

July 14, 1970

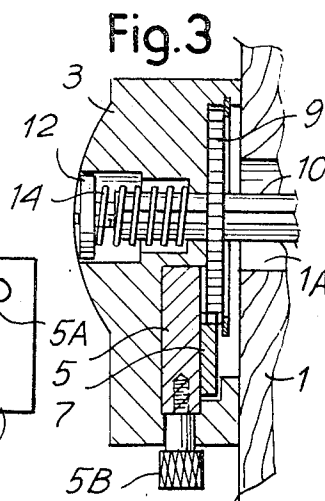
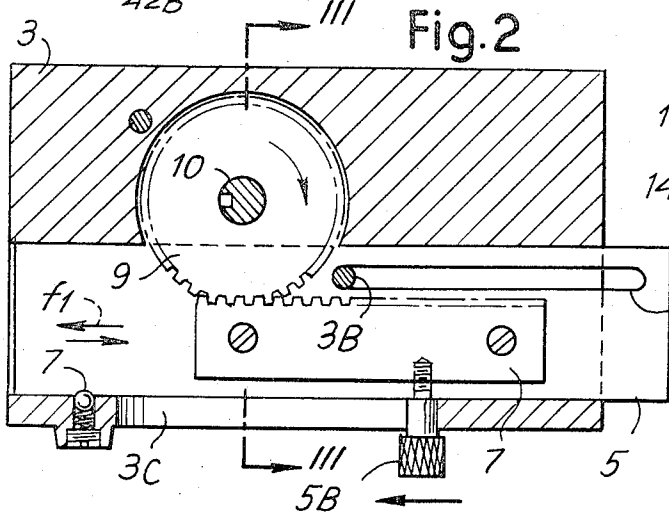
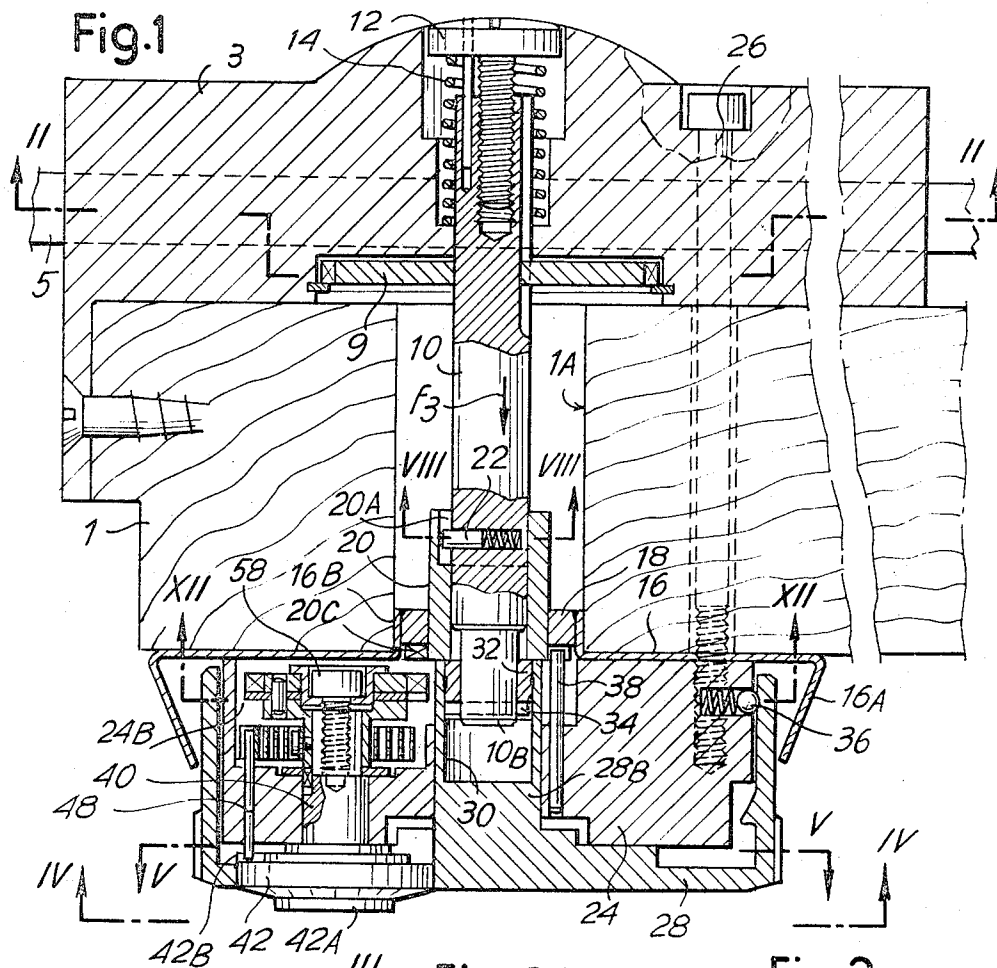
R. MARTELLINI

