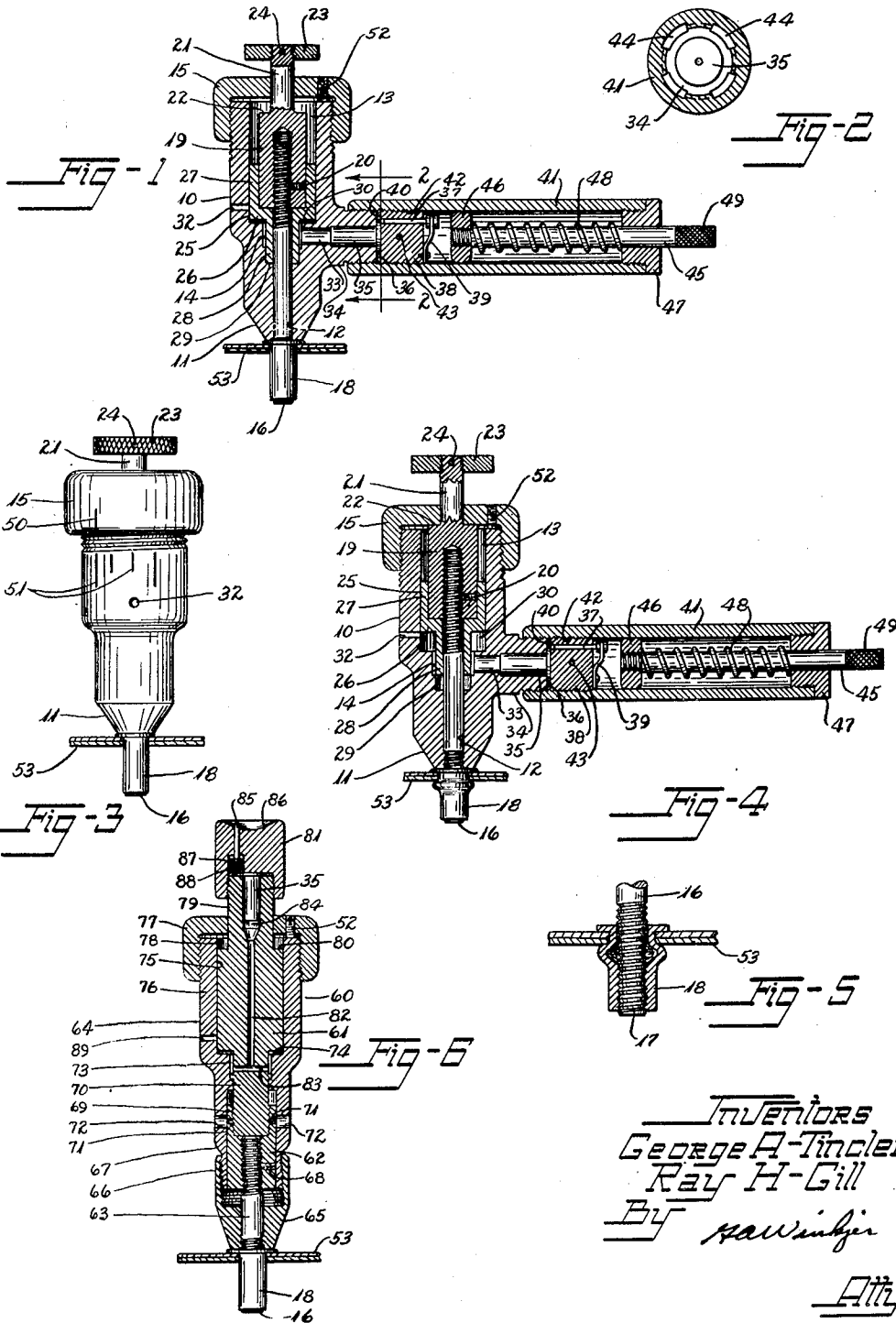


May 16, 1950

G. A. TINCLER ET AL
EXPLOSIVELY ACTUATED POWER TOOL
FOR UPSETTING TUBULAR RIVETS
Filed April 8, 1948

2,507,740



INVENTORS
George A. Tincler
Ray H. Gill
By *W. W. Winkler*

Att'y-

UNITED STATES PATENT OFFICE

2,507,740

EXPLOSIVELY ACTUATED POWER TOOL FOR
UPSETTING TUBULAR RIVETS

George A. Tincler, Union City, Pa., and Ray H. Gill, Akron, Ohio, assignors to The B. F. Goodrich Company, New York, N. Y., a corporation of New York

