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Lindsay

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(54) **HAND-HELD PNEUMATIC IMPACT POWER TOOL**

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(52) **U.S. Cl.** **173/115**; 173/128; 173/207
(58) **Field of Search** 173/115, 128, 173/206, 207, 14, 15, 16, 17

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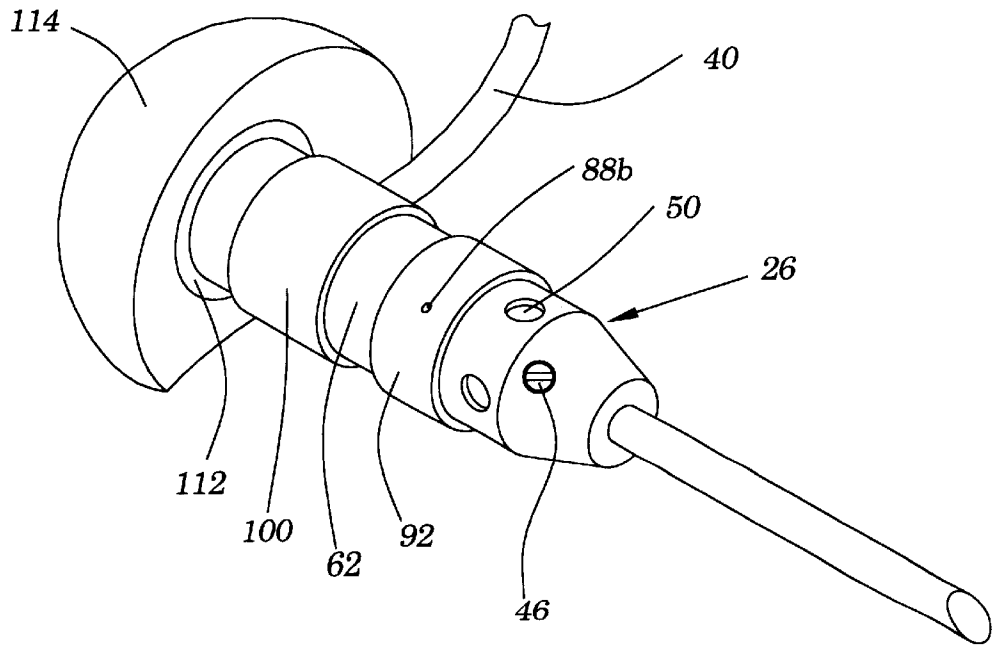
(57) **ABSTRACT**

A hand-held pneumatic impact tool for use in fine hand working operations includes a mechanism for adjusting impacting characteristics of the device that is conveniently located and adjusted by the user. The mechanism includes an annular band protruding around the outside diameter of the body of the impact tool that may be turned for adjusting an annular ring in the bore of the tool and thus altering the distance required for the piston to reach impact collision with the anvil. The impact tool also includes a handle containing a receiving-recess and a handle-attachment unit to permit manual removal and installation of the handle. The handle-attachment unit includes more than one protruding member positioned a distance into the receiving-recess, more than one groove on the outside diameter of body and running a distance and in a direction substantially parallel with the central longitudinal axis of the body and then changes direction and rotates around the central longitudinal axis of the body a distance.