**3,520,160**

## COMBINATION LOCKS

Filed Aug. 1, 1968

4 Sheets-Sheet 1



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COMBINATION LOCKS

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Fig.4

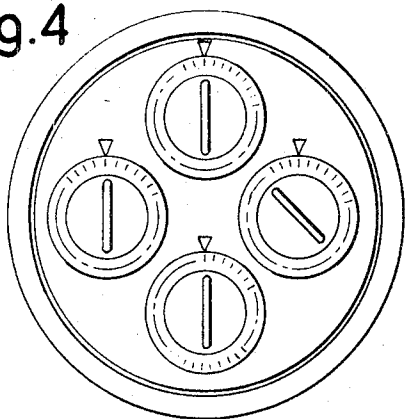


Fig.5

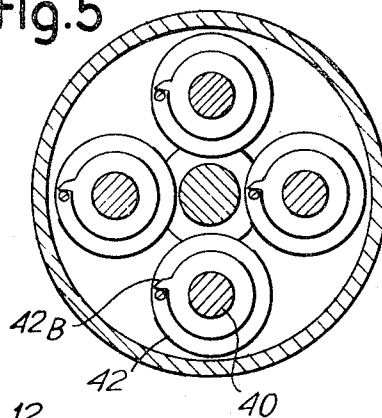
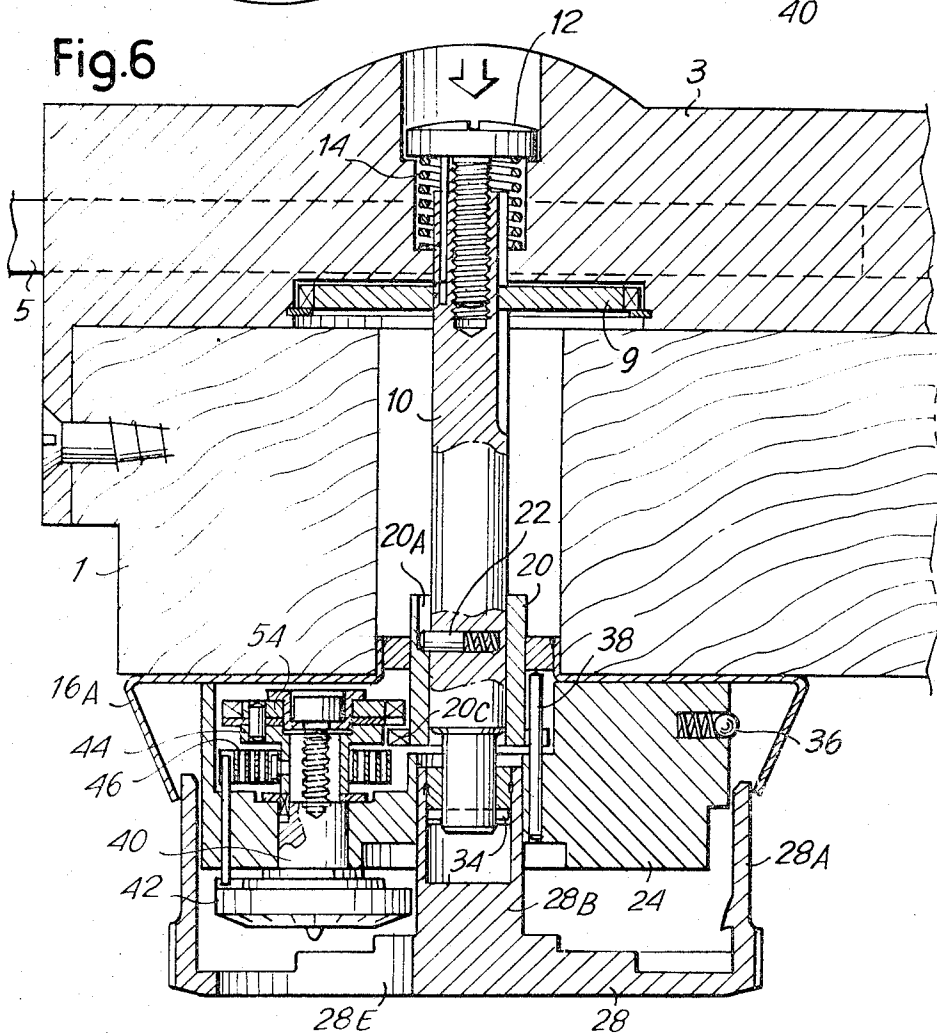


