

Dec. 23, 1947.

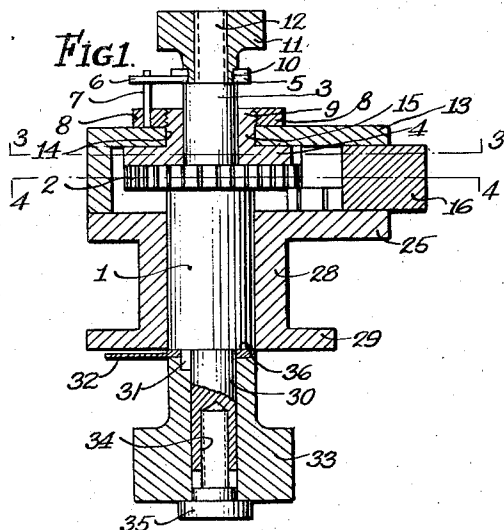
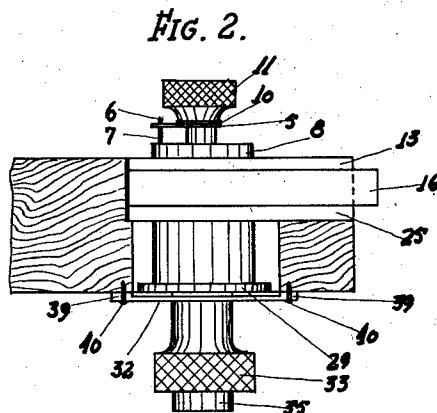
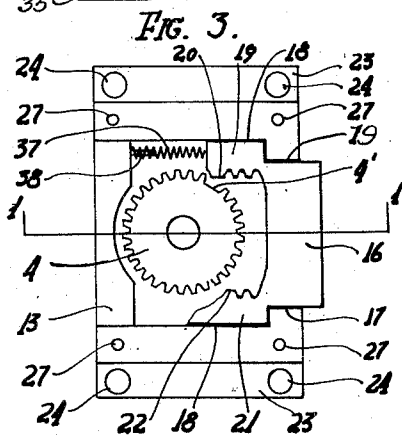
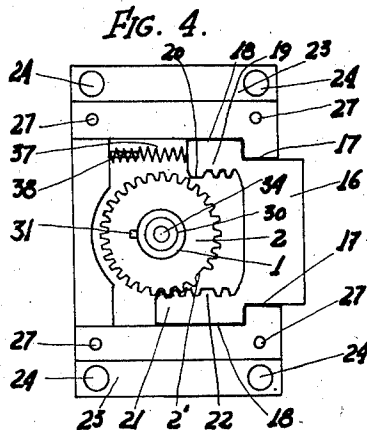
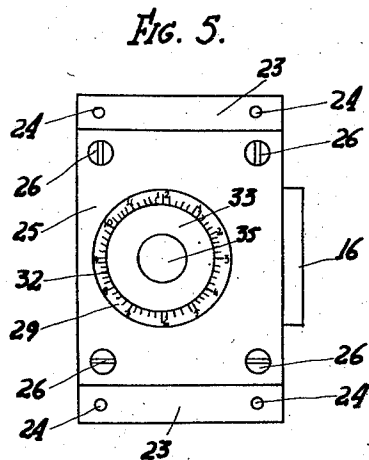
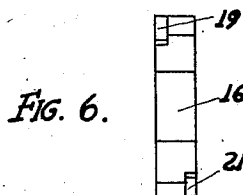
A. RABAL ET AL

2,433,157

COMBINATION LOCK

Filed May 27, 1946

2 Sheets-Sheet 1



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2 Sheets-Sheet 2

FIG. 7.

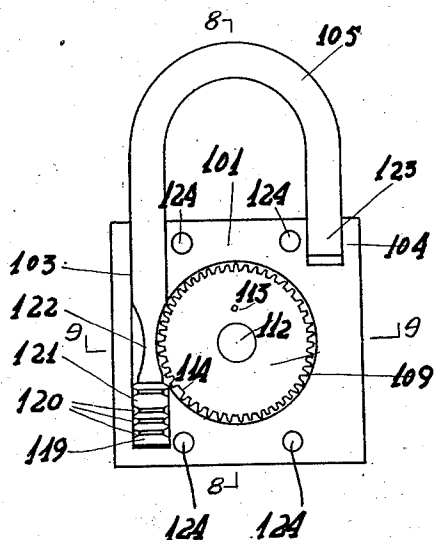


FIG. 8.

