

Aug. 2, 1938.

L. FUCHS

2,125,607

COMBINATION LOCK

Filed Feb. 18, 1937

4 Sheets-Sheet 1

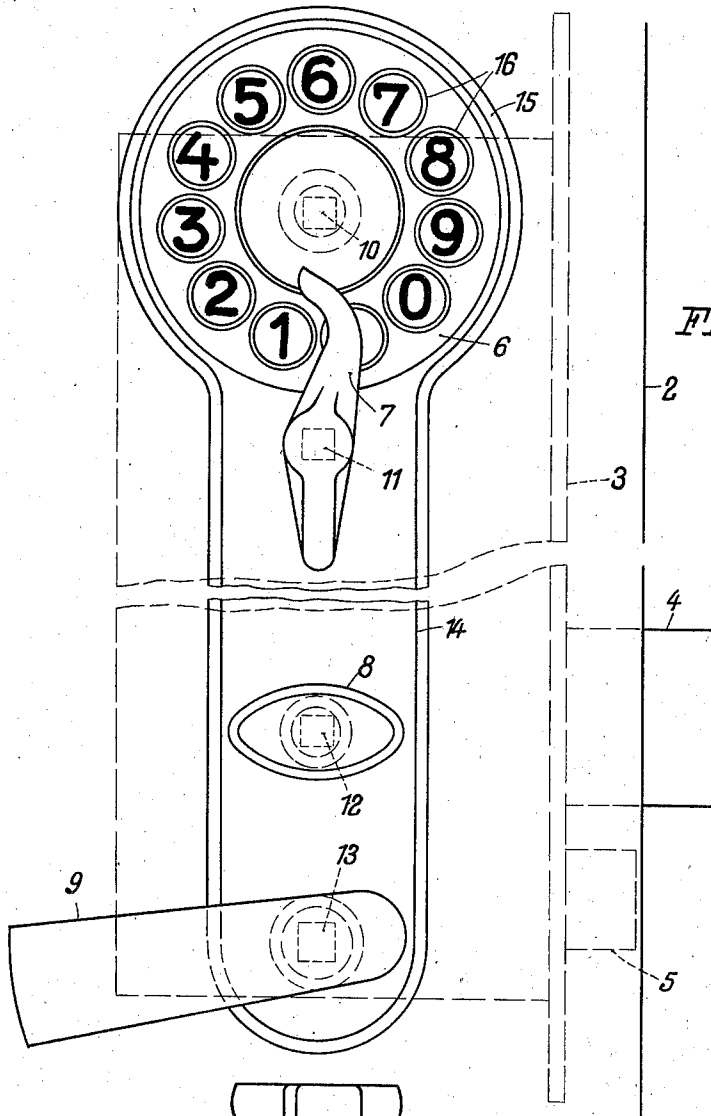


Fig. 1

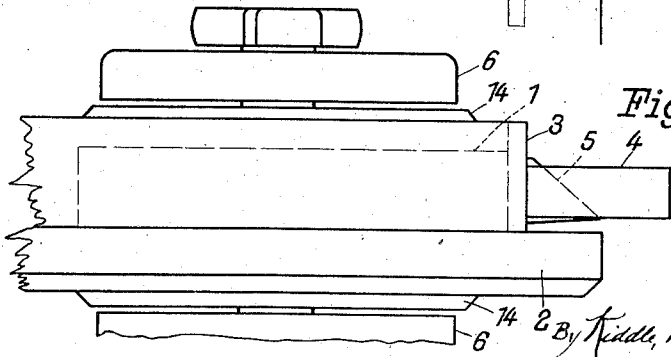


Fig. 2

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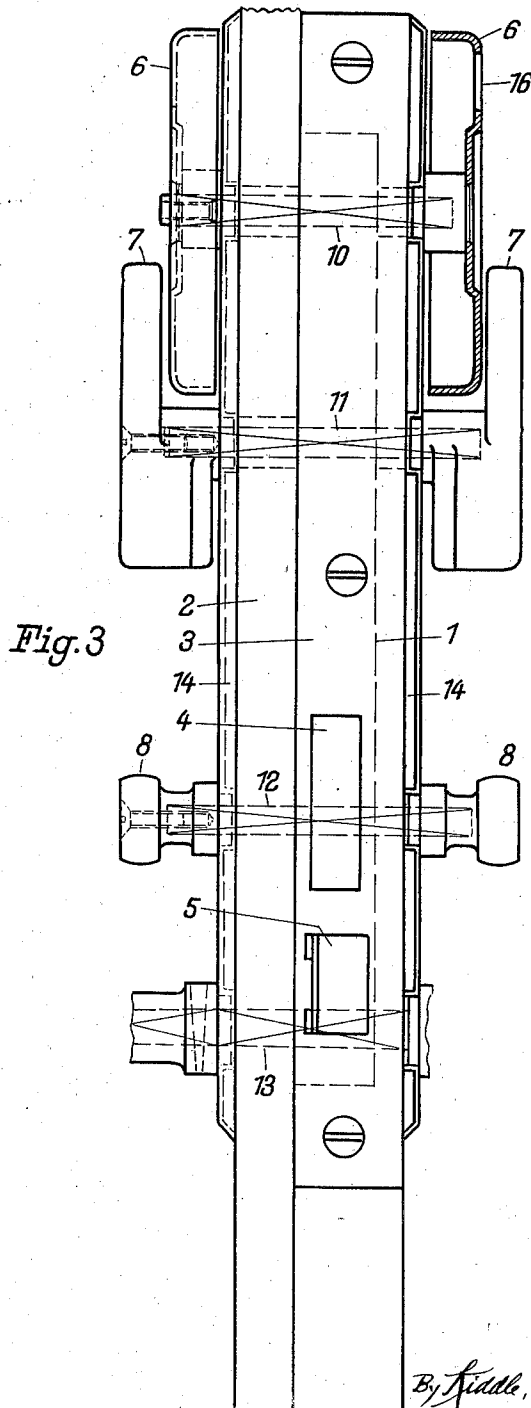
