Feb. 14, 1950 A. MASS 2,497,619

COMBINATION LOCK

Filed Oct. 15, 1948 3 Sheets-Sheet 1

Fig. 1

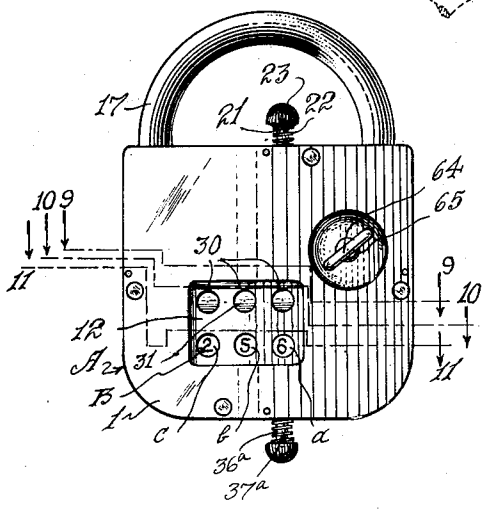


Fig. 2

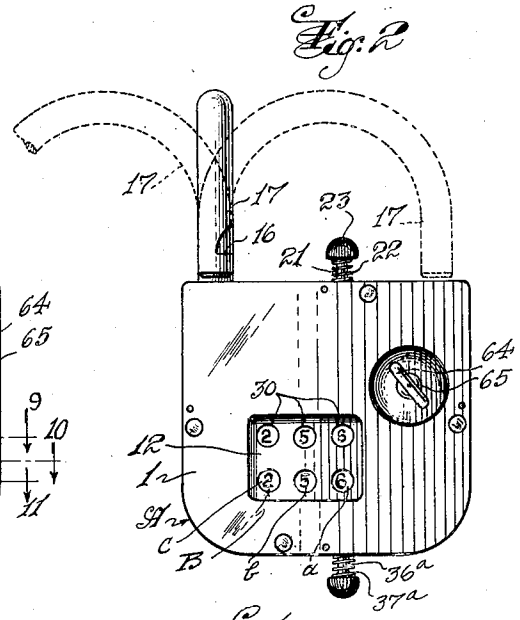


Fig. 8

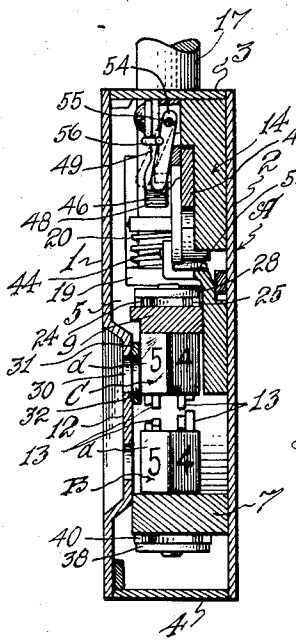


Fig. 9

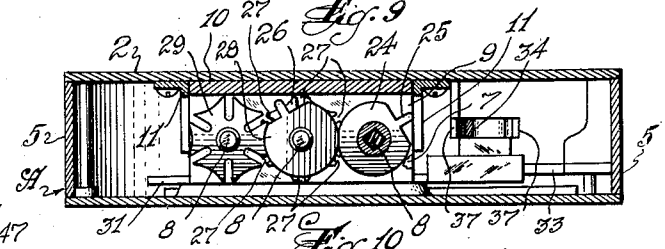


Fig. 10

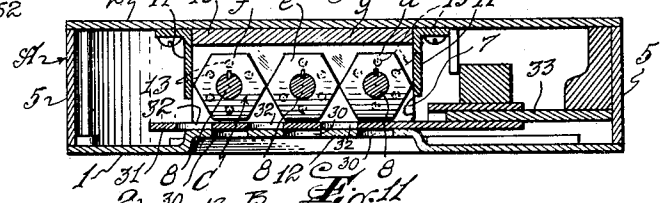
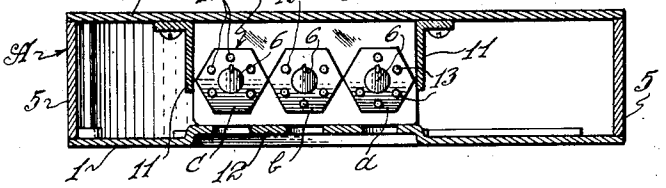