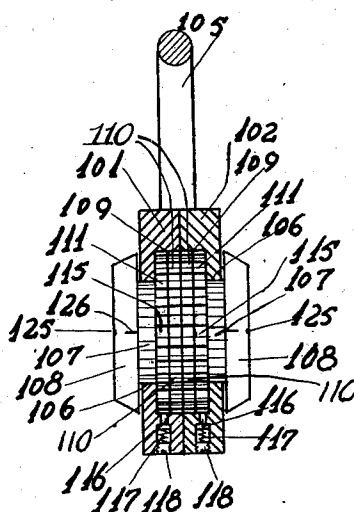
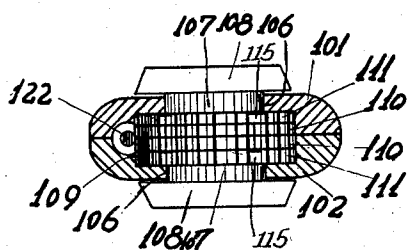


FIG. 9.

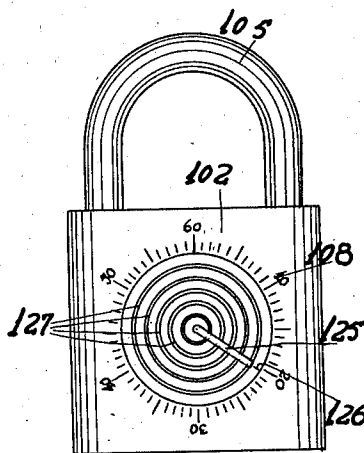


FIG. 10.

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UNITED STATES PATENT OFFICE

2,433,157

COMBINATION LOCK

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9 Claims. (Cl. 70—311)

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Our present invention refers to certain novel and useful improvements in combination locks.

The main object of our invention consists in providing a novel lock mechanism for use in door locks as well as in padlocks, which is of relatively simple construction as compared with the known generally very complicated combination locks.

One object of our invention is to provide a novel combination-lock mechanism, comprising at least one pinion and at least one rack, this rack having one broad tooth formed by two adjacent teeth without the usual clearing space between them and said pinion having at least one clearing space of a width corresponding to said broad tooth of said rack so that co-operation of the latter with said pinion is rendered possible only if their relative positions are correctly adjusted in accordance with a predetermined combination of numbers.

Another object of our invention is to provide a novel combination-lock mechanism, comprising a pair of pinions and a pair of racks, these racks having each one broad tooth formed by two adjacent teeth without the usual clearing space between them and said pinions having each one clearing space of a width corresponding to said broad tooth of each of said racks so that co-operation of the latter with said pinions is rendered possible only if their relative positions are correctly adjusted in accordance with a predetermined combination of numbers.

A further object of our invention is to provide a novel combination-lock mechanism, comprising two pairs of pinions and one rack for co-operating with one pair of said pinions, said rack having a broad tooth formed by two adjacent teeth without the usual clearing space between them and said pinions having a plurality of clearing spaces of a width corresponding to said broad tooth of said rack, so that said rack and pinion co-operation is rendered possible only if their relative positions are correctly adjusted in accordance with a predetermined combination of numbers, said rack being an integral part of the shackle of a padlock and said pinions being mounted on a shaft provided with a pair of knobs, one on each surface of the padlock, for rotating said shaft and operating the lock mechanism.

Still another object of our invention consists in providing a novel combination-lock mechanism, comprising a shaft, at least one pair of pinions mounted on said shaft and at least one rack for being operated by said pinions, said rack having a broad tooth formed by two adjacent teeth without the usual clearing space between them and said pinions having at least one clearing space be-

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tween two adjacent teeth of a width corresponding to said broad tooth of said rack so that co-operation of the latter with said pinions is rendered possible only if their relative positions are correctly adjusted in accordance with a predetermined combination of numbers, means for varying and adjusting the relative positions of said pinions to each other, and means for indicating the correct relative positions of said pinions in accordance with a given selected combination of numbers.

