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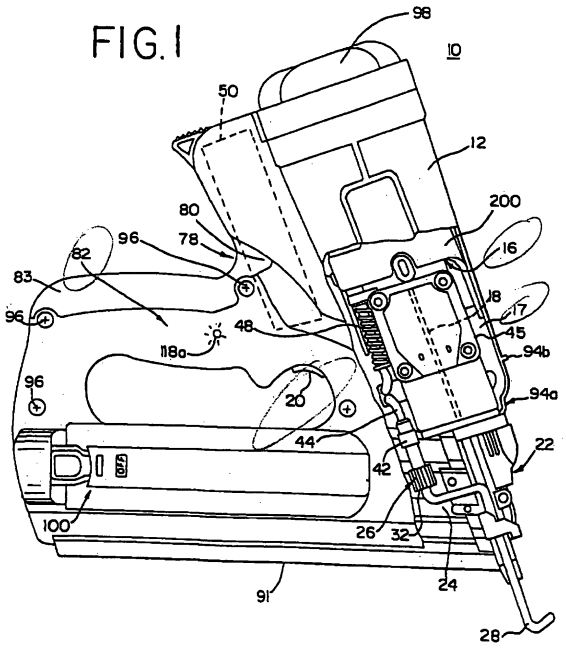
(54) Fastener driving tool for trim applications

(57) A powered tool constructed to drive a driver blade (18) in response to power from a power delivery source (16) to impact a fastener and drive it into a workpiece, comprising:
a housing (12) having a main chamber (17) enclosing said power delivery source;
a nosepiece (22) associated with said housing to accept a fastener and guide said driver blade toward impact with said fastener,
a handle (82);
a trigger (20) permitting an operator to actuate the power delivery source;
a fastener supply assembly (24) associated with said housing for supplying fasteners into said nosepiece;
a tool activation linkage (44) biased into a nonoperational position, and movable into an operational position when said tool is pressed against a workpiece;
a fastener follower (46) in said fastener supply means (24);
a distance amplifier lockout (52) to amplify movement of said fastener follower (46) when said fastener follower is brought into contact with said distance amplifier lockout in response to ejection of an individual fastener from said tool, said lockout (52) preventing said tool activation linkage (44) from being moved into said operational position.

FIG. 1



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Description

BACKGROUND OF THE INVENTION

[0001] The present invention relates generally to improvements in fastener driving tools, and specifically to improvements relating to the useability and functionality of such tools for installation of trim, and other decorative and finishing applications utilizing small fasteners and small workpieces, which will be collectively referred to herein as "trim applications". The tool of the invention includes a number of improved features especially suitable to provide enhanced operation and user comfort when using the tool in trim applications, while also improving ease of tool assembly. Preferably, the tool is a combustion powered tool, but aspects of the present invention are similarly applicable to other tools, such as pneumatically powered and powder actuated tools.

[0002] Portable combustion powered tools for use in driving fasteners into workpieces are described in U.S. Pat. Re. No. 32, 452, and U.S. Pat. Nos. 4, 552, 162, 4,483,473, 4,483,474, 4, 403, 722, and 5, 263, 439, all of which are incorporated by reference herein.

[0003] Such tools incorporate a generally gun-shaped tool housing enclosing a small internal combustion engine. The engine is powered by a canister of pressurized fuel gas, also called a fuel cell. A battery-powered electronic power distribution unit produces the spark for ignition, and a fan located in the combustion chamber provides for both an efficient combustion within the chamber, and facilitates scavenging, including the exhaust of combustion by-products. The engine includes a reciplocating piston having an elongate, rigid driver blade disposed within a piston chamber of a cylinder body.

[0004] The wall of a combustion chamber is axially reciprocable about a valve sleeve and, through a linkage, moves to close the combustion chamber when a workpiece contact element at the end of a nosepiece connected to the linkage is pressed against a workpiece. This pressing action also triggers a fuel metering valve to introduce a specified volume of fuel gas into the closed combustion chamber from the fuel cell. The metering valve may take the form of a solenoid valve, which is powered by the battery, or may be a purely mechanical valve.

[0005] Upon the pulling of a trigger, which causes the ignition of a charge of gas in the combustion chamber of the engine, the piston and driver blade are shot downward to impact a positioned fastener and drive it into the workpiece. As the piston is driven downward, a displacement volume enclosed in the piston chamber below the piston is forced to exit through one or more exit ports provided at a lower end of the cylinder. After impact, the piston then returns to its original, or "ready" position through differential gas pressures within the cylinder. Fasteners are fed into the nosepiece from a supply assembly, such as a magazine, where they are held in a properly positioned orientation for receiving the impact of the driver blade. Power of the tools differs according to the length of the piston stroke, volume of the combustion chamber, fuel dosage and similar factors.

[0006] The combustion powered tools have been successfully applied to large workpieces requiring large fasteners, for framing, roofing and other heavy duty applications. Smaller workpiece and smaller fastener trim applications demand a different set of operational characteristics than the heavy-duty, "rough-in", and other similar applications.

[0007] One operational characteristic required in trim applications is the ability to predictably control fastener driving depth. For the sake of appearance, some trim applications require fasteners to be countersunk below the surface of the workpiece, others require the fasteners to be sunk flush with the surface of the workpiece, and some may require the fastener to stand off above the surface of the workpiece. Depth adjustment has been achieved in pneumatically powered and combustion powered tools through a tool controlling mechanism, referred to as a drive probe, that is movable in relation to the nosepiece of the tool. Its range of movement defines a range for fastener depth-of-drive. Exemplary depth adjustment tool-controlling mechanisms are disclosed in U.S. Patent No. 3,519,186, U.S. Patent No. 4,767,043, U.S. Patent No. 5,219,110, and U.S. Patent No. 5,385,286.