Fig. 11



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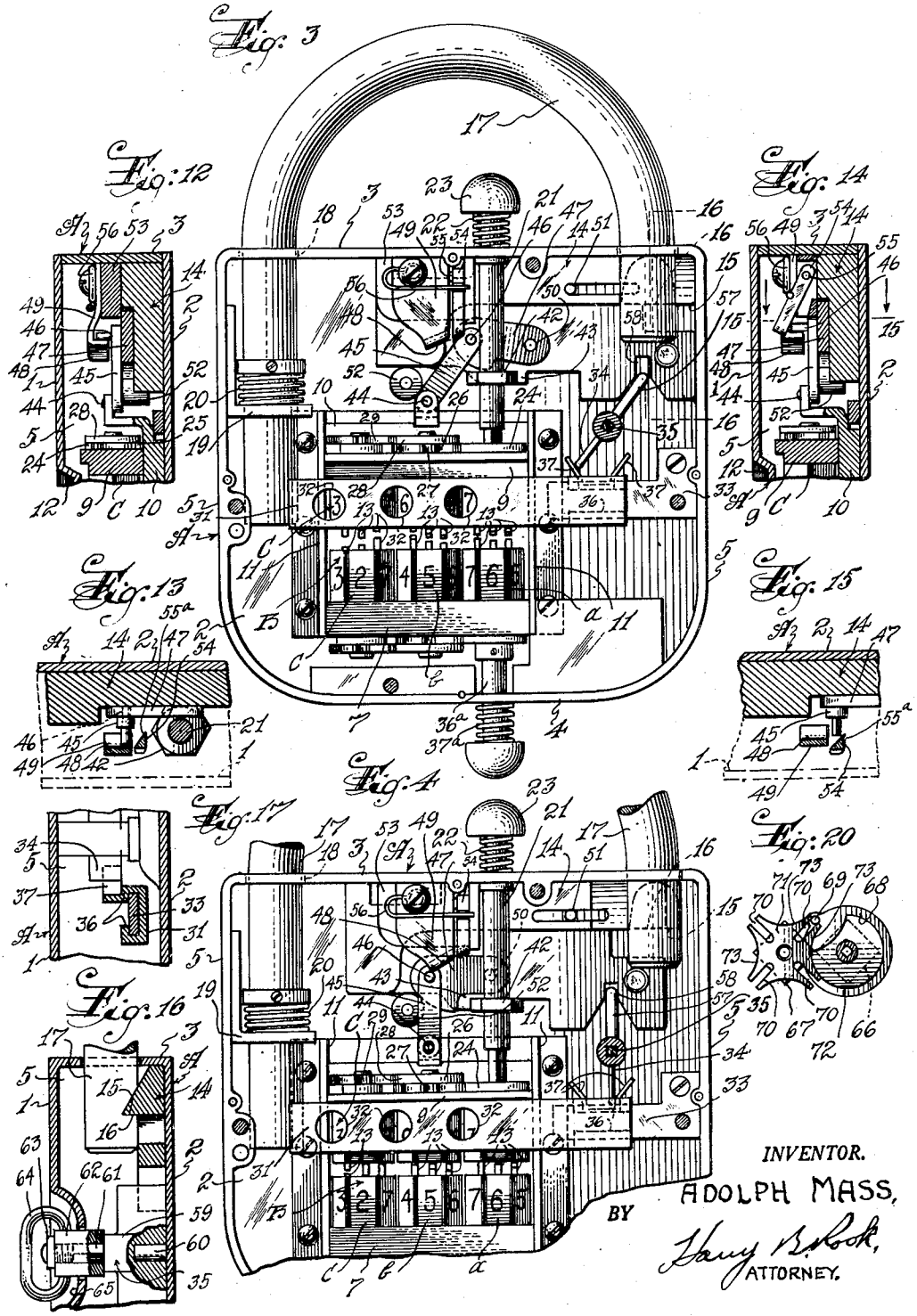
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COMBINATION LOCK