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4 Sheets-Sheet 2



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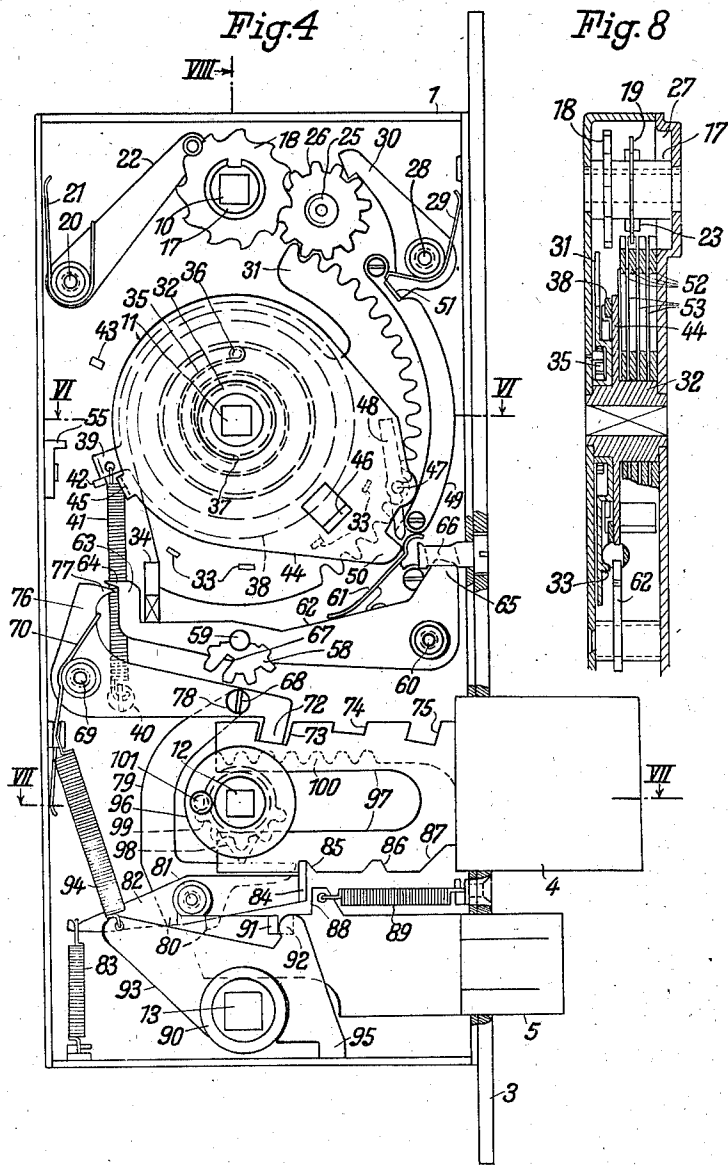
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4 Sheets-Sheet 3



