June 26, 1962 E. N. JACOBI 3,040,557

CYLINDER LOCK

Filed March 7, 1960

Fig. 1.

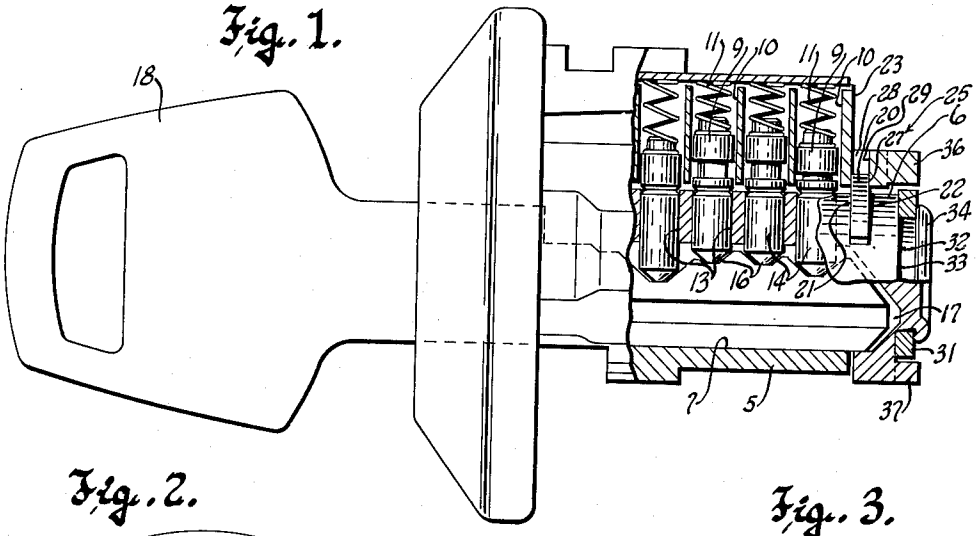


Fig. 2.

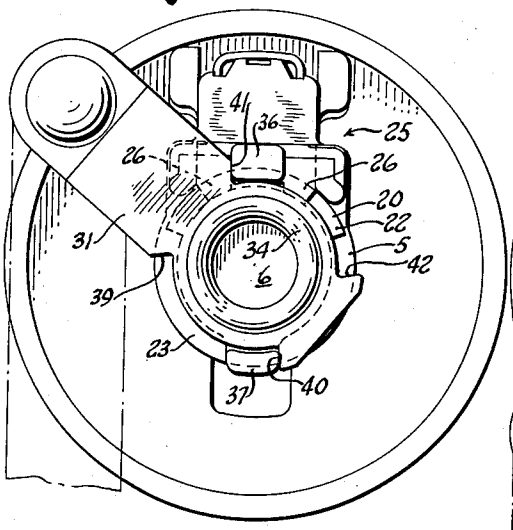


Fig. 3.

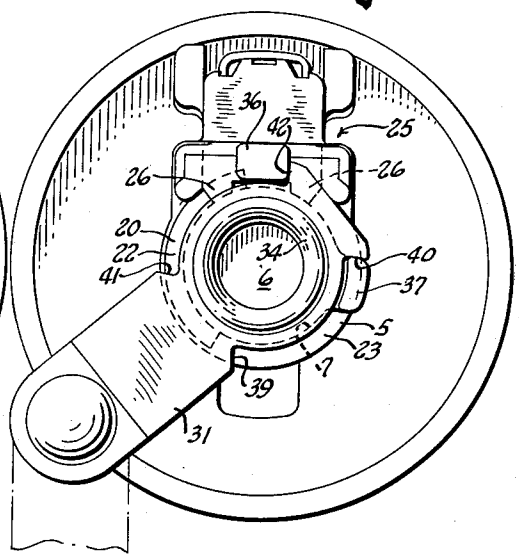
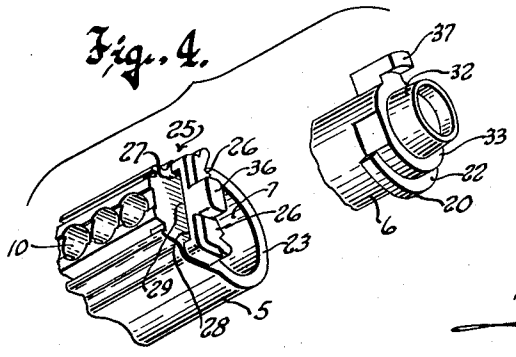


Fig. 4.