Filed Oct. 15, 1948 3 Sheets-Sheet 2



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COMBINATION LOCK

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Fig. 7

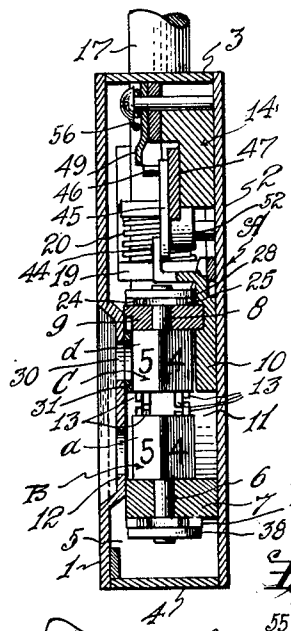


Fig. 5

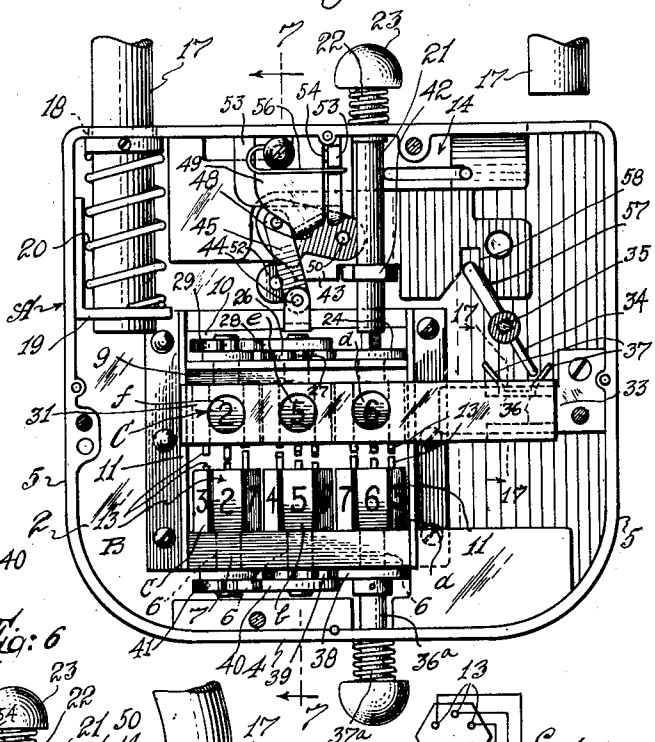


Fig. 6

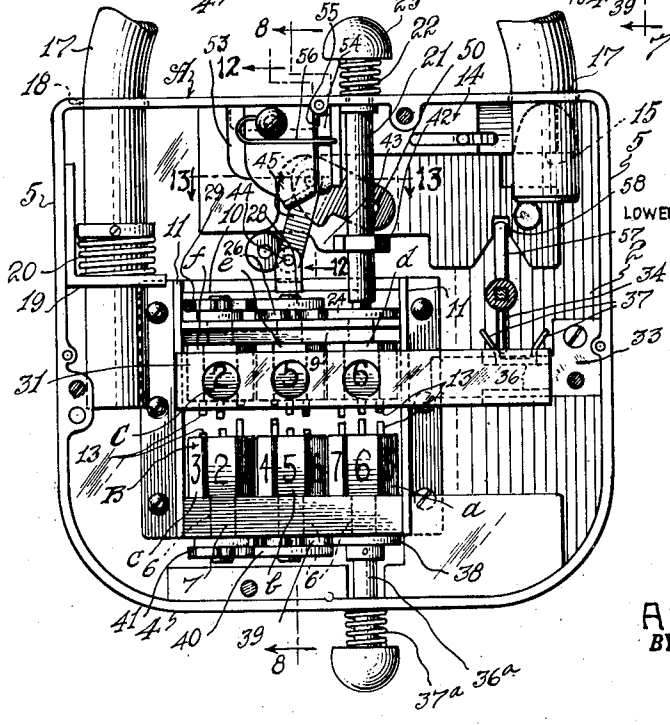


Fig. 18

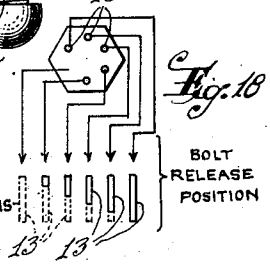
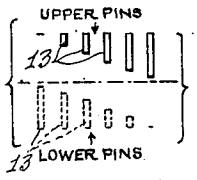


Fig. 19



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UNITED STATES PATENT OFFICE

2,497,619

COMBINATION LOCK

Adolph Mass, Maplewood, N. J.

