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TAMPER PROOF COMBINATION LOCK

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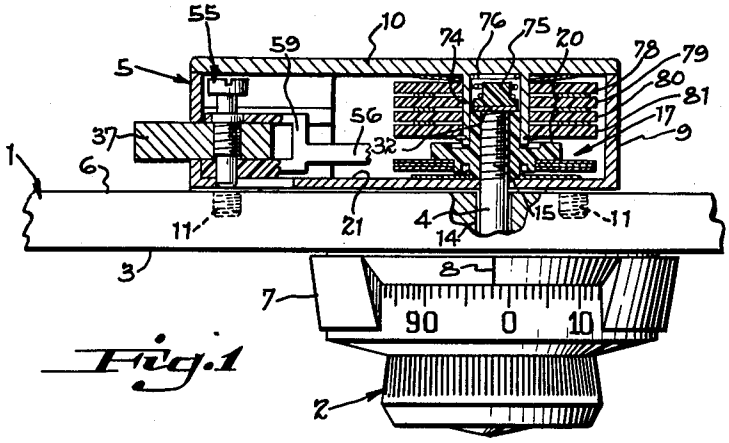


Fig. 1

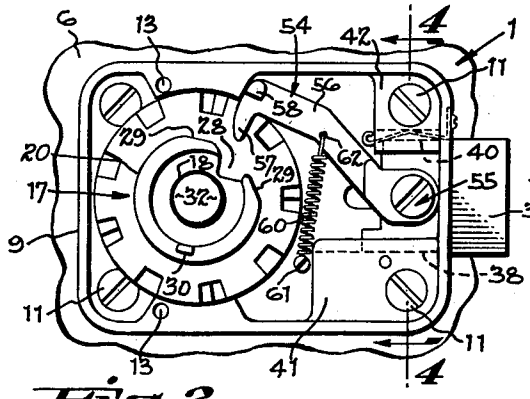


Fig. 2

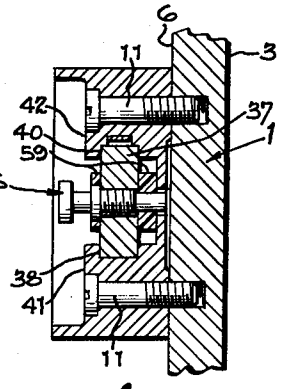


Fig. 4

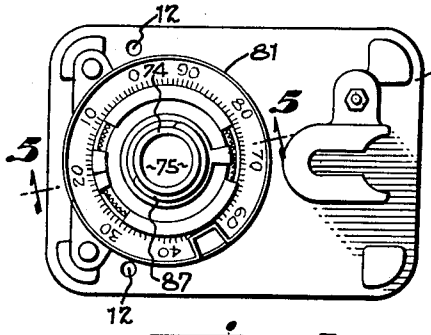


Fig. 3

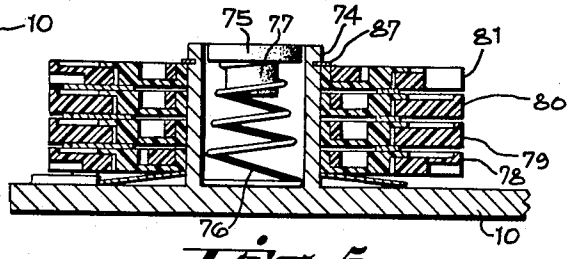


Fig. 5

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TAMPER PROOF COMBINATION LOCK

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Original application Apr. 27, 1960, Ser. No. 25,074. Divided and this application Mar. 20, 1961, Ser. No. 105,841

3 Claims. (Cl. 70—333)

This invention relates to combination locks of the type employed on safes and vaults. It is specifically directed to a combination lock having improved means for protection against unauthorized opening.

This application is a division of my co-pending application Serial No. 25,074, filed April 27, 1960, entitled, "Tamper Proof Combination Lock."

Since the advent of the combination lock a number of methods have been developed by interested persons for surreptitiously opening locks without knowing the proper combination. One of the most effective of these techniques has proved to be the use of sound amplifying equipment to detect noises and/or vibrations created as the dial of the lock is manipulated which may be used in a certain manner to indicate the position of the gates in the tumblers.

