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**Clifford et al.**

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[54] **IMPACT TOOLS**


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[52] **U.S. Cl.**.....**227/147,** 227/130

[51] **Int. Cl.**.....**B25c 7/00**

[58] **Field of Search**.....227/129, 130, 140, 147



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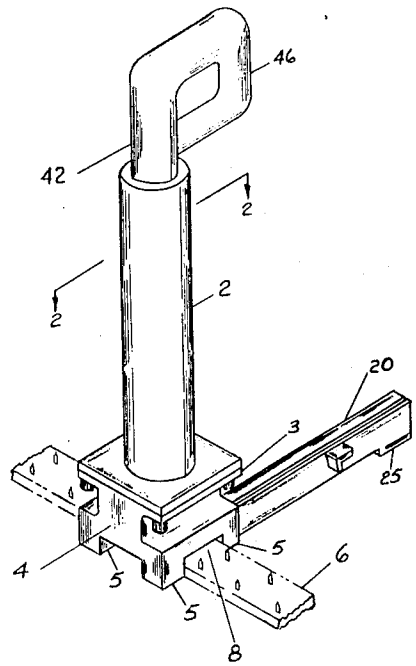
*Attorney*—Donald F. Daley



[57] **ABSTRACT**

Manual and pneumatically operated impact tools for driving fasteners into concrete through the utilization of the kinetic energy of a hammer impacting a driver. The tools are adapted to insure the perpendicularity of the fasteners and to drive the fasteners in close proximity to a wall or vertical surface.


