Nov. 25, 1958 W. BENNETT 2,861,830

DOOR LOCKS ADAPTED TO MUTUALLY ALIGN DOORS AND DOOR FRAMES AND THE LIKE

Original Filed May 4, 1953 4 Sheets-Sheet 1

FIG. 1.

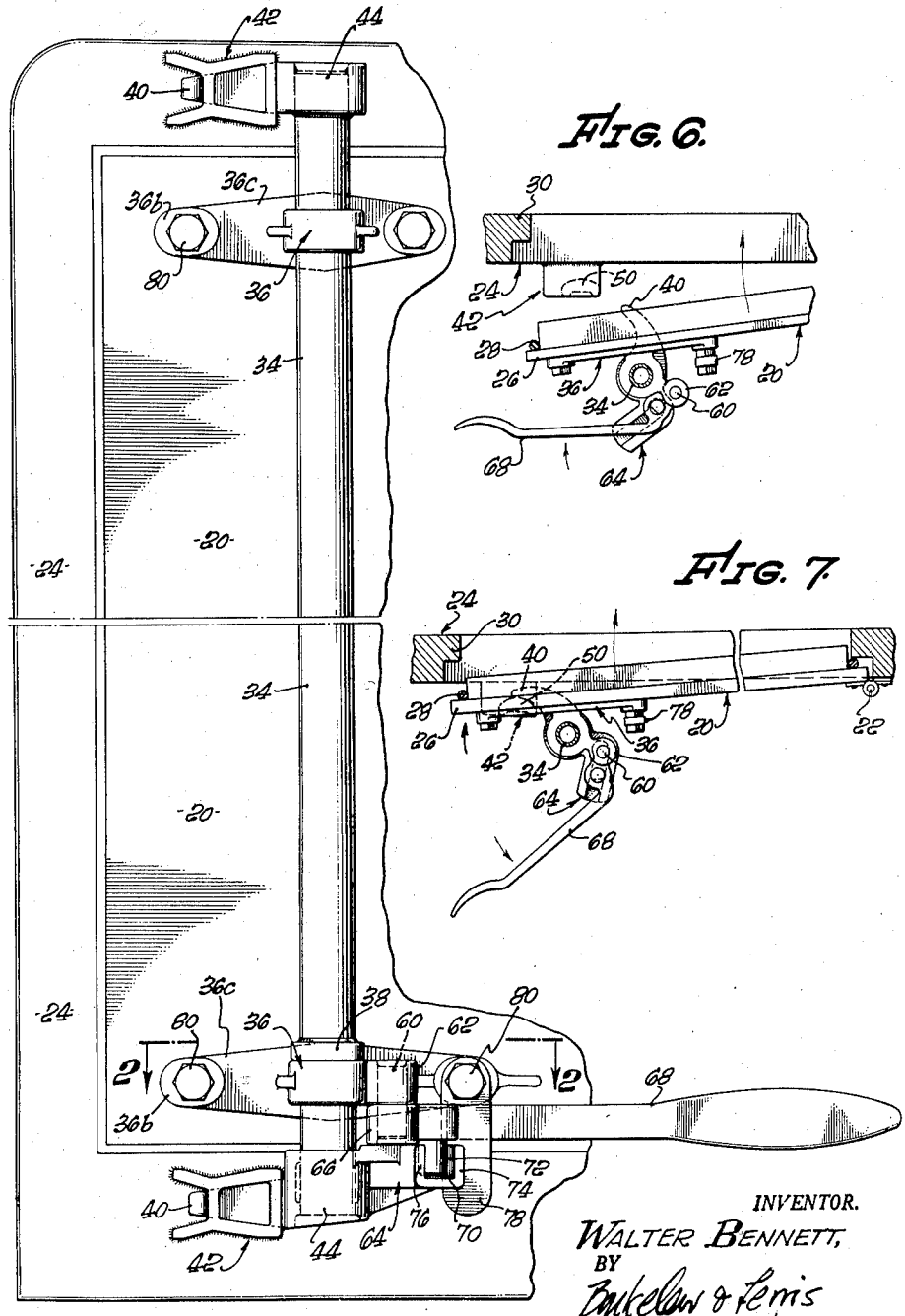


FIG. 6.

FIG. 7.

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FIG. 2.

