

Dec. 20, 1960

R. J. KOPF

2,964,752

FLUID OPERATED TOOL

Filed April 29, 1958

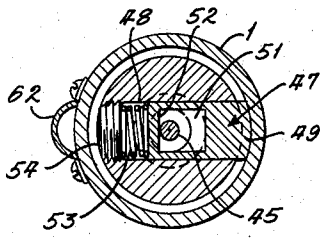


FIG. 4.

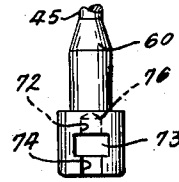
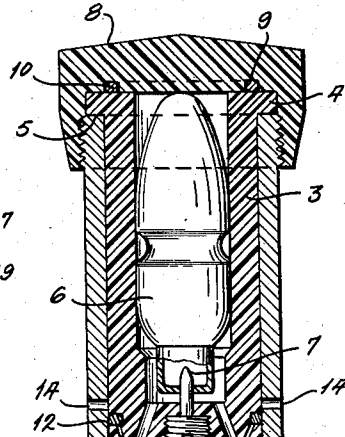


FIG. 6.



FIG. 7.

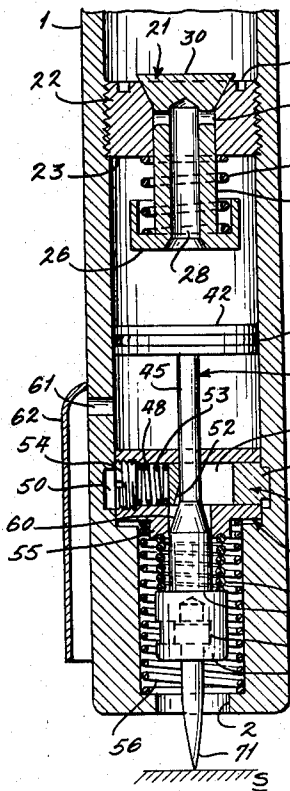


FIG. 2.

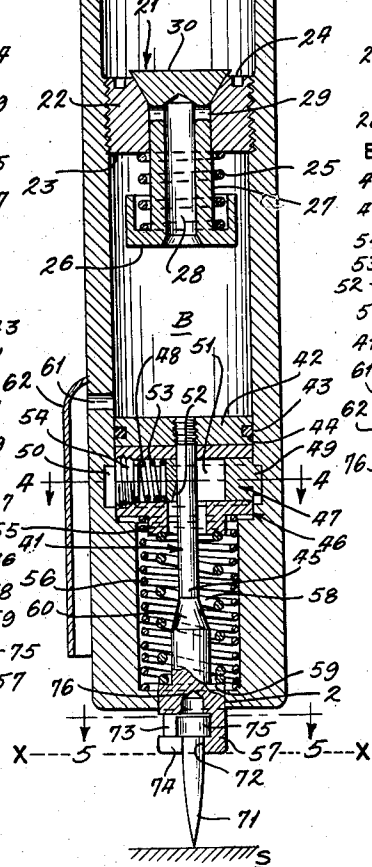


FIG. 1.

By

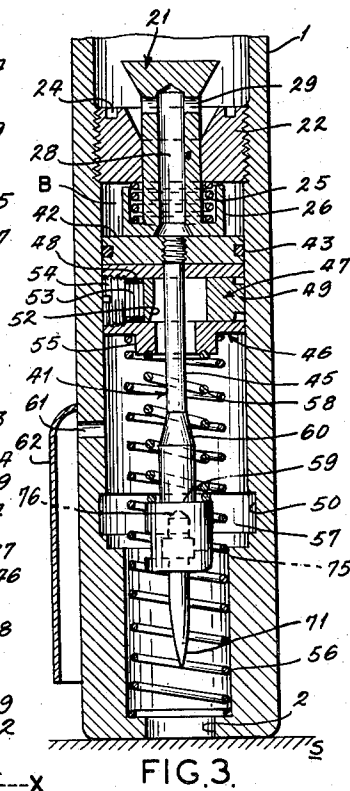


FIG. 3.

INVENTOR,
ROWLAND J. KOPF

Rowland J. Kopf
ATTORNEY

1

2,964,752

FLUID OPERATED TOOL

Rowland J. Kopf, Rocky River, Ohio, assignor to Olin Mathieson Chemical Corporation, East Alton, Ill., a corporation of Virginia

Filed Apr. 29, 1958, Ser. No. 731,846

12 Claims. (Cl. 1—106)

This invention relates to a power tool for driving fasteners.