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CYLINDER LOCK

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This invention relates to lock mechanisms and has more particular reference to cylinder locks, especially those of the pin tumbler type.

In locks of that type, the lock cylinder is releasably secured against rotation in a sleeve-like casing, in which it is housed, by means of spring biased pin tumblers having portions normally disposed partly in the casing and partly in the cylinder. The tumblers are radially retractable to free the cylinder for rotation by means of so-called drivers in the cylinder, which are actuated by a proper key upon its insertion into the cylinder.

One of the most annoying problems in the manufacture of pin tumbler locks of the character described has for long been the difficulty of limiting the axial motion or end play of the rotary lock cylinder to the degree necessary to assure against objectionable misalignment of the radial tumbler and driver bores in the casing and cylinder, respectively, during times when the key is inserted into or removed from the cylinder. At such times axial forces are imposed upon the cylinder tending to slide it forwardly or rearwardly in its casing, to cause misalignment between the radial bores in the cylinder and casing in which the tumblers and drivers operate. Even slight misalignment at such times prevents free and unobstructed entrance of the drivers into the casing bores and precludes proper retraction of the tumblers to inoperative positions at which the cylinder may be rotated in its bore.

One expedient widely resorted to in the past to minimize end play of the rotatable cylinder in its bore and assure proper entrance of the drivers into the lock casing during key insertion and/or removal, is disclosed in my Patent No. 2,105,659, dated January 18, 1938. As therein disclosed the cylinder is held against objectionable endwise displacement in the casing bore by a flat plate-like retainer which is imbedded in a transverse slot in the casing and has an inner edge portion that projects through the wall thereof into an annular groove in the adjacent external part of the cylinder.

In pin tumbler locks of that type, however, production methods of manufacture made it impossible to restrict end play of the rotatable lock cylinder to less than a few thousandths of an inch. For that reason it was customary to compensate for this small amount of end play of the cylinder and the resulting misalignment of the tumbler and driver bores, as well as for normal wear of the lock parts, through the provision of axially elongated tumbler bores in the lock casing. Such a construction is likewise disclosed in my aforesaid Patent No. 2,105,659.

This invention has as its purpose, to provide a pin tumbler lock mechanism of the character described wherein end play of the rotatable lock cylinder is held to a minimum of only a few thousandths of an inch, without resorting to the use of special cylinder retaining plates such as were heretofore necessary and which involved an additional piece part and assembling step in the manufacture of the lock mechanism.

More specifically, it is a purpose of this invention to provide a pin tumbler lock mechanism of the character described wherein the lock cylinder is held against axial displacement by means comprising interengaging male and female elements which are formed integrally with the cylinder and its casing at the time they are die cast, and which interengaging elements are located at the tumbler and driver sides of the casing and cylinder, respectively.

In this respect it is a more specific object of this invention to provide cylinder retaining means of the character described which comprises an accurately die cast partial flange on the exterior of the rotatable lock cylinder, at its rear, which is engageable in an accurately formed transverse slot in the lock casing in which the cylinder rotates, to hold end play of the cylinder to within a few thousandths of an inch and thereby minimize the danger of misalignment between the driver and tumbler receiving bores of the mechanism during key insertion and/or removal.

Still another object of this invention resides in the provision of interengaging cylinder retaining elements of the character described which function to retain the cylinder against rearward displacement from its bore throughout the entire normal range of cylinder rotation, but which retaining elements are disengaged from one another in any angular position of the lock cylinder beyond said normal range of rotation thereof.

