Dec. 29, 1970 M. R. DUMMER 3,550,472

VARIABLE TRIGGER LOCK

Filed Aug. 5, 1968 2 Sheets-Sheet 1

Fig.1

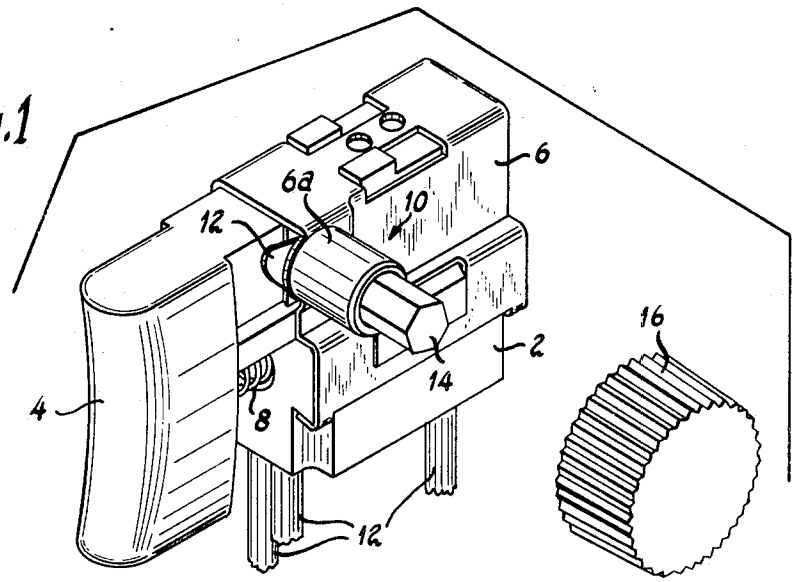


Fig.2

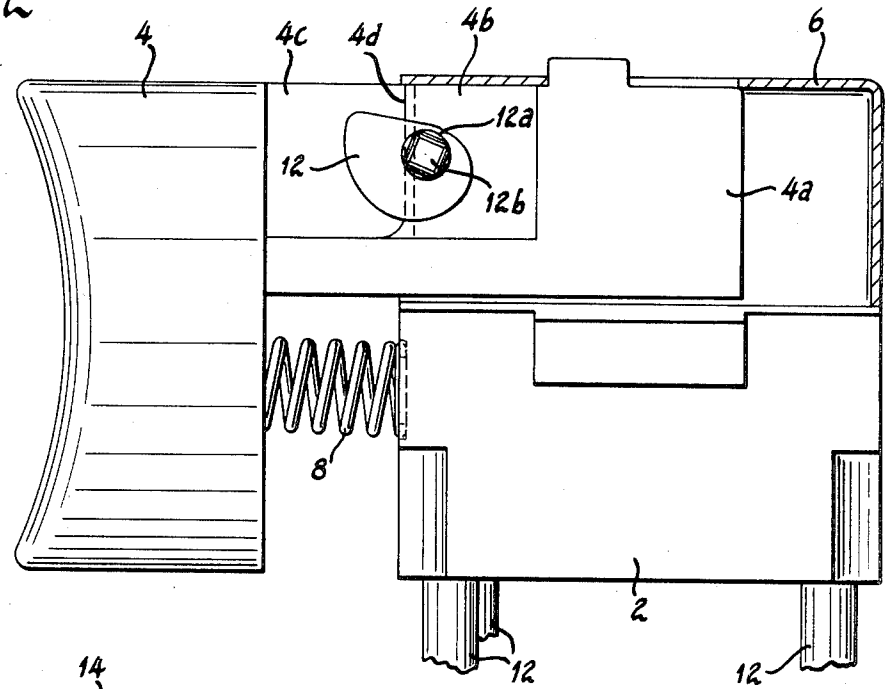
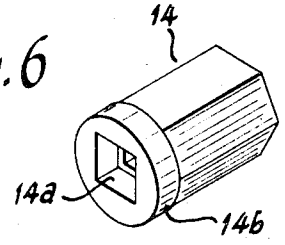