Various forms of power actuated fastener driving tools are known in the art. For the most part these tools are powered by either an explosion resulting from the discharge of a blank cartridge or some other form of explosive power or pneumatically by compressed air or some other fluid supplied to the tool by hoses connected to storage supply tanks. The explosively powered tools have an obvious advantage in not requiring connecting hoses and tanks and are therefore easier to handle and far more mobile than are the pneumatic tools, but have the disadvantage of not being safe in explosive atmospheres such as may be encountered in a mine. On the other hand, pneumatic tools while having the advantage of eliminating the necessity for reloading the tool with a new power charge each time it is used, are limited in their portability and ease of operation by long hose line connections especially during emergency fastening conditions such as in mines.

Both pneumatic and explosively powered tools normally drive fasteners at relatively high velocity. When fasteners are driven at high velocity it is possible that the fastener will not be embedded in a soft or thin material such as wood or thin metal plate, but rather will enter free flight usually because the fastener is driven clear through the material such as emergency repair material. If high velocity tools are improperly employed there is the additional possibility that the fastener will ricochet rather than being driven into fastening relationship with the intended materials.

In previous manually loaded fastener driving tools it has been necessary to insert the fastener into the interior of the tool, usually into a tool barrel. This is both inconvenient and time consuming because the tool must either be partially disassembled or the fastener must be positioned in the tool barrel by use of a rod. Properly locating prior tools on the structural member before driving the fastener into a structural member presents an additional difficulty since the fastener is not visible and the operator must either rely on index marks on the tool or else on guesswork in properly positioning the tool so that the fastener will be driven into the structural member at the desired point. Another factor to be considered is the initial cost and the weight of conventional tools brought about by the many working parts and the close tolerances required.

It is therefore an object of this invention to provide a power tool for driving fasteners at a relatively low velocity. Another object of this invention is to provide such a power tool which has a self-contained power supply thereby eliminating connecting hoses or other external supply lines. Another object of this invention is to provide a tool for driving a few fasteners in which the power supply does not have to be replenished after each use. Another object of this invention is to provide a portable tool having a self-contained power supply which does not have to be replenished after each use.

2

Another object of this invention is to provide a simple driving tool having a minimum of close fitting moving parts requiring exact tolerances. A further object of this invention is to provide a tool wherein the tool is actuated to drive the fastener by the natural hammering motion of the operator and the resilient movement of the fastener relative to the body of the tool. A still further object of this invention is to provide a tool in which the fastener is operatively secured to an external portion of the tool and wherein the tip of the fastener may be positioned against the structural member at the precise point where it is desired to embed the fastener. Another object of this invention is to provide a tool which is especially suited for emergency operation such as in mines and is simple and positive in operation and which is inexpensive to manufacture.

Other objects and advantages will become apparent from the following description and drawings, in which:

Fig. 1 is a longitudinal sectional view of an embodiment of the tool in the loaded but otherwise inoperative ready to get ready-to-fire position at which the operator need only push down the tool as far as he can to "fire" the tool and showing the pointed end of a loaded fastener engaging a structural member into which it is to be driven and also showing the relative position of the parts after the fastener is fully driven;

Fig. 2 is a partial sectional view of a portion of the tool of Figure 1 pushed to an intermediate ready-to-fire or drive position just prior to release of the driving fluid into a driving chamber;

Fig. 3 is a partial sectional view similar to Figure 2 showing a more advanced and irreversible stage in the midst of the firing or driving position in which a valve has been opened to admit the driving fluid into the driving chamber;

Fig. 4 is a sectional view taken on the line 4—4 of Figure 1;

Fig. 5 is a sectional view of the fastener holding portion of the tool taken on the line 5—5 of Figure 1;

Fig. 6 is a side view of a portion of the fastener holding element shown in Figure 1.

It should be noted that the view of the tool in Figures 1, 2 and 3 of the drawing are transversely aligned to facilitate comparison of the position of parts of the tool in various stages during the driving sequence and that the position of the structural member into which the fastener is to be driven has been varied to correspond to its position with relationship to the tool during each stage of the driving sequence.

Briefly, the tool comprises a hand controlled portable driving tool with a fastener holding means and a pair of chambers A and B separated by a valve 21 for passing any suitable high pressure fluid from the storage chamber A to the holder driving chamber B. Chamber A is of suitable volume and is charged at a selected gas pressure. The valve is opened by placing the tip of the fastener 71 against a structural member S into which it is to be driven and pressing the tool toward the member. Movement of the tool body 1 over fastener 71 and the fastener carrier 41 releases a spring pressed block 46 to open the valve. The driving power is provided by a highly compressed gas which is introduced into the storage chamber A preferably by rupturing a compressed fluid capsule 6 of suitable size inserted into the upper end of the tool designed to take the necessary size of capsule.