**2 Claims, 6 Drawing Figures**



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SHEET 1 OF 3

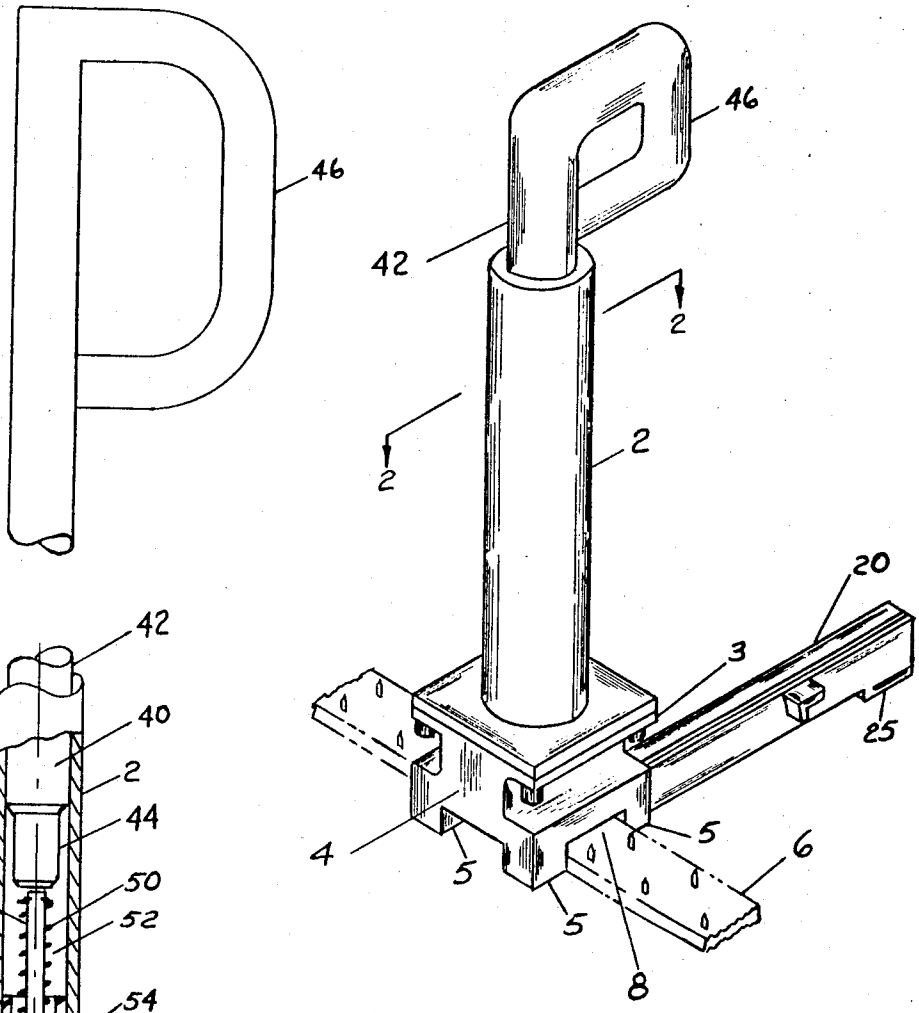



FIG. 1

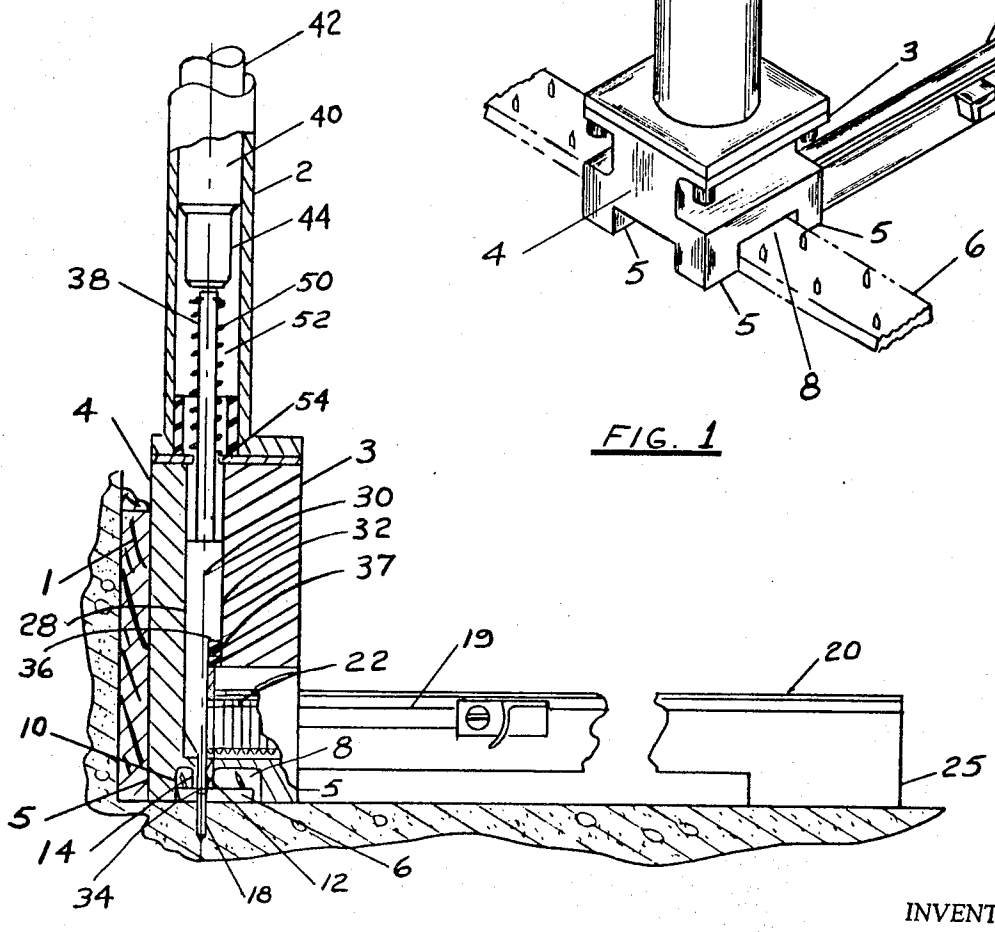



FIG. 2

