April 19, 1955 C. H. H. WOHRLE 2,706,394

CYLINDER LOCK

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Fig. 1

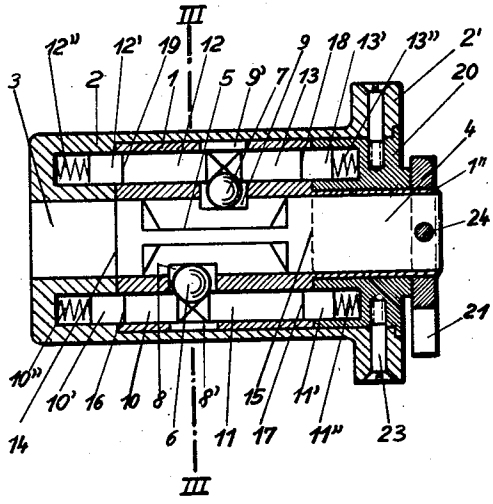


Fig. 3

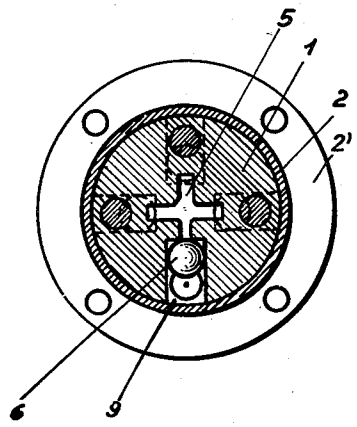
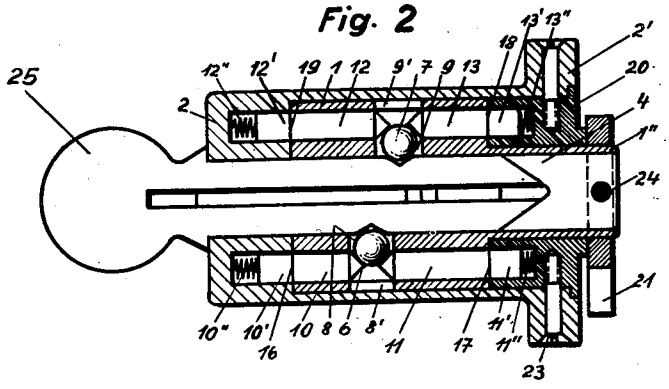


Fig. 2



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Fig. 4

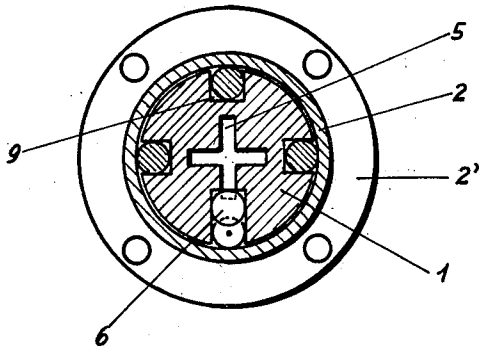
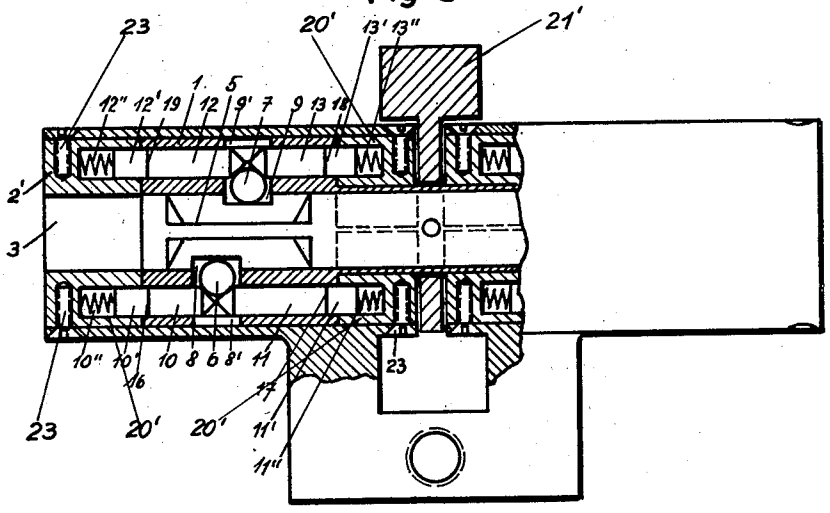


Fig. 5



Inventor:

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CYLINDER LOCK

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4 Claims. (Cl. 70—363)

The invention relates to improvements in cylinder locks, and particularly in cylinder locks of the type in which a plurality of pairs of tumblers of the pin type which are movable parallel to the axis of the keyway and are provided with control faces, may be coordinated for opening the lock whereby displacement of intermediary ball-shaped means takes place transversely to the axis of said keyway by means of a key and against the action of spring means and through the bittings of said key.