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4 Sheets-Sheet 4

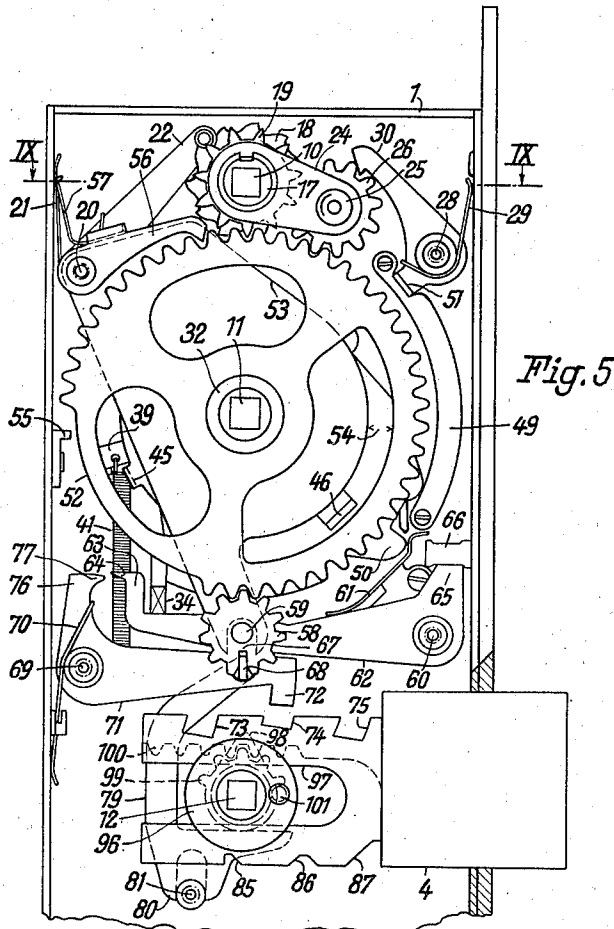


Fig. 5

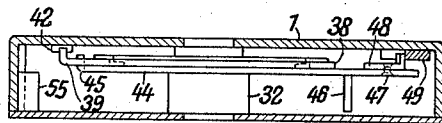


Fig. 6

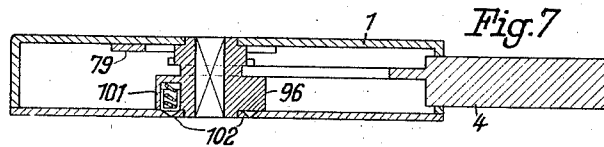


Fig. 7

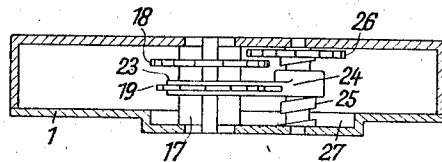


Fig. 9

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UNITED STATES PATENT OFFICE

2,125,607

COMBINATION LOCK

Leo Fuchs, Berlin, Germany

Application February 18, 1937, Serial No. 126,323
In Germany January 10, 1933

12 Claims. (Cl. 70—305)

This invention relates to combination locks having a plurality of locking members and a setting member intended for the successive operation of the locking members, said setting member being adjustable relatively to a fixed numeral scale and limited in each of its paths of travel by a stop. In known combination locks of this type the setting member is designed as a selector dial, which after dialling each numeral is brought back into the starting position by a spring. At the same time, provision is made for the selector dial to be coupled to the following locking member after the completion of each dialling operation, more particularly during its return run.

The returning of the dial after each dialling operation has been found to be very disadvantageous, because in consequence of the continual use of the same operating handles (holes) uneven wear and finger prints show on the dial, which enable unauthorized persons to ascertain the numerals of the combination and to discover the combination of numerals of the lock.

