United States Patent

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[54] **POWER ADJUSTMENT FOR PISTON TOOL**
10 Claims, 8 Drawing Figs.

[52] **U.S. Cl.** **227/10**
[51] **Int. Cl.** **B25c 1/14**
[50] **Field of Search** 227/8, 10

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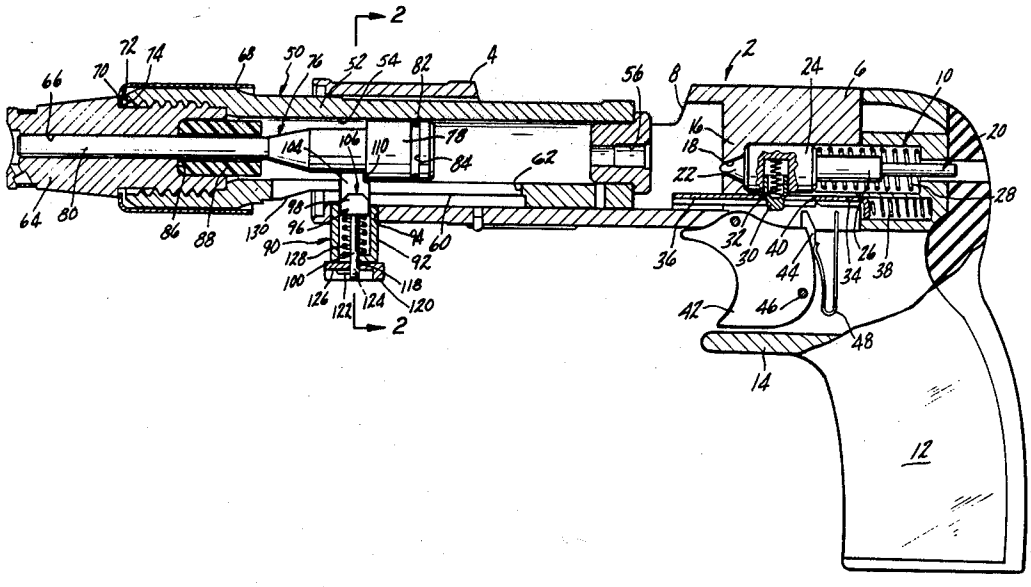
ABSTRACT: Piston return and power adjusting means for an explosive-actuated tool, said means including a pawl member adapted to extend into the interior of the barrel with a first portion in a position to contact the piston to return it to its firing position when the barrel member is moved forward relative to the housing and a second portion adapted to limit the forward movement of the barrel, one of the portions of the pawl member being provided with a cutout so that the distance the piston is returned can be varied.