Application April 8, 1948, Serial No. 19,686

9 Claims. (Cl. 218—19)

1

The invention relates to fluid-powered tools for upsetting tubular rivets and especially to portable hand tools operated by gases under high pressure independently produced therein, as by the firing of a cartridge.

Objects of the invention are to provide an improved, gas-operated, portable hand tool for installing tubular rivets which tool does not require air compressors and other cumbersome apparatus for use therewith; to provide effectively for utilizing the expansive action of gas under high pressure for upsetting the rivet; to provide for independently producing high pressure in the tool itself and for controlling the magnitude of the pressure; to provide for effecting high operating pressure without requiring special pressure-sealing means in the tool; to provide for automatic release of the gas pressure after the upsetting of the rivet; to provide for adjustment of the tool with respect to grip-range of the rivet and to accommodate a range of rivet sizes; and to provide for lightweight, simplicity, and ruggedness of construction, inexpensiveness of manufacture, and for effectiveness of operation and low cost of use and maintenance. A further, more specific, object is to provide an improved rivet upsetting tool utilizing explosive cartridges for its operation.

These and other objects and advantages of the invention will be apparent from the following description.

In the accompanying drawings which form a part of this specification, and in which like numerals are employed to designate like parts throughout the same,

Fig. 1 is a view, in longitudinal section, of a tool constructed in accordance with and embodying the invention, the tool being shown inactive and positioned for upsetting a tubular rivet in the work, parts being broken away.

Fig. 2 is a sectional view taken along line 2—2 of Fig. 1.

Fig. 3 is an end view in elevation of the tool shown in Fig. 1, parts being in section and broken away.

Fig. 4 is a view, similar to Fig. 1, but showing the tool at the end of the rivet-upsetting operation before its withdrawal from the work.

Fig. 5 is a sectional view of the rivet and the work after the upsetting operation and showing a threaded draw rod of the tool engaging the rivet, and

Fig. 6 is a view, similar to Fig. 1, but showing a modified construction of the tool.

The construction of one form of the tool of

2

the invention is shown in Figs. 1 to 4, the parts of which tool may be made of alloy steel or other suitable metal having the desired strength, corrosion and heat-resisting characteristics, and includes a tubular body or cylinder housing 10. The housing may be of greater outside diameter at its upper part than that at its lower part which may have a tapered, flat ended portion 11 constituting a non-adjustable setting anvil. The housing has an axial bore 12 which is counter-bored at its upper region to provide a cylinder chamber 13 and an annular inlet passage or port 14 of reduced diameter in communication with the lower end of the cylinder chamber. The chamber is closed at its upper end by a closure cap 15 which may threadedly engage the exterior threads of the housing 10.

A draw rod 16 in the bore 12 is threaded at its lower end portion 17 to engage the internal threads of a tubular rivet 18. At its upper end the draw rod is fixed to a coupling 19, preferably of cylindrical form, disposed in the chamber 13, and is secured as by being threaded in the coupling and locked against relative rotation therebetween by a set screw 20. This permits adjustment of the draw rod relative to the coupling and the anvil, and assures movement of the draw rod and coupling as a unit both in a rotating and a reciprocating manner for engagement and disengagement with the rivet and for upsetting the latter.