Fig.6



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Fig.7

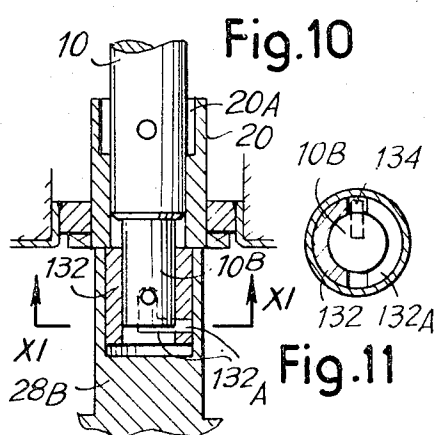
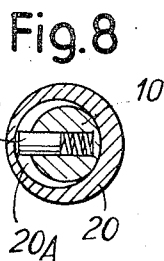
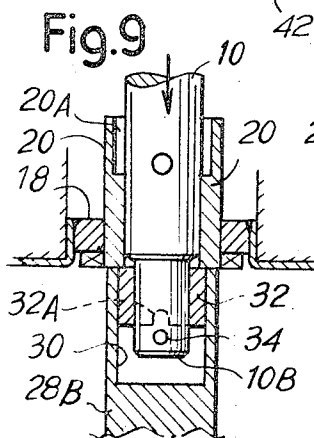
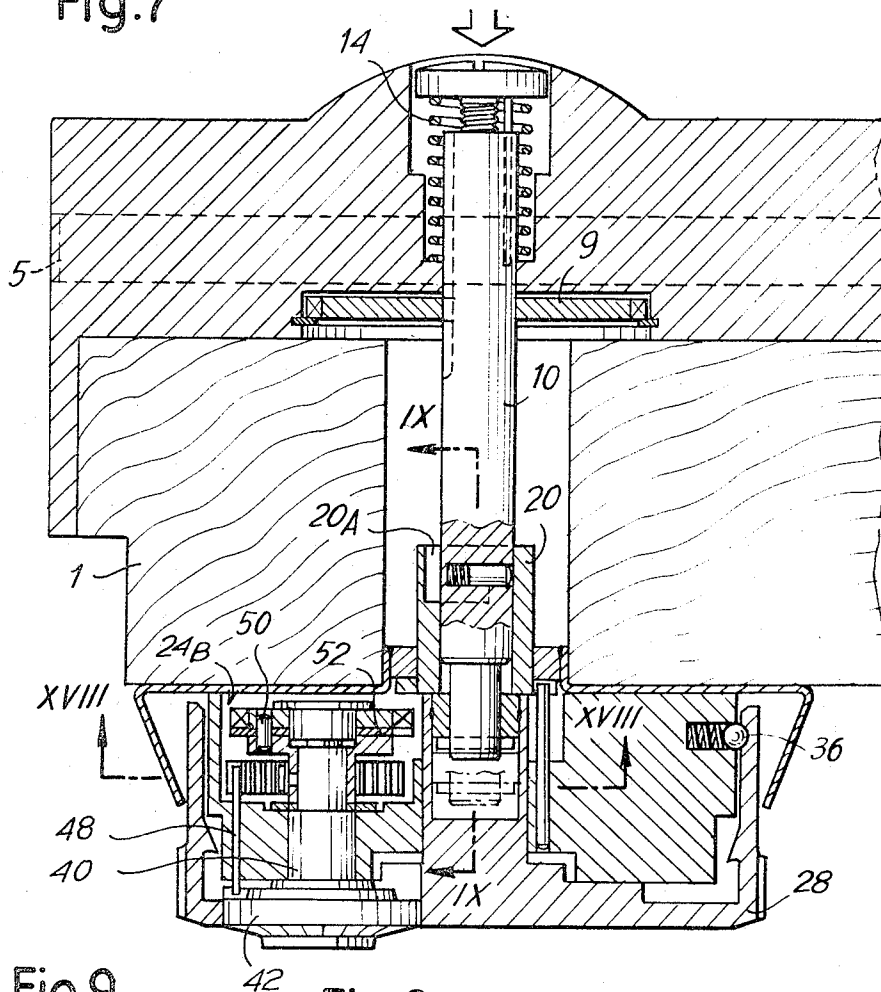


