May 31, 1927. 1,630,958

J. L. MAUCH

NUT LOCK AND THE LIKE

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Fig. 1.

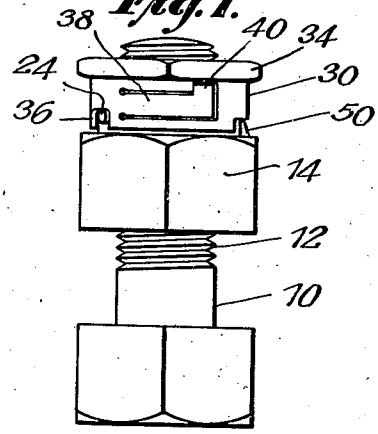


Fig. 2.

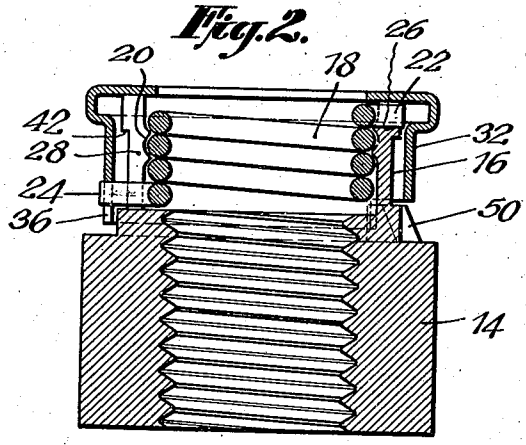


Fig. 3.

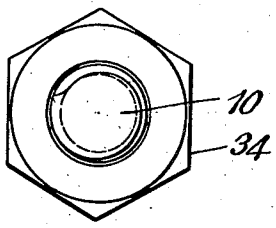


Fig. 5.

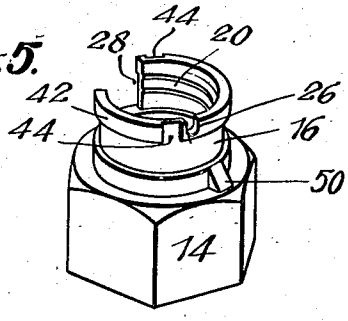


Fig. 4.

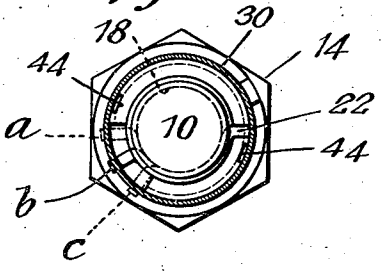


Fig. 6.

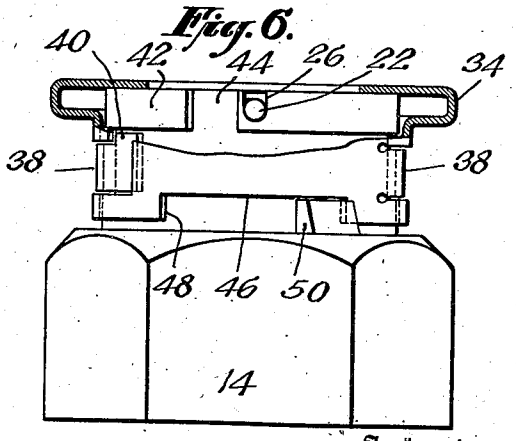
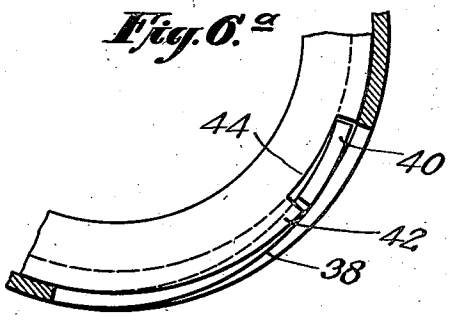


Fig. 6a.



Inventor
JOHN L. MAUCH.

By His Attorney
W. Anthony Mina

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J. L. MAUCH

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Fig. 7.

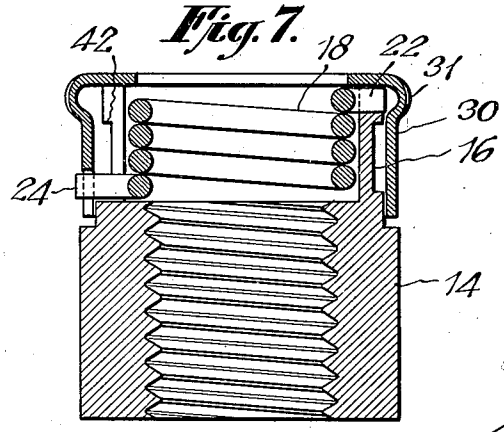


Fig. 8.

