Apr. 10, 1923. 1,451,036

W. T. BENHAM

COMBINATION LOCK

Filed July 11, 1921

Fig. 1.

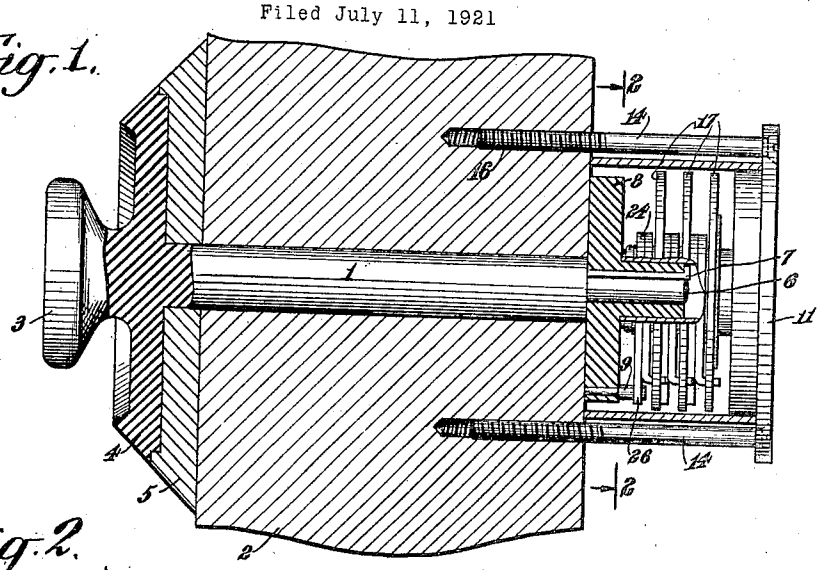


Fig. 2.

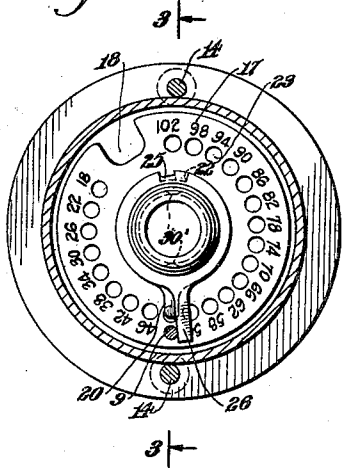


Fig. 3.

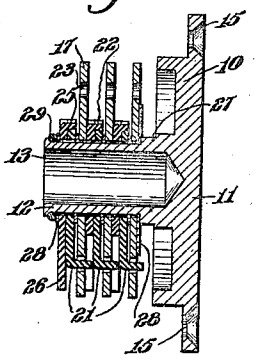


Fig. 4.

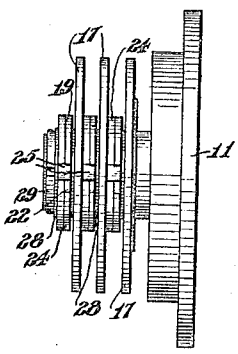


Fig. 5.

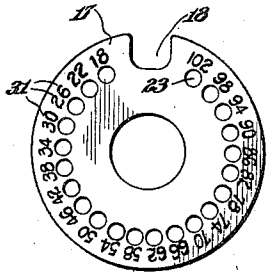


Fig. 6.

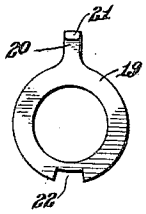


Fig. 7.

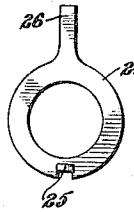
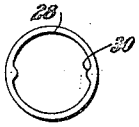


Fig. 8.



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Patented Apr. 10, 1923. 1,451,036

UNITED STATES PATENT OFFICE.

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COMBINATION LOCK.

Application filed July 11, 1921. Serial No. 483,675.

To all whom it may concern:

Be it known that I, WILLIAM T. BENHAM, a citizen of the United States, residing at Norwood, in the county of Hamilton and State of Ohio, have invented certain new and useful Improvements in Combination Locks, of which the following is a specification.

My invention relates to locks and more particularly to locks of the "permutation" or "combination" type.

