March 6, 1951 C. J. FINKE ET AL 2,544,305

MULTIPLE KEY LOCKING SYSTEM

Filed July 28, 1948

Fig. 1.

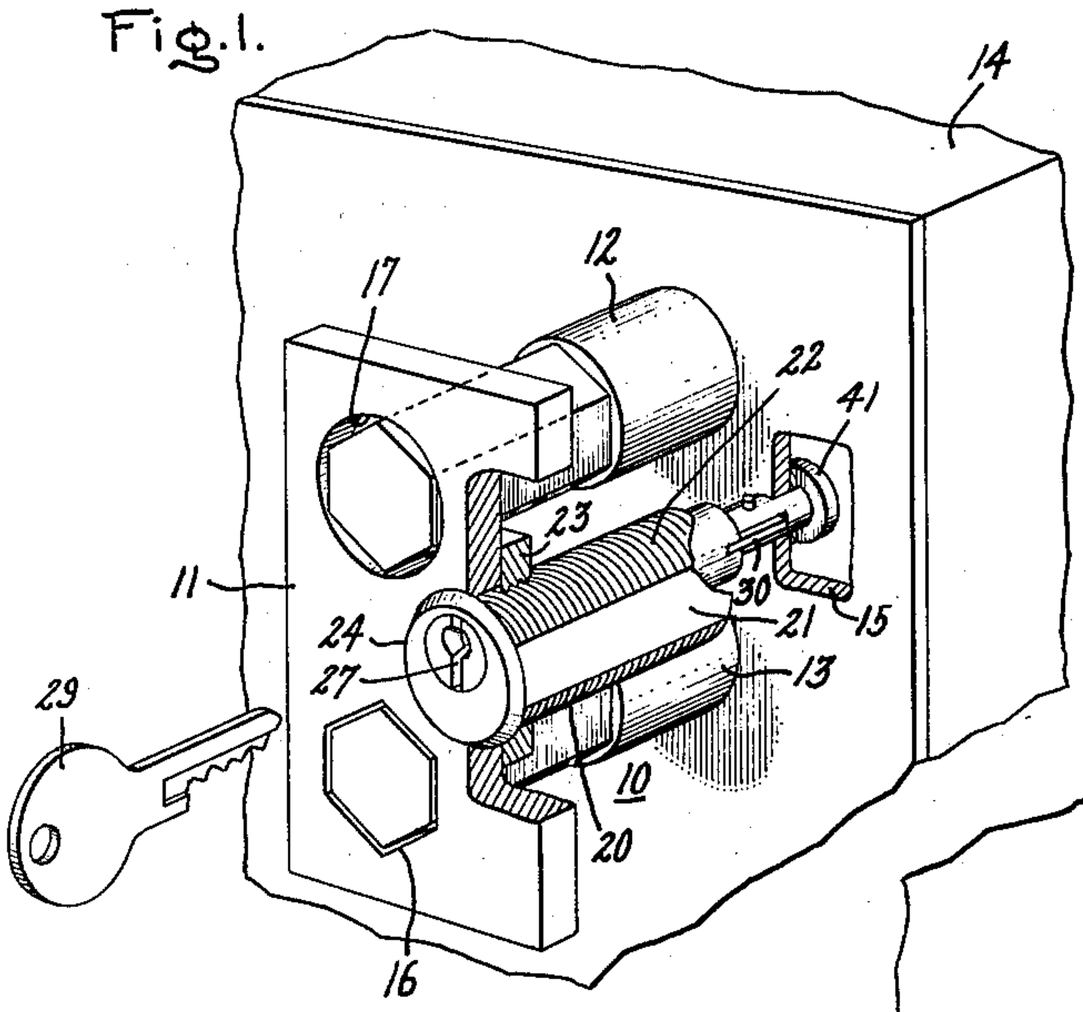


Fig. 5.

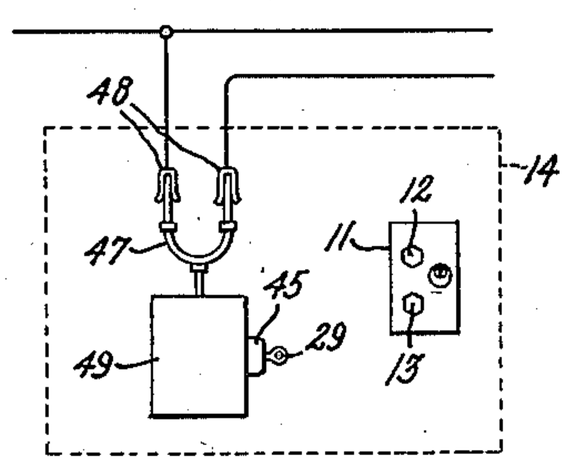


Fig. 2.

