

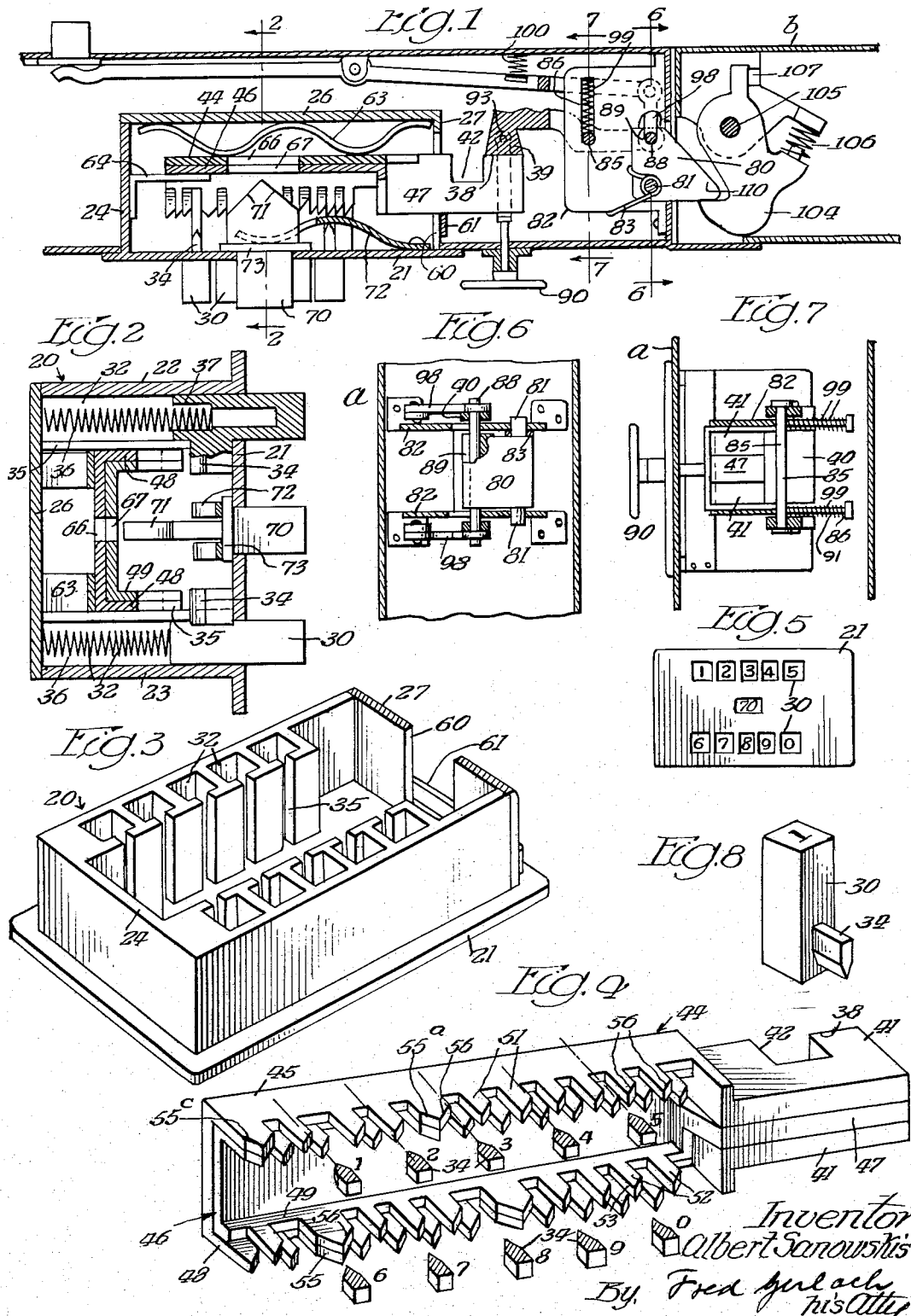
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COMBINATION LOCK

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COMBINATION LOCK

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5 Claims. (Cl. 70—313)

The invention relates to combination locks.

One object of the invention is to provide an improved combination lock of the type which is controlled by a set of keys or buttons, and which is provided with a lock controlling device which is shiftable step-by-step in one direction by the operation of the keys in predetermined sequence and which, when the keys are not operated in said sequence, will effect a reverse movement of the lock controlling device.

