March 26, 1929. H. BECK 1,706,994

COMBINATION LOCK

Filed Nov. 6, 1925

Fig. 1.

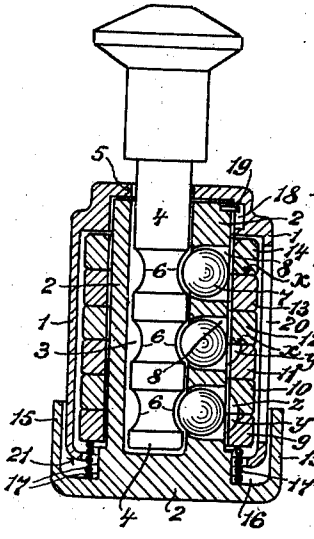


Fig. 2.

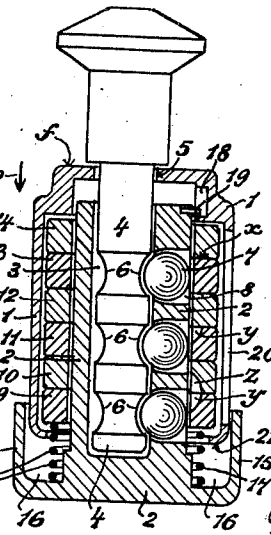


Fig. 3.

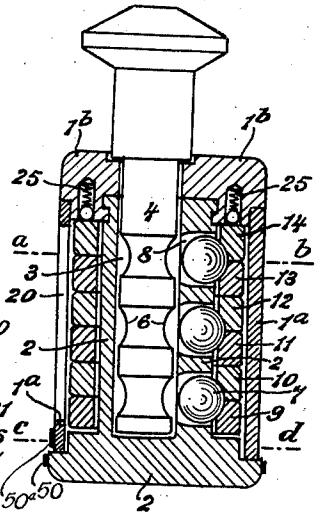


Fig. 6.

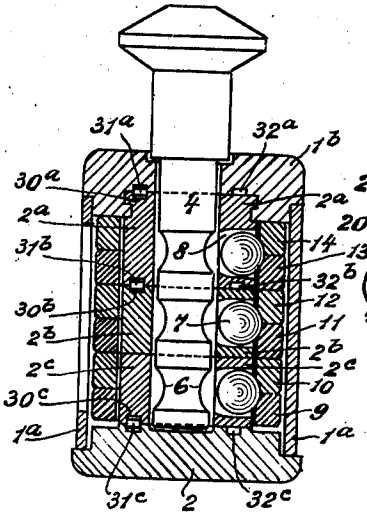


Fig. 4.

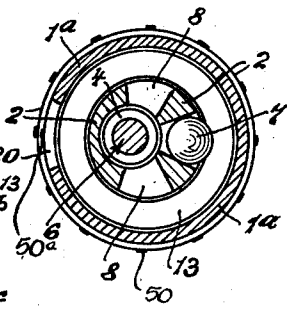
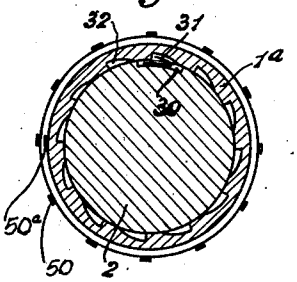


Fig. 5.



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UNITED STATES PATENT OFFICE.

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COMBINATION LOCK.

Application filed November 6, 1925, Serial No. 67,235, and in Austria November 11, 1924.

This invention relates to improvements in combination locks.

Combination locks are already known in which holding members, arranged in zones, are adapted to engage suitably disposed notches of a bolt or the like and thereby lock the same against removal, the said bolt being disengaged only by a certain adjustment of rings, provided with a number of characters. In such devices the holding members enter into corresponding recesses arranged in these character-rings.

One object of the present invention is to improve this type of combination locks and this is accomplished by utilizing unbolting members, (which preferably consist of character or numeral rings), which comprise a number of parts so constructed, that each individual part, irrespective of the position of the other parts of this zone holds the holding members in the locking position until it has been brought into the unbolting position.

Several embodiments of the invention are illustrated in the accompanying description and drawings in which—

Fig. 1 shows in sectional elevation a combination lock with the character-rings in the depressed position, and

Fig. 2 illustrates the lock shown in Fig. 1, but with the character-rings in the regular position.

Fig. 3 shows in sectional elevation a modified combination lock.

Figs. 4 and 5 are sectional plan views of the lock illustrated in Fig. 3, the sections being taken on lines *a*—*b* and *c*—*d* respectively of Fig. 3.

Fig. 6 illustrates in sectional elevation a further modified construction of the combination lock.