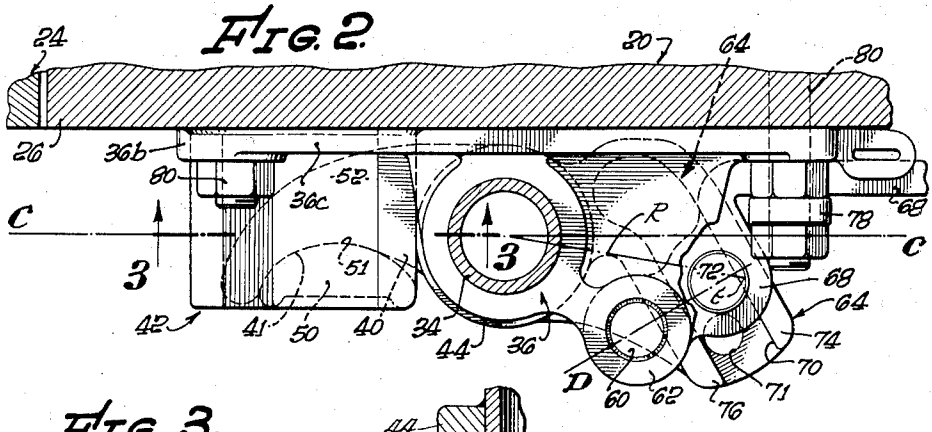


FIG. 3.

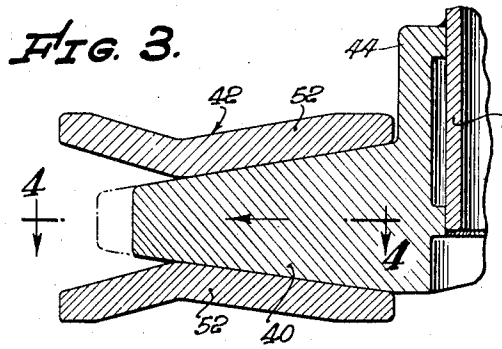


FIG. 4.

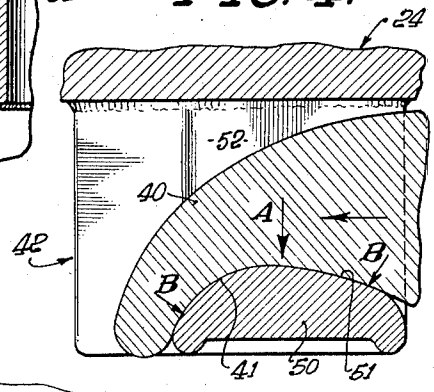
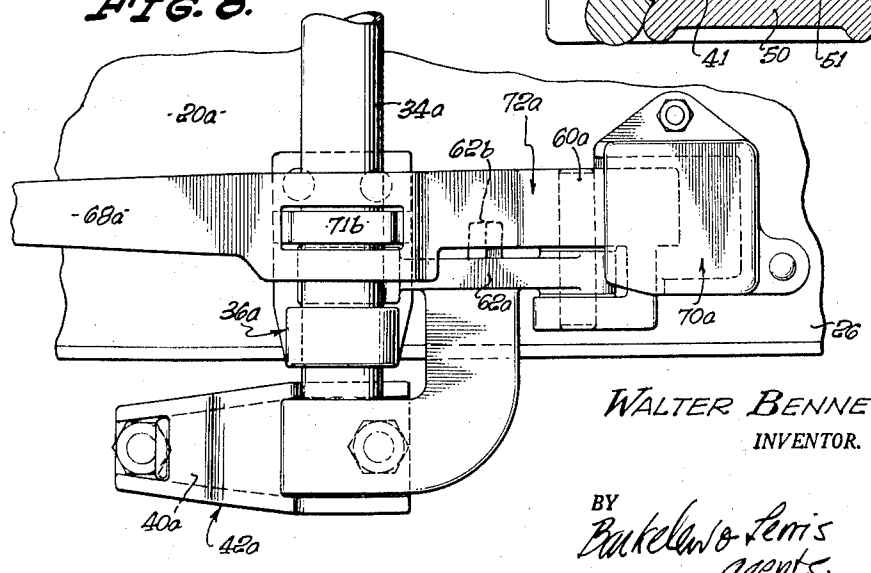


FIG. 8.



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DOOR LOCKS ADAPTED TO MUTUALLY ALIGN DOORS AND DOOR FRAMES AND THE LIKE

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FIG. 5.