Cylinder locks with axially arranged pins are known per se but have been restricted to primitive designs and structures which permit only a small number of tumbler variations and are not secure against picking.

The main purpose of the present invention is to provide means affording a very effective cylinder lock structure which, notwithstanding its small dimensions, permits a great number of variations and possesses smaller dimensions than known cylinder locks provided with radial tumblers.

Another important feature of the invention resides in the provision of means conducive to a very intricate cylinder lock which, however, consists only of relatively few parts and is for all practical purposes safe against picking, thus surpassing the heretofore known best cylinder locks with radial tumblers.

According to the invention, the cylinder lock which has axial pins or tumblers controlled by a radially operating auxiliary member has as one of its characteristic features that the pins are arranged in pairs and are together of greater length than the lock cylinder but are sub-divided so that the respective end faces of the abutting pins coincide with one respective end face of the lock cylinder when in unlocked position.

Another essential feature of the invention consists in that the radially operating auxiliary or intermediary members in order to conform their axial position to the location of the key control faces (bittings) are mounted in guide pockets or recesses whose dimensions are greater in axial direction than those of said intermediary members, e. g. greater than the diameter of a ball or spherical element employed as the intermediary member.

Other purposes and features of the invention will appear from the following description and the accompanying drawings which show a preferred embodiment of the invention as described in greater detail. In this description, in which certain parts and their function are referred to by specific technical terms, such terms are not to be taken as restrictive but in the broadest sense of their technical purport relative to the known state of the art.

In the drawings:

Fig. 1 is a longitudinal section through a cylinder lock embodying the invention;

Fig. 2 represents the cylinder lock of Fig. 1 with key inserted and with pins thereby shifted to unlocked position;

Fig. 3 is a section of the cylinder lock taken along line III—III of Fig. 1;

Fig. 4 is a section similar to that of Fig. 3 but showing a cylinder lock in modified form; and

Fig. 5 is a longitudinal section through a so-called double cylinder lock embodying the invention.

The cylinder lock as shown comprises the plug or lock cylinder **1** and surrounding casing **2**. These two parts **1** and **2** have a concentric keyway **3** which, in the embodiment shown, is of cylindrical formation at its outer face part and has a cruciform portion **5** adjacent its central part, i. e. in the vicinity of the cylinder lock and tumblers. By means of this varying formation of the

portions of the keyway **3** a considerable advantage is attained in the manufacture of such locks in that the tools required to provide for the cruciform portion need only be applied in the keyway proper where the cruciform portion is arranged to actuate the locking pins or tumblers.

As may be seen particularly from Fig. 3, the cylinder lock has a plurality (namely, four in the example shown) of diametrically opposite, longitudinally extending guide passageways or bores which are arranged at 90 degree intervals around the circumference of the cylinder lock and directed parallel to the axis of the keyway and extend through the lock cylinder and from each end of the lock cylinder into the cylinder casing. These guide passageways or bores contain the tumblers which, in the example shown, consist of cylindrical steel pins **10**, **10'**, **11**, **11'**, **12**, **12'** and **13**, **13'**. In each bore or recess there are arranged two locking tumbler systems of the pin type each composed of inner pins **10**, **11**, and outer pins **10'**, **11'**; or inner pins **12**, **13** and outer pins **12'** and **13'**. The facing or contiguous ends of pins **10** and **11** and of pins **12**, **13** are conically shaped and terminate in points, as shown.

The outer pins **10'**, **11'**, **12'**, **13'**, as will be later explained in greater detail, are entirely contained within the passageways or bores of the cylinder casing in open position of the lock, and partly within the casing and partly in the lock cylinder in closed position of the lock. Springs **10''**, **11''**, **12''**, **13''** disposed between the end wall and the outer faces of the outer pins force the pairs of pins in each passageway or bore towards each other and in contact with their conical tips or points.