[0008] Another depth-of drive adjustment having a spool on a thread for adjusting dep this disclosed in U.S. Patent 5,685,473. The spool has ribs that engage a spool restraining element when the tool controlling mechanism is pressed inwardly toward the tool body. This prevents spool movement when the tool is enabled for firing. In these prior depth adjustment mechanisms, the operator typically obtains a desired depth through trial and error. If depth is altered for some reason, it may take additional trial and error to return to a previously used depth. This experimentation to obtain a desired depth slows operation of the tool, and may result in workpiece damage in trim applications which require a precisely controlled depth.

[0009] Another difficulty in trim applications relates to the small fasteners used. Typically, these fasteners are fed into the nosepiece by a magazine which is angularly mounted below the handle used by an operator to grip and trigger the gun. They are advanced by a spring loaded fastener pusher, generally similar in operation to those found in staplers. It is preferable to prevent firing when a certain number of fasteners are remaining, or when the fasteners are exhausted, but the resulting movements created in the magazine by trim sized fasteners provide very little mechanical feedback due to their small size. For example, typical finishing brads loaded into a magazine move in increments of about 1 . 5 mm. As a result, a lockout bar moving with the brads is unable to block the larger diameter drive probe and related linkage, used to enable firing, upon the movement induced after the driving of a small diameter brad.

[0010] The fasteners used in trim applications may also be difficult to manipulate and load due to their small size. Rear loading, top loading, and side loading arrangements are known in the art. The side and top loading arrangements are more mechanically complex since the direction in which the fasteners are loaded into the magazine is not in the same direction into the nosepiece that the fasteners travel during operation. The known rear loading arrangement is more easily implemented, but is more difficult to use because no portion of the gun provides a guiding surface for a user to align a fastener, or the beginning of a group of fasteners, with the opening for placing fasteners into the magazine.

[0011] User ergonomics and tool balance also play a more pronounced role in trim applications. Manipulation of the tool to fasten horizontally disposed trim pieces and trim pieces in awkward positions results in user fatigue, which is amplified by a tool which is not balanced around the user grip area. Typical combustion tools have the handle disposed away from the axis of the driver blade to accommodate the fuel cell held in the housing at a point adjacent to the termination of the handle at the housing. This results in a natural tendency of the tool to lean away from the user when gripped at the handle since most of the tool's weight is centered near the axis of the driver blade. Recoil is also pronounced since the distance between the handle and the driver acts as a moment arm. A user must oppose these forces when using the tool, resulting in fatigue.

[0012] User comfort is also affected by tool weight and stability. Typically, the fastener driving tools are held together by numerous screws and rivets at various points around tool's periphery. This increases weight and decreases rigidity. Since the magazine and tool housing are separate pieces, the separate fastening also can lead to alignment problems in delivering fasteners into the nosepiece. These operational problems are separate from additional assembly problems related to the same typical tool features, which make assembly more difficult and expensive.

[0013] Trim applications also require more exacting positioning during firing. Typical tools obscure an operator's sight line since the body of the tool interferes with the view to a portion of the workpiece proximate to the point at which the fastener will be driven into the workpiece.

[0014] Tools having self contained power sources generally must also be portable, and cost is an important concern. To keep cost and weight down, many portable tools lack an on/off switch. To prevent unintentional operation of the tool, some operators disengage the battery held in the handle or some other portion of the tool. In the combustion tools, the battery is necessary to produce the spark and fan movement necessary to tool operation. If the operator is moving, for instance by climbing a ladder or scaffold, the loosely held disconnected battery (or batteries) may fall out. This is an inconvenience to the operator, a cause of damage to the battery, and a potential hazard to the operator and anyone below the operator.

[0015] Accordingly, it is an object of the present invention to provide an improved fastener driving tool useful for driving of fasteners in trim applications and which addresses drawbacks in conventional fastener driving tools.

[0016] Another object of the present invention is to provide an improved fastener driving tool for trim applications which prevents tool operation when a predetermined number of small fasteners remain in the magazine. A related object of the invention is to provide an improved tool with a distance amplifying lockout which multiplies the mechanical movement associated with the movement of the fasteners in the magazine after driving of a fastener to block the drive probe and linkage from moving into an operational position.

SUMMARY OF THE INVENTION

[0017] The above-listed objects are met or exceeded by the present improved fastener driving tool, which is especially suited to trim applications. The tool of the present invention includes features aiding in the operation, ergonomics, and assembly of the tool.

[0018] To facilitate prevention of firing when a certain number of small fasteners remain, the preferred tool also includes a distance amplifying lockout. The lockout is pivotally mounted and is engaged by a rod that is part of a fastener follower when a predetermined number of fasteners remain. An engagement end is located further from the pivot point than a rod contact point to provide a significant amplification in movement. The amplification is sufficient to move the engagement end into a position to prevent the tool's drive probe and linkage from being placed into an operational position after a single fastener has been expended.