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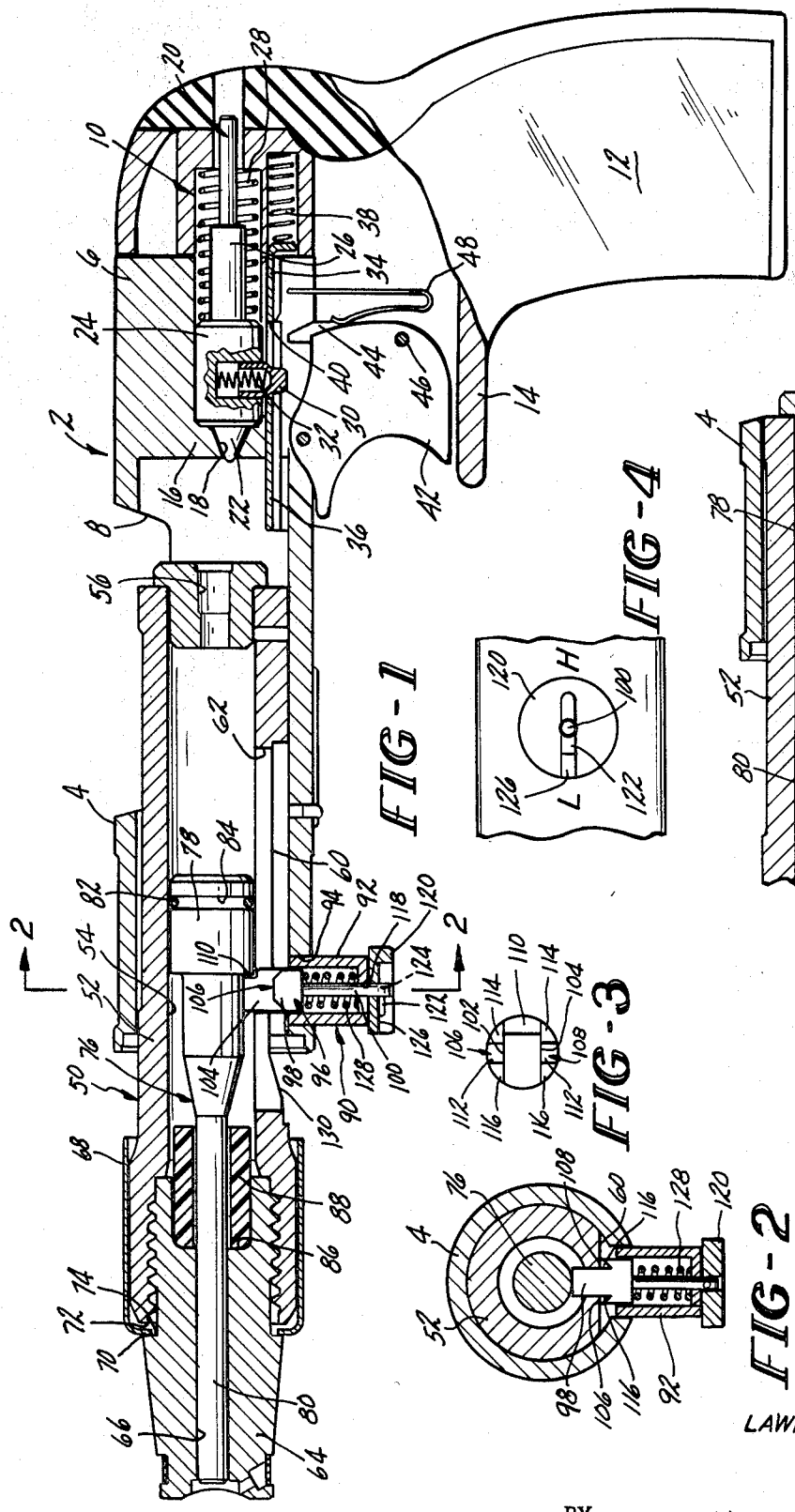

FIG-1

FIG-4

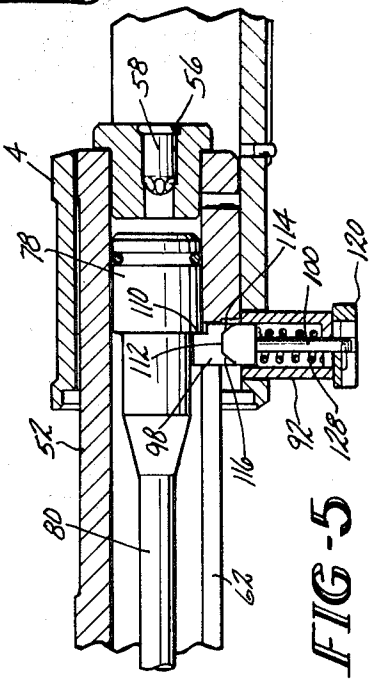

FIG-5

FIG-3

FIG-2

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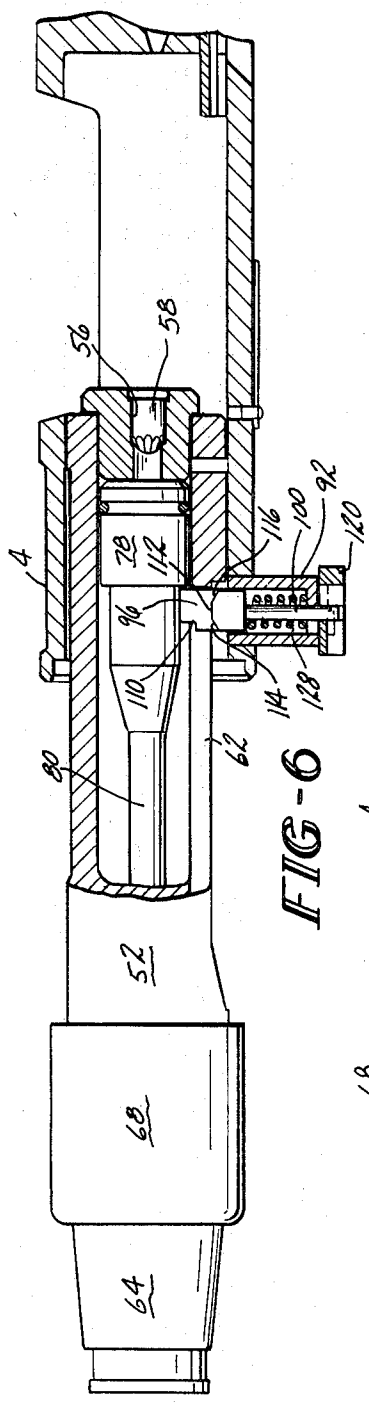