Another object of the invention is to provide a combination lock in which the lock controlling device is movable step-by-step and is frictionally held in the positions into which it is shifted by the keys.

Another object of the invention is to provide a combination lock which is simple in construction and which can be economically produced.

Other objects of the invention will appear from the detailed description.

The invention consists in the several novel features which are hereinafter set forth and are more particularly defined by claims at the conclusion hereof.

In the drawings—

Figure 1 is a horizontal section through a door provided with a combination lock embodying one form of the invention;

Figure 2 is a section of the combination lock taken on line 2—2 of Fig. 1;

Figure 3 is a perspective of the case for the combination lock, the cover plate being shown in section;

Figure 4 is a perspective of the lock controlling racks and the wedge elements on the keys;

Figure 5 is a front elevation of the lock;

Figure 6 is a section taken on line 6—6 of Figure 1;

Figure 7 is a section taken on line 7—7 of Figure 1; and

Figure 8 is a perspective of one of the keys.

The invention is exemplified as applied to an automobile door *a* which fits into an opening in a surrounding frame *b* of the vehicles.

The combination lock includes a case which is adapted to be fixedly set into an opening cut into the outer side of the door *a*. This case includes a body-section 20 and a cover-section 26 which are suitably secured together to house the operating mechanism of the combination lock. The body-section 20 includes a top wall 22, a bottom wall 23, an end wall 24, and a front wall 21, all integrally formed. The cover section 26 closes the back of the body-section and is provided with an integral angular end 27. The cover-section is suitably secured to the body-section, usually by screws, to form therewith a housing or enclosing case for the operating mechanism of the combination lock.

A series of keys 30 of rectangular contour are individually mounted in upper and lower rows for axial sliding movement in rectangular guideways 32 formed along the top and bottom of the case. Each key 30 is provided with an integral V-shaped wedge element 34 which extends through a vertical slot 35 on the inner side of a guideway 32. Each element 34 is retractable by a spring

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36 which urges one end of the element 34 against the inner face of the front wall 21 of the body section of the casing. Each spring 36 extends into a recess 37 in one of the keys 30. The outer faces of the keys 30 are provided with numerals 0 to 9, inclusive.

The combination lock includes members 41 and 47 of a bolt for controlling the release of a lever 40 which is mounted inside of the door *a* and is adapted to control a spring-pressed door latch 80 for locking the latch against release from the outside of the door and releasing said latch to permit the door to be opened from the outer side of the door. Bolt-member 41 is provided with a notch 42 which, when in registry with the inner angular end 39 of lever 40, permits said lever to be shifted into position to release the latch 80 to permit the door to be opened. Lever 40 is fulcrumed at 85, as hereinafter more fully described, and carries a cross-pin 88 which is movable into a notch 89 to a lock the latch 80, which is fulcrumed at 81, against pivotal movement. When the inner face 38 of the portion of the bolt-member 41 between notch 42 and the outer end of the bolt is abutted by the angular end 39 of lever 40, cross-pin 88 on said lever will be held in notch 89 and lock latch 80 against pivotal movement. Bolt-member 41 is provided with a longitudinal slot, and a bolt-member 47 fits in said slot, conforms in contour to the bolt 41, and is provided with a notch and a face which normally coincide with notch 42 and face 38, so that lever 40 will not be released when relative movement occurs between bolt-members 41 and 47 which misaligns the slots 42.

A rack 44 is integrally formed with bolt-member 41 and is longitudinally movable in the case for controlling the step-by-step movement of said bolt-member into position to release lever 40. A supplemental rack 46 is integrally formed with bolt-member 47, is longitudinally movable in and slidable relative to the rack 44, and controls the step-by-step movement of bolt-member 47 into position for releasing lever 40. Rack 44 is provided with flanges 48, and rack 46 is provided with flanges 49 which slidably fit and lap the inner faces of flanges 48. Racks 44, 46 are adapted to be moved step-by-step, by the wedge-elements 34, when the keys 30 are operated according to and in the sequence of the combination used, to shift the bolt-members 41, 47 into position to release lever 40.