8 Claims, 5 Drawing Sheets



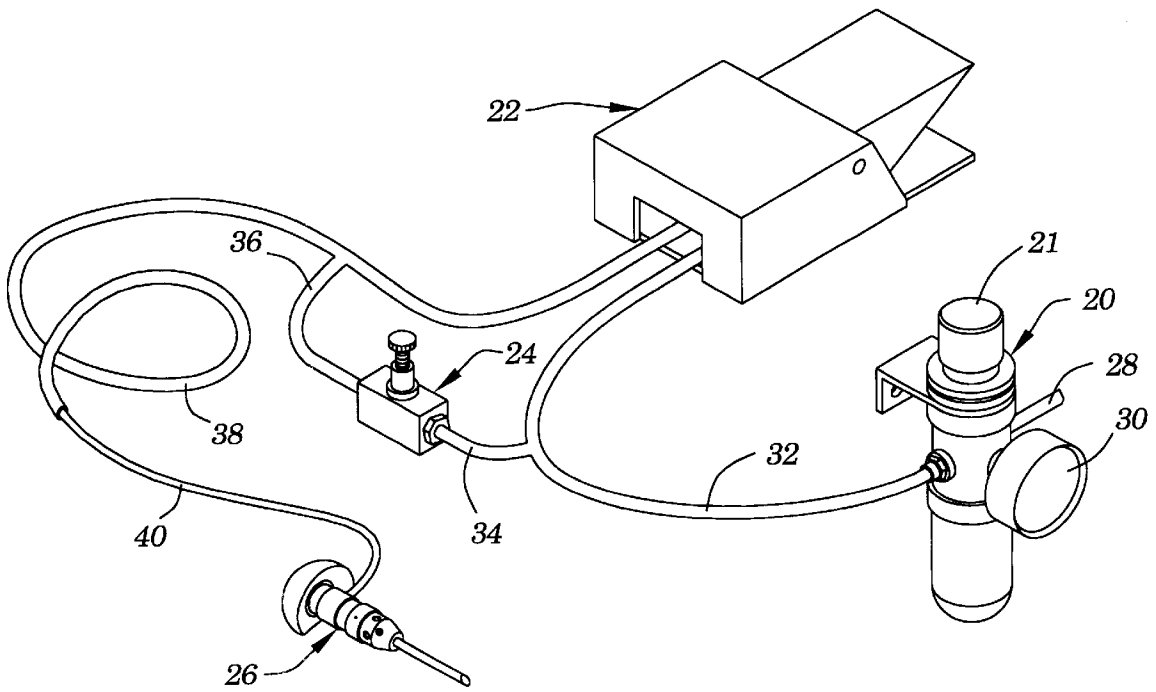


FIG. 1

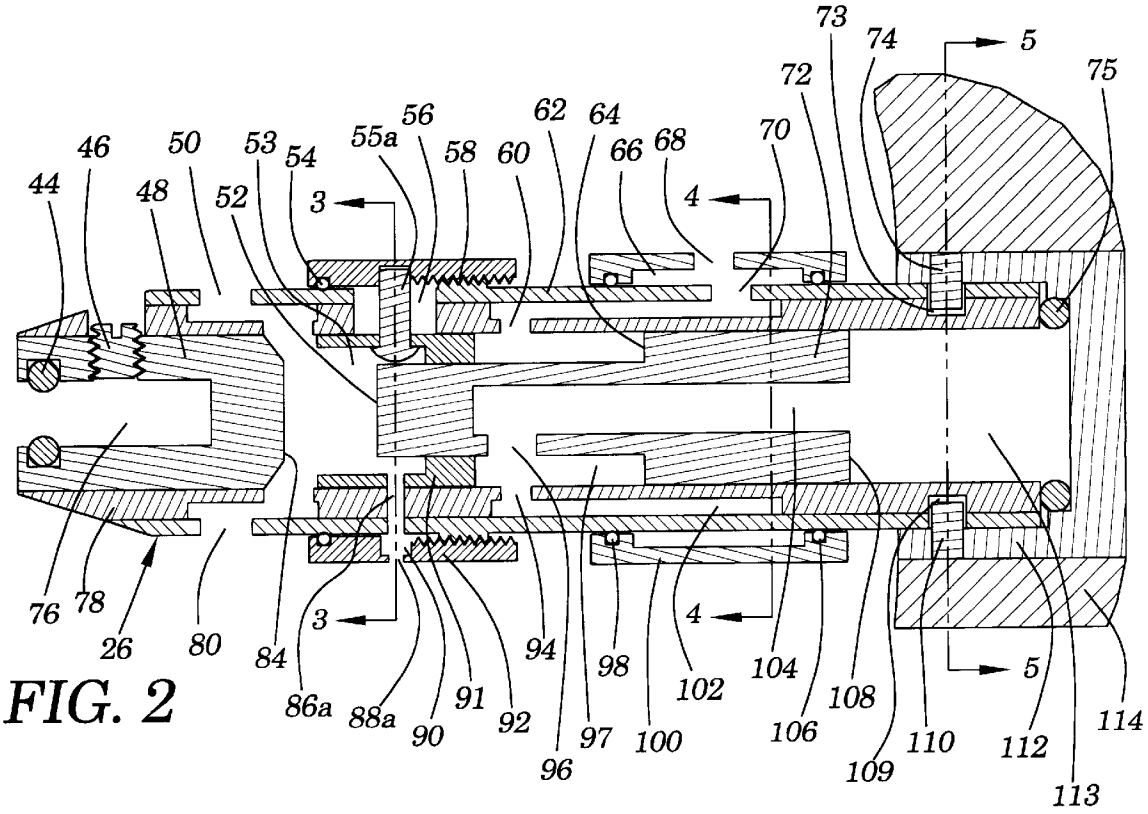


FIG. 2

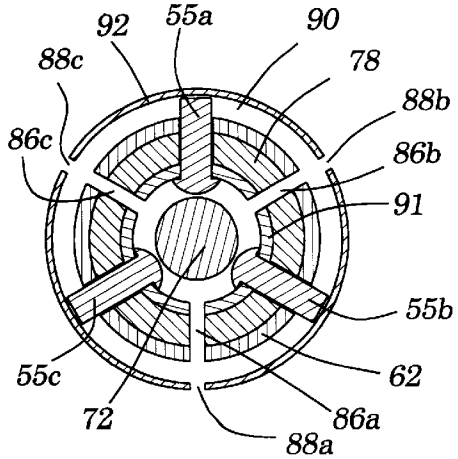


FIG. 3

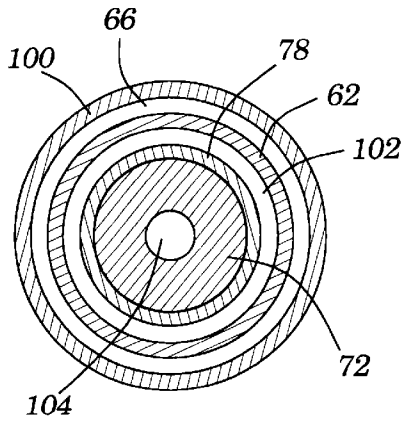


FIG. 4

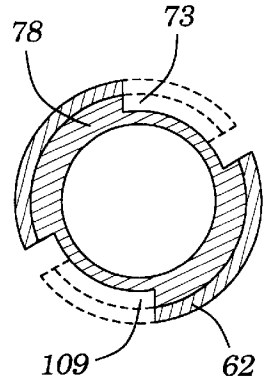


FIG. 5

