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Glover et al.

[11] **3,847,233**

[45] **Nov. 12, 1974**

[54] **TRIGGER MECHANISM FOR HAND-OPERATED POWER DEVICE PROVIDING AUTOMATIC LOCK-OFF AND MANUAL LOCK-ON OPERATION**

[75] Inventors: **Richard Warmath Glover,** Joppa; **Gordon Frederick Musch,** Fork, both of Md.; **John A. Summa,** Anaheim, Calif.

[73] Assignee: **The Black and Decker Manufacturing Company,** Towson, Md.

[22] Filed: **June 29, 1973**

[21] Appl. No.: **375,160**

[52] **U.S. Cl.** ..... **173/170,** 200/159 R

[51] **Int. Cl.** **B23b 45/00**

[58] **Field of Search** ..... 173/169, 170; 251/116; 200/159 R

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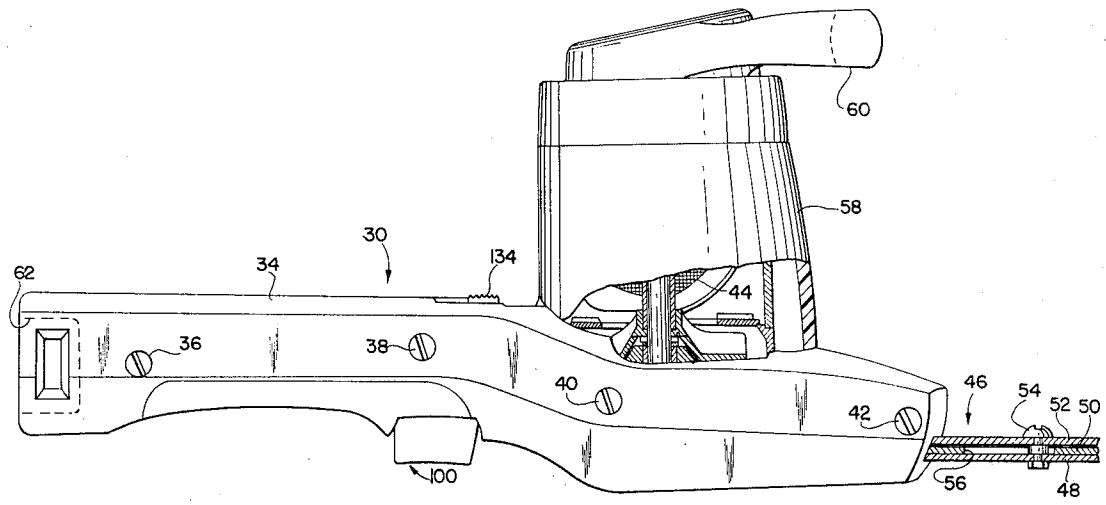
Primary Examiner—James A. Leppink

Attorney, Agent, or Firm—Joseph R. Slotnik; Leonard Bloom; Edward D. Murphy

[57] **ABSTRACT**

A trigger mechanism for a hand-operated power tool includes a trigger and a manually operable locking device which provides an automatic lock-off feature to normally lock the trigger in its inoperative position, a manual unlock feature to permit the trigger to be unlocked for movement between its inoperative and operative positions, and a manual lock-on feature to permit the trigger to be locked in its operative position. The locking device is capable of two (2) distinct modes of movement, a first mode which permits the trigger to be unlocked for movement between its inoperative and operative positions for manual control, for example, on-off operation of the power tool and a second mode which permits the trigger to be locked in its operative position for continuous operation of the tool. A positive intentional action by an operator is required to shift the locking device from its first mode of movement to its second mode of movement to prevent inadvertent movement of the locking device to its lock-on position. Furthermore, the locking device can be shifted to its second mode of movement only after the trigger is in its operative position.

15 Claims, 20 Drawing Figures



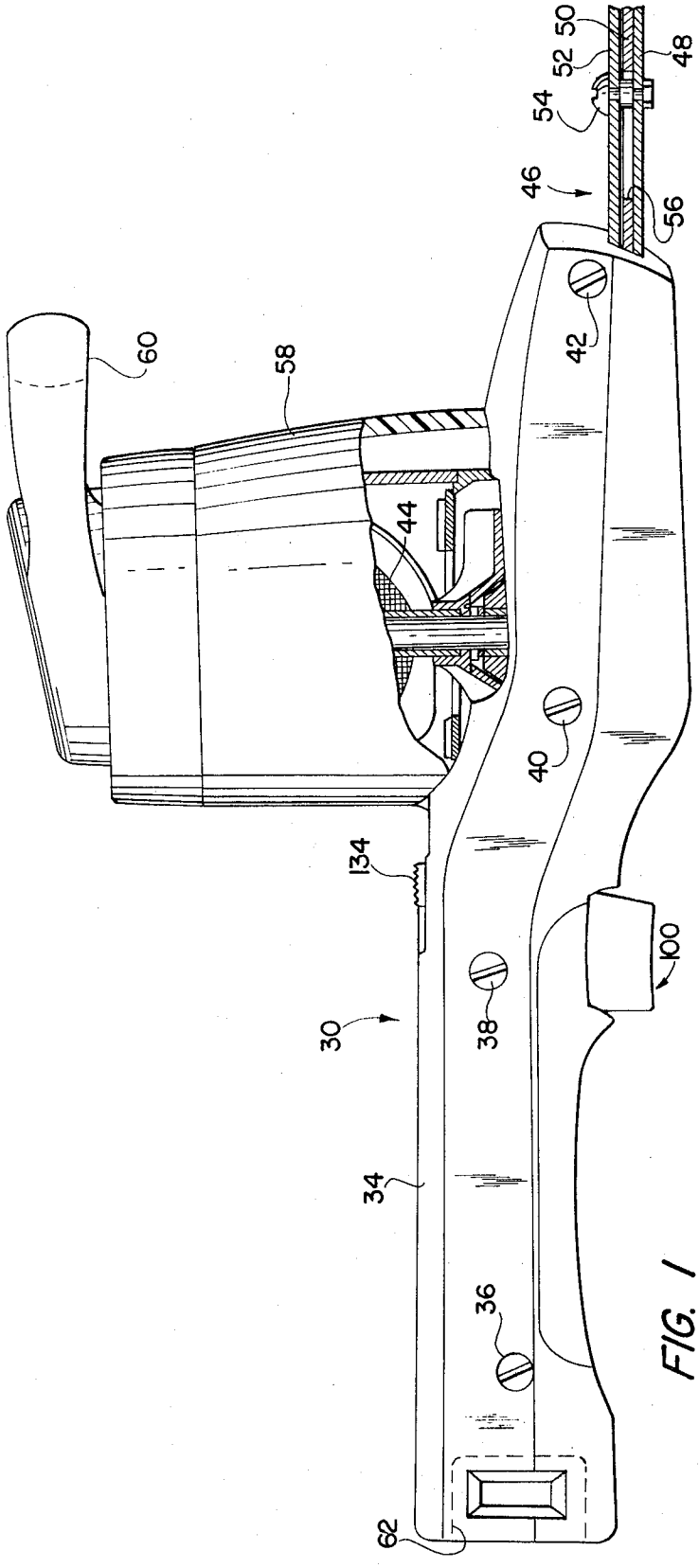

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FIG. 1

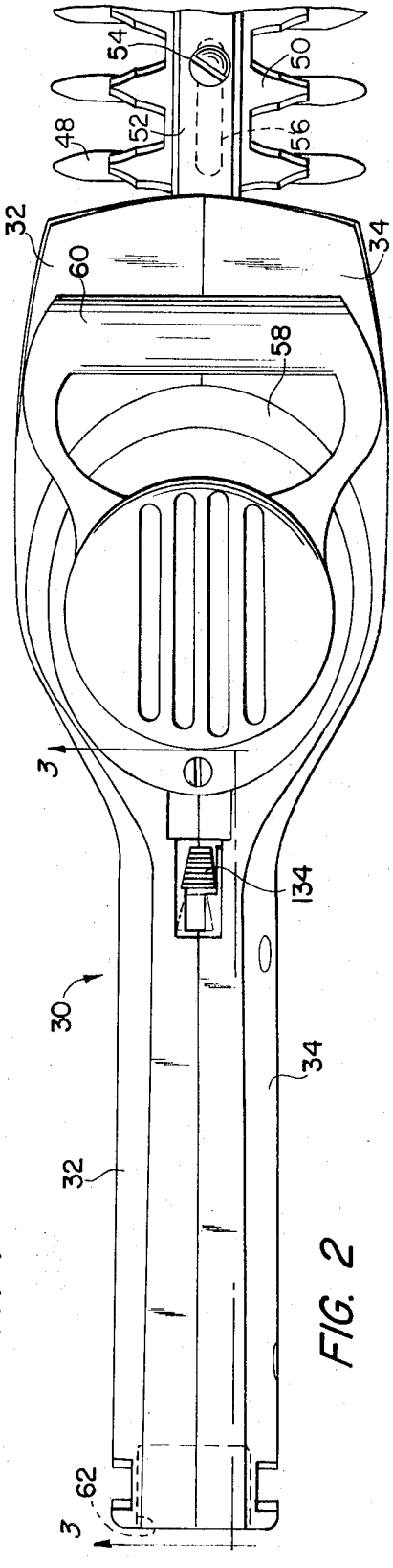
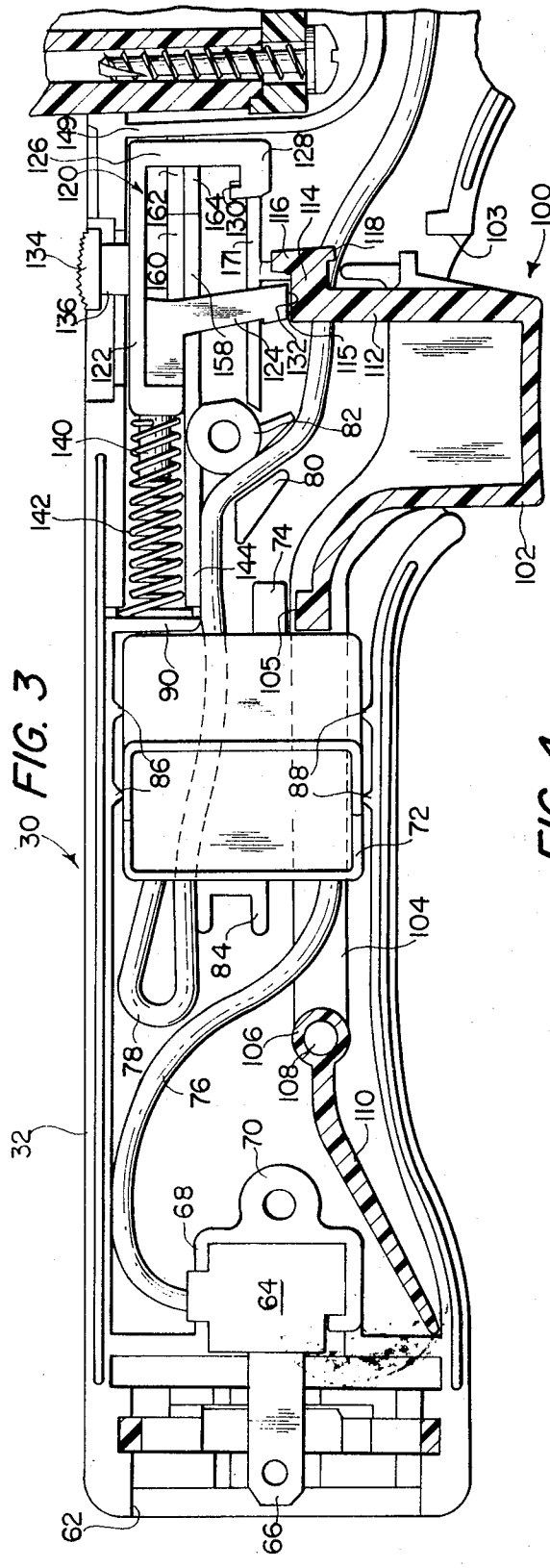
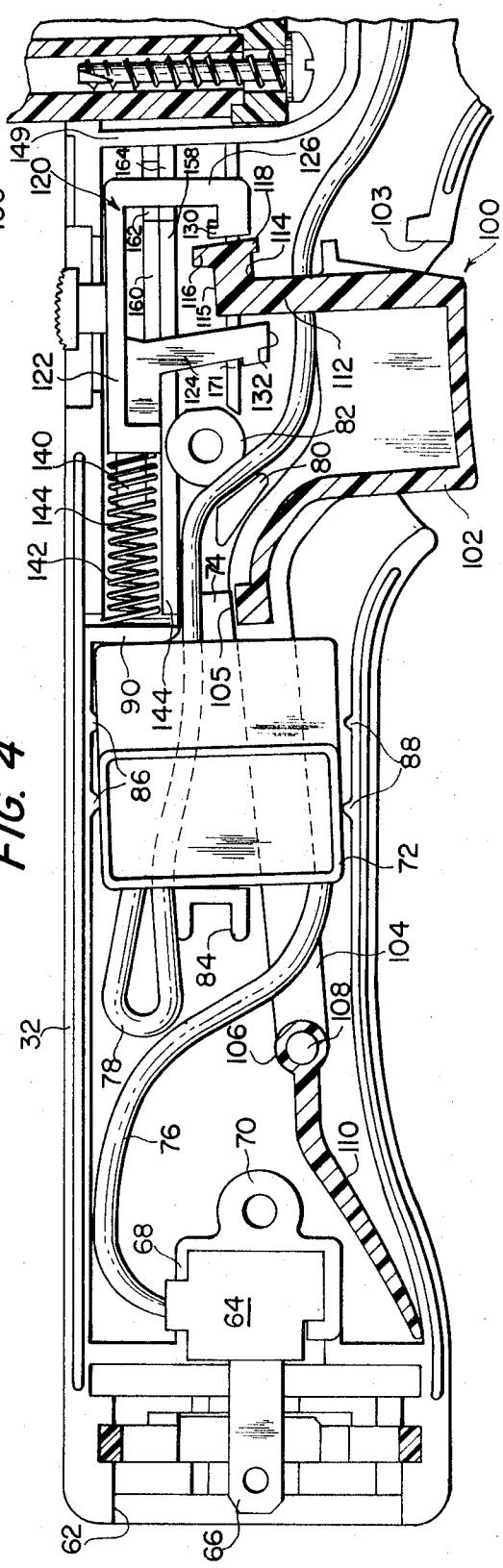