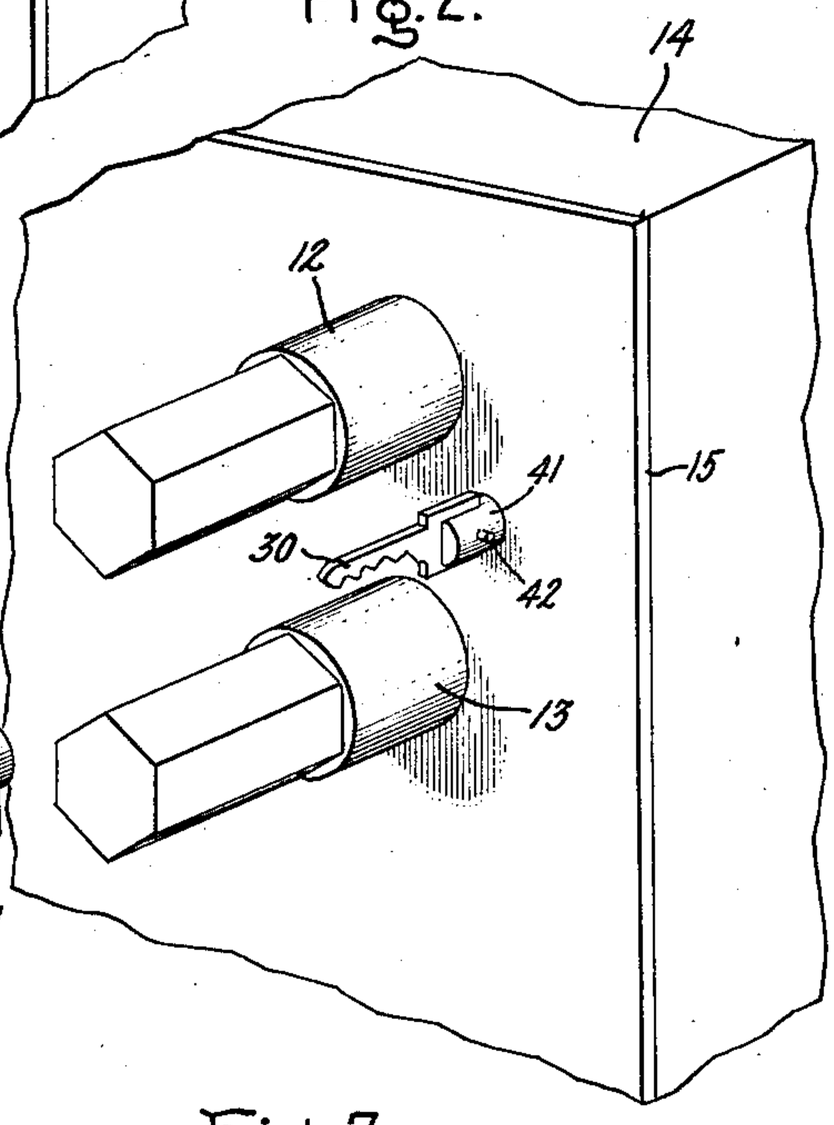


Fig. 6.

