Nov. 29, 1966 D. R. CRUMB 3,287,944

LOCKING MEANS

Filed March 18, 1964 2 Sheets-Sheet 1

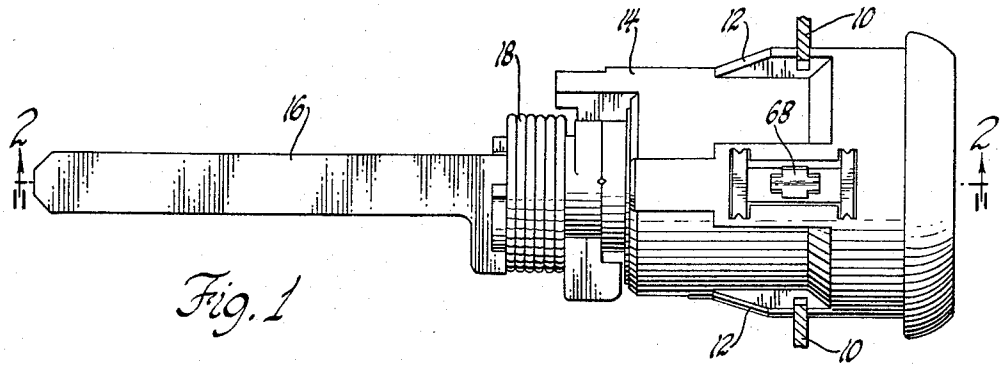

Fig. 1

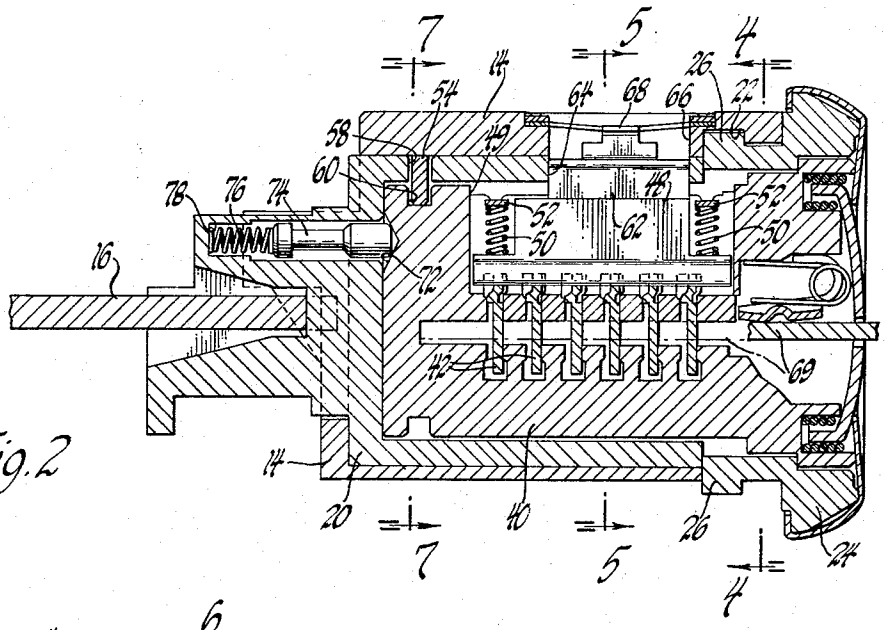

Fig. 2

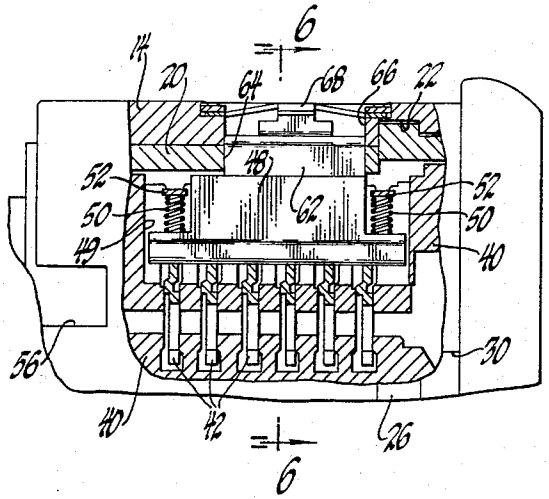

Fig. 3

INVENTOR.
Duane R. Crumb
BY
J. L. Carpenter
ATTORNEY

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LOCKING MEANS

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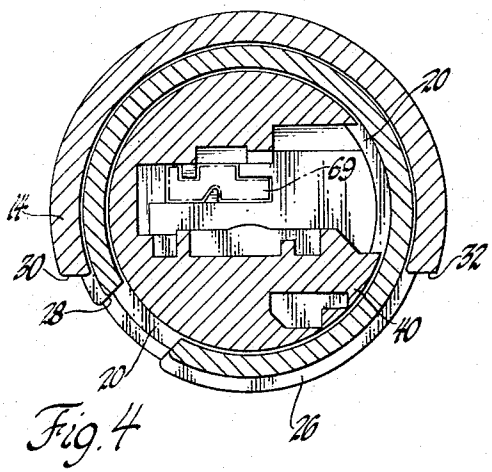

Fig. 4