Each of the flanges 48 is provided with a series of teeth or tongues 50 and slots 51 between said teeth, and the flanges 49 of rack 46 are provided with teeth or tongues 52 and intermediate slots 53. Said teeth have inner ends for engagement by the wedge-elements 34 on the keys 30, and the intermediate slots are adapted to receive said elements. These teeth on the racks which are successively shifted into confronting relation with the wedge-elements 34 on the keys corresponding to the predetermined combination if the keys are operated according to and in the sequence of the numbers of the combination, are provided with ends and which are inclined so that the racks will be operated step-by-step to the right and in the direction which will cause the racks to move bolt-members 41, 47 into position for releasing lever 40. Other teeth on the racks are provided with oppositely inclined ends 56 for causing the wedge-elements 34 on keys 30, which are not in the predetermined combination or if the keys are not operated in the sequence of the combination to shift the racks in the opposite direction, to prevent the bolt-members 41 and 47 from releasing lever 40. In other words, the wedge elements 34 on the keys 30, which are operated according to and in the sequence of the combination, will shift racks 44 and 46 step-by-step in unison to move bolt-members 41, 47 into position to release lever 40, and when the keys are not operated according to and in the sequence of the com-

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bination, one or both of the racks will be moved in the opposite direction to misalign the notches 42 in bolt-members 41 and 47 and thereby prevent the release of lever 40.

The racks illustrated are designed for the combination 6-3-9-1. Normally, when they are reset for locking, the racks 44, 46 will be in the position illustrated in Fig. 1 and corelatively positioned as illustrated in Fig. 4. When the No. 6 key is depressed, its wedge element 34 will engage an inclined surface 55 on the lower teeth on each of the racks 44, 46 and shift both racks conjointly one step toward the latch-releasing position of bolt-members 41, 47; this will move both racks into position so that the wedge element 34 on the No. 3 key will be aligned with the inclined surfaces 55^a on one of the upper teeth on each of the racks, and depression of said key will conjointly shift both racks and bolt-members 41, 47 a second step to the right or toward latch-releasing position; this second step will bring the inclined surfaces 55^b on one of the lower teeth of each of the racks into alignment with the wedge element 34 on the No. 9 key, and depression of said key will then conjointly shift both racks the third step toward lock-releasing position; the wedge element 34 on the No. 1 key will then be aligned with the inclined surfaces 55^c on one of each of the upper teeth on both racks, and when the No. 1 key is depressed, its wedge element 34 will engage said inclined surfaces and conjointly shift both racks the fourth step, so that the notches 42 in both racks will register with the angular terminal 39 of lever 40, and the latter will be released for pivotal movement from the outer side of the door.

If any key other than the No. 6 key is first depressed while the racks are in normal locking position, its wedge element 34 will be aligned with a tooth having an inclined surface 56 which will cause one or both of the racks to move to the left one step and misalign the notches 42 in bolt-members 41, 47. The racks will then be disarranged so that it will be impossible to shift the bolt-members 41, 47 into position to release lever 40 by the keys until the racks have been reset to their normal position. Similarly, if after one or more keys of the combination have been operated and shifted the racks conjointly one or more steps, and the key next in the sequence in the combination is not operated, it will engage the inclined surface 56 on a tooth of one or the other of the racks to produce relative movement between them which will misalign the notches 42 in the bolt-members 41 and 47 so that they cannot be shifted into lever-releasing position until the racks are reset into normal position and the keys of the combination are operated in the correct sequence.

Bolt-member 41 extends through and is guided in a slot 60 in the end 27 of cover 26. The front faces of bolt-members 41 and 47 fit against a bar 61 which is fixed to said cover. A pair of leaf-springs 63 is interposed between rack 44 and the back wall 26 of the body section of the case to urge bolt-members 41 and 47 forwardly. A stop 64 fixed in the case is engageable by the front face of rack 46 to limit the forward movement of the racks by springs 63. Springs 63 permit the racks to yield backwardly in the event that the teeth thereon become arranged to obstruct the movement of the keys and excessive force is applied to the keys, and prevent breakage of the teeth. Springs 63 exert a pressure against rack 44 and friction between the rack 44 and the rack 46. This friction may be sufficient to cause the racks to move in unison when one of them is shifted by a wedge element 34, so that the inclined teeth 55, 55^a, 55^b, and 55^c may be omitted from the inner rack 46.

When bolt-members 41, 47 have been shifted to bring notches 42 therein in registry with the angular end 39 of lever 40, said lever will be free to swing on its fulcrum 85, so that its angular end 39 can be shifted into the notches 42 in bolt-members 41, 47 for withdrawing cross-pin 88 from the notches 89 to release the latch 80

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and permit the door to be opened. A pull button 90 is slidably mounted in the outer wall of the door, and is provided with a fork which is connected at 93 to lever 40 so that, when the bolts are in unlocking position, a pull on the button 90 will shift lever 40 to release latch 80 and permit the door to be opened.