The construction and functioning of the tool will be more clearly understood from the following detailed description.

Referring to Figure 1, the tool comprises a tube 1 of suitable diameter and wall thickness and open at the front end at a hole 2, and open at the other end for charging.

Inserted into the open end of the tool is a cup-shaped insert 3 having a flange 4 which overlies and engages the end surface 5 of the open end of the tool. A dischargeable compressed gas containing capsule 6 containing gas at from any suitable low pressure to any suitable high pressure is inserted into the cup-shaped insert 3. A piercing point 7 is screw-threaded into the bottom of the cup-shaped insert 3 and projects through the bottom of the cup for piercing the discharge end of the capsule. The capsule is forced against the point by a cap 8 which is screw-threaded to the outer surface of the tube and seals the flanged end 4 of the cup-shaped insert 3. The cap is provided with a circular groove 9 which receives an O-ring 10 to additionally seal the joint between the cap and the flanged portion 4 of the insert. Passageways 11 are provided in the bottom of the cup adjacent the piercing point 7 to permit the compressed fluid released from the capsule 6 to escape from the insert 3. A second O-ring seal 12 may be provided in the outer surface of the cup-shaped member to prevent the compressed fluid from escaping between the insert 3 and the inner surface of the tube 1. Pressure leads 13 may be provided from the O-ring groove as shown, to improve the sealing capacity of the O-ring. Vents 14 are provided through the tube immediately rearwardly of the O-ring 12 to allow the compressed gas to escape should the cap 8 be loosened while the tool is still charged, to prevent the cap 8 and insert 3 from being driven outwardly by the compressed fluid. A carbon dioxide capsule 6 of the type used in charging seltzer bottles charged at a suitable pressure for the purpose of this invention is shown, although any type of capsule containing any suitable charge such as compressed air at an adequate pressure and volume may be provided depending on the intended driving capacity of the tool, or the tool may be charged at intervals from an external supply of compressed fluid introduced into the tool in any conventional manner such as through a dispenser valve.

Where the tool is intended for a number of successive "shots," both the cup-shaped insert 3 and the cap 8 are preferably fabricated from a heat insulating material such as phenol or urea-formaldehyde or hard rubber to prevent the cold which results upon the discharge of the compressed gas in the capsule from unduly chilling the outer portions of the tool. If the insert and cap were of metal they would eventually become so cold that they could not be held in the bare hand of the operator. For a single "shot" tool insulating material is not necessary.

The tube is divided into two compartments or chambers A and B by a valve 21 and valve block 22. The valve block threadably engages the internal surface of the tube 1 and abuts against a shoulder 23 formed in the tube. A tight fitting threaded connection between the valve block and the tube insures a fluid tight joint. Holes 24 are provided in the block for engagement by a tool to facilitate screwing the block into the tube. A poppet valve 21 is seated in the valve block 22 and is normally maintained in the closed position by a spring 25 seated between the valve block 22 and a valve spring cap 26 made integral with the stem 27 by being welded or threaded to the free end of the valve stem 27. The cylindrical wall of the cap 26 is of sufficient length to engage the adjacent face of the valve block 22 and prevent the coils of the spring 25 from the abutting against each other when the valve is fully open. The valve stem is provided with a longitudinal bore 28 opening out through the free end of the stem. Passageways 29 are provided through the stem adjacent the juncture of the frusto-conical valve head 30 and the stem 27. As shown, the opening of the bore 28 at the end of the stem may be flared and similar enlarging flares may be provided at the ends of the passageways 29 through the stem to facilitate the flow of fluid between the chambers A and B. The openings of bore 28 and passageway 29, the length

of stem 27 and relative proportions of the areas of valve head 30 and piston 42 and relative volumes of chambers A and B are selected with the objective of admitting enough gas to chamber B to accomplish driving.

A fastener carrier 41, having forwardly biased movable parts including shank 45, piston 42 and head 57, is telescopically received in the tube 1 with head 57 adapted to protrude through the hole 2 in the end of the tube 1. The inner end of the fastener carrier shank has a carrier piston 42 which closely engages the inner surface of the tube 1 with a sliding fit to provide the necessary fluid-tight engagement between the piston and tube. The engagement between the carrier piston 42 and the tube must be substantially fluid-tight with respect to high gas pressure in chamber B as the piston is pneumatically driven and any appropriate sealing means may be provided in addition to or in lieu of a relatively close sliding fit. For purposes of illustration, an O-ring 43 is shown seated in a peripheral groove 44 in the carrier piston 42. All O-rings are of slightly greater diameter than the depth of the groove.