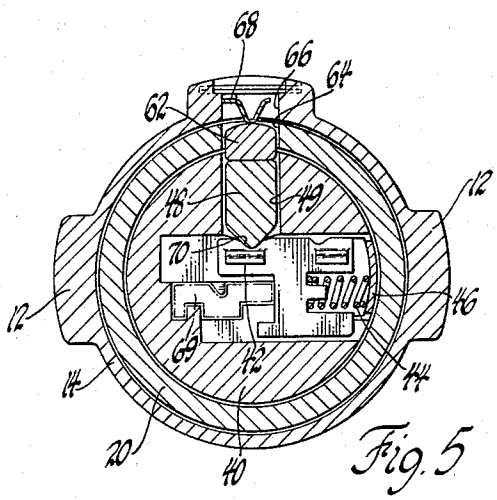

Fig. 5

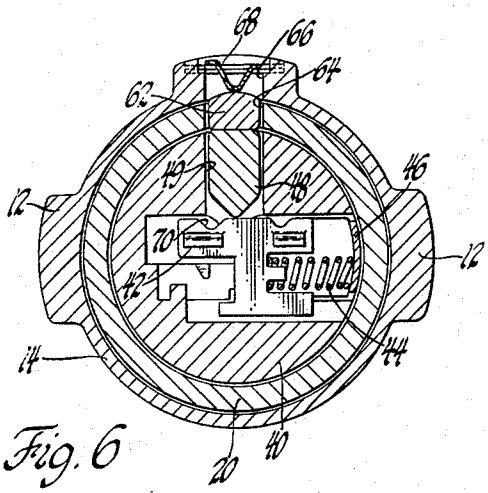

Fig. 6

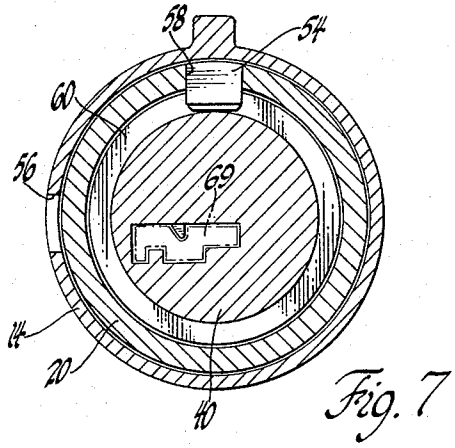

Fig. 7

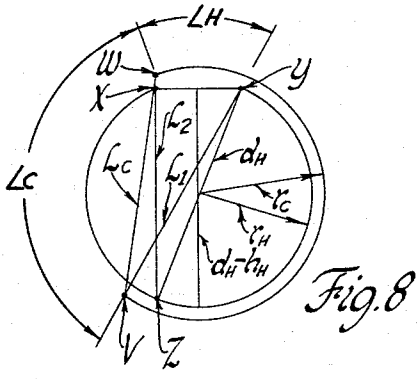

Fig. 8

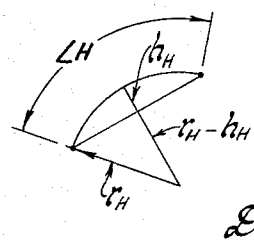

Fig. 9

INVENTOR.
Duane R. Crumb
BY
J. K. Carpenter
ATTORNEY

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3,287,944

LOCKING MEANS

Duane R. Crumb, Webster, N.Y., assignor to General Motors Corporation, Detroit, Mich., a corporation of Delaware