After each operation of the racks to shift the bolt-members 42, 47 into lever-releasing position, it is necessary to retract the racks to their normal locking position and to reset their teeth for operation by the keys of the combination. The racks 44 and 46 are provided with normally aligned slots 66 and 67. A resetting key 70 is slidably mounted in the front wall 21 of the case, and is provided with a V-shaped wedge 71 which, when the key 70 is pressed inwardly, will enter slots 66 and 67 and shift both racks into their normal position. A leaf spring 72 is applied to a shoulder 73 on button 70 for retracting button 70 after each inward stroke. When the reset button 70 is pressed while the racks are out of normal position, the V-shaped end 71 will enter and pass through slots 67 and 66 and shift the racks into their normal locking position. If there has been relative movement of the racks, the wedge 71 will engage the slots 66 and 67 in both racks and shift them into normal relative position.

The combination lock and latch 40 are exemplified for use in a vehicle door, with means for permitting the door to be opened from the inside of the vehicle while the bolt-members 41, 47 remain in their normal or locking position, and means for releasing the door so it can be opened from the outside of the vehicle when the bolt-members 41, 47 have been shifted to latch-releasing position by operating the keys 30 in proper combination and sequence.

The fulcrum pin 81 of latch 80 is supported in brackets 82 which are fixedly mounted in the door. A spring 83 is applied to urge latch 80 into the position shown in Fig. 1, the outer side of said latch engaging the edge of a slot in the edge of the door through which the latch projects. A catch 104 is pivotally mounted at 105 in the vehicle door frame, and a spring 106 is applied to normally hold said catch against an abutment 107 fixed in said body. Latch 80 is provided with an inclined end 110 for swinging the catch to clear the latch when closing the door, the latch 80 snapping into a recess in the catch 104 for locking the latch against outward movement.

Lever 40 is forked and its fulcrum pin 85 extends through and is seated in slots 86 in brackets 82 and is pressed to its seat by a pair of springs 99. Lever 40 is operable to withdraw cross-pin 88 from notch 89 in latch 80 for releasing the latch from the inner side of the door while lever 40 is restrained by bolt-members 41, 47. For this purpose a button 95, accessible from the inside of the vehicle, is mounted in the inner side of the door and is adapted to rock a lever 96 which is fulcrumed at 97 and provided with a fork end to which links 98 are pivoted. Links 98 connect the cross-pin 88 and the forked end of lever 96. A spring 100 urges lever 96 into position to cause its forked end to hold cross-pin 88 in the notch 89 of latch 80. When button 95 is pressed, lever 96 will shift links 98 to withdraw cross-pin 88 from notch 89 in latch 80 and release the latch to permit it to swing inwardly against the force of spring 83, and thereupon permit the latch to clear the catch 104 and the door to be opened. In this movement of cross-pin 88, lever 40 remains in engagement with bolt-members 41, 47, and springs 99 permit the fulcrum pin 85 to be shifted while said bolts remain in locking position. When the door is open and is swung into closing position, latch 80 will shift catch 104 against the force of spring 106 to permit latch 80 to be locked by catch 104 when the door is in its closed position.

In the construction described, the lever 40 exemplifies a locking element for the latch which controls the opening and closing of the door; the racks 45 and 46 exemplify

separately movable devices which are shiftable for controlling the release of the locking element; the V-shaped wedge elements 34 on the keys exemplify means for shifting the racks when the keys are operated in a predetermined sequence to release the locking element; the springs 63 exemplify spring-means for permitting the racks to be shifted when the racks are constructed against step-by-step movements.

When it is desired to change the combination of the form of invention illustrated in Figs. 1 to 8, it is only necessary to substitute racks 44, 46 provided with teeth having inclined ends for imparting step-by-step movement to the racks, by the keys of the combination.

A characteristic of the invention is that the rack provided with wedge-teeth is frictionally held in the position into which they are shifted step-by-step by the keys, and the racks are free to move in one direction by the keys of and in sequence of the combination and are shifted in the opposite direction when the keys are otherwise shifted.