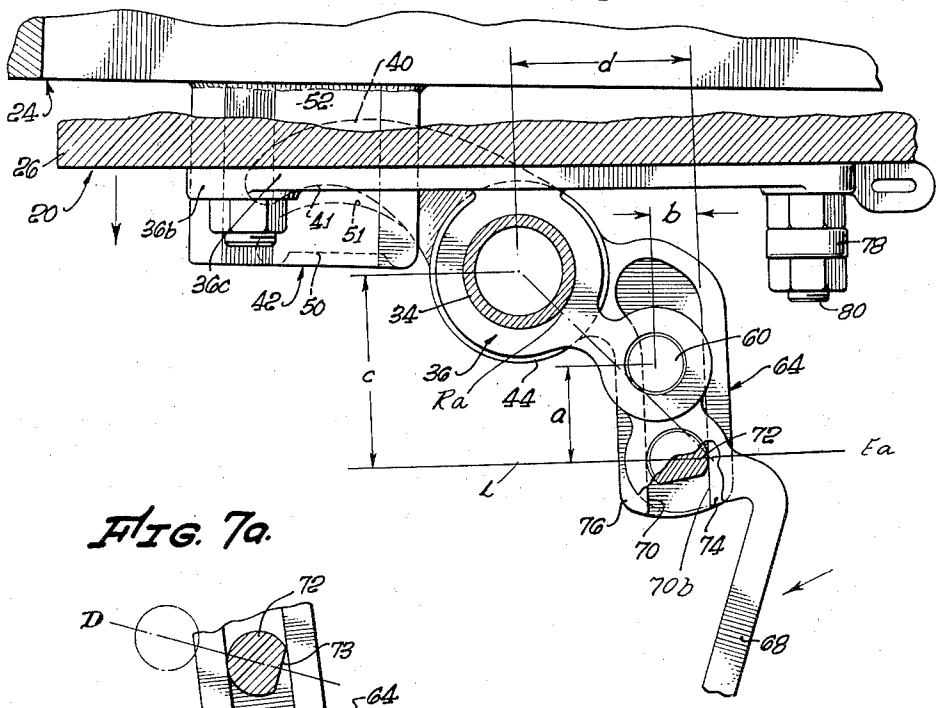
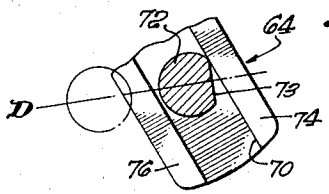


FIG. 7a.

FIG. 7b.



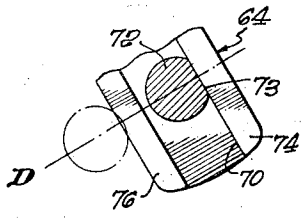


FIG. 7c.

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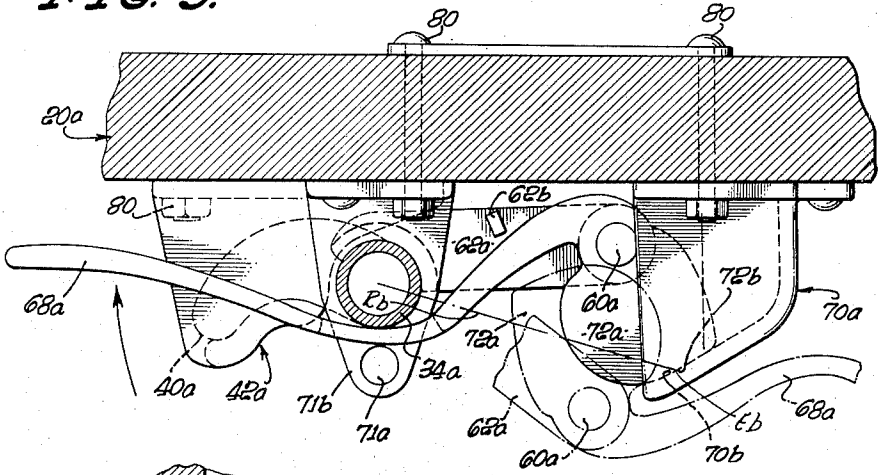
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DOOR LOCKS ADAPTED TO MUTUALLY ALIGN DOORS AND DOOR FRAMES AND THE LIKE

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FIG. 9.



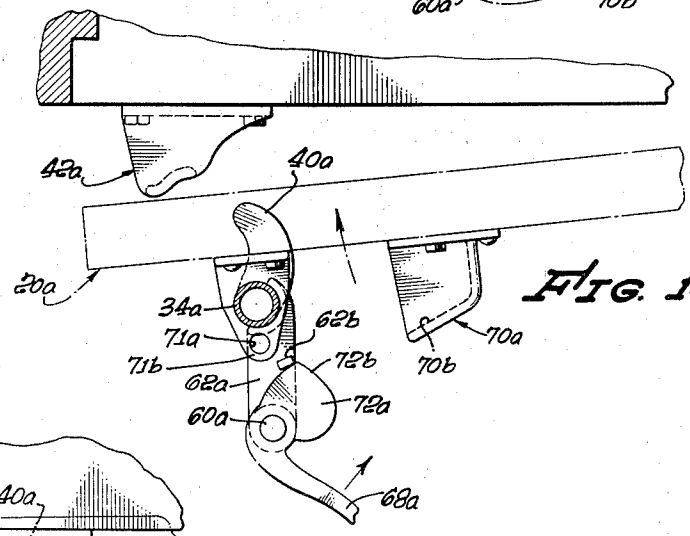


FIG. 10.