FIG-6

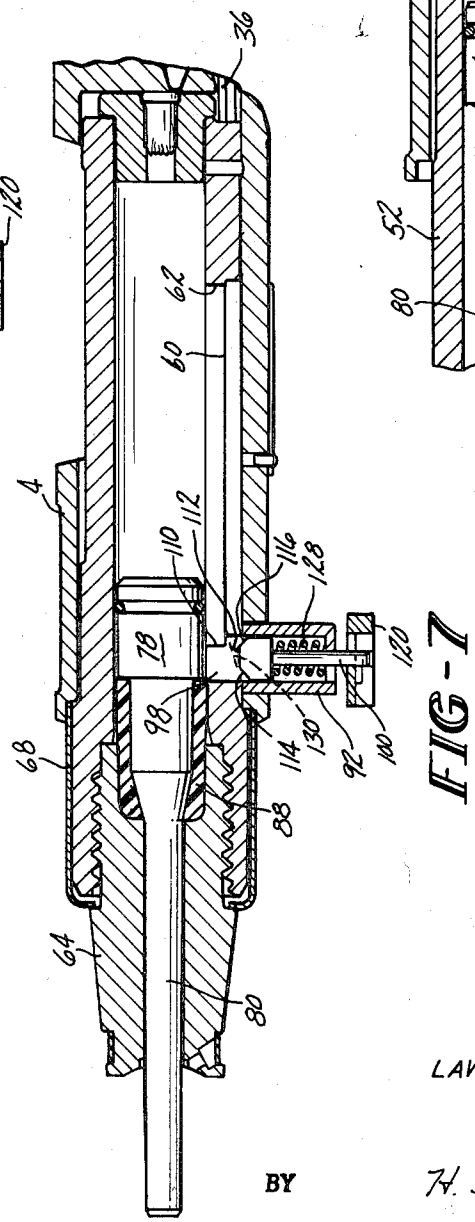

FIG-7

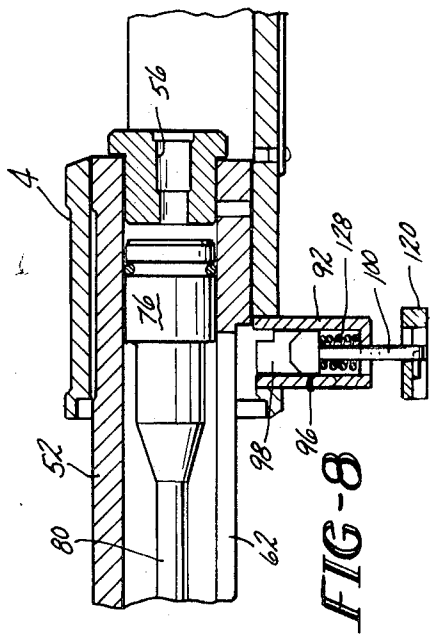

FIG-8

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POWER ADJUSTMENT FOR PISTON TOOL

This invention relates generally to improvements in tools for driving fasteners and the like into masonry, concrete, wood, steel or the like. More particularly, this invention relates to improvements in explosive-actuated tools of the type that utilize a piston to drive the fastener element.

In the use of piston-type cartridge actuated tools the power output required of a cartridge for a given tool is dependent upon the size of the fastener to be driven and the type of work surface. For example, a lower power level is needed for driving a 1-inch fastener into concrete as compared to the power level required for driving a 2-inch fastener into steel.

Accordingly, manufacturers of piston-type explosive-actuated tools generally provide cartridges having different loads for use in a given tool. Each load is capable of generating a different power level so that the proper power level may be used depending upon the type of material and fastener to be driven. However, in order to minimize inventory and manufacturing costs, manufacturers generally provide only three or four different loads. Accordingly, there frequently exists a situation wherein for a given set of variables, one power load tends to overdrive the fastener and the next lower available power load does not adequately drive the fastener.