The shank 45 of the fastener carrier passes freely and telescopically through a bore in a relatively massive sear block 46. The sear block 46 is telescopically received in the tube 1 and, except when held stationary, engages the walls of the tube with a free sliding fit. A spring pressed sear 47 is mounted in the sear block 46. Referring to Figures 1 and 4, the sear 47 is a cylindrical member slidably received in a transverse cylindrical bore 48 through the sear block 46. A lug 49 on the sear engages a peripheral groove 50 in the inner surface of the tube 1. The fastener carrier shank 45 passes freely through an elongated opening 51 in the sear 47, thereby permitting piston 42 and block 46 to be moved apart or into abutment under the action of a main spring 58. A cam surface 52 on the sear is normally urged toward the shank 45 of the fastener carrier 41 by a spring 53 received in the cylindrical bore 48 in the sear block 46 and is held in place by a bolt 54 threaded into the transverse bore 48 in the sear block 46. The forward end of the sear block has a producing cylindrical portion 55 which serves as a retainer for a sear block supplementary driving and return snubber compression spring 56. One end of this spring is seated against the sear block 46 and the other end of the spring is seated against the end of the tube around hole 2 adjacent the juncture of the flanged part of the end and the inner surface of the reduced diameter part of the side wall of the tube.

The end of the fastener carrier 41 opposite the carrier piston 42 is provided with a fastener carrying head 57 of greater outside diameter than the fastener carrier shank 45 to form the shoulder 59 for abutment with one end of main spring 58. The fastener holding structure of the fastener carrying head will be described below. The fastener carrier driving head compression spring 58, which has a high spring rate and energy storage capacity compared to spring 56, is seated against the cylindrical protrusion 55 of the sear block 46 and the other end of spring 58 is seated against the shoulder 59 provided by the inner end of the fastener carrying head 57 to bias the carrier 41 forwardly with head 57 protruding normally when block 46 is held captive by sear 47. On the shank 45 of the fastener carrier 41 intermediate the head 57 and the piston 42 is a frusto-conical cam surface 60. As the fastener carrier 41 is relatively slowly taken into the moving tube 1 as the latter is thrust manually against the force of the fastener carrier head biasing spring 58, thereby storing up considerable energy in it, the frusto-conical cam surface 60 on the shank of the carrier engages the cam surface 52 in the sear 47 before the coils of spring 58 can bottom and forces the sear to telescope laterally in the cylindrical bore 48 in the sear block 46 and against the force of the sear spring 53 to release the sear lug 49 from the groove 50 in the inner surface of

5

the tube 1. This permits the sear block 46 to be driven inwardly by spring 58 mainly and supplemented by spring 56, thereby rapidly releasing the spring energy dynamically by a collision of block 46 with piston 42 and causing the entire carrier 41 to collide with valve end cap 26 for opening valve 21. The design is such that the momentum of the release block 46 and the recoiling piston 42 cannot be impeded either by the gas trapped in chamber B or the valve spring 25 sufficiently to interfere with the desired impact with cap 26. It will be understood that the size of block 46 and carrier 4 and valve head 30, the pressure in chamber A, the relative length of chamber B and of the valve stem and cap, and also the force of valve spring 25 are selected to permit the momentum of the moving piston 42, shank 45, block 46, sear 47 and fastener 71 to open valve 21 upon impact with little, if any, assisting force from expanded spring 56 at the time of impact with cap 26. Thus, spring 56 need not have a final compressive force greater than the closing force of the gas on valve head 30 although the dynamic force applied by piston 42 be adequate to open the valve, which then proceeds to close but not before piston 42 has reversed with explosive force under the impact of the fraction of expanding volume of gas released into chamber B. At the moment of piston reversal spring 56 exerts little, if any, resistance. It is not the force of the gas in chamber A on valve 21 which drives the fastener 71 and recompresses spring 56 quickly, but the force of the small but expanding volume under high and sufficient pressure in chamber B which does so. When the valve head 30 closes again as shown in Figure 2, there is driving pressure in chamber B until vent 61 is uncovered as shown in Figure 1 in which position fastener carrier head 57 protrudes from opening 2 again, but this time in contact with the work surface as at line X—X and piston 42 has cleared port 61, as shown in Figure 1.

A vent 61 passes through the tube 1 rearwardly of the carrier piston 42 when the carrier head 57 is in the normal or inoperative position shown in Figure 1. The vent 61 permits the spent driving fluid to escape from chamber B of the tube 1. A shield 62 is secured over the vent. A plurality of smaller vents may be provided at different places and a different type of vent than that shown may be employed.