In combination locks it has been usual to provide a series of tumblers, each carrying in adjustable position thereon, a pawl adapted to be engaged on one side or the other by a similar pawl on the adjacent tumbler, so that the tumblers may be progressively set in rotation during the working of the combination. The pawls are adapted to be set at predetermined combination numbers on their respective tumblers, but the proper combination numbers for the dialing will not be immediately apparent from noting the set of the pawls, because the pawls will be picked up by the engaging pawl at one side or the other, depending upon the direction of the rotation of the picking-up pawl. The width of the pawl picked up will determine the variation between the number at which the pawl is set and the number which must be dialed to properly position the tumbler. For instance, suppose a tumbler is set at a place marked 50 and is of such width that when the picking-up pawl engages this pawl on one side it is on a line with the place marked 49, and when the engagement is made from the other direction the picking-up pawl is aligned with the place marked 51. Then the proper combination number to be dialed for the tumbler whose pawl is set at 50 is either 49 or 51, depending on the direction of rotation of the picking-up pawl. Such an arrangement is very confusing when it is desired to reset the combination. Also, when the knob is started in one direction, one series of combination numbers must be dialed, and when the knob is started in the other direction, another, and different series of combination numbers must be dialed. Also, as no pawl takes a position directly over another pawl, many series of combination numbers may not be used.

It is the aim of my invention to provide a lock which will be free of the above-mentioned objectional features, and one of the objects of my invention is to provide a combination lock comprising a tumbler system which may be worked by dialing a knob to a predetermined series of combination numbers irrespective of the direction in which the knob is first rotated. Another object of my invention is to provide means whereby the combination of the tumblers may be easily and readily reset, and means whereby the sequence of numbrs which comprise the proper combination to be dialed by the knob may be readily and simply ascertained. A further object of my invention is to provide a combination lock which is easy and efficient in operation, simple and durable in construction, and one which may be set to a practically unlimited number of different combination settings. Other objects will be in part obvious and in part pointed out hereinafter.

In accordance with my invention instead of providing a series of tumblers each of which has mounted thereon a single pawl which is adapted to be engaged at one side or the other by the pawl of an adjacent tumbler, and also adapted to engage one side or the other of the pawl on another adjacent tumbler, I mount two pawls on each of the tumblers. One pawl is adapted to be set in fixed position on the tumbler, and is adapted to act as a picking-up pawl to transmit rotation to an adjacent tumbler, and the other pawl is adapted to be engaged or picked up by a picking-up pawl on another adjacent tumbler. The two pawls of each tumbler are interlocking and one of them, the picking-up pawl, interlocks with the tumbler. The interlocking engagement between the two pawls is such that a certain extent of lost motion is present in the engagement, and their relative position is such that when a picking-up pawl picks up the pawl which it engages on the adjacent tumbler, the picking-up pawl will be exactly in line with the picking-up pawl of the adjacent tumbler. By reason of the lost motion present between the two pawls on each tumbler, the position of a tumbler in picking up an adjacent tumbler will be the same irrespective of the direction in which the tumbler is rotated. In my improved construction each tumbler may be rotated a full revolution in either direction before the tumbler picks up an adjacent tumbler, thus increasing the possible number of combination numbers

that may be employed and giving other advantages to the construction. The tumblers are similarly marked with combination numbers, and the picking-up pawls are adapted to be set and fixed at any desired number. The combination to be dialed to effect the opening of the lock will be the series of numbers at which the pawls of the tumblers are set, and the same combination of numbers may be dialed to work the combination irrespective of the direction in which the dial knob is first rotated.

In order that a clearer understanding of my invention may be had, attention is hereby directed to the accompanying drawings forming a part of this application and illustrating one possible embodiment of my invention. Similar reference characters designate similar parts throughout the several views of the drawings. Referring to the drawings, Fig. 1 is a side elevation, partly in section, of a lock embodying my invention; Fig. 2 is a sectional view taken on the line 2—2 of Fig. 1; Fig. 3 is a sectional view of the tumbler system; Fig. 4 is a side elevation of the tumbler system; Fig. 5 is a top plan view of one of the tumblers; Fig. 6 is a top plan view of one of the pawls; Fig. 7 is a top plan view of another pawl; Fig. 8 is a plan view of an antifriction washer.

Referring to the drawings, I provide a combination lock having a shaft 1 rotatably mounted through a wall 2 or other element upon which the lock is to be attached. The outer end of shaft 1 is supplied with a dial knob 3 and a dial 4 rotatable with the shaft. To the outer face of the wall 2 is attached a dial 5 in the usual manner. The other end of shaft 1 is extended to provide a stump 6 upon which is suitably fastened as by means of a key 7 a drive pinion 8 carrying a drive pin 9, which pin 9 is adapted upon the rotation of the knob 3 to operate the tumbler system.

The tumbler system, as shown, comprises a support 10, consisting of a suitable supporting plate 11 carrying an inwardly extending arbor 12, recessed as at 13 to receive the stump 6 of the shaft 1 for rotation therein. The support 10 may be secured to the inside of the wall 2 by means of screws 14 extending through suitable perforations 15 provided in the plate 11 and entering into the material of the wall 2 as at 16.