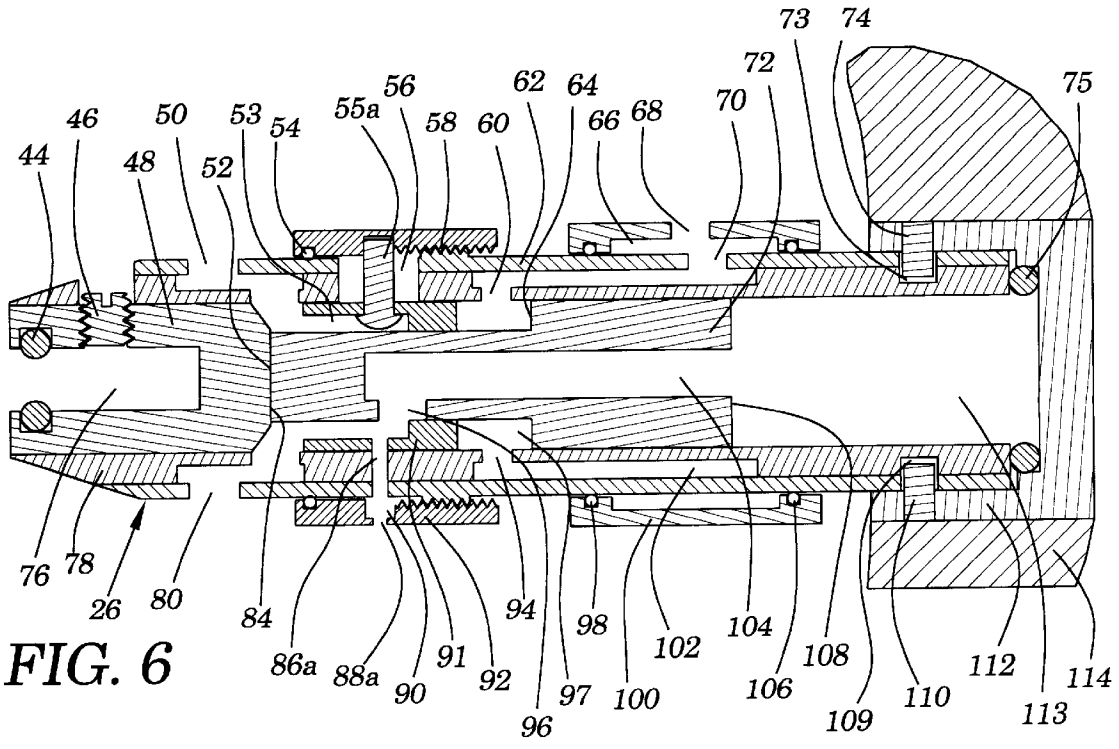

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FIG. 6

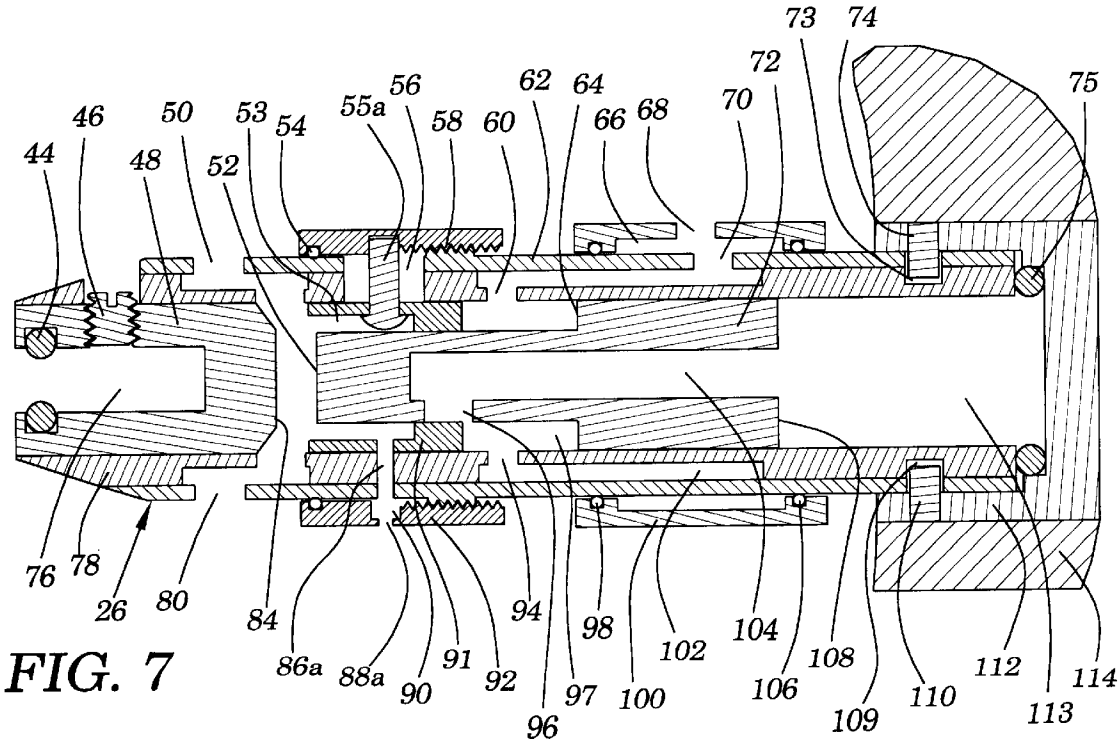
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FIG. 7

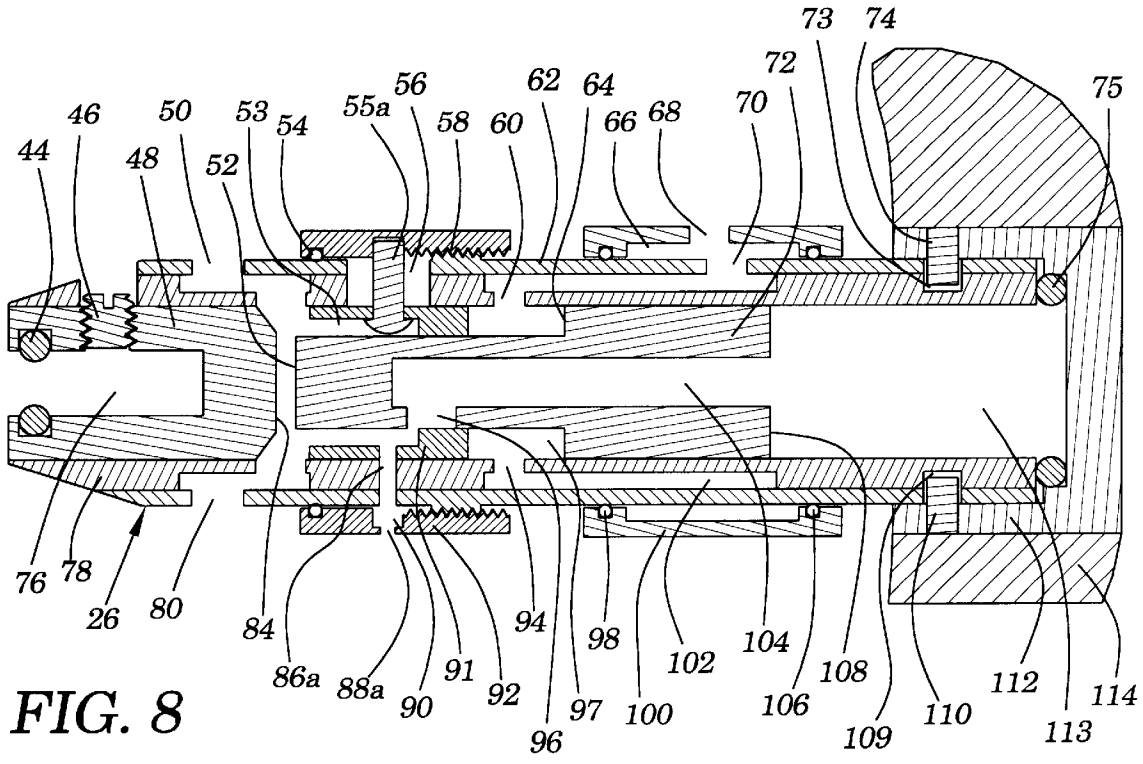
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FIG. 8