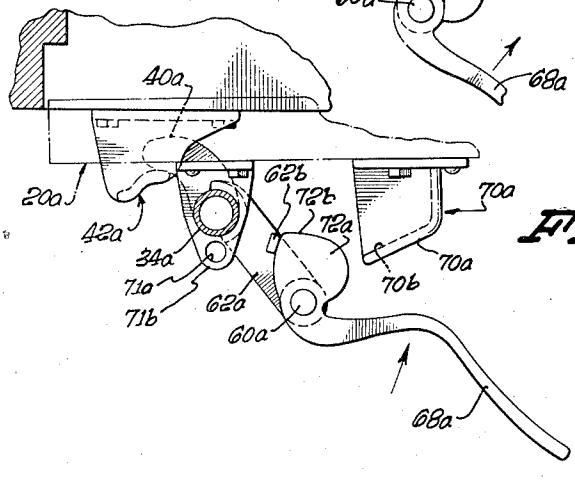


FIG. 11.

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United States Patent Office 2,861,830
Patented Nov. 25, 1958

2,861,830

DOOR LOCKS ADAPTED TO MUTUALLY ALIGN DOORS AND DOOR FRAMES AND THE LIKE

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Original application May 4, 1953, Serial No. 352,925, now Patent No. 2,764,443, dated September 25, 1956. Divided and this application August 6, 1956, Serial No. 602,369

1 Claim. (Cl. 292—240)

The present invention has reference to locks, and, although applicable to any relatively movable member, is particularly applicable and effective when used on swinging doors. The invention also has certain features which make it particularly effective when applied to the swinging door or doors commonly used to close the rear end of a van-type transport body. The invention will be described and its action explained with particular reference to such doors and body; but without implying that the invention is limited to any such specific use.

This application is a division of my copending application Ser. No. 352,925, filed May 4, 1953, now Patent No. 2,764,443, September 25, 1956, entitled Door Locks. That application describes a locking mechanism including a lock or latch device comprising a locking tongue and a keeper which, when forced into interengagement, have the function not only of holding a door or similar member closed, but also of forcibly aligning a door with its door frame and rigidly holding such two members in alignment. Specifically, as applied for example to the rear door or doors of a van-type vehicle, it has the function of aligning a deformed door frame with the door, and so rigidly connecting them that the door becomes a gusset for the door frame.

The mechanism described in said application also includes a lock operating mechanism adapted, among other things, to apply great closing force to such a lock. The claims of said prior application are directed to such operating means regardless of any particular lock formation and function. The claim of this present divisional application are directed to the lock formation in and of itself and in combination with a forcible operating means. The described operating means is to be taken as a preferred or typical means for forcibly operating the lock, but without implying limitation thereto.

As has been indicated, a primary object of the present invention is to provide a lock that will forcibly align and hold a door, or doors, and its or their frame rigidly in alinement. In doing that, the lock makes the door or doors act as rigidifying gussets for an otherwise unbraced frame, and not only prevents deformation and structural failure of the frame (e. g. the rear open end of a van-type vehicle) but also prevents wear between the door and frame and/or between the two doors of a double set.

There are many other objective features and corresponding accomplishments of the invention, all of which will be best understood as they are explained in connection with the specific and preferred illustrative embodiments of the invention set out in illustrative detail in the following description and shown in the accompanying drawings in which:

Fig. 1 is a fragmentary elevation showing one illustrative preferred form of my present invention, with the parts shown in their closed positions;

Fig. 2 is an enlarged horizontal section on line 2—2 of Fig. 1, with the parts in their closed positions;

Fig. 3 is a further enlarged detail section on line 3—3 of Fig. 2;

Fig. 4 is a detail section on line 4—4 of Fig. 3;

Fig. 5 is a schematic view similar to Fig. 2 but showing the parts in positions approaching the closed position;

Figs. 6 and 7 are diagrammatic views showing other progressive positions of the locking mechanism;

Figs. 7*a*, 7*b* and 7*c* show details of progressive positions of the locking mechanism;

Fig. 8 is a fragmentary elevation showing a modified form of the invention with the lock in closed position;

Fig. 9 is a plan section of the parts shown in Fig. 8; and

Figs. 10 and 11 are diagrams showing progressive positions of the locking mechanism of Figs. 8 and 9.

In the drawings a typical swinging door is shown at **20**, hinged at one vertical edge on hinges **22** (see Fig. 7) in a door framing **24** which may be of any type and structure. The door itself is shown as having a rabbeted flange **26** which may either serve to trap another door of a pair, or may, through packing **28**, seat directly on a shoulder **30** in the door frame structure **24**. The present lock mechanism is applicable to any such door. As explained later, the door here shown, whether it is a single door or the right hand door of a pair, acts as a gusset to brace the door frame.