Filed Mar. 18, 1964, Ser. No. 352,868
6 Claims. (Cl. 70—364)

The present invention relates to locking means and particularly to means by which various items may be assembled and retained together for rotation of each with respect to the remainder. The present invention is especially advantageous when in the form of a lock since unauthorized operation is prevented.

A lock of the type presently used in the rear compartment lids of many automobiles comprises essentially a casing secured in the lid, a cylinder within the casing, a side bar which keys the cylinder to the casing and prevents rotation of the cylinder within the casing and which is retracted within the cylinder permitting such rotation when a coded key is inserted in the cylinder, and a driving shaft which rotates with the cylinder to operate the latch mechanism for the rear compartment lid.

It has been discovered, however, that unauthorized operation of the latch mechanism is possible without using the coded key, by causing the cylinder and casing to rotate coincidentally within the lid. To accomplish this, a screw driver or similar object can be inserted in the cylinder and sufficient rotational force applied thereto to rotate both the cylinder and casing, or a wrench can be clamped around the casing head and sufficient rotational force applied thereto to rotate both the casing and the cylinder. In either of these situations the rotation of the cylinder, transmitted by the driving shaft, will operate the latch mechanism, effecting an unauthorized entry into the rear compartment of the automobile.

To prevent such unauthorized entry into the rear compartment, it was necessary to develop some manner of preventing the transmission of rotation to the driving shaft from the casing head and from the cylinder when the coded key is not inserted therein.

To prevent rotation of the driving shaft by the cylinder without the coded key, the present invention provides a sleeve between the casing and the cylinder of the lock. The driving shaft is coupled to this sleeve rather than to the cylinder. The cylinder is incorporated in the lock so as to be freely rotatable within the sleeve and casing when the coded key is not inserted therein.

To permit the free rotation of the cylinder the present invention provides a modified side bar mechanism comprising two side bars. A primary side bar remains completely within a recess in the cylinder. A secondary side bar is positioned radially outward of the primary side bar. When the coded key is not inserted in the cylinder the secondary side bar is contained in both a slot in the casing and a slot in the sleeve and keys these latter two members together, preventing rotation of the sleeve within the casing. Under these conditions there is nothing which prevents rotation of the cylinder within the sleeve. However, when a coded key is inserted in the cylinder and the cylinder is rotated to bring the recess containing the primary side bar into radial alignment with the slots containing the secondary side bar, the secondary side bar is forced, by a spring, to move radially inwardly out of the slot in the casing and to reside in the slot in the sleeve and the recess in the cylinder, keying these latter two members together. Under these conditions, the sleeve and the cylinder will rotate coincidentally within the casing, causing rotation of the driving shaft and operation of the latch mechanism.

To prevent rotation of the driving shaft by the casing head, the present invention provides a separate casing and casing head assembled by a novel tongue-in-groove joint which permits rotation of the casing head upon the casing. The joint is formed by a flange on the casing head and a groove about the inside of the casing. To permit assembly, a notch is formed in the flange and a gap is formed through the side of the casing whereby the flange may be inserted in the groove. The notch and the gap may be so proportioned that the joint may be easily assembled and yet be locked to prevent accidental disassembly.

The details, as well as other objects and advantages of the present invention, will be apparent from the accompanying description and the drawings, in which:

FIGURE 1 is a side view, in elevation, of a lock incorporating the present invention;

FIGURE 2 is an enlarged sectional view taken along line 2—2 of FIGURE 1 illustrating the lock as it appears with the coded key inserted in the cylinder thereof;

FIGURE 3 is a view of the lock, partially in section with parts broken away, illustrating the lock as it appears without the coded key inserted in the cylinder thereof;

FIGURE 4 is a sectional view taken along line 4—4 of FIGURE 2;

FIGURE 5 is a sectional view taken along line 5—5 of FIGURE 2;

FIGURE 6 is a sectional view taken along line 6—6 of FIGURE 3;

FIGURE 7 is a sectional view taken along line 7—7 of FIGURE 2;

FIGURE 8 is a diagram illustrating the geometric relationship existing between the casing and the head necessary to assemble the casing and head; and

FIGURE 9 is a diagram illustrating the development of one of the parameters of that geometric relationship.