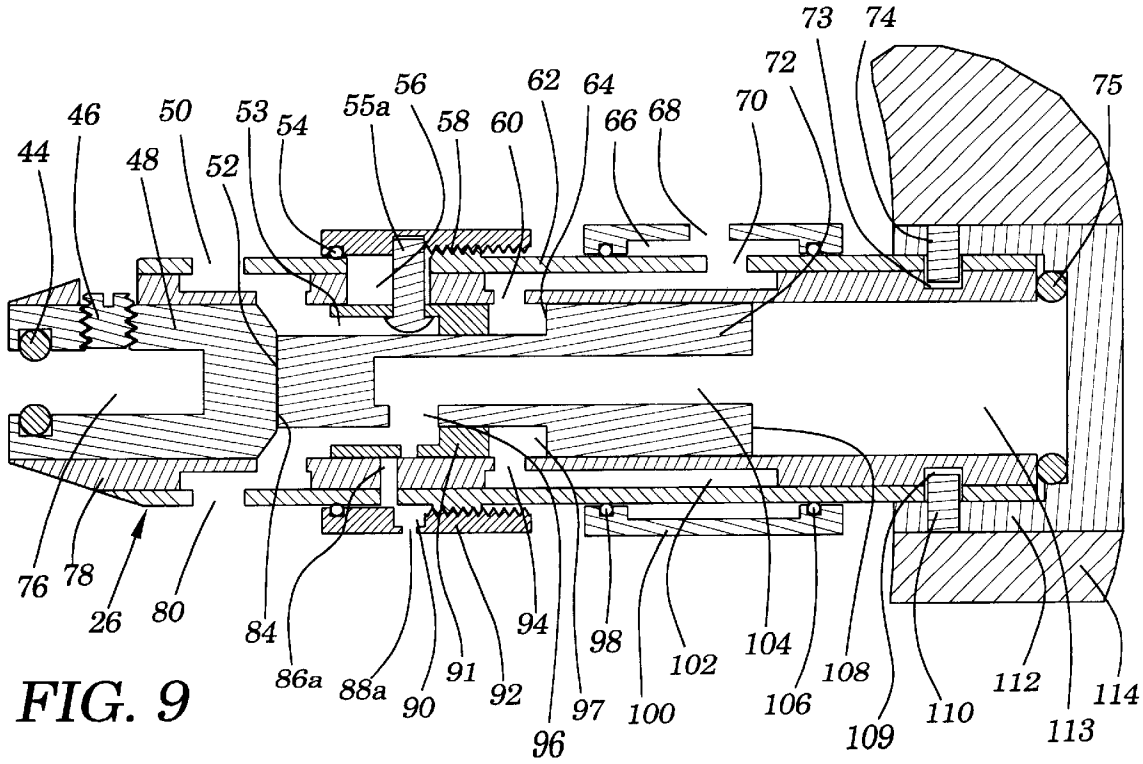
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FIG. 9

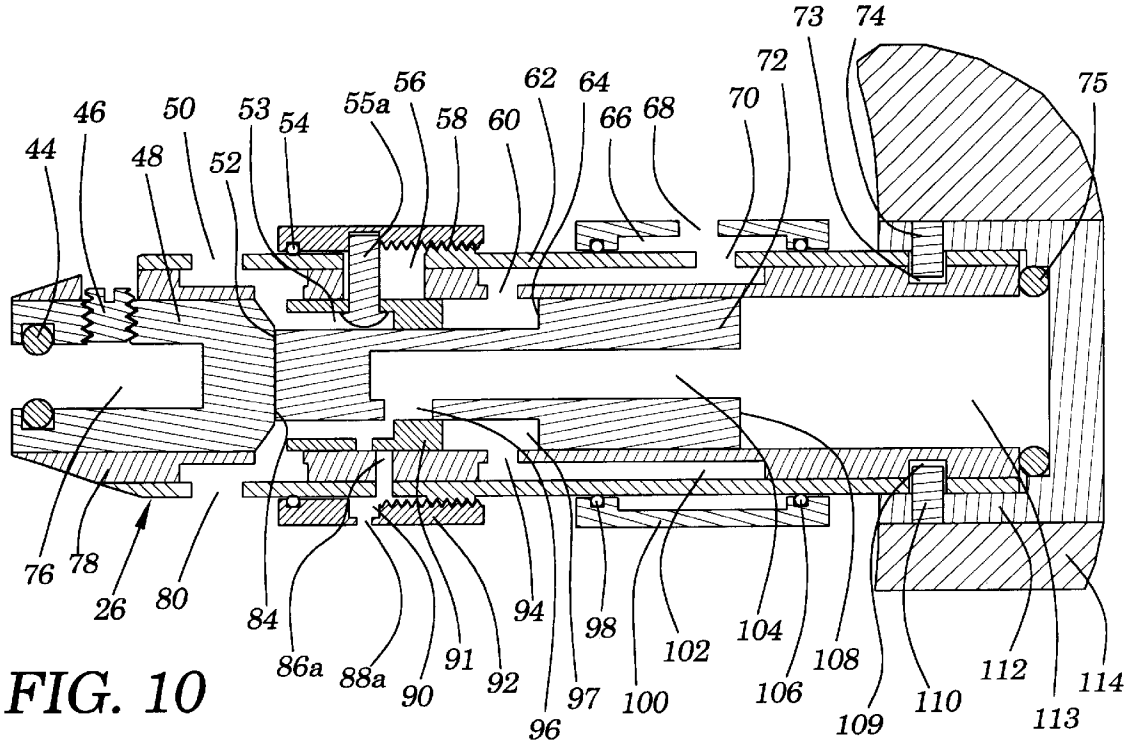
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FIG. 10

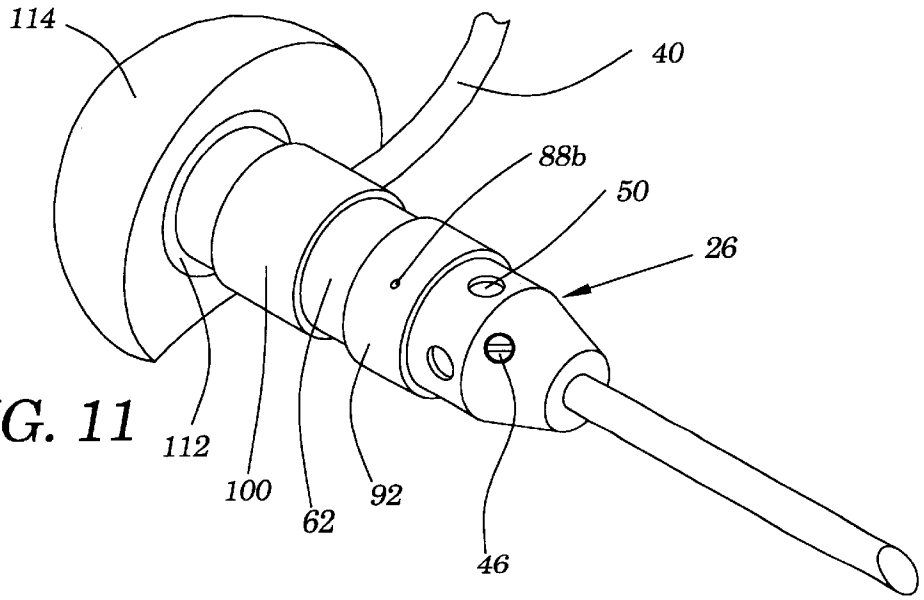
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FIG. 11

HAND-HELD PNEUMATIC IMPACT POWER TOOL

BACKGROUND OF THE INVENTION—Field of Invention

The present invention relates to impact power tools and, more particularly, to an improved hand-held pneumatic impact power tool for delicate hand engraving and stone setting in the hand engraving and jewelry fields.