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FIG. 2


FIG. 3
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FIG. 4
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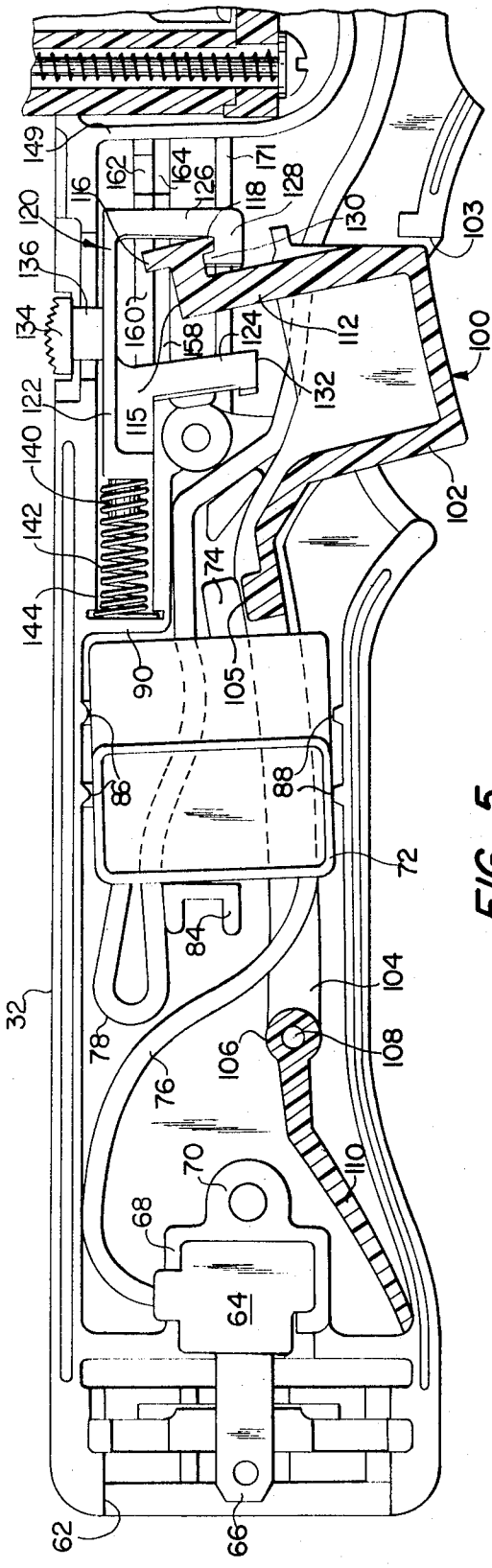