The coupling 19 has an upward extension or guide rod 21 of reduced diameter thereby providing an annular, flat shoulder 22 for contacting the closure cap 15. The guide rod extends through and projects beyond an axially aligned aperture in the cap in close fitting, sliding relation with the wall thereof, and may have a knurled collar 23 fixed at its upper end as by threaded engagement therewith and a retaining pin 24. The arrangement facilitates manual movement of both the draw rod and the coupling for engaging and disengaging the tubular rivet 18.

For compelling axial movement of the coupling in the direction toward the cap 15 to upset the rivet, the coupling 19 is carried by a hollow piston 25 and forms with the latter a piston structure disposed in the cylinder chamber 13, the coupling contacting an end wall 26 of the piston and being in telescopic, movable and substantially loose-fitting relation to a depending annular side wall 27 of the piston to permit separation of the coupling and draw rod from the piston as for tool servicing purposes. The side wall 27 is in snug fitting, sliding relation to the wall of the cylinder

chamber so that a minimum of high-pressure gas may escape past the piston.

The piston has a cylindrical portion or projection 28 of reduced, uniform diameter extending axially downward from its end wall 26 into the inlet port 14 and seating against the flat end wall 29 of the port 14 for the inactive condition of the tool. This construction makes possible the provision of the desired reaction area of the piston immediately available for action thereon by the pressure-gases in the small gas-expansion space at 30 between the end wall 26 and the lower end of the cylinder chamber 13. The piston has an axial bore for receiving the draw rod 16 in sliding relation therewith. An exhaust port 32 is provided in the wall of the chamber 13 in a position to be uncovered during the travel of the piston to permit the expanded gas to escape to the outer atmosphere.

A firing chamber 33 adapted to receive a cartridge 35 is in communication with the inlet passage 14 and is provided by a laterally extending, exteriorly threaded, hollow boss 34 of the housing 10 at the region of the inlet port, which boss has an end seating face 36.

A firing pin 37 movably disposed in an exteriorly threaded, breech block 38 having a seating face 40, is held by a spring retainer 39. The breech block 38 is mounted in a tubular handle 41 and threadedly engages an end portion 42 of the handle so that the seating face 40 seats tightly against the cartridge 35 while the latter is seated tightly against the seating face 36 of the boss, the breech block being held in position by a suitable retaining pin 43. The threads of the handle end portion 42 where it extends beyond the seating face of the breech block 38, and the threads of the hollow boss 34 are cut away at two or more circumferentially spaced-apart regions at 44, as shown especially in Fig. 2, to provide a quick-detachable connection of the handle 41 to the housing 10 facilitating rapidly loading and unloading the cartridge to and from the firing chamber.

For conveniently operating the firing pin 37, a trigger structure in the handle has a shaft 45 secured to a collar 46 located adjacent the retainer 39, the shaft extending axially through and beyond an apertured closing plug 47 threadedly engaging the other end of the handle. A compression type coil spring 48 is mounted about the shaft between the collar 46 and the plug 47 to provide under compression a striking force to the trigger structure. The free end of the shaft may be knurled at 49 for facilitating gripping the same.

The tool hereinabove described advantageously includes provision for adjustment to accommodate rivets of different lengths and for adjustment of travel of the piston, that is, adjustment of the grip range of the rivet. The adjustment for rivets of different lengths is accomplished by effecting the desired axial positioning of the draw rod 16 in the coupling 19 so that the lower end portion 17 projects beyond the setting anvil 11 a sufficient extent to engage the threads of the rivet, the screw 20 assuring maintenance of the draw rod at the position thus established.

The adjustment for grip range of the rivet, that is, the control of the expansion or upsetting of the rivet, is accomplished by rotating the closure cap 15 about the housing 10. This will vary the axial position of the cap 15 with respect to that of the coupling 19 and piston 25 for the inactive condition of the tool shown especially in Fig. 1,

whereby the axial travel of the piston is adjusted.

The cap 15 may have a pointer mark at 50 and the housing a position-indicating scale at 51 for convenience of adjusting the tool. The cap has suitable position-retaining means which may, for example, be a set screw 52.

