39 Winstanley Road Saffron Walden
Essex CB11 3EQ(GB)
Inventor: **Kempster, Adrian**
5 Redebourn Lane Bury
Huntingdon Cambridgeshire(GB)

(74)

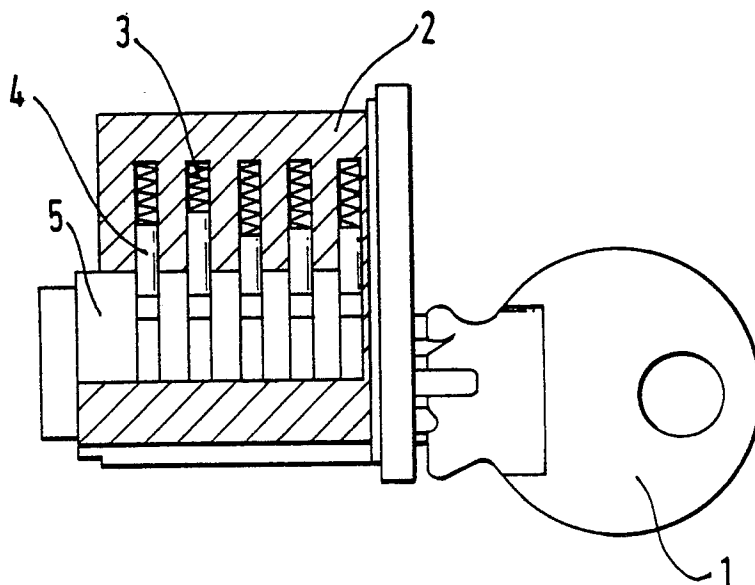
Representative: **Smith, Sydney et al**
Elkington and Fife High Holborn House 52/54
High Holborn
London WC1V 6SH(GB)

(54)

Cylinder locks with locking pins having a hardened surface.

(57)

A cylinder lock having an inner barrel (5) rotatable in an outer cylinder (2) is lockable with spring loaded pins (4) which pins are of steel, are provided with a hard corrosion resistant carbide or nitride layer and the steel of which has been hardened. The carbide layer may be chromium carbide formed by chromizing. The steel pins may be carburized before chromising. The nitride layer may be chromium nitride formed by chromising of a steel which has been nitrided. The pins are hard and corrosion resistant and impart improved burglar proofness to the lock.



EP 0 298 681 A1

CYLINDER LOCKS WITH LOCKING PINS HAVING A HARDENED SURFACE

This invention relates in particular to locks of improved burglar proofness, and in particular to the manufacture of the locking pins which achieves this purpose.

There has been an increasing incidence of cylinder locks of cars, telephone cash boxes, and similar devices for safe keeping and also of doors to buildings in which the lock is being destroyed by drilling through the barrel from the front. The development of what are termed cordless drills and carbide tipped drills have made such a practise relatively simple. Having drilled through the barrel destroying the pins in their housings it is a simple matter to rotate the barrel and hence open the lock and enter the cash container, vehicle or other containment.

Locks of the type in question are traditionally made of brass because it is easily machined and is generally corrosion resistant. The latter attribute is enhanced with nickel and/or chromium electroplating.

The locking mechanism in the cylinder locks consists of a set of spring loaded pins which, when in place, prevent the inner barrel rotating in the outer cylinder. The insertion of the appropriate key pushes the pins back into the cylinder so allowing the barrel to rotate and hence open the lock. To prevent corrosion of the pins which would stop the lock from functioning correctly they are made from one of several corrosion resisting alloys. These are not hard and in fact cannot be sufficiently hardened.

To prevent the theft and damage already referred to it is considered sufficient that the locks be "drillproof", that is, that entry and/or access to the container should be made sufficiently difficult that the technique in question is no longer worthwhile. It is not considered necessary that the lock be totally indestructible only that it should not be capable of being forced by a drilling out of the barrel and pins. The contents of the locked container would be safe and with time the felonious practice would fall into disuse.

The more or less obvious means of providing a tamper-proof lock would be to make it from a hardenable steel alloy. This has been tried but abandoned because the steel, although it can be protected to some extent against corrosion, cannot be so guaranteed as can brass. Further the intricate machining and certain other operations in lock construction make steel, especially when hardened, a more difficult material to use.