In accordance with the present invention this drawback is obviated by eliminating the automatic return of the setting member to the initial position and by disposing the operating handles on the setting member at equal distances relatively to one another and in an endless row. At the same time it is advisable to choose a prime number for the number of operating handles.

The setting member can, for example, be designed as a disc, cylinder or a band loop.

The combination lock is preferably provided with checking or locking means which hold the setting member in each end position of a setting.

The progressive coupling of the setting member with each successive locking member can be effected in any desired manner, provided that no complete returning of the setting member to its starting position is associated therewith. A returning of the setting member in a manner independent of and varying from the setting path of travel after every dialling operation could be provided without affecting the result aimed at by the invention. It appears to be particularly advantageous to effect the progressive coupling by making the stop which restricts the path of travel of the setting member resilient by a spring or springs and by utilizing the displacement or rocking of said stop, resulting from each dialling operation, for the purpose of effecting the required connection between the setting member and each successive locking member.

If a rockably mounted lever be provided for the progressive coupling of the setting member

with each successive locking member, it is advisable to arrange this lever in such a way that it can be rocked out beyond its starting position, and to utilize this additional rockability for the securing of the lock, i. e. for the displacement of the locking members.

In order more clearly to understand the invention, reference is made to the accompanying drawings, which illustrate diagrammatically and by way of example, and in which:—

Fig. 1 depicts the arrangement of the lock in the door;

Fig. 2 shows a view from above of the arrangement shown in Fig. 1;

Fig. 3 shows a view from the side of the arrangement shown in Fig. 1;

Fig. 4 shows a representation of the interior of the lock after removal of the tumblers and appertaining setting means;

Fig. 5 shows a representation corresponding to Fig. 4 with the tumblers and appertaining setting means fitted;

Fig. 6 shows a section through the lock housing, taken along the line VI—VI in Fig. 4, showing a part of the coupling mechanism;

Fig. 7 shows a section through the line VII—VII in Fig. 4;

Fig. 8 shows a section through the line VIII—VIII in Fig. 4; and

Fig. 9 shows a section through the lock housing, taken along the line IX—IX of Fig. 5, and representing a portion of the lock mechanism.

The lock mechanism is enclosed in a housing 1, which is accommodated in a cavity in the door 2 and firmly secured to the door by a latch plate 3 (Figs. 1-3). The latch plate has an opening for the latch 4 and a further opening for the catch 5. Externally of the lock housing 1 lie the two setting dials 6 with stops 7, the latch handles 8 and the door handles 9 serving to operate the catch 5. All of these parts are secured to the lock and connected to the parts of the lock within the housing 1 by means of the rectangular spindles 10, 11, 12 and 13. The aforesaid rectangular spindles are mounted on each side of the door in plates 14 the upper disc-shaped ends of which form numeral plates 15. The numeral plates are provided with eleven divisions, of which, however, only ten are numbered progressively from 1 to 0.

The setting dials 6 secured on the spindle 10 are each provided with eleven apertures 16, which are disposed at the same distance from one another and in an endless row.

