July 19, 1938. R. K. GRAY 2,123,940

CYLINDER LOCK

Filed Feb. 29, 1936

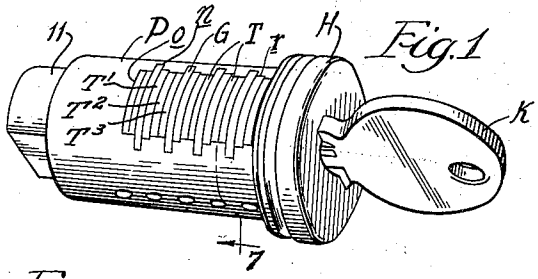


Fig. 1

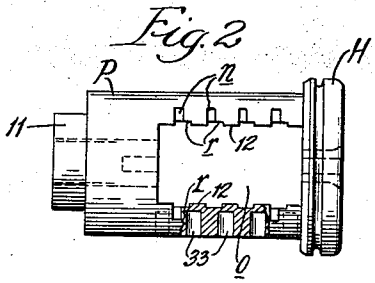


Fig. 2

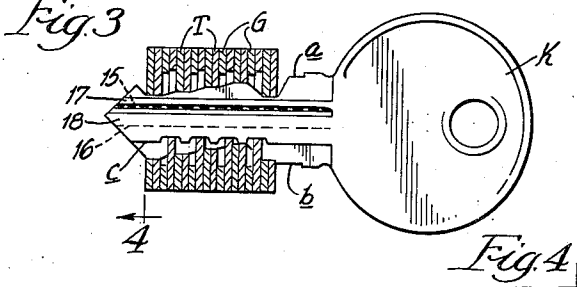


Fig. 3

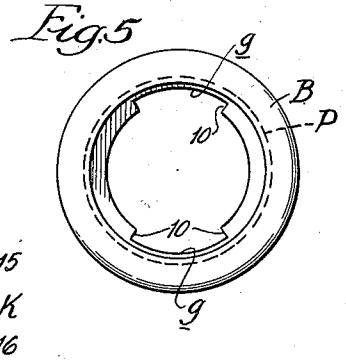


Fig. 5

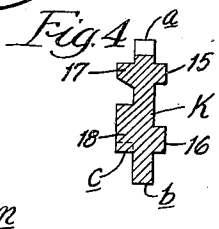


Fig. 4

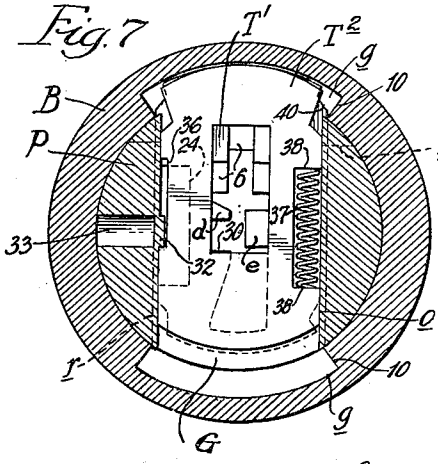


Fig. 7

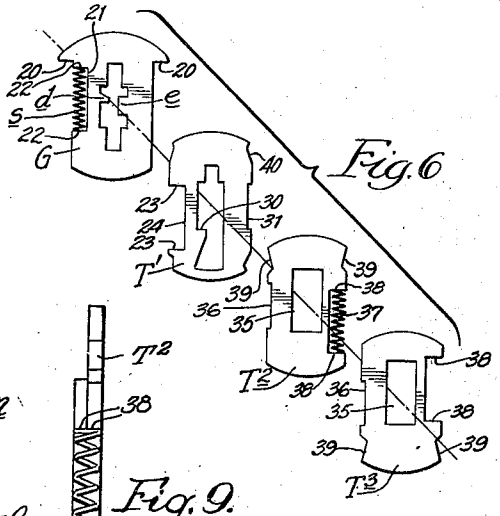


Fig. 6

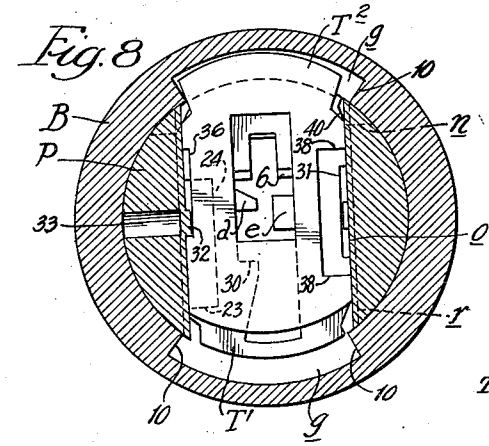


Fig. 8

Fig. 9.

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CYLINDER LOCK

Raymond K. Gray, Chicago, Ill.

Application February 29, 1936, Serial No. 66,458

19 Claims. (Cl. 70—364)

The present improvements have to do with a cylinder lock employing key-operated tumblers in conjunction with key guides which have a floating mounting such that the key may be inserted or removed with a minimum of friction and be directed through an axial path even though the tumblers themselves be supported in slightly offcenter positions.

For its objects my invention is concerned with an assembly of tumblers and guides which may be economically produced, which will be difficult to pick, and which will otherwise fulfill satisfactorily the usual requirements of a lock. All such objects, as well as others to be hereinafter disclosed, are attainable in a construction of which a suggestive embodiment is illustrated in the accompanying drawing in the manner following:

Fig. 1 is a view in perspective of the plug-guide-tumbler assembly;

Fig. 2 is a view in elevation of the plug showing the through opening therein from which the guide-tumbler assembly has been removed;

Fig. 3 is a longitudinal section through the guide-tumbler assembly removed from the plug alongside one piece of the operating key therefor which is shown in elevation;

Fig. 4 is an enlarged transverse section through the key, taken on line 4 of Fig. 3;

Fig. 5 is a view in elevation of the barrel end into which the plug is adapted to be fitted;

Fig. 6 is a view of the four units comprising the guide-tumbler assembly, separated and arranged in their proper order;

Fig. 7 is an enlarged transverse section taken on line 7 of Fig. 1, showing the parts in their normal locking positions, the key being omitted;

Fig. 8 is a view similar to Fig. 7, but showing the parts in the position they would occupy while undergoing picking, the key being omitted from this view; and