In the operation of the tool, the latter may be loaded by detaching the handle 41; inserting the cartridge 35, which may, for example, be a .22 calibre, long rifle, blank cartridge, into the firing chamber 33; and then attaching the handle to the boss 34, whereby the breech block 38 firmly holds the cartridge in position for firing by the pin 37. The amount of powder charge of the cartridge may be selected in accordance with the size of the rivet to be upset. The rivet 18 may be threaded on the end portion 17 of the draw rod 16 as by suitable rotation of the rivet while the collar 23 is held against rotation. With the handle grasped by the operator, the rivet is inserted in the work 53 so that the head end of the rivet seats against a face of the work. The shaft 45 of the trigger structure is then pulled and released, whereupon the cartridge is fired by the pin 37.

The gases of combustion pass from the firing chamber 33 to the inlet port 14 and thence to the gas-expansion space at 30 beneath the piston 25. The low ratio of the volume of space available for expansion of gas subsequent to firing of the cartridge to the volume of powder charge makes possible the high pressures, such, for example, as about 20,000 to 50,000 lbs. per square inch, sufficient to upset the rivet. The gases upon expansion urge the piston toward the cap 15 until the coupling 19 seats its shoulder 22 against the cap which prevents further upward movement of the draw rod 16. The movement of the piston 25 opens the exhaust port 32 permitting the gases to escape to the outer atmosphere.

The axial upward movement of the draw rod applies axial force to the wall of the shank of the rivet 18 upsetting a portion of such wall to a bulged form against the back of the work 53, thus securely clamping the latter between the head end and the bulge, as shown especially in Fig. 4, and holding the rivet in the work. The collar 23 may be rotated to disengage the draw rod from the upset rivet. The tool is then ready for re-loading to upset another rivet.

The modified construction 60 shown in Fig. 6 includes the features of the tool hereinabove described but has a different arrangement of the piston structure 61, coupling 62 and draw rod 63 in the cylinder housing 64 and has an adjustable setting anvil 65. The tapered, flat ended anvil 65 receiving the draw rod 63 therethrough has its upper portion 66 interiorly threaded to engage the exterior threads of a hollow end portion 67 of the housing. The coupling 62 is positioned in the end portion 67 for axial movement of it and the draw rod which threadedly engages the coupling, as shown in Fig. 6. A set screw 68 adjustably holds the draw rod at the desired position in the coupling.

The coupling 62 at its upper part at 69 is counterbored and interiorly threaded to engage the threads at the lower end of a cylindrical portion 70 of reduced diameter extending axially downward from the piston 61 and integral therewith. Set screws 71, 71 adjustably secure together the coupling and the piston and are accessible for adjustment through aligned apertures 72, 72 in the end portion 67 of the housing.

The bore of the housing 64 adjacent the lower

5

end of the piston is recessed to provide an annular inlet passage or port 73 in communication with the gas-expansion space at 74 of the cylinder chamber 75. The piston 61 is positioned for axial movement in the cylinder chamber 75 of the upper end portion 76 of the housing. The cylinder chamber is closed by a suitable apertured closure cap 77 threadedly engaging the upper end portion 76 so as to permit piston movement in the space at 73 and to provide for adjustment of the travel of the piston 61.

The piston 61 has an upwardly extending guide rod 79 of reduced diameter thereby providing an annular flat shoulder 80 for contacting the closure cap 77, the guide rod 79 extending through and beyond the cap and having, desirably, a left hand thread connection with a breech block 81. The piston has an axial bore 82 of small, uniform diameter extending centrally from the upper end of the guide rod 79 to the projection 70 and intersecting a transverse bore 83 of small, uniform diameter in communication with the inlet port 73 for the inactive condition of the tool. The guide rod 79 is counterbored to provide a firing chamber 84 for receiving a suitable cartridge 35 which seats against the end face of the guide rod and is held firmly by the breech block 81.