Such methods depend in part on the sound and/or feel of very slight but detectable vibrations transmitted to the manipulator through the dial shaft or arbor. A primary object of this invention is the provision in a combination lock of means whereby such variations in sound and feel are damped and are preventsd from being usefully transmitted to the manipulator, whereby the susceptibility of the lock to attack by manipulation is substantially reduced.

Combination locks of the type to which this invention is directed comprise a rotatable dial on the outside of the safe which is coupled through a driver connected to the dial shaft, to a set of circular tumblers in a lock case on the inside of the safe. Each tumbler is provided with a gate in its periphery and is so interconnected to the other tumblers by dogs and lost motion couplings that the gates of all the tumblers can be aligned at a given angular position only by a precise and unique set of left and right turns applied to the dial. When all the gates are aligned with respect to one another and are properly angularly oriented, a fence drops into the slot formed by the aligned gates, simultaneously establishing a drive connection between a notch in the driver and a dog integral with the fence. When the dial is further rotated in the proper direction, the dog draws in the bolt, to which it is connected by an angle bar, so that the lock may be opened. Locks of this general structure are conventional. This invention relates to improvements whereby locks of the character described are enabled to more effectively resist surreptitious attack by the various techniques which have been developed.

Further objectives and advantages of the invention can best be made apparent by reference to the following detailed description of the drawings in which a preferred embodiment of the invention is disclosed.

In the drawings,

FIGURE 1 is a top view, partly in section, of a combination lock in accordance with this invention mounted on a safe door, showing the arrangement of the respective elements in the lock case;

FIGURE 2 is a view of the case with the cover plate removed, showing the bolt in the extended or locked position;

FIGURE 3 is a view of the cover plate subassembly showing the tumblers mounted thereon;

FIGURE 4 is a sectional view taken on line 4—4 of

FIGURE 2 showing the manner in which the bolt is coupled to the angle bar; and

FIGURE 5 is a sectional view through the tumbler and cover plate assembly, taken on line 5—5 of FIGURE 3;

In FIGURE 1, a combination lock incorporating the principles of this invention is shown mounted on a safe door denoted generally by **1**. A dial **2** for setting the combination and operating the lock is located on the outside **3** of the door. The dial is rotatably connected through the safe door by an arbor **4** to the lock assembly proper, which is denoted generally at **5** and is mounted on the inside **6** of the door.

The dial **2** is journalled in a fixed frame **7** provided with an index mark **8**. A series of numbers is embossed around the circumference of the dial in the usual manner.

The invention particularly relates to the lock assembly **5** mounted on the inside of the door. This assembly is enclosed within a generally rectangular housing comprising a hollow case **9** and a cover plate **10**. Certain of the lock elements are mounted from the case while other cooperating elements are mounted on the cover plate, as will be more fully described.

The case **9** is mounted on the safe door **1** by machine screws **11** accessible only from the interior of the case. The cover plate **10** is secured to the case by machine screws (not shown) which pass through openings **12** in the cover plate and are threaded into the case at **13**.

The drive shaft arbor **4** is positively connected to the dial and is journalled in the frame **7**, extending through an opening **14** in the safe door and into the interior of the case. The arbor is externally threaded as at **15** and is provided with a pair of diametrically opposite longitudinal keyways, not shown, at the end which extends into the case.

A driver, which may be conventional, indicated generaly at **17** (FIGURES 1 and 2) is threaded on the arbor in the interior of the case and comprises a hollow cylindrical shaft **18** and a shoulder **20** of large diameter.

The circumference of the shoulder **20** is configurated with a notch **28**, the shape of which can best be seen from FIGURE 2. The portions **29** of the circumference of shoulder **20** on either side of notch **28** constitute inwardly sloping cam surfaces. A drive dog **30** extends outwardly from the forward face of shoulder **20** near its periphery.

The driver is preferably made of nylon so as to be self-lubricating and silent in operation, and is positively keyed to the arbor **4**, onto which it is threaded for axial adjustment, by means of a key having a flat inner end **32** as shown in FIGURE 2. When the dial is turned and the arbor rotated, the driver is thus positively rotated with it.