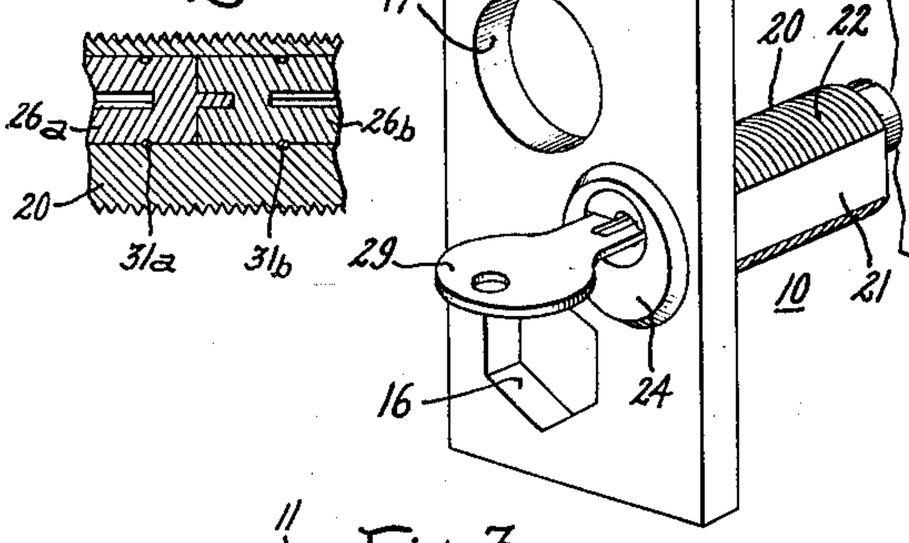


Fig. 7.

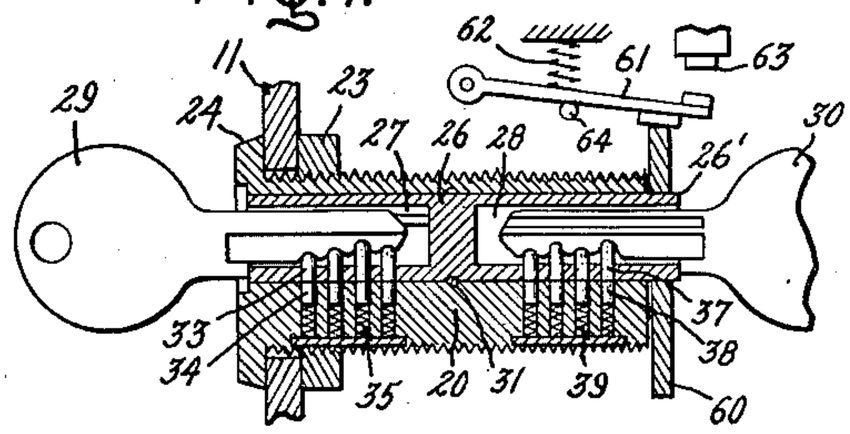


Fig. 3.

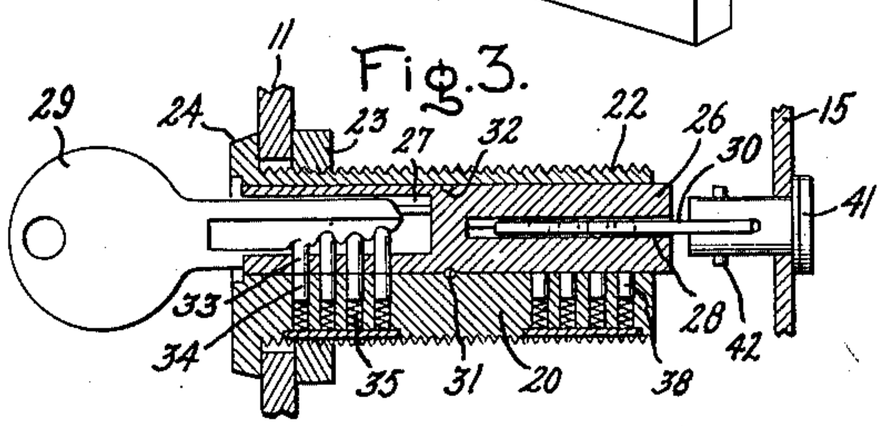
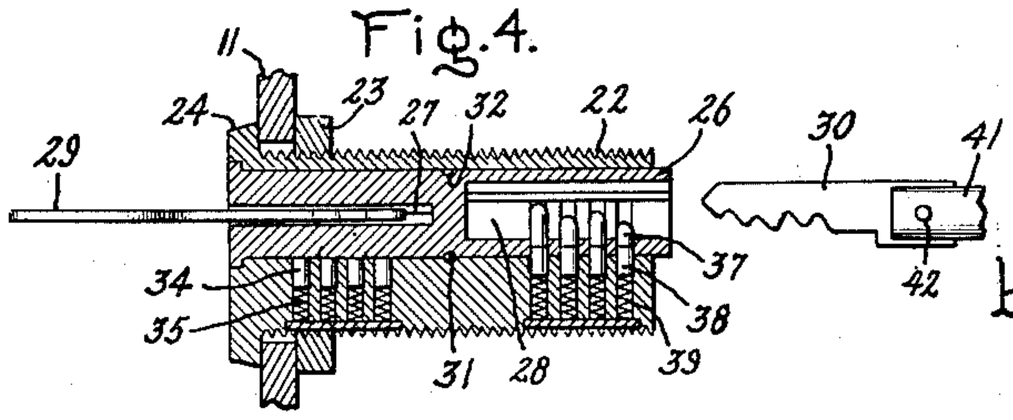


Fig. 4.