Fig. 9 is a view in elevation looking toward the side edges of two adjacent primary tumblers showing an associated spring co-acting therewith to project the two tumblers in opposite directions.

The present lock comprises a cylindrical barrel B recessed at one end to receive the head H of a plug P which is fitted rotatably within the barrel, all as is common practice. Extending lengthwise of the barrel interiorly thereof are opposite grooves *g* having radial side walls 10. The plug, as shown, is of cylindrical form with a boss 11 or eccentric device at its end opposite the head, and intermediately of its ends is transversely slotted to provide a through opening *o* which is wide and elongated to receive a plurality of tumblers T and guides G, the former of which have capacity for a sliding movement transversely of the plug. When actuated by springs (to be presently described), the tumblers are shifted endwise to enter at their ends into one or the other of the barrel grooves whereby to lock the plug and barrel against relative rotation; but when the proper key K is fitted into the plug the several tumblers are oppositely shifted so that their ends are aligned and removed from the barrel groove, thereby freeing the plug for rotation.

The features of improvement which characterize this invention are concerned largely with the plug-tumbler-guide assembly and the coaction of these parts with the barrel and with the operating key. As indicated clearly in Figs. 1 and 2, the plug opening *o* is provided with certain pairs of opposed shallow slots *r* (here shown as four in number), each receiving the opposite edges of a plate guide G. The space between each pair of guide plates is sufficient for the accommodation of three plate tumblers T′, T^2, and T^3, the two latter being termed "primary". The first of these tumblers, i. e., the one which is "secondary", may be slightly different in form and width so as to fit into the shallow recess *r* along with the guide G. In this position, the secondary tumbler is slidingly confined by the guide on one side and by a step 12 on the other side. The primary tumblers are supported slidingly by the steps, the relationship of each guide plate, together with the associated tumblers, being indicated in Fig. 6 where these elements are shown spaced apart in their proper order. Beyond one of the end guide plates additional primary tumblers may also be used, as shown in Fig. 1.