In view of the above, it is an object of the present invention to provide means for adjusting the power output of the piston-type fastening tool for a given power load.

More specifically, it is an object of the present invention to provide means for changing the output of a given power load when used in a piston-type tool tool.

A further object of this invention is to provide means for adjusting the power output of a piston tool which acts during the movement of the barrel into its breech open position.

These and other objects of the invention will be more readily understood by reference to the following description of a preferred embodiment and to the accompanying drawings in which:

FIG. 1 is a transverse sectional view of a power-actuated tool incorporating the power adjustment feature of the present invention;

FIG. 2 is a cross-sectional view taken along the lines 2–2 of FIG. 1;

FIG. 3 is a top plan view of the piston return pawl;

FIG. 4 is a bottom plan view of the control knob;

FIG. 5 is a partial transverse sectional view similar to FIG. 1, but showing the barrel means positioned at the end of the piston return stroke and the piston return pawl so positioned as to effect a reduced power output;

FIG. 6 is a partial transverse sectional view similar to FIG. 5, but showing the piston return pawl so positioned as to effect maximum power output;

FIG. 7 is a transverse sectional view showing the components of the tool positioned when the tool is cocked and the piston member overdriven; and

FIG. 8 is a transverse sectional view showing the piston return pawl in a position which will enable the barrel member to be removed from the housing.

Referring specifically to the drawing, FIG. 1 shows a tool constructed in accordance with the present invention having a housing 2 including a tubular forward portion 4 and a rearward portion 6. The tubular forward portion 4 includes an elongated opening 8 to provide access for loading and unloading an explosive cartridge. The rearward portion 6 of the housing 2 houses the firing mechanism 10 and also includes a pistol grip 12 and a trigger guard 14.

The firing mechanism 10 includes a breech face 16 having a frustoconical opening 18 therein. A firing pin 20 is mounted behind the breech face 16 for axial movement in the housing 2 and includes a frustoconical nose portion 22, a body portion 24 and a rearwardly extending rod portion 26. The firing pin 20 is urged forwardly by a suitable spring member 28. A detent member 30 extends radially downwardly from the body portion 24 of the firing pin 20. The detent member 30 is spring biased outwardly by suitable spring means 32.

A cocking rod 34 is mounted for reciprocation in the rearward portion 6 of the housing 2 and includes a forward portion 36 extending through the breech face 16 and into the tubular forward portion 4 of the housing 2. The cocking rod 34 may be spring biased forwardly by a suitable spring member 38. The cocking rod may also include an elongated opening 40 through which the detent member 30 on the firing pin 20 may extend.

A trigger member 42 having a sear portion 44 may be pivotally mounted above the trigger guard 14 by a pivot pin 46. The trigger is resiliently urged away from the firing position by spring member 48.

A barrel assembly 50 is reciprocally mounted within the tubular portion 4 of the housing 2 and extends from the muzzle end thereof. The barrel assembly 50 includes a barrel member 52 having a bore 54 therein. The barrel member 52 includes a cartridge receiving chamber 56 at its breech end for the reception of an explosive cartridge 58. The bottom outside surface of the barrel member includes an axially extending bottom portion 60 which is planar in a horizontal direction. An elongated slot 62 extends through said bottom portion 60. The barrel assembly 50 also includes a muzzle bushing 64 which has a bore 66 of lesser diameter than the bore in the barrel member 52 and is threadedly received within the forward end of the barrel member 52. A sleeve member 68 surrounds the muzzle end of the barrel member 52 and includes an inturned flange 70 which is positioned between the forward edge 72 of the barrel member 52 and a shoulder 74 on the external surface of the muzzle bushing 64.

A piston member 76 may be mounted for reciprocal movement within the barrel assembly 50. The piston member 76 includes a generally cylindrical head portion 78 and a reduced elongated cylindrical shank portion 80. A piston ring 82 may be mounted within a suitable groove 84 about the circumference of the head portion 78 of the piston member 76.

The muzzle bushing 64 is provided with a counterbore 86 in its rearward surface. A suitable buffer member 88 is mounted in the counterbore 86 to absorb the energy of the piston member 76 in the event that the piston member 76 is overdriven. In the preferred embodiment, the buffer member 88 comprises a hollow, cylindrical member fabricated from any suitable material such as polyurethane, nylon or other suitable elastomeric materials. The interior diameter of the buffer member 88 must be at least as great as the diameter of the bore 66 in the muzzle bushing 64, which in turn is of such a size as to slidably receive the shank portion 80 of the piston member 76. The buffer member 88 extends rearwardly in the tool out of the counterbore 86 into the bore 54 of the barrel member 52 for a short distance.