The fastener carrying head 57 which is formed integrally with the fastener carrier 41 carries either headed fastener 71 or an unheaded fastener. A longitudinal bore 72 is formed through the free end of the head 57 to receive an unheaded pin. In order to receive the headed fastener 71, the carrier head is provided with a groove 73 of greater width than the diameter of the bore 72. The bottom of the groove 73 is semi-circular and concentric with the bore 72. It should be noted that the groove is intermediate the ends of the bore 72. The end of the bore opening through the free end of the head 57 has a cutout portion 74 aligned with the groove 73. The fastener has a head 75 for supporting objects. The head 75 of a fastener 71 is inserted into the groove 73 with its shank passing through the cutout portion 74 of the bore 72. In the event an unheaded fastener such as a threaded one is used, the rear end is inserted into any suitable holding socket such as the bore 72 and is seated against the inner wall 76 of the bore rearwardly of the head receiving groove 73. The head 57 is preferably magnetized to more firmly hold an iron or steel fastener. Other types of fastener carrier heads which securely hold a fastener may be provided. For example, it may include the jaws of a chuck or a threaded socket to threadably receive a fastener having a threaded head.

Operation

In advance of all operation, it is necessary that the tool first be charged with fluid. To charge the tool with the driving fluid, the cap 8 is removed and a gas cap-

6

sule 6 is placed into the cup-shaped insert 3. The cap 8 is then screwed onto the tube 1 forcing the capsule 6 against the piercing point 7 which ruptures the capsule, allowing the compressed fluid contained therein to escape through the passageways and into the storage chamber A of the tool.

Before each operation or firing a new fastener 71 is inserted into the projecting carrier head 57. It should be noted that as a first or pre-penultimate step of operation it is merely necessary to insert the fastener into the projecting head of the carrier and that no portion of the tool need in any way be disassembled, nor is it necessary to position the fastener in a barrel. At this stage the tool is in the ready-to-get ready-to-fire stage shown in Figure 1. To drive a fastener, the pointed tip of the fastener is positioned against the structural member S into which it is to be driven, at the precise point where it is desired to emplace the fastener and the body of the tool is pressed to the ready-to-fire stage shown in Figure 2 and finally is pressed all the way toward the structural member thus compressing spring 58, releasing the sear block 46 and the springs, and opening valve 21 which results in firing the tool. This in turn drives the fastener into the structural member and the fastener and tool are relatively positioned again as shown in Figure 1. By firing is meant the sudden release and application of the actuating fluid pressure to the driving piston head with explosive impact so that the applied force is equivalent to that obtained upon firing certain types of explosive charges. In the event an unheaded fastener has been driven into the structural member it is merely necessary to draw or turn the tool away from the structural surface to release the fastener. In the event a headed fastener has been driven into the structural member the tool is moved sidewise slightly parallel to the structural member to permit the fastener head to be released by passing through the groove in the fastener carrier head.

The internal driving sequence of the tool is as follows: Referring to Figure 2, with the fastener 71 positioned against the structural member S the tool body is pressed toward the structural member and the fastener carrier 41 is taken into the tubular tool body 1. During this phase, main spring 58 is compressed and the sear 47 and sear block 46 are still in their normal position with the sear lug 49 engaged in the groove 50 in the tube. As the carrier 41 is taken further into the tube 1 its frusto-conical cam surface 60 engages the cam surface 52 in the sear 47 transversely telescoping the sear into the sear block 46 against the force of the sear spring 53. The sear lug 49 is eventually thus disengaged from the groove 50 in the tube releasing the sear block. The sear block driving spring 58 and snubber 56 then force the sear block 46 assisted by spring 56 initially toward cap 26 of the valve 21 and toward carrier piston 42. The sear block 46 thus forced engages the carrier piston 42 and with impact drives it largely by the released energy of spring 58 against cap 26 of the valve stem 27 to unseat the frusto-conical valve head 30, as shown in Figure 3. The relative lengths of valve stem 27 and chamber B, the position of the vent 61, and the size of the piston 42 and 46 are such that cap 26 is impacted sufficiently to open the valve before chamber B can be pressurized sufficiently to cushion the blow and resist this action. It will be understood that the design constants are varied to obtain no more impact than is needed to release the desired amount of gas needed to drive the fastener into the work material S. At this point, spring 56 exerts the least, if any, force on cap 26 and spring 58 exerts none. With the valve open a fraction of the compressed fluid in the storage chamber A flows through the passageways 29 and into the bore 28 in the valve stem 27 and out therefrom between it and the unsealed face of piston 42 in adequate volume to charge piston displacement chamber B as shown in Figure 3, thereby forcing outwardly the fastener carrier piston 42 the area of which exceeds

the area of valve head 30 sufficiently to drive the fastener 71 into the structural member S, to return the carrier 41 against the snubber spring 56 and to leave the tool parts positioned again as in Figure 1. The fastener is then removed from the fastener carrying head and the tool is ready to receive another fastener. It will be appreciated that with no fastener 71 in the head 57 the tool parts as shown in Figure 1 are in the safety position at which the sear mechanism in the absence of a loaded fastener cannot be actuated by pushing tube 1 against work piece S or otherwise readily pressing head 57 until it is flush with the end of the tube.