Within the housing 1 there is secured to the

spindle 10 a sleeve 17, on which a ratchet wheel 18 having eleven cams is firmly mounted and a pinion 19 having eleven-teeth is slidably mounted. A catch lever 22, pivoted at 20 and loaded by the spring 21, is engaged with the ratchet wheel 18 and locks the latter, and thus also the setting dials 6, in one direction of rotation and ensures that the holes 16 in the setting discs 6 always lie exactly opposite the figures on the numeral plates 15. The pinion 19 is guided on the sleeve 17 by means of tongue and grooving, and lies in the fork 23 of a lever 24 the hub of which is formed as a nut for the threaded spindle 25 on which a pinion 26 is secured. Opposite the pinion 19 and the fork 23, the housing is furnished with a widened portion 27. The catch 30, pivoted at 28 and loaded by the spring 29, engages on one side, and a toothed segment 31 on the other side, with the pinion 26, said toothed segment being mounted free to rotate on a hub 32 firmly joined to the spindle 11 and possessing four projecting cams 33. The toothed segment 31 lies in the position of rest against a stop 34, under the pressure of a spiral spring 35, the outer end of which is attached at 36 to the housing 1 while its inner end is attached at 37 to the toothed segment 31, and which is accommodated in the hollow hub of the toothed segment. Around the hub 32 there is also disposed a disc 38, free to turn, on the angular attachment 39 of which acts a tensile spring 41 secured at 40. In the path of travel of the angular attachment 39 there are provided fixed stops 42 and 43. A plate 44 is firmly joined to the hub 32 and is provided with an angular projection 45, lying against the angular attachment 39 in the position of rest, and an engaging piece 46, while a catch 48 is pivoted to said plate at 47. The catch 48 is loaded by a spring which is not illustrated and which tends to rock the catch in an anti-clockwise direction in the view shown in Fig. 4, and said catch is controlled by the fixed arc 49. The plate 44 possesses a projection 50, in the path of travel of which lies an angular attachment 51 on the pawl 30. On the hub 32 there are finally mounted, in such a way as to be free to rotate, four disc-shaped spoke-wheels 52 which are provided with toothing over the greater part of their periphery and are separated from one another by distance plates 53 which are held at 20 and form, with the wheels 52, an arc-shaped passage 54 for the carrier 46. The path of rotation of the wheels 52 is limited by a stop 55, which projects into the path of movement of the teeth. With each wheel there is engaged a catch lever 56 (Fig. 5) which is pivoted at 20 and is loaded by the spring 57. The catch levers 56 are so shaped that they merely obstruct, but do not prevent, the turning of the various wheels 52 in both directions. One of the wheels 52 is always engaged with the pinion 19; each wheel 52 is in addition allocated a pinion 58 having eleven teeth. All the pinions 58 are mounted free to rotate on the spindle 59 and are also kept at a distance from one another by the distance plates 53. The spindle 59 is secured to the lever 63, which is pivoted at 60 and loaded by the spring 61 and which carries at its end 63 a tongue 64. The opposite end 65 of the lever 62 lies against the cam 66 rotatably mounted in the housing wall, which cam is so shaped that, when it rotates, the lever 62 is rocked in an anti-clockwise direction out of the position illustrated in Figs. 4 and 5, under the action of the spring 61. On every pinion 58 there is provided a tooth gap with a recess 67. When the pinion 58 is in

the corresponding position, a bolt 68 can engage in the recesses 67, this bolt being secured to the lever 71 pivoted at 69 and loaded by the spring 70. The nose 72 of the lever 71 is so shaped that it can engage in the upper notches 73, 74 and 75 of the latch 4. The arm 76 of the lever 71 is shaped at its end as a tongue 7; to the second lever arm there is pivoted at 78 an angle-piece 79 which encloses with its fork 80 the pin 81 which acts as pivot bearing for the lever 82. The lever 82 is loaded by the tensile spring 83 and possesses an angular heat-off portion 84 which can engage in the lower notches 85, 86, 87 of the latch 4 and, in the position shown in Fig. 4, lies in the path of movement of the projection 88 provided on the catch 5. The tensile spring 89 acts on the projection 88. On the rear, narrowed portion of the catch 5, which is guided between the pin 81 and a sleeve 90 secured on the spindle 13, there is provided an angular projection 91 which lies in the path of travel of a cam 92 on the lever 93, which is secured on the sleeve 90, is loaded by the tensile spring 94 and is supported by the projection 95 against the base of the housing 1 of the lock. On the spindle 12 there is secured a hub 96, which lies in the slot 97 in the latch 4 and carries a cam 98 and also a toothed arc 99. The cam 98 lies in the plane of the free end of the lever 79, and the toothed arc 99 in the plane of the toothing 100 of the latch 4. On the hub 96 there is in addition secured a snap bolt 101, in the path of movement of which lie two recesses 102 provided on the inner wall of the housing 1.

The manner in which the lock acts is as follows:—

Reference will first be made to Fig. 4, which illustrates the closed position of the lock, in which the latch 4 and the catch 5 are locked. The unlocking of the latch 4 is dependent upon the cam 98 releasing the angle-piece 79 and upon the nose 72 being at the same time removed from the notch 73. The unlocking of the catch 5 is dependent upon the bent-off portion 84 being removed from the path of movement of the projection 88; this, however, in consequence of the small depth of the notches 85 and 86, is possible only after the latch 4 has been completely drawn back into the interior of the housing, so that the bent-off portion 84 can enter the deeper notch 87.