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FIG. 5

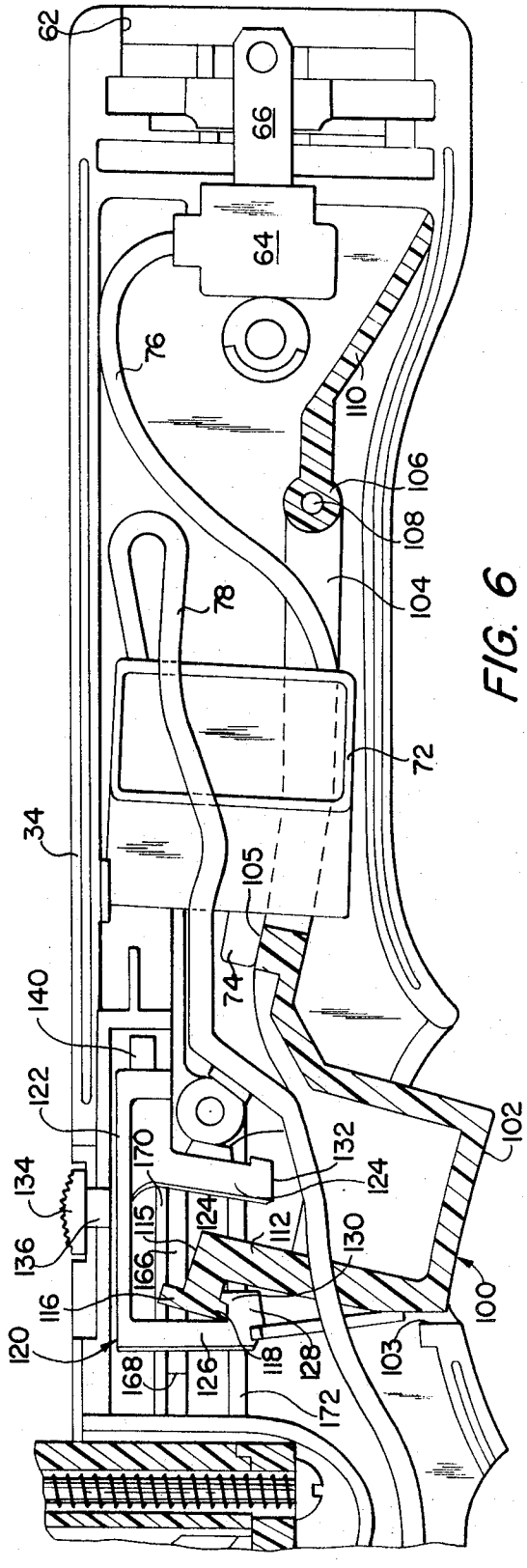

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FIG. 6

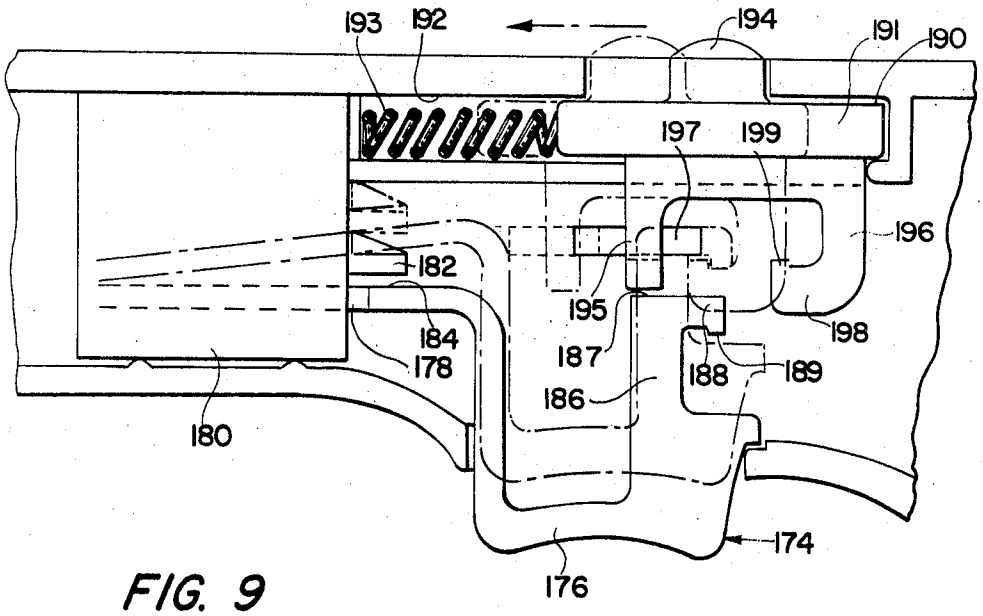

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FIG. 9

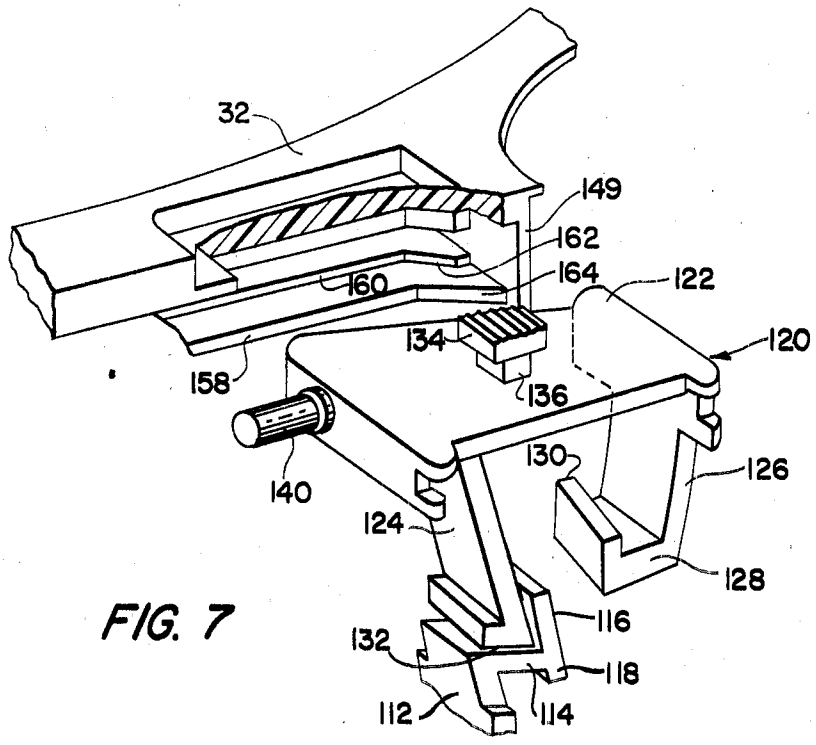

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FIG. 7

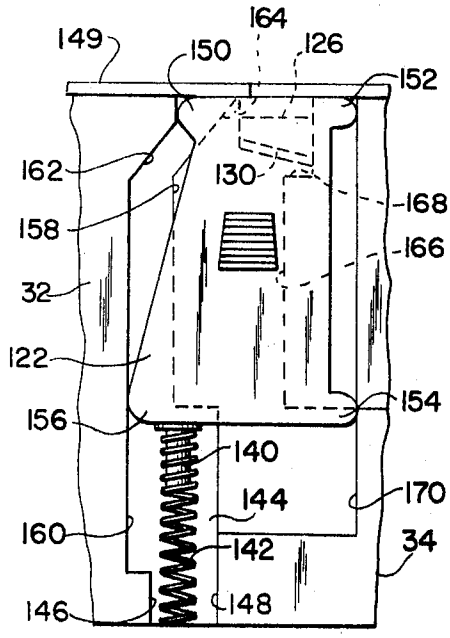


FIG. 8A

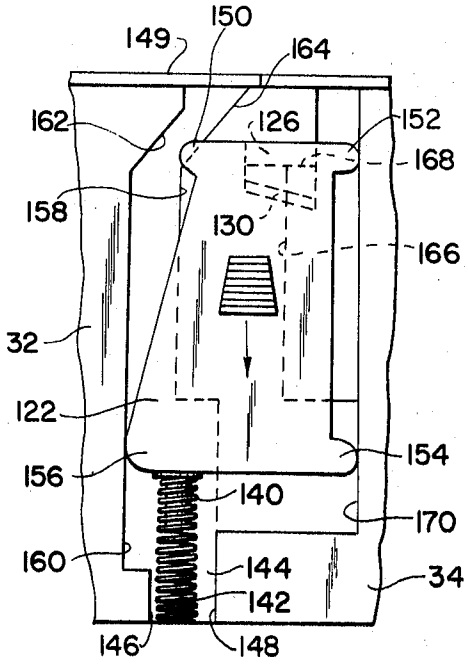


FIG. 8B

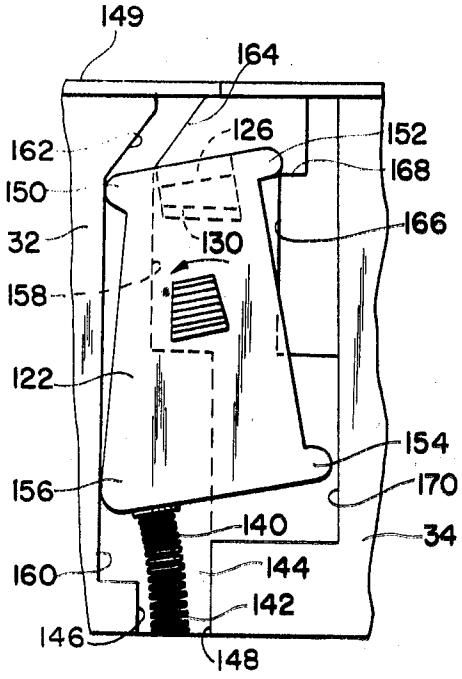


FIG. 8C

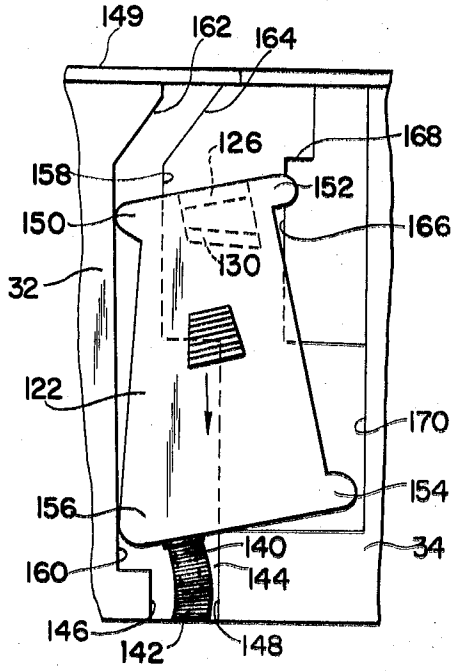


FIG. 8D

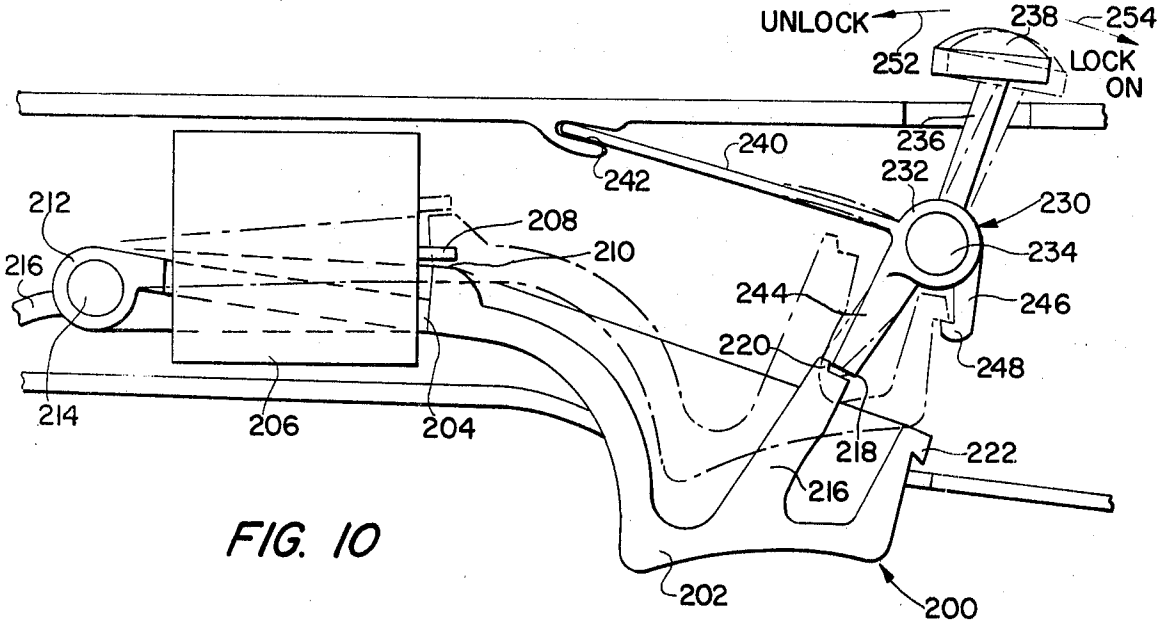

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FIG. 10

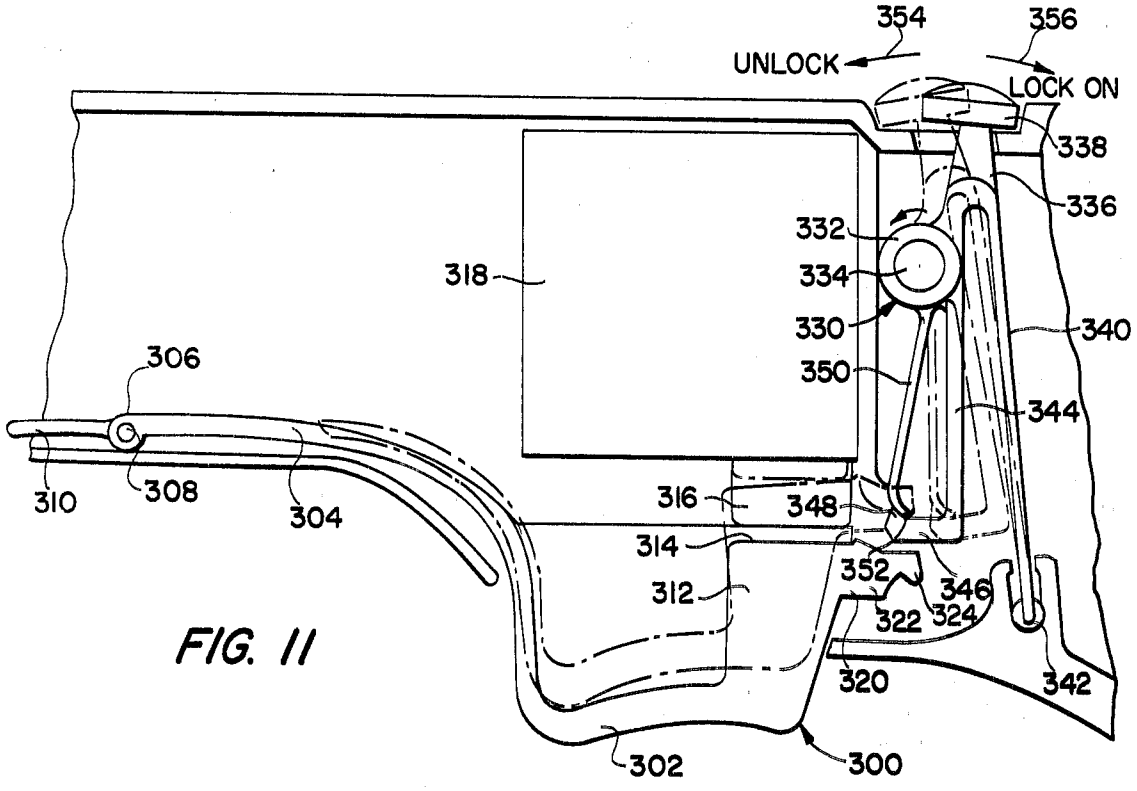

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FIG. 11

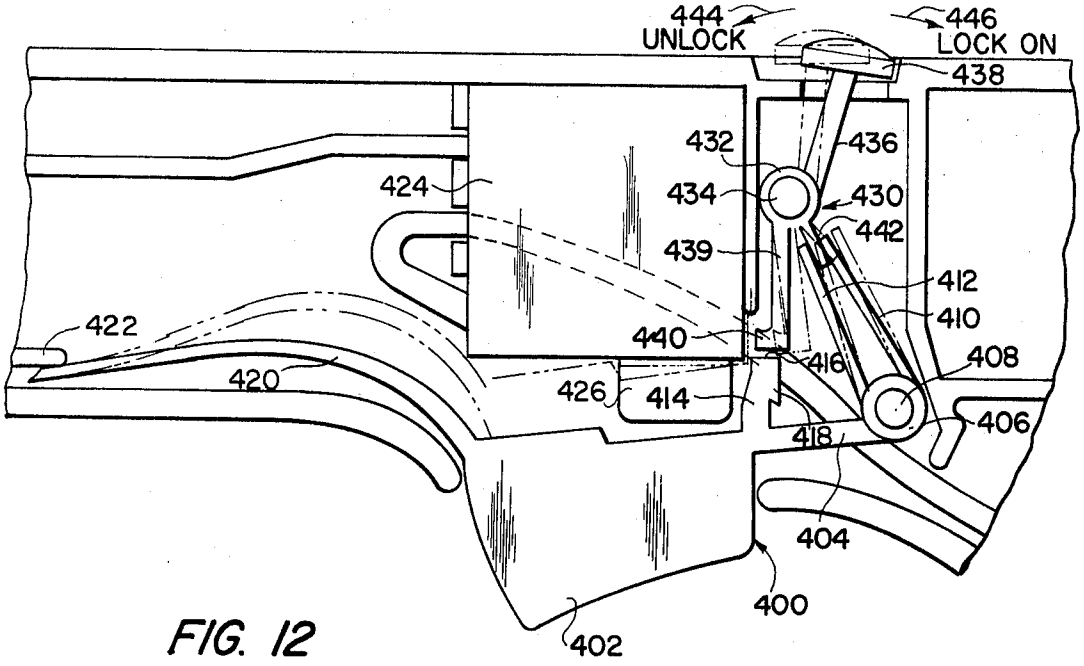

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FIG. 12

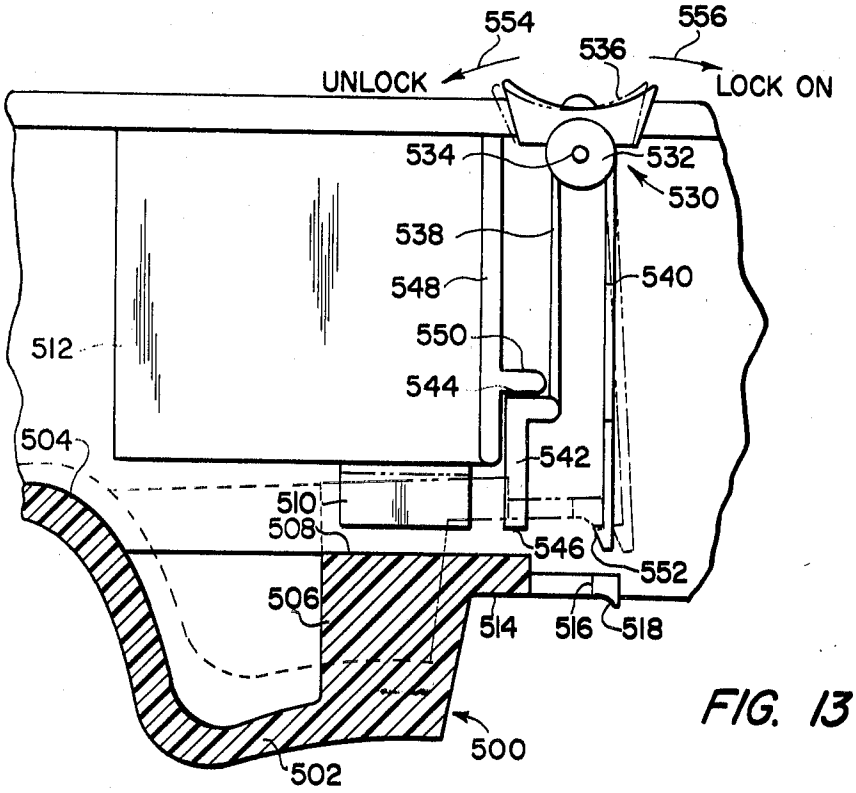

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FIG. 13

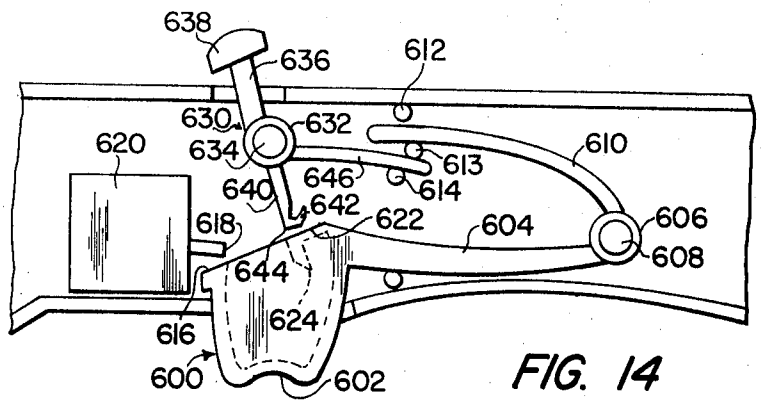


FIG. 14

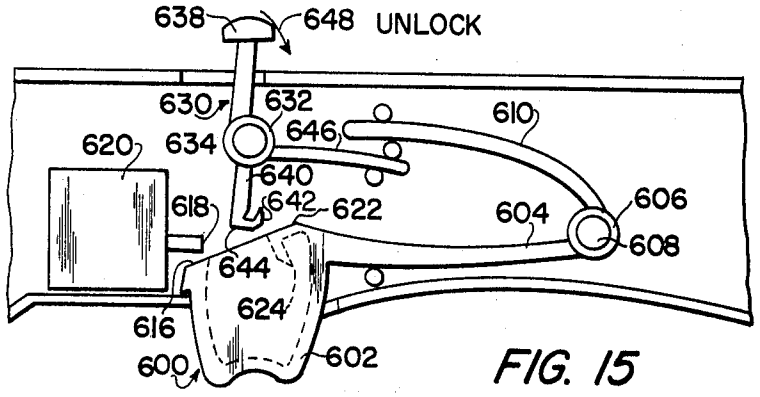


FIG. 15

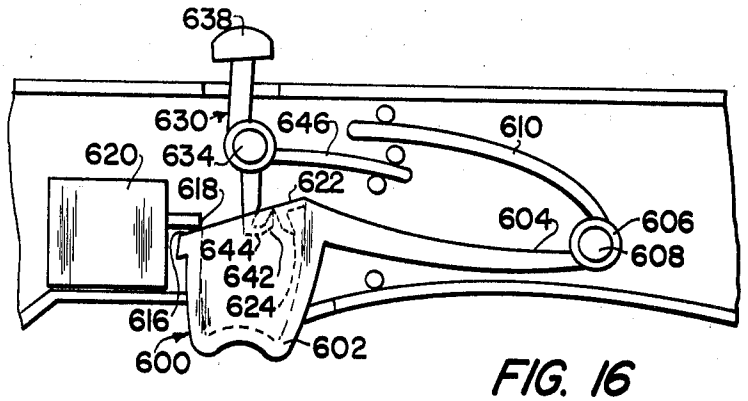


FIG. 16

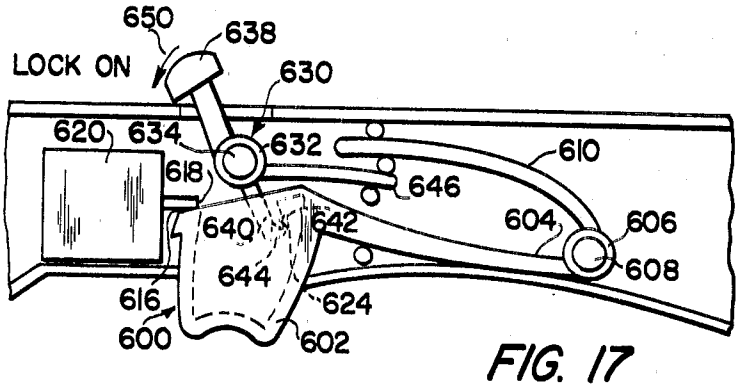


FIG. 17

TRIGGER MECHANISM FOR HAND-OPERATED POWER DEVICE PROVIDING AUTOMATIC LOCK-OFF AND MANUAL LOCK-ON OPERATION

The present invention relates to a trigger mechanism for a hand-operated power device and, more particularly, to a trigger mechanism for a portable, hand-operated power tool driven by an electric motor which is automatically locked off when the trigger mechanism is inoperative and which permits the tool to be temporarily locked on for continuous operation of the tool.

In the prior art, portable, hand-operated power tools, e.g., electrically powered hedge or shrub trimmers, grass shears and power saws, have included trigger mechanisms incorporating automatic lock-off and manual lock-on features. These features have been provided by a locking device movable between lock-off and lock-on positions to control the operation of a trigger. The automatic lock-off feature has protected an operator against accidental operation of the power tool, and the lock-on feature has enabled the operator to continuously operate the power tool without the necessity of exerting continuous manual pressure on the trigger.

The prior art trigger mechanisms have been capable of operation by a simple activity to operate the power tool between its lock-off and lock-on states. For example, it has been possible for an operator, by continuous movement of the locking device in a single direction, to unlock the trigger mechanism from its lock-off state and to operate the trigger mechanism to its lock-on state. Since only a simple activity has been required to operate the prior art trigger mechanisms from lock-off to lock-on states, the possibility of accidental lock-on operation of the power tool has been enhanced along with the attendant risk of injury to the operator.

To avoid the disadvantages of the prior art, it is desirable to provide a trigger mechanism having automatic lock-off and manual lock-on features for a portable, hand-operated power tool which requires positive, intentional action, distinct from the activity required to unlock the trigger mechanism, to operate the trigger mechanism into its lock-on state. The requirement of a positive, intentional action minimizes the possibility of inadvertent lock-on operation of the tool.

It is an object of the present invention to provide a trigger mechanism for a hand-operated power tool which provides automatic lock-off and manual lock-on operation and requires an operator to consciously perform a complex activity to operate the trigger mechanism from its lock-off state to its lock-on state to minimize the possibility of inadvertent operation of the tool.

It is an additional object of the present invention to provide a trigger mechanism for a hand-operated power tool incorporating a locking device, normally located in a lock-off position, which is movable in two (2) distinct modes of movement, a first mode including an unlock position and a second mode including a lock-on position, which requires a positive, intentional action by an operator to shift the locking device from its first mode of movement to its second mode of movement, and which can only be shifted to its second mode after the trigger mechanism is actuated "on".