The opposite ends of all guides and tumblers are desirably convex so as to conform in the case of the guide plates, to the periphery of the plug P and, in the case of the tumblers, to the bottoms of the barrel grooves which are of like form. In addition, internal slots are provided in the guides and tumblers, that for the guide plate having a form which is substantially the same as the cross sectional form of the key K which, as shown, (see Fig. 4) comprises a relatively thin body having a pair of spaced longitudinal ribs 15 and 16 extending along one side, together with a further rib 17 opposite the former, and a ledge 18 close to the rib 17 but spaced slightly therefrom. Upon opposite key edges *a* and *b* and upon the ledge *c* are formed cams or bits for engaging with the plate tumblers, as will be presently explained.

The guide plate slot, as will be noted from Fig. 6, is complementary to the key in that it is shaped in conformity therewith, being provided with a pair of inwardly extending opposed lugs *e* and *d* so located as to occupy positions between the ribs **15** and **16** on one side of the key, and the rib **17** and ledge **18** on its opposite side. It will be noted that the edge of the rib **17** proximate to the ledge is inclined to widen the entrance to the space therebetween, and the lug *d* is provided with one correspondingly inclined edge. This special cross sectional form of key and guide slot therefor assures that no key which is otherwise formed can be inserted into the lock.

One end of each guide plate is formed with a head laterally extended to provide a pair of shoulders **20** adapted to be received in notches *n* which open off of the slots *r*. In addition an elongated recess **21** is formed in one side edge of the plate for the reception of a coiled spring *s* whose opposite ends exert thrusts against shoulders **22** at the ends of the recess **21** and at the ends **23** of a similar recess **24** in the side edge of the secondary tumbler T′ which lies adjacent thereto. The locations of these recesses with respect to the ends of each pair of guide and tumbler plates, respectively, are such that they align only when the plate ends are misaligned, whereby the spring *s* tends to project one plate end beyond the other. The position of each guide plate in the plug is fixed by its enlarged head engaging in the notches *n* and held therein by the proximate internal surface of the barrel just beyond its grooves *g*, the guide plate being free to float or reciprocate to a slight extent between the bottom of the notches *n* and the internal surface of the barrel B, the spring *s* tending to press the guide plate into the notches *n*. The secondary tumbler is free to slide endwise to project one end into the proximate barrel groove.

As shown, the secondary tumblers are slightly wider than the primary tumblers, and their side edges extend straight to a point close to both ends thereof where these edges are slightly inset as at **40** and then incline outwardly again to provide in effect a notch. Internally each secondary tumbler is provided with an elongated slot for reception of the key K. To one side of this slot is a shallow recess of sufficient length to accommodate the key rib **17** and ledge **18** the cam face *c* of which is adapted to engage a lug **30** which extends into the tumbler slot at one end of the recess. The key slot in this tumbler extends beyond this lug a considerable distance, so that the end thereof will be close to the convex end of the tumbler and beyond the corresponding ends of the key slots in the primary tumblers presently to be described. The side edge of the tumbler opposite the recess **24** is shallowly recessed at **31** to receive, if desired, an extruded boss **32** produced by a tool entering the body of the plug through a radial opening **33**. By using such an expedient the several tumblers may be locked slidingly in the plug once they have been assembled therein.