In the construction shown in Figs. 1 and 2, the reference character designates the casing of the combination lock and 2 indicates the member for supporting or carrying holding members. These holding members comprise balls 7. The supporting member 2 is provided with a bore or hole 3 for the reception of a locking bolt 4. The latter passes through a hole 5 of the casing 1 and is provided with a number of circumferential notches 6 (in the illustrated embodiment three notches being shown), which are suitably curved inwardly, so that they are adapted to be entered by the ball-shaped holding members 7. The latter are disposed in bores or holes 8, of the wall of the supporting member 2 and, in the bolted condition of the lock, they engage the notches 6 of the bolt 4. A number of pairs of freely rotatable locking rings or locking control members 9—10, 11—12 and 13—14, which correspond to the number of zones of the holding members or notches of the bolt 4, are located on the cylindrical exterior of supporting member 2. In the illustrated embodiment three pairs of such rings are provided. The horizontally disposed contacting faces *x* of the two rings of each pair of rings are located in the horizontal central plane of the respective holding balls. Each of the rings 9, 11 and 13 is furnished with a recess *y*, while each of the rings 10, 12 and 14 is provided with a corresponding recess *z*. When a corresponding pair of the locking rings are properly adjusted their two recesses are associated in the manner shown with respect to the pair of rings 9—10. The inner curved walls of said recesses are then continuous so that the respective balls 7 is adapted to enter the said recesses *y*—*z* and thus disengage the bolt 4 by freeing the notch 6 of the latter. It is obvious that, for securing this result the combined recesses *y*—*z* must be sufficiently deep to permit the ball 7 to enter them sufficiently. If one zone is provided with a number of holding balls 7, which are arranged in corresponding radially disposed holes 8 of the supporting member 2, the pair of rings associated with the respective zone must be provided with a corresponding number of recesses *y* and *z*, which are located so as to correspond to the holes 8 of the supporting member. If the two rings are correctly adjusted the two recesses *y* and *z* thereof are combined to form a spherical segmental shaped recess. Instead of holding balls holding members of any other convenient shape may be employed. Of course, if non-spherical holding members are used correspondingly shaped recesses must be provided in the rings as well as in the bolt.

The lower part of the supporting member 2 is formed with an upwardly directed flange 15, which partly encloses the cylindrical casing 1. A spring 17 is located in the annular space 16 formed by the said flange 15, the said spring having the tendency to continuously and upwardly force the entire set of rings 9 to 14 as well as the casing 1, so that in the normal position the bottom face of a recess 18, provided in the casing 1, abuts a stop 19 secured to the supporting member 2.

By applying suitable force upon the surface *f* of the casing 1, the latter together with the set of rings can be forced down in the direction of the arrow *p* until the device is in the position shown in Fig. 1. In this position the top face of the recess 18 abuts the stop 19. A number of characters (figures, numerals, letters and the like) are provided on the outsides of the rings 9 to 14, and the adjustment of the rings can be controlled through a slot 20 in the casing 1.

In Fig. 1, the casing and set of rings are shown in the depressed position, so that the spring 17 is fully compressed. The pair of rings 9 and 10 has been placed into the opening or unlocking position, so that the recesses *y* and *z* of this pair of rings have been associated to form a spherical segment. Considering the pair of rings 11 and 12, the ring 11 is also disposed in the open or unlocking position, while the ring 12 is in the locking position. As the contacting face *x* of this pair of rings is located in the horizontal central plane of the holding ball 7 of this zone, a sufficiently large surface of this ball rests against the upper ring 12, and in spite of the unlocking position of the ring 11 it cannot be determined by any inspection whether this last mentioned ring is in the unlocking position. The rings 13 and 14 are in the locking position.

In order to prevent any shaking of the holding balls in the unlocked position (as shown with respect to the pair of rings 9 and 10 in Fig. 1), the bolt 4 or the holding ball 7 consists of a permanently magnetized material, which is strongly magnetized before the assembly of the lock, so that the balls remain in the notches of the bolt 4, even if the pair of rings of the corresponding zone are in the unlocking or open position. Of course in this case the other parts of the lock, particularly the rings 9 to 14, must be made of material which cannot be magnetized.

An essential feature of the combination lock according to the present invention consists in that in the ordinary position, i. e. if the spring 17 is completely expanded and assumes the position shown in Fig. 2, the unlocking members or rings 9—14 are shifted such an extent, that an unbroken surface of the said members is presented to the balls 7. Owing to the unstressed condition of the spring 17, all rings are freely rotatable in this position, but any attempt to determine the opening combination fails, because even when the rings are turned through an angle of 360 degrees, the unbroken inner surface or surfaces of the rings slide past the balls.