A firing pin 85 extends axially through the breech block in position for setting off the cartridge when the exposed end of the pin at the depression 86 in the breech block is manually struck as by a hammer. The firing pin 85 is retained in the breech block as by a collar 87 and compression spring 88 structure arranged on the pin adjacent the guide rod.

The cap and housing may have indicator scale markings like those of the tool shown in Figs. 1 to 4, inclusive, for indicating the adjustment of the cap with respect to travel of the piston. The cap may be provided with suitable position-retaining means 52 for maintaining the desired position of adjustment.

Adjustment of the modified tool 60 for different lengths of rivets 18 may be accomplished by effecting the desired axial positioning of the setting anvil 65. Further adjustment may be effected by altering the axial relationship of the coupling 62 and the piston 61 through loosening the set screws 71, 71' for permitting the desired axial movement of the coupling relative to the piston and then re-tightening the set screws. The adjustment of the tool for the grip-range of the rivet is accomplished by rotation of the closure cap 77 to the desired setting on the housing 64.

The operation of the modified tool 60 differs from that of the tool 10 in that the housing 64 itself is held by the operator while a hammer blow is struck against the firing pin 85 to set off the cartridge 35 which has been previously disposed in the firing chamber 84. The gases of combustion traverse the bores 82, 83 in the piston to the inlet port 73 and then pass to the gas-expansion space 74 where they force the piston-coupling-draw rod unit upwardly toward and into contact with the cap 77 and thereby upset the rivet 18 in the work 53. Such axial movement of the piston uncovers an exhaust port 89 in the wall of the cylinder chamber 75 thereby permitting the gas to escape to the outer atmosphere. After the rivet has been upset, the tool may be detached from the same by rotating the breech block to effect the preliminary unscrewing of the draw rod relative to the rivet

6

after which the entire tool may be rotated for full disengagement from the rivet.

The invention makes possible the production of portable hand tools of simplified construction having reduced weight and size, and low operating and maintenance cost as compared to prior tools for upsetting tubular rivets.

Variations may be made without departing from the scope of the invention as it is defined in the following claims.

We claim:

1. A power tool for upsetting tubular rivets, said power tool comprising a housing having at one end thereof an anvil for holding the rivet in place, a chamber in said housing having an end recess of reduced cross-sectional area extending toward said anvil, a piston structure in said chamber having a portion of reduced cross-sectional area as compared to that of said end recess of said chamber extending into said end recess, the reduced portion of said piston structure and the wall of said end recess of the chamber providing space between them constituting an inlet passage in communication with said chamber, means in communication with said inlet passage for supplying pressure-fluid to said chamber to compel movement of said piston structure in the direction away from said anvil, and a draw rod secured to said piston structure for movement therewith and extending through said anvil and housing for engaging the rivet.

2. A power tool for upsetting tubular rivets, said power tool comprising a housing having at one end thereof an anvil for holding the rivet in place, a chamber in said housing having an end recess of reduced cross-sectional area extending toward said anvil, a piston structure in said chamber having a portion of reduced cross-sectional area as compared to that of said end recess of said chamber extending into said end recess, the reduced portion of said piston structure and the wall of said end recess of the chamber providing an annular space between them constituting an inlet passage in communication with said chamber, means in communication with said inlet passage for supplying pressure-fluid to said chamber to compel movement of said piston structure in the direction away from said anvil, a closure element closing the end of said chamber opposite the anvil end of the housing and adjustably mounted on said housing for limiting travel of said piston structure, and a draw rod secured to said piston structure for movement therewith and extending through said anvil and housing for engaging the rivet.

3. A power tool for upsetting tubular rivets, said power tool comprising a tubular housing having at one end thereof an anvil and providing at the other end thereof a chamber therein having an end recess of reduced diameter extending toward said anvil, a piston structure in said chamber, a closure cap closing said other end of the housing and adjustably mounted thereon for limiting travel of said piston structure, said piston structure having an extension through and beyond said cap in rotatable and sliding relation therewith and a portion of reduced diameter as compared to that of said end recess of said chamber extending into said end recess, the reduced portion of said piston structure and the wall of said end recess of the chamber providing space between them constituting an annular inlet passage in communication with said chamber, means in communication with said inlet passage for supplying pressure-fluid to said

7

chamber to compel movement of said piston structure in the direction away from said anvil, and a draw rod secured to said piston structure for movement therewith and extending through said anvil for engaging the rivet.