In this respect, it is also a purpose of this invention to provide a rotatable cylinder lock of the character described wherein the cylinder carried retaining flange constrains the cylinder to axial assembly motion into the rear of its casing while the cylinder occupies an angular position of rotation beyond its normal range of rotation, and wherein a latch arm connected to the rear of the lock cylinder after its proper assembly in the casing cooperates with abutments on the cylinder and the casing to preclude rotation of the cylinder beyond a normal range necessary to effect movement of the latch arm between locking and unlocking positions.

A further object of this invention resides in the provision of a rotatable cylinder lock of the character described wherein rotation of the lock cylinder in either direction from a key inserting and withdrawing position effects locking and/or unlocking rotation between defined limits of a latch arm, journaled on a bearing carried by the rear of the cylinder and having a lost motion driving connection therewith.

With the above and other objects in view which will appear as the description proceeds, this invention resides in the novel construction, combination and arrangement of parts substantially as hereinafter described and more particularly defined by the appended claims, it being understood that such changes in the precise embodiment of the herein disclosed invention may be made as come within the scope of the claims.

The accompanying drawing illustrates one complete example of the physical embodiment of the invention constructed according to the best mode so far devised for the practical application of the principles thereof, and in which:

FIGURE 1 is a side elevational view of a pin tumbler lock mechanism embodying this invention, portions thereof being broken away and shown in longitudinal section;

FIGURE 2 is a rear elevational view of the mechanism seen in FIGURE 1, showing the cylinder in its key inserting and removing position and the latch arm at one extreme of motion;

FIGURE 3 is a view similar to FIGURE 2 showing how rotation of the cylinder is limited by the latch arm when the latter reaches its other extreme of motion; and

FIGURE 4 is a fragmentary separated perspective view, taken from the rear, illustrating the manner in which the cylinder is assembled into its casing.

Referring now more particularly to the accompanying drawing, in which like reference characters have been applied to like parts throughout the views, the numeral 5 designates the sleeve or casing of a more or less con-

ventional pin tumbler lock mechanism, such as may be mounted on the door of an automobile to control locking and unlocking of the latch mechanism on the door as a consequence of rotation of a lock cylinder **6** in the bore **7** of the sleeve.

As is conventional in pin tumbler locks, the cylinder is normally held against rotation out of its key inserting and withdrawing position seen in FIGURES 1 and 2 by means of a plurality of tumblers **9** freely slidably received in axially equispaced radial bores **10** in the casing or sleeve **5**. The tumblers are biased radially inwardly by light springs **11** toward operative positions at which the inner ends of the tumblers project into radial bores **13** in the cylinder to lock the cylinder against rotation. The bores **13** normally register with the tumbler bores **10** and each contains a driver **14**.

The springs **11** maintain the tumblers and their respective drivers in end to end engagement, and the drivers have rounded inner ends **16** which project into a keyway **17** in the cylinder for engagement by the notched edge of a key **18** inserted into the keyway. The key, of course, acts through the drivers to lift the tumblers **9** to positions at which their lower ends are flush with the exterior of the cylinder, thus allowing it to be turned in either direction out of its key inserting and removing position.

While the bores **13** in which the drivers **14** are slidably received are perfectly cylindrical, the bores **10** in which the tumblers operate are slightly elongated axially of the casing so as to accommodate a small degree of axial end play of the cylinder without interfering with free movement of the drivers into the tumbler bores as is necessary for key insertion and removal.