The passageways or bores in the example shown are cylindrical in form. However, as shown in Fig. 4, they may also constitute longitudinal grooves in the lock cylinder, closed on the outside by the tubular casing **2**.

In the cruciform part of the keyway the lock cylinder contains radial passageways **8**, **8'**, **9**, **9'** whose number and radial orientation correspond to said cruciform part and hence to the bores for the pins while their axial position corresponds and is conformed to that of the facing conical tips of the individual tumbler pins.

In these radial passageways there are arranged the intermediary members controlling the tumbler pins, said members consisting, in the embodiment shown, of steel balls **6** and **7**. According to the invention, the axial extent of radial passageways or channels **8** and **9** is greater than the axial extent of the intermediary members, i. e. the diameter of the aforesaid balls. The resulting functional advantage will be later described.

As appears in particular from Fig. 3, the radial passageways extend into the region of the cruciform keyway so that the intermediary member, e. g. the aforesaid ball protrudes toward the key, while on the other hand said ball is in contact with the conical surfaces of the inner pins **10**, **11**, **12**, **13** which, under the action of the compression springs **10''** etc. tend to force said ball into the path of the key inserted in said keyway.

The coextending end faces of the lock cylinder and casing are designated by numerals **14** (Fig. 1, left) and **15** (Fig. 1, right). In the embodiment shown, the cylinder casing consists of two parts so that the lock cylinder **1** can be inserted from the right of Fig. 1. To this end, as shown in Fig. 1, the right-hand part of the lock cylinder has a shoulder forming the aforementioned right-hand end face **15**. Onto the reduced portion **1''** of the lock cylinder is slid the insert **20** which forms part of the casing and which fills that space of the portion which was left free for the insertion of the lock cylinder or plug. The aforesaid insert is removably attached to the casing at flange **2'** by means of countersunk screws **23**.

Outside the insert **20** on the reduced portion **1''** of the plug is fitted a locking element or nose **21** by means of a cotter **24** in any known manner.

The key **25**, shown in Fig. 2 in inserted position, is of the familiar cruciform section for cylinder locks with radial pins, but normally has only one control face on each blade, namely, in the instant case, a controlling notch.

The locking principle of the cylinder lock according to the invention consists in that the adjoining or end sur-

faces **16, 17, 18, 19** of the corresponding pairs **10, 10'** etc. of inner and outer pins, when the proper key is applied, coincide with the plane of the end surfaces **14** and **15** between the lock cylinder **1** and the casing **2** and the insert **20** so that neither the inner nor in particular the outer pin of any pair can interfere with the rotative movement. The correct position of the end surfaces **16** to **19** obviously depends on the proper position of two opposite inner pins **10, 11** or **12, 13** in their guides or recesses. This positioning is effected by the action of the intermediary member, namely, the ball **6** or **7** which, corresponding to its radial position in the transverse passageway **8** or **9**, more or less separates the conical points or tips of the inner pins **10** to **13** when thrust radially in outward direction by the control notches (bittings) of the inserted key (Fig. 2).

The bittings of the key, the radial bores for the control members and the division of the tumblers or pins are so coordinated to each other that when the key is inserted, as aforesaid, the end surfaces **16** to **19** of the several pairs of pins coincide with the end surfaces **14, 15** between lock cylinder and casing, thereby permitting rotation of the lock cylinder and hence of the bolt or nose by means of the key.

Instead of the cruciform part as shown, the key may alternatively be of star-shaped cross-section. The control faces in the several blades or ribs, for example notches, and the corresponding transverse passageways in the lock cylinder may preferably be displaced or staggered relative to each other, as shown in the drawings. This has the advantage that not only the form of the control surfaces, i. e. the depth of the notches in the example shown, but also their relative position along the several blades or ribs may be employed as a means of variation for locking purposes. It is also possible to avoid any excessive weakening of the key because of coincidence of notches.

It has been mentioned above that the radial passageways **8, 8'** and **9, 9'** are larger in the direction of the axis of the key than the width of the intermediary member, e. g. than the diameter of the ball **6** or **7**. Hence, the intermediary members in the form of balls **6, 7** are free to move not only radially but also axially, whereas in the third dimension or direction, namely perpendicular to the plane of Fig. 1, they are preferably retained by the walls defining the passageways. These two degrees of play or possibilities of displacement in two planes not only increase ready variations of the lock but also, as a particularly important advantage of the invention, render the lock practically pick-proof because during the picking operation the ball cannot be arranged simultaneously in two different planes. Consequently, in view of this high degree of security, the number of key control faces (bittings) can be reduced.