Fig.6



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Fig. 3

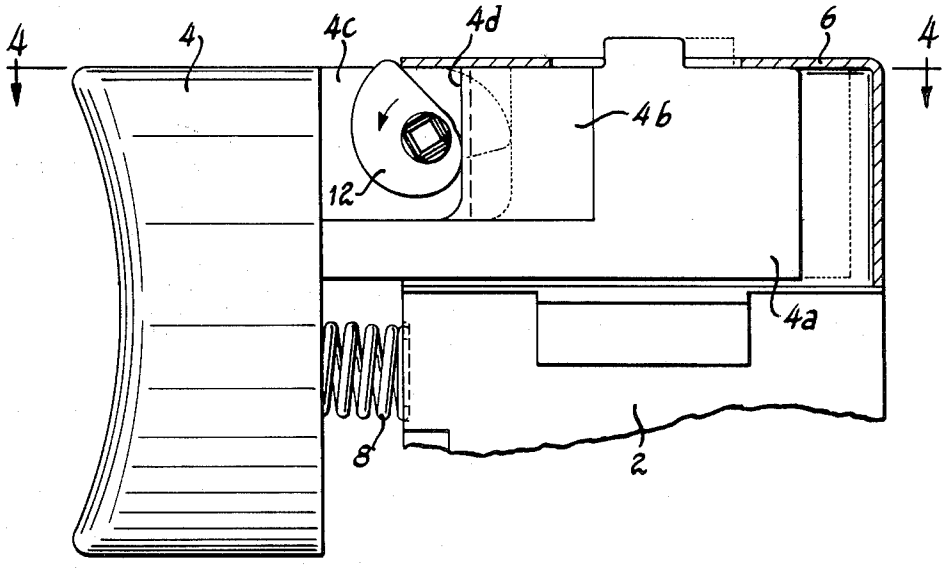


Fig. 4

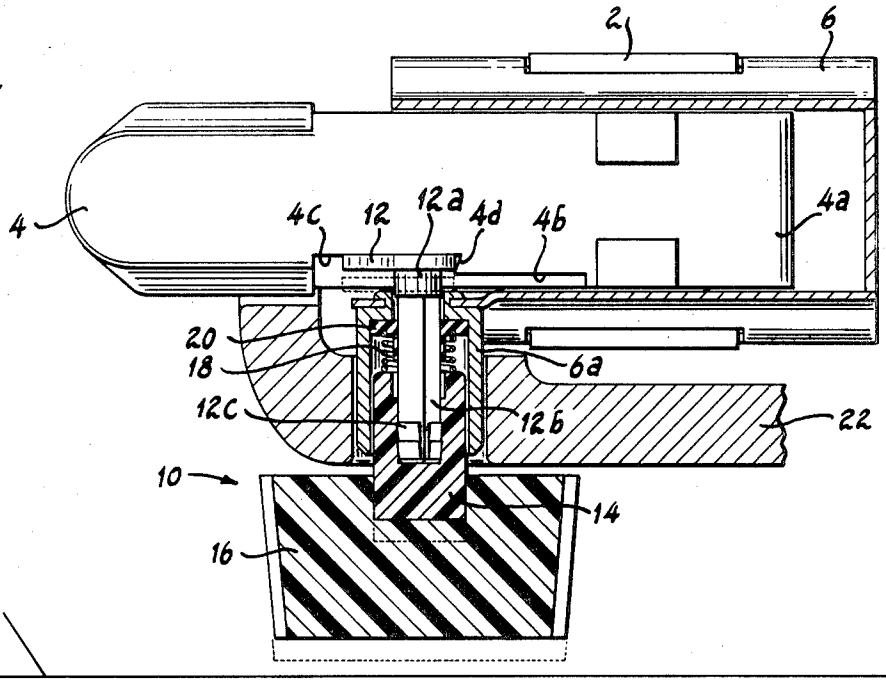
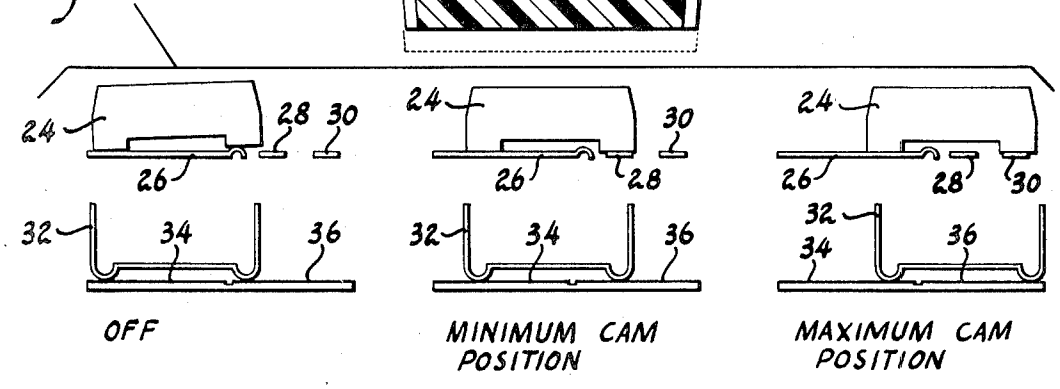