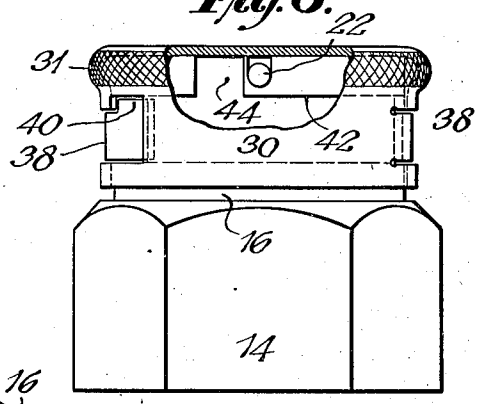


Fig. 9.

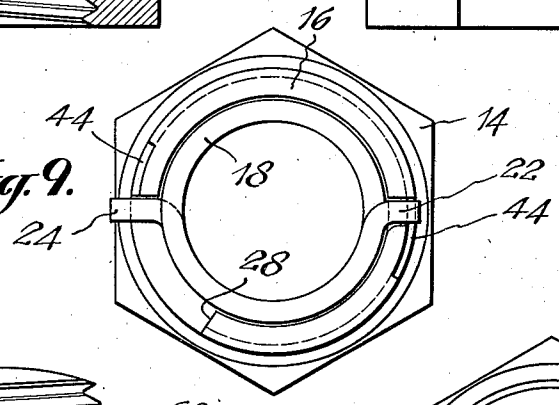


Fig. 10.

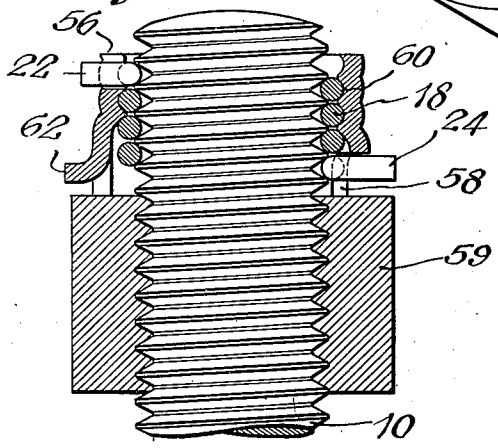


Fig. 11.

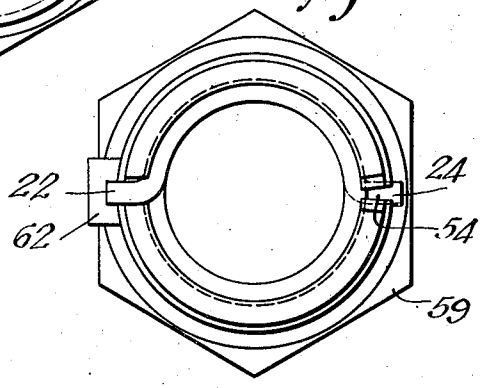


Fig. 13.

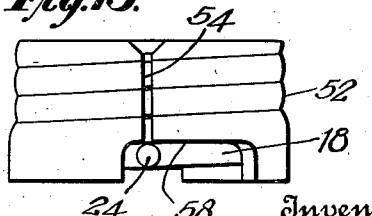
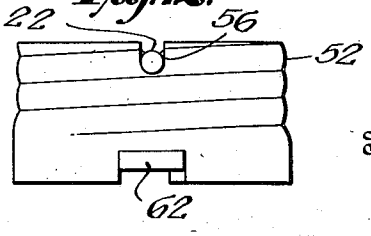


Fig. 12.



Inventor
JOHN L. MAUCH.

By His Attorney
D. Anthony Mina

May 31, 1927. 1,630,958

J. L. MAUCH

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Fig. 14.

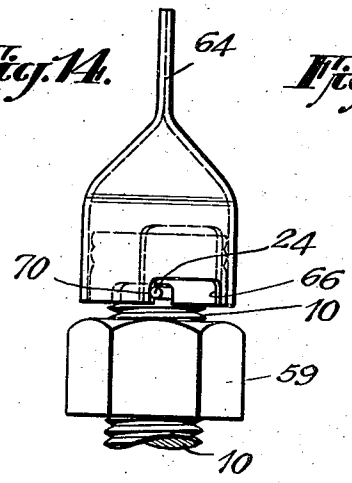


Fig. 15.

