

PATENT SPECIFICATION

(11)

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- (21) Application No. 18777/72 (22) Filed 22 April 1972
(23) Complete Specification filed 16 April 1973
(44) Complete Specification published 24 March 1976
(51) INT. CL.² E05B 29/06 // 19/08
(52) Index at acceptance
E2A 3B 5D
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(54) IMPROVEMENTS IN OR RELATING TO LOCKING DEVICES

(71) We, WILMOT-BREEDEN LIMITED, a British Company, of Amington Road, Birmingham 25, do hereby declare the invention for which we pray that a patent may be granted to us, and the method by which it is to be performed, to be particularly described in and by the following statement:—

This invention relates to key-operated locking devices of the type having a tumbler-containing portion (hereinafter referred to as a lock "plug" but often referred to as a "barrel") which can be turned, by means of the appropriate key, within a housing which is hereinafter referred to as the lock "cylinder". The tumblers project from the plug for locking engagement with the cylinder, being retracted into the plug by the key as the latter is inserted.

The key is accordingly profiled to suit the form and the number of tumblers, and the number of tumblers thus governs the total number of different key combinations which can be achieved. High security devices accordingly have a correspondingly large number of tumblers, but when the number reaches a figure of say ten (as with some vehicle steering column locks) the overall length of the lock plug is increased to such an extent that the device cannot normally be used for a vehicle door lock or in an ignition switch, for example.

The invention has as its main object to enable a high security locking device with a correspondingly large number of tumblers to have a plug of shorter axial length than is normally associated with such a device.

According to the invention there is provided a lock plug with a key-receiving slot for a double-entry key and lock tumblers arranged in two separate banks respectively positioned at opposite sides of the slot, the tumblers of each pair being retractable in opposite directions by the appropriate key and the key-engaging sur-

faces thereof being adjacent to opposite edges of the slot, the tumblers operating independently in the sense that they provide the same security as an equal number of tumblers arranged in a single row axially of the plug in the usual manner.

A double-entry key is one which can be inserted either way round, i.e. in either of two positions 180° apart, and although keys of this nature are known with conventional locking devices special provision has to be made with the present invention to obtain the aforesaid independent operation of the tumbler of the two banks thereof.

Corresponding tumblers of the two banks thereof may be coplanar, i.e. the two banks in register one with the other, with each of the two tumblers of each coplanar pair thereof retracted in opposite directions by the key. Thus, the length of the plug occupied by the tumblers can be one half the length of what it would be in a conventional device with the same number of tumblers. In this case the ability to use a double-entry key may be achieved by arranging for a different depth of key insertion in the two key positions. The plug may have a single stop face, or two stop faces on the plug may be staggered axially thereof, for engagement by similarly staggered faces on the key which limit the depth of key insertion. Such an arrangement enables the key to have identical series of "cuts" appropriately arranged on both edges, with the cut on either edge capable of edge operating all tumblers but actually operating only one bank of tumblers at any one time.

Instead of corresponding tumblers of the two banks being coplanar, the tumblers of the two banks and individual slots therefor may be staggered axially of the plug. This enables the key to have identical cuts on 90

both edges but now the same depth of insertion can be used for the two key positions. In this case also the tumblers may be retracted in opposite directions, but if preferred retraction in the same direction can be employed or any combination of tumblers movements can be employed.

With the tumbler slots of the two banks staggered the key may have the crests of the cuts operating one bank staggered with the crests operating the other bank.

To prevent lock picking by "jiggling" the tumblers, i.e. applying a slight torque to the plug and oscillating the tumblers until one by one they are free of the cylinder, all or some of the tumblers may be profiled for engagement with the locking recess or recesses in the surrounding housing so that when the plug is turned slightly from the locking position such engagement prevents tumbler withdrawal.

The invention provides a "high security" device with the axial plug dimensions of a low security device, for example a ten tumbler device with about the same dimensions as a conventional five or six tumbler device. If a lower security is acceptable some tumblers, say a complete bank, can be omitted thus allowing a full range of devices to be assembled from common components.

A lock plug in accordance with the invention is illustrated in the accompanying drawings and will now be described, by way of example, with reference thereto. In the drawings:—

Figure 1 is a side view of a lock plug in accordance with the invention.

Figures 2 and 3 are respectively sectional views on the lines II-II and III-III in Figure 1.

Figure 4 is a detail view similar to that of Figure 1 of a body of the plug.

Figure 5 is an outer end view of the plug body.

Figures 6 and 7 are respectively sectional views on the lines VI-VI and VII-VII in Figure 4.

Figures 8 and 9 are respectively sectional views on the lines VIII-VIII and IX-IX of Figure 5.

Figure 10 is a profile view of a typical double-entry key for operation of the device.