The physical structure of the presently preferred form of the lock mechanism is best shown in Figs. 1 to 5 and will first be explained with reference to those figures. As there shown, a vertical lock shaft **34**, preferably formed of tubing or pipe, is rotatively mounted in two journal members **36** which are rigidly secured to the outer face of the door at its swinging side near its top and bottom. A collar **38** or other shoulder formation rigidly attached to the shaft rests on one of the journals to support the shaft and its carried parts in proper position to cooperate with other parts mounted on the door frame structure. That door frame structure may, for instance, be the rear end framing of a vehicle body.

Two curved locking tongues **40** are rigidly mounted on the upper and lower ends of shaft **34** in positions respectively just above and below the upper and lower edges of the door. These locking tongues, in their locking position, engage in keepers **42** which are mounted on the door frame structure just above and below the door opening. The two tongue and keeper units are duplicates, so a detailed showing and description of the lower unit will suffice for both. As here shown in preferred form, the shaft-mounted hub **44** of the lower tongue **40**, in addition to carrying the tongue also carries one element of the lock operating cam mechanism. However the lower tongue **40** might have its own hub **44** like the upper tongue; and the cam mechanism element could be mounted on its own individual hub on shaft **34** and that hub and the cam mechanism could be spaced along the shaft from the lower tongue just as it is spaced from the upper tongue. This is spoken of particularly for the purpose of pointing out later that, in finally locked condition, the shaft **34** may be put in torsional stress between the camming mechanism and both locking tongues, as well as only the upper locking tongue as here specifically shown.

As will appear, the camming mechanism rotates the shaft and its tongues between such an open position as shown in Fig. 6, and the final locked position shown in Figs. 1 and 2, passing through intermediate positions such as shown in Figs. 7 and 5. The shaft and tongues are rotated through about 90° between the open position of Fig. 6 and the finally locked position of Fig. 2; and as will appear from the successive positions shown in Figs. 6, 7, 5 and 2, the tongue enters the box-like keeper **42** by a swinging movement from the right to the left in the drawings. In thus entering the keeper the tongue has a component of movement toward the left in the keeper as well as a component of movement outward,

away from the door frame. Those two movement components are indicated by arrows in Figs. 3 and 4.

The keeper **42** is a box-like structure with an outer wall **50** presenting an inner face **51** that is convex as viewed in horizontal section as in Fig. 4. The tongue **40** is curved as viewed in plan (Figs. 2 and 4) and has an outer concave face **41** which, in the final locked position of Figs. 2 and 4, fits the convex keeper face **51**. In that final locked position the tongue is being forced in the direction of the arrow A of Fig. 4 and its concave face is therefore pressing against keeper face **51** not only in direction A but also in directions B. In consequence, the tongue, thus engaging the keeper, is forcibly pressed in the door closing direction, opposite to A; and is also held from displacement in the plane of the door. As the tongue in locked position is being held rigid with relation to the door, the door is also held rigidly with relation to the frame.

The box-like keeper has upper and lower walls that present inner faces converging toward the left; and the tongue, in the aspect of Fig. 3, is correspondingly tapered. Consequently, as the tongue forcibly enters the keeper in the direction of the arrow in Fig. 3, the interengagement of the tapering and converging faces will correct any relative vertical displacement that may exist between the tongue and keeper. This action is of some practical importance where the door and/or door frame structure are liable to become deformed. For instance, the rear end framing of a transport body which has a rear door opening substantially as large as the body itself, may be very liable to warpage to rhomboidal shape when the vehicle is standing on uneven ground. The frame door opening then, at the swinging edge of the door, stands vertically displaced from that edge of the door. Assuming that the door itself is stiff in its own plane and held at its hinged edge with no loosenesses either horizontally or vertically, and assuming that shaft **34** and the tongues are vertically immovable on the swinging end of the door then the forcible entry of the tapered tongues into the tapering keeper boxes will force the vertically displaced door framing into its proper rectangular shape as the tongues move to their final locked position of Figs. 2, 3 and 4.

As stated before, collar **38** or an equivalent shoulder holds shaft **34** up in the bearings **36**. Another such shoulder under either journal **36** could be used to hold shaft **34** and the tongues from moving up relative to the door. But the camming mechanism now to be described provides the necessary upwardly bearing thrust in the specific design here shown.

In this specific illustrative embodiment of the invention the lower journal member **36** carries a rigid pivot pin **60** projecting downwardly from mounting lug **62**. Pivoted on that pin and confined vertically between lug **62** and a cam slot member **64**, is the pivoted end **66** of a manual lever handle **68**. Cam slot member **64** is rigidly mounted on shaft **34**. In this particular design, as mentioned before, it is mounted on and integral with hub **44** of the lower locking tongue. The confinement of **66** between **64** and **62** makes those parts perform a thrust function to hold shaft **34** down in its journals.