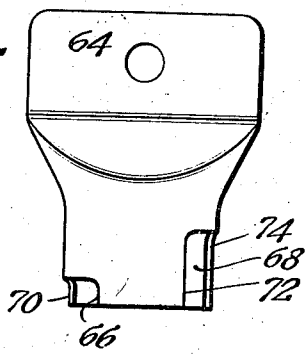
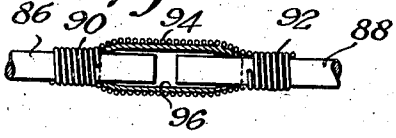


Fig. 20.



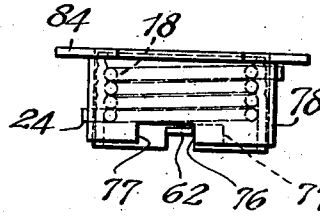
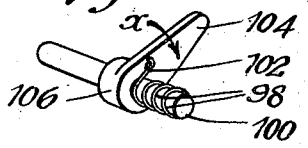


Fig. 16.

Fig. 21.



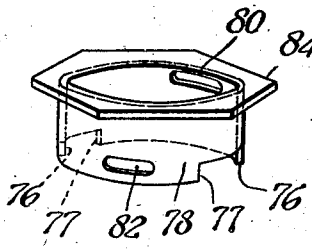
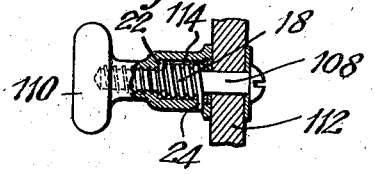


Fig. 17.

Fig. 22.



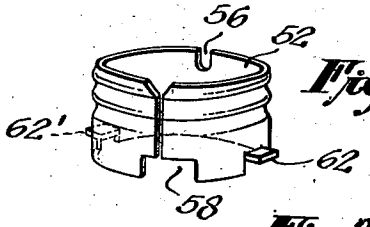


Fig. 18.

Fig. 23.

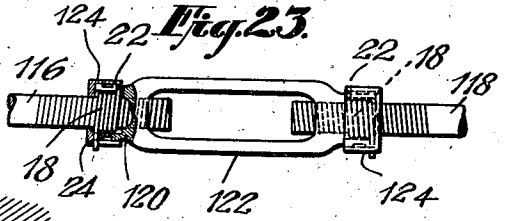
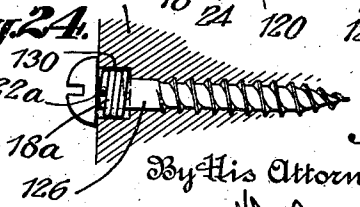


Fig. 19.



Fig. 24.



Inventor
JOHN L. MAUCH.
By His Attorney
W. Anthony Mina

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UNITED STATES PATENT OFFICE.

JOHN L. MAUCH, OF BROOKLYN, NEW YORK.

NUT LOCK AND THE LIKE.

Application filed October 18, 1924. Serial No. 744,316.

This invention relates in general to means for preventing relative rotary motion betwen two members, and while not limited thereto is particularly adapted for locking nuts and the like against relative movement.

The invention is based on the principle that a small pulling force applied tangentially at the end of a member helically wound on a cylindrical member will with the friction between the helical member and said cylindrical member counterbalance a much greater force applied tangentially to the opposite end of said helical member. For example, if a piece of rope is coiled several times around a capstan on a dock and one end of the rope is fast to a ship and the other end grasped by a seaman, the latter can hold the ship against outward movement, or can by releasing the pull on the end of the rope slightly, permit the same to move outward a desired distance.

My invention is in a broad way based on this general principle, but I substitute for the force applied by the seaman to one end of the rope, a resistance obtained by expanding a helical member such as a spring on a shaft. The pressure of the coils normal to the surface of the shaft will produce a frictional resistance tending to hold the spring from slipping tangentially when a force is applied to the end thereof. By the expression "expanding a spring on to a shaft" I mean that the normal diameter of the spring is increased. For example, assuming a spring wound on a ¾ inch mandrel to be used, I propose to expand same over a shaft or bolt whose diameter is say, for example, ⅞ of an inch, or, in other words, I expand the diameter of the spring ⅛ of an inch. It is clear that the coils of the spring will exert considerable pressure on the surface of the shaft and that said pressure is substantially perpendicular or normal to the plane of the shaft at all points of contact between the spring coil and shaft. By seating the spring in a wedge-shaped groove, such as a screw thread in the shaft, greater friction will be obtained than in the case where the spring is seated on a cylindrical shaft. Inasmuch as the radial pressure of the coils will be resolved into component pressures acting normal to the wedge faces, the sum of these component pressures are of greater magnitude than the unresolved radial pressure and hence a greater friction between the spring and the grooved shaft is obtained.