Application October 15, 1948, Serial No. 54,739

14 Claims. (Cl. 70—25)

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This invention relates in general to combination locks of the type comprising a plurality of rotatable tumblers, one object of the invention being to provide a lock of this character which shall be compact, simple and reliable in construction and which can be easily and quickly adjusted or set and operated.

Another object is to provide such a combination lock which shall include two relatively movable series or sets of tumblers having cooperating portions such that when the two series of tumblers are in one relation to each other, a bolt is locked while when the two series of tumblers are in another relation to each other, the bolt is released or unlocked, in combination with novel and improved means for causing relative movement of said two series of tumblers and approximately simultaneous movement of the bolt to actuate the latter into locked and unlocked positions, respectively.

A further object is to provide a combination lock which shall include a novel and improved construction combination and arrangement of two series of tumblers each of which series shall include a plurality of tumblers, and means for relatively rotating the tumblers of each series to set or adjust the lock and to permit opening of the same, and means for causing relative movement of the said series of tumblers for opening and closing the lock.

A still further object is to provide in a combination lock, novel and improved rotatable tumblers and means for rotating the tumblers comprising a finger piece for rotating one tumbler and operative driving connections between the tumblers.

Other objects, advantages and results of the invention will be brought out by the following description in conjunction with the accompanying drawings in which

Figure 1 is a front elevational view of a combination padlock embodying the invention, showing the lock in closed condition;

Figure 2 is a similar view showing the lock in open condition;

Figure 3 is a greatly enlarged front elevational view of the lock with the front cover plate removed and showing the parts in the positions shown in Figure 1;

Figure 4 is a fragmentary view similar to Figure 3 showing the lock in partially opened condition;

Figure 5 is a similar view showing the lock in completely opened condition;

Figure 6 is a similar view showing one position

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of the parts during the operation of the bolt into locking position;

Figure 7 is a transverse vertical sectional view approximately on the plane of the line 7—7 of Figure 5;

Figure 8 is a similar view approximately on the plane of the line 8—8 of Figure 6;

Figures 9, 10 and 11 are enlarged horizontal sectional views approximately on the planes of the lines 9—9, 10—10 and 11—11, respectively, Figure 9 showing the Geneva movements of the upper set of tumblers in plan view, Figures 10 and 11 showing in plan view the upper ends of the upper set of tumblers and the lower set of tumblers, respectively.

Figure 12 is a fragmentary transverse vertical sectional view approximately on the plane of the line 12—12 of Figure 6;

Figure 13 is a fragmentary horizontal sectional view approximately on the plane of the line 13—13 of Figure 6;

Figure 14 is a view similar to Figure 12 showing the parts in another position;

Figure 15 is a horizontal sectional view approximately on the plane of the line 15—15 of Figure 14;

Figure 16 is a fragmentary transverse vertical sectional view approximately on the plane of the line 16—16 of Figure 3;

Figure 17 is a similar view approximately on the plane of the line 17—17 of Figure 5;

Figure 18 is a schematic or diagrammatic illustration of the pins of the two series of tumblers in bolt-releasing position;

Figure 19 is a similar view showing positions of the pins when the bolt is in locking position, and

Figure 20 is an enlarged fragmentary plan view of a modified driving connection between adjacent tumblers.

For the purpose of illustrating the invention I have shown it embodied in a padlock, but it will be understood that the invention may be utilized in other types of locking mechanisms, for example door locks.