As indicated in FIGURE 4, the assembly of the rotatable lock cylinder with the sleeve must be effected by axial insertion of the cylinder into the rear of the sleeve. This follows by reason of the fact that the cylinder is provided with an arcuate transverse flange **20** which projects from its exterior, near the rear of the cylinder. The flange has front and rear faces **21** and **22**, respectively, which are perfectly flat and lie in parallel planes normal to the cylinder axis. The front face **21** of the flange abuts the rear **23** of the casing or sleeve to limit forward axial motion of the cylinder in its bore. Rearward axial displacement of the cylinder is substantially precluded by means of a ledge **25** on the casing or sleeve, projecting axially rearwardly therefrom, and having circumferentially spaced retaining lugs **26** which extend inwardly behind the cylinder flange **20** to hold it contiguous with the rear **23** of the sleeve.

The retaining lugs **26** thus cooperate with the rear of the casing or sleeve to define a groove **27**, opening inwardly toward the axis of the cylinder, in which the cylinder flange **20** is snugly but slidingly received to substantially preclude axial motion of the cylinder in its bore.

It is a feature of this invention that the transverse flange **20** on the rear of the cylinder and the groove **27** in the rear of the casing in which the flange is slidingly confined, constitute cylinder retaining means that are very accurately formed during die casting of the cylinder and casing. The usual procedure for forming parts such as the flange **20** during die casting of a lock cylinder, has been to produce the flange at the junction between mating axially separable die parts. That procedure, however, gives rise to considerable variation in the flange thickness and can even result in the provision of stepped or otherwise malformed opposite faces **21** and **22** thereon.

In the lock mechanism of this invention, however, the flange and the groove **27** in which it is to be received are located at the tumbler bore sides of the cylinder and sleeve, and are so formed during die casting, each by a radially slidable die part, as to enable their dimensions to be easily held to very close tolerances, of about a few thousandths, to thus produce mating surfaces that are extremely accurately located. It is for this reason that the groove **27** in the casing or sleeve **5** is formed by a core

slot **28** which extends radially through the ledge **25**. The rearwardly facing side of the slot is coplanar with and forms an upward extension of the end surface **23** on the sleeve, and the forwardly facing side **29** of the slot defines the front surfaces of the retaining lugs **26**. The slot **28**, of course, can be very accurately formed during die casting by an accurately machined blade that is mounted in the die casting mold for in and out radial sliding motion.

The provision of such accurately formed cylinder retaining means, of course, assures against such axial displacement of the cylinder as hitherto prevented the key **18** from being freely inserted into or removed from the cylinder, which is an annoyance that results when misalignment between the tumbler and driver bores prevents the drivers from entering the tumbler bores.

Upon insertion of a proper key **18** into the cylinder, the tumblers release the cylinder for rotation in either direction out of its key inserting and withdrawing position shown in FIGURES 1 and 2. Such rotation of the cylinder is translated into locking or unlocking motion of a latch arm **31** on the rear of the lock mechanism, so as to enable the latch mechanism of a door upon which the lock mechanism may be mounted to be controlled by the lock cylinder.

The latch arm is a metal stamping, and it is a feature of this invention that the latch arm **31** is freely rotatably mounted on a bearing **32** projecting from the rear of the lock cylinder, coaxial therewith. The bearing **32** is slightly smaller in diameter than the cylinder so as to form a rearwardly facing shoulder **33** at its junction therewith, against which the front face of the latch arm engages to be loosely held thereagainst by securing means **34** engaging over the rear face of the arm. As shown, the securing means **34** for the latch arm may comprise a rolled over rim on a hollow rear end portion of the bearing.

Referring to FIGURE 2, it will be noted that the casing or sleeve is provided with a rotation stop **36** which projects rearwardly from the ledge **25** and is located directly over and thus diametrically opposite a drive lug **37** on the rear of the cylinder when the latter is in its key inserting and removing position shown. The inner end of the latch arm **31** extends substantially diametrically across the rear of the lock cylinder, between the stop **36** and lug **37**. Hence, the arm has one portion at all times located between the drive lug **37** and the rotation stop **36** at one side of the vertical plane containing the latter, and another portion at the opposite side of said plane which likewise at all times occupies a position between the rotation stop and the drive lug.