The proper axial position of the several control members results from suitable arrangement of the control means or notches in the key which, as aforesaid, in addition displace the balls in radial direction by virtue of their radial depth.

Enlargement of the cross-section of the transverse passageway in axial direction has further the advantage that differences in position between the key control faces and the transverse passageway within manufacturing tolerances will be irrelevant and cannot jam the intermediary member in the passageway.

The extent of displacement of the inner pins by the ball or any other chosen control means depends not only on the depth of the notches in the kev but also on the angle of the conical tips of the inner pins. If the vertex angle is 90°, then the linear extent of axial displacement of an inner pin is equal to the radial displacement of the control ball and hence to the depth of the notch in the key. If the vertex angle is more obtuse, i. e. if the cone is flatter, this will lead to a decreased length of displacement or stroke while conversely a more acute vertex angle will produce an increased length of displacement or stroke. In this respect, the cylinder lock according to the invention differs from cylinder locks with radial pin action in which the pins directly rest on and engage the notches.

The invention may also be applied to so-called double cylinder locks where in otherwise known manner, plugs or lock cylinders are placed on both sides of the bolt or nose **21**. Relative to known double cylinder locks, the double cylinder lock according to the present invention

has the advantage that the two plugs or cylinder locks may be made in one piece and are actuatable from either side by a key of suitable symmetrical form and sufficient length to displace the tumblers or pins on both sides of the unitary plug into inoperative position, thereby unlocking said plug for rotation relative to the lock casing.

As Fig. 5 shows, there will then be provided inserts **20'** at both ends of each cylinder lock which are affixed in position by means of countersunk screws **23** in the same manner as described for the embodiment of Figs. 1 to 3. Locking element **21'** has the same function as element **21** of Fig. 1.

It is well understood that the forms of the tumblers may vary (cylindrical, square, etc.) and that instead of ball-shaped elements other forms may be employed to fulfill the requirements as hereinabove outlined.

Although two specific embodiments of the invention have been described and shown in the drawings, it should be noted that the invention may be realized in modified form and adaptations of the arrangements herein disclosed may be made as may readily occur to persons skilled in the art without constituting a departure from the spirit and scope of the invention as defined in the objects and in the appended claims.

Having thus described the invention, what is claimed as new and desired to be secured by Letters Patent, is:

1. A lock comprising a lock cylinder having opposite end faces, a cylindrical casing surrounding said lock cylinder, said casing and said cylinder meeting at each of said opposite end faces in a respective plane perpendicular to the axis of said cylinder, at least one passageway extending in the direction of the axis of said cylinder and in the vicinity of the circumference thereof up to each of said end faces and therebeyond into said casing, at least four tumbler elements constituting two cooperative pairs of tumbler elements, each pair being movably mounted in said passageway and including an outwardly disposed element and an inwardly disposed element provided with respective perpendicular end faces contacting each other, each of said inwardly disposed tumbler elements being provided with an oblique control surface at its free end remote from its respective perpendicular end face, a keyway in said lock cylinder for the reception of a key, a transverse channel connecting said keyway with said passageway, an intermediary element located in said transverse channel and in contact with said control surfaces of both of said inwardly disposed tumbler elements, and spring means disposed at opposite ends of said casing for normally urging both pairs of said tumbler elements against said intermediary element, said tumbler elements being of such length that upon insertion of the proper key in said keyway said intermediary element displaces each pair of said tumblers to the extent that their respective end faces coincide with the plane established between the respective end faces of said lock cylinder and said casing to thereby permit rotation of said lock cylinder for operating said lock.

2. A lock according to claim 1, wherein said control face of each of said inwardly disposed tumbler elements is substantially cone-shaped and terminates in a pointed end.

3. A lock according to claim 1, wherein the cross-section of said transverse channel in the direction of the cylinder axis is larger than the cross-section of said intermediary element in said direction, to thereby permit displacement of said intermediary element in an axial direction as well as in a radial direction within said channel and minimize the possibility of lock-picking.

4. A lock according to claim 1, wherein each of said inwardly disposed tumbler elements comprises a cylindrical pin terminating in a pointed end disposed concentrically with respect to said passageway, and wherein said intermediary element is substantially spherical.

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