Fig. 5



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3,550,472

VARIABLE TRIGGER LOCK

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Int. Cl. F16h 21/20
U.S. Cl. 74—531 10 Claims

ABSTRACT OF THE DISCLOSURE

A variable trigger lock for the index finger operated trigger type actuator of a variable speed control switch for a portable electric tool such as a drill. A knob on the outside of the tool handle when depressed and rotated by the user rotates a cam that abuttingly engages a vertical shoulder on the horizontally slidable part of the trigger for stepless locking in any speed position. A slight depression of the trigger allows a spring to snap the cam out from its depressed position clear of the shoulder for automatic release.

BACKGROUND OF THE INVENTION

This invention relates to the art of locking a variable speed control device in any speed position in a stepless or continuously adjustable manner.

E. T. Piber Pat. No. 3,383,943, dated May 21, 1968, and assigned to the assignee of this invention, discloses an all-speed lever lock for the index finger operated trigger of a speed control switch for a portable tool. This all-speed lever lock has a thumb operated cam that frictionally grips a surface on the trigger, this surface being hoizontally disposed on the horizontally slidable part of the trigger. The trigger becomes locked because its tendency to restore under the force of its return spring causes a progressively larger cam contour to grip the trigger.

While this prior lever lock is effective for its intended purposes, the present invention is an improvement thereon.

SUMMARY OF THE INVENTION

This invention relates to a variable trigger lock having stepless adjustability, positive engagement and automatic release.

An object of the invention is to provide an improved variable lever lock for a depressible actuator trigger.

A more specific object of the invention is to provide an improved variable trigger lock that replaces the conventional depressible pin trigger lock of portable drills and is mounted in the same bushing.

Another specific object of the invention is to provide an improved variable trigger lock that will lock the speed control trigger of a portable tool in any speed position and that can also be used for adjusting the trigger position to adjust the speed.

A more specific object of the invention is to provide an improved continuously adjustable trigger lock for a speed control device which has positive locking action without slip or creepage under vibration or other severe operating conditions.

Another specific object of the invention is to provide a trigger lock of the aforementioned type which has automatic release in response to slight depression of the locked trigger.

Another object of the invention is to provide a trigger lock of the aforementioned type that requires minimum modification of the trigger for cooperation therewith.

Another object of the invention is to provide a trigger lock of the aforementioned type that is simple in construction and efficient in operation and economical to manufacture.

Other objects and advantages of the invention will hereinafter appear.

BRIEF DESCRIPTION OF THE DRAWINGS

FIG. 1 is an enlarged isometric view of a variable speed control switch including a variable lock for its trigger constructed in accordance with the invention with the knob shown detached;

FIG. 2 is a still more enlarged front elevational view with the frame broken away and the knob and lock button removed showing the trigger in its undepressed position;

FIG. 3 is a view like FIG. 2 showing the trigger partly depressed and the lock in its minimum speed locking position;

FIG. 4 is a cross-sectional view taken along line 4—4 of FIG. 3 with the lock button and knob attached;

FIG. 5 is a schematic diagram showing operating positions of the switch and potentiometer relative to locking cam positions; and

FIG. 6 is an isometric view of the lock-button to which the knob is mounted.