With these objects in view and others more particularly explained in the following description and clearly set forth in the appended claims, the present invention will now be described in detail with reference to the accompanying drawings which show, by way of examples only, two specific embodiments of our combination-lock mechanism as incorporated in a door lock and in a padlock, and on which:

Figure 1 is a horizontal sectional view taken along the line 1—1 of Figure 3, showing the mechanical structure of a door lock according to our invention;

Figure 2 is a top view of the same lock as applied to a door;

Figure 3 is a vertical section along the line 3—3 of Figure 1;

Figure 4 is a vertical section along the line 4—4 of Figure 1;

Figure 5 is a front elevation of the lock shown in Figures 1 to 4, and

Figure 6 is a front view of the bolt or latch of said lock.

Figure 7 is an elevation showing the inner surface of one of the two halves of a padlock, according to the invention, with the corresponding shackle in its locked position;

Figure 8 is a vertical section along the line 8—8 of Figure 7;

Figure 9 is a horizontal section along the line 9—9 of Figure 7, and

Figure 10 is a front elevation of the padlock shown in Figures 7 to 9.

Referring to the accompanying drawings and more particularly to Figures 1 to 6 inclusive, the combination door lock according to our invention comprises a shaft 1, a pinion 2 fixedly mounted on a gudgeon 3 of said shaft, and a second pinion 4 loosely mounted on said gudgeon. The shaft gudgeon 3 has a screw-threaded end 12 bearing a nut 11 which by means of a washer 10 presses a second washer 5 against the shoulder formed by said gudgeon 3 and its end portion 12. The washer 5 is provided with a laterally extending portion

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or crank pin 6 adapted to act upon a pin 7 provided on an internally screw-threaded washer 8, which by means of the screw-threads thereof is fixedly mounted on an externally screw-threaded portion of a shouldered sleeve 9 of the pinion 4. Thus, when the shaft 1 rotates, the washer 5 will rotate, too, and will cause the pin 7 to be moved around with the result that the washer 8, sleeve 9 and pinion 4 will also rotate.

The reference numeral 13 indicates the casing of the lock, the rear wall of which is provided with a hole 14 adapted to form a bearing for the inner portion 15 of the shouldered sleeve 9.

The lock bolt 16 is suitably guided between the inner walls 17 and 18 (Figures 3 and 4) of the casing 13 and is maintained in its normal locking position by a spring 37 surrounding a pin 38 and acting upon the inner upper end of the lock bolt 16. The lock bolt comprises an upper rack portion 19 and a lower rack portion 21 which are provided with a broad tooth 20 and 22, respectively, formed by two adjacent teeth without the usual clearing space between them. The rack portions 19 and 21 are arranged as shown in Figure 6 in different vertical planes of the body of the lock bolt 16 and in such a manner that the upper rack portion 19 engages the pinion 4 and that the lower rack portion 21 engages the pinion 2 when the latter is moved from its intermediate inoperative position as shown in Figure 1 to its operative position in alignment with said lower rack portion 21. Corresponding to the broad teeth 20 and 22 of the rack portions 19 and 21, the pinions 4 and 2 are provided each with a clearing space 4' and 2', respectively, sufficient to engage said broad teeth, said clearing spaces being simply formed by cutting away one of the teeth of each of said pinions.

The casing 13 includes a pair of vertical blades 23 provided with holes 24 for fastening the lock by means of suitable screws (not shown) in a door, drawer or the like, and a front wall 25 (Figures 2 and 5) which is fixed in place by means of the screws 26 engaging the holes 27 (Figures 3 and 4). The front wall 25 of the casing 13 forms a sleeve like portion 28 supporting the shaft 1, and a flange 29 provided at the front end of said sleeve 28. On the front surface of this flange there is marked a scale showing as many equidistant marks as teeth are provided on the pinions 2 and 4 including the one which has been cut away to provide for the clearing spaces 2' and 4'. Supposing these pinions have sixty teeth, said scale has to show sixty marks conveniently numbered 1 to 60.

The front end of the shaft 1 is formed by a stem 30 which, fixed by means of a splint 31 or the like, carries a pointer 32 and a knob 33 held in its correct position by a fitting screw 35 engaging an internally screw-threaded hole 34 of the stem 30 and pressing the knob 33 and the pointer 32 against the shoulder 36.

The reference numeral 39 (Figure 2) indicates an annular cover adapted to cover the hole of a door, drawer or the like, through which extends the shaft 1 of the lock, said cover being fixed in place by means of nails 40 or the like.