The invention and various applications thereof will be apparent from the following specification when read in connection with the accompanying drawings which illustrate the various embodiments of the invention. In the drawings—

Fig. 1 is an elevation of a threaded bolt having a lock nut applied thereto embodying the invention.

Fig. 2 is an enlarged longitudinal section of the nut and its associated locking means.

Fig. 3 is a plan of Fig. 1.

Fig. 4 is a similar plan with a portion sectioned off.

Fig. 5 is a perspective view of the main body portion of the lock nut.

Fig. 6 is an enlarged view of the lock nut as seen from the right side of Fig. 1, the scale of the drawing being the same as that of Fig. 2.

Fig. 6ª is a detail view.

Fig. 7 is a longitudinal section of a slightly modified form of lock nut.

Fig. 8 is an elevation thereof as viewed from the right of Fig. 7.

Fig. 9 is a top plan of Fig. 7, with the cap removed.

Fig. 10 illustrates an alternative form of nut lock.

Fig. 11 is a top plan thereof.

Fig. 12 is a front elevation of the nut lock detached from the bolt and nut.

Fig. 13 is a view from the opposite side shown in Fig. 12.

Fig. 14 is a view illustrating the action of a key or wrench adapted for use in removing the nut lock shown in Fig. 10.

Fig. 15 is a detail in side elevation of the key shown in Fig. 14.

Fig. 16 is a side view of a modified form of nut lock having a self-contained release key.

Fig. 17 is a perspective view of the key portion of the nut lock shown in Fig. 16.

Figs. 18 and 19 are perspective details of other elements of the nut lock shown in Fig. 16.

Fig. 20 is a view illustrating the application of the invention to a shaft coupling.

Fig. 21 illustrates a further application of the invention wherein my improved locking means can be utilized as a substitute for a pawl and rachet.

Fig. 22 illustrates means for locking screws against relative movement with other members, such as knobs and the like.

Fig. 23 shows the nut lock applied to a turn-buckle.

Fig. 24 illustrates a further application of the invention.

Referring first to the embodiment of the invention illustrated in Figs. 1 to 6 inclusive, 10 represents a bolt having standard V threads cut therein and 14 is a nut also threaded to fit the threads in the bolt in the usual manner. The nut 14, however, is provided with an extension sleeve 16 whose inner bore is of appreciably greater diameter than the outside diameter of the bolt 10. Located within the sleeve 16 is a helical spring 18, the normal inside diameter of which is less than the diameter of the bolt 10. Or, stated more specifically, the internal diameter of the spring 18 before it is applied to or engaged with the threads 12 of the bolt, is smaller than said internal diameter becomes after the spring is engaged with the bolt. It is thus apparent that when the bolt is screwed into the spring the latter will be expanded and therefore will exert an appreciable pressure on the threads thereof. It is further apparent that the radial pressure or grip of each coil of the spring will be resolved into two component forces acting normal to the inclined or wedge faced walls of the threads of the bolt. By the theory of the resolution of forces it can be proven that the sum of the two component forces is greater than the radial force, hence I obtain a greater friction with a spring seated in a wedge-shaped groove than would be obtained in the case of a spring seated on a smooth cylindrical surface.

Before the spring is expanded it fits loosely within the sleeve 16, sufficient clearance being provided so that when expanded it practically engages the inner wall of the sleeve. This wall in some cases is formed with a helical groove 20 forming a seat for the spring coils so that axial thrust on the bolt may be transmitted through the spring coils to the sleeve portion of the nut as well as to the screw threaded portion thereof, thus increasing the holding capacity or power of the nut. At the top the spring 18 is formed with an outwardly extending prong 22 and at the bottom with a similar prong 24. The prong 22 engages quite snugly a slot 26 formed in the upper edge of the sleeve 16. The prong 24, on the other hand, passes freely through a recess 28 formed in the opposite side of the wall of the sleeve 16. Before the spring 18 is expanded by screwing the bolt 12 thereinto, the prong 24 occupies the position indicated at *a* in Fig. 4. After the bolt has been screwed in place the prong 24, because of the expansion of the spring, moves to the position indicated at *b*. Means are provided whereby the prong 24 may be moved further, such as to the position indicated at *c*. This action will loosen the grip of the spring on the bolt, as will be apparent.