Inventors:
Christian J. Finke,
Miguel A. Guzman,
by Ernest C. Britton
Their Attorney.

Patented Mar. 6, 1951 2,544,305

UNITED STATES PATENT OFFICE

2,544,305

MULTIPLE KEY LOCKING SYSTEM

Christian J. Finke, Drexel Hill, and Miguel A. Guzman, Philadelphia, Pa., assignors to General Electric Company, a corporation of New York

Application July 28, 1948, Serial No. 41,094

4 Claims. (Cl. 70—265)

1

The invention relates to multiple-key locking systems particularly interlocking systems involving a plurality of locks.

One object is to provide an improved double-end double-key form of cylinder locking device that may be used with advantage in switchgear safety interlocking systems or other similar service where it is desired to enforce predetermined locking operations by means of two separately and oppositely removable keys.

Another object is to provide an improved double-key cylinder locking device with angularly related outwardly open key-receiving slots and detents at opposite ends thereof so as to enable one of the keys to become detached for unlocking another lock only while the double-key locking device is locked to the other key thereof.

Thus in accordance with one form of the invention one of the keys may be permanently fixed so that a movable interlocking member or door or the like carrying the double-key lock body must always be locked to the relatively fixed key in a predetermined position before the other key can be detached for unlocking another lock.

Another object is to provide an improved double-key cylinder lock having cooperating sets of detents relatively angularly displaced so that each key locks the cylinder in a different angular position and is locked in the cylinder when the other key is removed.

Further objects and advantages of the invention will appear in the following description of the accompanying drawing and its scope will be pointed out in the appended claims.

In the drawings Fig. 1 is a perspective view partly in section of a typical switchgear interlock embodying the double-key sequential locking improvement of the present invention with the parts shown in the locked interlocking position and with one of the keys of the double-end double-key locking device removed; Fig. 2 is a similar perspective view of the interlocking mechanism shown in Fig. 1 with the movable interlock member out of its interlocking position so that the removable key shown in Fig. 1 is locked in the lock; Figs. 3 and 4 are cross-sectional views of the improved double-key double tumbler cylinder lock carried by the removable interlocking member shown in Figs. 1 and 2 with the double-end key receiving cylinder in the different angular positions that permit removal of the corresponding key; Fig. 5 schematically shows a typical switchgear interlocking system in which the interlocking mechanism of Figs. 1 and 2 may be applied; Fig. 6 is a fragmentary view of a slightly modified

2

form of double-end tumbler cylinder construction and Fig. 7 shows a further planar aligned key and tumbler modification of the double-end double-key cylinder lock construction adapted for separately and oppositely removable double key switch interlocking or other similar service.

In Fig. 1, the improved double-key locking device embodying the improvements of the present invention is designated generally by the reference character 10 and is shown applied to lock a movable interlocking member 11 in interlocking engagement with the hexagonal ends of the rotatable high and low speed driving shafts 12 and 13 of an ordinary form of circuit breaker elevating or position-changing mechanism indicated generally by the reference character 14 so as to positively prevent rotation of either shaft when the interlocking member 11 is in its interlocking position as shown. To accomplish this purpose with minimum strain on the lock 10 the interlocking member 11 is provided with an hexagonal socket opening 16 for receiving the hexagonal end of the low speed shaft 13 therein and with a cirular opening 17 for receiving the hexagonal end of the high speed shaft 12 therein so as to mechanically block the shaft 13 against rotation and thereby prevent operation of the elevating mechanism 14 until the interlock member 11 is removed.

The improved locking device 10 is provided with a block or body 20 having the usual opposite flattened sides 21 for mounting the lock in a correspondingly shaped opening formed in the interlock member 11 or the like and with the usual threaded sides 22 for threaded engagement with the clamping nut 23 to clamp the interlock member 11 between the flanged nose 24 of the block 20 and the clamping nut 23.