Fig. 11

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Fig.12

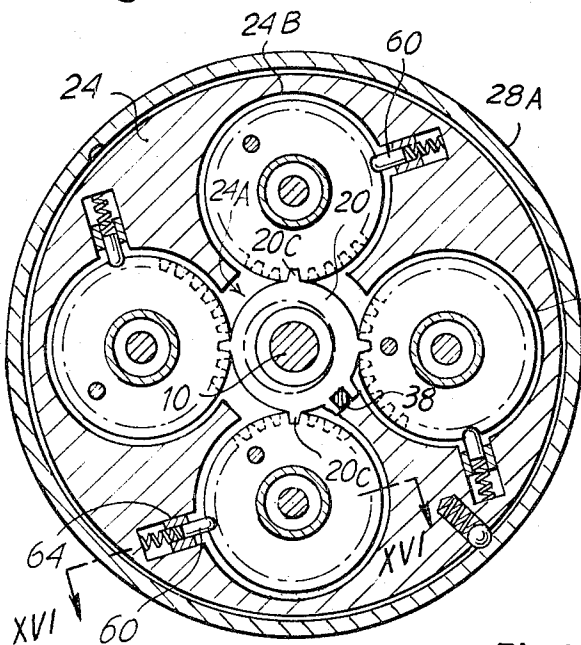


Fig.14

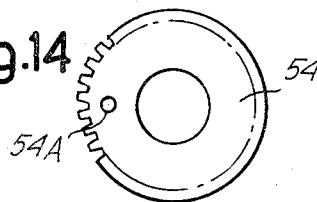


Fig.15

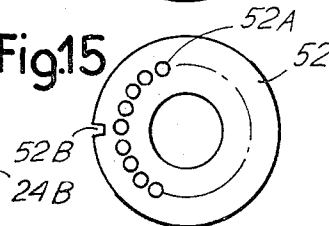


Fig.13

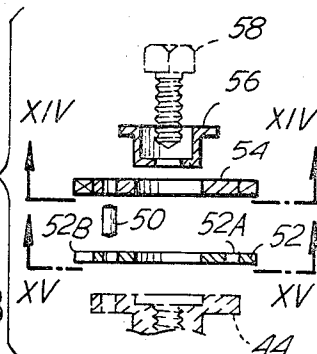


Fig.16

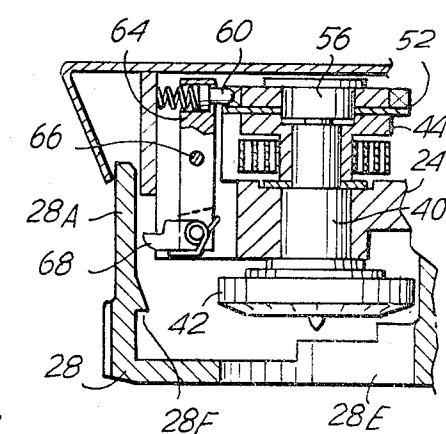
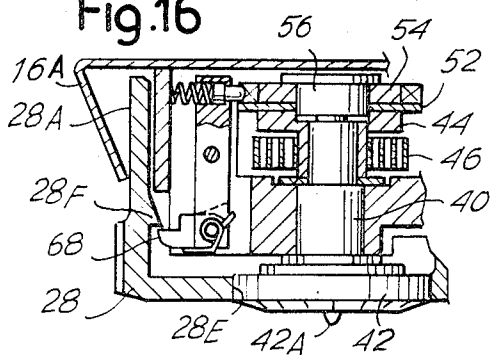


Fig.18

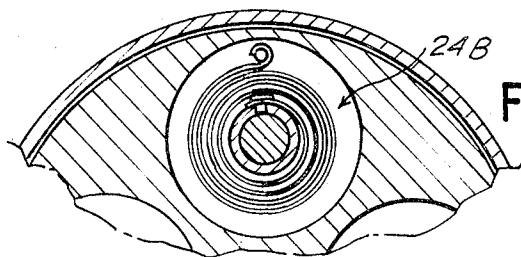


Fig.17

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## COMBINATION LOCKS

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4,693/67

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U.S. Cl. 70—312

6 Claims

### ABSTRACT OF THE DISCLOSURE

A combination lock for a safe door has four combination devices each required to be set to a predetermined angular position before the safe door can be unlocked. Each combination device is angularly biased into a predetermined angular position and is allowed to return to its predetermined angular position only on rebolting the door after the correct combination has been selected to allow the door to be unbolted.

### FIELD OF THE INVENTION

The present invention relates to combination locks.

An object of the invention is to provide an improved combination lock which, once the correct combination has been selected to allow the door to be unbolted, will on rebolting of the door automatically displace the correct combination.

A further object of the invention is to provide an improved combination lock which can be opened from the inside of the door without requiring the selection of a correct combination.