The bolt illustrated is formed with right-hand threads and the spring 18 is wound right-handed and the pitch of its coils corresponds substantially to the pitch of the screw threads. Assuming the bolt to be held stationary and the nut to be turned clockwise, as viewed from the top of Fig. 1, because of the engagement between the prong 22 and notch 26, turning movement of the nut will tend to unwrap or lessen the grip of the spring on the bolt, thus permitting it to be threaded to the desired position thereon. On account of the angular dimensions of the recess 28 formed in the sleeve, the prong 24 at the lower end of the spring is allowed a certain freedom or play which permits the necessary relative movement between the convolutions of the spring and the bolt, to enable the gripping action to be overcome when the nut is turned relatively to the bolt in a clockwise direction (in the case of right-hand threads and spring). On the other hand, counter-clockwise movement of the nut relatively to the bolt is prevented, it being apparent that such movement tends to wrap the spring more tightly around the bolt because of the substantial radial pressure exerted by the coils of the spring on the bolt. The locking action between the nut and bolt is augmented by virtue of the fact that the spring was initially expanded to engage it with the bolt. It is clear that the device thus far described provides means whereby a nut can be screwed in one direction relatively to a bolt to a desired position and effectively locked against rotation in the opposite direction.

In order to permit the release of the bolt I have provided means whereby the grip of the spring on the bolt can be relieved. These means include in the form shown in Figs. 1 to 6, a cap 30 comprising a shell-like portion 32 and a hexagonal portion 34 for coaction with a suitable wrench. This cap is slotted at 36 for engagement with the prong 24 of the spring. The circumferential dimension of another slot 46 formed in the lower edge of the sleeve as hereinafter referred to is such that clearance is provided for the cap to turn sufficiently without striking lug 50 (Fig. 6) to move prong 24 from the dotted position *a* to the dotted position *c* in which position it may be locked by means to be presently described. The cap is provided with resilient leaves 38 the free ends of which are each provided with an upwardly extending prong 40. Each prong normally underlies an annular flange 42 formed on the sleeve 16. This flange, as shown best in Figs. 5 and 6, is provided with

notches 44 with which the prong 40 can be engaged so as to lock the cap 30 against relative movement with respect to the sleeve 16. Normally the upwardly extending prong 40 is held out of register with the notches 44 by reason of the engagement between the prong 24 and slot 36 of the cap. By turning the cap 30 counter-clockwise, as viewed from the top, with respect to the sleeve 16, the prong 24 will be moved from the full line position indicated at *b* in Fig. 4 to the dotted line position indicated at *c*. This movement will bring the prong 40 into register with the notch 44 whereupon the cap can be lifted slightly so as to engage the prong and notch and thus hold the same against relative movement. It will be appreciated that this act will lessen the grip of the spring on the bolt, it being remembered that the prong 22 of the spring is held against movement relative to the sleeve by its engagement with the notch 26 and that the prong 24 at the opposite end of the spring has been turned in a direction slightly to expand it. The sleeve will hold the spring thus slightly expanded and permit the nut to be turned either clockwise or counterclockwise with respect to the bolt. Thus the nut can be readily removed under this condition. It is to be noted that the cap is prevented from being pulled off the sleeve by virtue of the fact that portions of the leaves 38 (as indicated in Fig. 6[a]) underlie the flange 42 of the sleeve.

It is not intended that the hexagonal portion 34 of the cap should be used primarily as a means for turning the nut 14. However, as a precautionary measure I have made provision so that in the event the nut sticks to the bolt by rust or other conditions, that after the cap has turned through a predetermined angle with respect to the sleeve, the same will engage the nut and either turn the nut or prevent further relative movement between the cap and the nut. This connection serves to prevent a careless operator from exerting sufficient pressure on the hexagonal portion of the cap as to shear the prong 22 from the spring. To these ends I cut away a portion of the cap 30 as indicated at 46 to form a shoulder 48 which is adapted to engage a lug 50 projecting upwardly from the top of the nut 14. As thus constructed it is apparent that after the cap has been turned through a determined angular distance relatively to the sleeve 16 the shoulder 48 will engage the lug 50 and further turning movement exerted on the cap will be transmitted to the nut and tend to unscrew the same from the bolt. Inasmuch as the direction in which the cap is turned at this time tends to turn the prong 24 (from position *b*) in a direction to expand the spring and bring said prong into engagement with the edge of the recess 28, formed in the sleeve 16, no appreciable shearing action will be exerted on either of the prongs. It will be appreciated that without the provision of such means as the shoulder 48 and lug 50 a careless operator could cause damage by exerting too great a pressure on the hexagonal portion of the cap. If the nut were rusted to a bolt such pressure might tend to shear one of the prongs from the spring.

