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"A Combination Lock"

This invention relates to a combination lock having a plurality of dials, each dial being coupled to a corresponding rotary element having a periphery which is circular except for a peripheral portion that must be
5 turned to a predetermined position relative to cooperable means to permit the lock to be opened.

In accordance with the present invention, the peripheral position has a notch and the cooperable means
10 has a ridge portion for each notch, the ridge portions engaging with the notches, respectively, when the notches have said predetermined position, wherein the rotary elements comprise sleeves supported for rotation on shaft, each dial being supported on a corresponding sleeve for
15 rotating that sleeve, each sleeve having a flange constituting the circular periphery of that sleeve, with the notches being formed in the flanges, respectively, the sleeves and the ridge portions having relative sliding movement to open the lock, and wherein each dial has a
20 series of indicia spaced about its periphery with one indicium displayed when the peripheral portion of the corresponding sleeve has said predetermined position, each sleeve having an interface between its flange and the corresponding ridge portion when the corresponding dial
25 is turned to display an indicium that succeeds said one indicium at either side thereof, with the areas of the interface at opposite sides of a plane extending from the axis of the shaft to the peak of said corresponding ridge portion being equalised sufficiently to prevent that
30 sleeve from turning its notch to said predetermined position in response to pressure exerted by said corresponding ridge portion.

The present application is divided out of Application No. 7939895 to which reference is made for details of
35 the general background and prior art.

In the accompanying drawings:-

Figure 1 is a plan view illustrating the external appearance of an embodiment of a combination lock in accordance with the invention;

5 Figure 2 is a vertical sectional view taken along line 2-2 of Figure 1;

Figure 3 is a vertical sectional view taken along line 3-3 of Figure 2;

10 Figure 4 is a bottom plan view of a sliding bolt in accordance with the invention; and

Figures 5 and 6 are diagrammatic views illustrating, respectively, a prior art bolt-sleeve arrangement and a bolt-sleeve arrangement in accordance with the invention.

15 A problem which may be encountered in a prior combination lock employing a sliding bolt is illustrated in Figure 5, where the sliding bolt 89 and a typical sleeve 90 are shown diagrammatically. To open the lock (as will be described shortly) bolt 89 must slide toward
20 the viewer (perpendicular to the plane of the drawing) in a direction parallel to the axis of rotation 92 of the sleeves, only one of which is shown in Figure 5. Each sleeve has a circular periphery 94 with a flat portion 96. In the unlocked position of the sleeves, each sleeve
25 assumes the phantom line position shown in Figure 5 so that the bolt may bypass the flat portions 96. When a sleeve is turned one number position away from its unlocked position (36° in the illustrative embodiment) the shaded portion of the sleeve will provide an interface with
30 the bolt and will block movement of the bolt required to open the lock. It is apparent in Figure 5 that the shaded portion is highly asymmetrical relative to line 98 (representing an axial plane of sleeves 90 that is perpendicular to the bolt 89). If pressure is exerted
35 on the bolt tending to move the bolt toward the viewer, a force may be exerted on the sleeve at the larger

portion of the shaded area which may have a component tending to turn the sleeves about its rotational axis, particularly if a chamfer or worn area exists at the interface of the sleeve and the bolt. Thus a sleeve
5 may be turned to its unlocked position undesirably, for example when a luggage case bearing the lock is dropped.

As shown in Figure 6, if sleeves 90a are employed, with V-notches 96a, rather than flat portions 96, and if the bolt 89a has ridge portions 100 that mate with the
10 notches, the shaded area of contact between the bolt and the sleeves is much more symmetrical about line 98, that is, the sub-areas at opposite sides of line 98 are substantially equalized, so that a force exerted by the bolt at one sub-area is counterbalanced by a force exerted
15 at the opposite sub-area, preventing the application of a torque to the sleeves that is substantial enough to turn a sleeve to its unlocked position. In Figure 6 line 98 extends from rotational axis 92 to the peak of ridge portion 100.