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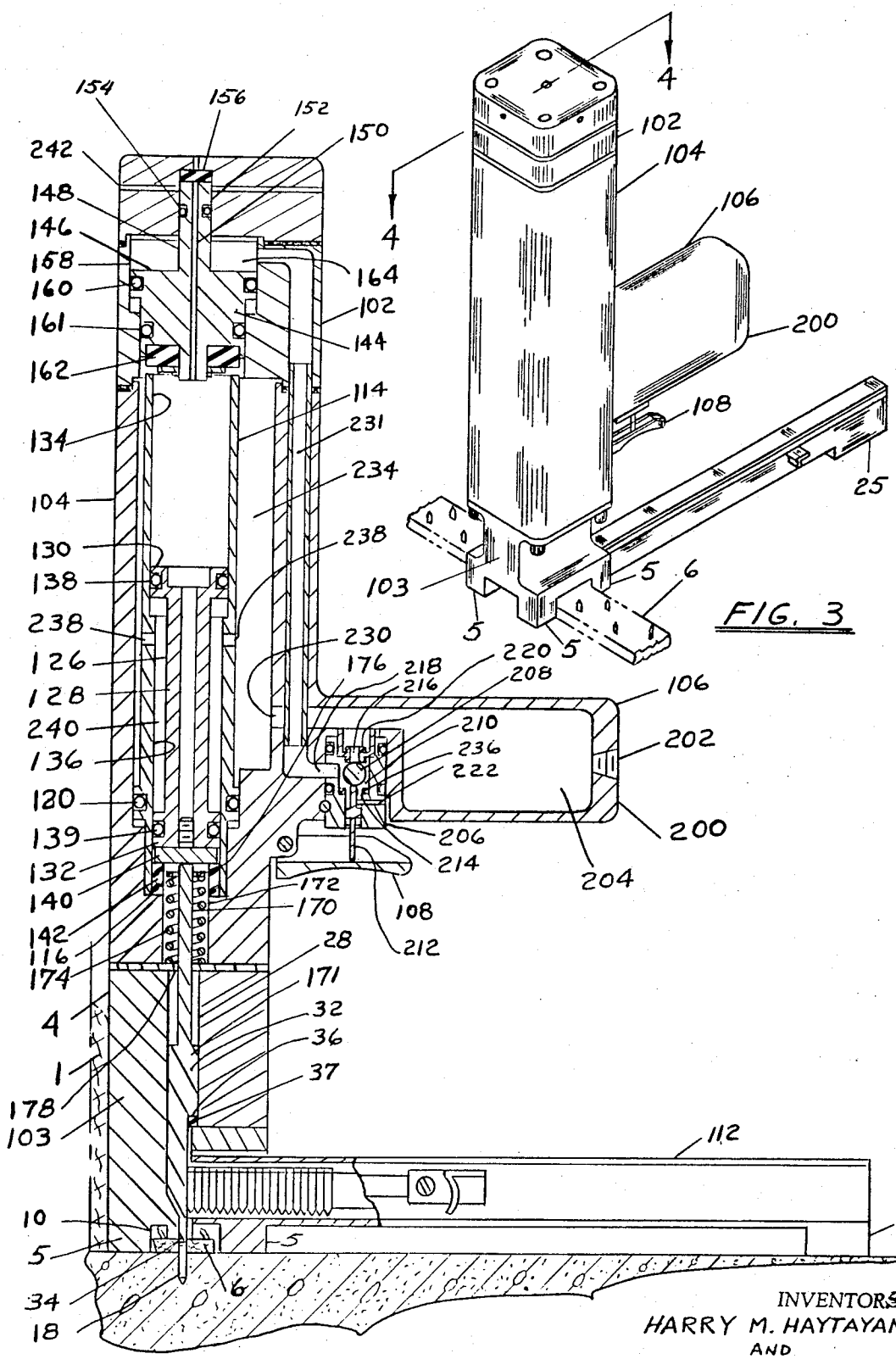



FIG. 3

FIG. 4

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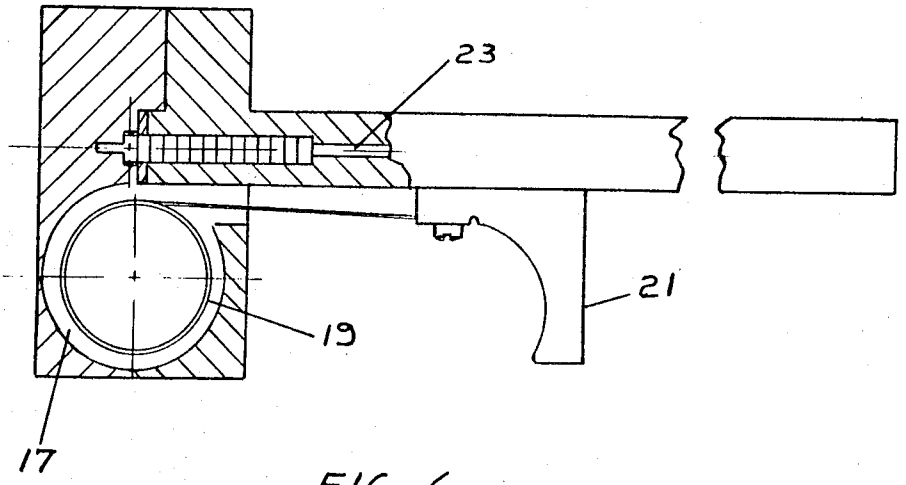