The lock plug while of unusually short length provides the security of a conventional ten tumbler device. Ten tumblers are arranged in two banks of five, A1, A2 ... A5 and B1, B2 ... B5, respectively disposed symmetrically on opposite sides of a double-entry key slot 10 in the plug body 11. Each tumbler A or B is individually spring loaded to the projecting locking position as shown in Figure 2, and extends almost half way across the key slot 10.

Corresponding tumblers of the two banks A and B thereof are coplanar, the tumblers thus being "paired" laterally of the plug, A1:B1 etc., with the two tumblers of each pair projecting therefrom in opposite directions and respectively being disposed on opposite sides of the key slot 10. On their inner sides the tumblers have cut-away steps 12 for engagement by the key 13 with accompanying retraction of the tumblers A and B into the plug, and each tumbler is independently loaded by its own spring 14 to the projecting locking position. The key has two identical series of flats C1, C2 ... C5 and D1, D2 ... C5 on each edge, with the series C1, C2 ... C5 respectively operating one bank of tumblers A1, A2 ... A5, the key engaging steps 12 of which are located adjacent to one edge of the slot 10, and the other series D1, D2 ... D5 respectively operating the outer bank of tumblers B1, B2 ... B5, the key-engaging steps 12 of which are located adjacent to the other edge of the slot 10. The series of flats on the two edges of the key are transposed in the manner shown, and to enable the double-entry key 13 to be used and correctly positioned in each key position the plug body 11 has stop faces 15 and 16 at the opposite shorter sides of the key slot 10 which faces are relatively displaced, in the axial direction, by half the pitch of the tumblers A and B. These faces 15 and 16 are engaged by faces 17 and 18 at the end of the key shank which are similarly relatively displaced. In one key position the faces 17 and 18 respectively engage the plug faces 15 and 16, whereas in the other key position only the face 17 engages the plug face 16, thereby providing a different and appropriate depth of key insertion for each of the two key positions.

The tumblers A and B are housed in corresponding pairs of slots in the plug body 11, the pairs respectively being identified as E1, F1; E2, F2 ... E5, F5 in the drawings. The two slots of each pair are separated by intermediate walls 19 of the die-cast plug body 11, as shown particularly in Figure 6, these walls being offset to provide a narrower slot mouth at the end from which the corresponding tumbler A or B projects when the key is removed. The sides of the key slot 10 are formed, in the regions between the tumbler slot pairs, with offset nose-like projections 20 for key guidance. These projections engage the usual side guide grooves 21 in the key 13.

At its wider end each tumbler slot E or F has a side spring pocket such as 22 (Figure 4), and each of these pockets houses the corresponding tumbler spring 14 as shown in Figure 2. The five springs 14 of each bank of tumblers A or B are re-

tained in position, in the corresponding row of pockets 22, by a common staking bar 23. Each staking bar 23 seats in a corresponding longitudinal groove 24 in the plug body 11, extending across the related row of pockets 22, and is there "staked" in position by upsetting the metal of the plug body 11 alongside the staking bar.

A single additional tumbler 25 is positioned at the inner end of the plug body 11, in its own wide width slot 26 (Figures 1 and 3). It has its own spring 27, retained by the corresponding staking bar 23, and it has no locking function, being unaffected by key insertion. This tumbler 25 is provided solely to retain the plug within an outer housing of a complete locking device, on fitting into the housing the tumbler 25 springs out to engage an internal groove in the cylinder, so that the plug cannot thereafter be removed. Projecting stubs 28 at the inner end of the plug body 11 provide for rotary coupling of the plug to a device, such as a steering column lock bolt or ignition switch mechanism, to be key-operated by means of the locking device.

The tumbler springs 14 engage side projections 29 of the tumblers A and B, these projections moving in the spring pockets 22 during key-actuated movement of the tumblers. The projections 29 engage the bottoms of the spring pockets 22 to limit outward displacement of the tumblers A and B to the locking positions.

As an anti-pick feature projecting corners of the tumblers A and B may be cut away, as shown for example in broken lines in Figure 2 at 30, in a manner complementary to an undercut inclined side face of the corresponding groove in the surrounding housing (not shown) which is engaged by the projecting tumblers A and B. This prevents lock picking by "jiggling", and to avoid any possibility of normal key insertion being prevented if a torque is applied to the key as it is inserted one bank of tumblers A is cut away at the inner edge and the other bank B is cut away at the outer edge. The straight opposite side edges thus prevent the plug being turned in either direction until all the straight tumbler edges appropriate to the direction of torque applied to the plug have cleared the housing, the anti-pick protection then coming into operation to prevent the remaining tumblers being retracted by jiggling. As an alternative all the anti-pick tumblers may be cut away on the same projecting edges, one or more of the tumblers not being cut away so that key insertion is not blocked and the anti-pick protection does not come into operation until such tumbler or tumblers have been retracted.