The bolt **37** of the lock shown for purposes of illustration is a generally rectangular bar which is longitudinally movable in slots **38** and **40** respectively presented by two corner blocks **41** and **42** formed integrally with the case. When the bolt is in the position shown in FIGURE 2 in which it extends outwardly through an opening in the case wall, its outer end engages a cooperating slot in the safe frame, not shown, whereby the safe door is locked. Withdrawal of the bolt inside the case permits the door to be opened. The bolt is freely slidable in slots **38** and **40** so that it may readily be drawn in when the proper combination has been set. The two corner blocks **41** and **42** and the slots milled in them are shown in section in FIGURE 4. It will be seen that the bolt is spaced by the slots from the case bottom **21** to provide room for the jaws of the angle bar, as will be described.

Movement of the bolt in slots **38** and **40** is governed by angle bar generally designated by **54**, which connects the inner end of the bolt to the driver **17** once the proper combination has been set, so that an angular rotation of

the driver is transformed into a linear movement of the bolt. At one end, the angle bar is provided with a clevis **59**, to straddle the bolt. The clevis is pivotally connected to the bolt by a stud **55**.

Shank **56** of the angle bar **54** extends diagonally from the bolt to the upper part of the case, above the driver. At its other end, the angle bar has a downwardly extending dog **57** for engagement in the notch **28** with the driver. A fence **58** extends laterally from the angle bar adjacent the dog and is so arranged that when the dog **57** engages notch **28**, the fence engages the aligned gates. A tension spring **60** is connected from a post **61** presented by the case to a point **62** on the shank **56** of the angle bar so that the bar is constantly urged downwardly (counterclockwise in FIGURE 2), whereby dog **57** rides on the periphery of shoulder **20**.

The vibration damping means to which this invention relates is preferably mounted to the cover plate assembly shown in FIGURES 1 and 3. This assembly is held to the case by mounting screws not shown.

Extending into the interior of the case from the plate **10** in axial alignment with arbor **4** is a hollow cylindrical bearing **74**. When the cover plate is mounted on the case, this bearing **74** encircles the outer portion of arbor **4** and driver shaft **18**. In accordance with a preferred embodiment of the vibration damping mechanism of this invention, a nylon friction plug **75** and a compression spring **76** is set inside bearing **74**. The diameter of the coils of spring **76** is such that the spring holds itself frictionally inside the bearing, while a small coil at the end of the spring is press-fitted around the neck **77** of plug **75**.

Rotatably journalled on bearing **74** are the lock tumblers, four in the embodiment shown, numbered **78**, **79**, **80** and **81**. More or fewer may be used as desired. The tumblers themselves may be of known type, for example of the type described in my previously referred to application Serial No. 25,074, filed April 27, 1960, and need not be described in detail herein.

The lock is opened by rotating dial **2** to the left and right in accordance with the combination to which the lock has been set. Since this operation is conventional and well understood, it need not be described here in detail. During the setting of the combination, until all the gates are aligned, dog **57** rides upon the periphery of the driver, fence **58** being spaced a slight distance outwardly of the tumblers so that the tumbler gates cannot be located by "feel" as the fence moves past them. When the

driver has been rotated to a position corresponding to that in FIGURE 2, the dog gradually moves off cam surface **29** and attempts to drop into notch **28**; if the gates are unaligned then the fence is slowly lowered onto the circumference of one or all the tumblers, and remains thereon until dog **57** is gently raised by the cam surface **29** on the other side of the notch.

Once the gates have been aligned, dog **57** is permitted to engage notch **28**, the fence simultaneously moving into the gates. As the driver is now rotated counterclockwise dog **57** is driven to the left, the angle bar pulling stud **55** with it, the bolt sliding in slots **38** and **40**.

While it is possible that detectable sounds or contacts otherwise might be transmitted through the arbor as it is rotated, providing a basis for attack on the lock, I have found that the friction plug **75** functions to isolate the arbor from the source of such contacts. In the assembled lock, spring-loaded plug **75** bears frictionally on the end of key **32** and damps or prevents any "feel" from being transmitted through the arbor.

While I have described a preferred embodiment of the sound damping means of this invention, the invention is not limited to that embodiment alone but also includes other modifications and variations coming within the scope of the following claims.

Having described my invention, I claim:

1. In a combination lock having rotatable tumblers and an arbor for turning said tumblers, means frictionally bearing directly against the inner end surface of said arbor to dampen vibrations established therein when said tumblers are rotated.

2. In a combination lock having rotatable tumblers and an arbor for turning said tumblers, a plug spring urged into frictional contact with the end of said arbor to dampen vibrations established upon the rotation of said tumblers.

3. A combination lock according to claim 2 wherein said plug is made of nylon.

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