It is a further object of the present invention to provide a trigger mechanism for a hand-operated power tool incorporating a locking device which is automatically returned to its lock-off position upon termination of the operator of the trigger mechanism.

In accordance with the invention, a trigger mechanism for a hand-operated power device including a motor and a control operatively associated with the motor includes a trigger manually movable from an inoperative position to an operative position to actuate the control and operate the mtoor, and locking means cooperatively engageable with the trigger for normally locking the trigger in its first position, the locking means being movable in first and second distinct modes of movement, with the first mode including a normal, lock-off position wherein the locking means is cooperatively engageable with the trigger to prevent movement of the trigger from its inoperative position to its operative position and an unlock position wherein the trigger is movable to its operative position to actuate the control and the second mode including a lock-on position wherein the locking means is cooperatively engageable with the trigger to lock the trigger in its operative position to continuously actuate the control and operate the motor. Preferably, the trigger is normally biased toward its inoperative position and the locking means is normally biased toward its lock-off position. A positive, intentional action is required by an operator to shift the locking means from its first mode of movement to its second mode of movement to reduce the likelihood of inadvertent operation of the power device to its lock-on state and thus minimize the risk of injury to the operator.

In a preferred embodiment of the trigger mechanism, for use in a hand-operated power tool including an electric motor and a handle which supports a switch operatively associated with the motor, the locking means comprises a manually operable locking device slidably mounted on the handle and movable in two (2) distinct orientations relative to the handle. The slidable locking device is movable longitudinally relative to the handle, in its first orientation, from a lock-off position, cooperatively engageable with the trigger to prevent movement of the trigger from its inoperative position to its operative position, toward an unlock position wherein the trigger is manually movable to its operative position to actuate the switch.

Upon movement to its unlock position, the locking device is shiftable laterally relative to the handle, into its second orientation, and subsequently movable longitudinally relative to the handle to a lock-on position cooperatively engageable with the trigger to lock the trigger in its operative position to continuously actuate the switch and operate the motor. A positive, intentional action, i.e., a lateral shifting of the locking device from its first orientation to its second orientation, is required to operate the trigger mechanism to its lock-on state. Furthermore, the locking device is movable to its second orientation only when the trigger is in its operative position.

The slidable locking device is normally biased toward its lock-off position with the locking device in its unlock position and the trigger in its operative position, the locking device is cooperatively engageable with the trigger to permit the operator to release the locking device without movement back to its lock-off position until the trigger is returned to its inoperative position. If, with the locking device in its unlock position, the trigger is completely released, the locking device is au-

tomatically returned to its lock-off position to lock the trigger in its inoperative position. Similarly, if, with the locking device in its lock-on position, the trigger is disengaged from the locking device and completely released, the locking device is automatically returned to its lock-off position to lock the trigger in its inoperative position.

In an alternative embodiment of the trigger mechanism, the locking means comprises a pivotal locking device mounted on the handle and pivotable in a first direction from a lock-off position, cooperatively engageable with the trigger to prevent movement of the trigger from its inoperative position to its operative position, toward an unlock position wherein the trigger is manually movable to its operative position to actuate the switch. With the trigger in its operative position, the locking device is pivotable in a second direction to a lock-on position cooperatively engageable with the trigger to lock the trigger in its operative position to continuously actuate the switch and operate the motor. A positive, intentional action, i.e., a reversal of the direction of pivotal movement of the locking device, is required to operate the trigger mechanism to its lock-on state.

The pivotal locking device is normally biased toward its lock-off position and the trigger is normally biased toward its inoperative position. With the locking device in its unlock position and the trigger in its operative position, the locking device is cooperatively engageable with the trigger to permit the locking device to be released without movement back to its first position until the trigger is allowed to return to its inoperative position. If, with the locking device in its unlock position, the trigger is completely released, the locking device is automatically returned to its lock-off position to lock the trigger in its inoperative position. Similarly, if, with the locking device in its lock-on position, the trigger is disengaged from the locking device and completely released, the locking device is automatically returned to its lock-off position to lock the trigger in its inoperative position.

The automatic lock-off and manual lock-on features of the trigger mechanism of the present invention preclude inadvertent operation of the power tool. The automatic lock-off feature requires an operator to perform an unlock activity prior to actuation of the trigger to operate the tool. In addition, the manual lock-on feature requires the operator to perform a positive, intentional action, which is distinct from the unlock activity, to achieve lock-on operation of the power tool. These safety features of the trigger mechanism prevent an inexperienced operator from accidentally turning on the power tool and locking the tool on for continuous operation.

The accompanying drawings illustrate preferred embodiments of the invention and, together with the description, serve to explain the principles of the invention.

BRIEF DESCRIPTION OF THE DRAWINGS

FIG. 1 is a side elevation, partially cutaway, of a portable hand-operated power tool, e.g., a shrub or hedge trimmer, including a handle which supports a trigger mechanism constructed in accordance with the principles of the present invention, a motor, and a cutting blade assembly;

FIG. 2 is a plan view of the portable power tool of FIG. 1 illustrating the construction of the handle in two sections;

FIG. 3 is an enlarged side view, taken along line 3—3 of FIG. 2, of the handle of the portable power tool, with one handle section removed, illustrating a manually movable trigger and a slidable locking device of the trigger mechanism with the locking device in its lock-off position and the trigger in its inoperative position;

FIG. 4 is an enlarged side view of the same power tool handle of FIG. 1 illustrating the locking device moved to its unlock position to permit the trigger to be manually moved to its operative position;

FIG. 5 is an enlarged side view of the same power tool handle of FIG. 1 illustrating the locking device moved to its lock-on position to lock the trigger in its operative position;

FIG. 6 is an enlarged side view of the opposite section of the power tool handle of FIG. 3 illustrating the locking device moved to its lock-on position to lock the trigger in its operative position;

FIG. 7 is an enlarged perspective view of a portion of the handle section and locking device of FIG. 3;

FIG. 8A is a plan view, partially cutaway, of a portion of the power tool handle illustrating the locking device in its lock-off position;

FIG. 8B is a plan view of the same portion of the handle illustrating the locking device moved in a first orientation relative to the power tool handle to its unlock position;

FIG. 8C is a plan view of the same portion of the handle illustrating the locking device shifted laterally from its unlock position into a second orientation relative to the power tool handle;

FIG. 8D is a plan view of the same portion of the handle illustrating the locking device moved in its second orientation to its lock-on position;

FIG. 9 is a side view, partially in section, of a portion of a power tool handle which includes an alternative embodiment of the trigger mechanism of this invention incorporating a slidable locking device;

FIG. 10 is a side view, partially in section, of a portion of a power tool handle including an alternative embodiment of the trigger mechanism of this invention which incorporates a pivotal locking device having a pair of locking arms which are cooperatively engageable with a trigger to provide for automatic lock-off and manual lock-on operation of the trigger;

FIG. 11 is a side view, partially in section, of a portion of a power tool handle including an alternative embodiment of the trigger mechanism of this invention incorporating a pivotal locking device having a single locking arm which is cooperatively engageable with a trigger to provide for automatic lock-off and manual lock-on operation of the trigger;

FIG. 12 is a side view, paritally in section, of a portion of a power tool handle including an alternative embodiment of the trigger mechanism of this invention which incorporates a trigger having first and second integral leaf springs to provide bias forces for a pivotal locking device having a single locking arm cooperatively engageable with the trigger to provide for automatic lock-off and manual lock-on operation of the trigger;

FIG. 13 is a side view, partially in section, of a portion of a power tool handle which incorporates an alter-

native embodiment of the trigger mechanism of this invention including a pivotal locking device having a pair of spring arms which are cooperatively engageable with the trigger to produce desired bias forces on the locking device and to provide for automatic lock-off and manual lock-on operation of the trigger;

FIG. **14** is a side view, partially in section, of a portion of a power tool handle including an alternative embodiment of the trigger mechanism of this invention which incorporates a pivotal locking device including an integral leaf spring and a single locking arm which is cooperatively engageable with a trigger to provide for automatic lock-off and manual lock-on operation of the trigger;

FIG. **15** illustrates the trigger mechanism of FIG. **14** with the locking device moved to its unlock position;

FIG. **16** illustrates the trigger mechanism of FIG. **14** with the trigger moved to its operative position; and

FIG. **17** illustrates the trigger mechanism of FIG. **14** with the locking device moved to its lock-on position to lock the trigger in its operative position.

TRIGGER MECHANISMS INCLUDING SLIDABLE LOCKING DEVICES

FIG. **1** illustrates a portable, hand-operated power tool, e.g., a shrub or hedge trimmer, which incorporates a trigger mechanism constructed according to the principles of this invention. The power tool includes an elongated, hollow handle, generally **30,** consisting of two (2) half-sections **32** and **34** (FIG. **2**). The half-sections of handle **30** are held together by a plurality of screws or bolts **36, 38, 40** and **42** (FIG. **1**).

Referring to FIGS. **1** and **2,** handle **30** includes a rearward portion which is relatively narrow and elongated to provide a convenient shape to be gripped by one hand of an operator. As shown in FIG. **2,** the handle includes a forward portion which is greater in width than the rearward portion to provide support for a motor **44** which drives the power tool. A cutting blade assembly, generally **46,** extends forward from the front end of handle **30.** The cutting blade assembly is standard in construction and, thus, only a portion of the assembly is shown in FIGS. **1** and **2.**

Cutting blade assembly **46** includes a lower, stationry blade **48** and an upper, reciprocating blade **50.** The blade assembly also includes an elongated support member **52** which extends forward from the front end of the handle above reciprocating blade **50.** Lower, stationary cutting blade **48** is secured to support member **52** by a plurality of nuts and bolts **54** (one shown in FIG. **1**) spaced along the cutting blade assembly. Upper, reciprocating blade **50** includes a plurality of elongated slots **56** extending longitudinally along the blade for receiving bolts **54** to permit blade **50** to be reciprocated relative to stationary blade **48** and support member **52.** A drive mechanism (not shown) is provided to convert rotary output of motor **44** to reciprocating motion of blade **50.** Alternatively, the blades **48, 50** can reciprocate in opposite directions through a suitable transmission.

A generally cylindrical cover **58** (FIG. **1**) is supported by the wide, forward portion of the handle **30** to protect the motor and drive mechanism. A hand grip **60** is secured at the top of cover **58** to allow the operator to grip the tool with both hands.

In the present embodiment, the rear end of handle **30** is provided with a power cord receptacle **62** for receiving a detachable power cord to connect the tool to an electrical power source. The power cord receptacle receives a specially shaped power cord connector (not shown) of a detachable power cord to enable the tool to be connected to the power source. It is understood that the detachable power cord and receptacle do not constitute any part of the present invention and that other power cord arrangements, e.g., a permanently attached power cord, can be used to supply electric power to the tool.

Referring to FIG. **3,** the tool includes a plug **64** located within the interior of handle **30** with a pair of plug blades **66** (one shown in FIG. **3**) extending rearwardly into power cord receptacle **62.** A generally rectangular support **68** extends inwardly from the interior of handle section **32** for supporting plug **64** in a fixed position relative to the handle. The connector of the detachable power cord (not shown) received in power cord receptacle **62** is adapted to make electrical contact with plug blades **66** to connect the tool to a source of electrical power. Support **68** includes a first cylindrical projection **70** extending inwardly from the interior of handle section **32** including a central opening for receiving screw **36** in the assembly of the handle.

As shown in FIG. **3** the power tool handle supports a control in the form of a switch **72** operatively associated with motor **44.** Switch **72** includes an actuator **74,** normally biased downward to an off position and movable upward to an on position to operate the motor. A pair of conductors **76** (only one shown) connects plug **64** to switch **72.** A second pair of conductors **78** (only one shown) connects switch **72** to motor **44.** Conductor **78** extends between a flange **80** and a second cylindrical projection **82** extending inwardly from the interior of handle section **32.** Cylindrical projection **82** includes a central opening for receiving screw **38** (FIG. **1**) in the assembly of the handle. Similar cylindrical projections (not shown) are provided on the interior of handle section **32** for receiving screws **40** and **42** (FIG. **1**).

As shown in FIG. **3,** the body of switch **72** is substantially rectangular in shape and is received in a generally rectangular area in the handle defined by a rearward stop **84** projecting inwardly from the interior of handle section **32,** a first pair of ribs **86** projecting downwardly from the top of handle section **32,** a second pair of ribs **88** extending upwardly from the bottom of handle section **32,** and a forward wall **90** projecting downward from the top of the handle section.

The power tool handle supports a trigger mechanism for actuating switch **72** to control on-off operation of motor **44.** The trigger mechanism provides automatic lock-off, manual unlock and manual lock-on operations for control of the motor. The lock-on operation requires a positive, intentional action by the operator to achieve continuous operation of the motor.

In accordance with the invention, the trigger mechanism includes a trigger manually movable from a first, inoperative position to a second, operative position to actuate the control and operate the motor. In a preferred embodiment of the trigger mechanism, means is provided for normally biasing the trigger toward its first, inoperative position. The preferred embodiment of the trigger mechanism shown in FIG. **3** includes a trigger, generally **100,** mounted within the interior of handle **30** and having a finger engageable portion or body **102** protruding downwardly through a trigger

opening **103** defined by adjacent slots provided in the bottom of handle sections **32** and **34**. Trigger **100**, which may be constructed of a suitable elastomeric and essentially nonconductive material, also includes a pair of spaced, parallel arms **104** extending rearwardly from its finger engageable portion **102**.

As shown in FIG. **3**, switch **72** is positioned in the space between arms **104** of the trigger. The arms terminate in a collar **106** which is pivotally mounted on a pin **108** projecting inwardly from the interior of handle section **34** to pivotally support trigger **100**. In addition, the trigger includes an integral flexible finger or leaf spring **110** which extends backward from collar **106** and engages the bottom of handle sections **32** and **34** to normally bias finger engageable portion **102** of the trigger in a downward, inoperative position (FIG. **3**). Finger engageable portion **102** of the trigger is movable upward to an operative position (FIGS. **4** and **5**), in which case the finger **110** deflects as shown. The finger engageable portion **102** of trigger **100** includes a surface **105** located between arms **104** for engaging actuator **74** of the switch upon movement of the trigger to its operative position.

As shown in FIG. **3**, an arm **112** extends vertically upward from the front edge of finger engageable portion **102** of trigger **100**. A finger **114** projects horizontally forward from arm **112**. The upper end of arm **112** terminates in a flat, lock-off surface **115**. A first flange **116** is provided on the upper surface of finger **114**, and a second flange or lock-on member **118** is provided on the lower surface of the finger.