Specifically describing the illustrated embodiment of the invention, the lock includes a casing A which is shown as approximately rectangular in plan view and comprises a front wall 1, a rear wall 2, a top wall 3, a bottom wall 4 and side walls 5.

Within the casing are two sheets or series of tumblers, each comprising three tumblers revoluble on parallel axes, and as shown one tumbler series B is stationarily fixed in the casing while the

other tumbler series C is movable as a unit relatively to the series B. The lower series B comprises three tumblers *a*, *b* and *c* each of which has a coaxial stub shaft 6 which is journaled in a bearing bracket 7 fixedly secured on the rear wall 2 of the casing. The upper tumbler series C comprises three tumblers *d*, *e* and *f* each of which has a stub shaft 8 that is journaled in a bearing bracket 9 that is rigidly mounted on a slide 10 which is slidably mounted between guides 11 and the front and rear walls 1 and 2 of the casing as best shown in Figures 6, 7 and 9, the front wall 1 having a depressed panel 12 against which the bearing bracket 9 slidably abuts. As shown, the two sets of tumblers are so related that the tumblers *d*, *e* and *f* of the upper set may move endwise toward and from the lower set of tumblers *a*, *b* and *c*. The tumblers *a*, *b* and *c* are opposed to and cooperate respectively with tumbers *d*, *e* and *f* and each tumbler is shown as hexagonal in cross section and elongated with its flat faces or panels consecutively numbered from "2" to "7" inclusive, although any suitable characters or indicia may be utilized. At the end of each of the tumblers of one set that is opposed to the corresponding tumbler of the other set is a plurality of pins 13 each of which corresponds to one panel or face. It will be understood, however, that the pins 6 might be substituted by other types of projections and recesses. As shown, the pins or each of the tumblers *a*, *b* and *c* progressively increase in length from the pin corresponding to the panel 2 to the pin corresponding to the panel 7, or from the first to the last indicia, while on the upper tumblers *d*, *e* and *f*, the pins progressively degrease in length from the pin corresponding to the panel 2 to the pin corresponding to the panel 7. Therefore, in order to permit the upper set C of tumblers to move toward the lower see B a predetermined distance to permit opening of the lock, the tumblers of the two sets must be so positioned that the pins of each tumbler of the upper set of tumblers are in direct longitudinal alinement with the pins of the corresponding indicia of the cooperative lower tumbler. This is best schematically illustrated in Figures 18 and 19 which are in effect a development of the pins of one of the tumblers in each of the upper and lower sets, the pins of the upper tumbler being shown in solid lines and of the lower tumbler being shown in dotted lines. Figure 19 shows relation of the pins when the lock is in closed position but ready for opening, while Figure 18 shows the pins in lock-opening or bolt-releasing condition.

The tumblers *d*, *e* and *f* of the upper set are the master or setting tumblers, while the tumblers *a*, *b* and *c* of the lower set are the operating tumblers for opening the lock; and when the pins of the lower tumblers *a*, *b* and *c* are properly or complementally located with respect to the corresponding pins of the upper tumblers *d*, *e* and *f*, respectively the slide 10 may move downwardly a predetermined distance to move the upper tumblers *d*, *e* and *f* toward the lower tumblers *a*, *b* and *c* and thereby permit unlocking movement of the bolt 14 as shown in Figures 4 and 5. When the pins are otherwise related, the movement of the upper set of tumblers in said direction is limited to a distance less than said predetermined distance and release of the bolt is prevented. The mechanism for operating the bolt will be hereinafter described.

As shown, the bolt 14 has a shoulder 15 to engage a shoulder 16 on one arm of a U-shaped

shackle 17 (see Figures 3 and 16) for holding the shackle in locked condition; and the other arm of the shackle is slidable in an opening 18 in the top wall of the casing and in an opening in a bracket 19 fixed on the casing to permit the first-mentioned arm to move into and out of the casing for closing and opening the lock, respectively, as shown in Figures 1 and 2. Preferably a spring 20 is provided for normally actuating the shackle outwardly of the casing into the positions shown in Figure 2.