Since the width, or edge-to-edge distance of the latch arm as seen in FIGURE 2, is considerably less than the arcuate distance between the rotation stop **36** and the drive lug, it will be appreciated that the cylinder can be rotated relative to the latch arm, while its drive lug **37** is transiently engageable with the arm to provide a lost motion driving connection between it and the cylinder.

At its hub portion, the latch arm is shaped to provide opposite arcuate side edges which are concentric to the cylinder axis. The lower arcuate edge on the hub portion terminates in a pair of spaced opposing abutments **39** and **40**, one of which is transiently engageable by the drive lug **37** of the cylinder during rotation thereof in either direction out of its key inserting and removing position shown in FIGURES 1 and 2, to carry the latch arm toward either a locking or an unlocking position. The upper arcuate edge on the hub portion of the latch arm similarly terminates in a pair of opposing abutments **41** and **42**. These abutments are located to cooperate with the rotation stop **36** to define the limits of rotary motion of the latch arm, and through the cooperation between the latch arm and the drive lug, to also define the range of rotation of the lock cylinder.

The lost motion driving connection between the cylinder and the latch arm allows the cylinder to be rotated by its key to one extreme position of rotation at which

the latch arm has been carried, for example, to its locking position at which it may remain while the cylinder is rotated back to its key inserting and removing position and releasably locked therein by withdrawal of the key therefrom. Similarly if the cylinder is rotated in the opposite direction to carry the latch arm to its other limit of motion, the arm may remain at said other limit of motion while the cylinder is rotated back to its key inserting and removing position and locked therein by withdrawal of the key therefrom.

While the invention herein described is ideally suited for use with pin tumbler locks such as shown, it is by no means limited to use with such locks. The novel retaining means, namely the accurately formed flange **20** and groove **27** by which the cylinder is maintained against axial displacement from its sleeve can be provided on plate tumbler locks or others of a different nature than pin tumbler locks.

Similarly the provision of a latch arm mounted on a bearing forming part of the rotatable lock cylinder and having a lost motion driving connection therewith, together with the cooperation between the latch arm and a rotation stop on the sleeve in which the cylinder rotates, constitutes structure that can be incorporated in rotatable cylinder locks of different types.

It is another feature of this invention that the flange **20** on the rear of the lock cylinder is so located and proportioned that a portion thereof will be maintained in the retaining groove **27** of the sleeve or casing throughout the entire range of rotation of the cylinder permitted by the latch arm **31**, without danger of the flange becoming disengaged from both of the retaining lugs at the rear side of the groove. The cylinder could only be removed from the rear of its casing if it were possible to rotate the cylinder beyond its normal range of rotation, but as stated hereinbefore, the engagement of the latch arm **31** with the rotation stop **36** on the sleeve prevents such extended rotation of the cylinder.

Consequently, the lock cylinder must be assembled into the rear of the casing before the latch arm is secured on its bearing **32** on the rear of the cylinder, and while the cylinder is held in a position of rotation which lies beyond its normal range of rotation, such as seen, for example, in FIGURE 4. This allows the flange **20** on the rear of the cylinder to be brought into engagement with the rear **23** of the casing at a location entirely to one side of the ledge **25** on the rear of the sleeve. Thereafter, the cylinder can be rotated to bring the flange under the retaining lugs and into the groove **27** in the ledge **25**, and the latch arm **31** secured in place on its bearing by rolling over the rim on the rear of the bearing against the rear of the latch arm.

From the foregoing description taken together with the accompanying drawing, it will be readily apparent to those skilled in the art that this invention provides a rotatable cylinder lock mechanism featuring improved cylinder retaining means for securing the cylinder against axial displacement in its bore without the need for special securing plates or discs such as were necessary heretofore, and wherein part of the retaining means is utilized to perform the additional function of limiting rotation of the cylinder in its bore.