As indicated more clearly in the sectional views of Figs. 3 and 4 the lock 10 is provided with a double tumbler cylinder 26 that is rotatably mounted in the block or body 20 and is held against axial movement in the body 20 by a pin 31 that engages with a corresponding channel or groove 32 extending circumferentially around the cylinder 26. The rotatable cylinder 26 is provided with angularly displaced outwardly open key-receiving slots 27 and 28 in the opposite ends thereof for the corresponding removable key 29 and the relatively fixed key 30 so as to require removal and insertion of the two keys in opposite axial directions.

The removal key 29 which also is used for unlocking another lock has registering engagement with a set of cylinder tumblers 33 carried in suit-

able bores formed in the cylinder 26 in radial alignment with the key slot 27 so as to align the ends of the cooperating set of body tumblers 34 carried in a row of bores in the block or lock body 20 and thereby free the cylinder 26 for rotation when the key 29 is inserted in the slot 27 as shown in Fig. 3. Each of the body tumblers 34 is provided with a spring 35 for raising the tumbler into locking engagement with the cylinder bores of the corresponding tumbler 33 when the key 29 is withdrawn from slot 27 for unlocking the other lock while at the same time locking cylinder 26 against rotation from the angular position shown in Figs. 1 and 3.

In accordance with the present invention the key-receiving slot 28 at the opposite end of the cylinder 26 is angularly displaced from the key-receiving slot 27 and this is also true of the set of cylinder tumblers 37 that are carried in suitable bores formed in radial alignment with the key slot 28 for cooperation with the row of body tumblers 38 carried in suitable bores formed in the body 20. Furthermore, as shown in both Figs. 3 and 4 the row of body tumblers 38 is formed in alignment with the row of body tumblers 34 in the body 20 while the cylinder tumblers 37 are angularly displaced from the tumblers 33 in the cylinder, this displacement being 90° in the preferred form of lock illustrated. When key 30 is withdrawn from slot 28 in the cylinder 26 or vice versa in case key 30 is relatively fixed, the row of block tumblers 38 are forced upwardly by the springs 39 so as to positively lock the cylinder 26 against rotation from the angular position shown in Fig. 4 thereby effectively preventing removal of the key 29 from slot 27 at the opposite end of the cylinder.

Thus, whenever key 20 is inserted in slot 27 to rotate cylinder 26 to the angular position shown in Fig. 4 wherein key 30 can be removed from slot 28, then the key 29 becomes locked in the cylinder by the engagement of tumblers 33 therewith and vice versa. Hence the key 29 can be removed and used for unlocking another lock only when the lock body 20 is locked to the key 30 as shown in Figs. 1 and 3 but is irremovably held in the slot 27 when the cylinder 26 is turned to a different angular position such as shown in Fig. 4 wherein the lock body 20 can be released from the fixed key 30.

If desired, the modified cylinder construction illustrated in Fig. 6 may be used in the double-key double tumbler form of lock. As shown in Fig. 6, a pair of rotatable cylinders 26*a* and 26*b* are provided with interlocking dove-tailed ends to insure rotation of both parts in unison in the body 20 of the lock. In this case each one of the cylinder parts is held against axial movement in the body by means of separate pins 31*a* and 31*b* which cooperate with circumferential grooves in substantially the same way as previously described. Each of the cylinder parts 26*a* and 26*b* is provided with a key slot and a set of cylinder bores that are angularly displaced in the same way as previously described.

With the improved angularly displaced double-key lock construction of the present invention, it will be evident that as shown in Fig. 1 the interlocking member 11 is locked in its interlocking position by the engagement of the fixed key 30 with the set of tumblers 37 in the cylinder 26 and the cylinder 26 is locked against rotation by engagement of the row of tumblers 34 with the bores formed in the cylinder. As shown the relatively fixed key 30 is rotatably attached to the wall 15

of the elevating mechanism 14 by means of a headed swivel member 41 that extends through the wall 15 with the key 30 secured thereto by the pin 42. Thus the relatively fixed key 30 can rotate in the wall 15 about the axis of the headed swivel member 41 but cannot be removed therefrom.