Attention is now directed particularly to Figs. 2 and 5. For convenience of description the line C—C on Fig. 2, parallel to the face of the door, will be used as a datum. With the parts in the final locked position of Fig. 2, with tongue **40** projecting to the left of shaft **34** into keeper **42**, the cam slot **70** of member **64** in this illustrative embodiment stands at an angle of about 60° to C—C. Pivoted handle **68** carries a cam pin **72** which projects down into cam slot **70** and plays between the two opposite walls **74** and **76** of that slot. In the final locked position of the parts, the line D, determined by the axes of pivot pin **60** and cam pin **72**, lies preferably at right angles to the length of slot **70**, and thus in this particular illustrative embodiment makes an angle of about 30° with C—C. In that position the main length of handle **68** lies back flatly against or close to the door face and is held against accidental displacement by a suitable keeper, such as the one shown at **78** pivoted on an extension of one of the bolts **80** that bolt the lower journal member **36** to the door.

Referring now to the relative magnitudes indicated by *a*, *b*, *c* and *d* in Fig. 5, it can be shown that

$$(1) \qquad \frac{T}{t}=\frac{c+ud}{a+ub}$$

where *t* represents the input torque about the axis of pivot pin **60**, T represents the output torque about the axis of shaft **34**, and *u* is the coefficient of friction between cam pin **72** and the wall of slot **70**.

The above equation may be explained as follows. Consider F as the force applied by pin **72** to wall **70***b* in a direction normal to that slot wall, the line of force being represented by L which has such relationship with said slot wall. Then the

$$(2) \qquad \text{Input torque } t=Fa$$

where —*a*— is the perpendicular distance between pivot point **60** and line of force L.

The opposite and equal reaction force F acts, of course, along line L, and the

(3) Output torque T of shaft **34**=*Fc* where —*c*— is the perpendicular distance between the shaft center and line L. From (2) it follows that

$$(4) \qquad F=\frac{t}{a}$$

and from (3) it follows that

$$(5) \qquad F=\frac{T}{c}$$

Therefore

$$(6) \qquad \frac{t}{a}=\frac{T}{c} \text{ or } \frac{T}{t}=\frac{c}{a}$$

If we now introduce the friction factor, we have, in place of Equation 2

$$(7) \qquad t=F\ (a+ub)$$

And, in place of Equation 3

$$(8) \qquad T=F\ (c+ud)$$

Substituting $(a+ub)$ for —*a*— and $(c+ud)$ for —*c*—, in Equation 6, we have

$$\frac{T}{t}=\frac{c+ud}{a+ub}$$

Assuming *u* to be 0.40 the ratio

$$\frac{T}{t}$$

from such a position as shown in Fig. 6 to the final closed position of Fig. 2, varies from about 0.3 to 2.75. That is assuming pin **72** to be of full round shape (no flat as shown). However the presence of the flat face **73** on pin **72** does not materially change the torque ratio. Of course, if *u* is neglected, or is made to be very small (as it can be by, for instance, using an anti-friction bearing sleeve around pin **72**) the ratio

$$\frac{T}{t}$$

will approach infinity as the closed position of Fig. 2 is reached.

That changing ratio of the torques of course means that, from a starting position of the handle such as in Fig. 6 substantially parallel to the plane of the door, a given small angular movement of the handle (e. g. to the position of Fig. 7) throws the locking tongue through a relatively large angle; approximately 60° as seen by comparing Fig. 6 with Fig. 7. The remaining large angu-

lar throw of the handle from the position of Fig. 7 to the finally closed position of Fig. 2 (approximately 150°) moves the locking tongue through a very small angle (compare Fig. 7 with Fig. 2) under relatively great torque with the result of finally forcing the door closed with great force.

As the door is finally forced closed, the relative positions of the locking parts may be such that shaft **34** is finally put under torsional strain to keep the door tightly closed in spite of slight variations in the relative locations and dimensions of parts of the locking mechanism, and of the door and its frame. The overhanging portions of the shaft, between bearings **36** and the tongues **40** at the shaft ends, may also at the same time be put under elastic bending stress. Elastic deformation of other parts of the mechanism may also have the same effect, but the elastic deformation of the shaft is the greater factor. That deformation also is effective in pressing the door tightly closed even though pin **72** is provided with the flat **73** which functions the same as if, in the final locked position of Fig. 2, pin **72** (with no flat) were moved to a position "over center" with relation to slot wall **74**; that is, to a position where line D (Fig. 2) were angularly rotated about **60** in counter-clockwise direction. As will be explained, the flat has that same handle locking action and at the same time provides a broad surface for the pressure action between pin **72** and the slot wall.