The described arrangement, with the two

wards of each pair retracting in opposite directions, enables both edges of the key to be used with the key flats made right across the key, thereby simplifying key cutting although it is necessary as described to arrange for different depths of key insertion according to key position. In all cases with coplanar pairs of tumblers the latter will normally be movable in completely separate slots. However, the two tumblers of each pair may butt together on the key centre line and occupy a common slot, thereby corresponding to a conventional lock tumbler divided into two halves operated by the key independently, in the sense that the key has to be appropriately profiled in respect of each of the ten tumblers employed.

In another embodiment of the invention, not shown in the drawings, the two banks of wards are staggered axially of the plug, the displacement of the bank relatively to the other being equal to half the ward spacing common to both banks. This enables the same depth of insertion to be used for both key positions, each edge of the key again having two series of cuts. To facilitate manufacture the key may be of laminated construction, with precut halves joined by spot welding, riveting, adhesive or other means. Any one of the tumblers can project from the plug in either direction according to choice, and anti-jiggling protection may be provided as described.

Each of the embodiments provides a device with ten independently operated wards which is thus usable when high security is required while having an axial length of plug about the same as or only slightly longer than, a normal five tumbler device with the tumblers arranged in a single bank. When the security of a five ward device is adequate one bank of tumblers can merely be omitted from the present device.

A double-entry key for use with a lock plug in accordance with the invention is described and claimed in our copending Application No. 18083/73 (Serial No. 1428966).

WHAT WE CLAIM IS:—

1. A lock plug with a key-receiving slot for a double-entry key and lock tumblers arranged in two separate banks respectively positioned at opposite sides of the slot, the tumblers of each pair being retractable in opposite directions by the appropriate key and the key-engaging surfaces thereof being adjacent to opposite edges of the slot, the tumblers operating independently in the sense that they provide the same security as an equal number of tumblers arranged in a single row axially of the plug in the usual manner.

2. A lock plug according to claim 1, wherein corresponding tumblers of the two



tained in position, in the corresponding row of pockets 22, by a common staking bar 23. Each staking bar 23 seats in a corresponding longitudinal groove 24 in the plug body 11, extending across the related row of pockets 22, and is there "staked" in position by upsetting the metal of the plug body 11 alongside the staking bar.

A single additional tumbler 25 is positioned at the inner end of the plug body 11, in its own wide width slot 26 (Figures 1 and 3). It has its own spring 27, retained by the corresponding staking bar 23, and it has no locking function, being unaffected by key insertion. This tumbler 25 is provided solely to retain the plug within an outer housing of a complete locking device, on fitting into the housing the tumbler 25 springs out to engage an internal groove in the cylinder, so that the plug cannot thereafter be removed. Projecting stubs 28 at the inner end of the plug body 11 provide for rotary coupling of the plug to a device, such as a steering column lock bolt or ignition switch mechanism, to be key-operated by means of the locking device.

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2. A lock plug according to claim 1, wherein corresponding tumblers of the two

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banks thereof are coplanar.

3. A lock plug according to claim 2, having means for restricting the depth of key insertion by a different extent for each of the two key positions.
4. A lock plug according to claim 3, wherein stop faces on the plug are staggered axially thereof for appropriate engagement by the key, the axial spacing of these faces being equal to half the spacing of the pairs of tumblers.
5. A lock plug according to any of the preceding claims, wherein the tumblers are mounted in individual slots in the plug body.
6. A lock plug according to claim 1 or 2, wherein the tumblers of the two banks thereof and individual slots for the tumblers are staggered axially of the plug.
7. A lock plug according to any of the preceding claims, wherein to prevent lock picking by "jiggling" the tumblers all or some of the latter are profiled for engagement with a locking recess or recesses in the surrounding housing, such engagement preventing tumbler withdrawal on an attempt to jiggle the lock.
8. A lock plug according to any of the preceding claims, wherein each tumbler has its own spring housed in an individual spring pocket in the plug, and all the springs of each bank are retained by a cor-

responding one of two staking bars recessed into the plug body.

9. A locking device embodying a plug according to any of the preceding claims.

10. A lock plug and key combination, wherein the plug is in accordance with claim 3 or 4 and the key has on each edge two interspersed series of cuts, the cuts of one series being appropriate to operate one bank of wards and the cuts of the other series being appropriate to operate the other bank of wards.

11. A lock plug and key combination, wherein the plug is in accordance with claim 6 and the key has identical cuts on each edge, the same depth of key insertion being used for each key position.

12. A lock plug constructed and arranged substantially as herein particularly described with reference to the accompanying drawings.

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Reference has been directed in pursuance of section 9, subsection (1) of the Patents Act, 1949, to patent No. 1282969.

Printed for Her Majesty's Stationery Office by The Tweeddale Press Ltd., Berwick-upon-Tweed, 1976.
Published at the Patent Office, 25 Southampton Buildings, London WC2A 1AY, from which copies may be obtained.