Referring first to FIGURE 1, the lock illustrated is secured in the vehicle rear compartment lid (not shown) by means of a bracket **10** clamped in grooved ears **12** of the casing **14**. The driving shaft **16**, which upon rotation operates the latch mechanism (not shown), is coupled to the lock by a spring **18**.

The sleeve **20**, shown in FIGURES 2–7, is located in casing **14**. Spring **18**, connected to projections on casing **14** and sleeve **20**, biases sleeve **20** in one direction of rotation. Driving shaft **16** is coupled to sleeve **20** and constrained to coincidental rotation therewith. The coupling and spring connection are entirely conventional, and accord generally with that shown in Jacobi 2,655,028.

Referring to FIGURES 2 and 4, the casing head **24** is coupled to casing **14** by a flange **26**, formed on casing head **24**, which extends into an annular groove **22** formed about the inside of casing **14**. Formed in casing head **24** is a notch **28** extending through flange **26**. A gap, as between **30** and **32**, formed in the side of casing **14** extends from the ends thereof beyond groove **22**. This construction permits flange **26** to be inserted, as described below, and rotated and retained in groove **22**.

The diagram of FIGURES 8 and 9 illustrate the geometric relationship necessary to insert flange **26** into groove **22** to assemble casing head **24** and casing **14**. In the diagrams, r_C is the radius of the periphery of groove **22** in casing **14**, and r_H in the radius of the periphery of flange **26** on casing head **24**. The difference between these radii is accentuated in the drawing, actually they differ only by a tolerance sufficient to permit rotation of the casing head **24** within the casing **14**.

$\angle H$ is the angle subtended by notch **28** in casing head **24**, and $\angle C$ is the angle subtended by the gap between **30** and **32** on casing **14**. L_C is the chord across $\angle C$.

h_H (FIGURE 9) is the rise of the arc of $\angle H$. d_H is the diameter of the periphery of flange **26** (twice r_H).

V and W are the end points of chord L_C, corresponding to points **30** and **32** on casing **14**. X and Y are the end points of the arc subtended by $\angle H$, corresponding to the sides of notch **28** in flange **26**. Since r_C and r_H are nearly equal, W and X are coexistent. Z is the point on casing head **24** diametrically opposite point Y. Line L_1 extends between points V and Y, and line L_2 extends between points Z and W–X.

It will be appreciated that if L_C is greater than d_H the casing and casing head may be assembled without difficulty, notch **28** being unnecessary.

If L_C is less than d_H, and notch **28** is formed in flange **26** of such a size that d_H minus h_H is shorter than L_C, casing **14** and casing head **24** may be assembled by transverse movement of casing head **24** and casing **14** together.

If L_C is shorter than d_H minus h_H, casing **14** and casing head **24** may be assembled by rotation of one relative to the other if notch **28** and gap **30–32** are formed according to the relationships set out below.

Casing **14** and casing head **24** may be assembled without relative rotation when $\angle C+\angle H=180°$ and L_C is greater than d_H-h_H. It will be appreciated that

$$L_C=2r_C \text{ sine } \angle C/2 \text{ and } (d_H-h_H)=r_H\ (1+\text{cosine } \angle H/2)$$

Therefore, in order for casing **14** and casing head **24** to be assembled without relative rotation, $\angle H$ must be greater than twice the angle whose cosine is

$$\frac{r_H}{2r_c-r_H}$$

The value of $\angle C$ is determined from the relationship $\angle C=180°-\angle H$.