To render a lock "drill-proof" it is considered sufficient to blunt or break the drill as it is forced into the barrel. This involves imposing some hard, strong material across the path the drill would take on being pushed forward.

There are relative factors to be considered namely the power available in the drill and the size or diameter of drill used. In committing a felony, the wrongdoer will only have at his disposal hand tools or small portable power tools quite capable under normal circumstances of penetrating brass with a drill of 1/4 - 3/8 inch (6.35 - 9.52 mm) diameter. If it is possible to jam or sieze the drill during its passage through the brass barrel then it will blunt or break so thwarting the attempt to break open the lock.

After experiment we have found that making the spring loaded pins from a carbon containing steel and hardening them by a process of heating and quenching in oil has been quite sufficient to cause breakage of the drill when trying to break open the lock. However such pins do not have a good resistance to corrosion which prohibits their use.

After further experiment we have found that the pins, if chromised or nitrided before hardening, can have a protective layer of chromium carbide or chromium nitride formed on their surface, which in addition to improving their corrosion resistance is also very hard, in fact harder than the pins and which enhances the performance of the pin in breaking or impeding the drill as before described.

According to the invention, there is provided a cylinder lock having an inner barrel rotatable in an outer cylinder and lockable by spring loaded pins characterised in that the pins are of steel, are provided with a hard corrosion resistant carbide or nitride layer, and the steel of which has been hardened.

The carbide layer is preferably chromium carbide. The layer is preferably formed by a carbide forming process with subsequent hardening. The carbide forming process is preferably chromizing.

The nitride layer is preferably chromium nitride. The layer is preferably formed by a nitride forming process with subsequent hardening. The nitride forming process is preferably nitriding followed by chromizing.

We have further found that it is possible to use a low carbon steel for the manufacture of the pins which is soft and therefore more easily fabricated than one containing the higher amount of carbon required to produce a hard pin. The pins made from low carbon steel can be carburized before chromizing although other methods of introducing carbon can be used. A preferred method of carburization is pack cementation.

In order that the invention may be more easily understood the following Examples are given, by way of illustration only:-

Example I

A steel wire of diameter 0.104" (2.604 mm) and of a chemical composition to BS 970-070M20, that is to say:-

Carbon 0.16 - 0.24%

Manganese 0.50 - 0.90%

**Phosphorus)
and) 0.050% max.**

**Sulphur)
Silicon dependant on manufacture**

was cut to appropriate lengths (about 0.2") (5.08 mm) and the ends made round and smooth. They were then packed in a mixture of carbon and other chemicals known under the Trade Name "Pearlite" in a sealed container and heated in an electric furnace at a temperature of 900° C for 8 hours after which the container was removed and allowed to cool. After opening and removing the pins examination showed they had absorbed more than 0.8% carbon. The pins were thoroughly cleaned to remove all traces of the carbon-rich powder and packed in a further sealed container with a powder rich in chromium and also containing a small quantity of ammonium iodide. This process is termed chromising and is broadly as described in the book "Chromium" by Brandes & Sully published by Butterworth.

The container was heated in a furnace at 960 C for 8 hours after which it was removed and allowed to cool. The pins were removed from the powder and thoroughly cleaned. Examination by metallographic means showed they had acquired a surface layer of chromium carbide of thickness 18-20 micrometres (µm) and a surface hardness of 1850 D.P.N. The pins were then heated to a temperature of 820 C and held at the temperature for 5 minutes and then quenched in a quenching oil to achieve a hardening of the central part of the pin. After tempering the pins at a temperature of 180 C for 1 hour they were tested for hardness and the central part which had not been chromised was found to have a hardness of 700 D.P.N. Again the pins were thoroughly cleaned to a smooth bright finish. They were subject to a corrosion test involving a spray of 3% aqueous NaCl and after 24 hours exposure showed no evidence of corrosion. This was considered satisfactory. The pins were now assembled into suitable locks as would be the case with the conventional pins referred to above.

The locks were mounted in a suitable frame to hold them rigid as would be the situation in normal use. Then using a 3/8" (9.52 mm) hand-held power drill operated by a larger than average size workman an attempt was made to penetrate the lock. After a protracted period of drilling at various angles the drill became blunt and the attempt was abandoned with the lock intact. In a further test a second lock was placed in the vice of a pillar drill which after a short time resulted in a broken drill bit. Using a lock of standard manufacture not containing the specially treated pins the drill readily passed through the barrel then allowing it to be turned and opened.