In accordance with the invention, the trigger mechanism also includes locking means cooperatively engageable with the trigger for normally locking the trigger in its first or inoperative position. The locking means is movable in first and second distinct modes of movement with the first mode including a normal, lock-off position wherein the locking means is cooperatively engageable with the trigger to prevent movement of the trigger from its first, inoperative position to its second, operative position, and an unlock position wherein the trigger is movable to its second position to actuate the control, and the second mode including a lock-on position wherein the locking means is cooperatively engageable with the trigger to lock the trigger in its second or operative position to continuously actuate the control and operate the motor. The locking means requires a positive, intentional action by an operator to shift the locking means from its first mode of movement to its second mode of movement. The requirement of a positive, intentional action minimizes the possibility of inadvertent movement of the locking means to its lock-on position and reduces the risk of injury to the operator.

Referring to FIG. **3**, in the preferred embodiment of the trigger mechanism, the locking means is embodied as a manually operable locking devide **120** slidably mounted for longitudinal movement relative to handle **30**. The locking device comprises a platform **122**, generally trapezoidal in shape, having first and second spaced arms **124** and **126**, respectively, projecting downward from the platform.

Arm **126** is located at the front of platform **122** and includes a finger **128** projecting laterally backward from the arm and a raised lip **130** projecting upward from the rear edge of the finger. As shown in FIg. **7**, lip **130** extends diagonally across finger **128** at a predetermined angle. First arm **124** is inclined in a forward direction and terminates in a lower, lock-off surface **132**.

Referring to FIG. **3**, a finger engageable button **134** is mounted on a stem **136** which projects upwardly from the top surface of platform **122**. The upper surface of button **134** is shaped to facilitate manual movement of the locking device. Stem **136** projects upward through an opening in the handle provided by corresponding slots formed at adjacent locations in the top of handle sections **32** and **34** (FIG. **2**).

A pin **140** (FIG. **3**) projects rearwardly from the rear edge of platform **122** and is received in the front end of a coil spring **142**. The opposite end of coil spring **142** engages vertical wall **90**. The coil spring is received in a channel defined by the top of the handle section **32** and a horizontal rib **144** extending inwardly from the interior of the handle section. The rear end of coil spring **142** is confined laterally between surfaces **146** and **148** (FIG. **8A**) provided on handle sections **32** and **34**, respectively. The coil spring normally biases the front edge of locking device **120** into engagement with a vertical wall **149** provided by the two (**2**) handle sections.

Referring to FIG. **8A**, the front edge of platform **122** of locking device **120** is narrower in width than its rear edge. The platform is provided with a pair of rounded flanges **150** and **152** projecting laterally from its front edge. A flange **154** projects laterally from the rear edge of platform **122** on the same side of the platform as flange **152**. The rear edge of the platform also includes a rounded corner **156** opposite flange **154**.

Referring to FIG. **3**, handle section **32** includes an elongated rib **158** projecting inwardly from its interior which, with the top of the handle section, provides an elongated track for receiving rounded flange **150** and corner **156** of platform **122**. As shown in FIG. **8A**, corner **156** of the platform engages an elongated, straight guide surface **160** formed on the interior of handle section **32**. Guide surface **160** includes an inwardly tapered cam surface **162** located adjacent to vertical wall **149**. In addition, rib **158** is provided with a similar inwardly tapered cam surface **164**.

Referring to FIG. **6**, handle section **34** includes a rib **166** projecting inwardly from its interior. Rib **166** is cutaway at a predetermined distance from front wall **149** to establish a ledge or obstruction **168** in the path of movement of second arm **126** of the locking device. In addition, an elongated, straight guide surface **170** is provided on the interior of handle section **34**. As shown in FIG. **8A**, pin **140** of platform **122** is offset laterally from the center line of the platform. As a result, coil spring **142** exerts a biasing force on platform **120** which produces a moment about the point of contact between rounded flange **154** of the platform and guide surface **170** of handle section **34** to normally urge rounded flange **152** of the platform into engagement with guide surface **170**.

Guide surfaces **160** and **170** of the handle sections permit locking device **120** to be moved longitudinally in two (**2**) distinct orientations relative to the handle. A first orientation, shown in FIGS. **8A** and **8B**, exists when rounded flanges **152** and **154** of platform **122** are in contact with guide surface **170** of handle section **34**. Longitudinal movement of locking device **120** in its first orientation constitutes a first mode of movement relative to the handle. A second orientation, shown in FIGS. **8C** and **8D**, exists when rounded flange **150** and

rounded corner **156** of the platform are in contact with guide surface **160** of handle section **32.** Similarly, longitudinal movement of locking device **120** in its second orientation constitutes a second mode of movement relative to the handle.

As shown in FIG. **3,** handle section **32** includes a horizontal rib **171** projecting inwardly from its interior and extending parallel to rib **158.** Similarly, handle section **34** (FIG. **6**) includes a corresponding horizontal rib **172** projecting inwardly from its interior. The lower end of first arm **124** of locking device **120** is located between ribs **171** and **172** to further guide the locking device in its longitudinal movement relative to the handle.

In the operation of the trigger mechanism of the preferred embodiment, trigger **100** is normally biased toward its inoperative position (FIGS. **3** and **8A**) by its flexible finger **110.** In addition, locking devide **120** is normally biased forward into a lock-off position by coil spring **142.** As shown in FIG. **3,** when locking device **120** is in its forward, lock-off position, lock-off surface **132** on the lower end of first arm **124** is located in registration with top surface **115** of trigger finger **114** to prevent upward movement of the trigger **100** from its inoperative position.

When it is desired to unlock the trigger mechanism, the operator manually engages button **134** and slides locking device **120** longitudinally backward to its unlock position (FIGS. **4** and **8B**). As shown in FIG. **8B,** with locking device **120** in its first orientation, i.e., with rounded flanges **152** and **154** of platform **122** in contact with guide surface **170** of handle section **34,** the locking device is limited in the extent of its longitudinal movement relative to the handle by ledge **168.** When locking device **120** is moved longitudinally backward from its unlock position in its first orientation, it can only be moved backward until its second arm **126** moves into engagement with ledge **168.** The initial backward movement of locking device **120** from its lock-off position to its unlock position, with the locking device oriented parallel to the longitudinal axis of the handle, constitutes its first mode of movement. At this point, locking device **120** is not, however, capable of any further backward movement in its first orientation.

Referring to FIG. **4,** with locking device **120** located in its unlock position, the operator can move the trigger **100** upward to its operative position by manually applying pressure to finger engageable portion **102.** Upon upward movement of trigger **100** to its operative position, arm **112** and finger **114** of the trigger move upward between arms **124** and **126** of locking device **120.** At the same time, actuating surface **105** of the trigger moves actuator **74** of switch **72** upward to actuate the switch and operate motor **44.**

With trigger **100** moved upward to its operative position and locking device **120** moved to its unlock position, the trigger and locking device are cooperatively engageable to permit the locking device to be released without movement back to its lock-off position until the trigger is allowed to return to its inoperative position. If the operator disengages button **134** to permit locking device **120** to be urged forward by coil spring **142,** the locking device moves forward by a slight distance until its first arm **124** engages arm **112** of the trigger. Thus, with trigger **100** raised to its operative position (FIG. **4**), its arm **112** prevents locking device **120** from returning to its lock-off position until the trigger is returned to its downward, inoperative position (FIG. **3**). If, however, the trigger is completely released by the operator, locking device **120** is automatically returned to its lock-off position (FIGS. **3** and **8A**) by coil spring **142.**

As described above, ledge **168** which projects laterally inward from handle section **34** into the path of movement of locking device **120,** limits the locking device to longitudinal movement by a predetermined distance in its first orientation. After locking device **120** is moved backward to its unlock position, i.e., with its arm **126** in contact with ledge **168** (FIG. **8B**), it is necessary to shift the locking device laterally into its second orientation relative to the handle to permit further longitudinal movement of the locking device. Referring to FIG. **8C,** locking device **120** can be shifted laterally relative to the handle into its second orientation by pivotal movement of the locking device in a counterclockwise direction about its rounded corner **156.** The lateral shifting motion of locking device **120** is terminated when its rounded flange **150** moves into engagement with guide surface **160** of handle section **32.** This lateral movement of locking device **120** is sufficient to disengage second arm **126** of the locking device from ledge **168.** Thus, with locking device **120** in its second, diagonal orientation relative to the longitudinal axis of the handle, i.e., with its rounded flange **150** and corner **156** in contact with guide surface **160,** the locking device can be moved longitudinally backward relative to the handle to its lock-on position (FIGS. **5** and **8D**). The further backward movement of locking device **120,** which becomes capable with the locking device oriented diagonally relative to the longitudinal axis of the handle, consitutes its second mode of movement and can be achieved only when trigger **100** is moved upwardly to its operative position so that finger **114** is clear of lip **130.** As shown in FIGS. **8C** and **8D,** with locking device **120** in its second, diagonal orientation relative to the handle, ridge **130** on second arm **126** of the locking device is moved to a central position and oriented perpendicularly relative to the longitudinal axis of the handle.

Referring to FIG. **4,** to permit locking device **120** to be moved backward from its unlock position to its lock-on position, it is necessary to move finger engageable portion **102** of trigger **100** upward by a sufficient distance to raise its finger **114** and flange **118** above finger **128** and ridge **130** of the locking device. The operator can then move locking device **120** backward to its lock-on position (FIGS. **5** and **8D**). As shown in FIG. **5,** upon release of trigger **100,** its flange **118** engages ridge **130** of locking device **120** to lock the trigger in its operative position and to prevent forward movement of the locking device by coil spring **142.** At this time, the operator can disengage trigger **100** and button **134** without terminating operation of motor **44.**

When it is desired to terminate lock-on operation of the trigger mechanism, the operator manually engages trigger **100** and moves its finger engageable portion **102** upward to disengage flange **118** of the trigger from ridge **130** of the locking device. Coil spring **142** immediately moves locking device **120** forward until its first arm **124** engages arm **112** of the trigger. The locking device is thus held in its unlock position (FIG. **4**) until trigger **100** is completely released.

When the operator disengages trigger **100** to allow it to return to its inoperative position, locking device **120** is moved forward to its lock-off position by coil spring **142.** During forward movement of the locking device from its unlock position to its lock-off position, rounded flange **150** and second arm **126** of the locking device move along cam surfaces **162** and **164** (FIG. 8C), respectively, to shift the locking device laterally back to its first orientation by pivotal movement of the locking device in a clockwise direction. The locking device is thus automatically returned to its lock-off position (FIGS. **3** and **8A**).

FIG. **9** illustrates a first alternative embodiment of the trigger mechanism which, like the embodiment of FIGS. **3–8,** incorporates a locking device slidably mounted on the power tool handle. The trigger mechanism of FIG. **9** includes a trigger, generally **174,** having a finger engageable portion **176** which extends downwardly through an opening provided in the bottom of the power tool handle. A pair of spaced, parallel arms **178** (one shown) extend rearwardly from the finger engageable portion. A switch **180** is mounted in the space between arms **178** and includes an actuator **182** normally biased downward to an off position and movable upward to an on position to operate the power tool motor. Trigger **174** includes an actuating surface **184** located between its arms **178** for engaging switch actuator **182.** The remaining rearward structure of the trigger is not illustrated, but it can be substantially the same as the structure of trigger **100** of FIGS. **3–6.**

Finger engageable portion **176** (FIG. **9**) is hollow and includes a thick front wall provided with an upwardly extending arm **186.** The upper end of arm **186** terminates in a flat, lock-off surface **187.** A finger **188** projects forwardly from arm **186** and is provided with a downwardly projecting lock-on member or lip **189.**

The trigger mechanism of FIG. **9** also includes a slidable locking device, generally **190,** mounted for longitudinal and lateral movement relative to the handle. The locking device includes a platform **191** slidably received in an elongated track **192** provided in the handle. A coil spring **193** engages the rear end of platform **191** to normally bias locking device **190** in a forward direction. A manually engageable button **194** extends upwardly from platform **191** through an opening provided in the top of the handle to enable an operator to move the locking device relative to the handle.

Locking device **190** includes first and second arms **195** and **196,** respectively, extending downwardly from platform **191.** A rib **197** projects forwardly from first arm **195** toward second arm **196.** Second arm **196** includes a rearwardly projecting finger **198** provided with an upwardly extending ridge **199** at its rear end.

In the operation of the trigger mechanism of FIG. **9,** trigger **174** is normally biased downward to its inoperative position by resilient means such as flexible finger **110** of the first embodiment. In addition, locking device **190** is normally biased forward into a lock-off position by coil spring **193.** With locking device **190** in its forward, lock-off position, the lower end of its first arm **195** is located in registration with the top, lock-off surface of arm **186** of trigger **174** to prevent upward movement of the trigger from its inoperative position.

When it is desired to unlock the trigger mechanism, the operator manually engages button **194** and slides locking device **190** longitudinally backward to an unlock position. The longitudinal movement of locking device **190** backward from its lock-off position to its unlock position constitutes its first mode of movement. With locking device **190** located in its unlock position, the operator can move trigger **174** upward to its operative position by manually applying pressure to its finger engageable portion **176.** Upon upward movement of trigger **174** to its operative position, arm **186** of the trigger moves upward between arms **195** and **196** of locking device **190** until its upper surface **187** moves into contact with rib **197** of the locking device. At the same time, actuating surface **184** of the Trigger moves switch actuator **182** upward to actuate switch **180.** to actuate switch **180.**

With locking device **190** in its unlock position, its rib **197** limits the extent of upward movement of trigger **174.** Thus, with trigger **174** in its operative position, if the operator attempts to move locking device **190** longitudinally backward relative to the handle, finger **198** of its second arm **196** engages finger **188** of the trigger to prevent further longitudinal movement of the locking device relative to the handle.

Further, with trigger **174** in its operative position and locking device **190** in its unlock position, the trigger and locking device are cooperatively engageable to permit the locking device to be released without movement back to its lock-off position until the trigger is allowed to return to its inoperative position. If the operator disengages button **194** to permit locking device **190** to be urged forward by coil spring **193,** the locking device moves forward by a slight distance until its first arm **195** engages arm **186** of the trigger. Thus, with trigger **174** raised to its operative position, its arm **186** prevents locking device **190** from returning to its lock-off position until the trigger is returned to its downward, inoperative position.

If it is desired to lock trigger **174** in its operative position to containuously actuate switch **180,** the operator manually engages button **194** and moves locking device **190** laterally relative to the handle to move rib **197** laterally out of the vertical path of movement of arm **186** of the trigger. With locking device **190** and its rib **197** shifted laterally relative to the handle, trigger **174** can be raised upward by a further distance to move its finger **188** out of the longitudinal path of movement of finger **198** of the locking device. The operator can then move locking device **190** longitudinally backward to a lock-on position (indicated in phantom lines). The longitudinal movement of locking device **190,** after it is shifted laterally relative to the handle, constitutes its second mode of movement. Upon release of trigger **174** by the operator, its lock-on member or lip **189** engages ridge **199** of locking device **190** to lock the trigger in its operative position and to prevent forward movement of locking device by coil spring **193.** At this time, the operator can disengage trigger **174** and button **194** without terminating operation of the power tool motor.