The primary tumblers T^2 and T^3 which are alike are arranged inversely with respect to each other. Each of these tumblers has an internal slot **35** which may be rectangular in form with dimensions such as to closely surround the key. The slot is located with reference to the cam formations on the opposed key edges *a* and *b*. In one side edge of the tumbler is a shallow recess **36** wherein an extruded boss **32** may be received, and in the opposite side edge of the tumbler, closer to one end than the other, there is a deeper recess for a coiled spring **37** whose opposite ends exert thrust against the end shoulders **38** (see Fig. 9). When assembled in the plug, a single spring acting on a pair of primary tumblers tends to project them into misalignment with one end of each disposed in one of the barrel grooves *g* whereby to lock the plug against rotation. The side edges of each tumbler, adjacent its end which is projected into locking engagement with the barrel, are notched with an inclined surface as at **39** corresponding in angle to the notches **40** at the ends of the side edges of the secondary tumbler. The positions of the slots **35** with reference to the key cam edges *a* and *b* are such that the primary tumblers are brought into alignment upon insertion of the key, thereby freeing the plug for rotation.

In the assembled lock, the secondary tumblers coact only with the ledge or offset cams of the key. The primary tumblers respond to engagement from the opposed edge cams of the key. The guide plates direct and support the key. The mounting of these guides is a floating one, i. e., there is a slight tolerance which permits the shoulders of these plates to move away from their supporting notches as required for accommodation of the key in an axially centered position within the barrel. The width of the secondary tumblers is such as to occupy the full space between the walls **10** of each barrel groove, and in consequence the primary tumblers are thereby centered so as to prevent interference with the movements of such tumblers in entering or leaving the barrel grooves, and reduce to a minimum resistance to insertion or withdrawal of the operating key. The key opening through the plug head is sufficiently large to allow the key freedom of movement for such purpose. This is important so as to overcome manufacturing inaccuracies.

In the event an attempt is made to pick the lock, it is usual to rotate the plug to create a side pressure on the tumblers. This pressure is applied only to the secondary tumblers in the present lock, because of their greater width and the extension of their straight side edges into the barrel groove to completely fill the space between the radial walls **10**, as shown in Fig. 7. The primary tumblers accordingly remain free of side pressure. It thereupon becomes necessary to pick the secondary tumblers in order that the plug may be rotated to the position of Fig. 8 where, it will be noted, the maintenance of a rotary force will apply a side pressure to all the tumblers. To advance further with the picking, all primary tumblers must be moved—a difficult operation because the primary tumblers must be picked on the opposite ends of their slots and each secondary tumbler at points between opposite ends of the primary tumbler slots, which are guarded in part by the lug *d* of the guide. Furthermore, resistance to movement of all tumblers is afforded by engagement of their side notches with the plug. If an effort be made to rake the tumblers, it will be found that, because of the greater length of the slots in the secondary tumblers, the lower ends of such slots (as viewed in Fig. 6) lie below the corresponding ends of the primary tumbler slots, thereby making it impossible for the picking tool to align the secondary tumblers with the primary tumblers.

Reference to Fig. 3 will indicate a definite relationing between the cams on the opposed key edges and the opposite slot ends of the primary

tumblers. The lengths of these slots correspond with the distance between the two sets of key cams just noted at the points where engagements occur, so that the primary tumblers are of the double bitted type, i. e., they may be key-actuated, both ways. With the key inserted, as shown in the drawing, the primary tumblers are positively aligned and secured against sliding movement in either direction. The secondary tumblers which are single bitted are engageable as at **30** by the offset cams *c* on the key having a relationship to the remaining cams and the primary tumblers engaged thereby such as to cause the secondary tumblers to align therewith, thereby freeing the plug for rotation within the barrel. The primary tumblers, furthermore, are grouped in pairs, and while two in number are in effect as one. This results from the fact that each pair of such tumblers is adapted to be engaged by the same key cam (see Fig. 3). The presence of the second tumbler in each such pair renders picking more difficult and also provides for sliding movement of one tumbler ahead of the other in response to longitudinal movement of the key. The definite relationing of the several cam surfaces to the tumblers which are operated thereby extends, therefore, even to the key bits which engage each pair of primary tumblers, as just noted.