BRIEF DESCRIPTION OF THE DRAWINGS

[0019] Other features, objects and advantages of the invention will be apparent by reference to the detailed description and the drawings, of which:

FIG. 1 is a partially cut away side view of the preferred fastener driving tool;

FIG. 2 is an opposite side view of the fastener driving tool of FIG. 1;

FIG 3 is a partially cut away side view of a portion of the preferred tool including a distance amplifying lockout;

FIG 4 is a partially cut away alternate view of the portion of the preferred tool including the distance amplifying lockout;

FIG 5 is a perspective relational view of the preferred tool, a preferred fastener magazine and a preferred fastener follower;

FIG 6 shows a portion of the preferred tool and magazine in an uncompleted assembly state;

FIG 7a shows the portion of the preferred tool in FIG 6 in a completed assembly state;

FIG 7b illustrates a completed front assembly of the preferred tool of FIG 6;

FIG 7c is a top view of a joining element from FIG 7b.

DETAILED DESCRIPTION OF THE PREFERRED EMBODIMENT

[0020] Broadly stated, the present invention concerns an improved fastener driving tool that is especially suited for installation of trim, and other decorative and finishing applications utilizing small fasteners and small workpieces, which will be collectively referred to herein as "trim applications". The tool of the invention is maneuverable and comfortable, it provides repeatable depth control, and includes a number of features which render use and assembly more efficient and reliable.

[0021] Referring now to FIGs. 1 and 2, the preferred embodiment of a compact fastener driving tool for trim applications is generally designated 10. A housing 12 of the tool 10 encloses a self contained internal power source 16 within a housing main chamber 17. As in conventional combustion tools, the power source 16 includes a combustion chamber that communicates with a cylinder. A piston within the cylinder is connected to the upper end of a driver blade 18. Through depression of a trigger 20, an operator induces combustion of a measured amount of propellant within the combustion chamber, causing the driver blade 18 to be forcefully driven downward into a nosepiece 22. The nosepiece guides the driver blade 18 to strike a fastener that had been delivered into the nosepiece via a fastener magazine 24. Thus, general operation is like that of conventional combustion fastener driving tools. From the following description of novel features of the preferred tool 10, artisans will also appreciate that many of the features of the present invention can be advantageously applied to fastener driving tools having alternate power sources, such as pneumatic and powder actuated tools.

[0022] Referring now to FIGs. 5 - 7, shown is a distance amplifying lockout 52 that amplifies the movement of the fastener follower 46 after a rod 54 contacts its contact point 56, which is located between its pivot mounting 58 and its engagement end 60. The rod 54 is preferably flexible to aid in assembly when housing halves 12a and 12b are brought together (see FIG. 8). The rod 54 must be flexible enough to bend over the distance amplifying lockout. It will either bend into place at the contact point when the housing halves are brought together or after the fastener follower 46 is pulled back for the first time. The contact point 56 is located near the axis of rotation defined by the pivot mounting 58 so that further movement of the rod 54 after contacting the point 56 produces an amplified movement of the engagement end 60. In the illustrated embodiment, a .060" movement at the contact point 56 created by the discharge of a single trim fastener is translated into a 200" movement of the engagement end 60. The pushing of the rod 54 at the contact point 56 overcomes a light spring force supplied by a light spring 62 to move the engagement end 60 into a position which will block a terminal end 64 of the probe 28 from moving upward. As is best seen in FIG. 5, the engagement end 60 is preferably shaped to accommodate the terminal end 64 of the probe, and an opposite surface 66 mates with a solid (preferably steel) portion 68 of the tool 10. The opposite surface 66 jams solidly against the solid portion 68, while the curve in the engagement end 60 draws the lockout 52 inward after it engages the terminal end 64, thereby ensuring engagement of the full diameter of the probe 28. This reinforced position with the engagement end 60 in an axis of movement of the terminal end 64 of the probe 28 will oppose significant forces applied by an operator trying to actuate the tool 10, and provide a clear indication that the magazine 24 is low or has been emptied of fasteners. As will be appreciated by artisans, it is a matter of design choice to determine the number of fasteners remaining when the lockout 52 is actuated. Such adjustments may be accomplished, for example, by altering the length of the rod 54.

[0023] It has been mentioned that the rod 54 must be resilient enough to bend out of the way of lockout 52 when halves of the housing are rotated together. Other factors are also important with respect to the magazine 24, follower 46 and lockout 52. First, the follower 46 should contact a portion of the housing before the lockout 52 is pushed to a breaking point. This protective position is illustrated in FIGs. 2 and 5. This protects the lockout 52 from accidental breakage when an operator accidentally allows the follower 46 to slam back toward the lockout 52. Second, at the point of disabling, the follower 46 should keep light pressure on remaining fasteners. Thus, the housing 12 should not be contacted by the follower 46 at that point, which is when 10 fasteners remain in a preferred embodiment. In other words, after the 11 th remaining fastener, for example, is shot, the rod 54 activates the lockout 52 while keeping pressure on the 10th brad to keep the remaining brads in position.

[0024] Once operation is prevented, an operator may pull back the fastener follower 46 to move it back along the magazine 24 so that more fasteners may be loaded into the magazine 24. It is a bypass type follower, so a bar 70 and associated spring 71 pivotally control a fastener engager 72 so it will travel over fasteners in the magazine 24 on the way back, or travel over fasteners on the way forward when an operator presses the bar 70. When bar 70 is released and the follower 46 is behind a group of fasteners, the engager 72 will engage the rearmost fastener upon meeting it. A constant force negator spring (not shown) is rolled into a molded pocket within the housing 12, and exerts force to pull the fastener follower 46 toward the nosepiece 22 and engage the engager 72 with the rearmost fastener within the magazine 24. After lockout, the operator overcomes this force to pull the fastener follower 46 back, and the distance am-

plifying lockout 52 is moved to a resting position through force supplied by the light spring 62. The resting position is defined by a stop end 74 of the lockout 52, which abuts a solid portion 76 of the tool 10.