In Figs. 7 to 9 I have illustrated a slightly modified form of lock nut, this form being very similar to the nut just described, it being noted, however, that the inner bore of the extension sleeve 16 and the nut 14 is a plain cylindrical surface and that the cap 30 is provided with a knurled head 31 instead of the hexagonal head of the former structure. The cap of these figures is adapted to be moved relatively to the sleeve 16 by the operator grasping the knurled portion 31 with his hand. And inasmuch as it is impossible by mere manual hand engagement to damage the prongs 22 and 24 of the spring 18 the cap 30 illustrated in these figures is not provided with a shoulder similar to that shown at 48 in Fig. 6, nor is the nut 14 in this embodiment provided with a lug adapted for engagement with the cap. The other parts of the lock nut shown in these figures are substantially the same as the parts described above in connection with Figures 1 to 6 and the parts are identified by similar reference characters.

In Figs. 10 to 13 inclusive I illustrate an extremely simple form of nut lock embodying the invention, which can be cheaply manufactured and sold as a unit independent of either a bolt or nut, in fact the device in some applications will serve the function of a nut although it is primarily intended for use as a nut lock. Figs. 12 and 13 are elevations from opposite sides of the nut lock, showing the same detached. This form of lock consists merely of a spring retaining shell 52 which is split longitudinally as at 54 and provided at the top with a notch 56 for engaging the upper prong 22 of the locking spring 18 and formed with an elongated recess 58 at the bottom to permit the lower prong 24 of the spring to project therethrough and partake of the limited angular movement with respect to the shell. The shell as shown is crimped in suitable dies to form a helical seat 60 for the coils of the locking spring 18. This seat is adapted to transmit to the threads of the bolt the axial thrust occasioned in screwing the sleeve 52, or the nut lock as a whole, against the nut 59 to be locked to the bolt 10. At the lower end an outwardly extending lug 62 is formed on the shell which is adapted to be engaged by a suitable key or tool for operating the nut lock. Fig. 15 illustrates a suitable key or tool for manip-

ulating this type of nut lock and Fig. 14 shows a key in the act of unscrewing the nut lock from the bolt 10. This key is formed of a piece of cylindrical tubing which is collapsed together at 64 to form a hand grip. The lower portion of said key is slotted as at 66 and 68. The edge 70 of the key slot 66 is adapted to engage the lower prong 24 of the locking spring. Thus turning the key counterclockwise as viewed from the top it will press against the prong 24 and tend to expand the spring and thus loosen its grip on the bolt 10. After slight expansion of the spring has taken place the edge 72 of the other key slot 68 will engage the lug 62 and transmit the turning movement of the key to the shell 52 and therefore unscrew the same from the bolt. On the other hand, turning the key in a clockwise direction will cause the opposite shoulder 74 of the key slot 68 to engage the lug 62 on the shell and the clockwise movement of the key will be transmitted through the lug 62 and shell 52 to the upper prong 22 of the spring 18. Such clockwise movement, of course, applied to the top prong of the spring tends to loosen the grip of the latter on the bolt and permits the nut lock to be readily screwed up to the desired position. The circumferential length of the key slot 66 is such that when the key is turned clockwise in threading the nut lock on the bolt the key does not engage the outwardly extending prong 24 on the lower end of the locking spring.