FIG. 6

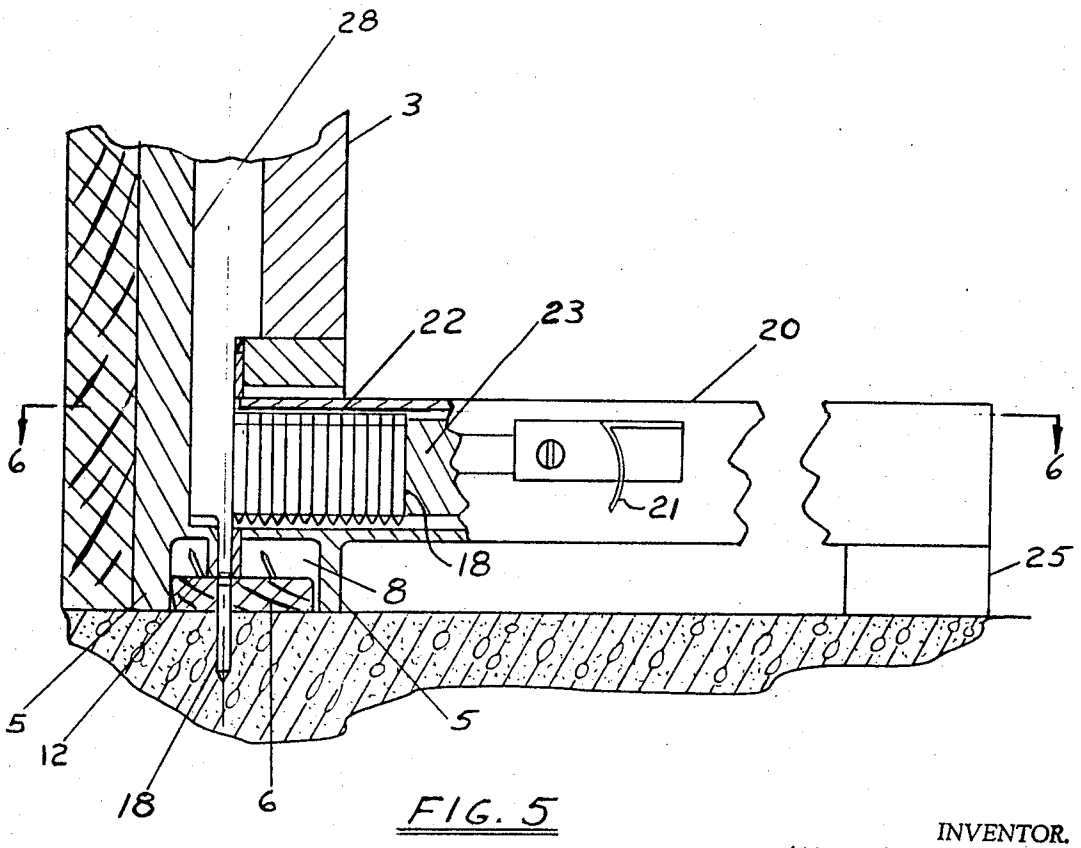



FIG. 5

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# IMPACT TOOLS

## BACKGROUND OF THE INVENTION

The present invention relates generally to impact tools for driving fasteners and the like, and specifically to manually and pneumatically operated impact tools for driving fasteners into concrete or other masonry surfaces.

Though the present invention is specifically intended to drive fasteners into concrete or hard, brittle surfaces, it is usable in driving fasteners into wood or other structural material. Nail or fastener driving devices are well known for applications such as laying hardwood flooring where nails are driven through wood boards into a wood subflooring. The impact tools used for this type of application usually consist of large bulky devices which are not suited for driving nails into concrete or hard, brittle surfaces.

Conventional nailing machines utilize a brute force technique where the piston area is made large enough to generate the necessary force to drive the nail into the woodpiece. The present invention utilizes not only the force generated by the action of the high pressure air on the piston, but it also utilizes the kinetic energy of the piston. This kinetic energy is generated by allowing the piston to pick up velocity before it contacts the driver.

The present invention is particularly adapted for use in the installation of the small wooden strips used to hold wall to wall carpeting to concrete. Wall to wall carpeting is normally held in place by 1'' wide and ¼'' thick strips of wood secured to the flooring near the wall. These strips of wood have small tacks extending upward to grip the carpet and must be mounted very close to the wall or baseboard. Normally they are mounted ¼'' from the wall. The means presently used to install this stripping are explosive guns and manual hammers. The explosive technique is costly because of the cartridge expense and loading time required after every nail insertion. The manual technique is also costly because it requires the services of a skilled operator and is slow because of nailing accuracy requirements and the number of hammer blows required per nail. Skill is required to prevent or minimize damage to the baseboard or wall and chipping of the cement.