DESCRIPTION OF THE PREFERRED EMBODIMENT

Referring to FIG. 1, there is shown the exterior appearance of a variable speed control switch with the rotary knob of the variable trigger lock detached. This variable speed control switch is provided with an insulating base **2**, a switch actuating member such as a trigger **4**, a metal frame **6**, a trigger return spring **8**, and a variable trigger lock **10**. Electrical conductors **12** extend from holes in the bottom of the base for connecting it to an alternating current source and a load device such as the universal motor of a portable electric drill.

Base **2** houses the electrical components and connections which control the speed of the drill motor when trigger **4** is depressed.

Trigger **4** is generally of conventional configuration and is provided with the usual index finger engaging part with a rear bore part way therein for retaining spring **8** so as to abut the base, and a contact-carrying part **4***a* slidably extending over the base. The front face of the contact-carrying part of the trigger is provided with a shallow stepped recess having a first depth **4***b* providing clearance for the locking cam and a second depth **4***c* defining a vertical undercut shoulder **4***d* for engagement by the locking cam **10***a* as shown in FIGS. 2–4. As will be apparent, the contact-carrying part of the trigger extends horizontally over the top of the base so that the vertical shoulder provides positive locking of the trigger in any adjusted position as hereinafter more fully described.

Frame **6** is a conventional sheet metal frame that clamps the contact-carrying part of the trigger to the base while allowing sliding thereof against the force of the return spring. This frame also has rigidly secured thereto a bushing **6***a* for rotatably supporting the variable trigger lock. This bushing **6***a* is similar to or the same as the bushing that has heretofore been used to support the conventional plunger type locking pin used on power drills.

As shown in FIGS. 2 to 4, variable trigger lock **10** comprises an internal portion consisting of a lock cam **12** for locking the tirgger and an external part consisting of a lock button **14** with or without a knob **16** for manually operating the lock cam. This variable trigger lock also comprises a compression spring **18** providing automatic release and arubber washer **20**.

Lock cam **12** consists of an eccentric cam having a shaft extending therefrom. This shaft comprises a cylindrical portion **12***a* and a substantially square portion **12***b*. Cylindrical portion **12***a* is immediately adjacent the cam and is long enough to journal the lock cam in the hole within the reduced stem or mounting portion of bushing **6***a*. This cylindrical portion of the shaft is short enough so that it will not interfere against the washer with full retraction of the cam under spring force clear of the trigger. Square portion **12***b* of the shaft extends from the cylindrical portion to the end of the shaft and is provided with serrations **12***c* or low teeth directed so as to allow insertion of this portion of the shaft through washer **20** and spring **18** into a square hole in lock button **14**. These teeth bite into the lock button if attempt is made to pull the shaft from the hole.

Washer **20** is preferably composed of a good friction material such as rubber or the like and is provided with a square hole through its tubular portion snugly fitting the square portion of the shaft for turning therewith. Helical spring **18** surrounds the tubular portion of this washer and the square portion of the shaft and is compressed between the lock button and the annular portion of the washer to press the latter against the annular inner wall of bushing **6***a*. This annular portion of the washer centers the cam shaft in the bushing. The friction between the washer and the bushing caused by the spring force tends to prevent the lock cam from rotating out of its set position.

Alternatively, a detent construction between the annular portions of the washer and bushing could be used to provide feel and stops at one or more fixed speed points. For this purpose, nibs and dents in the abutting parts could be used. The washer should preferably be made of metal for this purpose.

As shown in FIGS. 1 and 6, lock button **14** is generally cylindrical in shape and has the aforementioned square hole **14***a* extending axially into its inner end for receiving the square, serrated portion of the lock cam shaft. The exterior of the lock button is round for a short distance on its inner end **14***b* to journal it within the bushing. The remainder thereof is hexagonal in shape to provide either a gripping surface for manual rotation by the user or to fit into a knob with frictional engagement as shown in FIGS. 1 and 4.

When the variable speed control switch with its variable trigger lock is used in a portable electric drill, the lock button and knob appear as shown in FIG. 4. As shown therein, the bushing extends out through a hole in the housing or drill handle **22**. Lock button **14** extends out from the handle and may be gripped by the user to rotate the lock cam. Alternatively, knob **16** may be press-fitted on the external end of the lock button to provide a larger member for gripping by the fingers or thumb of the user.