I claim:

1. In a lock, the combination of a hollow barrel having a longitudinal groove internally thereof, a plug adapted for rotative mounting in the barrel provided with a longitudinal key slot and a transversely extending through opening, a plurality of plate tumblers within the plug opening adapted to slide transversely of the plug into and out of interlocking relation with the groove in the barrel, all of the tumblers being slotted for reception therethrough of a flat key and certain of the tumbler slots having edges positioned for engagement by cams on one key edge and other of the tumbler slots having edges positioned for engagement by cams which are offset with respect to and remote from the cammed key edge, and key guides interposed between certain of the tumblers disposed within the plug opening and limitedly movable transversely therein in a manner to float as required for alignment with the key.

2. In a lock, the combination of a hollow barrel having opposed longitudinal grooves internally thereof, a plug adapted for rotative mounting in the barrel provided with a longitudinal key slot and a transversely extending through opening, a plurality of plate tumblers within the plug opening adapted to slide transversely of the plug into and out of interlocking relation with the grooves in the barrel, all of the tumblers being slotted for reception therethrough of a flat key and certain of the tumbler slots having edges positioned for engagement by cams on one key edge, other of the tumbler slots having edges positioned for engagement by cams which are opposite the key edge first named, and still other of the tumbler slots having edges positioned for engagement by cams which are offset with respect to and remote from the cammed key edge first named, and key guides interposed between certain of the tumblers disposed within the plug opening and limitedly movable transversely therein in a manner to float as required for alignment with the key.

3. In a lock, the combination of a hollow barrel having opposed longitudinal grooves internally thereof, a plug rotatably fitted in the barrel and formed with a longitudinal key slot and a transversely extending through opening, a series of plate tumblers disposed within the plug opening adapted for sliding movement into and out of interlocking relation with the grooves in the barrel, separately formed guide plates between certain of the tumblers extending transversely across the plug opening and serving to separate the tumblers into groups, coacting means on the plug, barrel and guide plates providing a floating mounting for the latter, all of the tumblers and guide plates being slotted for reception therethrough of a flat key having two opposed and one offset cam edges, and certain of the tumbler slots having edges positioned for engagement by one or the other of the opposed cam edges of the key and other of the tumbler slots having edges positioned for engagement by the cam edge which is offset with respect thereto.

4. In a lock, the combination of a hollow barrel, a plug rotatably fitted into the barrel, a plurality of groups of plate tumblers slidable transversely of the plug for interlocking engagement with the barrel, each group comprising primary and secondary tumblers all slotted to receive therethrough a flat key having edge cams and other cams offset with respect thereto, one set of tumblers having slot edges so positioned as to be engaged by the edge cams of the key and the other set of tumblers having slot edges so positioned as to be engaged by the offset cams of the key, one end of the slots in one set of tumblers being disposed a greater distance from the barrel axis than are the corresponding slot ends in the other set of tumblers, and key guides interposed between certain of the tumblers and limitedly movable transversely of the plug in a manner to float as required for alignment with the key.

5. In a lock the combination of a hollow barrel, a plug rotatably fitted into the barrel, a plurality of groups of plate guides and plate tumblers, the latter slidable transversely of the plug for interlocking engagement with the barrel, each group comprising a guide plate and a plurality of tumblers all slotted to receive therethrough a flat key having edge cams, a floating mounting for the plate guides on the plug such that they may shift slightly as required for centering of the key, the tumblers having slot edges so positioned as to be engaged by the key cams whereby to move into or out of interlocking engagement with the barrel.

6. In a lock, the combination of a hollow barrel having a longitudinal groove internally thereof, a plug rotatably fitted within the barrel and formed with a longitudinal key slot and a transversely extending through opening, an assembly of plate tumblers and plate guides disposed within the plug opening, the former adapted for sliding movement into and out of interlocking relation with the groove within the barrel, co-acting means on the barrel, plug and guide plates providing a floating mounting for the latter, all of the tumblers and guide plates being slotted for reception therethrough of a flat key having cams adapted to engage with the tumblers for actuation thereof.