About the arbor 12 I mount for rotation thereon a series of tumblers 17. These tumblers or disks 17 are preferably unitary and are duplicates one of another. Each disk is provided with a peripheral slot 18 into which the angle bar (not shown) of the bolt mechanism is adapted to fall when all the slots 18 of the disks 17 have been properly aligned and positioned. For each disk I provide two pawls and an antifriction washer. One of these pawls 19 is shown in Fig. 6 and comprises a loop portion adapted to extend about the arbor 12 and a radially disposed portion 20 and a projecting portion 21 extending axially at right angles to finger 20. Diametrically opposite the finger portion 20 the periphery of the pawl 19 is provided with a recess 22, as shown. This pawl 19 is adapted to be placed about the arbor 12 closely adjacent to a tumbler with the projecting portion 21 extending through one of a number of suitable perforations 23 provided therefor in the disk 17. Closely adjacent to pawl 19 I position another pawl which I have illustrated in Fig. 7. This pawl 24 comprises a loop portion adapted to encircle the arbor 12, and is provided with a downwardly extending projection 25 adapted to seat within the recess 22 provided in pawl 19. Upon pawl 24, and diametrically opposite projection 25 thereon, I provide a radially extending finger portion 26 extending outwardly a greater distance from the arbor 12 than does the finger portion 20 or projection 21 on pawl 19. The socket 22 is sufficiently extended, so that when the two pawls are positioned together on the arbor 12 with the projection 25 of pawl 24 seated in socket 22 of pawl 19, there will be a certain amount of lost motion between the two pawls. The purpose of this lost motion will be more specifically pointed out hereinafter.

In assemblying my lock, I first properly position my dial 5, and the shaft 1 carrying the dial 4 and dial knob 3 in the wall 2, and then place the drive tumbler 8 on the inner end of shaft 1 as by means of a key 7. I then take the support 10 and position one of the disks 17 about the arbor 12. Preferably I have provided an annular shoulder 27 on arbor 12 for this first disk 17 to rest upon. Then I place a pawl 19 about arbor 12, so that the projection 21 on the pawl extends through the desired perforation in the disk 17. Next, I place a pawl 24 about the arbor 12, so that its projection 25 will be seated within the recess 22 of the pawl 19. Then I mount a second disk 17 about the arbor, and against this disk place another pawl 19 with its projection 21 extending through the desired perforation in that disk, and place a second pawl 24 against this pawl 19 with its perforation 25 into recess 22 thereof. If I desire my system to comprise more tumblers I mount additional tumblers and pawls in a similar manner until I have the desired number of tumblers, each with two cooperating pawls, mounted upon the arbor 12. When my tumblers and pawls have been assembled, I place the entire system against the inside of the wall 2 with the stump 6 of the shaft 1 entering into the recess 13 in the arbor 12 and secure the system to the wall by means of screws 14 or by other suitable means. If desired, antifric-

tion washers may be placed between the various elements of the tumbler system, as shown at 28, and outside of the member which has been last mounted on the arbor 12 I preferably mount a spring washer 29 to more securely hold the various elements of the tumbler system in close proximity to adjacent elements. One type of friction washer which I have found satisfactory is illustrated in Fig. 8, and, as shown, may comprise an annular ring having two oppositely-disposed inwardly-extending projections 30. The washer 28 is adapted to be seated about the arbor 12 with its projections 30 seated in properly placed grooves 30′ provided in the periphery of the arbor.

When assembled the operation of the lock is as follows:—The rotation of dial knob 3 causes rotation of drive tumbler 8 and its drive pin 9. Drive pin 9 is adapted to engage the finger 26 of the last mounted pawl 24, and when the projection 25 of the pawl 24 engages the side of the recess 22 of the adjacent pawl 19, the nearest disk 17 will start to rotate on account of the engagement of finger 21 with the disk 17. Finger 21 of pawl 19 extends beyond the opposite side of the first disk 17 sufficiently to engage against one side or the other of finger 26 of the second pawl 24, and thereby transmits rotation to the second tumbler 17. In like manner the projection 21 on pawl 19 carried on the second tumbler engages the finger 26 of the pawl 24 which cooperates with the third disk 17. Thus by rotating knob 3 all the tumblers may be progressively rotated. The extent of the recess 22 in the pawls 19 and the width of the projections 21, on pawl 19, and 25, on pawl 24, and the width of the finger 26 on pawl 24, are so arranged that when the drive pin 9 starts to rotate the first tumbler, it will be positioned exactly over the projection 21 on the first pawl 19. Similarly when any of the fingers 21 of the pawls transmit rotation to any of the adjacent tumblers, the finger 21 of the picking-up pawl will be exactly over the finger 21 of the pawl on the tumbler which is picked up. This taking up action is effected in identical manner irrespective of whether the rotation is in one direction or the other.