In order to use an automatic or manually operated impact device to secure the strip as close to the wall as possible, the impact device must be small in diameter, easily positionable and capable of positioning the strip without damaging the tacks or the wall or the baseboard. It should also be capable of automatically positioning the strip a specific distance from the wall and still drive the nail or fastener perpendicular to the flooring. These aspects are particularly important when the strips are to be secured to concrete flooring, since the nail should be driven with one blow and driven perpendicular to the floor so that the concrete does not chip and the nail does not bend.

It is therefore an object of the present invention to improve impact tools for driving fasteners or the like and to provide an impact tool which is relatively small in diameter and which will drive fasteners or nails into hard, brittle surfaces such as concrete with one sharp blow. It is a further object of this invention to provide an impact tool for use in positioning and fastening



wooden strips to concrete or other surfaces. It is a further object of this invention to provide an automatic impact tool which positions a nail perpendicular to a surface and drives the nail into the surface with one blow.

These and other objects of the invention are attained by means of an impact tool having an automatic nail feeding and positioning device wherein a nail or fastener is positioned in close proximity to an anvil or driver which transmits the driving force from a piston or hammer to the nail. The piston is mounted in a cylinder directly above the driver and movable into contact with the driver to provide the driving force. The movement of the piston is sufficient to produce the kinetic energy necessary to drive the nail into concrete or other hard surface. Means are provided to operate the piston manually or pneumatically.

For a better understanding of the invention as well as other objects and features thereof, reference is had to the following detailed description of the invention to be read in connection with the accompanying drawings, wherein:

FIG. 1 is an isometric view of a manually operated impact tool embodying the present invention.

FIG. 2 is a side view of the impact tool shown in FIG. 1, with portions broken away to internal structure.

FIG. 3 is an isometric view of a pneumatically operated impact tool embodying the present invention.

FIG. 4 is a side sectional view taken along lines 4—4 of FIG. 3.

FIG. 5 is an enlarged view of a portion of FIG. 4.

FIG. 6 is a partial sectional view of the magazine taken along lines 6—6 of FIG. 5.

FIG. 1 of the drawings shows a manually operated impact tool utilizing the present invention. A housing or main body 2 which provides the structural support for the impact mechanism is mounted above the driver housing 3 which includes positioning guides for a workpiece 6. The main body 2 and the driver housing 3 are shaped so that one outer surface 4 will fit flush with a wall or baseboard 1. When the workpiece 6 is wall to wall carpeting attachment strips, the workpiece is accurately positioned from the wall by means of the legs 5 on the bottom of the driver housing 3. The lower end of the driver housing 3 has a channel 8 extending therethrough parallel to the surface 4. The channel 8 is large enough to receive a workpiece 6 and has an edge guide 10 which gauges and positions the workpiece 6 relative to the surface 4.

### Manual Impact Tool

In order to drive a nail or fastener into the workpiece 6 there is shown in FIG. 2 an axially aligned nail slot 12 extending downward through a nail guide member 14. The length of guide member 14 is determined so that it contacts or is in close proximity with the surface through which the nail is to be driven. The length of the nail guide 14 and the depth and width of the channel 8 can be varied for specific specialized applications.

The slot 12 is sized to receive and guide a nail or fastener 18. Nails are fed from a spring-loaded cartridge or magazine 20 through a nail track 22 in the magazine to a positioning station which consists of an opening extending downward through the housing 3 into the slot 12. The slot 12 is rectangular shaped and

the nail 18 has a tee shaped head so that the nail is held in place in the slot by the pressure exerted by nails being urged into the slot from a magazine. The tee shaped head allows passage of the nail through the slot 12 when impacted by a driver 30. The magazine 20 is attached to the housing 3 by appropriate fasteners, and may be of any type which automatically supplies nails to the slot 12 as each nail is driven into the workpiece 6.