However it is not possible to determine by manipulation the opening position of the lock in case the same is in the position shown in Fig. 1, i. e. when the rings are in the depressed position, as the rings are strongly pressed against each other and thus cannot be rotated. Even if the rings can be then revolved, they cannot be independently revolved.

Moreover the bottom ring 9, in the depressed condition, is entirely covered by the flange 15 of the supporting member 2 which prevents any attempt to adjust the lock (see Fig. 1).

Further it may be mentioned that the entire set of rings is located in the casing 1 in such a manner, that the rings turn together with the casing. In order to attain this object the bottom end of the casing 1 is turned inward as shown at 21 in Fig. 1.

If it is desired to alter the word or number by which the lock can be unlocked, it is necessary only to change the order of the rings.

Another means to increase the number of opening combinations and thus prevent unauthorized opening of the lock consists in that, as shown in Fig. 3, the sleeve 1^a of the casing is formed separate from the lid or cover 1^b and can be rotated with respect to the holding members, whereby a scale 50 provided on the bottom portion of the supporting member 2 renders it possible to adjust the sleeve to certain positions and to also adjust the slot 20, provided for the adjustment of the rings, or to adjust a mark or sign 50^a provided instead of the said slot. The sleeve 1^a can be fixed in the adjusted position by means of a small locking spring 31, which consists of a folded strip of steel and is disposed partly in a recess 30 in the bottom portion of the supporting member 2 and partly enters one of a number of grooves 32, arranged in the inside of the sleeve 1^a.

In the construction shown in Fig. 3, the entire set of rings 9 to 14 is under the continuous action of springs 25, disposed in cylindrical holes of the casing-lid 1^b.

These springs are of such strength, that the unlocking members 9 to 14 can be rotated by exerting sufficient force, but it is impossible to determine the opening combination because of the great frictional resistance to be overcome to revolve the said members.

A further means of increasing the opening combinations consists in making the holding members or their supporting members adjustable with respect to the rotatable rings, provided with the characters.

According to the construction shown in Figs. 3, 4 and 5 this can be accomplished by providing the support 2 of the holding members 7 with a larger number of holes or passages 8 than holding members 7 (Fig. 4), so that it is possible to place the latter in any of the holes 8 and thus vary and increase the possibility of locking combinations.

Instead of this arrangement or additional to the same, the entire support 2 together with all holding members 7 can be rotated with respect to the rings 9 to 14 and to the casing 1^a (Fig. 3) and can be fixed in this

adjusted position in that the locking spring 31 engages the grooves 32, provided in the sleeve 1^a.

In the modified construction shown in Fig. 6, the support of the holding members is divided or separated into annular members 2^a, 2^b and 2^c, corresponding in number to the number of zones of holding members 7, each annular member being rotatable separately. In order to secure the annular member 2^a in the adjusted position, the same is provided at the top surface with a recess 30^a (similar to Fig. 5) for the reception of a locking spring 31^a, the latter engaging one of a number of grooves 32^a arranged in the lid 1^b of the casing.

By similar locking spring arrangements 30^b, 31^b, 32^b and 30^c, 31^c, 32^c, the members 2^a and 2^b can be secured with respect to each other or the member 2^b can be fixed with respect to the base 2 of the arrangement.

The combination lock can be employed for many objects, such for instance as a padlock, a railway car lock, a safe lock and the like.

I claim—

1. A combination lock comprising in combination a hollow supporting member having superposed holes in the wall thereof, a holding member movably located in each said hole, a bolt having recesses, said bolt being removably located in the supporting member, the said recesses being spaced on the bolt to correspond to the spacing of the said holding members in the holes of the supporting member, locking control members each composed of a plurality of parts revolubly mounted on the said supporting member, one such locking member being associated with each holding member, each part of each said locking member having a recess to permit the entry of a holding member into the recesses of its associated locking member when the parts of the latter are properly adjusted.

2. A combination lock comprising in combination a hollow supporting member having superposed holes in the wall thereof, a holding member movably located in each said hole, a bolt having recesses, said bolt being removably located in the supporting member, the said recesses being spaced on the bolt to correspond to the spacing of the said holding members in the holes of the supporting member, locking control members each composed of a plurality of parts revolubly mounted on the said supporting member, one such locking member being associated with each holding member, each part of each said locking member having a recess to permit the entry of a holding member into the recesses of its associated locking member when the parts of the latter are correctly adjusted, and a spring adapted to continuously force the locking control members into the locking position.