A piston return and power level control means 90 is attached to the housing 2 adjacent the muzzle end of the forward portion 4. The means 90 comprises a pawl housing 92 which extends transversely to the axis of the tool and extends into a bore 94 in the housing 2. The pawl housing 92 may be attached to the housing 2 by any suitable method such as by threaded engagement, welding, or the like.

A pawl member 96 is positioned within the pawl housing 92 and includes a head 98 and a reduced rod portion 100. The upper portion of the head 98 is adapted to extend through the slot 62 in the barrel member 52 into the interior thereof. The upper portion of the head 98 is machined on opposite sides thereof to provide two opposite planar portions 102 and 104 and opposed shoulders 106 and 108. In addition, an offset portion 110 is provided having a bottom surface which extends in a direction substantially perpendicular to the flat sides 102 and 104. Each of the shoulders 106 and 108 formed by machining the upper portion of the head 98 includes an intermediate planar portion 112 and first and second downwardly tapering portions 114 and 116.

The reduced rod portion 100 of the pawl member 96 extends through an opening 118 in the bottom of the pawl housing 92. A control knob 120 is attached to the end of the rod portion 100 by means of a retaining pin 122 which is mounted

in a transverse bore **124** in the rod portion and extends into a slot **126** in the control knob **120**. A suitable spring member **128** positioned between the bottom of the pawl housing **92** and the bottom surface of the head **98** of the pawl member **96**, urges the pawl member **96** toward the axis of the barrel member so that the intermediate planar portions **112** of the shoulders **106** and **108** engage the bottom of the barrel member along the surface adjacent the slot **62**.

In operation, after a fastener is loaded into the muzzle bushing **64** and a fresh cartridge placed in the cartridge receiving chamber **56**, in order to fire the tool, the forward face of the muzzle bushing **64** is placed against the work surface and the housing **2** of the tool pushed forward relative to the barrel assembly **50** so that the cocking rod **34** abuts the rearward face of the barrel member **52**. The cocking rod **34** is thereby moved rearwardly within the housing **2**. As the detent member **30** in the firing pin **20** extends into the opening **40** in the cocking rod **34**, the firing pin **20** is also moved rearwardly with respect to the housing against the bias of its spring member **28**. When the barrel member **52** is moved into the rearwardmost or firing position, the detent member **30** in the firing pin **20** will be in alignment with the sear portion **44** of the trigger member **42** so that when the trigger member **42** is depressed, the detent member **30** will be depressed inwardly and out of the opening **40** in the cocking rod **34** and the firing pin **20** will be propelled forwardly under the influence of its spring member **28**, whereby the cartridge **58** positioned within the cartridge receiving chamber **56** will be fired and the piston member **76** propelled forwardly to thereby drive a fastener into the work surface.

After the firing operation, when the barrel assembly **50** is moved forwardly into its forward or breech open position, the pawl member **96** will engage the forward face of the head portion **78** of the piston member **76**, holding the piston member **76** stationary relative to the housing. The piston member **76** will thereby be returned to its rearward or firing position as the barrel assembly **50** is moved forward within the housing **2** until the rearward end of the slot **62** abuts the pawl member **96** thereby limiting the forward movement of the barrel assembly **50** relative to the housing.

By virtue of the unique design of the pawl member **96**, if the control knob **120** is turned so that the offset portion **110** in the head **98** is in a position to be abutted by the piston member **76** when the barrel assembly **50** is moved forwardly relative to the housing **2**, when the barrel assembly **50** reaches its forward position, the piston member **76** will be spaced from its rearwardmost or firing position a distance equal to the width of the offset portion **110** as shown in FIG. **5**. This results in a larger initial volume between the cartridge and the rearward face of the head portion **78** of the piston member **76** so that the gases generated upon the actuation of the cartridge during the next firing operation are capable of a certain degree of expansion prior to the piston member being driven. This results in less energy being imparted to the piston than if the volume between the head portion **78** and the cartridge were less.