7. In a lock, the combination of a hollow barrel having a longitudinal groove internally thereof, a plug rotatably fitted in the barrel and formed with a longitudinal key slot and a transversely extending through opening, a series of primary and secondary plate tumblers disposed within the plug opening adapted for sliding movement into

and out of interlocking relation with the barrel groove, all of the tumblers being slotted for reception therethrough of a flat key having two sets of cams one adapted to engage only the primary tumblers and the other only the secondary tumblers, the points of engagement for the secondary tumblers being closest to the axis of the barrel, and key guides interposed between each series of tumblers disposed within the plug opening and limitedly movable transversely therein in a manner to float as required for alignment with the key.

8. In a lock, the combination of a hollow barrel having a longitudinal groove internally thereof, a plug rotatably fitted within the barrel and formed with a longitudinal key slot and a transversely extending through opening, a plurality of primary and secondary tumblers arranged in groups and disposed within the plug opening adapted for sliding movement into and out of interlocking relation with the barrel groove, the secondary tumblers being slightly wider than the primary tumblers and the opposed walls of the plug through opening being further spaced at points opposite the secondary tumblers for accommodation thereof, all of the tumblers being slotted for reception therethrough of a flat key having a plurality of sets of cams adapted to engage respectively with the primary and secondary tumblers for actuation thereof.

9. In a lock, the combination of a hollow barrel having a longitudinal groove internally thereof, a plug rotatably fitted within the barrel and formed with a longitudinal key slot and a transversely extending through opening, a plurality of primary and secondary tumblers each recessed along one edge between its opposite ends and arranged in groups disposed within the plug opening adapted for sliding movement into and out of interlocking relation with the barrel groove, means integral with one of the plug walls, displaced therefrom and engaging within the side recesses of certain of the tumblers in a manner to limit sliding movements thereof whereby to prevent disassembly of the tumblers from the plug, all of the tumblers being slotted for reception therethrough of a flat key having a plurality of sets of cams adapted to engage respectively with the primary and secondary tumblers for actuation thereof.

10. In a lock, the combination of a hollow barrel having a longitudinal groove internally thereof, a plug rotatably fitted within the barrel and formed with a longitudinal key slot and a transversely extending through opening, a plurality of plate tumblers and guides arranged in groups each comprising one guide, a secondary tumbler and two primary tumblers in the order named, the several groups of plate tumblers and guides being disposed within the plug opening and the tumblers being adapted for sliding movement into and out of interlocking relation with the barrel groove, all of the tumblers and guides being slotted for reception therethrough of a flat key having two opposed and one offset sets of aligned cams and certain of the tumbler slots having edges positioned for engagement by one or the other of the opposed sets of cams, and the slots of the secondary tumblers having edges positioned for engagement by the set of cams which is offset with respect to the other sets of cams, and means affording a floating mounting for the guides in the plug.

11. In a lock, the combination of a hollow barrel having a longitudinal groove internally thereof, a plug rotatably fitted within the barrel and formed with a longitudinal key slot and a transversely extending through opening, the spaced walls defining the through opening in the plug being provided with opposed steps forming between them a series of recesses, a guide plate and a tumbler disposed within the plug opening with their opposed edges fitted slidingly into the recesses thereof, other tumblers disposed within the plug opening having their opposed edges fitted slidingly against the steps thereof, all of the tumblers being adapted for sliding movement into and out of interlocking relation with the barrel groove, means affording a floating mounting for each guide in the plug, all of the tumblers and guides being slotted for reception therethrough of a flat key having multiple sets of cams certain of which are adapted to engage only with the primary tumblers and others of which are adapted to engage only with the secondary tumblers, for actuation thereof, the slots in the latter set of tumblers being extended lengthwise thereof for a substantially greater radial distance in one direction than in the primary set of tumblers.