The operation of the combination door lock as hereinbefore described with reference to the Figures 1 to 6 inclusive is as follows:

In order to clearly explain the operation of the lock, it has to be mentioned that the upper rack portion 19 of the lock bolt 16 is as short as shown in Figures 3 and 4, whereas the lower rack portion 21, which has been shown in Figure

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3 partly broken away, is of sufficient length to always secure an operative engagement of the same by the pinion 2 as shown in Figure 4.

Now suppose the bolt 16 is in its locking condition and all other component parts are in their positions as shown in Figures 1 to 5, and suppose the combination of numbers to which the lock responds is that of twenty and fifty, for the purpose of opening a door to which the lock is applied, we proceed as follows: we first turn the knob 33 to the left until the crank pin 6 encounters the pin 7, and we continue turning the knob in the same direction until the pointer 32 indicates the number twenty on the scale 29 (Figure 5). By this operation the pin 7 by means of the washer 8 and the sleeve 9 moves the pinion 4 to its position as shown in Figure 3, in which its clearing space 4' is left in the correct position to take up that broad tooth 20 of the upper rack portion 19 of the lock bolt 16 when the latter is moved into the lock casing 13 by the pinion 2, because the rotation of the pinion 4 as aforesaid does not cause the withdrawal of the lock bolt 16.

After thus adjusting the pinion 4, we now turn the knob 33 to the right until the pointer 32 indicates the number fifty, which is the second one of the aforementioned combination, thereby moving the pinion 2 to its position as shown in Figure 4, but without rotating the second pinion 4 due to that the latter is loosely mounted on the shaft gudgeon 3 and so that the crank pin 6 now is not acting upon the pin 7. In the said position of the pinion 2 its clearing space 2' is left in the correct position to take up the broad tooth 22 of the lower rack portion 21 of the lock bolt 16, provided said pinion 2 be moved from its intermediate position as shown in Figure 1 into alignment with the rack 21, for which purpose we smoothly pull the knob 33 outwards thereby bringing the pinion 2 into alignment and engagement with said rack 21, without imparting any axial movement to the pinion 4. Hereafter, we continue turning the knob 33 to the right and cause the pinion 2 to withdraw the lock bolt 16. As the pinion 4 remains in its adjusted position, the same does not prevent the upper rack 19 from moving inwards and the lock bolt from being withdrawn, against the pressure of the spring 37. After thus opening the door, we let go the knob 33 and then the lock bolt 16 is returned to its locking position by the pressure of said spring 37. Finally, we turn the knob 33 to the left until the crank pin 6 engages the pin 7 and turns the same around moving the pinion 4 out of its adjusted position, thereby simultaneously disadjusting the pinion 2.

From the foregoing description it will be readily understood that the combination of numbers may be changed at any time by loosening the knob 33 and the nut 11 and thereafter changing the position of the pointer 32 and of the washer 5.

Referring now to Figures 7 to 10 inclusive of the accompanying drawings, the same illustrate the embodiment of our present invention in a padlock, the casing of which is composed of the two halves 101 and 102 and which is provided with the two usual holes 103 and 104 for receiving the ends of the shackle 105. Both lock halves 101 and 102 have a central perforation 106 for rotatively supporting a composite shaft which comprises two identical separate parts each composed of a disk-like portion 107, a stem portion 112 and a knob 108. The stem portions 112 have

their inner ends disposed opposite each other and each of these portions carries two pinions 110 and 111 fixed to the disk-like portions 107 by means of bolts or screws 113 and housed in circular recesses 109 provided on the inner surface of the two lock halves 101 and 102.

The two pinions 110 and 111 have certain of their teeth cut away so as to provide enlarged clearing spaces, the arrangement being such that the two pinions 110 have each but one clearing space 114, whereas the two pinions 111, having every tenth tooth cut away, have a number of clearing spaces 115, for the purposes as will be hereinafter explained.

Each of the pinions 111 co-operates with a pawl 116 provided with a spring 117 which by means of a set screw 118 is held in place and under pressure within a small recess formed in the bottom portion of each of the halves 101 and 102 of the lock casing (Figure 8).

The end 119 of the shackle 105 is provided with circumferential grooves 120 forming a rack adapted to be engaged by the teeth of the two pinions 110, the arrangement of said grooves being such that the same form one of the rack teeth 121 of a breadth corresponding to the enlarged clearing space 114 of the pinions 110, for the purpose as will be hereinafter explained.