Claims

1. A powered tool constructed to drive a driver blade (18) in response to power from a power delivery source (16) to impact a fastener and drive it into a workpiece, comprising:

   a housing (12) having a main chamber (17) enclosing said power delivery source;
   a nosepiece (22) associated with said housing to accept a fastener and guide said driver blade toward impact with said fastener;
   a handle (82);
   a trigger (20) permitting an operator to actuate the power delivery source;
   a fastener supply assembly (24) associated with said housing for supplying fasteners into said nosepiece;
   a tool activation linkage (44) biased into a non-operational position, and movable into an operational position when said tool is pressed against a workpiece;
   a fastener follower (46) in said fastener supply means (24);
   a distance amplifier lockout (52) to amplify movement of said fastener follower (46) when said fastener follower is brought into contact with said distance amplifier lockout in response to ejection of an individual fastener from said tool, said lockout (52) preventing said tool activation linkage (44) from being moved into said operational position.

2. The tool according to claim 1, wherein said lockout (52) comprises an elongated arm (58) having an engagement end (60), said elongated arm being pivotally mounted to said tool at a pivot position adjacent to an axis of movement defined by a workpiece contacting probe (28) connected to said linkage (44), said engagement end (60) being biased away from said axis of movement, and wherein said fastener follower (46) engages said elongated arm between said pivot position and said engagement end to move said engagement end (60) a greater distance than said fastener follower (46) moves the elongated arm at the point where said fastener follower engages said elongated arm (58) so that the engagement end is moved into said axis of movement to block said probe (28).

3. The tool according to claim 2, wherein said elongated arm (58) further comprises a stop end (74) opposite said engagement end and said stop end (74) abuts a solid portion (76) of said tool (10) when said engagement end (60) is biased away from said axis movement to define a resting position of the elongated arm.

4. The tool as defined in claim 2, wherein said engagement end (60) includes a curved surface for accepting an upper terminal end of said probe (28).

5. The tool as defined in claim 3, wherein said engagement end (60) includes a flat surface opposite said curved surface for engaging a solid portion of said tool to oppose upward movement of said upper terminal end of said probe (28).

FIG. 1

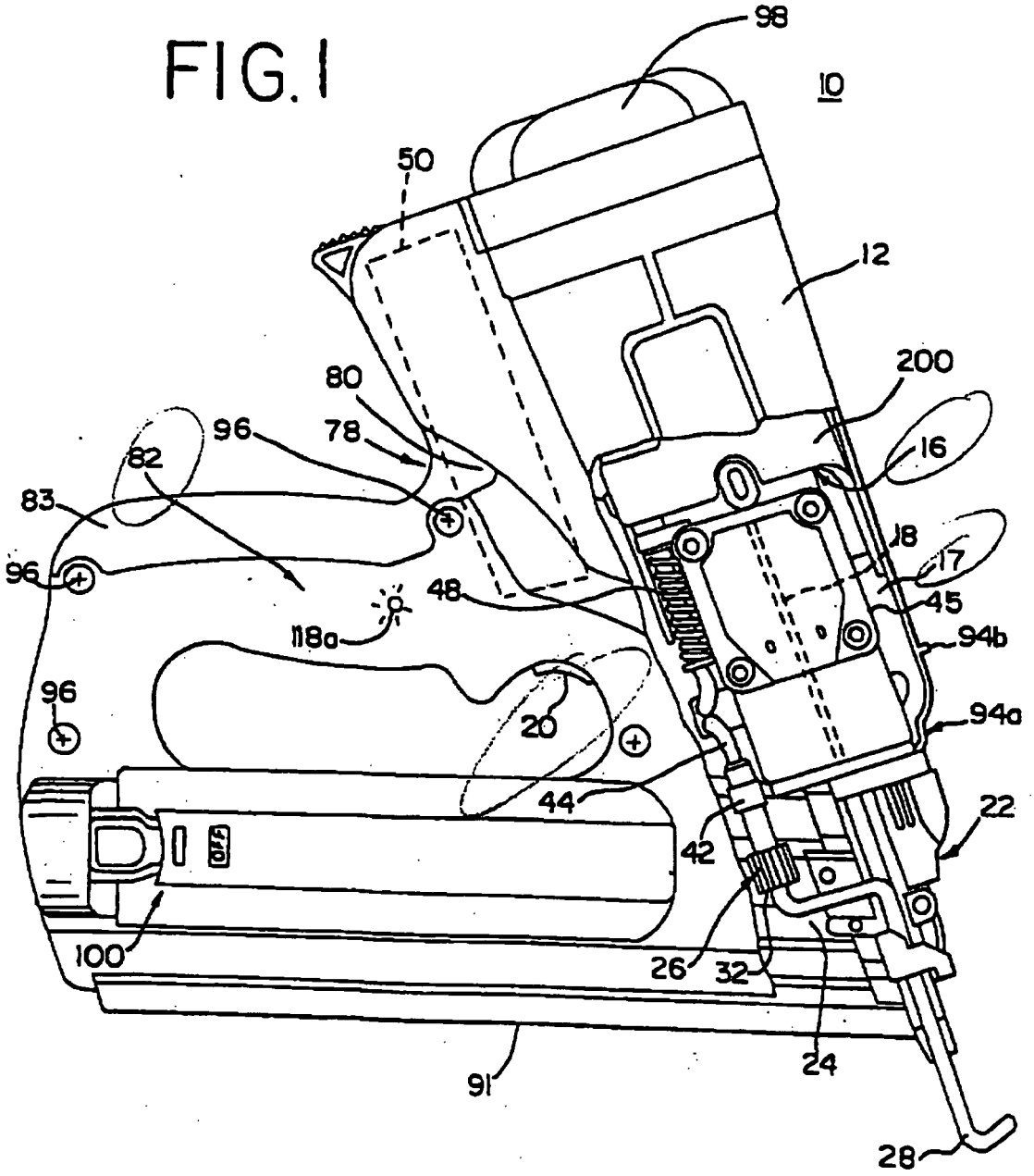
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FIG. 2