When it is desired to terminate lock-on operation of the trigger mechanism, the operator manually engages trigger **174** and moves its finger engageable portion **176** upward to disengage locking member or lip **189** of the trigger from ridge **198** of the locking device. Coil spring **193** immediately moves locking device forward until its first arm **195** engages arm **186** of the trigger. The locking device is held in its unlock position until trigger **174** is completely released.

When the operator disengages trigger **174** to allow it to return to its inoperative position, locking device **190** is automatically returned to its lock-off position by coil spring **193.** The handle can be provided with cam surfaces (not shown), similar to cam surfaces **162** and **164** of the preferred embodiment (FIGS. **5** and **8B**) to return locking device **190** laterally to its first mode of movement during forward movement of the locking device from its unlock position to its lock-off position.

The embodiments of FIGS. **3-9** provide trigger mechanisms having automatic lock-off and manual lock-on features. Each trigger mechanism provides two (2) distinct modes of movement for its locking device and requires a positive, intentional action, i.e., lateral movement of the locking device relative to the handle, to shift the locking device between its first mode of movement and second mode of movement. This requirement of a positive, intentional action precludes inadvertent operation of the trigger mechanism to its lock-on state.

TRIGGER MECHANISMS INCLUDING PIVOTAL LOCKING DEVICES

FIGS. **10, 11, 12, 13** and **14** illustrate further alternative embodiments of the trigger mechanism of the present invention for use in connection with hand-operated power tools. Each of the embodiments includes a pivotal locking device pivotable in a first direction from a first position, cooperatively engageable with the trigger to prevent movement of the trigger from its inoperative to its operative position, toward a second position wherein the trigger is manually movable to its operative position to actuate the switch. In addition, the locking device is pivotable in a second direction to a third position cooperatively engageable with the trigger to lock the trigger in its operative position to continuously actuate the switch and operate the motor. Pivotal movement of the locking device in its first direction constitutes a first mode of movement, and pivotal movement in its second direction, a second mode of movement.

Referring to FIG. **10,** a second alternative embodiment of the trigger mechanism includes a trigger, generally **200,** including a finger engageable portion **202** which extends downwardly through an opening provided in the bottom of the power tool handle. A pair of spaced, parallel arms **204** (one shown) extends rearwardly from the finger engageable portion. A switch **206** is mounted in the space between arms **204.** The switch includes an actuator **208** normally biased downward to an off position and movable upward to an on position to operate the power tool motor. Trigger **200** includes an actuating surface **210** located between its arms **204** for engaging switch actuator **208.** The rearward ends of arms **204** terminate in a collar **212** pivotally mounted on a pin **214** projecting inwardly from the interior of the power tool handle. Like the previous embodiments, trigger **200** may be constructed from plastic or suitable elastomeric and essentially nonconductive material and may have an integral flexible finger or leaf spring **215** extending backward from collar **212** and engaging the interior of the handle to normally bias finger engageable portion **202** of the trigger to its downward, inoperative position. Finger engageable portion **202** is hollow and includes an arm **216** projecting upward from its base. The upper end of arm **216** includes a flat ledge or lock-off surface **218** and a stop **220.** In addition, the front edge of finger engageable portion **202** of the trigger is provided with a sharp, downwardly projecting lock-on member or lip **222.**

The trigger mechanism of FIG. **10** also includes a pivotal locking device, generally **230,** comprising a cylindrical body **232** mounted on a pivot pin **234** projecting inwardly from the interior of the handle section. A stem **236** extends upwardly from cylindrical body **232** through an opening provided in the top of the handle. A button **238** is provided at the top of stem **236** to enable the operator to manually pivot locking device **230** about its pivot pin **234.**

Locking device **230** also includes an integral leaf spring **240** extending backward from cylindrical body **232.** The spring is received in a notch **242** provided in the handle. In addition, locking device **230** includes a first arm **244** projecting radially from cylindrical body **232** and normally in registration with ledge **218** of trigger **200** to prevent movement of the trigger from its inoperative position. A second arm **246** also projects radially from cylindrical body **232** and includes a hook end **248.**

In the operation of the trigger mechanism of FIG. **10,** leaf spring **240** normally maintains locking device **230** in a lock-off position wherein arm **244** of the locking device is in registration with ledge **218** of trigger **200** to prevent movement of the trigger from its inoperative position. With the locking device in its lock-off position, stop **220** prevents pivotal movement of the locking device in a clockwise direction. When it is desired to operate the trigger mechanism, an operator manually engages and moves button **238** in the direction indicated by arrow **252** against the action of leaf spring **240** to pivot locking device **230** in a counterclockwise direction to an unlock position. Arm **244** is thus moved out of registration with ledge **218** of trigger **200** to permit the operator to raise finger engageable portion **202** of the trigger to its operative position to move actuator **208** upward to actuate switch **206** and operate the motor.

If, after unlocking the trigger mechanism, it is desired to lock the trigger in its operative position (indicated by phantom lines), the operator must intentionally move button **238** in the opposite direction indicated by arrow **254** also against the action of leaf spring **240** to pivot locking device **230** in a clockwise direction to move its hook end **248** into engagement with lip **222** of the trigger. The operator can then release both trigger **200** and button **238** without terminating the operation of the motor.

When it is desired to terminate the lock-on operation of the trigger mechanism, the operator raises trigger **200** to disengage its lip **222** from hook end **248** of locking device **230.** Upon disengagement of the lip and hook end, locking device **230** is moved toward its intermediate lock-off position by integral leaf spring **240.** When trigger **200** is allowed to return to its inoperative position, locking device **230** is automatically returned to its lock-off position and its arm **244** is in registration with ledge **218** of the trigger to lock the trigger in its inoperative position.

Referring to FIG. **11,** a third alternative embodiment of the trigger mechanism includes a trigger, generally **300,** including a finger engageable portion **302** which extends downwardly through an opening provided in the bottom of the power tool handle. An arm **304** extends rearwardly from the finger engageable portion. Arm **304** terminates in a collar **306** pivotally mounted

on a pin **308** extending inwardly from the interior of the power tool handle. An integral leaf spring **310** extends rearwardly from collar **306** and engages the handle to bias trigger **300** in a normally downward, inoperative position. Finger engageable portion **302** is hollow and includes a thick front wall **312** having a flat top surface **314** for engaging an actuator **316** of a switch **318.** Switch actuator **316** is normally biased downward to an off position and is movable upward to an on position to operate the power tool motor. In addition, an arm **320** projects forwardly from the front edge of trigger **300** and includes an upper, lock-off surface **322** and downwardly projecting lock-on member or lip **324.**

The trigger mechanism of FIG. **11** also includes a pivotable locking device, generally **330,** comprising cylindrical body **332** mounted on a pivot pin **334** projecting inwardly from the interior of the handle. A stem **336** extends upwardly from cylindrical body **332** through an opening provided in the top of the handle. A button **338** is provided at the top of stem **336** to permit an operator to pivot locking device **330** about its pivot pin **334.**

A primary, integral leaf spring **340** projects downward from stem **336** and is received in a notch **342** provided in the lower surface of the handle. An arm **344** projects downward from cylindrical body **332** and terminates in a finger **346** having an upwardly extending ridge **348.** A second, integral leaf spring **350** projects downward from cylindrical body **332** and includes a bent end **352** which normally engages the inner edge of ridge **348.**

In the operation of the trigger mechanism of FIG. **11,** primary spring **340** normally biases locking device **330** into a lock-off position wherein finger **346** of the locking device is located above arm **320** in registration with lock-off surface **322** to prevent movement of the trigger from its downward, inoperative position to its upward, operative position. When it is desired to unlock the trigger mechanism, the operator engages and moves button **338** backward as indicated by arrow **354** to pivot locking device **330** in a counterclockwise direction to an unlock position to move finger **346** of the locking device out of the path of movement of arm **320** of the trigger. The operator can then raise trigger **300** to its operative position (indicated by phantom lines) to move actuator **316** upward to actuate switch **318** and operate the motor. If, after movement of locking device **330** to its unlock position, the operator releases button **338,** the locking device is urged toward its initial position by return bias action of primary spring **340** until secondary spring **350** engages the front edge of arm **320** of the trigger. Secondary spring **350** is of sufficient strength to resist bending under the return bias action of primary spring **340.** Thus, upon release of button **338,** locking device **330** pivots in a clockwise direction toward its initial position, but it cannot completely return to its initial position because of the engagement between finger **320** of the trigger and secondary spring **350** of the locking device.

If it is desired to lock trigger **300** in its operative position, the operator engages and moves button **338** forward as indicated by arrow **356** to pivot locking device **330** in a clockwise direction to its lock-on position. The operator, by applying sufficient pressure on button **338,** can overcome the resistance of secondary spring **350.** Thus, upon movement of locking device **330** to its lock-on secondary spring **350** is moved toward arm **344** of the locking device to permit ridge **348** to move beneath lip **324** of trigger **300.** The viasing force exerted by integral leaf spring **310** of the trigger maintains lip **322** in engagement with ridge **348** to lock the trigger in its operative position.

When it is desired to terminate the lock-on operation of the trigger mechanism, the operator raises trigger **300** slightly to disengage its lip **324** from ridge **348** of locking device **330.** Upon disengagement of lip **322** and ridge **348,** secondary spring **350** exerts a sufficient return bias on locking device **330** to pivot the locking device in a counterclockwise direction to move finger **346** out of the path of movement of the trigger. Thus, upon release of trigger **300** by the operator, the trigger is free to return to its downward, inoperative position. Locking device **330** is thereafter automatically returned to its initial, lock-off position by primary spring **340.**

Referring to FIG. **12,** a fourth alternative embodiment of the trigger mechanism includes a trigger, generally **400,** comprising a finger engageable portion **402** which extends downwardly through an opening provided in the bottom of the power tool handle. An arm **404** projects forwardly from the finger engageable portion. Arm **404** terminates in a collar **406** pivotally mounted on a pin **408** projecting inwardly from the interior of the power tool handle. A primary leaf spring **410** and a secondary leaf spring **412** project upwardly from collar **408.** In addition, a finger **414** projects upwardly from arm **404** and is provided with a flat, lock-off surface **416** and a sharp, downwardly projecting lock-on member or lip **418.** An integral leaf spring **420** extends rearwardly from finger engageable portion **402** of the trigger and is received in a notch **422** provided on the handle.

A switch **424** including an actuator **426** is mounted on the handle above finger engageable portion **402** of the trigger. Switch actuator **426** is normally biased downward to an off position and is movable upward to an on position to actuate the switch and operate the power tool motor.

The trigger mechanism of FIG. **12** also includes a pivotal locking device, generally **430,** including a cylindrical body **432** mounted on a pivot pin **434** projecting inwardly from the interior of the power tool handle. A stem **436** extends upwardly from cylindrical body **432** through an opening provided in the top of the handle. A button **438** is provided at the top of stem **436** to enable an operator to pivot the locking device **430** about its pivot pin **434.** The locking device also includes a first, elongated arm **439** projecting downwardly from cylindrical body **432** and including a laterally projecting finger **440.** In addition, a second, relatively short arm **442** projects from cylindrical body **432** and is located between primary spring **410** and secondary spring **412** of the trigger.

In the operation of the trigger mechanism of FIG. **12,** primary spring **410** and secondary spring **412** normally bias locking device **430** into a lock-off position. With locking device **430** in its lock-off position, finger **440** of the locking device is located in the path of movement of finger **414** above its lock-off surface **416** to prevent upward movement of the trigger to its operative position. When it is desired to unlock the trigger for movement to its operative position, the operator engages and moves button **438** rearward, as indicated by arrow **444,** to pivot locking device **430** in a counterclockwise direction to move the locking device to its

unlock position (indicated in phantom lines) against the biasing action of primary spring **410.** With locking device **430** in its unlock position, the operator can raise finger engageable portion **402** of trigger **400** to its operative position to pivot the trigger about pin **408** and move actuator **426** upward to actuate switch **424** and operate the motor. With trigger **400** in its operative position, both primary and secondary springs **410** and **412** are shifted to the positions shown in phantom lines. Thus, the biasing action of spring **410** on arm **442** is relaxed and locking device **430** cannot return to its original, lock-off position until the trigger is released.

If it is desired to lock trigger **400** in its operative position, the operator engages and moves button **438** forward to pviot locking device **430** in a clockwise direction against the biasing action of secondary spring **412** to a lock-on position with finger **440** of the locking device located underneath lip **418** of the trigger. The operator can then release trigger **400** which, under the action of integral leaf spring **420,** is biased downward to maintain engagement between lip **418** and finger **440.** When it is desired to terminate lock-on operation of the trigger memechanism, the operator raises trigger **400** slightly to disengage lip **418** and finger **440.** Upon disengagement of lip **418** and finger **440,** secondary spring **412** automatically pivots locking device **430** in the counterclockwise direction to move finger **440** out of the path of movement of finger **414** and lip **418** of the trigger. Upon release of trigger **400** by the operator, integral leaf spring **420** returns the trigger to its downward, inoperative position and primary spring **410** automatically returns locking device **430** to its lock-off position wherein arm **439** is positioned above finger **414** in registration with lock-off surface **416** to lock the trigger in its inoperative position.

Referring to FIG. **13,** a fifth alternative embodiment of the trigger mechanism includes a trigger, generally **500,** having a finger engageable portion **502** which extends downwardly through an opening provided in the bottom of the power tool handle. An arm extends rearwardly from the finger engageable portion. The remaining rearward structure of the trigger is not illustrated, but it can be substantially the same as the structure of trigger **300** of FIG. **11.** Finger engageable portion **502** is hollow and includes a thick front wall **506** having a flat upper surface **508** for movement into engagement with an actuator **510** of a switch **512.** Actuator **510** is normally biased downward to an off position and is movable upward to an on position to actuate the switch and operate the power tool motor. An arm **514** projects forwardly from the front edge of trigger **500.** An opening **516** is provided in arm **514** and a sharp, downwardly facing locking member or lip **518** is formed at the outer edge of the arm.