What is claimed as my invention is:

1. In a pin tumbler cylinder lock mechanism including a sleeve, a key actuatable cylinder rotatable in the sleeve and having a rear portion which extends rearwardly beyond the adjacent extremity of the sleeve, tumbler bores in the sleeve at one side thereof opening radially to its interior, tumbler bores in the cylinder opening radially to one side thereof and each being paired with a different one of the sleeve bores with which it is in radial register in one axial position of the cylinder within the sleeve and when the cylinder occupies a predetermined key inserting and withdrawing position of rotation, and a pair of endwise abutting pin tumblers in each pair of tumbler bores slidable radially of the cylinder between cylinder locking positions at which one of the tumblers of each pair extends part way into its cylinder and sleeve bores, and key positionable cylinder unlocking positions at which the abutting ends of the tumblers are tangent to the surface of the cylinder to free it for rotation in the sleeve, said pairs of tumblers being biased in radially inward directions, and said lock mechanism being characterized by means to prevent axial shifting of the cylinder in the locked position thereof, said means comprising: a flat flange integral with said rear portion of the cylinder and projecting radially from said side thereof but extending around only a portion of the circumference of the cylinder and having surfaces which face in opposite axial directions and are normal to the cylinder axis; a ledge formed integrally with the rear of the sleeve at said side thereof and projecting axially rearward therefrom toward the adjacent extremity of the cylinder so as to overlie said rear portion of the cylinder, said ledge having a radial slot therethrough providing opposing flat retaining surfaces between which the flange on the cylinder is snugly but slidingly engaged to preclude axial shifting of the cylinder in the sleeve and assure against misalignment between the paired tumbler bores in the locked position of the cylinder despite the imposition of axial forces on the cylinder incidental to insertion of a key thereinto; key actuation of the cylinder in either direction out of its locked position of rotation tending to carry said flange out of the slot in the ledge; and means providing rotation stops for the cylinder comprising a part on said rear portion of the cylinder having a rotation transmitting connection therewith, and abutment means on said ledge extending into the path of rotary movement of said part to preclude rotation of the cylinder an extent such as would withdraw the flange thereon from said slot in the ledge.

2. In a pin tumbler cylinder lock mechanism comprising a sleeve member having tumbler bores at one side thereof opening radially to its interior, a key actuatable cylinder member coaxially rotatable in the sleeve member and having tumbler bores opening radially to one side thereof, each of which is paired with a different one of the tumbler bores in the sleeve member to be in radial register therewith when the cylinder member is in one axial position within the sleeve member and occupies a predetermined key inserting and withdrawing position of rotation, and a pair of endwise abutting pin tumblers in each pair of tumbler bores slidable radially of the cylinder member between a locking position to which the tumblers of each pair are biased and at which one of the tumblers of the pair extends partway into its cylinder member and sleeve member bores, and key positionable unlocking positions at which the abutting ends of the tumblers are tangent to the surface of the cylinder member to free it for rotation in the sleeve member, said lock mechanism being characterized by means to prevent axial shifting of the cylinder member in the locked position thereof, said means comprising: a flat flange integral with one of said members, at the rear thereof, projecting radially from said side thereof toward the other of said members but extending circumferentially around only a portion of said one member and having surfaces which face in opposite axial directions and are normal to the axis of the members; a ledge formed integrally with the rear of said other member at said side thereof and projecting rearwardly from said other member, said ledge and the rear surface of said other member cooperating to provide opposing flat retaining surfaces between which the flange on the first designated member is snugly but slidingly engaged so that the flange and the ledge cooperate to define a rotatable connection between said members by which they are confined against relative axial shifting to assure against misalignment be-

tween the paired tumbler bores in the locked position of the cylinder member despite the imposition of axial forces on the cylinder member incidental to insertion of a key thereinto; and means providing rotation stops for the cylinder member by which it is prevented from being rotated to a position in which said rotatable connection is disengaged, said rotation stop means comprising a part on the rear portion of the cylinder member having a rotation transmitting connection therewith, and abutment means integral with the sleeve member, extending into the path of rotary movement of said part.

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