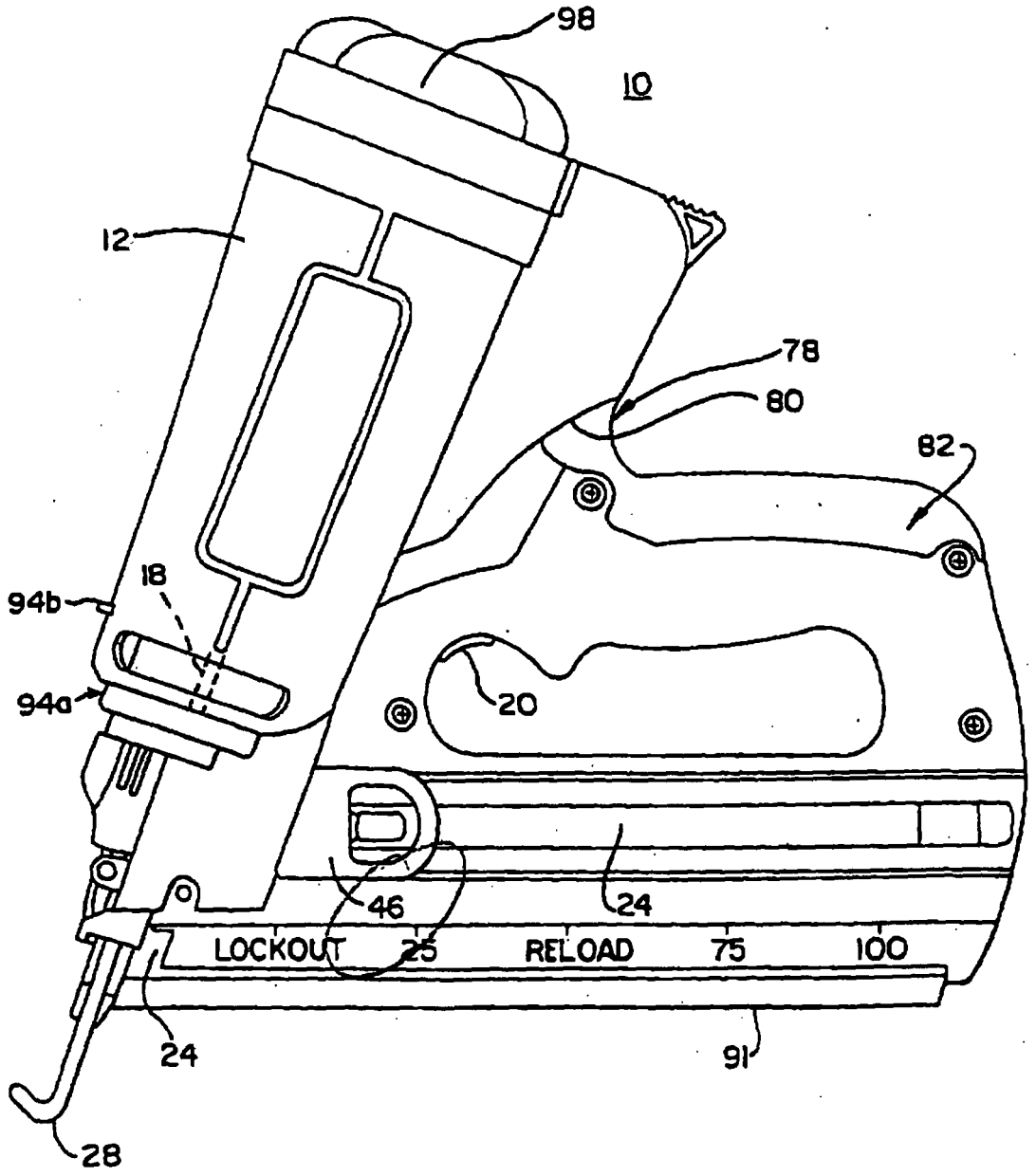
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FIG. 3