The trigger mechanism of FIG. **13** also includes a pivotal locking device, generally **530,** including a cylindrical body **532** mounted on a pivot pin **534** extending inwardly from the interior of the power tool handle. A manually operable button **536** is formed integrally with cylindrical body **532** and projects upward through an opening provided in the top of the handle to enable an operator to pivot locking device **530** about its pivot pin **534.** Locking device **530** also includes first and second arms or leaf springs **538** and **540,** respectively, extending downwardly from cylindrical body **532.** First arm **538** supports an L-shaped locking member **542** at its lower end having upper and lower surfaces **544** and **546,** respectively. The power tool handle includes a vertical rib **548** projecting inwardly from the interior of the handle with a flange **550** extending perpendicularly from the rib and located above upper surface **544** of locking member **542.** Second arm **540** is provided with a lower hook end **552.**

In the operation of the trigger mechanism of FIG. **13,** trigger **500** is normally biased toward its downward, inoperative position by its integral leaf spring (not shown), and locking member **530** is normally located in a lock-off position. With locking device **530** in its lock-off position, locking member **542** is located between the upper, lock-off surface of arm **514** of the trigger and flange **550** of the power tool handle. If the operator attempts to move finger engageable portion **502** of the trigger upward, its arm **514** moves into engagement with lower surface **546** of locking member **542** to urge upper surface **544** of the locking member into contact with flange **550** and prevent upward movement of the trigger to its operative position. When it is desired to unlock the trigger mechanism, the operator engages and moves button **536** backward, as indicated by arrow **554,** to pivot locking device **530** in a counterclockwise direction to an unlock position with locking member **542** out of the path of movement of arm **514** of trigger **500** and in registration with opening **516.** The operator can then raise finger engageable portion **502** of the trigger to its operative position (indicated in phantom lines) to move actuator **510** upward to actuate switch **512.** Upon upward movement of trigger **500** to its operative position, the lower end of locking member **542** moves into opening **516** formed in arm **514** of the trigger. With the lower end of locking member **542** received in opening **516,** locking device **530** cannot return to its initial, lock-off position until trigger **500** returns to its downward, inoperative position.

If it is desired to lock trigger **500** in its operative position, the operator engages and moves button **536** forward, as indicated by arrow **556,** to pivot locking device **530** in a clockwise direction to a lock-on position. Since locking member **542** is located within opening **516,** the extent of its clockwise movement is limited by the inner edge of the opening. Thus, as locking member **530** is rotated in a clockwise direction, primary leaf spring **538** produces a return bias force urging the locking member in the opposite direction. The operator pivots locking member **530** clockwise until hook end **552** of secondary leaf spring **540** engages lip **518** of the trigger. At this time, the operator can release both trigger **500** and button **536** of the locking device without movement of the trigger back to its inoperative position. The downward bias force exerted on trigger **500** by its integral leaf spring (not shown) maintains engagement between lip **518** of the trigger and hook end **552** of the locking device.

When it is desired to terminate lock-on operation of the trigger mechanism, the operator moves finger engageable portion **502** of the trigger slightly upward to disengage lip **518** of the trigger and hook end **552** of the locking device. Upon disengagement of lip **518** and hook end **552,** the return bias force produced by primary leaf spring **538** pivots locking device **530** in a counterclockwise direction to move hook end **552** from beneath lip **518** of the trigger. If the operator then releases trigger **500,** its leaf spring (not shown) returns the trigger to its downward, inoperative position. As

the trigger moves downward, locking member **542** is moved out of opening **516**, and locking device **530** is biased to its initial, lock-off position to move locking member **542** to its initial position between arm **514** of the trigger and flange **550** of the power tool handle.

Referring to FIG. **14**, a sixth alternative embodiment of the trigger mechanism includes a trigger, generally **600**, comprising a finger engageable portion **602** which extends downwardly through an opening provided in the bottom of the power tool handle. An arm **604** extends rearwardly from the finger engageable portion. Arm **604** terminates in a collar **606** which is pivotally mounted on a pin **608** extending inwardly from the interior of the handle. An elongated, integral leaf spring **610** extends forwardly from collar **606**. A plurality of pins **612, 613** and **614** is provided on the interior of the handle. The free end of leaf spring **610** is located between pins **612** and **613**. The leaf spring is slightly bent to exert a bias force on trigger **600** to urge its finger engageable portion **602** into a normally downward, inoperative position. Finger engageable portion **602** is hollow and includes a first ledge **616** formed at its front edge for engaging an actuator **618** of a switch **620**. Switch actuator **618** is normally biased downward to an off position and is movable upward to an on position to actuate the switch and operate the power tool motor. A second ledge or lock-off surface **622** is provided at the rear edge of finger engageable portion **602**, and a lock-on member or finger **624** projects downward from ledge **622**.

The trigger mechanism also includes a locking device, generally **630**, including a cylindrical body **632** mounted on a pivot pin **634** projecting inwardly from the interior of the handle. A stem **636** extends upwardly from cylindrical body **632** through an opening provided in the top of the handle. A manually engageable button **638** is provided at the top of stem **636** to enable the operator to pivot locking device **630** about pivot pin **634**. A locking arm **640** extends downwardly from cylindrical body **632** and terminates in a hook end **642** having a flat, bottom surface **644**. In addition, an integral leaf spring **646** projects from cylindrical body **632** and is received between pins **613** and **614**.

In the operation of the trigger mechanism of FIG. **14**, integral leaf spring **646** normally maintains locking member **630** in a lock-off position with locking arm **640** in registration with lock-off surface **622** of trigger **600**. If the operator attempts to raise finger engageable portion **602** of the trigger from its inoperative position, bottom surface **644** of locking arm **640** engages lock-off surface **622** and prevents movement of the trigger to its operative position. When it is desired to unlock the trigger mechanism, the operator engages and moves button **638** rearwardly, as indicated by arrow **648** (FIG. **15**), to rotate locking device **630** in a clockwise direction to move the locking device to an unlock position wherein locking arm **640** is moved out of the path of movement of lock-off surface **622** of the trigger. The operator can then raise finger engageable portion **602** of the trigger upward to its operative position to move actuator **618** upward to actuate switch **620**. As shown in FIG. **16**, the operator can then release button **638** to allow integral leaf spring **646** to bias locking device **630** toward its initial, lock-off position. With trigger **600** in its operative position, however, hook end **642** of locking arm **640** is urged into engagement with the front edge of finger **624** to prevent locking device **630** from completely returning to its lock-off position.

If it is desired to lock trigger **600** in its operative position, the operator raises finger engageable portion **602** slightly from the position shown in FIG. **16** to move finger **624** of the trigger above hook end **642** of the locking device. At the same time, the operator engages and moves button **638** forward, as indicated by arrow **650** (FIG. **17**), to pivot locking device **630** in a clockwise direction to a lock-on position with hook end **642** of arm **640** located below lock-on finger **624** of trigger **600**. The operator then allows the trigger to move slightly downward to move projection **624** into engagement with hook end **642**. With the trigger mechanism in its lock-on position (FIG. **17**), the operator can release both finger engageable portion **602** of the trigger and button **638** of the locking device without terminating operation of the motor.

When it is desired to terminate the lock-on operation of the trigger mechanism, the operator aises the finger engageable portion **602** of the trigger slightly to disengage its finger **624** from hook end **642** of locking arm **640**. Upon disengagement of projection **624** and hook end **642**, integral leaf spring **646** moves locking device **630** in a counterclockwise direction to move locking arm **640** out of the path of movement of finger **624** of the trigger. The operator then releases finger engageable portion **602** of the trigger to allow integral leaf spring **610** to return the trigger to its downward, inoperative position. When the trigger returns to its inoperative position, integral leaf spring **646** returns locking device **630** to its lock-off position (FIG. **14**) to locate locking arm **640** in registration with locking surface **622** of trigger **600** to prevent upward movement of the trigger to its operative position. The trigger is thus automatically locked in its inoperative position to prevent inadvertent operation of the power tool.

The embodiments of FIGS. **10–14** provide trigger mechanisms having automatic lock-off and manual lock-on features. Each trigger mechanism provides two (**2**) distinct modes of movement for its locking device and requires a positive, intentional action, i.e., a reversal in the direction of pivotal movement of the locking device, to operate the locking device from its first mode of movement to its second mode of movement to achieve lock-on operation of the trigger mechanism. The requirement of a positive, intentional action precludes inadvertent operation of the trigger mechanism to its lock-on state.

The invention, in its broader aspects, is not limited to the specific details shown and described, and modifications may be made in the details of the trigger mechanism without departing from the principles of the present invention.

What is claimed is:

1. A trigger mechanism for a hand-operated power tool including an electric motor and an on-off switch operatively associated with the motor and normally biased off, comprising:

a trigger manually movable from a first position to a second position to actuate the switch and turn on the motor, said trigger being normally biased toward its first position; and

manually operable locking means movable in two distinct modes of movement, said locking means being normally biased toward a first position, cooperatively engageable with said trigger to prevent

movement of said trigger from its first position to its second position, and movable in its first mode toward a second position wherein said trigger is manually movable to its second position to actuate the switch, said locking means being cooperatively engageable with said trigger when each is in its second position to permit said locking means to be released without movement to its first position until said trigger is allowed to return to its first position, said locking means being movable in its second mode to a third position cooperatively engageable with said trigger to lock said trigger in its second position to continuously actuate the switch and operate the motor; and

means biasing said locking means out of said third position to permit automatic disengagement of said locking means from said trigger.

2. A trigger mechanism for a hand-operated power device including a motor and a handle which supports a control operatively associated with the motor, comprising:

a trigger mounted on the handle and manually movable from a first position to a second position to actuate the control and operate the motor, said trigger being normally biased toward its first position; and

a manually operable locking device slidably mounted on the handle and movable in two distinct orientations relative to the handle, said locking device being normally biased toward a first position, cooperatively engageable with said trigger to prevent movement of said trigger from its first psition to its second position, and movable in its first orientation relative to the handle toward a second position wherein said trigger is manually movable to its second position to actuate the control, said locking device being cooperatively engageable with said trigger when each is in its second position to permit said locking device to be released without movement back to its first position until said trigger is allowed to return to its first position, said locking device being further movable in its second orientation relative to the handle to a third position cooperatively engageable with said trigger to lock said trigger in its second position to continuously actuate the control and operate the motor; and

means biasing said locking means out of said third position to permit automatic disengagement of said locking means from said trigger.

3. In a portable, hand-operated power tool including an electric motor and a handle which supports an on-off switch operatively associated with the motor and normally biased off, a trigger mechanism for operating the on-off switch, comprising:

a manually operable trigger mounted on the handle and movable from an inoperative position to an operative position to actuate the switch and turn on the motor;

integral spring means on said trigger for normally biasing said trigger toward its inoperative position;

a manually operable locking device slidably mounted on the handle for movement in first and second distinct orientations relative to the handle, said locking device being movable between a lock-off position and an unlock position in its first orientation and between its unlock position and a lock-on position in its second orientation, said locking device including first and second arms for engaging said trigger, said first arm being cooperatively engageable with said trigger when said locking device is in its lock-off position to prevent movement of said trigger from its inoperative position to its operative position, said trigger being manually movable from its inoperative position to its operative position when said locking device is moved to its unlock position to actuate the switch to control on-off operation of the motor, said second arm being cooperatively engageable with said trigger when said locking device is moved to its lock-on position to lock said trigger in its operative position to continuously actuate the switch and operate the motor; and

means for normally biasing said locking device toward its lock-off position, said first arm of said locking device being cooperatively engageable with said trigger when said trigger is moved to its operative position and said locking device is moved to its unlock position to permit said locking device to be released without movement back to its lock-off position until said trigger is allowed to return to its inoperative position.

4. In a portable, hand-operated power tool including an electric motor and a hollow handle which supports a switch operatively associated with the motor, a trigger mechanism for operating the switch, comprising:

a manually operable trigger mounted within the handle and including a finger engageable body extending through a first opening provided in the handle, said trigger being movable from an inoperative position to an operative position to actuate the switch and operate the motor, said finger engageable body including a lock-off surface and a lock-on member, said trigger being normally biased toward its inoperative position; and

a manually operable locking device slidably mounted within the handle for movement in first and second distinct orientations relative to the handle, said locking device including first and second arms extending toward said finger engageable body of said trigger, said locking device being normally biased into a lock-off position wherein said trigger first arm is in registration with said lock-off surface of said finger engageable body to prevent movement of said trigger from its inoperative position to its operative position, said locking device being movable in its first orientation from its lock-off position to an unlock position wherein said first arm is out of registration with said lock-off surface and said trigger is manually movable to its operative position to actuate the switch and operate the motor, said locking device being further movable in its second orientation between its unlock position and a lock-on position therein said second arm is cooperatively engageable with said lock-on member of said finger engageable body to lock said trigger in its inoperative position to continuously actuate the switch and operate the motor.

5. In a portable, hand-operated power tool including an electric motor and a hollow, elongated handle which supports a switch operatively associated with the motor, a trigger mechanism for operating the switch, comprising:

a manually operable trigger mounted within the handle and including a finger engageable body extending downward through a first opening provided in

the handle, said finger engageable body including a lock-off surface and a lock-on member, said trigger being normally biased downward toward an inoperative position and movable upward to an operative position to actuate the switch and operate the motor; and

a manually operable locking device slidably mounted within the handle above said trigger for longitudinal and lateral movement relative to the handle, said locking device including first and second arms extending downward toward said finger engageable body of said trigger, said locking device being normally biased toward a lock-off position wherein said first arm is in registration with said lock-off surface of said finger engageable body to prevent upward movement of said trigger from its inoperative position to its operative position, said locking device being longitudinally movable in a first orientation relative to the handle from its lock-off position to an unlock position wherein said first arm is out of registration with said lock-off surface and said trigger is manually movable to its operative position to actuate the switch and operate the motor, said locking device including a rib cooperatively engageable with said lock-off surface of said finger engageable body when said locking device is in its first orientation to limit upward movement of said trigger and locate its lockon member in the path of movement of said second arm to limit longitudinal movement of said locking device in its first orientation, said locking device being shiftable laterally into a second orientation relative to the handle to move said rib out of registration with said lock-off surface of said finger engageable body to permit further upward movement of said trigger, said lock-on member being located out of the path of movement of said second arm upon further upward movement of said trigger to permit further longitudinal movement of said locking device, said locking device being movable in its second orientation to a lock-on position wherein said second arm is cooperatively engageable with said lock-on member to lock said trigger in its operative position to continuously actuate the switch and operate the motor.