The functioning of the flat **73** as the parts approach final locked position is illustrated particularly in Figs. 7, 7*a*, 7*b* and 7*c*. In the positions of Figs. 7 and 5 the flat is inoperative or substantially so; the cylindric surface of pin **72** bearing against wall **74**. Beginning with about the position of Fig. 7 and through the progressive positions shown in Figs. 7*a* and 7*b* the flat **73** is moving more nearly into flat contact with wall **74**, until, in the position of Fig. 7*c*, with line D normal to the face of wall **74**, the flat fully engages that wall. From approximately the position of Fig. 7*b* to that of 7*c*, cam slot member **64** moves slightly in a retrograde direction, that is, clockwise about the axis of shaft **34** as flat **73** reaches its final position. Just before that position is reached the cam member **64** is in its furthest position counter-clockwise and shaft **34** and the other parts of the locking mechanism are under their greatest stress and elastic deformation. When cam member **64** has finally backed off to the position of Fig. 7*c*, that stress and deformation are slightly relieved, but the locking tongues are still held in heavy pressurable engagement with the keepers, and the door held tightly closed, by the elastic deformation which still exists. Slot wall **74** is pressed against flat **73** by the same elastic stresses, and holds pin **72** and handle in the position of Fig. 2, without any torque being exerted on the handle. In fact, positive torque in a clockwise direction must be exerted on the handle to move it from the fully locked position of Fig. 2. Thus, the handle is not only "dead" in that position but requires positive force to move it out of that position and to start the movement of the lock mechanism toward open position.

It will be noted that when the locking tongue **40** is in full pressural engagement with keeper **42**, as in Fig. 2, pivot pin **60** lies below the line R which represents a radius from shaft **34** extended to the then effective surface of cam interengagement—that is, point E where pin **72** engages slot wall **74**. On the other hand, in Fig. 5 pivot pin **60** lies above line Ra which represents a radius from shaft **34** extended to the then effective surface of cam interengagement—that is, point Ea where pin **72** engages slot wall **74**.

The relative movements of the parts from locked to unlocked condition, and the stresses, strains and torques involved, are in general simply the reverse of those involved in movement from open to locked condition. That would be exactly true if pin **72** were fully round and fitted slot **70** tightly. Exactly the same high torque ratio which facilitates forcible closing of the door would be applied to opening the door against any condition tending to stick it closed—ice in the space between the door edge and the frame, for instance. And the same is true generally when pin **72** has the flat **73**. In approximately the position of Fig. 7*a* or 7*b* the pin comes into contact with the face of slot wall **76**, and from that position on the handle exerts a high torque on member **64** to force or break the door open if necessary.

To securely lock the mechanism in closed position against unauthorized opening, it is sufficient to lock handle **68** in the position of Fig. 2 in any suitable manner. For example the swinging keeper **78** can be padlocked; or a padlock can be inserted and locked in the opening **71** in the member **64** to prevent pin **72** from moving in the opening direction.

In the modification shown in Figs. 8 to 11, the shaft **34***a* may be the same and have the same relation to door **20***a* as in Figs. 1 to 7; and tongues **40***a* and keepers **42***a* may be the same in structure, location and function as in Figs. 1 to 7. The tongue and keeper shown in Figs. 8–11 are somewhat modified in form, but are functionally the same as in Figs. 1–7. The modification of Figs. 8–11 is in the camming mechanism which operates the lock shaft and tongues.

In Figs. 8–11 an operating lever-handle **68***a* is pivoted at **60***a* on an arm **62***a* which is secured to the shaft **34***a*. A stop **62***b* on arm **62***a* limits the swing of handle **68***a* in the direction indicated with relation to **62***a*; so that, in the relative positions of Figs. 10 and 11, the arm **62***a* swings with handle **68***a*. Handle-lever **68***a* carries a cam formation **72***a* adapted to enter and to cooperate with the cam receiving member **70***a* which is mounted on the door.

The operation of this modification will be understood from Figs. 10, 11 and 9. In the open position of Fig. 10, the door can be pulled open or pushed toward closing position by pulling or pushing on handle **68***a*. In closing, upon tongue **40***a* reaching a position where by rotation it will enter keeper **42***a*, handle **68***a*, and with it the arm **62***a* and the tongues, is swung counter-clockwise through such a position as shown in Fig. 11 and into approximately the position indicated in broken lines for **68***a* and **62***a* in Fig. 9. In that last mentioned position the tongues **40***a* are well within their keepers and the cam members **72***a* is entering the box **70***a*. Then, from that position shown in broken lines in Fig. 9, handle **68***a* and its cam member **72***a* are now thrown around clockwise through approximately 180°, to the final position shown in full lines in Fig. 9. The shape of cam member **72***a* is such that, by engagement with the inner face of box **70***a*, it forces arm **62***a* through a total angle of about 30°, for 180° movement of the handle; and also such that the mechanical advantage of the handle over arm **62***a* and tongue **40***a* increases as the final locked position is reached. And in that final position a flat cam face **72***b* may bear flatly against a flat box face **70***b*, so that the parts are all held in their final locked positions with no rotative forces being exerted on the then "dead" handle. And in the final locked position the several parts and particularly the shaft may be under the same distortion stresses and with the same functional actions as in the form first described. A padlock inserted in hole **71***a* in a lug **71***b* projecting from a journal member **36***a* will prevent handle **68***a* from being swung out from its position of Fig. 9 and thus prevent the lock mechanism from being thrown open.