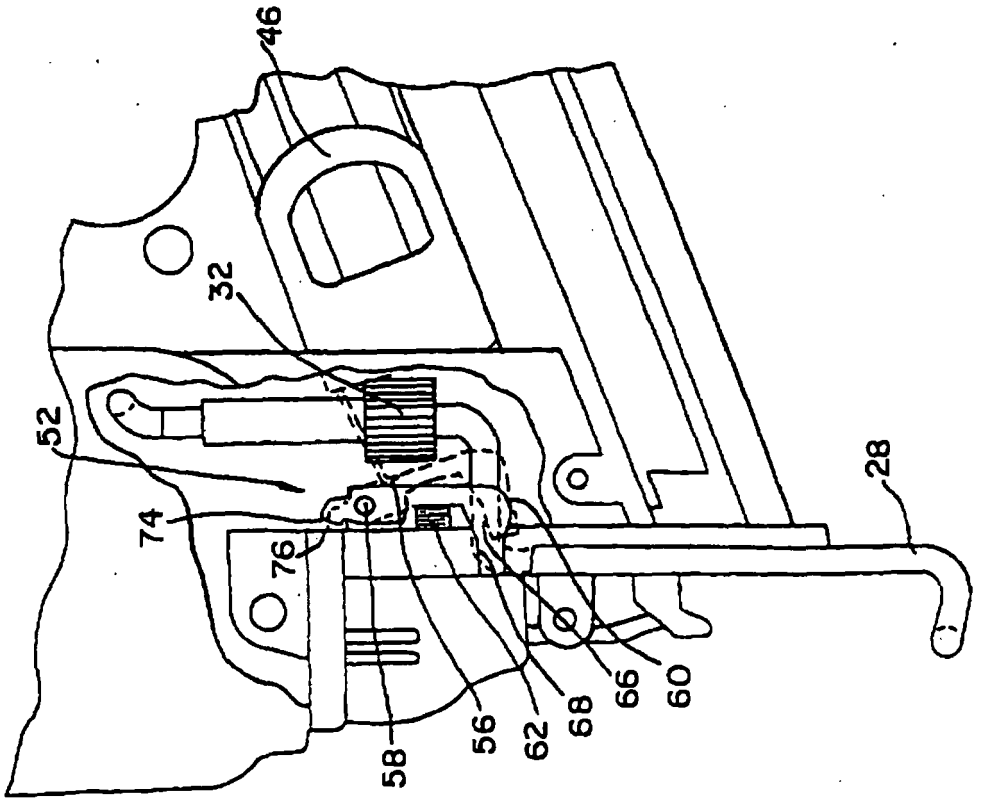

FIG 4

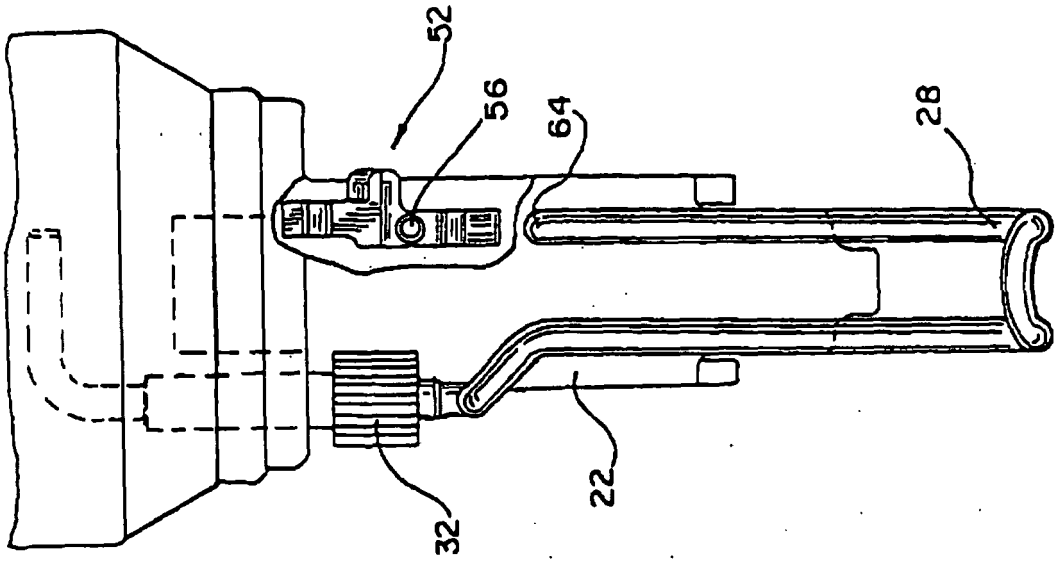

FIG. 5

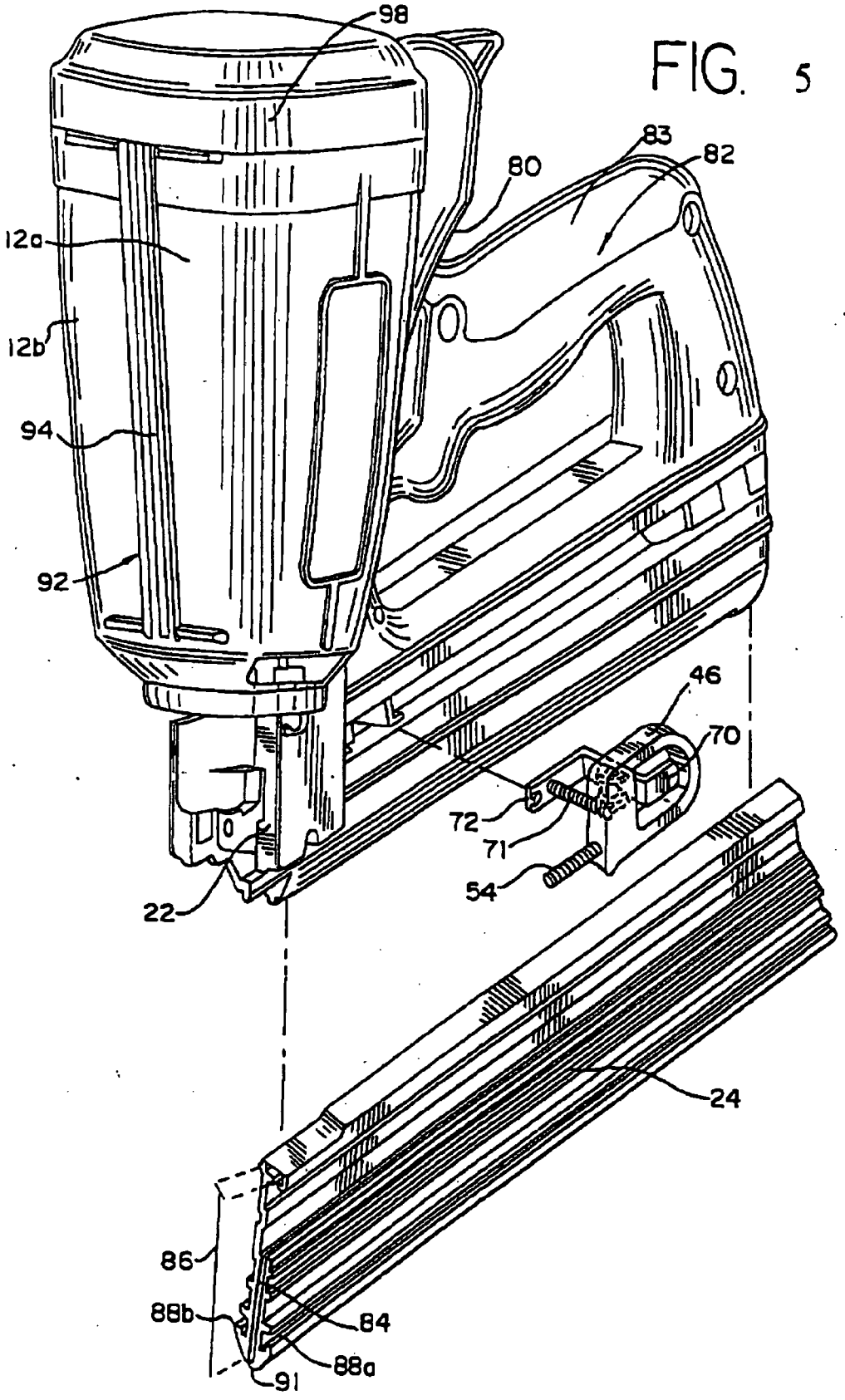