6. In a portable, hand-operated power tool including an electric motor and a hollow, elongated handle which enables an operator to grip the power tool, a trigger mechanism for controlling operation of the motor, comprising:

a switch mounted within the hollow handle and operatively associated with the motor, said switch including an actuator for controlling its on-off operation;

a manually operable trigger mounted within the handle and including a portion projecting through a first opening provided in the handle to be engaged by the operator, said trigger being movable from an inoperative position to an operative position and engageable with said switch actuator upon movement to its operative position to actuate said switch and operate the motor;

integral spring means on said trigger for normally biasing said trigger toward its inoperative position;

a manually operable locking device slidably mounted for longitudinal movement relative to the handle, said locking device being shiftable laterally between first and second distinct orientations relative to the handle, said locking device being movable from a lock-off position to an unlock position in its first orientation and from its unlock position to a lock-on position in its second orientation, said locking device including a manually engageable portion extending through a second opening provided in the handle to be engaged by the operator and first and second arms for engaging said trigger, said first arm being cooperatively engageable with said trigger when said locking device is in its lock-off position to prevent movement of said trigger from its inoperative position to its operative position, said trigger being manually movable from its inoperative position to its operative position when said locking device is moved to its unlock position to operate said switch actuator to control on-off operation of the motor, said second arm being cooperatively engageable with said trigger when said locking device is moved to its lock-on position to lock said trigger in its operative position to continuously actuate said switch and operate the motor; and

means for normally biasing said locking device toward its lock-off position, said first arm of said locking device being cooperatively engageable with said trigger when said trigger is moved to its operative position and said locking device is moved to its unlock position to permit said locking device to be released without movement back to its lock-off position until said trigger is allowed to retun to its inoperative position.

7. In a portable, hand-operated power tool including an electric motor and a hollow, elongated handle which enables an operator to grip the power tool, a trigger mechanism for controlling the operation of the motor, comprising:

an on-off switch mounted within the hollow handle and operatively associated with the motor, said switch including an actuator normally biased to an off position and movable to an on position to operate the motor;

a manually operable trigger mounted within the handle and including a portion projecting through a first opening provided in the handle to be engaged by the operator, said trigger being movable from an inoperative position to an operative position and engageable with said switch upon movement to its operative position to move said switch actuator to its on position and operate the motor;

integral spring means on said trigger engaging the handle to normally bias said trigger toward its inoperative position;

a manually operable locking device slidably mounted in a track provided within the handle for longitudinal movement relative to the handle, said locking device being shiftable laterally between first and second distinct orientations relative to the handle, said locking device being movable from a lock-off position to an unlock position in its first orientation and to a lock-on position in its second orientation, said locking device including a manually engageable portion extending through a second opening provided in the handle to be engaged by the operator and first and second arms for engaging said trigger, said first arm being cooperatively engageable with said trigger when said locking device is in its

lock-off position to prevent movement of said trigger from its inoperative position to its operative position, said trigger being manually movable from its inoperative position to its operative position when said locking device is moved to its unlock position to operate said switch actuator to control on-off operation of the motor, said second arm being cooperatively engageable with said trigger when said locking device is moved to its lock-on position to lock said trigger in its operative position to continuously hold said switch in its on position and operate the motor;

means for normally biasing said locking device toward its lock-off position, said first arm of said locking device being cooperatively engageable with said trigger when said trigger is moved to its operative position and said locking device is moved to its unlock position to permit said locking device to be released without movement back to its lock-off position until said trigger is allowed to return to its inoperative position;

an obstruction projecting laterally from the interior of the handle into the path of movement of said locking device for engaging one of its arms upon movement of said locking device to its unlock position to prevent further longitudinal movement of said locking device in its first orientation, said arm being released from said obstruction upon lateral movement of said locking device from its unlock position into its second orientation to permit said locking device to be moved to its lock-on position; and

a cam surface projecting laterally from the interior of the handle on the opposite side of said locking device from said obstruction for engaging said locking device upon release of said trigger to drive said locking device laterally from its second orientation to its first orientation during return movement of said locking device from its unlock position to its lock-off position.

8. In a portable, hand-operated power tool including an electric motor and a hollow, elongated handle which enables an operator to grip the power tool, a trigger mechanism for controlling the operation of the motor, comprising:

an on-off switch mounted within the hollow handle and operatively associated with the motor, said switch including an actuator normally biased to an off position and movable to an on position to operate the motor;

a manually operable trigger mounted within the handle and including a finger engageable portion projecting through a first opening provided in the handle to be engaged by the operator, said trigger including a pair of spaced, parallel arms extending backward from said finger engageable portion on opposite sides of said switch and pivotally connected to the interior of the handle, said finger engageable portion of said trigger being movable from an inoperative position to an operative position and engageable with said switch actuator upon movement to its operative position to move said switch actuator ot its on position and operate the motor, said trigger including an integral leaf spring projecting backward from said arms for engaging the interior of the handle to normally bias said finger engageable portion toward its inoperative position;

a manually operable locking device slidably mounted in a track provided within the handle for longitudinal movement relative to the handle, said locking device being shiftable laterally between first and second distinct orientations relative to the handle, said locking device being movable from a lock-off position to an unlock position in its first orientation and to a lock-on position in its second orientation, said locking device including a manually engageable portion extending through a second opening provided in the handle to be engaged by the operator and first and second arms for engaging said trigger, said first arm being cooperatively engageable with said trigger when said locking device is in its lock-off position to prevent movement of said trigger from its inoperative position to its operative position, said trigger being manually movable from its inoperative position to its operative position when said locking device is moved to its unlock position to operate said switch actuator to control operation of the motor, said second arm being cooperatively engageable with said trigger when said locking device is moved to its lock-on position to lock said trigger in its operative position to continuously hold said switch actuator in its on position and operate the motor;

means for normally biasing said locking device toward its lock-off position, said first arm of said locking device being cooperatively engageable with said trigger when said trigger is moved to its operative position and said locking device is moved to its unlock position to permit said locking device to be released without movement back to its lock-off position until said trigger is allowed to return to its inoperative position;

an obstruction projecting laterally from the interior of the handle into the path of movement of said locking device for engaging one of its arms upon movement of said locking device to its unlock position to prevent further longitudinal movement of said locking device in its first orientation, said arm being released from said obstruction upon lateral movement of said locking device from its unlock position into its second orientation to permit said locking device to be moved to its lock-on position; and

a cam surface projecting laterally from the interior of the handle oon the opposite side of said locking device from said obstruction for engaging said locking device upon release of said trigger to drive said locking device laterally from its second orientation to its first orientation during return movement of said locking device from its unlock position to its lock-off position.

9. A trigger mechanism for a hand-operated power device including a motor and a handle which supports a control operatively associated with the motor, comprising:

a trigger mounted on the handle and manually movable from a first position to a second position to actuate the control and operate the motor, said trigger being normally biased toward its first position; and

a pivotal locking device mounted on the handle and normally biased toward a lock-off position cooper-

atively engageable with said trigger to prevent movement of said trigger from its first position to its second position, said locking device being pivotable in a first direction from its lock-off position to an unlock position wherein said trigger is manually movable to its second position to actuate the control, said locking device being pivotable in a second direction to a lock-on position cooperatively engageable with said trigger to lock said trigger in its second position to continuously actuate the control and operate the motor, said second direction extending at an angle to said first direction.

10. A trigger mechanism for a hand-operated power tool including an electric motor and a handle which supports a switch operatively associated with the motor, comprising:

a manually operable trigger mounted on the handle and movable from an inoperative position to an operatqve position to actuate the switch to turn on the motor;

means for normally biasing said trigger toward its inoperative position;

a pivotal locking member on the handle including first and second arms for engaging said trigger, said locking member being pivotable in a first direction from a lock-off position, wherein said first arm is cooperatively engageable with said trigger to prevent movement of said trigger from its inoperative position to its operative position, to an unlock position wherein said trigger is manually movable to its operative position to actuate the switch, said locking member being pivotable in a second direction to a lock-on position wherein said second arm is cooperatively engageable with said trigger to lock said trigger in its operative position to continuously actuate the switch and operate the motor; and

means for normally biasing said locking member toward its lock-off position.

11. In a portable, hand-operated power tool including an electric motor and a handle which supports a switch operatively associated wth the motor, a trigger mechanism for operating the switch, comprising:

a manually operable trigger mounted on the handle and movable from an inoperative position to an operative position to actuate the switch to turn on the motor;

means for normally biasing said trigger toward its inoperative position;

a pivotal locking member on the handle including an arm for engaging said trigger, said locking member being pivotable in a first direction from a lock-off position, wherein said arm is cooperatively engageable with said trigger to prevent movement of said trigger from its inoperative position to its operative position, to an unlock position wherein said arm is out of the path of movement of said trigger and said trigger is manually movable to its operative position to actuate the switch, said locking member being pivotable in a second direction to a lock-on position wherein said arm is cooperatively engageable with said trigger to lock said trigger in its operative position to continuously actuate the switch and operate the motor, said second direction extending at an angle to said first direction; and

means for normally biasing said locking member toward its lock-off position.

12. In a portable, hand-operated power tool including an electric motor and a hollow handle which supports a switch operatively associated with the motor, a trigger mechanism for operating the switch, comprising:

a manually operable trigger mounted within the hollow handle and including a finger engageable body extending through a first opening provided in the handle, said trigger being movable from an inoperative position to an operative position to actuate the switch to turn on the motor, said finger engageable body including a lock-off surface and a lock-on member, said trigger further including integral spring means engaging the handle to normally bias said trigger into its inoperative position; and

a manually operable locking lever pivotally mounted within the handle adjacent to said finger engageable body of said trigger, said locking lever including a finger engageable portion extending through a second opening provided in the handle and first and second arms extending toward said finger engageable body of said trigger, said locking lever further including integral spring means engaging the handle to normally bias said lever into a lock-off position wherein said first arm is in registration with said lock-off surface of said finger engageable body to prevent movement of said trigger from its inoperative position to its operative position, said locking lever being pivotable in a first direction from its lock-off position to an unlock position wherein said first arm is out of registration with said lock-off surface and said trigger is manually movable to its operative position to actuate the switch, said locking lever being pivotable in a second direction with said trigger in its operative position to a lock-on position wherein said second arm is cooperatively engageable with said lock-on member of said trigger to lock said trigger in its operative position to continuously actuate the switch and operate the motor.

13. In a portable, hand-operated power tool including an electric motor and a hollow handle which supports a switch operatively associated with the motor, a trigger mechanism for operating the switch, comprising:

a manually operable trigger mounted within the hollow handle and including a finger engageable body extending through a first opening provided in the handle, said trigger being movable from an inoperative position to an operative position to actuate the switch to turn on the motor, said finger engageable body including a lock-off surface and a lock-on member, said trigger further including integral spring means engaging said handle to normally bias said trigger into its inoperative position; and

a manually operable locking lever pivotally mounted within the handle adjacent to said finger engageable body of said trigger, said locking lever including a finger engageable portion extending through a second opening provided in the handle and an arm extending toward said finger engageable body of said trigger, said arm including a laterally projecting finger, said locking lever furthe including first, integral spring means engaging the handle to normally bias said lever into a lock-off position wherein its finger is in registration with said lock-off surface of said finger engageable body to pre-

vent movement of said trigger from its inoperative position to its operative position, said locking lever being pivotable in a first direction from its lock-off position to an unlock position wherein said finger is out of registration with said lock-off surface and said trigger is manually movable to its operative position to actuate the switch, said locking lever including second, integral spring means com comprising an integral leaf spring extending generally parallel to its arm and normally located in contact with said finger, said locking lever being pivotable in a second direction with said trigger in its operative position to a lock-on position wherein said finger is in registration with said lock-on member of said trigger and said second spring means is biased away from said finger to lock said trigger in its operative position to continuously actuate the switch and operate the motor, said second spring means exerting a bias force on said locking lever to pivot said locking lever in the first direction upon disengagement of said finger and said lock-on member.

14. In a portable, hand-operated power tool including an electric motor and a hollow handle which supports a switch operatively associated with the motor, a trigger mechanism for operating the switch, comprising:

a manually operable trigger mounted within the hollow handle and including a finger engageable body extending through a first opening provided in the handle, said trigger being movable from an inoperative position to an operative position to actuate the switch to turn on the motor, said trigger including a lock-off surface and a lock-on member on its finger engageable body, said trigger further including integral spring means engaging said handle to normally bias said trigger into its inoperative position;

a manually operable locking lever pivotally mounted within the handle adjacent to said finger engageable body of said trigger, said locking lever including a finger engageable portion extending through a second opening provided in the handle and an arm extending toward said finger engageable portion of said trigger;

primary spring means on said trigger engaging said locking lever to normally bias said lever into a lock-off position wherein its arm is in registration with said lock-off surface of said trigger to prevent movement of said trigger from its inoperative position to its operative position, said locking lever being pivotable in a first direction from its lock-off position to an unlock position wherein its arm is out of registration with said lock-off surface and said trigger is manually movable to its operative position to actuate the switch, said locking lever being pivotable in a second direction to a lock-on position wherein its arm is cooperatively engageable with said lock-on member of said trigger to lock said trigger in its operative position to continuously actuate the switch and operate the motor; and

secondary spring means on said trigger engaging said locking lever and rendered operative upon movement of said trigger to its operative position to bias said locking lever in the first direction and pivot said locking lever in the first direction upon disengagement of said arm and said lock-on member to permit said trigger to return to its inoperative position.

15. In a portable, hand-operated power tool including an electric motor and a hollow handle which supports a switch operatively associated with the motor, a trigger mechanism for operating the switch, comprising:

a manually operable trigger mounted within the hollow handle and including a finger engageable body extending through a first opening provided in the handle, said trigger being movable from an inoperative position to an operative position to actuate the switch to turn on the motor, said finger engageable body of said trigger including an arm extending from its front surface, said arm including a lock-off surface, an opening adjacent to said lock-off surface, and a lock-on member adjacent to said opening, said trigger including integral spring means engaging said handle to normally bias said trigger into its inoperative position; and

a manually operable locking lever pivotally mounted within the handle adjacent to said finger engageable portion of said trigger, said locking lever including a finger engageable portion extending through a second opening provided in the handle and primary and secondary leaf springs extending toward said arm of said trigger, said primary spring including a hook end for engaging said lock-on member of said arm and said secondary leaf spring including a lock-off member for engaging said lock-off surface of said arm,

said locking lever being normally biased to a lock-off position wherein its lock-off member is in registration withsaid lock-off surface to prevent movement of said trigger from its inoperative position to its operative position, said locking lever being pivotable in a first direction from its lock-off position to an unlock position wherein its locking member is in registration with said opening in said arm and said trigger is manually movable to its operative position to actuate the switch, said locking member being received in said opening upon movement of said trigger to its operative position, said locking member being pivotable in a second direction with said trigger in its operative position to move said hook end of said primary leaf spring into engagement with said lock-on member of said arm to lock said trigger in its operative position to continuously actuate the switch and operate the motor, said secondary leaf spring being rendered operative upon movement of said locking lever to its lock-on position to bias said locking lever in the first direction and pivot said locking lever in the first direction upon disengagement of said hook end of said primary spring and said lock-on member of said trigger to permit said trigger to return to its inoperative position.

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