For rotating the tumblers of the upper set, an operating rod 21 has one end relatively nonrotatably connected to one tumbler, in the present instance the tumbler *d*, as by a polygonal portion of the rod fitting a correspondingly shaped socket in the tumbler and a spring 22 is interposed between the top wall of the casing and a knob or finger piece 23 on the rod outside the casing to frictionally resist rotation of said rod. The tumbler *d* is operatively connected to the next tumbler *e* and the latter is operatively connected to the last tumbler *f* by mechanism operating on the principles of a Geneva movement. More particularly there are a plurality of Geneva movements, the driving element of one Geneva movement being on one tumbler of each set, a driven element of a Geneva movement being on each of the other tumblers of each set, and a cooperating complemental driving element being on the next adjacent tumbler. As best shown in Figure 9, the driving element 24 comprising a disk having the major portion of its periphery constituting a major arc of a circle and another portion cut away to form a finger 25, is rigidly connected to the tumbler *d* and cooperates with a driven element 26 that is rigidly connected to the tumbler *e* and has six radial slots 27 opening through its periphery, one in alinement with each of the faces or panels of the tumbler, the portions of the periphery of said element between said notches being arcuately concave as indicated at 27 to receive the arcuate portion of the element 24.

Similarly a driving element 28 identical with the element 24 is also connected to the tumbler *e* and a driven element 29 identical with the element 26 is connected to the tumbler *f*. With this construction, by rotating the rod 21, the tumbler *d* may be continuously rotated in either direction to rotate the other two tumblers *e* and *f* step by step, the fingers of the driving elements 24 entering the notches 27 of the driven elements to rotate the latter. In this manner the desired panel or indicium of the tumbler *f* should first be exposed at the front of the casing, and this operation is continued until the desired panels of the tumblers *e* and *d* are brought to the front. This is the setting operation of the lock and the exposed indicia on the tumblers are the "'combination" for opening the lock. As shown on the drawings, this indicia constitutes the numbers 2—5—6. This setting operation is executed while the lock is in open condition as shown in Figs. 5 and 6 and the numbers or indicia are exposed through corresponding openings 30 in the front wall of the casing. However, the numbers constituting the combination should be invisible when the lock is in locked condition, and consequently I provide a shutter or slide 31 having spaced openings 32, one for each of the tumblers, said slide being mounted on a bracket arm 33 and actuated by a finger 34 on the operating shaft 35 so that when said shaft is moved to slide the bolt 14 into locking position as shown in Figure 3, the shutter will

close the openings 30 and obscure the indicia, while when the operating shaft 35 is rotated in the other direction to throw the bolt into unlocking position, as shown in Figure 5, the shutter will be slid to cause the openings 32 to register with the openings 30 and expose the combination indicia. More particularly, the slide 33 has a portion of its edges around the bracket 33 as indicated at 36, and a pair of arms 37 cooperate with the finger 34 in sliding the shutter.

Now turning to the operating tumblers *a*, *b* and *c*, they are actuated in substantially the same manner as are the setting tumblers *d*, *e* and *f*. The tumbler *a* has an operating shaft 36 connected thereto which is frictionally held against rotation by a spring 37, and a driving element 38 identical with the element 24 is connected to said tumbler *a* and cooperates with a driven element 39 identical with the element 26 which is connected to the tumbler *b* to cooperate with the driving element 38. A driven element 40 also identical with the element 24 is connected to the tumbler *b* and cooperates with a driven element 41 on the tumbler *c*. The tumblers are rotated by the rod 36 in the same manner as the tumblers *d*, *e* and *f* are operated by the rod 21. For preventing accidental operation of the setting rod 21 while the lock is in closed condition, the rod 21 may have a hexagonal collar 42 one side of which will always be in frictional contact with a portion 43 of the bolt 14 when the latter is in locking position as shown in Figure 3. This portion 43 of the bolt is moved from contact with the collar 42 when the bolt is in open condition as shown in Figure 5.