FIG. 6

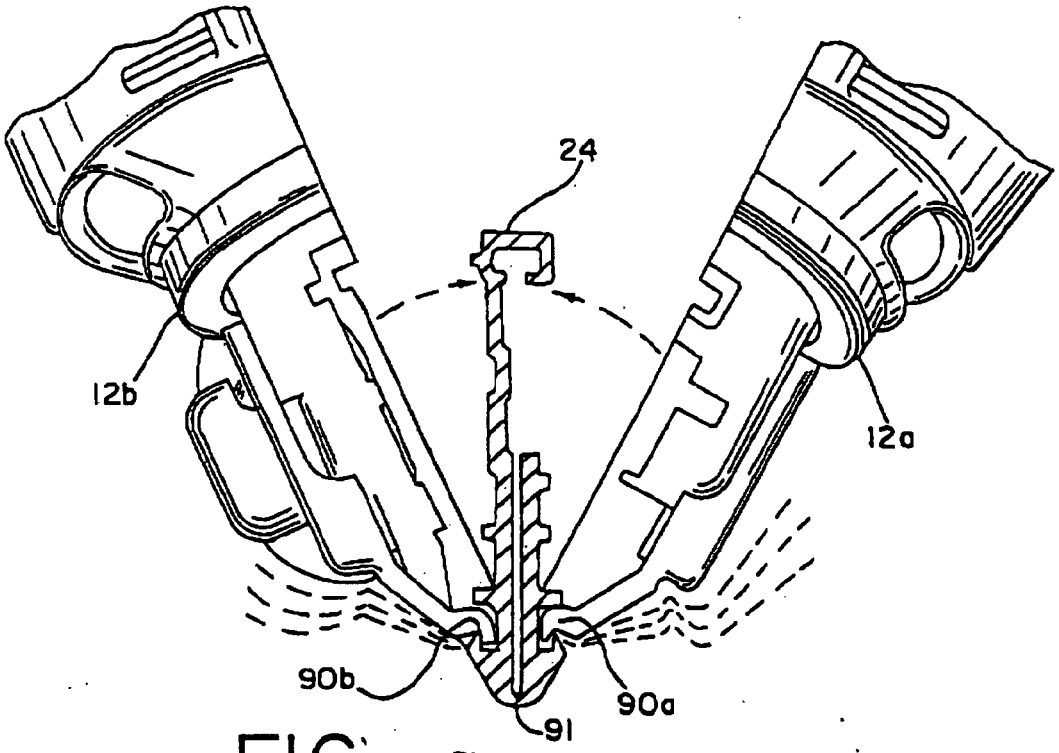

FIG. 7a

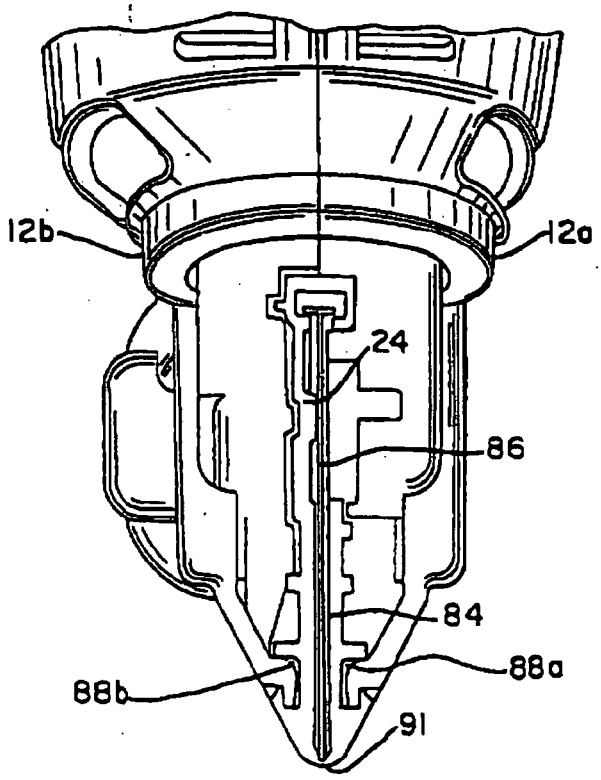

FIG. 7b