The nose 72 can be partially removed from the notch 73 by turning the hub 96, with the aid of the latch handle 8, in an anti-clockwise direction until the toothed arc 99 reaches the toothing 100 of the latch 4. In consequence of the release of the angle-piece 79, the spring 70 lifts the nose 72 upwards. At the same time, the catch 68 is placed in successive tooth gaps on the pinion 58. The depth of the tooth gaps, however, is such that the catch 68 cannot be displaced sufficiently to allow the nose 72 to emerge completely from the notch 73. That is the case only when the tooth gap on each pinion 58 having the recess 67 lies in each case opposite the catch 68.

Since the wheels 52, in the locked position, engage in each case with the first tooth of their crown wheel in the corresponding pinions 58, it is possible, by suitably rotating the various pinions when the lock is assembled, to set any desired figure combination for the unlocking of the lock. In the device depicted, however, provisions is also made to ensure that the figure combination can be set or changed only after the assembly of the lock, the pinions 58 being dis-

connected from the wheels 52. This is done by rocking the lever 62 out of position; it is, however, possible to do this only after the tongue 77 has been removed from the path of movement of the tongue 64 and after the cam 66, which can be operated from outside, has been turned a certain angle. The tongue 77 is removed from the path of movement of the tongue 64, during the unlocking of the lock, as soon as the catch 68 engages in the teeth of the pinions 58 provided with the recesses 67. In order that the catch 68 may remain engaged with the recessed teeth of the pinions 58 when the lever 62 is rocked away, the unlocked latch 4 is only partially brought back into the housing 1, so that the nose 72 enters the notch 74, which is less deep than the notches 73 and 75. Thereupon, each wheel 52 is turned, with the aid of the setting dial 6 and the pinion 19, as many teeth as correspond to the desired figure combination. The pinions 58 and the lever 62 are then brought back into the position shown in Fig. 5.

Assuming that the lock is set to the figure combination 4731 and is in the locked closed position visible in Fig. 4, the lock is unlocked and opened in the following manner:—

With the aid of the setting dial 6 the figure "4" is dialled, the stop lever 7 (Fig. 1) being rocked in a clockwise direction around the spindle 11. In consequence the plate 44 and with it the disc 38 are turned until the angular projection 39 strikes against the stop 43. The pawl 48 participates in this rotary movement, and is removed by the action of its loading spring (not shown) from the arc 49 and engages behind the first cam 33. At the same time, the pinion 19, the first wheel 52 (which in the representation in Fig. 5 lies farthestmost to the rear) and the corresponding pinion 58 are rotated by four teeth, so that the tooth gap, provided with the recess 67, on this pinion 58 lies in the path of movement of the catch 68. When thereafter the stop lever 7 is released, the spring 41 brings the disc 38, the plate 44, the pawl 48 and the stop lever 7 back into the starting position determined by the stop 42. At the same time, the toothed arc 31 is carried round by the pawl 48, until the latter is separated by the arc 49 from the first cam 33. The rocking of the toothed arc 31 is of such a magnitude that the pinion 26 is turned by four teeth. During this turning of the pinion 26, the pinion 19 is displaced by the fork 23 of the lever 24, so that it now engages with the second wheel 52.

The figures "7", "3" and "1" are dialled in a similar manner. After the last dialling operation the pinion 19 is displaced into the widened portion 27 of the housing 1. As in the case of each pinion 58 the tooth gap provided with the recess 67 lies in the path of movement of the catch 68, the latch 4 can be displaced as desired by means of the latch handle 8. The latch is secured in one of its limit positions by turning the stop lever 7 (Fig. 1) in an anti-clockwise direction. The plate 44 participates in this movement. The carrier 46 brings the wheels 52 back as far as the stop 55, while the projection 50 detaches the pawl 30 from the pinion 26, so that, under the action of the spiral spring 35, the toothed arc 31, the pinion 26, the lever 24 and the pinion 19 are also brought back into their starting position. The restoration of the stop lever 7 to the position shown in Fig. 1 is effected by hand.