The trigger is shown in its undepressed position in FIG. 2. In this position, the tool is turned off. This is depicted schematically in FIG. 5. As shown at the left in FIG. 5, in the undepressed position of the trigger, bridging contact **24** engages only contact strip **26** so that the switch is open and power is disconnected from the tool motor. In this position also, bridging slider **32** is at the maximum resistance points of the two resistor strips **34** and **36** of the speed control potentiometer. Alternatively, one of these strips such as **36** may be a contact strip.

The trigger is shown in its minimum locked speed depressed position in FIG. 3 in solid lines. As will be apparent, the lock cam has been rotated clockwise to stop against the frame at minimum speed position. The trigger has been depressed just enough so that pressing on the knob allows the lowest cam contour point to be received on locking shoulder **4***d*. The undercut of this shoulder shown in FIG. 4 tends to wedge the cam against deeper recess **4***c* to prevent the cam from slipping off the shoulder under spring force when the knob is released.

This wedging action also aids in tending to prevent the cam from rotating in higher locked speed positions. This condition is depicted schematically at the middle in FIG. 5. As shown therein, movable contact **24** has been moved enough to the right to bridge contact strip **26** to on-off contact **28**. Also, slider **32** has been moved to the right enough to decrease the resistances of the potentiometer thereby to run the tool at a slow speed.

The trigger is shown in its maximum locked speed depressed position in dotted lines in FIG. 3. In this position the lock cam has been rotated counterclockwise to stop against the frame and with the highest point of the contour being in abutting engagement with the shoulder on the trigger as shown in dotted lines. This provides maximum speed for the tool. This condition is depicted schematically at the right in FIG. 5. As shown therein, movable contact **24** has been moved all the way to the right to bridge contact strip **24** to shunting contact **30** to place the tool motor directly across the line for full speed operation. Also, slider **32** has been moved far over to the right to decrease the potentiometer resistances to a minimum for full speed.

As will be apparent, speed control takes place for depression of the trigger from the minimum cam position shown at the middle in FIG. 5 to the point of trigger depression wherein bridging contact **24** first engages shunting contact **30**. In this range of trigger movement, the tool motor speed can be increased from a very slow speed to full speed or near thereto depending on the nature of the variable speed control circuit and motor used.

Lock cam **12** is provided with a contour that increases gradually in radius from the minimum angle abutting shoulder **4***d* shown in solid lines in FIG. 3 to the maximum angle abutting shoulder **4***d* shown in dotted lines therein. This contour is arranged so that at any rotary position of the cam between such operative angles, its point of contact with shoulder **4***d* is at or very near a horizontal plane passing through the center axis of its shaft. In this way, minimum torque is applied by spring **8** to the lock cam. Any small amount of such torque that is applied in different rotary positions of the cam is easily overcome by the wedging effect of the cam into the undercut shoulder and the friction between washer **20** and the annular inner surface of bushing **6***a*. Also, due to the contour of the cam, the more that the trigger is depressed before locking, the closer such point of contact between the lock cam and shoulder approaches such horizontal plane so that although the spring force increases, the torque-producing lever arm decreases in length actually to reduce the torque. Thus, the lock cam stays in its adjusted position as set and does not creep or slip therefrom.

Lock cam **12** is preferably a casting made of metal such as zinc or the like that can readily be cast into proper form. Lock button **14** is preferably molded of plastic molding material or the like and the square hole therein is preferably stepped to facilitate insertion of the shaft of the lock cam therein. For this purpose, this hole is slightly enlarged to substantially the depth of the round exterior portion of the lock button with the remainder of the hole being smaller to grip the serrations on the square shaft pressed therein. Knob **16** may also be made of molding material or plastic material of the desired color.

Before the frame is clinched onto the base, lock cam **12** is inserted into the bushing. The washer is then inserted on the square shaft, followed by the helical spring whereafter the lock button is pressed onto the shaft. The frame may now be clinched onto the base to confine the slidable trigger thereon to provide the assembly shown in FIG. 1. Only the knob is left off until after the assembly has been put in the tool handle. The knob may then be pressed onto the lock button.

When the variable speed control switch with its variable trigger lock is used in a power tool such as a portable

drill, the user grips the drill handle with his right hand and depresses the trigger with his index finger to obtain the desired speed. If the user desires to run the drill for a period of time at such speed, he presses on the knob and rotates it counterclockwise with his thumb until the cam abuts the vertical shoulder on the trigger to lock it in the depressed position. The index finger may then relax the pressure on the trigger.