Even if the fastener carrier 41 and sear assembly 46—47 should be in the position shown in Figure 3 before the tool is charged with a compressed driving fluid it is merely necessary to insert and release a capsule 6 and the gas pressure acting on valve head 30 together with the force of spring 25 will close valve 21, but not before escape of gas into chamber B. As fluid escapes through the valve 21 the fastener carrier 41 and sear assembly 46—47 will be returned to the normal position shown in Figure 1.

The tool of the present invention is particularly suitable for driving fasteners into relatively soft structural members such as wooden beams or planking. It conveniently contains a source of power for driving a single fastener or a number of fasteners, but does not require a new power charge each time a fastener is driven, nor are power supply connecting lines required. Because the fastener carrier head protrudes from the tool and is clearly visible reloading a new fastener is extremely simple and quick. The tool is simple in design and requires but a minimum of maintenance. Obviously the tool may be adapted to drive fasteners of any size into any structural member or harder material such as steel or concrete by merely changing the pressure capacity of the tool or by making other modifications in its design such as increasing the diameter of chamber B, or the size of fluid capsule, or the length of the stroke, or dimensions of the carrier parts and springs certain of which are shown either enlarged or reduced from scale in the drawing to better depict the structure involved.

It is to be understood that the invention is not to be limited to the specific details herein disclosed. For example, other forms of valves may be substituted for the poppet valve shown and described. It is to be understood that wherever seals are disclosed, any form of appropriate sealing device may be utilized and that separate sealing members are not necessarily required, but are provided as a mechanical expedient to facilitate fabrication of the tool and reduce the close tolerances otherwise required in such fabrication. It is also to be understood that the fastener carrying head may be replaced in the tool combination by other appropriate heads known in the art, and that the invention is not to be limited to a gas capsule of any particular type, size or configuration.

The mechanism may be modified and simplified where, for example, a single powerful penetration is needed using all the gaseous charge at once and/or it is desired that the device be disposable.

Although certain specific embodiments and component parts are set forth in the foregoing it will be understood that various changes may be made in such embodiments and parts without departing from the spirit and scope of this invention and that this invention is not to be limited to such embodiments or components except as set forth in the appended claims. In any event, it is notable that in the portable fastener driving tool of this invention, the carrier 41 constitutes a power operated hammer head and receiver for a prepositioned nail and the fluid charge container constitutes the built-in source of power.

What is claimed is:

1. A pneumatically actuated tool for driving a fastener into a workpiece, said tool comprising a housing, a storage chamber on said housing for containing a compressed fluid at high pressure, a barrel extension of said

housing having a driving chamber open at the front end, a valve in said housing forming an interconnection between chambers for controlling the release of at least a fraction of said compressed fluid from said storage chamber to said driving chamber when said valve is open, a fastener driving member telescopically received in said driving chamber for movement of said housing forwardly and rearwardly with respect to said member for positioning said member respectively into and out of the open end of said chamber, said driving member including receiver means on the front end for holding a fastener at said open end in forwardly directed position to adapt said fastener to be held against said workpiece, and sear means to open said valve, and means on the opposite end of said driving member and responsive to the admission of said released fluid into said driving chamber to forcibly urge said driving member and said held fastener outwardly with respect to said driving chamber, said means to open said valve being responsive to said forward movement of said housing with respect to said driving member while said fastener is held against said workpiece.

2. The tool of claim 1 wherein the fluid responsive means is a piston slidably mounted in the driving chamber, the valve is normally closed and the valve opening means includes an impact block telescopically received in the driving chamber, means tending to urge said block toward the valve, the sear means being in the form of a latch member attached to said block to hold said block stationary with respect to said driving chamber, and release means on the fastener driving member for coaction with said latch member to release said block and permit it to be driven against said piston in said driving chamber by said urging means to attain sufficient momentum to cause said piston to contact and open said valve.

3. The tool of claim 1 wherein the valve is normally closed and the fastener receiver means on the driving member includes means for abutment with a fastener and holding it as an extension of said member and wherein the means to open said valve is responsive to forward movement of the housing into abutment with said workpiece and with respect to said driving member in abutment with said fastener.