BACKGROUND OF THE INVENTION—Description of Prior Art

An impact power tool is known from my earlier U.S. Pat. No. 6,095,256, to Lindsay, which may be used for engraving, carving and delicate stone setting operations. A type of device described in my earlier patent is incorporated herein by reference in order to help with the need for further discussion of the types of devices with which the present invention may be employed.

Although the known impact power tool mentioned above provides improved control of delicate hand-working operations not previously available, it would be desirable to provide a impact power tool with additional features to provide greater ease of use. A known embodiment disclosed in my earlier U.S. Pat. No. 6,095,256, to Lindsay, uses a unique feature to adjust the impacting characteristics of the tool. This feature is very beneficial to users, although to modify this impacting adjustment takes valuable time from the jeweler or engraver, as two setscrews need to be loosened before the user can begin to adjust.

Another embodiment disclosed in U.S. Pat. No. 6,095,256, to Lindsay is the a feature that gives more than one placement (chosen by the user) for tubing attachment to the impact power tool. This tubing placement feature uses small plugs to plug holes that are not in use. These small plugs can be easily lost and it takes time to move the tubing attachment to the desired position.

Another feature that needs improvement is how the handles are held on bodies of power tools such as these. The handles must have an airtight seal and yet they must be easily removed for the jeweler and engraver to facilitate cleaning the bore and piston and/or to change to a different weighted piston.

Further, as is addressed in U.S. Pat. No. 5,203,417, to Glaser a power tool that permits users to easily replace the tip of the tool with an alternate tip without having to tighten and loosen a threaded connection or setscrew can speed the work for jewelers or engravers and presents an advantage. The disadvantage of the system disclosed in U.S. Pat. No. 5,203,417, to Glaser is that users are required to fasten all tool tips into a specially designed tool carrier block that is then placed into a mating recess in the power tool. With this system, the user is still required to use a threaded setscrew to fasten the tip into the tool carrier block taking more time than desired.

OBJECTS AND SUMMARY OF THE INVENTION

In accordance with the present invention, a handheld impact power tool that overcomes the problems discussed above and which provides a convenient and unique mechanism for users to adjust length and speed of stroke quickly. The unique mechanism includes an annular band protruding around the outside diameter of the body of the impact power tool that may be turned for adjusting an annular ring in the bore of the impact power tool and thus altering the porting and the impacting characteristics of the impacting piston.

In accordance with the present invention, a handheld impact power tool that provides a feature for attaching air supply tubing to the power tool that may be moved around freely on the outside body of the power tool. The attachment feature includes an annular band around the outside diameter of the body of the power tool that attaches the air supply tubing. This annular band may be rotated and slid along the axis of the body to a position favored by the user.

Further, in accordance with the present invention, a handheld impact power tool that provides a handle that may be manually pushed on and turned to lock. The feature includes more than one pin fixed into the female receptacle handle. These pins are radial aligned and protruding a short distance into the inside diameter of the female receptacle. Included on the outside diameter of the body of the power tool are slots or grooves that permit the pins and handle to slide on and turn and thus tightening against an O-ring between the handle and body, thus sealing and holding the handle onto the body.

Finally, in accordance with the present invention, a handheld impact power tool that provides a simple and convenient construction method that permits quick interchangeability of tool tips. The method includes an o-ring made of a resilient material located inside of the tool holding recess for a friction fit to tool tips. The method also includes a setscrew that is friction fit so as not to vibrate within its mating threads. The screw is perpendicular to the axis of the tool holding hole and is used to index square shank tool tips that are commonly used in the jewelry and engraving fields. The screw is left slightly loosened from the shanks of the tool tips so that tool tips may be removed and replaced quickly. This setscrew may also be used to tighten a round shank tool tip permitting a secure attachment.

BRIEF DESCRIPTION OF THE DRAWINGS

Embodiments of the present invention are described below with reference to attached drawing figures, wherein:

FIG. **1** is a perspective view of a hand-held impact power tool system constructed in accordance with the present invention;

FIG. **2** is a sectional view of a hand-held impact power tool constructed in accordance with the present invention;

FIG. **3** is a sectional view taken along **3**—**3** of FIG. **2**;

FIG. **4** is a sectional view taken along **4**—**4** of FIG. **2**;

FIG. **5** is a sectional view taken along **5**—**5** of FIG. **2**, but with the handle and end cap removed;

FIG. **6** is the same view as FIG. **2**, differing in that the piston is occupying the extreme forward position;

FIG. **7** is the same view as FIG. **2**, differing in that the piston is occupying a slight rearward position;

FIG. **8** is the same view as FIG. **2**, differing in that the piston is occupying a slight forward position;

FIG. **9** is the same view as FIG. **2**, differing in that the length of stroke annular barrel is adjusted to the longest stroke and the piston is occupying the extreme forward position;

FIG. **10** is the same view as FIG. **2**, differing in that the length of stroke annular barrel is adjusted to the shortest stroke and the piston is occupying the extreme forward position;

FIG. **11** is an elevated, isometric view of a handpiece of a hand hand-held impact power tool in accordance with the present invention.

DETAILED DESCRIPTION OF THE PREFERRED EMBODIMENT

A hand-held pneumatic impact power tool system in accordance with the present invention is illustrated in FIG. **1**. The apparatus includes an air supply line **28**, a hand operated pressure regulator assembly **20**, a foot-operated flow control valve assembly **22**, a distribution line **32** extending between the hand operated pressure regulator assembly **20** and the foot-operated flow control valve assembly **22**, an impact handpiece **26**, a delivery line **38** and reduced diameter delivery line **40** extending between the foot-operated flow control valve assembly and the handpiece, and a hand-operated flow control needle valve **24** spliced between the distribution line **32** and delivery line **38** via lines **34** and **36**.

The air supply line **28** connects the pressure regulator assembly **20** to a source of pressurized air, such as a conventional air compressor. The pressure regulator assembly **20** includes an inlet connected to the supply line **28**, an outlet connected to the distribution line **32**, and a valve for regulating air flow between the inlet and the outlet. In addition, the pressure regulator assembly **20** includes a pressure-sensing element for sensing the pressure of the air distributed from the regulator and for controlling the regulator to limit the pressure of the distributed air. A hand-operated knob **21** is connected to the pressure regulator assembly **20** for adjusting the regulated pressure distributed by the regulator. A gauge **30** is provided on the regulator to monitor the pressure being distributed.