The sum of $\angle C+\angle H$ may be less than 180°, however, and casing **14** and casing head **24** may be assembled by relative rotation. The value of the sum of $\angle C+\angle H$ may be decreased only so long as L_1 is greater than d_H. An equivalent statement is that the sum of $\angle C+\angle H$ may be decreased so long as L_C is greater than L_2. When this condition obtains, casing **14** and casing head **24** may be assembled by pivoting casing **14** about point Y on casing head **24**. Point W on casing **14** just slips past point X on casing head **24**. Point V on casing **14** just slides past point Z on casing head **24**. It will be appreciated that $L_C=2r_C$ sine $\angle C/2$ and $L_2=2r_H$ cosine $\angle H/2$. Therefore, in order for casing **14** and casing head **24** to be assembled by relative rotation, $\angle H$ must be greater than twice the angle whose cosine is r_C/r_H sine $\angle C/2$.

The advantage of providing a joint requiring rotation to assemble and disassemble lies in the fact that an appreciable locking factor is obtained preventing accidental disassembly.

It will be appreciated that when such a joint is used to assemble two cylinders, only a relief on the surface of the inner cylinder corresponding to the portion swept by point W is necessary.

The cylinder **40**, shown in FIGURES 2–7, is located within sleeve **20**, casing **14** and casing head **24**. In addition to containing the tumbler and side bar mechanisms, to be hereinafter considered in more detail, the cylinder **40** serves to prevent transverse withdrawal of casing head **24** from casing **14**.

Referring to FIGURES 5 and 6, the customary tumblers **42** are retained within cylinder **40** by springs **44** and a retainer **46**. The primary side bar **48** is retained in a recess **49** in cylinder **40** by springs **50** and retainers **52**, shown in FIGURES 2 and 3.

Referring to FIGURES 2 and 7, a retaining member **54** prevents withdrawal of cylinder **40** from sleeve **20**. Retaining member **54** is inserted, through a notch **56** (FIGURES 3 and 7) in casing **14**, into a slot **58** in sleeve **20** and an annular groove **60** formed about cylinder **40**.

The secondary side bar **62** is located in a slot **64** in sleeve **20** and a slot **66** in casing **14**.

The operation and function of secondary side bar **62** is illustrated in FIGURES 5 and 6. FIGURE 5 illustrates the lock as it appears when the coded key, indicated by **69**, is inserted therein. Primary side bar **48** is retracted into notches **70** in tumblers **42** by springs **50**. Secondary side bar **62** is depressed by a spring **68** entirely out of slot **66** and into recess **49** to the extent that it keys cylinder **40** and sleeve **20** together. As cylinder **40** is rotated by the coded key **69**, sleeve **20** and driving shaft **16** rotate, operating the latch mechanism.

FIGURE 6 illustrates the lock as it appears when the coded key is not inserted therein. Primary side bar **48** is raised flush with the surface of cylinder **40** and prevents the depression of secondary side bar **62** into recess **49**. Secondary side bar **62** is contained in slots **64** and **66**, keying sleeve **20** to casing **14** and preventing rotation of sleeve **20**. Cylinder **40** may be rotated freely within sleeve **20** without transmitting rotation to sleeve **20**, driving shaft **16** or the latch mechanism.

Referring to FIGURE 2, an indentation **72** in cylinder **40** receives a plunger **74** biased by a spring **76** from a recess **78** in sleeve **20**. This provides the necessary momentary detent to align slot **64** with recess **49** and permit depression of secondary side bar **62** into recess **49**. The detent thus provided is not strong enough, however, to prevent rotation of cylinder **40** within sleeve **20**.

It will be appreciated that the lock above-described is adaptable for uses other than the indicated use in a vehicle rear compartment lid.

It will be further appreciated that the method of rotatably mounting the casing head on the casing can be put to use in arts other than locksmithing; that is, mounting a lock casing head upon a lock casing in this manner is but one application of a tongue-in-groove type joint between two objects.