### SUMMARY OF THE INVENTION

The present invention provides a combination lock for locking and unlocking a door, comprising a body member mounted on said door, a cap member housing said body member and having two dial-receiving apertures therein, means mounting said cap member with respect to said body member for both rotational movement with respect to said body member and axial movement between a first and a second predetermined position with respect to said body member, a first combination device having a dial member and disc means, said disc means having a first peripheral slot therein, means mounting said first combination device for angular rotation with respect to said body member whereby said dial member extends through a corresponding one of said dial-receiving apertures of said cap member when said cap member is in said first predetermined position, and lies spaced from said cap member when in said second predetermined position, a second combination device having a dial member and disc means, said disc means having a second peripheral slot therein, means mounting said second combination device for angular rotation with respect to said body member, whereby the dial member of the second combination device extends through a corresponding other of said dial-receiving apertures of said cap member when said cap member is in said first predetermined position, and lies spaced from said dial member when in said second predetermined axial position, a locking element having first and second teeth, means mounting said locking element for axial movement with respect to said body member between said combination devices whereby said first and second teeth can respectively engage in said first and second slots, means connecting said locking element with said cap member for simultaneous axial movement whereby axial movement of both said cap member and said locking element is allowed only when said first and second slot are aligned with said first and second teeth, a lock-

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ing bolt slidable between an open and a closed position with respect to said door, rack means rigid with said locking bolt, pinion means engaging with said rack means and rotatable to cause said locking bolt to slide between the open and closed positions, and means connecting said cap means with said pinion means for simultaneous rotation whereby rotation of said cap means in said second predetermined axial position causes said locking bolt to move between its open and closed position.

### BRIEF DESCRIPTION OF THE DRAWINGS

FIG. 1 is a longitudinal section of the lock embodying the invention in a position of closure;

FIG. 2 is a section taken on the line II—II of FIG. 1 to a reduced scale;

FIG. 3 is a section taken on the line III—III of FIG. 2;

FIGS. 4 and 5 are respectively a view taken on the line IV—IV and a section on the line V—V of FIG. 1;

FIGS. 6 and 7 show the lock of FIG. 1, when the correct combination has been selected respectively in an open and closed position;

FIGS. 8, 9, 10 and 11 are respectively a section taken on the line VIII—VIII of FIG. 2; a section taken on the line IX—IX of FIG. 7, a section on the line IX—IX of FIG. 7 showing a modification and a section taken on the line XI—XI of FIG. 10;

FIG. 12 is a section taken on the line XII—XII of FIG. 1;

FIG. 13 is an exploded sectional view of one of the combination devices;

FIGS. 14 and 15 are respectively views taken on the lines XIV—XIV and XV—XV of FIG. 13;

FIGS. 16 and 17 are sections taken on the line XVI—XVI of FIG. 12 with the lock respectively in a closed and open position; and

FIG. 18 is a section taken on the line XVIII—XVIII of FIG. 7.

### DESCRIPTION OF THE PREFERRED EMBODIMENT

In FIGS. 1 to 3, a door 1 supports the combination lock embodying the invention. A housing 3 is mounted on the inside of the door 1, in which a locking bolt 5 is slidably mounted. The travel or stroke of the locking bolt 5 in the directions of the double arrow  $f_1$  shown in FIG. 2 is limited both by a pin 3B rigid with the housing 3 which engages slot 5A in the locking bolt 5, and by an operational knob 5B, which is slidably engaged in a slot 3C in the housing 3. A resiliently biased ball 6 can engage notches in the locking bolt 5 to define the closed and open positions of the bolt. A rack 7 rigidly secured to one side of the bolt 5 meshes with a pinion 9. The pinion 9 is keyed onto a shaft 10 so as to be able to slide axially but not rotationally relative thereto. The bolt 5 can be operated from the inside of the door by means of the knob 5B after a button 12 has been operated to release the shaft 10 from the engagement with an arrangement on the outside of the door, which would otherwise prevent the rotation of the shaft 10.

On the outside of the door 1, that is, on the side of the door opposite that on which the housing 3 is mounted, there is provided a combination locking arrangement. The arrangement includes a plate 16, having an inwardly inclined peripheral edge 16A, which plate engages the door 1. A collar 16B of the plate 16 extends into a bore 1A, cut in the door 1 which bore also houses the shaft 10; the collar 16B being coaxial with the shaft 10. A ring 18 integral with the collar 16B slidably supports a sleeve 20 therein. One end portion of the sleeve 20 is provided with (see FIG. 8) an enlarged circular bore 20A eccentrically located with respect to the longitudinal axis of the sleeve. The normal bore and the enlarged bore 20A

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of the sleeve meet to define a step within the sleeve whose height varies circumferentially from zero to a maximum. The shaft 10 housed in the sleeve 20 is provided with a resiliently biased pin 22 which extends radially to the wall of the bore 20A; the pin 22 being engageable with the step within the sleeve 20.

A block 24 is secured to the plate 16 and thereby to the door 1. The block 24 defines a central recess 24A co-axial to the shaft 10, and four outer recesses 24B lying angularly spaced around the block 24, each being arranged to receive a combination device. The block 24 can be advantageously connected to the housing 3 by means of bolts 26 (see FIG. 1).

