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POWDER-ACTUATED TOOLS

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This invention relates generally to powder-actuated tools, and is directed more specifically to the elimination or, at least, the reduction of the blast effects and the recoil which normally occurs in the use of such tools.

One of the principal uses of powder-actuated tools is that of driving a penetrating member, such as a pin or stud, into steel, concrete or other material that is difficult to penetrate. Frequently, the penetrating member serves as a fastener after becoming embedded in the material, and hence should present a neat appearance. The tool itself is usually a portable device having a barrel, within which a cartridge is fired to drive the fastener into the work. The fastener is loaded back from the muzzle in order to acquire considerable velocity prior to its contacting the work, and the muzzle is generally placed against the work surface preparatory to firing.

Ideally, the tool should remain in firm engagement with the work surface until the fastener comes to rest, for otherwise there is danger of injury from ricochets or spalls. Heretofore, it has been customary to rely merely upon the operator to hold the tool against the work, although in some instances, safety devices have been provided to prevent operation of the tool when it is not properly positioned. In heavy-duty tools, which fire large powder charges, this task of holding the tool becomes formidable. Indeed, the recoil or jump may become so great that operation is possible only at the expense of extreme discomfort to the operator.

In the co-pending application, Serial No. 355,034, filed on May 14, 1953 by Robert W. Henning, Rowland J. Kopf and Roger Marsh now Patent No. 2,945,236, issued July 19, 1960 and owned by the assignee of the present application, there is disclosed a powder-actuated tool in which the barrel thereof is vented near the muzzle to permit escape of the propellant gases after the fastener is driven home. This arrangement has the desirable effect of reducing the amount of gas by-passing the fastener, and to some extent, controls recoil and noise.

It is an object of this invention to provide for substantial elimination of recoil and considerable reduction of noise, particularly in heavy-duty tools. Briefly, the tool barrel is perforated as disclosed heretofore, but the gas-escape ports are slanted forwardly and open into a blast chamber, preferably sealed, of substantial volumetric capacity. This chamber may be symmetrically disposed about the barrel, or the barrel may be ported along only a limited quadrant and the blast chamber may lie principally to that side of the barrel. Also, transverse baffles may be provided within the chamber to absorb and divert the slanted gas jets, or the gas may issue transversely and contact slanted baffles.

Other objects of the present invention, and certain of its practical advantages, will be referred to in or will be evident from the following description of three embodiments of the invention, as illustrated in the accompanying drawings, in which

FIG. 1 is a fragmentary longitudinal sectional view of a powder-actuated tool constructed in accordance with one embodiment of the present invention;

FIG. 2 is a cross-sectional view of the tool of FIG. 1, the view being on the line 2—2 of FIG. 1;

FIG. 3 is a view similar to FIG. 1 but showing another embodiment of the present invention; and

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FIG. 4 is a view similar to FIGS. 1 and 3 and showing still another embodiment of the present invention.

As is well known, powder-actuated tools are used to embed fasteners of different types in a wide variety of materials. Perhaps their greatest utility is in construction work in the field, where conditions demand maximum speed and prevent the use of more conventional electric drills and the like. For this reason, powder-actuated tools are generally lightweight and adapted for convenient handling. By the same token, they are not too well suited to resist recoil, and this tendency to recoil becomes especially unpleasant and tiring to the tool operator when powerful explosive charges are used. Such heavy-duty tools and charges are commonly employed in driving large fasteners into steel plate, although they also may be needed for concrete and other materials.

In use, the tool is placed up against the work, and as a result, the work surface is subjected to the blast effects of the propellant gases as they escape about the driven fastener, and these gases may cause spalling of concrete, splitting of wood or marring and burning of other materials. The gases may be directed from the surface by vents, but difficulty is encountered in protecting the operator and minimizing recoil. For example, in the tool of the aforesaid application Serial No. 355,034, the tool barrel is vented adjacent the muzzle, but the vent ports open into relatively narrow passages which direct the gas in jets rearwardly and then forwardly against a floating muzzle shield. Although the gases serve to hold the shield in contact with the work, they exert a force rearwardly against the body of the tool and thereby increase recoil. Moreover, as the gases escape about the shield, considerable blast noise may be developed.

Referring now to the drawings of the present application, certain portions of a powder-actuated tool are there illustrated to demonstrate how the aforesaid difficulties can be overcome or minimized in accordance with the present invention. For purposes of clarity, only those portions of the tool relevant to this invention are shown, the omitted portions being well known in the art.