12. In a lock, the combination of a hollow barrel having a longitudinal groove internally thereof, a plug rotatably fitted within the barrel and formed with a longitudinal key slot and a transversely extending through opening, a series of primary and secondary plate tumblers disposed within the plug opening adapted for sliding movement into and out of interlocking relation with the grooves in the barrel, one set of tumblers being wider than the other and the width of the through opening in the plug being correspondingly greater opposite such wider tumblers for reception thereof, all of the tumblers being provided near one end with opposed edge notches, those in the wider set of tumblers being closer to the tumbler ends than those in the other set of tumblers, whereby the wider set of tumblers will engage first with the opposite walls of the barrel grooves in the event of forced rotation of the plug, all of the tumblers being slotted for reception therethrough of a flat key having a plurality of sets of cams adapted to engage respectively with the primary and secondary tumblers for actuation thereof.

13. In a lock, the combination of a hollow barrel having opposed longitudinal grooves internally thereof, a plug rotatably fitted within the barrel and formed with a longitudinal slot, a plurality of double bitted tumblers extended transversely through the plug and slidably supported thereby adapted for movement into and out of interlocking relation with the barrel grooves, the tumblers being juxtaposed in pairs and the tumblers in each pair having means engageable simultaneously by the same key bit, and key guides interposed between the various pairs of tumblers disposed within the plug slot and limitedly movable transversely therein in a manner to float as required for alignment with the key.

14. In a lock, the combination of a hollow barrel having opposed longitudinal grooves internally thereof, a plug rotatably fitted within the barrel and formed with a longitudinal slot, a single bitted tumbler and a pair of double bitted tumblers extended transversely through the plug in group formation and slidably supported thereby adapted for movement into and out of interlocking relation with the barrel grooves, the several tumblers being provided with means definitely related to multiple sets of bits on a key such that all tumblers may thereby be aligned with both double bitted tumblers engaged simultaneously by the same key

bit, and key guides interposed between each group of tumblers disposed within the plug slot and limitedly movable transversely therein in a manner to float as required for alignment with the key.

15. In a lock, the combination of a hollow barrel having opposed longitudinal grooves internally thereof, a plug rotatably fitted within the barrel and formed with a longitudinal slot, a plurality of double bitted tumblers extended transversely through the plug and slidably supported thereby adapted for movement into and out of interlocking relation with the barrel grooves, the tumblers being juxtaposed in pairs and the tumblers in each pair having means engageable simultaneously by the same key bit, and a key guide having a floating mounting within the plug.

16. In a lock, the combination of a hollow barrel having opposed longitudinal grooves internally thereof, a plug rotatably fitted within the barrel and formed with a longitudinal slot, a single bitted tumbler and a pair of double bitted tumblers extended transversely through the plug in group formation and slidably supported thereby adapted for movement into and out of interlocking relation with the barrel grooves, the several tumblers being provided with means definitely related to multiple sets of bits on a key such that all tumblers may thereby be aligned with both double bitted tumblers engaged simultaneously by the same key bit, and a key guide having a floating mounting within the plug.

17. In a lock, the combination of a hollow barrel having opposed longitudinal grooves internally thereof, a plug rotatably fitted within the barrel and formed with a longitudinal slot, and a plurality of tumblers extended transversely through the plug and slidably supported thereby adapted for movement into and out of interlocking relation with the barrel grooves, one of the tumblers being of greater width than the remainder.

18. In a lock, the combination of a hollow barrel having opposed longitudinal grooves internally thereof, a plug rotatably fitted within the barrel and formed with a longitudinal slot, and a plurality of tumblers extended transversely through the plug and slidably supported thereby adapted for movement into and out of interlocking relation with the barrel grooves, one of the tumblers being of greater width than the remainder and having notches in opposite edges near an end thereof for engagement with the plug in the event of forced rotation.

19. In a lock, the combination of a hollow barrel having a longitudinal groove internally thereof, a plug rotatably fitted within the barrel and formed with a longitudinal key slot and a transversely extending through opening, and a plurality of key-operated flat tumblers each recessed along one edge between its opposite ends arranged within the plug opening adapted for sliding movement into and out of interlocking relation with the barrel groove, and means integral with one of the plug walls displaced therefrom and engaging within the side recesses of certain of the tumblers in a manner to limit sliding movements thereof whereby to prevent disassembly of the tumblers from the plug.

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