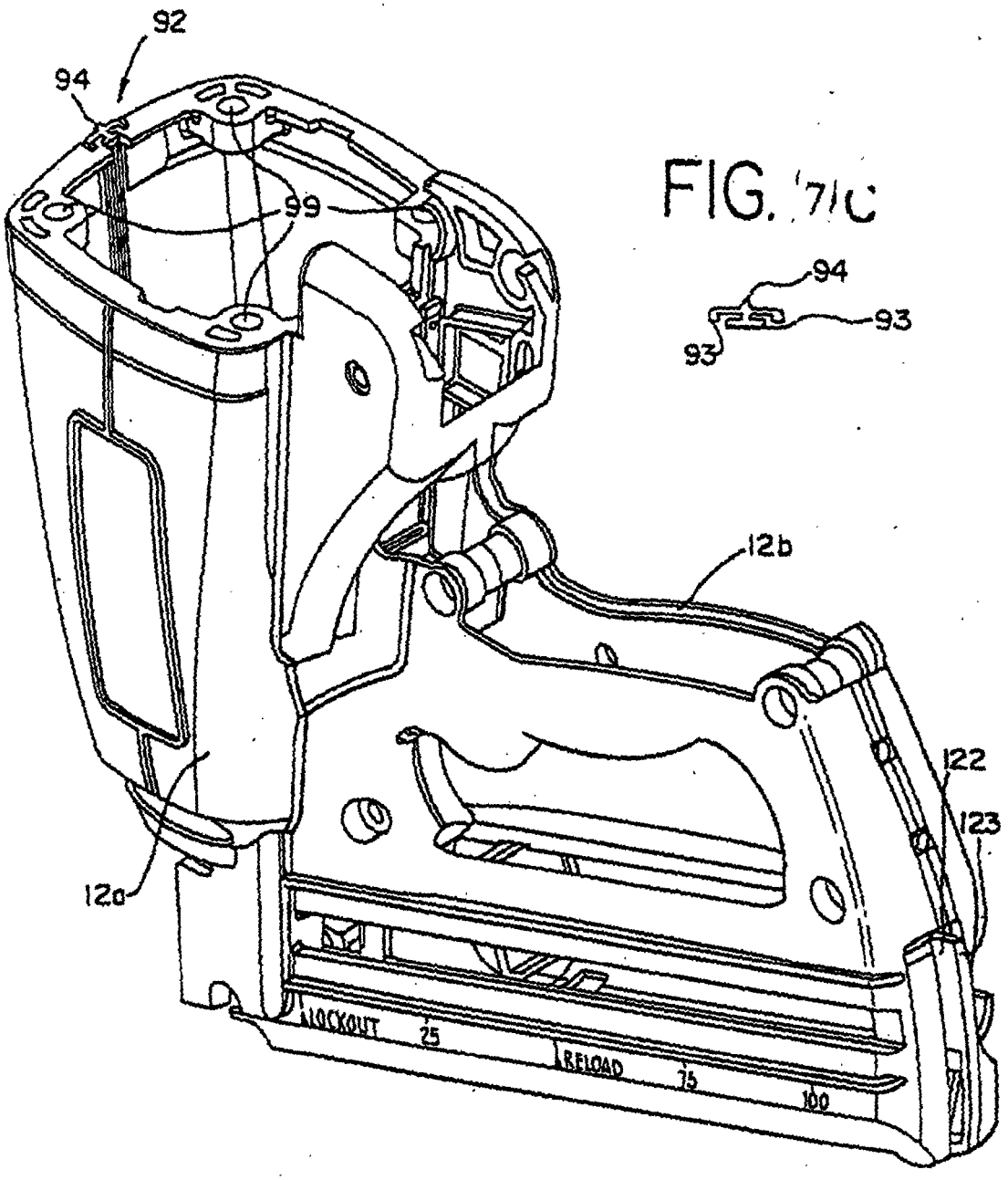

FIG. 7c

REFERENCES CITED IN THE DESCRIPTION

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