In the event that the operator notes that for a load of a given power output, not enough energy is being transferred to the piston member **76** for the fastening operation with the piston member **76** positioned as above, the operator may merely turn the control knob **110** of the pawl member **96** so that the offset portion **110** is facing away from the head portion **78** of the piston member **76**. With this arrangement, the rearwardmost portion of the head **98** of the pawl member **96** that extends into the bore of the barrel member **52** lies in the same plane as that portion of the head **98** of the pawl member **96** which is positioned within the slot **62**. Thus, when the barrel assembly **50** is moved into its forwardmost position and the end of the slot **62** is in abutment with the pawl member **96**, the piston member **76** will have been returned a greater distance as shown in FIG. **6** than in the case described previously. This results in a decrease in the initial volume between the rearward face of the head portion **78** of the piston member **76** and the cartridge **58**. Accordingly, the gases do not have as great a volume in which to expand prior to the piston member **76** moving and more energy is transferred to the piston member **76** and hence to the fastener.

For convenience, the bottom surface of the housing **2** can be marked with suitable indicia as shown on FIG. **4** to indicate to the operator whether the piston member **76** will be returned to its low power position or high power position.

As an alternative, if more than two settings of the piston member are desired, a plurality of offset portions could be provided on that portion of the pawl member which extends into the bore of the barrel, with each offset portion having a different width. In fact, it is even contemplated that if an infinite number of settings were to be desired, the offset portion could be provided by utilizing an arcuate cam surface so that the width of the offset constantly varies from a point wherein a portion of the head **98** of the pawl member **96** which normally extends into the bore of the barrel member **52** is coincident with the outer edge of the head **98** of the pawl member **96** positioned within the slot **62** to a point of maximum width to provide a maximum degree of initial volume.

One of the features of this invention resides in the fact that the power adjustment takes place upon the movement of the barrel member **52** into in its breech open position. This is due to the relationship between the portion of the pawl member **96** that engages the piston member **76** to hold it stationary with respect to the housing **2** as the barrel is moved forwardly and the portion of the pawl member **96** which acts to limit the forward movement of the barrel member **52**. Thus, it is contemplated that several other embodiments are to be considered within the scope of this invention. For example, the offset portion on the pawl member **96** could be provided in that region of the pawl member **96** which acts to limit the forward of the housing **2**. In such an embodiment, when the offset portion is in a position to be engaged by the barrel member **52**, the piston member will be returned to its rearwardmost position.

As a further alternative, it is considered to be within the scope of this invention to provide separate elements for each of the above-described functions. For instance, one element could serve to limit the forward movement of the barrel member **52** with respect to the housing **2** and the other element could serve to engage the piston member **76** and hold it stationary with respect to the housing **2**. With this embodiment, either of the two elements, or for that matter both, could be provided with offset portions or other suitable means to provide for the power adjustment by changing the amount the piston is returned.

The bottom surface of the barrel member **52** on both sides of the slot **62** adjacent its forward end, tapers downwardly or in a direction away from the axis of the tool as indicated by the numeral **130**. When the components of the tool are moved into the firing position, such as shown in FIG. **7**, the tapering portions **114** of the shoulders **106** and **108** on the pawl member **96** engage the tapered portion **130** on the bottom surface of the barrel member **52** which acts to cam the pawl member **96** downwardly away from the axis of the barrel member **52** to a point where the innermost portion of the pawl member **96** is at least flush with or below the inner surface of the barrel member **52**. Thus, in the event that the piston member **76** should be overdriven to the point shown in FIG. **7**, there would be no impact of the piston member **76** against the pawl member **96**, which would tend to damage either of the two members or both of them, but rather, the buffer member **88** will absorb the energy of the piston member **76**.

A further feature of this invention is the fact that the operator can grasp the control knob **120** and pull the pawl member **96** away from the axis of the barrel member **52** to a point where the innermost portion of the pawl member **96** is flush with or positioned outwardly from the inner surface of the housing **2** as shown in FIG. **8**. This enables the barrel member **52** to be withdrawn from the housing when it becomes necessary.

By virtue of the above-described configuration, the preferred embodiment includes means to provide a change in

the energy output for a load of a given power level. This is accomplished through a relatively inexpensive and simple mechanism. This mechanism is the same mechanism that serves to return the piston to its firing position. In addition, the above-described tool incorporates a piston return member which is so constructed to facilitate easy withdrawal of the piston. Further, the shape of the bottom portion of the barrel and piston return member is so configured that the piston return member will be cammed out of the path of the piston when the tool is in the firing position.

Although reference has been made above to several embodiments of this invention, it will be obvious that other modifications and alterations will readily suggest themselves to those skilled in the art. Accordingly, the scope of this invention should be ascertained from the following claims.