20 To further illustrate the invention, an embodiment employing a sliding bolt in a combination lock based upon the lock of U.S. Patent No. 3,416,338 will now be described in detail.

As shown in Figures 1 to 4, principal parts of the
25 combination lock may include combination dials A', sleeves B', shaft C', bolt D', and frame E'. The dials may protrude through slots in a cover plate 66', and a manual actuator 102 (sometimes called a "puller") extends through an opening in the cover plate and is attached to
30 one end of the bolt D'. The other end of the bolt has a latch member 104 that cooperates with a conventional spring-biased hasp 106.

The dials and the sleeves may have a construction similar to that described earlier and may be assembled
35 on shaft C' in a similar manner, with the sleeves being urged into successive abutting relationship by a spring

34', and with the dials cooperating with a dial spring 70'. The assembly of the dials, the sleeves, and the shaft may be supported on brackets 108 and 109. A lever 82' may be employed to disengage the sleeves from the dials to permit the combination to be changed, and the lock may have a combination "finding" feature as described in parent application No. 7939895.

As shown in Figures 2 to 4 the bolt has a series of openings 62' through which the dials extend, but these openings must be wide enough to permit movement of the bolt relative to the dials in a direction parallel to the axis of shaft C'. As is apparent in Figure 3, the bolt has a configuration similar to that shown in Figure 6. When the sleeves are turned to mate the notches 96a (Figure 6) with the ridge portions 100, manual actuator 102 may be moved to the right in Figure 2, with the ridge portions of the bolt bypassing the V-notch portions of the sleeves. Latch member 104 of the bolt may thus be disengaged from the hasp. When the bolt is moved to the right in Figure 2, lugs 110 (Figure 4) of the bolt engage bracket 108 and move the bracket to the right in Figure 2, compressing spring 34'. This spring returns the bolt to the left in Figure 2 when manual actuator 102 is released. Bracket 109 is moved to the left by lever 82', also compressing spring 34', when the combination is to be changed.

If any dial is off-combination, the corresponding sleeve will be turned so that the circular periphery 94 of the flange of the sleeve enters one of the openings 62', preventing movement of the bolt required to open the lock. As demonstrated in Figure 6, when a sleeve is one number position away from its unlocked position, the configuration of the sleeve-bolt interface will be much more evenly distributed about line 98 than the prior art (Figure 5) and the bolt will be unable to exert a substantial torque on the sleeve.

Although the foregoing embodiment has been described with reference to a combination lock employing a bolt that slides in a direction parallel to the axis of rotation of the sleeves, it will be apparent to those skilled in the art that certain advantages of the invention
5 may be achieved where the bolt slides in a direction perpendicular to the axis of rotation of the sleeves, and also where the sleeves slide relative to fixed abutments.

Claims:-

1. A combination lock having a plurality of dials, each coupled to a corresponding rotary element having a periphery that is circular except for a peripheral portion that must be turned to a predetermined position relative to cooperable means to permit the lock to be opened, characterised in that the peripheral portion has a notch and the cooperable means has a ridge portion for each notch, the ridge portions engaging with the notches, respectively, when the notches have said predetermined position, wherein the rotary elements comprise sleeves supported for rotation on a shaft, each dial being supported on a corresponding sleeve for rotating that sleeve, each sleeve having a flange constituting the circular periphery of that sleeve, with the notches being formed in the flanges, respectively, the sleeves and the ridge portions having relative sliding movement to open the lock, and wherein each dial has a series of indicia spaced about its periphery with one indicium displayed when the peripheral portion of the corresponding sleeve has said predetermined position, each sleeve having an interface between its flange and the corresponding ridge portion when the corresponding dial is turned to display an indicium that succeeds said one indicium at either side thereof, with the areas of the interface at opposite sides of a plane extending from the axis of the shaft to the peak of said corresponding ridge portion being equalised sufficiently to prevent that sleeve from turning its notch to said predetermined position in response to pressure exerted by said corresponding ridge portion.
2. A combination lock substantially as hereinbefore particularly described and as illustrated in Figs. 1 to 4 and 6 of the accompanying drawings.

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