4. A power tool as defined in claim 3 in which said housing has an external boss adjacent said inlet passage, and in which the pressure-fluid supplying means comprises a firing chamber in said boss in communication with said inlet passage and adapted to receive a fluid-pressure generating charge, a hollow handle including a breech block portion detachably connected to said boss, and means in said handle for setting off said charge.

5. A power tool as defined in claim 3 in which said housing has an external boss adjacent said inlet passage, and in which the pressure-fluid supplying means comprises an explosive-cartridge receiving chamber in said boss in communication with said inlet passage, a hollow handle including a breech block portion detachably connected to said boss, and means in said handle for setting off said explosive-cartridge.

6. A power tool as defined in claim 3 in which the pressure-fluid supplying means comprises a charge-receiving chamber in said extension of said piston structure for a fluid-pressure generating charge, a bore extending from said charge-receiving chamber through said piston structure into communication with said inlet passage, a breech block detachably connected to said extension, and means in said breech block for setting off said charge.

7. A power tool as defined in claim 3 in which the pressure-fluid supplying means comprises an explosive-cartridge receiving chamber in said extension of said piston structure, a bore extending from said receiving chamber through said piston structure into communication with said inlet passage, a breech block detachably connected to said extension, and means in said breech block for setting off the cartridge.

8. A power tool for upsetting internally threaded tubular rivets, said power tool comprising a tubular housing having at one end thereof an anvil for holding the rivet in place, a reciprocating hollow piston in the chamber of said tubular housing having a portion of reduced diameter extending toward said anvil, said chamber at the reduced portion of said piston having an end recess of reduced diameter which diameter exceeds that of said reduced portion, said reduced portion of said piston and the wall of said end recess of said chamber providing space between them constituting an annular inlet passage in communication with said chamber, a closure cap

8

for closing the end of said tubular housing opposite the anvil end thereof and adjustably mounted thereon for limiting travel of said piston, a coupling in said chamber disposed between the

5 piston and closure cap and movable with and mounted on said piston in telescopic relation thereto, said coupling having an extension through and beyond said cap in rotatable and sliding relation therewith, a draw rod in adjustable engagement with said coupling and extending through said piston and anvil for engaging the threads of the rivet, and means including an explosive cartridge for supplying pressure-fluid to said inlet passage and said chamber to operate

15 said piston.

9. A power tool for upsetting internally threaded tubular rivets, said power tool comprising a tubular housing having at one end thereof an anvil for holding the rivet in place, a piston structure in the chamber of said tubular housing, a closure cap for closing the other end of said housing and adjustably mounted thereon for limiting travel of said piston structure, said piston structure having an extension through and beyond said cap in rotatable and sliding relation therewith and a portion of reduced diameter extending toward said anvil, said chamber at the reduced portion of said piston structure having an end recess of reduced diameter which diameter exceeds that of said reduced portion said reduced portion of said piston structure and the wall of said end recess of said chamber providing an annular space between them constituting an inlet passage in communication with said chamber, a coupling between said anvil and said piston structure and engaging the reduced portion of the latter for movement therewith, a draw rod adjustably engaging said coupling and extending through said anvil for engaging the threads of the rivet, an explosive-cartridge receiving chamber in said extension of the piston structure in communication with said inlet passage, a breech block detachably secured to said extension, and means in said breech block for setting off the

45 cartridge.
 GEORGE A. TINCLER.
 RAY H. GILL.

REFERENCES CITED

50 The following references are of record in the file of this patent:

UNITED STATES PATENTS

Number	Name	Date
55 2,384,347	Schutz	Sept. 4, 1945