An operational cap 28 houses the block 24 and is provided with a cylindrical skirt 28A which surrounds the block 24 and extends into the peripheral edge 16 A of the plate 16. The operation cap 28 has a hub portion 28B which extends into the central recess 24A and lies co-axial with both the shaft 10 and the block 24. The hub portion 28B has a cavity 30 within which an annular abutment ring 32 (see FIG. 9) is rigidly secured. The abutment ring 32 accommodates a reduced diameter end portion 10B of the shaft 10. The end portion 10B of the shaft 10 is provided with a transversely extending pin 34 which can engage a diametral notch 32A in the ring 32 and thereby lock the shaft 10 to the operational cap 28.

The combination devices to be described hereinafter prevent the rotation of the operational cap 28 with respect to the block 24, until the cap 28 is moved from the position shown in FIGS. 1 and 7 into the position shown in FIG. 6. This axial movement of the operational cap 28 is prevented until the combination devices are all positionally operated for lock release. Only when these combination devices, are accurately positioned will the cap 28 be allowed to slide from the position shown in FIG. 1 to the position shown in FIG. 6 and thereafter rotated to open the lock. While the cap 28 is in a closure position, as shown in FIG. 1, a spring 14 axially biases the shaft 10 so that the transversely mounted pin 34 engages the notch 32A. Under these conditions, the means preventing the rotation of the outer operational cap 28 thereby prevent the simple operation of the locking bolt 5 by the knob 5B. The latter operation can however be performed when the button 2 is operated to axially urge the shaft 10 in the direction of the arrow  $f_3$  until the pin 34 disengages from the notch 32A. The axial stroke or travel of the shaft is limited by the resiliently biased pin 22 engaging the step inside the sleeve 20.

The cap 28 as shown in FIG. 1 is located by means of a resiliently biased ball 36 engaging a notch in the interior of the skirt 28A.

The sleeve 20 which can slide into and out of the recess 24A in the block 24 is provided with four teeth 20C, angularly spaced around the periphery of the sleeve at intervals of 90° (see FIG. 12). The sleeve 20 includes means defining a channel externally thereof with which a rod 38 rigid with the block 24 can slidably engage to prevent the sleeve 20 from rotating.

Each of the four combination devices is housed in the block 24 in a corresponding one of the four outer recesses 24B. Also each combination device has an operational disc 42 which extends through a corresponding aperture 28E in the operational cap 28.

Each combination device includes a shaft 40 on which the operational disc 42 is mounted. Each operational disc 42 is provided with a graduated scale, which may be provided, for example, with numbers. Each disc 42 has a control knob 42A. Within each recess 24B, the corresponding shaft 40 is made rigid with a flanged member 44. A coiled spring 46 wound about the member 44 is anchored at one end to a rod 48 rigid with the block 24 and at the other end to the member 44 itself. The member 44 is coupled to a small circular plate 52 (see FIGS. 13 and 15) and a toothed disc 54 by means of a pin 50 extending through corresponding apertures in their periph-

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eries. The plate 52 and the toothed disc 54 are mounted on a flanged bush 56 which is secured by means of a screw 58 to one end of the shaft 40. The plate 52 is provided with a series of circumferential apertures each of which may be engaged by the pin 50. Thus the relative angular position of the plate 52 and the toothed disc 54 can easily be adjusted by aligning the single hole 54A of the toothed disc with a selected one of the holes 52A in the plate 52 and then locking them together by means of the pin 50. The circular plate 52, which is of steel and lies between the members 44 and 54, has a single tooth slot 52B, which in each of the relative angular positions of the plate 52 and the toothed disc 54 allowed by the pin 50, will find itself in alignment with one of the tooth slots of the toothed disc 54. Consequently the possible relative angular positions of the member 44 and the members 52 and 54, which can be located by the pin 50 corresponds to one of the graduated marks on the disc knob 42 (or on the periphery of the housing 28E) which is indicated by a stationary index finger.

A resiliently mounted pin 60 (see FIGS. 12 16 and 17) co-operates with the teeth of the toothed disc 54 in such a manner as to define a plurality of stable positions of the assembled items 40, 42, 44, 52, 54. In each of these stable positions defined by the pin 60 a tooth 20C of the sleeve 20 engages with the toothed disc 54. As the plate 52, lying adjacent the toothed disc 54, has only a single tooth slot 52B the slot 52B will be located in alignment with the corresponding tooth 20C of the sleeve 20 in one angular position only of the assembled items 40, 42, 44, 52, 54. Only when all four sets of the assembled items of the combination devices are located in such a position whereby the slots 52B of the respective discs 52 are located in alignment with the four teeth 20C of the sleeve 20, will the sleeve 20 be allowed to move axially in the direction of the arrow  $f_3$  of FIG. 1, into the position shown in FIG. 6. In all the other positions at least one tooth 20C will be locked against axial movement by the periphery of the disc 52. Thus only when all four of the assembled items are located in their opening positions is it possible to move the operational cap 28 from the position shown in FIG. 1 to the position shown in FIG. 6 and thereby axially move the shaft 10, the pin 22, and the sleeve 20, the teeth 20C of which pass through respective slots 52B of the four discs 52.