Example II

A steel wire of diameter 0.104" (2.604 mm) and of chemical composition to BS970-410521 that is to say:

Carbon 0.09-0.15

Manganese 1% max.

Chromium 11.5-13.5%

Phosphorus) 0.040% max
 and Sulphur)
 Silicon 1% max
 Nickel 1% max.

was cut to appropriate lengths (about 0.2") (5.08 mm) and the ends made round and smooth. They were then heated in a molten salt nitriding both known under the Trade Name "Tufftride" for a temperature of 600 C for a period of 2 hours after which they were removed, allowed to cool and washed free of the salt. By this process, the pins had absorbed a sufficient quantity of labile nitrogen to subsequently form chromium nitride at the surface. The pins were thoroughly cleaned of any staining on the surface and then chromized in the same manner as described in Example I. After chromizing the pins were removed from the powder and thoroughly cleaned. Examination by metallographic means showed they had acquired a surface layer of chromium nitride of thickness 15-18 micrometres (mm.) and a surface hardness of 2050 D.P.N. The pins were then heated in vacuum to a temperature of 1000° C and held at temperature for 5 minutes and then quenched in nitrogen to achieve a hardening of the central part of the pin. After tempering the pins at a temperature of 200° C for 1 hour they were tested for hardness and the central part which had not been chromized was found to have a hardness of 380 D.P.N. Again the pins were thoroughly cleaned to a smooth bright finish. They were subject to a corrosion test involving a spray of 3% aqueous NaCl and after 48 hours exposure showed no evidence of corrosion. This was considered satisfactory. The pins were now tested as in Example I with the same results as those obtained with the pins with a surface coating of chromium carbide.

The above examples describe in some detail the technique used in the invention of a "drill-proof" lock but it must be made clear that other individual techniques similar to but not the same as those described can also be used. For example, it is possible to start with wire having a carbon content of 0.5% or higher when coating with chromium carbide. Other alloying elements such as chromium, nickel, vanadium, manganese etc. may be present to improve other fundamental mechanical properties of the wire pin when further processed.

The carbon-containing steel used to make the pins should preferably contain not less than 0.5% carbon. A low carbon steel may be used, as mentioned above, provided it is carburized to increase the carbon content.

Methods of carburizing the pin other than that described in the Example may be used such as gas carburizing or carburizing in a salt bath. The only requirement is that sufficient carbon is introduced to be able to form the chromium carbide and to achieve the optimum hardness on quenching. Chromizing as described in the Examples is normally carried out by the pack cementation process but this can be done by gaseous and salt bath techniques. These techniques used correctly are equally effective in achieving the coating of chromium carbide preferred. Other carbides can be formed to give the high surface hardness such as tungsten, molybdenum, vanadium, boron etc. but chromium is preferred because it has the better corrosion resistance.

Similarly, methods of nitriding the pin other than that described in Example II may be used such as gas or plasma nitriding the only requirement being that sufficient labile nitrogen is introduced to form the chromium nitride.

As described the final hardening process will generally be carried out in a way dependent on the base steel used. Thus, the steel will in general be heated to a temperature in excess of 750° C, will be held at this temperature for a relatively brief period of time, such as 4-30 minutes and then quenched in oil, water or gas. The latter would generally apply if the parts are heated in a vacuum furnace. A suitable oil is sold under the trade name "Quendila". Any suitable technique may be employed however provided that the chromium carbide or chromium nitride is not destroyed or impaired in any way during the process.

Finishing of the pins is of importance after the various processes and while barrelling in abrasive chips is preferred other techniques are available

The single figure of the accompanying drawing is a part sectional view of a cylinder lock according to the invention with the key in position. The key 1 pushes pins 4 which are spring loaded by springs 3 back into a cylinder 2 (shown in scrap section) which allows the barrel 5 to rotate and open the lock. According to the invention the pins 4 are provided with a hardened surface which imparts to the lock an increased burglar proofness when the key is withdrawn.