Referring to FIG. 6, a cavity 17 in housing 3 contains a spring 19. The spring is attached to the housing 3 by a shoulder screw. A lever 21 is attached to the end of the spring 19 and is also connected to a plunger 23, seen in FIG. 6, that travels in the nail track 22. The plunger contacts the nails 18 in the track 22 and through the action of the spring indexes the nails automatically to the positioning station and slot 12 as each nail is driven into the workpiece 6. The nails may be bonded together for ease of loading. The lever 21 is easily removed from the nail track 22 by drawing the plunger 23 out of the magazine against the action of the spring. The length of the nail guide 14 and the depth and width of the channel 8 can be varied for specific specialized applications.

The driver housing 3 has a lower portion consisting of a workpiece guide channel 8 and four legs 5 forming the channel 8. The legs 5 together with the magazine support leg 25 provide stability and perpendicularity for the entire tool. With the legs 5 and 25 resting on the surface into which a nail is to be driven, the nail will be perpendicular to the surface. The driver housing 3 has a driver guide track 28 extending downward through the housing to the nail slot 12. The guide track is sized and shaped to accommodate sliding movement of a driver 30. The driver 30 has an enlarged body portion 32 which mates with the guide track 28 for vertical sliding movement. The lower end of the driver 30 has a reduced rectangular impact head 34 extending downward into the slot 12. The end of the impact head 34 is positioned slightly above the head of a nail 18 positioned in the slot 12 when the driver is in an elevated position. When the driver is driven downward, the impact head contacts the nail in slot 12, driving it downward into the workpiece 6. Between the enlarged body portion 32 and the impact head 34 of the driver, there is a shoulder 36 positioned to engage a resilient bumper 37 to limit the downward movement of the driver. Above the enlarged body portion of the driver there is a drive head 38 extending upwards into the main housing 2.

The main housing 2 is tubular shaped with the interior of the tube adapted to receive and guide, for sliding movement, a hammer member 40. The hammer 40 consists of a rod shaped main body 42 sized for sliding movement within the upper portion of the housing 2, a hardened impact head 44 extending downward from the main body 42 to impact the drive head 38 of the driver, and a handle 46 secured to the upper portion of the main hammer body 42.

In operation, the impact tool is positioned over a workpiece by gripping the handle 46 and the main housing 2. The workpiece 6 is positioned by abutting the surface 4 of the housings 2 and 3 against a wall or baseboard. Raising the handle 46 elevates the hammer 40 within the tubular main housing 2 allowing a spring 50 in cavity 52 to urge the driver upwards until the enlarged body portion 32 of the driver contacts stop 54. The hammer is raised above the anvil a distance sufficient to permit enough kinetic energy to be developed when the hammer is moved downwards to drive a nail 18 into the workpiece and flooring. With the anvil in the elevated position, a nail 18 is indexed through the track 22 into the slot 12 by the spring 19 of the magazine 20. The hammer 40 is rapidly brought downward by movement of the handle 46 so that the impact head 44 of the hammer contacts the drive head 38 of the driver. The kinetic energy of the hammer is imparted to the driver 30 and the driver is driven downward with drive head 34 in contact with the nail 18 in slot 12. One sharp movement of the hammer is sufficient to drive the nail through the workpiece into concrete or masonry surface.

## Pneumatic Impact Tool

FIGS. 3 and 4 show a pneumatically operated fastener driving tool consisting of an upper housing member 102, a main housing 104, a driver housing 103, an air inlet assembly unit 106 and an actuating trigger 108. The driver housing 103 extends downward terminating in a workpiece positioning member of the same structure as that shown in FIGS. 1 and 2 and described relative to the manual impact tool. A cassette or magazine 112 is attached to the driver housing 103 and automatically provides nails or fasteners into the main housing 104 in the same manner previously described.

Within the main housing 104 there is a cylinder 114 which extends from the upper housing 102 downward to a point in the lower portion of the main housing 104 where it abuts a shoulder 116. The cylinder 114 is pneumatically sealed by an O ring 120 positioned in a slot in the lower portion of the cylinder and bearing against the inner surface of the main housing 104.

Within the cylinder 114 there is a piston 126 adapted for movement throughout the length of the cylinder 114. Piston 126 consists of a main stem 128 which is of smaller diameter than the two ends of the piston 130 and 132. The ends of the piston 130 and 132 are sized for intimate sliding movement within the walls of the cylinder 114. The cylinder 114 has a larger internal diameter 134 in the upper portion of the cylinder and a smaller inner diameter 136 in the lower portion of the cylinder. The ends of the piston 130 and 132 are thus of different diameter with the upper portion of the piston 130 being larger than the lower portion 132. This difference in size between the two ends of the piston provides the differential force necessary to propel the piston upward when the tool is pneumatically energized. The piston 126 is pneumatically sealed within the cylinder 114 by means of a pair of O rings 138 and 139. The lower end of the piston 126 has a hammer or impact head 140 secured on the end thereof. In its lowermost position the impact head 140 rests on a resilient bumper 142 limiting the downward movement of the piston 126.