Alternatively, the user may rotate the knob with his left hand while his right index finger depresses the trigger to reach the desired locked speed position. Also, the trigger may be depressed merely by pressing and rotating the knob with the left hand without any help from the right index finger once the trigger has been depressed enough for shoulder *4d* to catch on the cam as shown in FIG. 3.

To release the lock, a slight depression of the trigger causes spring **18** to snap it back clear of the shoulder.

While the apparatus hereinbefore described is effectively adapted to fulfill the objects stated, it is to be understood that the invention is not intended to be confined to the particular preferred embodiment of variable trigger lock disclosed, inasmuch as it is susceptible of various modifications without unduly departing from the scope of the appended claims.

What is claimed is:

1. In an electrical device having a handle portion and a control device mounted in the handle portion and including a movable actuating member extending from the handle portion for manipulation by the finger of the user, the improvement comprising:

variable means for locking the actuating member in any adjusted position within a predetermined range of movement thereof comprising:

a shoulder on the actuating member arranged substantially perpendicular to its direction of movement;

a locking member and means movably mounting it on the control device and having a progressively larger dimension for abutting said shoulder;

and means accessible on the outside of the handle portion for manually moving the desired dimension of said locking member into engagement with said shoulder thereby to provide a positive and solid stop to lock the actuating member in its adjusted position.

2. The invention defined in claim **1**, wherein said variable locking means also comprises:

means responsive to a slight further movement of the actuating member for snapping said locking member clear of said shoulder for automatic release.

3. The invention defined in claim **2**, wherein said snapping means comprises:

a helical compression spring around a portion of said locking member for applying a resilient outward force thereon to snap said locking member clear of said shoulder when the actuating member is slightly depressed and against the force of which said locking member must be depressed in order to engage said shoulder.

4. The invention defined in claim **1**, wherein said locking member comprises:

a cam having a contour of smoothly increasing radius and an integral shaft;

and said mounting means comprises a bushing on the control device in which said cam shaft is journaled.

5. The invention defined in claim **4**, wherein said variable locking means also comprises:

a washer slidable on said cam shaft and mounted nonrotatably relative thereto;

and a compression spring pressing said washer against an inner wall of said bushing for preventing rotation of said cam from its locking position.

6. The invention defined in claim **5**, wherein said washer comprises an annular member of good friction material such as rubber;

said bushing has a reduced end portion providing an annular internal wall against which said annular member is pressed by said spring;

and a lock button secured on the end of said cam shaft to compress said spring between itself and said washer.

7. The invention defined in claim **6**, wherein said lock button comprises:

a cylindrical portion journaled in the larger portion of said bushing;

and an external portion outside of the handle portion that may be grasped by the user to rotate said cam.

8. In a portable electric tool having a handle and a continuously adjustable speed control device mounted therein including a return-spring-biased movable operating trigger adapted to be actuated by the index finger of the user to control the speed of the tool;

a variable trigger lock comprising:

a shoulder formed in one side of the operating trigger substantially perpendicular to the direction of movement thereof;

an eccentric cam journaled for rotary motion adjacent said shoulder and being normally biased clear of said shoulder;

said eccentric cam having a shaft extending outwardly from the control device and the handle;

a mounting bushing having a reduced end portion secured to the control device in which said cam shaft is journaled;

a lock button journaled in the larger portion of said bushing and rigidly secured to said cam shaft;

and said lock button being accessible for manual operation of the user when the operating trigger is actuated to a slow speed position to cause said cam to abut said shoulder and lock the operating trigger in a desired steplessly adjustable speed position dependent on the amount of turning of said shaft and cam.

9. The invention defined in claim **8**, wherein said shoulder is undercut at an angle tending to wedge said cam against the operating trigger and thereby to keep said cam from rotating due to return spring force of the operating trigger.

10. The invention defined in claim **8**, wherein said variable trigger lock also comprises:

a compression spring on said shaft between said lock button and the annular wall adjacent the reduced end portion of said bushing responsive to a slight further actuation of the operating lever when it is locked to snap said cam clear of said shoulder for automatic release.

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