4. A pneumatically actuated tool for driving fasteners into a workpiece, said tool comprising a housing including a barrel extension, a storage chamber in said housing for holding a highly compressed gas, a driving chamber in said barrel extension having an open muzzle end, a partition separating said storage and driving chambers and a valve mounted in said partition for releasing said compressed gas from said storage to said driving chamber, said valve means comprising a normally closed poppet valve having its head opening into said storage chamber and having its stem extending through said partition into said driving chamber into a normally closed distal position, yieldable means urging said stem into said driving chamber, a fastener driving member having a means for carrying a fastener for protruding from said extension for abutment with said workpiece and being telescopically received in said driving chamber through said muzzle end of said driving chamber and piston means on said driving member responsive to said gas to urge said member outwardly with respect to said end of said driving chamber upon the admission of said gas into said driving chamber and means to open said valve when said member is urged inwardly sufficiently by the tool operator, said last means comprising a relatively massive impact block telescopically received in said driving chamber and resilient means associated with said driving member and responsive to telescoping movement of said housing with respect to said carrier means toward said workpiece to gradually store energy for urging said block toward said partition and extending stem end, holding means to cause said

block to move with said housing and prevent said block from moving toward said partition until released, means on said fastener driving member to release said holding means when said housing is further telescoped to further receive said driving member into said driving chamber nearer said partition, whereby the block impacts said piston means and the mass of both impacts said valve stem with sufficient force to open the valve and the gas in said storage chamber is released through said open valve and into said driving chamber to force said fastener driving member outwardly with respect to said driving chamber.

5. A fluid actuated driving tool comprising a tubular driving chamber member, a high pressure fluid container mounted adjacent said member for discharge therein, an inwardly biased fluid discharge block telescopically received in said tubular member for longitudinal movement therein, a block latch telescopically received in a transverse passageway of said block, means carried in said block for urging said latch outwardly with respect to said block for engagement with said tubular member, cooperating means on said tubular member to engage said latch for releasably fixing said block, relative to said tubular member, a longitudinally movable member telescopically passing through said block, and release means on said movable member to withdraw said latch from said engaging means on said tubular member when said block is substantially fully telescoped with respect to said longitudinally movable member as said block and tubular member are moved forwardly in unison, whereby said block is free to move under bias to discharge the fluid and energize the tool.

6. A tool for pneumatically driving a fastener into a workpiece, said tool comprising a fastener driving element, a body portion movable relative to said element, said element having means for carrying said fastener captively on the front end of said element in protruding relationship with respect to said body portion in one position of said portion, a charge of high pressure gas carried on said body portion to propel said fastener driving element relative to said body portion upon release of said gas, and movable detent means in said body portion together with cam means on said element for moving said detent means to release said gas upon movement of said body portion to another position relative to said element held by engagement of said carried fastener with said workpiece.

7. In a fluid actuated driving tool, a driving barrel, a self-contained pressure chamber for containing a fluid supply, a driving member carried in said barrel, a fluid power controlling a normally captive block slidably mounted for movement in said barrel when released in said tool and separated from said chamber by a wall, releasable means for holding said block captive at a position remote from said wall, means for releasing said holding means in response to movement of said barrel forwardly with respect to said driving member, a poppet valve to release said fluid, said poppet valve having a head portion on an end of a stem portion telescopically seated in said wall of said pressure chamber for engagement of the opposite end of said stem with said driving member as said driving member is driven back by said released block and means normally maintaining said valve closed, a hollow longitudinal bore in said stem opening through the end of said stem opposite said head, and a plurality of passageways through said stem opening into the hollow portion of said stem, whereby said fluid may flow through said bore in the stem when the valve is open by said engagement of said stem and driving member to energize the tool driving member and block forward once and to effect a recapture of said block by said holding means.

8. A pneumatically actuated tool for driving a fastener into a workpiece, said tool comprising a hollow body portion movably mounted for telescopically carry-

ing therein a fastener driving element, said element having receiver means for carrying said fastener on the front end of said element in protruding relationship with respect to said body portion, means for supplying at least one charge of gas at a sufficiently high pressure to propel said fastener driving element outwardly with respect to said body, means on said body to store said charge of gas, a first means on said body for releasing said charge from said supply means to said storage means and a second means on said body to release said charges one at a time responsive to forward movement of said body portion relative to said fastener driving element, and cooperating means on both said body portion and element responsive to thrust of the tool toward said workpiece and engagement of said fastener with said workpiece for actuating said second release means, said second release means being resettable for release of the next charge in response to said charge release.