An impact handpiece **26**, is illustrated in FIG. **2** in accordance with the present invention and includes a body shell **62** that is fixed over the outside diameter of a body **78** that includes an outside diameter and internal cavity. An anvil **48** is fixed in position within the impact end of the internal cavity of the body **78**. An annular ring **91** is contained within the internal cavity of the body **78** that can move axially with a free sliding fit within the internal cavity. The internal cavity also accommodates a two-step piston **72** that can move axially within the internal cavity. An adjustable tubing attachment ring **100** is fit with two o-rings **98** and **106** that give an airtight, yet sliding axially and rotary fit around the body shell **62**. The tubing attachment ring **100** is provided with an airline intake port **68**. A recess **66** is provided in the inside diameter of the tubing attachment ring **100**. A body shell intake port **70** is provided in communication with the recess **66**. An air-in recess **102** is provided on the outside diameter of the body **78** that is in communication with bore intake ports **60** and **94**. Air-in recess **102** on the body **78** and recess **66** in the adjustable tubing attachment ring **100** may be viewed in the sectional view in FIG. **4**. Referring back to FIG. **2**, a length of stroke barrel **92** and body shell **62** are provided with mating threads **58** so that the length of stroke barrel **92** may move along its axis as it is manually rotated around the body shell **62**. An o-ring **52** is provided between these parts to provide some friction so that the length of stroke barrel **92** will not vibrate or rotate accidentally during impacting usage. Referring to FIG. **2** and FIG. **3**., three pins **55***a*, **55***b*, and **55***c* (these could also be screws) have a secure, tight fit in the annular ring **91** and protrudes out from the annular ring into a provided slot **56** for each (only one slot is shown, and that is the slot for pin **55***a*, FIG. **2**). The slots are milled through both the body shell **62** and the body **78**. These three slots are the width of pins **55***a*, **55***b*, and **55***c* so that they provide a sliding fit to the pins. The length of the pins **55***a*, **55***b*, and **55***c* run in a perpendicular direction to the axis of the body and protrude out of body shell **62**. Referring to FIG. **2** and FIG. **3**, three small holes **86***a*, **86***b*, and **86***c* are provided in line axially to and across from pins **55***a*, **55***b*, and **55***c*. These three holes along with three more holes **88***a*, **88***b*, and **88***c* in the length of stroke barrel **92** are used for accessing and installing pins **55***a*, **55***b*, and **55***c*. A pin recess groove **90** (FIG. **2** and FIG. **3**) is provide in the inside diameter of the length of stroke barrel **92**. This groove **90** is the width of pins **55***a*, **55***b*, and **55***c* so it will provide a sliding fit to the pins.

The two-step piston **72** provided in the internal cavity of the body **78** divides the internal cavity into the following three chambers:

- a head chamber **53** defined by the front piston face **52**, an end face **84** of the anvil **48**, and one side of the annular ring **91**. This head chamber constantly communicates with the atmosphere through exhaust ports **50** and **80**;
- a central chamber **97** defined by the piston step end face **64**, the external diameter of the smaller step of the piston, and one side of the annular ring **91**. This central chamber constantly communicates with the compressed air source through intake ports **60** and **94**;
- a rear chamber **113** defined by the rear piston face **108** and an end cap **112**. Depending on the position of the piston relative to the body, this rear chamber periodically communicates with a compressed air source through passage **104**, piston port **96**, and intake ports **60** and **94**, or with the atmosphere through passage **104**, piston port **96**, and exhaust ports **50** and **80**.

A tool tip recess **76** is provided to hold a tool tip in the anvil **48** and by tightening setscrew **46**. Alternately, users may adjust setscrew **46** slightly loose and square shank tool tips that are commonly used in the jewelry and engraving fields my be quickly removed and installed without having to loosen and tighten setscrew **46**. When setscrew **46** is used in this manner it functions as an index to prevent square or round shank tool tips with a flat from rotating. An o-ring **44** being formed of a resilient rubber type material is provided in the anvil in a location as depicted in FIG. **2**. This o-ring **44** provides a snug friction fit to tool tip shanks. It provides a means to hold the toot tip shanks with enough friction to hold them in recess **76**, yet the user can manually remove them easily.

A handle **114** is comfortably shaped to fit into the palm of the hand and to provide bottom clearance as the tool is used over the work. The handle **114** is permanently fixed onto an end cap **112**. The end cap **112** attaches over the body shell **62** with an airtight seal. The attachment method includes pins **74** and **110** that are permanently fixed onto and protruding slightly into the inside diameter of the end cap **112**. Two slots **73** and **109** are provided on the body shell **62** and also slightly into the outside diameter of body **78**. These two slots are the width of pins **74** and **110** providing a sliding fit. These slots run from the handle end of the body shell **62** a distance and then rotate a distance around the diameter. Slots **73** and **109** are illustrated in FIG. **5**. Note: handle **114**, end cap **112**, and pins **110** and **74** have been removed from the illustrated sectional view in FIG. **5**. To attach the handle **114** and end cap **112**, users line up pins **74** and **110** with slots **73** and **109**, the handle is pushed on and turned. End cap **112** is drawn on tightly against o-ring **75** creating an airtight seal.

Operation

The hand-held pneumatic impact power tool operates as follows. Referring to FIG. **2**, when compressed air is introduced to the airline intake port **68** and piston **72** is in a position illustrated in FIG. **2**, compressed air will fill the central chamber **97** via bore intake ports **60** and **94** and also the rear chamber **113** via piston port **96** and passage **104**. The

air pressure in the central chamber will attempt to push the piston further to the rear of the internal cavity by pressing against the piston step end face **64**, but the air pressure in the rear chamber **113** will attempt to push the piston in the opposite direction toward the front of the cavity by pressing against the rear piston face **108**. Because the surface area of the rear piston face **108** is greater than the surface area of piston step end face **64**, the piston will shift toward the front of the cavity until the front piston face **52** collides with end face **84** of the anvil **48**, thus delivering an impact. While the piston was traveling toward the end face **84** of the anvil **48**, piston port **96** for a short time was aligned with annular ring **91** and the compressed air from the central chamber was then shut off to piston port **96** and thus to the rear chamber **113**. With continuing movement of the piston toward the end face **84** of the anvil **48**, piston port **96** became in communication with head chamber **53** permitting the air pressure that was built up in the rear chamber **113** to be released into the atmosphere through passage **104** in the piston, to the head chamber **53**, and finally out exhaust ports **50** and **80**. With the piston in this front most position now illustrated in FIG. **6** and the air pressure released out of the rear chamber **113**, the air pressure in the central chamber **97** pressing against the piston step end face **64** and together with an impacting recoil will shift the piston back to the rearward position illustrated in FIG. **2**. With the piston in this rearward position, piston port **96** is now back in communication with central chamber **68** and air pressure from bore intake ports **60** and **94**. The air pressure will again build in rear chamber **113** through passage **104** and the process is repeated, thus oscillating the piston.