3. A combination lock comprising in combination a hollow supporting member having superposed holes in the wall thereof, a holding member movably located in each said hole, a bolt having recesses, said bolt being removably located in the supporting member, the said recesses being spaced on the bolt to correspond to the spacing of the said holding members in the holes of the supporting member, locking control members each composed of a plurality of parts revolubly mounted on the said supporting member, one such locking member being associated with each holding member, each part of each said locking control member having a recess to permit the entry of a holding member into the recesses of its associated locking control member when the parts of the latter are correctly adjusted, a revoluble casing external to said locking control members and provided with an inspection window, and means for adjusting the casing with respect to the holding members, for the purpose specified.

4. A combination lock comprising in combination a hollow supporting member having superposed holes in the wall thereof, a holding member movably located in each said hole, a bolt having recesses, said bolt being removably located in the supporting member, the said recesses being spaced on the bolt to correspond to the spacing of the said holding members in the holes of the supporting member, locking control members each composed of a plurality of parts revolubly mounted on the said supporting member, one such locking control member being associated with each said holding member, each part of each said locking control member having a recess to permit the entry of a holding member into the recesses of its associate locking control member when the parts of the latter are correctly adjusted, a spring adapted to continuously force the locking control members into the locking position, a revoluble casing external to said locking control member, and means for adjusting the casing with respect to the holding members.

5. A combination lock comprising in combination a hollow supporting member having holes in the wall thereof, a holding member movably located in each hole, a permanently magnetized bolt having recesses and removably located in the supporting member, the said recesses being spaced on the bolt to correspond to the spacing of the said holding members in the holes of the supporting member, composite locking control members each composed of a plurality of parts revolubly mounted on the said supporting member, one such locking control member being associated with each locking member, each part of each locking control member having a recess to permit the entry of a holding member into the recesses of its associated locking control member when the parts of the latter are correctly adjusted.

6. A combination lock comprising in combination a hollow supporting member having superposed holes in the wall thereof, a holding member movably located in each hole, a bolt having recesses and removably located in the supporting member, the said recesses being spaced on the bolt to correspond to the spacing of the said holding members in the holes of the supporting member, locking control members each composed of a plurality of parts revolubly mounted on the said supporting member, one such locking control member being associated with each holding member, in each part of each locking control member having a recess to permit the entry of a holding member into the recesses of its associated locking control member when the parts of the latter are correctly adjusted, and means for adjusting the holding members with respect to the locking control members.

7. A combination lock comprising in combination a hollow supporting member having superposed holes in the wall thereof, a holding member movably located in each hole, a bolt having recesses and removably located in the supporting member, the said recesses being spaced on the bolt to correspond to the spacing of the said holding members in the holes of the supporting member, locking control members each composed of a plurality of parts revolubly mounted on the said supporting member, one such locking control member being associated with each holding member, each part of each locking control member having a recess to permit the entry of a holding member into the recesses of its associated locking control member when the parts of the latter are correctly adjusted, and means for adjusting the supporting member and with the holding members with respect to the locking control members.

8. A combination lock comprising in combination a hollow supporting member comprising a plurality of hollow superposed parts which are turnable with respect to each other, each part of the said supporting member, having a hole in the wall thereof, a holding member movably located in each said hole, a bolt having recesses and removably located in the supporting member, the said recesses being spaced on the bolt to correspond to the spacing of the said holding members in the holes of the supporting member, locking control members each composed of a plurality of parts revolubly mounted on the said supporting member, one such locking control member being associated with each holding member, each part of each locking control member having a recess to permit the entry of each holding member into the recesses of its associated locking control member when the parts of the latter are correctly adjusted, each part of the supporting member being adjustable with respect to its associated locking control member.

9. A combination lock comprising in combination a hollow supporting member having holes in the wall thereof arranged in superposed rows, a holding member movably located in one hole of each row, a bolt having recesses and removably located in the supporting member, the said recesses being spaced on the bolt to correspond to the spacing of the said holding members in the holes of the supporting member, locking control members each composed of a plurality of parts revolubly mounted on the said supporting member, one such locking control member being associated with each row of holding members, each part of each locking control member having a row of recesses to permit the penetration of the holding member of the associated row into the recesses of its associated locking control member when the parts of the latter are correctly adjusted.

10. In a lock, the sub-combination of a hollow casing, a bolt adapted to be removably located within the said casing, a holding member located within the said casing and adapted to engage the said bolt to prevent the removal thereof from the said casing and turnable locking control means having a recess into which the said holding member is adapted to enter at the will of the operator to release it from the said bolt, and resilient means adapted to normally hold the said holding member and said locking control means in a relative position in which the said holding member is adjacent an unrecessed portion of the said locking control means.

In testimony whereof I affix my signature.

HEINRICH BECK.