Referring to the upper housing 102, there is mounted therein an upper piston 144 having a pressure bearing surface 146, a guide stem 148 and a release vent 150 extending through the length of the piston 144. The guidestem 148 is fitted for movement within a bearing surface 152 within the housing 102 and is pneumati-

cally sealed by means of an O ring **154**. Upward movement of the piston **144** is limited by a resilient bumper **156** in the upper end of the guide cylinder **152**. The lower or main portion of the piston **144** is sealed within a major cylinder **158** by means of a pair of O rings **160** and **161**. The lower portion of the upper piston has a resilient seal **162** which acts as a bumper and seal for the main piston **126** at the upper end of the main piston stroke. A chamber **164** is formed within the upper housing **102** by the cylinder **158** and the bearing surface **146** of the upper piston **144**. The upper portion of piston **144** is larger than the lower portion of the same piston. Pneumatic pressure within the chamber **164** provides the differential force necessary to drive the piston **144** downward against the main cylinder **114** providing a seal for the upper end of the cylinder **114** and a stop for the main piston **126** in its upward movement.

Within the lower end of the main housing **104** there is a driver stem **170** extending upwards from an anvil or driver **171** and positioned within a small diameter cylinder **172** in the main housing **104**. The anvil stem extends from a point wherein it will be contacted by the impact head **140** on the end of the piston **126** when the piston is in its lowermost position to a point immediately above the head of a nail or fastener **18** positioned within the impact tool at the positioning station. The anvil stem is surrounded by a compression spring **174** which bears against a retaining ring **176** in the anvil stem and a flange **178** located between the lower portion of the main housing **104** and the driver housing **103**. Flange **178** also limits the upward movement of the driver **171**. Downward movement of the piston **126** causes the impact head **140** to strike the upper end of the driver stem **170**, which in turn imparts the force to the head of the nail or fastener **18**.

The fastener supply assembly **112** and the positioning of the nails **18** and the workpiece **6** are the same as previously described for the manual impact tool. The driver housing **103** has legs **5** which together with leg **25** on the magazine **112** provide perpendicularity to the tool and nails. The surface **4** on the housings **103** and **104** provide alignment with a wall or baseboard and positioning of the workpiece **6** relative to the wall or baseboard.

## Pneumatic System

The pneumatic supply assembly **106** is mounted within a handle **200**. The handle **200** is adapted for holding and positioning the impact tool and for coupling to a high pressure air source. The end of the handle **200** has the suitable connectors **202** for connection to an outside high pressure air source not shown. Air flows from the high pressure source into the handle wherein a high pressure reservoir chamber **204** is provided. Within the handle a ball valve assembly **206** is positioned to be actuated by the trigger **108**. The ball valve assembly consists of a ball **208** mounted within a valve chamber **210**. An actuating pin **212** extends from the trigger **108** upward through an opening **214** in the valve **206** into contact with the ball **208**. High pressure air from the reservoir **204** flows through an opening **216** into the chamber **210** and exits through an opening **218**. The high pressure forces the ball **208** downward within the chamber **210** against the resilient sealing ring **236** thus allowing the air to pass through the opening **216** into the chamber **210** and out the opening **218**. Actuating the trigger **108** forces the rod **212** upward, which in turn forces the ball **208** upward against the resilient ring **220** surrounding the opening **216** and sealing off the opening **216**. Release of the trigger **108** allows the air under pressure in reservoir **204** to force the ball **208** back downward, thus opening the flow of air through the opening **216** to the chamber **210** and out the opening **218**. When the trigger is actuated and the ball **208** is forced against the opening **216** cutting off the air supply, the air in the chamber **210** and the passage **218** are vented to atmosphere through the opening **214** for the rod **212** by means of an air vent **222**.