Figs. 16 to 19 inclusive illustrate a further modification somewhat similar to the arrangement just previously described wherein the operating collar or key forms a unit with the nut lock. In this form of the device I provide a spring retaining shell 52 similar to that shown in Figs. 12 and 13 formed with a slot 56 for engagement with the upper prong 22 of the locking spring 18. This sleeve is also provided with a lower slot 58 through which the prong 24 of the spring freely passes. As distinguished from the shell shown in Figs. 12 and 13, however, the shell used in this form of device, as shown in Fig. 18, is provided with two projections 62 and 62′. These projections co-operate with the vertical edges 76 of key slots formed in the lower portion of the operating collar 78 which surrounds the shell 52. This operating collar is provided at the top with a slot 80 through which the upper prong 22 of the spring projects in order to hold the collar in place over the retainer. The collar is provided with a similar slot 82 at the bottom through which the lower prong 24 of the spring projects. The collar as shown in Fig. 17 is provided with a hexagonal portion 84 to afford engagement with a wrench. In this form of device when the collar 78 is turned clockwise the nut lock can be readily threaded on to the bolt, the turning movement of the collar being transmitted in a clockwise direction to the upper prong 22 of the spring, thus tending to lessen its grip and permit the nut lock to be readily threaded on the bolt. At this time the edges 76 of the cut away portion of the collar engage the lugs 62 and 62′ on the spring retaining shell. In removing the nut lock from the bolt the collar 78 will be turned counterclockwise and pressure will be transmitted to the spring through the lower prong 24 thereof. At this time the edges 77 of the cut away portions engage the prongs 62 and 62′.

Fig. 20 shows a further application of the invention wherein 86 and 88 represent two shafts in substantially axial alignment and 90 and 92 represent the opposite ends of a continuous spring which have been expanded so as to exert a frictional grip on the cylindrical surface of the shaft. The central portion of this spring is enlarged as at 94 and engages a sleeve 96 fitted over the contiguous ends of the shafts. This arrangement provides a simple flexible lock or coupling between the two shafts which will lock them both to rotate in the same direction practically as a unit or will permit one to be rotated relatively to the other in the opposite direction.

Fig. 21 shows the further application of the invention wherein the coils of a spring 98 are expanded over a shaft 100 so as to exert a frictional grip thereon and one end of the spring is extended outwardly in tangential direction and formed with an angular prong 102 which enters a recess formed in an arm 104 the hub 106 of which is loosely mounted on the shaft 100. With this arrangement it is apparent that a force applied in the direction of the arrow X will tend to tighten the grip of the spring on the shaft and hence movement of the arm 104 will be transmitted to the shaft 100. On the other hand, movement of the arm 104 contrary to the direction of the arrow will not be transmitted to the shaft at this time the action being to release the grip between the spring and the shaft. This device can be readily used in place of a pawl and ratchet.

In Fig. 22 I have illustrated my improved locking device applied to a screw 108 attached, for example, to a screw-knob 110 of a piece of furniture such as a dresser drawer 112. In this application of the device the locking spring 18 engages the threads of the screw 108 and the prong 22 thereof engages a slot 114 formed in the hub of the knob. The opposite prong 24 of the locking spring extends through a clearance slot formed in the hub of the knob so that if it is desired to remove the knob at any time a suitable sharp tool can be applied so

as to release the grip of the locking spring on the screw.

Fig. 23 shows the invention applied to a turn-buckle, the locking springs 18 gripping the ends of the turn-buckle rods 116 and 118 whose ends are screw-threaded in opposite directions. The prongs 22 of the locking springs at their inner ends snugly engage slots formed in the hubs 120 of the turn-buckle member 122 and the ends 24 of the locking springs each pass freely through a clearance recess formed in the turn-buckle hubs and engage with the edge of a slot formed in a cap 124 somewhat similar to the cap 30 described in connection with Fig. 7, said cap being adapted to release the grip of the spring on the turn-buckle rods 116 and 118 when it is desired to adjust the same.

In Fig. 24 I have shown the invention applied to an ordinary button head wood screw 126 having on its shank a spring 18^a which it will be noted is wound in the opposite hand to that of the screw threads, the latter having right-hand threads and the spring being a left-hand spring. The spring 18^a grips the shank of the wood screw and as the latter is screwed into the board 128 the spring and the screw will turn together. Preferably a small counter-bore 130 will be formed in the board and as the prong 22^a strikes the face of the board it will encounter a slight resistance. Further driving in of the screw which, of course, will be accompanied by clockwise turning movement thereof will cause a slight loosening of the spring the end opposite to that having the prong 22^a being free. As the screw is driven home and flush with the surface of the board 128 the prong 22^a will form its own notch in the board and any effort to turn the screw counter-clockwise will be resisted by the spring, such counter-clockwise movement tending to wrap the spring tighter on the screw and the prong 22^a being locked to the board will prevent such movement and hence will adequately lock the screw against becoming loose again.

Though I have described with great particularity specific structural details of the various embodiments of the invention herein illustrated it is not to be construed that I am limited thereto and various modifications and substitutional equivalents may be made by skilled artisans without departure from the invention as defined in the appended claims.