In the arrangement of FIG. 6 the cap 28 can be angularly rotated as there is no interference between the discs 42 and the apertures 28E, and so releasing the locking bolt 5 by means of the pin 34, the shaft 10 and the pinion 9. The rotation of the members 28, 10, 9 does not cause angular rotation of the sleeve 20, which is prevented from rotating by the rod 38 engaging with the channel formed in the sleeve 20. When the cap 28 has been rotated sufficiently to allow the door to open the resiliently biased pin 22 will have angularly moved around the bore 20A by such an amount as to be located in a position diametrically opposite the position shown in FIG. 8, that is, in the position shown in FIG. 7. In this position axial movement of the pin 22 by the shaft 10 is no longer limited by the step in the bore of the sleeve, which step is non-existent in this position. The operational cap 28 after rotation will return into a position adjacent the body 24, (see FIG. 7) under the action of the spring 14 which biases the shaft 10. The teeth 20C again pass through the slots 52B, as they move into engagement with the combination devices. Thereafter a "zero setting" operation takes place which will be hereinafter described.

FIG. 7 shows the arrangement in an open position. In this position, it is possible to close the lock both from the inside (by pressing the button 12 and thereby disengaging the pin 34 from the shaft 10), and from the outside, as the pin 22 no longer engages the step within the sleeve 20 upon the axial movement of the operational cap 28.

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The angular movement of each set of assembled items 40, 42, 44, 52 and 54 takes place against the rotational bias of the spring 46, which is advantageously supplemented by an initial pre-load of the spring. Thus the spring 46 resiliently urges the assembled items in an angular direction, towards a "zeroing" position. Each set of assembled items is prevented from normally returning (under the effect of the spring 46) to the zero setting position, by the retaining effect of the pin 60, which also defines the stable angular positions of the toothed disc 54 with respect to the teeth 20C. The retaining action of the pins 60 which cannot normally be overcome by the spring 46, can however be overcome by manual rotation of the discs 42.

The lock also has provision for automatic zeroing, that is for returning the combination devices into a predetermined starting position which annuls the combination. To achieve this the pins 60 are spaced from the teeth of the respective toothed discs 54, at the instant after the teeth 20C have returned through the slots 52B in a direction opposite to the arrow  $f_3$ . To achieve this (see FIGS. 12, 16 and 17) the resilient pins 60 are mounted on respective rocker arms 64 which pivot about pivots 66 with respect to the block 24. Each rocker arm 64 is provided at an end remote from the pin 60 with a resiliently mounted lever 68, which as shown in FIGS. 16 and 17 can be rotated in the counter-clockwise direction with respect to the rocker arm 64, but not in the clockwise direction. The skirt 28A of the operational cap 28 is provided with inner projections 28F, which as the cap 28 is moved from the position shown in FIGS. 1 and 16 into the position shown in FIGS. 6 and 17, engages the respective levers 68 to rotate them in a counterclockwise direction, leaving the position of the rocker arms 64 unaltered. When the cap 28 is returned (by hand or by effect of the spring 14) from the position shown in FIGS. 6 and 17 to the position shown in FIGS. 1 and 16, the inner projections 28F which have a sloping profile, engage the levers 68, causing thereby a small angular movement in the counter-clockwise direction of the respective rocker arms 64 about the pins 66. The pins 60 are thus disengaged for a short time from the respective teeth of the discs 54, allowing the biasing action of the respective springs 46 on the respective sets of assembled items 40, 42, 44, 52, 54, to return them to a predetermined position that is, the "zero" setting position. This zero setting position can be defined (see FIG. 5) by projections 42B carried internally by the knobs 42 and which co-operate with the ends of the rods 48, which rods provide an anchoring for the springs 46, the ends of the rods 48 thus forming the zeroing stops of the aforesaid sets of assembled units.

As has been already described the locking bolt 5 can be operated from the interior by pressing the button 12 and moving the knob 5B. In a modification, there is provided a knob in place of the button 12, which is capable of controlling both the axial movement and the angular movement of the shaft 10 for operation from the inside of the door.

FIGS. 10 and 11 show a modification in which members similar to those of the hereinbefore described embodiment are similarly referenced. The ring 32 is replaced by a bush 132 having a slot 132A. The slot 132A has a substantially semi-circular central portion and two end recesses similar to those denoted by 32A in FIG. 9. A single pin 134 projects from the end 10B of the shaft 10 for engagement with one or other of the recesses of the slot 132A.