## Operation

In operation, the high pressure source is connected to the air inlet connectors **202** in the handle **200** of the impact tool. The air enters the reservoir **204** and passes through the passage **216** to the passage **218** of the valve assembly **206** and then through the passage **231**. The air enters chamber **164** and forces the piston **144** down against cylinder **114**. Simultaneously, the high pressure air enters the air accumulator **234** through a passage **230** in the main housing **104**. The high pressure air then enters the main cylinder **114** through holes **238** and lifts the piston upward against the rubber seal **162** of the upper piston **144**. A chamber **234** surrounds the cylinder **114** and extends upward to the lower portion of the upper housing **102**. The chamber **234** is open to the top end of the cylinder **114** when the upper piston **144** is in the upward position. The upper piston **144** seals the cylinder **114** from the chamber **234** when it is in its downward position. At this time the anvil stem **170** is held in the raised position by the compression spring **174**. In the pneumatic system, the vent port **222** of the valve body **206** is sealed off by the ball **208** being forced downward against a resilient sealing ring **236** surrounding the stem **212**. The high pressure air in the chamber **164** above the upper piston forces the upper piston downward into the position shown in FIG. 2 sealing off the cylinder **114** from the accumulator chamber **234**. The high pressure air in the accumulator passes through a series of openings **238** in the cylinder wall **114** into the chamber **240** formed by the undercut portion of the piston **126**. The high pressure air in the chamber **240** causes the piston to move upward due to the difference in diameter of the upper portion **130** of the piston **126** and the lower portion **132**. Air within the cylinder **114** above the piston **126** is vented to atmosphere through the opening **150** in the upper piston **144** and the air vent line **242** provided in the upper housing **102** to the guide cylinder **152**. The downward or sealing movement of the upper piston **144** is achieved by means of the differential in the diameter of the upper piston exposed to the high pressure air in the chamber **164** and that exposed to the high pressure air in the cylinder **114** and the accumulator **234**.

Actuation of the trigger **108** forces the rod **212** to move the valve ball **208** upward against the resilient member **220** in the opening **216**. The ball **208** cuts off the high pressure air supply and vents the chamber **164** above the upper piston **144** through the passage **231**, through **218**, the valve chamber **210** and the air vent

222. The venting action of chamber **164** causes a differential in pressure between the upper portion of the upper cylinder **144** and the lower portion of the upper cylinder **144** that is exposed to the high pressure air of the accumulator **234**. The unbalanced force generated causes the upper cylinder to move upwards, thus cutting off the vent **242** and exposing the top of the cylinder **114** to the high pressure air in the accumulator **234**. The high pressure air in the accumulator **234** is then exposed to the top surface of the upper portion **130** of the piston **126**, causing the piston **126** to move in a downward direction. This downward movement results from the difference in diameter between the upper portion **130** and the lower portion **132** of the piston **126**. As the piston **126** moves to its downward position the impact head **140** contacts the anvil stem **170** which imparts the kinetic energy produced by the movement of the piston **126** to the head of the nail or fastener and drives it into the wood strip **6** and the concrete or masonry surface. The downward movement of the piston **126** is arrested by the resilient bumper **142**.

Release of the trigger **108** allows the high pressure air to move the ball **208** downward within the chamber **210** against the resilient sealing ring **236** thus sealing off the vent **222** and energizing the impact tool for its next operation by moving the piston **126** upward and the upper piston **144** downward to the sealing position. The anvil stem is returned to its uppermost position by means of the compression spring **174**. A new nail or fastener is automatically inserted into position by the cassette or magazine and the operator merely moves the tool to the next position preparatory to actuating the trigger and driving another nail.

While the invention has been described with reference to the structures disclosed herein, it is not confined to the specific details set forth, since it is apparent that many modifications and changes can be made by those skilled in the art. This application is therefore intended to cover such modifications or changes as may come within the purposes of the improvements or scope of the following claims.

What is claimed is:

1. An impact tool for driving fasteners through a workpiece into masonry surfaces or the like including:
   - a driver housing having means to locate a workpiece in a position to receive a fastener above the workpiece and means to align the impact tool so that a fastener in the positioning station is substantially perpendicular to the surface into which the fastener is to be driven, including four leg members extending downward from the driver housing in a position to straddle the workpiece and a fifth leg member remote from the driver housing to provide stability;
   - a driver positioned in the driver housing immediately above the fastener positioning station and movable downward through the fastener positioning station;
   - means to impact the driver with a velocity sufficient to force the driver downward through the positioning station displacing a fastener in the positioning station; and
   - fastener supply means adapted to position and hold a fastener in the positioning station in the driver housing for each operation of the impact tool.

2. The impact tool of claim **1** wherein the fifth leg member is attached to and extending downward from the fastener supply means.

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