What I claim is:

1. The combination with a bolt and a nut threaded thereon, of a spring whose coils embrace and exert a pressure on the threads of the bolt, said spring having an offset end engaging said nut so that relative rotation between the bolt and nut is permitted in one direction and prevented in the opposite direction and means rotatable on the exterior of the nut with its axis of rotation coincident with the axis of the nut arranged to engage another offset end of said spring.

2. A device of the class described including two elements, and means for resisting relative rotary movement of said elements comprising a helical spring having one end engaging one of said elements and the coils thereof embracing and gripping the other element, said spring having a prong to which a force can be applied to release the grip of the coils, means for applying such a force to said prong and means for locking the last named means after it has been actuated to apply said force.

3. The combination with a bolt and a nut having threads engaging said bolt of a spring whose coils embrace and exert a pressure on the threads of the bolt, said nut having a sleeved extension enclosing said spring and having a recess for engagement with an offset end formed on the spring whereby rotary movement of the nut relatively to the bolt in one direction tends to tighten the grip of the spring on the bolt and movement in the opposite direction expands the spring and loosens said grip, and means carried by the nut for locking the spring in expanded position.

4. The combination with a bolt and nut screwed thereon of a spring whose coils embrace and exert a pressure on the threads of the bolts, said nut having a sleeved extension enclosing said spring and having a recess for engagement with an offset end formed on the spring whereby rotary movement of the nut relatively to the bolt in one direction tends to tighten the grip of the spring on the bolt and movement in the opposite direction loosens said grip and means rotatable about the axis of said sleeved extension and engaging a prong on the opposite end of said spring and adapted to be turned to slightly expand said spring and release its grip on said bolt.

5. The combination with a bolt and a member in threaded engagement therewith of a locking device including a spring whose coils lie in the thread grooves of said bolt and exert a pressure thereon, and a sleeve surrounding said spring and having notches therein through which the prongs extend outwardly from the opposite ends of said spring and means for expanding and locking the spring expanded to permit the bolt or nut to turn freely in either direction.

6. The combination of two inter-engaging threaded elements with means for normally resisting their relative rotary movement comprising a spring in contracted engagement with one element and having one end engaging the other element, the other end of said spring passing freely through an opening in the last named element, and a collar

loosely mounted on the latter and engaging the end of the spring projecting therethrough, said collar having a resilient portion adapted to be sprung into engagement with the said second named element to temporarily lock it against movement relative thereto.

7. The combination with a bolt and nut, of locking means for normally preventing their relative movement in a determined direction comprising a notched and slotted sleeve secured to said nut, a spring located in said sleeve and embracing said bolt and having one end engaging the notch in said sleeve and the other end passing freely through the slot in said sleeve, an annular flange on said sleeve having a recess formed therein, an operating collar notched for engagement with the end of the spring which passes freely through said sleeve, said collar having a spring leaf located below said flange and formed with a lug adapted to engage the recess in said flange.

8. In combination a bolt and nut, having means co-acting therewith including a helical spring embracing the bolt and a member movable relatively to the nut arranged to release the grip of said spring, said nut having a shoulder formed thereon and said member having a portion adapted to engage the latter so as to turn the nut upon the release of said spring.

9. A device of the class described comprising a threaded lock nut, a spring locking member supported in a recess therein, a release cap operatively connected with said spring and means for normally preventing detachment of the cap from the nut.

10. A device of the class described comprising a threaded lock nut, a spring locking member mounted in a recess within the nut, said recess having grooves formed to fit the convolutions of the spring, a release cap mounted on the exterior of the nut having a portion adapted to cooperate with an offset end of said spring.

11. A device of the character described comprising a threaded nut having a sleeved extension, a locking spring housed within said extension, the exterior of said sleeved extension being formed with an annular shoulder, a release cap rotatably mounted on said extension, said release cap having a portion adapted to underlie said shoulder so as to prevent dislodgment thereof.

12. A locking device of the character described including a threaded nut, a lug on the exterior of said nut, a spring locking member mounted within the cavity formed in the nut, said spring having offset ends, one portion of said nut being notched to engage one offset end of the spring, another portion of said nut being slotted to permit free movement of the other offset end of the spring, a release cap journalled on said nut and having a portion notched for engagement with the last mentioned offset end of said spring, said release cap having a shoulder for coaction with the aforesaid lug.

In witness whereof I have hereunto signed my name.

JOHN L. MAUCH.