I claim:

1. In a combination lock for locking and unlocking a door,
  - a body member mounted on said door,
  - a cap member housing said body member and having two dial receiving apertures therein,
  - means mounting said cap member with respect to said body member for both rotational movement with

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respect to said body member and axial movement between a first and a second predetermined position with respect to said body member,

a first combination device including a dial member and disc means, said disc means having a first peripheral slot therein,

means mounting said first combination device for angular rotation with respect to said body member whereby said dial member extends through a corresponding one of said dial-receiving apertures of said cap member when said cap member is in said first predetermined position, and lies spaced from said cap member when in said second predetermined position,

a second combination device including a dial member and disc means, said disc means having a second peripheral slot therein,

means mounting said second combination device for angular rotation with respect to said body member, whereby the dial member of the second combination device extends through a corresponding other of said dial receiving apertures of said cap member when said cap member is in said first predetermined position, and lies spaced from said dial member when in said second predetermined axial position,

a locking element including first and second teeth,

means mounting said locking element for axial movement with respect to said body member between said combination devices whereby said first and second teeth can respectively engage in said first and second slot,

means connecting said locking element with said cap member for simultaneous axial movement whereby axial movement of both said cap member and said locking element is allowed only when said first and second slot are aligned with said first and second teeth,

a locking bolt slidable between an open and a closed position with respect to said door,

rack means rigid with said locking bolt,

pinion means engaging with said rack means and rotatable to cause said locking bolt to slide between the open and closed positions, and

means connecting said cap means with said pinion means for simultaneous rotation whereby rotation of said cap means in said second predetermined axial position causes said locking bolt to move between its open and closed position.

2. A combination lock according to claim 1 wherein said first and second combination devices each include a toothed disc,

means mounting said toothed disc co-axially with and rigid with said disc means,

resilient means having first and second end portions, means mounting said first end portion of said resilient means rigidly with said combination device and said second end portion rigidly with said body member whereby said resilient means urges said combination device towards a predetermined angular position with respect to said body member,

pin means,

means mounting said pin means resiliently with respect to said body member to engage said toothed disc to prevent said combination device when located in any angular position, from returning to said predetermined angular position under the action of said resilient means, and

release means rigid with said cap member and engaging with said pin means as said cap member is moved from said second to said first predetermined position whereby to cause said pin means to disengage said toothed disc and allow said combination device to rotate into said predetermined angular position.

3. A combination device according to claim 2 wherein the pin means comprises

a pin,

an elongate member,  
means mounting said elongate member pivotally with  
respect to said body member and for engagement  
with said pin,

an arm,  
means mounting said arm pivotally with respect to said  
elongate member adjacent an end thereof, 5

means biasing said arm into a fixed angular position  
with respect to said elongate member, whereby to  
allow said arm rotation in only one angular direction  
from said fixed angular position, and said release  
means of said cap member urging said arm to rotate  
in said one angular direction when said cap member  
is moved from said first to said second predetermined  
position and urging said arm to act with said elongate  
member, and thereby release or disengage said pin  
means from said toothed disc, when said cap member  
is moved from said second to said first predetermined  
position. 10 15

4. A combination lock according to claim 2 wherein 20  
said toothed disc has a single peripheral hole therein and  
said disc means has a plurality of peripheral holes therein,  
said toothed disc being angularly movable with respect  
to said disc means whereby each of said plurality  
of holes can be aligned with said single hole, and 25  
each said combination device includes

rod means extending through an aligned pair of holes  
whereby to lock the toothed disc and said disc means  
in a predetermined relative angular position and  
thereby determine the opening combination setting 30  
of the combination lock.

5. A lock according to claim 1 wherein said cap mem-  
ber has a recess therein and said means connecting said  
cap means with said pinion means comprises,

a shaft engaged with said pinion means for relative 35  
axial movement,

pin means rigid with said shaft and engageable with

said recess in said cap member whereby to couple  
said shaft and said cap member for simultaneous  
rotation,

spring means, and means mounting said spring means  
with respect to said door to urge said pin means into  
engagement with said recess, said shaft being axially  
movable in opposition to said spring means to release  
said pin means from said recess and allow relative  
angular movement between said shaft and said cap  
member.

6. A lock according to claim 2 wherein each said dial  
member has a stop extending therefrom and  
said resilient means includes

abutment means mounted on said body member adja-  
cent each said dial member for engagement with said  
stop on each said dial member to define said pre-  
determined angular position.

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R. L. WOLFE, Assistant Examiner

U.S. Cl. X.R.

70—156, 314, 318, 326, 329