For controlling the operation of the bolt, the slide 10 is pivotally connected at 44 to one end of a toggle link 45 the other end of which is pivotally connected at 46 to one end of a second toggle link 47 the other end of which is pivotally connected at 50 to the bolt 14 which is in turn shown as slidably mounted in the casing by a pin and slot connection 51 and a roller 52. The toggle is so located that when the bolt is in locking position the slide 10 is pulled upwardly to hold the pins of the upper set of tumblers out of engagement with the pins of the lower tumbler set as best shown in Figure 3. The pivot pin 46 projects beyond the link 45 as best shown in Figures 12 and 14, and as the bolt is slid toward its open or unlocking position, the pivot pin 46 engages the under surface of an inclined flange 48 on a fixed guide member 49 which causes the toggle to push the slide 10 downwardly as best shown in Figure 4 so as to bring the ends of the aligned pins on the upper series of tumblers into engagement with the corresponding pins of the lower tumblers as best shown in Figure 4. Then upon further movement of the bolt into completely open position as shown in Figure 5, the toggle pulls upwardly on the slide 10 to move the upper tumblers away from the lower tumblers, the toggle link 47 being constrained to swing upwardly and thus to pull the slide as the pivot point 50 moves nearer the pivot point 44 (compare Figures 4 and 5); and at the same time the pin 46 is moved upwardly in juxtaposition to the upper side of the inclined flange 48 as shown in Figure 5 so as to hold the slide against downward movement during the return of the bolt to locking position as shown in Figure 6.

Preferably an auxiliary guide member 54 is pivotally connected at 55 to the bracket 53 on which the guide member 49 is mounted, said guide member having a beveled end adjacent the end of the inclined flange 48 to positively guide the pin 46 under said guide flange and to permit said pin to move freely away from said guide flange as the bolt reaches its full-closed position. It is desirable that the guide member 54 be yieldingly influenced, as by a spring 56 into its normal position wherein it may guide the pin 46 beneath the flange 48, and preferably the underside of the free end of the guide member 54 is beveled as shown at 55*a* in Figure 15 to facilitate the passage of the pin 46 from beneath the guide member during the closing movement of the bolt, as shown in Figures 14 and 15.

The bolt is slid in both directions by a finger 57 carried by the operating shaft 35 and engaging opposite sides of a V-shaped notch 58 in the lower edge of the bolt. This operating shaft may be of any suitable construction but is shown as comprising a hub portion 59 having a socket in one end to receive a stud 60 on the rear wall of the casing, Figure 16, said hub having a polygonal portion 61 on which a finger piece 62 is fitted and held by a nut 63 screw threaded on the extremity of the hub. The finger piece may have a pivoted finger loop 64 and the front wall of the casing may have a recess 65 into which said finger loop may normally be swung and located in an out of the way position.

It will be understood by those skilled in the art that the tumblers may have more or less than six sides or panels; for example as shown in Figure 20, the tumblers 66 and 67 have four panels. It is also possible to use other driving gear than the specific Geneva movement shown in Figures 3 to 8 inclusive, and as shown in Figure 20, the driving element 68 on one of the tumblers comprises a disk having a driving pin 69 projecting therefrom to engage notches 70 in the periphery of the four-step driven element 71. The driving element also has a stop hub 72 to cooperate with arcuately concave stop surfaces on the driven element 71.

Other modifications and changes in the details of construction of the lock will occur to those skilled in the art as within the spirit and scope of the invention.

I claim:

1. A combination lock comprising a bolt movable into and out of locking position, coaxially rotatable opposed tumblers at least one of which is movable toward and from the other and each having a plurality of projections extending toward the other, whereby when certain of said projections of one tumbler are in one position directly opposed to certain pins of the other tumbler said movable tumblers may move a certain distance toward the other tumbler while when said projections of the tumblers are in other positions movement of said movable tumbler toward the other tumbler is limited to less than said certain distance, and a connection between said movable tumbler and said bolt to release said bolt from and to hold said bolt in locking position when said projections are in the first mentioned and second-mentioned positions respectively.

2. A combination lock as defined in claim 1 wherein said projections are of different lengths.

3. A combination lock as defined in claim 1 wherein each of said tumblers has a plurality of peripherally spaced indicia corresponding in number and character to the peripherally spaced indicia of the other tumbler, and each of said projections corresponds to one of said indicia.