The invention exemplifies a combination lock which includes a device which is operable step-by-step in one direction to lock-releasing position when the keys are operated in a predetermined sequence and which, when the keys are operated out of sequence, the device will be shifted in the opposite direction to prevent the release of the lock until the device has been reset to its normal position. The invention also exemplifies a combination lock which is efficient in preventing its unlocking operation and is simple in construction and adapted to be applied to doors of different types.

The invention is not to be understood as restricted to the details set forth, since these may be modified within the scope of the appended claims without departing from the spirit and scope of the invention.

This application is a division of my application Serial No. 17,230, filed March 26, 1948, Patent No. 2,665,577.

Having thus described my invention, what I claim as new and desire to secure by Letters Patent is:

1. A combination lock comprising: a bolt for controlling the operation of a locking device; a pair of separately slidable racks for operating the bolt to release the locking device, each rack being provided with a longitudinal series of teeth; a series of selectively slidable keys spring-biased away from the racks and provided with elements for simultaneously engaging the teeth and shifting both racks step-by-step, the racks being provided with teeth for conjointly operating both racks a succession of steps only by the selective operation of certain of the keys in a predetermined sequence for releasing the locking device, and with some teeth for shifting one rack relatively to the other when other keys are operated or when said certain keys are operated out of sequence and thereby rendering the keys ineffective to operate the racks to release the locking device by the further operation of the keys.

2. A combination lock comprising: a bolt for controlling the operation of a locking device; a pair of separately slidable racks for operating the bolt to release the locking device, each rack being provided with a longitudinal series of teeth; a series of selectively slidable keys spring-biased away from the racks and provided with elements for engaging the teeth and shifting the racks step-by-step, the racks being provided with teeth for conjointly operating both racks a predetermined number of steps by selective operation of certain of the keys in a predetermined sequence for releasing the locking device and with teeth for shifting one rack relatively to the other when other keys are operated, or when said certain keys are operated out

of said sequence, and thereby disarranging the teeth on the racks and rendering the keys ineffective to operate the racks to shift the bolt to its releasing position by the further operation of the keys.

3. A combination lock comprising: a bolt for controlling the operation of a locking device; a pair of separately slidable racks for operating the bolt to release the locking device, each rack being provided with a longitudinal series of teeth; a series of selectively slidable keys spring-biased away from the racks and provided with elements for simultaneously engaging the teeth and shifting the racks step-by-step, the racks being provided with teeth for conjointly operating both racks a succession of steps only by the selective operation of certain of the keys in a predetermined sequence for releasing the locking device, the racks having some teeth which will shift one rack relatively to the other when other keys are operated, or when said certain keys are operated out of said sequence, and thereby disarranging the teeth on the racks and rendering the keys ineffective to shift the racks into lock-releasing position by the further operation of the keys, and a device for resetting the racks into normal position after disarrangement, for the release of the locking device by subsequent operation of certain keys in said predetermined sequence.

4. A combination lock comprising: a bolt for controlling the operation of a locking device and including relatively slidable members; a pair of racks separately slidable with the bolt-members, respectively, for operating the bolt to release the locking device, each rack being provided with a longitudinal series of teeth; a series of selectively slidable keys spring-biased away from the racks and provided with elements for engaging the teeth and shifting the racks step-by-step, the racks being provided with teeth for conjointly operating the racks a succession of steps only by the selective operation of certain of the keys in a predetermined sequence for releasing the locking device, and with some teeth for shifting one rack and bolt-member relatively to the other rack and bolt-member when other keys are operated or when said certain keys are operated out of said sequence and thereby disarranging the teeth on the racks and rendering the keys ineffective to shift the racks into position to release the locking device.

5. A combination lock comprising: a bolt for controlling the operation of a locking device; a pair of separately slidable racks for operating the bolt to release the locking device, each rack including a plate with marginal flanges each having a longitudinal series of teeth, one of said racks being slidable in the other; a series of selectively slidable keys spring-biased away from the racks and provided with elements for simultaneously engaging the teeth and shifting both racks step-by-step, both flanges of the racks being provided with teeth for operating both of the racks a succession of steps only by the selective operation of certain of the keys in a predetermined sequence for releasing the locking device and with some teeth for shifting one rack relatively to the other when other keys are operated or when said certain keys are operated out of said sequence, and thereby disarranging the teeth on the racks and rendering the keys ineffective to shift the racks to bolt-releasing position by further operation of the keys.

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