Illustrations FIG. **7** and FIG. **8** depict the idling ready-state of the impact handpiece. This idling state is similar to what is described above except the piston oscillates with a very short movement stroke and without the front piston face **52** colliding or impacting with the end face **84** of the anvil **48**. This idling state can be achieved with very short movement strokes because piston port **96** is the same width as the annular ring **91**. With this configuration the piston port **96** can move a very short distance to either side from alignment with the annular ring **91** for receiving and exhausting sufficient air pressure to oscillate the piston. The air pressure and airflow required for this idling oscillation are very low. FIG. **8** depicts the idling state with the piston shifted to the front position and the piston port **96** in communication with head chamber **53**. FIG. **7** illustrates the idling state with the piston shifted to the rear position and piston port **96** in communication with central chamber **97**.

Referring to FIG. **1**, the hand operated pressure regulator assembly **20**, the foot-operated flow control valve assembly **22**, and the hand operated flow control needle valve **24** operate together supplying the needed airflow to the handpiece as follows. With an air compressor or the like supplying air pressure through the supply line **28**, the hand-operated pressure regulator **20** is adjusted to the desired pressure by turning knob **21** and viewing pressure gauge **30**. The hand-operated flow control needle valve **24** is adjusted to permit a fine flow of air between the distribution line **32** and delivery line **38** and the reduced diameter delivery line **40** and finally to the handpiece **26**. This will permit the piston to begin oscillating in an idling state within the handpiece. The hand-operated flow control needle valve **24** is adjusted so that the idling is faint with slight piston oscillation. The idling impact handpiece is now ready for impact operation. The user places the idling impact tool's graver or tool tip onto the work and slowly depresses the foot pedal of the foot-operated flow control valve assembly **22**. The piston in the handpiece will begin delivering light impacts. As the user continues to depress the foot pedal, thus increasing air pressure to the handpiece, the piston will deliver harder and harder impacts. When the user has finished an engraving or stone setting operation he or she lets up on the foot pedal and the impact tool will return to the idling oscillation ready-state.

Illustrations FIG. **9** and FIG. **10** depict how the impacting characteristics of the handpiece can be altered by the jeweler or engraver by adjusting the length of stroke barrel **92**. In FIG. **9** the length of stroke barrel **92** has been turned on threads **58** moving the barrel toward the handle **114** end of the handpiece. Referring to FIG. **3**, because pins **55***a*, **55***b*, and **55***c*, are securely attached to annular ring **91** and because these pins are protruding into pin recess groove **90** in the length of stroke barrel **92**, the annular ring will therefore move longitudinally within the internal cavity of body **78** together with the length of stroke barrel **92**. Referring to FIG. **9**, by adjusting the annular ring **91** along its axis within the handpiece by this mechanism it is possible to adjust the speed of the piston impacts and the length of strokes, which will affect the impact power range of the handpiece without air flow or pressure to do so. The location of annular ring **91** within the bore determines the central location where piston **72** oscillates. When piston port **97** is either side of alignment with annular ring **91** piston **72** will begin to receive energy to shift directions from the direction it is traveling during the oscillation cycle even though piston **72** will continue to travel in its original direction for a time through inertia. Depending on the air pressure delivered to the tool through the foot-operated flow control valve assembly, the travel distance of the piston (equal on either side of annular ring **92**) will be determined. By placing an obstacle (anvil **48**) a distance away and within reach of the oscillating piston (determined by the air pressure delivered to the handpiece) the travel distance of the piston on one side of annular ring is interrupted with an early termination of continued movement providing an impact collision between the piston and anvil. Adjusting length of stroke barrel **92**, and thus annular ring **91** rearward (towards handle **114**) the central location of the oscillating piston is moved further away from anvil **48**. In this position the piston will require more air pressure delivered by the person operating the foot-operated flow control valve in order for the piston to gain enough inertia to begin to reach and collide into end face **84** of the anvil **48**. After impact the piston will rebound or bounce to some degree from the collision. This bounce energy together with the return stroke pneumatic energy helps in the return stroke. Referring to FIG. **10**, when length of stroke barrel **92** is adjusted in the opposite direction than just described so that annular ring **91** is moved forward (away from handle **114**) and having piston **72** in its front most position (i.e. making an impact) the air pressure and flow delivered from the foot-operated flow control valve will not need to be as great to allow the piston to deliver an impact against the anvil. This is because moving annular ring **91** (which is the central location of where piston **72** oscillates) to a closer distance to end face **84** of anvil **48** the inertia required for piston **72** to travel either side of annular ring **91** is less. With less inertia the impacts will be much lighter in force.

When the airflow is increased through the foot control (by depressing the foot control pedal) with the tool adjusted to either a short or long stroke setting the impact frequency as well as piston inertia will increase, thus delivering faster impact cycle times as well as an increase in impacting power within the range of the length of stroke setting. The foot

control is used to control and meter air pressure/flow to the tool. This air pressure/flow will affect the piston oscillation within the scope of where the length of stroke adjustment is set. Adjusting the length of stroke setting to one location and fully depressing the foot control to a certain P.S.I. level will give a range of impacting speed and power. Adjusting the length of stroke setting to another location and fully depressing the foot control to the same P.S.I. level will give a different range of impacting speed and power. Physically moving the distance required for the piston to travel in order for it to collide with the anvil, increases the stroke length of the piston as well as the inertia of the piston because it has more time to gain a greater velocity before impact. Being able to adjust the annular ring **91** by simply turning length of stroke barrel **92** and thus altering the speed of impact and power ratio over all P.S.I levels provides a great benefit to the user. Jewelers and engravers can easily and quickly adjust this feature to their work requirements.

Referring to FIG. **10** and FIG. **11**, airline intake port **68** in attachment ring **100** is where reduced diameter delivery line **40** attaches. Attachment ring **100** may be rotated about and slid longitudinally along the axis of body shell **62** on an airtight seal of two o-rings **98** and **106**, giving the user a great amount of adjustment possibilities for positioning the delivery line. In the isometric view in FIG. **11** the attachment ring **100** is depicted as rotated to one side.

Conclusion, Ramifications, and Scope

Accordingly, the reader will see that the hand-held pneumatic impact tool provides superb control and features for helping the jeweler or engraver carry out his work more easily and quickly. Furthermore, the invention has additional advantages in that:

- it provides an easily adjusted mechanism for users to adjust the length of piston stroke and impact speed of a hand-held impact power tool. The mechanism provides an annular band protruding around the outside diameter of the body of the power tool that may be turned for adjusting an annular ring in the bore of the power tool and thus altering the porting and the impacting characteristics of the impacting piston;
- it provides a feature for attaching air supply tubing to the power tool that may be moved around freely on the outside body of the power tool. The attachment feature provides an annular band around the outside diameter of the body of the power tool that attaches the air supply tubing. This annular band may be rotated or slid along the axis of the body to a position favored by the user;
- it provides a handle that may be manually pushed on and turned to lock. The feature provides more than one pin fixed into the female receptacle handle. These pins are radial aligned and protruding a short distance into the inside diameter of the female receptacle. Provided on the outside diameter of the body of the power tool are slots or grooves that permit the pins and handle to slide on and turn and thus tightening against an O-ring between the handle and body, thus sealing and holding the handle onto the body; and
- it provides a method that permits quick interchangeability of tool tips. The method provides a resilient o-ring material located inside of the tool holding recess for a friction fit to tool tips. The method also includes a setscrew that is perpendicular to the axis of the tool holding hole and is used to index square shank tool tips that are commonly used in the jewelry and engraving fields. The screw is left slightly loosened from the shanks of the tool tips so that tool tips may be removed and replaced quickly. This setscrew may also be used to tighten it on the shank permitting a more secure attachment.