4. A combination lock as defined in claim 3 wherein said indicia are consecutively arranged and said projections of one tumbler are of grad-

ually increasing lengths from the first to the last of said indicia while the projections of the other tumbler are of gradually decreasing lengths from the first to the last indicia.

5. A combination lock comprising a bolt, two sets of tumblers each set including a plurality of tumblers rotatable about parallel axis and each tumbler of one set coaxial with and in opposed relation to a tumbler of the other set, means mounting at least one of said tumbler sets for movement toward and from the other tumbler set, each tumbler of one set having a plurality of projections of different lengths extending toward the opposed tumbler of the other set, means including elements interconnecting said tumblers for rotating them, whereby when certain of said projections of each tumbler of one set are in one position directly opposed to certain pins of opposed tumbler of the other set said tumbler sets may relatively move toward each other a predetermined distance while when said projections on the tumblers are in other relative positions relative movement of said tumbler sets toward each other is limited to less than said predetermined distance, and an operative connection between said bolt and said tumbler sets to release and to hold said bolt from and in locking position when said projections are in the first-mentioned and second-mentioned positions respectively.

6. A combination lock as defined in claim 5, wherein each said tumbler has a plurality of identical peripherally spaced indicia and each of said projections corresponds to one of said indicia.

7. A combination lock as defined in claim 5, wherein each said tumbler has a plurality of identical peripherally spaced indicia and each of said projections corresponds to one of said indicia, said indicia are consecutively arranged and said projections on the tumblers of one set are of gradually increasing lengths from the first to the last indicia while the projections on the other set are of gradually decreasing lengths from the first to the last indicia.

8. A combination lock as defined in claim 5 wherein said means for rotating said tumblers comprises an operating rod for one tumbler of each set, and driving connections between said one tumbler of each set and the other tumblers of the corresponding set.

9. A combination lock as defined in claim 5 wherein said means for rotating said tumblers comprises an operating rod for one tumbler of each set, a plurality of Geneva movements, the driving element of one Geneva movement being on said one tumbler of each set, a driven element of a Geneva movement being on each of the other tumblers of each set and a cooperating complemental driving element being on a next adjacent tumbler.

10. A combination lock as defined in claim 5 wherein said operative connection between said tumbler sets and said bolt comprises two toggle links one pivotally connected to said one tumbler set and the other connected to said bolt, means for moving said bolt, and guide means for said toggle links to cause them to push and to pull on said one tumbler set upon movement of said bolt from locking to unlocking position and from unlocking to locking position, respectively.

11. In a combination lock, a plurality of tumblers rotatable on parallel axes, and means for rotating said tumblers comprising an operating rod for one tumbler, a plurality of Geneva movements, the driving element of one Geneva movement on said one tumbler, a driven element of a Geneva movement being on each of the other tumblers and a cooperating complemental driving element being on an adjacent tumbler.

12. A combination lock as defined in claim 1 wherein one of said tumblers has indicia thereon, and with the addition of means for covering and uncovering said indicia upon movement of said bolt into locking position and into unlocking positions, respectively.

13. In a combination lock, a casing, a tumbler set comprising a plurality of tumblers rotatable on parallel axes and each having spaced indicia on its periphery, a driving element of a Geneva gear movement having a driving pin connected to one tumbler and a complemental driving element connected to an adjacent tumbler and having radial slots to cooperate with said driving pin for rotating the second-mentioned tumbler, said pin corresponding to one of said indicia on the corresponding tumbler and each of said slots corresponding to one of said indicia on the other tumbler.

14. A combination lock as defined in claim 13, wherein said indicia on each tumbler are consecutive and with the addition of another similar tumbler set comprising a plurality of tumblers rotatable in said casing on parallel axes and having each tumbler disposed opposite to one of the first-mentioned tumblers, means for relatively moving said sets of tumblers toward and from each other, projections one for each of said indicia on each tumbler of each set, extending toward and opposed to the projections on the tumblers of the other set, said projections on the tumblers of one set increasing in length from the first to the last indicia and said projections on the tumblers of the other set decreasing in length from the first to the last indicia.

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No references cited.