I claim:

1. In a power-actuated tool, housing means, barrel means telescopically received within said housing means for forward and rearward movement, a cartridge receiving chamber communicating with the interior of said barrel means, said barrel means having an axially extending slot, piston means positioned within said barrel means for movement between a driving position adjacent said cartridge receiving chamber and a driven position, said piston means including a head portion and a reduced shank portion and piston return and power adjustment means for returning said piston means to its driving position, said piston return and power adjustment means including a pawl member having a first portion normally extending through said slot into the interior of said barrel member at a point forward of said head portion and a second portion positioned to be engaged by the barrel member to limit forward movement thereof, one of said portions having at least one offset portion with respect to the other moveable into operable position for varying the point to which the piston is returned.

2. The power-actuated tool of claim 1 wherein said piston return and power adjustment means further includes means for urging said pawl member inwardly into a position wherein said first portion extends into said barrel member.

3. The power-actuated tool of claim 2 wherein said pawl member includes oppositely disposed shoulders normally in contact with said barrel member for limiting the inward movement of said pawl member.

4. The power-actuated tool of claim 1 wherein said pawl member includes opposed planar surfaces spaced apart a distance not greater than the width of said slot and said first portion includes an offset portion, the bottom surface of said offset portion being substantially perpendicular to said planar surfaces.

5. The power-actuated tool of claim 1 further including a pawl housing attached to said housing, said pawl member including rod portion having its free end extending away from said housing and protruding through said pawl housing, and a control knob connected to said free end.

6. The power-actuated tool of claim 1 wherein said piston return and power adjustment means further includes a pawl housing attached to said housing, said pawl member being mounted for telescopic movement within said pawl housing, said pawl member having a rod portion with the free end thereof extending away from said housing and protruding through the outer end of said pawl housing, said pawl member including a pair of oppositely disposed shoulders normally in contact with the outer surface of said barrel member, spring means interposed between said pawl member and said housing for urging said shoulders into engagement with said barrel member, said pawl member including opposed planar surfaces, one extending upwardly from one of said shoulders, said planar surfaces being spaced apart a distance not greater than the width of said slot, said first portion including an offset portion having a bottom surface extending substantially perpendicular to said planar surfaces, and a control knob attached to the free end of said rod portion.

7. In a power-actuated tool, housing means, barrel means telescopically received within said housing means for movement between a forward breech open position and a rearward breech closed position, a cartridge receiving chamber communicating with said barrel means, fastener driving means positioned within said barrel means for movement between a driving position adjacent a said cartridge receiving chamber and a driven position, first means for limiting the forward movement of said barrel relative to said housing, second means for engaging said fastener driving means to hold said fastener driving means stationary with respect to said housing upon forward movement of said barrel means to return said fastener driving means to its firing position, one of said first or second means having at least two surfaces thereon offset with respect to each other, said means having said two surfaces being adjustable to present one of said surfaces for engagement by said barrel or said fastener driving means to vary the relative distance of movement between the barrel means and the fastener driving means as the barrel means is moved into its breech open position to vary the position of said fastener driving means with respect to said cartridge receiving chamber.

8. In a power-actuated tool, housing means, barrel means telescopically received within said housing means for movement in opposite directions, a cartridge receiving chamber at one end of said barrel means, piston means positioned in said barrel means for movement between a driving position and a driven position, piston return and power adjustment means for engaging said piston upon the movement of said barrel means in one direction to return said piston to its driving position and for limiting the movement of said barrel means in said one direction, and at least two offset surfaces on said piston return and power adjustment means for varying the amount of return of said piston to a predetermined position in relation to said cartridge chamber.

9. For use in a power-actuated tool of the type including housing means, barrel means having a slot therein and telescopically received within said housing means for forward and rearward movement, cartridge receiving means communicating with the interior of said barrel means, and fastener driving means mounted in said barrel means for movement between a driving position and a firing position, piston return and power adjustment means including a pawl housing attached to said housing means and having an open end, a pawl member telescopically mounted within said pawl housing and having a first portion extending into said barrel means and a second portion positioned within said groove, means for urging said pawl member toward said barrel means, one of said first or second portions having a surface offset with respect to the other of said portions.

10. The piston return and power adjustment means of claim 9 wherein said pawl member has a rod member attached thereto, the free end of said rod member protruding through said housing, and a control knob attached to said free end.