Claims

1. A cylinder lock having an inner barrel rotatable in an outer cylinder and lockable by spring loaded pins characterised in that the pins are of steel, are provided with a hard corrosion resistant carbide or nitride layer, and the steel of which has been hardened.
5
2. A lock as claimed in claim 1 characterised in that the corrosion resistant layer is a carbide, in particular chromium carbide.
3. A lock as claimed in claim 2 characterised in that prior to formation of the carbide layer the steel pins are carburized to provide a high carbon content in the steel.
- 10 4. A lock as claimed in claim 1 characterised in that the corrosion resistant layer is a nitride, in particular chromium nitride.
5. A lock as claimed in claim 4 characterised in that prior to formation of the nitride layer the steel pins are nitrided to provide a high level of labile nitrogen in the steel.
6. A lock as claimed in claim 1 characterised in that the steel pins have been hardened after application
15 of the corrosion resistant layer by heating to an elevated temperature and quenching the heated pins
7. A steel pin, for use in a cylinder lock, as defined in any of claims 1 to 7.
8. A pin of hardened steel provided with a hard corrosion resistant carbide or nitride layer.

20

25

30

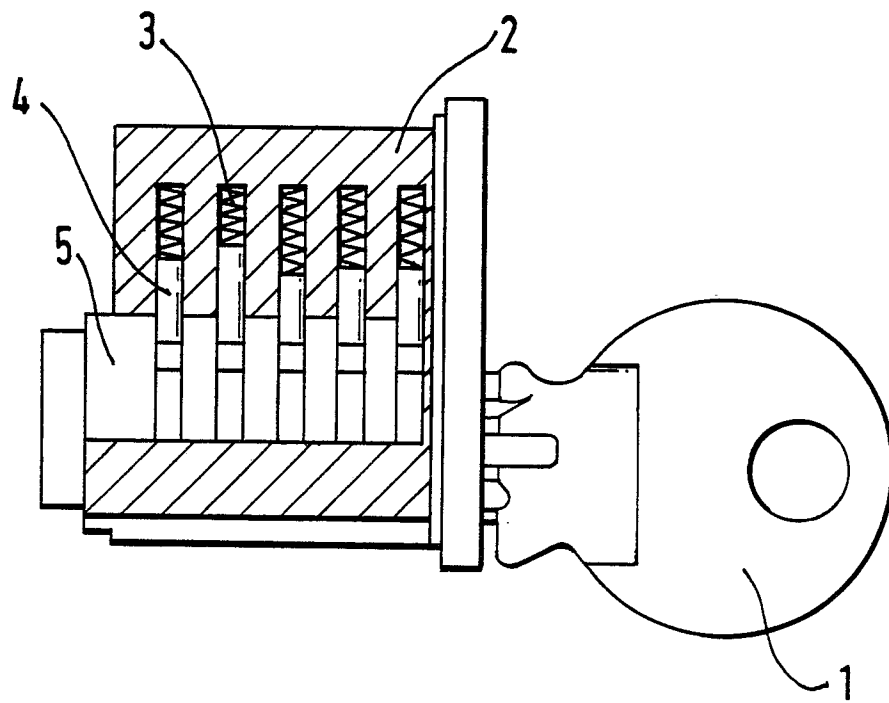
35

40

45

50

55





DOCUMENTS CONSIDERED TO BE RELEVANT			EP 88306072.5
Category	Citation of document with indication, where appropriate, of relevant passages	Relevant to claim	CLASSIFICATION OF THE APPLICATION (Int. Cl. 4)
P, A	<u>EP - A1 - 0 238 442</u> (KELLER, ERNST) * Claims 4-6; fig. 1-4 * --	1, 7	E 05 B 27/00
A	<u>DE - A1 - 2 758 589</u> (FA. WILHELM KARRENBURG) * Claim 3; fig. 1-3 * ----	1	
			TECHNICAL FIELDS SEARCHED (Int. Cl. 4)
			E 05 B
The present search report has been drawn up for all claims			
Place of search VIENNA		Date of completion of the search 10-10-1988	Examiner CZASTKA
CATEGORY OF CITED DOCUMENTS X : particularly relevant if taken alone Y : particularly relevant if combined with another document of the same category A : technological background O : non-written disclosure P : intermediate document T : theory or principle underlying the invention E : earlier patent document, but published on, or after the filing date D : document cited in the application L : document cited for other reasons & : member of the same patent family, corresponding document			