9. In a pneumatically actuated tool for driving a fastener having a leading work surface penetrating tip portion, a hollow tool body portion with an end opening, a fastener driving element resiliently carried and telescopically received by the body portion of said tool and having means normally positioned adjacent said opening to receive a fastener in such a manner as to normally place said leading tip of a fastener emplaced therein protruding from said opening, and means to actuate the tool to drive the fastener, responsive to the tip of the fastener being pressed into abutment with the work surface into which it is to be driven with thrust sufficient to move and place the body portion adjacent said opening substantially into abutment with said surface, said actuating means comprising a supply of gas under pressure, a sear means cooperable with and coaxially mounted with respect to said element and body portion, and a normally closed valve for release of a charge of said gas in response to release of said sear means, said sear means being responsive to movement of said body portion to said abutment with said surface.

10. In a tool for propelling an elongated fastener of the type described, a hollow body member and a fastener driving member mounted in said body for longitudinal movement of said body with respect to said member, fluid pressure means to forcefully drive said driving member in a path in a first direction upon actuation of said tool, said fluid pressure means comprising a reservoir of fluid under pressure, said driving member having a receptacle portion for releasably carrying said fastener with its longitudinal axis substantially in said direction, cooperating means on said body member and driving member respective to the presence of said fastener in said receptacle and to movement of the body member relative to said driving member sufficiently in said first direction to actuate the tool, said cooperating means comprising a valve normally closed for releasing at least a portion of said fluid upon impact, an impact member mounted on said driving member and in said body member and biased opposite to said first direction toward said valve, a sear reciprocatably mounted with respect to said driving member and impact member in said body member, means for biasing said sear across said first direction to a position for latching with said body member and responsive to said driving member longitudinal movement to unlatch and release said impact member for actuation of said valve.

11. In a fluid actuated portable tool for driving a fastener having a leading tip portion adapted for impaling penetration into a workpiece and a trailing end portion adapted for supporting objects on said workpiece, the combination comprising a fastener driving member, a fluid reservoir containing a charge of fastener propelling fluid under pressure, a tool body mounting said reservoir and telescopically receiving said fastener driving member, said body being adapted for movement between a ready-to-get-ready-to-fire position and a ready-to-fire

11

position, discharge means in said body for said charge, said driving member being normally held outwardly with respect to said tool body in the ready-to-get ready-to-fire position of said tool by a latch member on said body, impacting means biased for actuation of said discharge means and normally held inoperative by said latch member, and a receptacle on the outermost portion of said fastener driving member to fixedly receive the trailing end of said fastener whereby the tip portion of the fastener projects outwardly from said tool in the said position for engagement with said workpiece to adapt said tool for actuation by thrust toward said workpiece, whereupon said driving member is received inwardly and said body is moved towards said workpiece sufficiently to a ready-to-fire position for actuating said discharge means thereby propelling said driving member outwardly to drive the tip portion of the received fastener into said workpiece.

12. In a fluid actuated fastener driving tool, a pressure chamber for containing a fluid, a poppet valve to release said fluid, a valve actuating normally captive block releasably held in said tool, a driving piston and means for receiving a fastener positioned on the front of said piston, said piston and block being separated from said chamber by a wall, said block being separated from said wall by said piston, said block being mounted in said tool for movement therein with respect to said piston when released, means biasing said block towards said valve, detent means for holding said block in captive

12

position against said bias, cooperating means on said piston and block for acting on said detent means at a predetermined position of said piston, fastener and block thereby releasing said block, said poppet valve having a head portion seated in said wall on an end of a stem portion telescopically passing through said wall of said pressure chamber for impact engagement of the opposite end of said stem with said piston upon contact with said released block and means normally maintaining said valve closed, a hollow longitudinal bore in said stem opening through the end of said stem opposite said head and passageways through said stem opening into the hollow bore of said stem, whereby said fluid may flow through said bore in the stem when the valve is open by said engagement of said stem and block to energize the tool piston once and move said block back to said normally captive position.

References Cited in the file of this patent

UNITED STATES PATENTS

2,723,656 Andina Nov. 15, 1955

FOREIGN PATENTS

14,447	Great Britain	of 1907
137,454	Sweden	Sept. 23, 1952
219,261	Great Britain	July 24, 1924
444,508	France	Aug. 9, 1912
607,444	Great Britain	Aug. 31, 1948

UNITED STATES PATENT OFFICE
CERTIFICATION OF CORRECTION

Patent No. 2,964,752

December 20, 1960

Rowland J. Kopf

It is hereby certified that error appears in the above numbered patent requiring correction and that the said Letters Patent should read as corrected below.

Column 1, line 16, after "fasteners." insert the following:

This application is a continuation-in-part of copending prior patent application Serial No. 542,946, filed Oct. 26, 1955 now abandoned.

Signed and sealed this 30th day of May 1961.

(SEAL)

Attest:

ERNEST W. SWIDER

Attesting Officer

DAVID L. LADD

Commissioner of Patents