In order to remove the interlocking member 11 from its interlocking position as shown in Fig. 1 so as to permit rotation of shaft 13 of the breaker elevating mechanism 14, it is necessary first to insert the key 29 in the slot 27 and thereby align the cooperating tumblers 33 and 34 to permit rotation of cylinder 26 so as to bring slot 28 and tumbler set 37 at the opposite end of the cylinder into alignment with the row of block tumblers 38. Thereupon the interlocking member 11 may be bodily removed from its engagement with the shafts 12 and 13 with the locking device 10 carried along therewith out of engagement with the fixed key 30 and key 29 non-removable from the slot 27 as shown in Fig. 2. Consequently, the only way that key 29 can be made accessible for unlocking another lock 45 such, for example, as shown in Fig. 5 is to replace the interlock member 11 into interlocking engagement with the shafts 12 and 13, thereby inserting key 30 in slot 28 and aligning the tumblers 37 and 38 so as to permit rotation of the cylinder 26 by means of the key 29 to return tumblers 33 into alignment with tumbler 34 and in this way permit removal of key 29. During such enforced sequential operation key 30 is rotated 90° along with the cylinder 26 so as to again lock the interlock member 11 in its interlocking position before the key 29 can be removed. Thus the interlock 11 must be in its interlocking position before key 29 becomes available for unlocking the lock 45 which is fastened to the solenoid mechanism 49 of the breaker 47. The solenoid mechanism 49 is the means for opening and closing the contacts of breaker 47. Only when the breaker 47 which as schematically shown in the interlocking system of Fig. 5 is raised by the elevating mechanism 14 into engagement with disconnect 48, can the breaker contacts be closed. To remove the breaker from the housing the first thing is to lock the breaker open with key 29 in lock 45, remove key 29 and place in the interlocking member 11, unlock and remove the interlocking member 11 from the shafts 12 and 13. The key 29 cannot now be removed from the interlock 11, and now by means of the elevating mechanism 14 the breaker can be lowered for removal from the housing.

In this way the improved locking device of the present invention effectively insures that the circuit breaker 47 can be closed by operation of the solenoid 49 only when the interlocking member 11 is locked in its interlocking position to prevent operation of the elevating mechanism 14. Conversely the interlocking member 11 can be removed only when the key 29 is inserted in slot 27 after removal from the lock 45 with this lock locked in position to prevent operation of the solenoid 49 and at the same time effectively insure no operation of the breaker.

It should be understood however that the improved locking device of the present invention is not limited in its application to the circuit breaker interlocking system illustrated schematically in Figs. 1 and 5, but may be applied to other forms of interlocking members or to doors or the like in any service where it is a desire to enforce a predetermined sequence of locking operations.

Furthermore, it will be understood by those

skilled in the art that many of the advantages of the present invention can be obtained when the key slots **27** and **28**, together with the cylinder tumblers **33** and **37**, are formed in planar alignment in cylinder **26** and the row of body tumblers **34** is angularly displaced 90° from the row of body tumblers **38** in the lock body **20**. Thus with either the relative angularly displaced detent construction illustrated in the drawings or the alternative relative angularly displaced detent construction just described, the double-key lock has a rotatable cylinder provided with a key-receiving slot at each end thereof and cooperating relatively angularly-displaced tumblers for locking the cylinder in different angular positions with a corresponding one of the keys locked therein. Furthermore, each key locks the cylinder in a separate angular position and is locked in the cylinder when the other key is removed.

In the modified form of the invention shown in Fig. 7, the essential parts of the double key lock **10** are substantially the same as previously described so as to require removal and insertion of the two keys in opposite axial directions except that the outwardly open key slots **27** and **28** are formed in planar alignment in the opposite ends of the rotatable cylinder **26** and the two sets of cylinder detents **33** and **37** as well as the cooperating sets of body detents **34** and **39** also are formed in planar alignment in the cylinder **26** and in the lock body **20**. Furthermore, an operating cam **60** is fixedly secured to the projecting end **26'** of the rotatable cylinder **26** so as to operate a suitable interlocking device such, for example, as the pivotedly mounted switch member **61**. As shown, the switch member **61** is biased to the open position by the compression spring **62** so as to normally disengage the cooperating switch contact **63** and rest against the stop **64** when the lock **10** is in its unlocked position in which it is shown in Fig. 7.