Although the invention has been described with reference to the illustrated preferred embodiment, it is noted that equivalents may be employed and substitutions made herein without departing from the scope of the invention as recited in the claims. For example:

- One or more body shell intake ports **70**, bore intake ports **60**, piston ports **96**, pins **55***a*, slots **56**, exhaust ports **50**, setscrews **46**, pins **74**, or slots **73** may be substituted over the number of those illustrated in the preferred embodiment.
- An equivalent may be employed by eliminating the length of stroke barrel **92** and attaching in its place a slide that does not use threads but is used by pushing it longitudinally along the handpiece axis. This slide may be a band totally around the diameter of the body, partially around the body or just a protrusion in one place on the body;
- An equivalent made be used by eliminating length of stroke barrel **92** and in its place providing an element protruding from the body attached to annular ring **91** (similar to pin **55***a*). This protrusion would be used for adjusting the annular ring **91**;
- The foot control valve in FIG. **1** is illustrated with a horizontal pivoting pedal. This foot control may be replaced with any type of foot operated flow control valve;
- The piston pneumatic oscillation principle in the present invention utilizes air pressure for biasing the piston in both the forward impact stroke toward the anvil and in the return stroke away from the anvil may be substituted with a pneumatic oscillation principle that utilizes air pressure for biasing the piston in one direction (either toward or away from the anvil) and a spring for biasing the piston in the opposite direction; and
- The length of stroke adjustment is achieved in the invention by moving the piston's oscillation central location a farther distance or a closer distance to the fixed anvil. An equivalent embodiment may be achieved by moving the anvil closer or farther from the piston's oscillation central location or by moving both simultaneously apart or together.

Accordingly, the scope of the invention should be determined not by the embodiments illustrated, but by the appended claims and their legal equivalents.

I claim:

1. A hand-held pneumatic impact power tool for use in hand working operations for use with a supply of pressurized air, comprising:

a body presenting a bore, the bore having a central longitudinal axis;

a piston received within said bore and being shiftable relative to said body along said central longitudinal axis;

an oscillation means by which said piston will oscillate back and forth a distance along said central longitudinal axis under the action of said supply of pressurized air;

an anvil received within said bore;

an impacting location within said bore located at a position along said central longitudinal axis where said piston and said anvil will collide;

a second location within said bore defined as a location point along said central longitudinal axis where said

piston just begins to receive sufficient energy for shifting directions from the direction it is traveling during the oscillation cycle even though said piston will continue to travel in its original direction for a time from inertia;

an adjustable means for adjusting the distance between said second location and said impacting location; and

a manual means located on a said impact power tool body for the user of the said hand-held pneumatic impact power tool to manually adjust said adjustable means.

2. A hand-held pneumatic impact power tool as recited in claim **1**, wherein said adjustable means is not adjusted by impact collisions between said piston and said anvil.

3. A hand-held pneumatic impact power tool as recited in claim **1**, wherein said adjustable means is not adjusted by metering the air pressure or air flow from said supply of pressurized air.

4. A hand-held pneumatic impact power tool as recited in claim **1**, wherein said manual means is in the form of an annular ring around said body and having a central longitudinal axis extending in a parallel direction with the central longitudinal axis of said body, said adjustable means being rotatable around said body.

5. A hand-held pneumatic impact power tool as recited in claim **1**, further comprising: a foot-operated flow control valve including an inlet port in communication with said supply of pressurized air and an outlet port, said foot-operated flow control valve is movable between an off position in which the air flow is zero and a number of on positions in which the air flow ranges from zero to the pressure of said supply of pressurized air.

6. A hand-held pneumatic impact power tool as recited in claim **5**, further comprising: a second flow control valve in communication with said supply of pressurized air and said body.

7. A hand-held pneumatic impact power tool for use in hand working operations for use with a supply of pressurized air, comprising:

a body presenting a bore and having first and second ends, the bore having a central longitudinal axis;

a piston received within said bore and being shiftable relative to the body along said central longitudinal axis;

an oscillation means by which said piston will oscillate under the action of said supply of pressurized air;

a handle containing a receiving-recess extending in a direction parallel with the central longitudinal axis of said bore; and

a handle-attachment means to permit manual removal and installing of said handle, said handle-attachment means includes more than one protruding member positioned a distance into said receiving-recess, said handle-attachment means includes more than one groove on the outside diameter of said second end and running from said second end for a distance and then changes direction and rotates around the central longitudinal axis of said body a distance.

8. A hand-held pneumatic impact power tool for use in hand working operations for use with a supply of pressurized air, comprising:

a body presenting a bore and having first and second ends, the bore having a central longitudinal axis;

a piston received within said bore and being shiftable relative to the body along said central longitudinal axis;

an oscillation means by which said piston will oscillate under the action of said supply of pressurized air;

a handle containing a receiving-recess extending in a direction parallel with the central longitudinal axis of said bore; and

a handle-attachment means to permit manual removal and installing of said handle, said handle-attachment means includes more than one protruding member positioned on the outside diameter of said second end, said handle-attachment means includes more man one groove on the inside diameter of said receiving-recess and then changes direction and rotates around the central longitudinal axis a distance.

* * * * *

UNITED STATES PATENT AND TRADEMARK OFFICE

CERTIFICATE OF CORRECTION

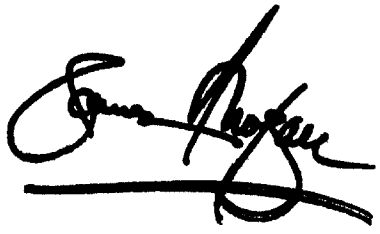
PATENT NO. : 6,488,102 B2
DATED : December 3, 2002
INVENTOR(S) : Steven J. Lindsay

It is certified that error appears in the above-identified patent and that said Letters Patent is hereby corrected as shown below:

Column 9,
Line 8, after "located on" delete the word "a".

Signed and Sealed this

Seventeenth Day of June, 2003



JAMES E. ROGAN
Director of the United States Patent and Trademark Office