A brief comparison of the two forms will bring out their similarities both as to function and structure. In Fig. 2, the lever-handle is pivoted on a pivot **60** which is stationary with reference to the door, and carries a camming member **72** which operates on a camming member **64** that is carried by the tongue operating shaft **34**. In Fig. 9, the relative carriages of handle pivot **60***a* and of camming member **70***a* are simply reversed; the handle pivot **60***a* now being carried by shaft **34***a* and the camming member **70***a* being stationary with reference to the door. In the final action of forcing the door closed

by movement of the handle between the two positions of Fig. 9, the functionings of the two forms are very similar to each other. However the form of Figs. 8–11 has one functional detail that the first form does not have. In the last figures the tongues are first moved into their keepers and into positions close to their final locked positions by swinging the handle counterclockwise to the broken line position of Fig. 9. Then from that position the handle may be swung through approximately 180° clockwise to give the tongues their final locking movement. In the form of Fig. 2 etc. the maximum movement of handle **68**, both to enter the tongue in the keeper and then to force the tongue to final position, is 180°.

It will be noted by reference to Fig. 9, that when the locking tongue **40***a* is in full pressural engagement with keeper **42***a* (at which time the cam member **72***a* is in the full line position) pivot pin **60***a* lies above the line R*b* which represents a radius from shaft **34***a* extended to the then effective surface of cam interengagement—that is, point E*b* where cam **72***a* engages cam face **72***b*; whereas, when cam **72***a* is in the dot-dash position of Fig. 9, said pivot pin **60***a* lies below the extended radius R*b*.

Both forms of the locking mechanism have a further advantageous feature. It is not necessary to rivet or weld the journals **36** or **36***a* to the door to prevent unauthorized tampering. If all the bolts that hold the parts to the door should be removed, it is still impossible to remove tongue **40** from keepers **42**, if the parts are locked in their relative closed positions by padlocks in the openings **71** and **71***a*. To remove the tongues from the keepers it is necessary to rotate the whole assembly clockwise about a vertical axis located, in Fig. 2 for instance, somewhere to the right of the left hand ends **36***b* of the mounting lugs **36***c* of journals **36**. The extension of those lugs in contact with the door to the left of that axis makes that rotation impossible. In Fig. 9 the same mounting lugs may be similarly extended; or, in that form of the mechanism, the locked handle **68***a* extending to the left performs the same function.

In the following claim, the terms "vertical," "horizontal," "upper" and "lower," are to be taken as terms defining the relations of the various specified elements. It is obvious that my locking mechanism can be applied, for example, to a door hinged at its upper or lower edge as well as to one hinged at a vertical edge as shown here.

I claim:

The combination with a door frame defining a door opening and a door hinged at a vertical edge to the frame at one side of the door opening and adapted to close the door opening by swinging inwardly into it, of door locking means adapted to forcibly aline the door with the door frame, said locking means embodying in combination a vertically extending shaft rotatably mounted on the outer face of the door on an axis spaced laterally from the hinged edge of the door, said shaft being substantially immovable in an axial direction with relation to the door, the ends of said shaft projecting beyond the upper and lower edges of the door and overhanging the upper and lower elements of the frame when the door is closed, means for forcibly rotating said shaft, elongate locking tongue elements fixed one each on each of the overhanging ends of the shaft and projecting radially therefrom, box-like keeper elements mounted one each on the upper and lower elements of the frame near said overhanging shaft ends and having openings which extend in horizontal directions generally parallel to the plane of the frame, said tongue elements adapted severally to enter said keeper elements, on rotation of the shaft, with a substantially horizontal swinging movement having a component in a direction outwardly of the door and a component in a direction parallel to the plane of the door, the keeper elements having outer opening-defining walls with which the tongues when in the keeper openings engage in their componental movement outwardly of the door to force the door closed, said tongue and keeper elements having interengaging upper and lower surfaces, the upper and lower engaging surfaces on at least one of said elements tapering toward each other in the direction of entry of the tongue element into the keeper element to force the frame and door relatively in a vertical direction simultaneously with the forcible closing of the door, the outer opening-defining walls of the keeper elements having inwardly facing locking surfaces convex in horizontal planes, and the tongue elements having complementary outwardly facing surfaces concave in horizontal planes and which engage with said convex surfaces and overhang said convex surfaces at each of the ends of the tongues to prevent relative movements of the door and frame in horizontal directions in their plane.

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