The shackle 105, immediately above its rack portion 119, 120, 121, comprises a circumferential notch 122, which permits the pinions 110 to freely rotate as long as the shackle is in its locking condition. The other end 123 of the shackle 105 is inserted into the hole 104 while in its locking position.

The reference numeral 124 indicates a number of holes provided in the two halves 101 and 102 of the lock casing for receiving suitable bolts, screws or rivets to fixedly join said halves.

The two knobs 108 are provided each with a radial groove 125 which permits localizing by sense of touch a pointer mark 126 and determining its position, when it is dark, with relation to the numbers marked on an annular scale surrounding each knob 108 (Figure 10), these scales having as many marks as teeth are provided on the pinions 110 and 111. One of the knobs 108 has its outer surface provided with a number of concentric grooves 127 for the purpose of distinguishing the same from the other knob which is left without such circular grooves.

The operation of this padlock incorporating our invention is as follows:

Suppose the lock mechanism is in its locking condition and the combination of numbers to which it responds is that of 24 for the grooved knob and 33 for the plain knob, for the purpose of unlocking the shackle in darkness, we proceed in the following manner: We first turn both knobs 108 in such a way that their radial grooves 125 are in vertical condition and the marks 126 indicate the number 60 of Figure 10. Hereafter we slowly turn the grooved knob 108 to the right thereby rotating the two pinions 110 and 111 associated with said knob. While rotating the pinion 111, the same acts upon the pawl 116 against the pressure of the spring 117, and the successive movements of this pawl produce audible signals, every tenth of which is a different one due to that the pawl then enters the enlarged clearing spaces 115 of the pinion 111. By counting these signals it is very easy to adjust the grooved knob 108 so that its pointer mark 126 indicates the number 24 of the scale. In the same manner the plain knob 108 is adjusted at

the number 33. For the event that the signals are not sufficiently audible, it will be appreciated that by sense of touch it will be readily possible to count the successive steps of the pinions 111 according to the successive movements of the pawls 116 into the clearing spaces between the teeth of said pinions.

By these adjustments of the knobs 108 the pinions 110 are turned to the positions as illustrated in Figure 7, in which their enlarged clearing spaces 114 are so disposed as to take up the enlarged tooth 121 of the rack portion 119, 120, 121 of the shackle 105, with the result that now the shackle may be moved upwards to its unlocked condition. This will not be possible if one or both of the two pinions 110 are not correctly adjusted in accordance with the predetermined combination of numbers.

It will be understood that the present invention is by no means restricted to the specific embodiments as described and illustrated, but that various amendments and changes may be made therein and that such amendments and changes are to be considered as falling within the scope of this invention as clearly outlined and set forth in the following claims.

What we claim as new and desire to secure by Letters Patent is:

1. In a combination lock, a lock mechanism comprising at least one pinion and at least one rack for co-operating with said pinion, one broad tooth formed on said rack by two adjacent teeth without the usual clearing space between them, and at least one enlarged clearing space provided on said pinion of a width corresponding to said broad tooth of said rack, and means for adjusting said pinion with regard to said rack in accordance with a predetermined combination of numbers.

2. In a combination lock, a lock mechanism comprising a pair of pinions and a pair of racks for co-operating with said pinions, one broad tooth formed on each of said racks by two adjacent teeth without the usual clearing space between them, and one enlarged clearing space provided on each of said pinions of a width corresponding to said broad teeth of said racks, and means for adjusting said pinions with regard to said racks in accordance with a predetermined combination of numbers.

3. In a combination lock, a lock mechanism comprising two pairs of pinions and one rack for co-operating with one pair of said pinions, one broad tooth formed on said rack by two adjacent teeth without the usual clearing space between them, one enlarged clearing space provided on each of the two pinions co-operating with said rack of a width corresponding to said broad tooth of said rack, and a number of like enlarged clearing spaces on each of the remaining two pinions, means for co-operating with these last-mentioned pinions and the enlarged clearing spaces provided thereon to facilitate the adjustment of said two rack-engaging pinions, and means for adjusting the latter with regard to said rack in accordance with a predetermined combination of numbers.