As can be seen from the foregoing, the setting

dial 6 is always turned in the same direction; there is no return movement, so that it is practically impossible for an unauthorized person to ascertain the figures of the figure combination or the combination itself by means of finger prints or varying wear on the setting dial 6.

Particularly great security against betrayal of the figure combination or of the individual figures is afforded when a prime number is chosen for the number of holes 16, because in such case different holes are always used for the dialling. An exception is formed only by the case—which can be avoided without difficulty—when the cross total of the figure combination is equal to the prime number.

What I claim is:—

1. In a combination lock, a plurality of locking members, a setting member provided with an endless row of operating handles equally spaced apart and adjustable relatively to a fixed scale, said setting member remaining in position after each adjustment, a stop arranged in the path of said operating handles and limiting the travel of said setting member, and means for the progressive coupling of the setting member with the locking member following in each case.

2. In a combination lock, a plurality of locking members, a setting member provided with an endless row of operating handles equally spaced apart and adjustable relatively to a fixed scale, a stop arranged in the path of said operating handles and limiting the travel of said setting member, checking means retaining the setting member in its final position, and means for the progressive coupling of the setting member with the locking member following in each case.

3. In a combination lock, a plurality of locking members, a setting member provided with a prime number of operating handles equally spaced apart as an endless row and adjustable relatively to a fixed scale, said setting member remaining in adjusted position after each operation, a stop arranged in the path of said operating handles and limiting the travel of said setting member, and means for the progressive coupling of the setting member with the locking member following in each case.

4. In a combination lock, a plurality of locking members, a setting member provided with a prime number of operating handles equally spaced apart as an endless row and adjustable relatively to a fixed scale, a stop arranged in the path of said operating handles and limiting the travel of said setting member, checking means retaining the setting member in its final position, and means for the progressive coupling of the setting member with the locking member following in each case.

5. In a combination lock, a plurality of locking members, a setting member provided with an endless row of operating handles equally spaced apart and adjustable relatively to a fixed scale, said setting member remaining in position after each adjustment, a stop lever arranged in the path of said operating handles and rockable against the action of a spring, which lever, when out of the normal position, enters into operative connection with means for the progressive coupling of the setting member with the locking member following in each case.

6. In a combination lock as defined by claim 5 in which the said stop lever is rockable out of its normal position in the opposite direction too and, when rocked in this opposite direction, enters into operative connection with means which

displace the locking members for the purpose of securing the lock.

7. In a combination lock, a plurality of locking members, a setting member provided with an endless row of operating handles equally spaced apart and adjustable relatively to a fixed scale, checking means retaining the setting member in its final position, a stop lever arranged in the path of said operating handles and rockable against the action of a spring, which lever, when out of the normal position, enters into operative connection with means for the progressive coupling of the setting member with the locking member following in each case.

8. In a combination lock as defined by claim 7 in which the said stop lever is rockable out of its normal position in the opposite direction too and, when rocked in this opposite direction, enters into operative connection with means which displace the locking members for the purpose of securing the lock.

9. In a combination lock, a plurality of locking members, a setting member provided with a prime number of operating handles equally spaced apart as an endless row and adjustable relatively to a fixed scale, said setting member remaining in position after each adjustment, a stop lever arranged in the path of said operating handles and rockable against the action of a spring, which lever, when out of the normal position, enters into operative connection with means for the

progressive coupling of the setting member with the locking member following in each case.

10. In a combination lock as defined by claim 9 in which the said stop lever is rockable out of its normal position in the opposite direction too and, when rocked in this opposite direction, enters into operative connection with means which displace the locking members for the purpose of securing the lock.

11. In a combination lock, a plurality of locking members, a setting member provided with a prime number of operating handles equally spaced apart as an endless row and adjustable relatively to a fixed scale, checking means retaining the setting member in its final position, a stop lever arranged in the path of said operating handles and rockable against the action of a spring, which lever, when out of the normal position, enters into operative connection with means for the progressive coupling of the setting member with the locking member following in each case.

12. In a combination lock as defined by claim 11 in which the said stop lever is rockable out of its normal position in the opposite direction too and, when rocked in this opposite direction, enters into operative connection with means which displace the locking members for the purpose of securing the lock.

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