Thus, in order to close the interlocking switch **61** into engagement with contact **63** so as to complete an electric interlocking circuit, both of the keys **29** and **30** must be inserted into their respective slots at the opposite ends of the cylinder **26** before the cooperating sets of cylinder and body detents **33**, **34** and **37**, **39** are brought into alignment to permit free rotation of the cylinder **26** in the barrel **20** so as to rotate cam **60** to close the interlock switch. Hence, if key **29** is in the possession of one person and key **30** in the possession of another person, it is necessary that both persons insert their respective key in the lock before the interlocking switch can be closed and opened by operation of either key. Furthermore, when the interlocking switch is closed, both keys are locked in the lock and it is only when the interlocking switch is open that either key can be removed to unlock another lock.

It will be evident to those skilled in the art that many of the advantages of the present invention can be obtained when the cylinder **26** is fixedly mounted and the lock body **20** arranged to be rotated on the cylinder along with an interlocking cam member or the like only when the two keys **29** and **30** are each inserted in their respective slots in the opposite ends of the cylinder. In this case both keys become locked in the lock when the body **20** is rotated so as to angularly displace the two sets of body tumblers **34** and **39** from the cooperating sets of cylinder tumblers **33** and **37**. Consequently, neither key can be removed for unlocking another lock unless the lock body **20** together with its interlocking member

carried thereby is in a predetermined interlocking position wherein the body and cylinder tumblers are in planar alignment.

What we claim as new and desired to secure by Letters Patent of the United States is:

1. A double-key sequential locking device having a pair of separately removable keys and a rotatable cylinder provided with an outwardly open key-receiving slot in each end thereof to require removal and insertion of the two keys in opposite axial directions and cooperating relatively angularly-displaced tumblers for locking the cylinder in different angular positions with a corresponding one of the keys locked therein when the other key is removed.

2. A double-key sequential locking device having a pair of separately removable keys and a body provided with tumblers, a cylinder rotatably mounted in the body and provided with an outwardly open key-receiving slot to require removal and insertion of the two keys in opposite axial directions and cooperating tumblers at each end thereof having a relative angular displacement with respect to the body tumblers whereby each key upon removal locks the cylinder in a separate angular position and upon insertion is locked in the cylinder when the other key is removed.

3. A double-key sequential locking device having separately removable keys and comprising a pair of interconnected tumbler locks in opposing alignment and having a common body and an interconnected pair of cylinders rotatable as a coaxial unit in the body and each provided with an outwardly open key-receiving slot to require removal and insertion of the two keys in opposite axial directions, and cooperating relatively angularly displaced tumblers in the body and cylinder whereby each key upon removal locks the cylinders in a separate angular position and upon insertion is locked in the corresponding cylinder when the other key is removed.

4. A double-key locking device having a pair of separately removable keys and comprising a tumbler lock body having two rows of body tumbler bores formed in alignment therein, a cylinder rotatably mounted in the body and provided with angularly displaced outwardly open key-receiving slots at the opposite ends thereof in opposite moval and insertion of the two keys in opposite axial directions and angularly displaced tumbler bores formed therein in cooperating axial alignment with the body bores, and cooperating tumbler sets mounted in the body and cylinder bores whereby each key upon removal locks the cylinder in a different angular position and upon insertion is locked in the cylinder when the other key is removed.

CHRISTIAN J. FINKE.
MIGUEL A. GUZMAN.

REFERENCES CITED

The following references are of record in the file of this patent:

UNITED STATES PATENTS

Number	Name	Date
1,409,094	Greenison	Mar. 7, 1922
2,126,333	Kirk	Aug. 9, 1938
2,220,786	Grainger	Nov. 5, 1940
2,336,936	Johnson	Dec. 14, 1943

FOREIGN PATENTS

Number	Country	Date
329,162	Italy	Sept. 2 1935

Certificate of Correction

Patent No. 2,544,305 March 6, 1951

CHRISTIAN J. FINKE ET AL.

It is hereby certified that error appears in the printed specification of the above numbered patent requiring correction as follows:

Column 6, line 48, strike out the words "in opposite" and insert instead *to require re-*;

and that the said Letters Patent should be read as corrected above, so that the same may conform to the record of the case in the Patent Office.

Signed and sealed this 19th day of June, A. D. 1951.

[SEAL]

THOMAS F. MURPHY,
Assistant Commissioner of Patents.