I claim:

1. In a cylinder lock, the combination comprising, a casing, an output sleeve rotatably mounted within the casing, a plug rotatably mounted within the sleeve, said plug and said casing having radial recesses and said sleeve having a slot alignable in a predetermined position of the plug and of the sleeve relative to the casing, a pair of separate side locking bar members received for movement radially within said recesses and slot, said members being arranged one radially overlying the other within the recesses and slot and having portions defining a parting face between said members, and key-operated tumbler means mounted within said plug for movement therein between locking and unlocking positions transversely of the path of movement of said members, said tumbler means in the locking position thereof locating the radially inner of said members wholly within the plug and the radially outer of said members within the sleeve and the casing in positions aligning said parting face with the circumferential interface between the plug and the sleeve whereby the sleeve and the casing are keyed together and the plug is freely rotatable within the sleeve, said tumbler means in the unlocking position thereof locating said members in an unlocking position within said recesses and slot wherein the plug and sleeve are keyed together and freely rotatable within the casing.

2. The combination recited in claim **1** wherein, in the unlocking position of said members, said tumbler means locates said inner member wholly within the plug and said outer member in a keying position within the sleeve and the plug and out of the casing recess.

3. The combination recited in claim **1** wherein the casing has a wall the interior surface of which is of circular cross section, said interior surface being formed with an annular groove, and a casing head having an exterior surface of circular cross section formed with a flange thereon, said flange having a notch formed in the circumference thereof, said casing having a gap less than the diameter of said flange formed in said wall, said notch and said gap permitting transverse assembly of said flange in said groove, said flange cooperating with said groove

to form a tongue-in-groove joint, said casing head being mounted on said casing by said joint.

4. In a cylinder lock, a hollow lock casing having an annular wall, and a casing head having an annular wall, one of said walls defining a bore and being formed with an annular groove therein, the other of said walls being formed with an annular flange thereon, said flange having a notch formed in the periphery thereof, said one wall having a gap opening to said bore and defining an entrance to said groove having a chordal dimension less than the diameter of said flange and greater than the angle subtended by said notch, said notch and said gap permitting radial insertion of said flange through said gap into said groove for assembly of said casing head onto said casing, said flange cooperating with said groove to form a tongue-in-groove joint having said other wall within said one wall.

5. In a cylinder lock, a hollow lock casing having an annular wall, and a casing head having an annular wall, one of said walls defining a bore and being formed with an annular groove therein, the other of said walls being formed with an annular flange thereon, said flange having a notch formed in the periphery thereof, said one wall having a gap opening to said bore and defining an entrance to said groove having a chordal dimension less than the shortest diametrical dimension taken across said flange within the chordal span of said notch and greater than the angle subtended by said notch, said notch and said gap permitting assembly of said casing head onto said casing by radial insertion of said flange through said gap into said groove and simultaneous relative rotation between said casing head and said casing, said flange cooperating with said groove to form a tongue-in-groove joint having said other wall within said one wall.

6. A tongue-in-groove jointed assembly comprising a first cylindrical member having a wall defining a circular bore, said wall being formed with an annular groove having a radius r_C, and a second cylindrical member having an exterior surface of circular cross section formed with a flange having a radius r_H, said second member having a relief formed in the circumference extending towards the exterior of said second member and subtending an angle $\angle H$, said first member having a gap formed in said wall subtending an angle $\angle C$, r_C being greater than r_H, $\angle H$ being greater than twice the angle whose cosine is r_C/r_H sine $\angle C/2$, the sum of $\angle H$ plus $\angle C$ being less than 180 degrees, said flange cooperating with said groove to form a tongue-in-groove joint, said first and second members being connected by said joint.

References Cited by the Examiner

UNITED STATES PATENTS

650,184	5/1900	Maddock	285—209
1,417,132	5/1922	Barker	70—364
1,965,889	7/1934	Fitz Gerald.	
2,024,441	12/1935	Fitz Gerald	70—362
2,040,258	5/1936	Jacobi	70—370
2,049,658	8/1936	Moore	70—448
2,105,659	1/1938	Jacobi	70—364
2,431,894	12/1947	Spain	70—362
2,648,972	8/1953	Diesel	70—419
2,650,492	9/1953	Jacobi	70—367
2,655,028	10/1953	Jacobi	70—367

EDWARD C. ALLEN, *Primary Examiner.*

BOBBY R. GAY, *Examiner.*

PERRY TEITELBAUM, *Assistant Examiner.*