Each of the disks 17 are preferably supplied with a plurality of perforations, each of which is adapted to receive projection 21 of a pawl 19. The disks are preferably supplied with an identical number of perforations, and these perforations are preferably similarly numbered with appropriate combination numbers, as shown at 31. The dials 4 and 5 are supplied with markings and numbers appropriate to the numbers supplied on the tumblers. To set the combination the pawl 19 is adjusted on the first mounted tumbler, so as to have its projection 21 extending through the perforation which is given the first number of a combination which is desired. The finger 21 of the pawl 19 on the second tumbler is fixed in the perforation which is marked a number corresponding to the second number of the desired combination. The third pawl 19 is adjusted with its finger 21 in the perforation of the third tumbler and which is marked with the third number of the combination. If there are more tumblers, the remaining pawls 19 are similarly adjusted to the respective combination numbers remaining. To reset the combination it is only necessary to adjust one or more of the pawls 19 into different perforations in their respective tumblers. If for any reason it is desired to learn the combination of numbers which must be dialed to open the lock, it is only necessary to note the numbers opposite the various perforations on the disks 17 which are engaged by the projections 21 of the respective pawls. The numbers so indicated are the proper combination numbers, and their proper sequence is the same as is the sequence of tumblers beginning with the number indicated on the tumbler which was first mounted on the arbor 12.

It will be noted that in my improved lock a combination of two or more identical numbers, such as 50—50—50, may be used. On account of the lost motion between the two pawls which cooperate with each disk, the three tumblers may be rotated so that the places numbered 50 on each of the three disks may be brought into position one exactly over the other. When the combination is set for such a series of numbers or for any other series of numbers, the lost motion between the two pawls cooperating with each tumbler is so constituted that the same series of combination numbers will open the lock irrespective of the direction in which the knob 3 for the first tumbler is rotated.

As many changes could be made in the above construction and many apparently widely different embodiments of this invention could be made without departing from the scope thereof, it is intended that all matter contained in the above description or shown in the accompanying drawings shall be interpreted as illustrative and not in a limiting sense.

What I claim is:—

1. In a combination lock of the character described, in combination, an arbor, a rotatable tumbler, a pawl engaging said tumbler and adjustable in fixed position thereon for rotation therewith, a second pawl journaled directly on said arbor for rotation substantially concentrically with respect to said pawl and tumbler, a lost motion connection between said two pawls, and means adapted to engage and to rotate said second pawl to effect rotation of said tumbler.

2. In a combination lock of the character described, in combination, an arbor, a disk tumbler rotatably mounted on said arbor, a pawl mounted about said arbor and engaging said tumbler and adjustable in fixed position thereon, a second pawl journaled on said arbor adjacent said first pawl for rotation concentrically with respect to said pawl and tumbler, a lost motion connection between said two pawls, and means adapted to engage and to rotate said second pawl to effect rotation of said tumbler.

3. In a combination lock of the character described, in combination, an arbor, a disk tumbler rotatably mounted on said arbor, a pawl mounted about said arbor and engaging said tumbler and adjustable in fixed position thereon, a second pawl journaled on said arbor adjacent said first pawl for rotation concentrically with respect to said pawl and tumbler, a lost motion connection between said two pawls, and means adapted to engage and to rotate said second pawl to effect rotation of said tumbler, said means comprising a second tumbler rotatably mounted on said arbor adjacent said second pawl, and a pawl mounted on said arbor adjacent said second tumbler in engagement therewith and adjustable in fixed position thereon, said pawl having a portion adapted to engage the above mentioned second pawl, and a mechanism for rotating said second tumbler.

4. In a combination lock of the character described, an arbor, a tumbler rotatably mounted on said arbor, a plurality of perforations in said tumbler, a pawl having a loop portion rotatably encircling said arbor, and having a projecting portion seated in one of said perforations, a second pawl having a loop portion rotatably encircling said arbor, and a finger portion extending radially therefrom, a recess in said first pawl, and a projection on said second pawl adapted to seat within said recess, said recess being larger in width than the width of said projection on said second pawl to permit a certain extent of lost motion between said two pawls, when rotated relatively about said arbor.

5. In a combination lock of the character described, an arbor, a tumbler rotatably mounted on said arbor, a plurality of perforations in said tumbler, a pawl having a loop portion adapted to embrace said arbor, and having a projecting portion adapted to extend through any one of said perforations, a second pawl having a loop portion adapted to embrace said arbor, and a finger portion extending radially therefrom, a recess in said first pawl diametrically opposite its said projecting portion, a projection on said second pawl diametrically opposite its finger portion and adapted to seat within said recess, said recess being larger in width than the width of said projection on said second pawl to permit a certain extent of lost motion between said two pawls, the finger portion of said second pawl being disposed substantially in the same line with the projecting portion of the first pawl, and having a limited extent of movement laterally in respect thereto.

This specification signed and witnessed this 29th day of June 1921.

WILLIAM T. BENHAM.

Witnesses:
JNO. J. SCOTT,
M. BOUR.