4. A combination lock, comprising a casing, a locking member movably mounted in said casing, at least one rack portion provided in said locking member and at least one pair of independent pinions for engaging said rack portion of said locking member, one broad tooth formed on said rack portion by two adjacent teeth thereof without the usual clearing space between them and

at least one enlarged clearing space provided on each of said pinions for engaging said broad tooth of said rack portion, and means for adjusting said pinions with regard to said rack portion in accordance with a predetermined combination of numbers.

5. A combination door lock, comprising a casing, a lock bolt movably mounted in said casing, two rack portions provided at the inner end of said lock bolt and two independent pinions for engaging said rack portions, one broad tooth formed on each of said rack portions by two adjacent teeth thereof without the usual clearing space between them and one enlarged clearing space provided on each of said pinions for engaging said broad teeth of said rack portions, a shaft for mounting said pinions, and means in connection with said shaft for adjusting said pinions with regard to said rack portions in accordance with a predetermined combination of numbers.

6. A combination padlock, comprising a casing, a locking shackle movably mounted in said casing, a rack portion formed at one end of said shackle and a pair of independent pinions for engaging said rack portion of said shackle, one broad tooth formed on said rack portion by two adjacent teeth without the usual clearing space between them and one enlarged clearing space provided on each of said pinions for engaging said broad tooth of said rack portion, two separate shaft portions for independently mounting said two pinions, and means in connection with said shaft portions for adjusting said pinions with regard to said rack portion in accordance with a predetermined combination of numbers.

7. A combination padlock, comprising a casing, a locking shackle movably mounted in said casing, a rack portion formed at one end of said shackle and a pair of independent pinions for engaging said rack portion of said shackle, one broad tooth formed on said rack portion by two adjacent teeth without the usual clearing space between them and one enlarged clearing space provided on each of said pinions for engaging said broad tooth of said rack portion, two separate shaft portions for independently mounting said two pinions, an operating knob provided on each shaft portion for rotating the same, a second pinion mounted on each shaft portion and a spring-loaded pawl for co-operating with each of these last-mentioned pinions, a radial groove provided on the outer surface of each of said operating knobs and a pointer mark coinciding with said radial groove provided on the edge of each of said knobs to indicate a number of an annular scale provided on the front and rear surfaces of the lock casing around said knobs for adjusting the first-mentioned pair of pinions with regard to the rack portion of the shackle in accordance with a predetermined combination of numbers.

8. A combination door lock, comprising a casing, a lock bolt movably mounted in said casing,

two rack portions provided at the inner end of said lock bolt and two independent pinions for engaging said rack portions, one broad tooth formed on each of said rack portions by two adjacent teeth thereof without the usual clearing space between them and one enlarged clearing space provided on each of said pinions for engaging said broad tooth of said rack portions, a shiftable shaft for fixedly mounting thereon one of said pinions and for loosely mounting thereon the other pinion, a knob provided at the outer end of said shaft for shifting and rotating the same together with said first-mentioned pinion, and means provided at the opposite end of said shaft for transmitting the rotating movement of the latter to said other pinion, and a pointer and a scale of numbers provided in connection with said operating knob for adjusting said pinions with regard to said rack portions in accordance with a predetermined combination of numbers of said scale.

9. A combination door lock, comprising a casing, a lock bolt movably mounted in said casing, a spring for maintaining said bolt in its normal locking position, an upper rack portion and a lower rack portion provided at the inner end of the lock bolt and on different vertical planes of the latter, a first pinion co-operating the upper rack portion and a second pinion normally disposed in an intermediate position between the vertical planes of said upper and lower rack portions and adapted to engage said lower rack portion, a shaft slidably and rotatively mounted in a sleeve formed by the lock casing for loosely mounting thereon said first pinion and for fixedly mounting thereon said second pinion, said rack portions having each one broad tooth formed by two adjacent teeth without the usual clearing space between them and said pinions having each one enlarged clearing space of a width corresponding to said broad teeth for engaging the latter, said shaft comprising an operating knob and a pointer extending outwards over an annular scale of numbers for directly adjusting said second pinion with regard to said lower rack portion in accordance with one scale number of a predetermined combination and for indirectly adjusting said first pinion with regard to said upper rack portion in accordance with a second scale number of said combination by means of a crank pin adapted to act upon another pin provided on a washer which by means of a sleeve is rigidly connected with said first pinion.

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The following references are of record in the file of this patent:

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