As will be noted, the here illustrated parts of said tool comprise, in the embodiment of the invention illustrated in FIGS. 1 and 2, a barrel 10 having threadedly connected to its rear end portion, as at 11, a breech block 12 which is suitably recessed at 13 to receive a firing pin (not shown) for the detonation of a powder load or cartridge 14 which is mounted in the rear end portion of the barrel. Surrounding the rear end portion of the barrel and the breech block connected thereto is a housing structure 15 having threadedly connected to its front end portion, as at 16, the rear end portion of a forwardly extending sleeve structure 17 which surrounds the barrel 10, as best shown in FIG. 1.

Interposed between and engaged by the breech block 12 and the rear end portion of the sleeve structure 17 is an annular collar 18, and to prevent relative rotary movement of the barrel 10 and the breech block 12 and relative rotary movement of the breech block 12 and the sleeve structure 17 suitable splines 19 and 20 are here respectively provided, as shown in FIG. 1.

To open the breech, the housing structure 15 and/or the sleeve structure 17 are relatively turned to separate the parts at the threaded connections 11 and 16, and after the tool is loaded by insertion of the powder load 14 and a fastening element 22, the breech may be closed by reverse turning movement of the housing and sleeve structure, as will be readily understood.

In use of the tool, the muzzle of the tool barrel is placed against the work W, which may be of steel, concrete or the like, and the firing pin of the tool actuated to detonate the powder load 14, with consequent driv-

ing of the fastening element 22 forwardly through the tool barrel and into the work W, as shown in FIG. 1.

In accordance with the present invention, and for the purpose of substantially eliminating recoil and of materially reducing noise, a blast chamber 24 is provided near the muzzle of the tool barrel, and the barrel is provided with one or more gas-venting ports 25 which open into said chamber. As here shown, said chamber is formed by radially enlarging the front end portion of the sleeve housing 17, and although the chamber may be uniformly disposed about the axis of the tool barrel, as in the embodiment of the invention shown in FIG. 4, the blast chamber 24 of the embodiment of FIGS. 1 and 2 is laterally offset with respect to the axis of said tool barrel. Moreover, in this embodiment of the invention, the chamber side wall on its laterally offset portion is slanted forwardly and radially outwardly, as at 26, and then extends, for the terminal part thereof, directly forwardly, as at 27. To close the chamber at its front end, a plate 28 is provided, the closure plate being welded or otherwise suitably secured to and within the surrounding chamber wall at the front end thereof and said closure plate being provided, of course, with a suitable aperture 29 for reception of the tool barrel 10.

Although the size, shape, disposition and location of the gas-venting ports 25 may be varied as desired, four such ports are shown in the embodiment of the invention illustrated in FIGS. 1 and 2. In this embodiment, the ports are in longitudinally or axially spaced relation in a line on that side of the tool barrel to which the blast chamber is offset, and each of said ports is slanted forwardly and outwardly. Preferably, the forwardmost port 25 is located some distance rearwardly of the muzzle or forward end of the tool barrel so that such port is not blocked by the fastening element 22 if a portion of said element remains in the tool barrel after a firing operation and before the tool is removed from the work, as in FIG. 1.

In this particular embodiment of the invention, the blast chambers 24 is provided with a series of baffles having transverse partition or baffle portions 30, each of which is located forwardly of one of the gas-venting ports so as to be struck by gas issuing therefrom. As here shown, the closure plate 28 for the front end of the blast chamber serves as a transverse partition or baffle portion for the forwardmost port, although a separate transverse partition or baffle portion may be provided for such port, if desired. In addition, the baffles have their transverse partition or baffle portions 30, although not the front closure plate 28 in the present embodiment of the invention, provided with a series of small, laterally spaced and longitudinally extending baffle portions 31 which are located opposite the vent ports 25. Preferably and as here shown, the baffle portions 31, which may be rearwardly inclined toward the axis of the tool barrel, increase in height or longitudinal extent outwardly from the tool barrel and also, increase in number toward the front end of the chamber, the number increase being in accordance with the increase in the lateral extent of the transverse partition or baffle portions 30 toward the front of said chamber.

In operation of the tool, the forward component of thrust from the gas reacts with the transverse partition or baffle portions 30 and the front closure plate 28 and is transmitted through the body of the tool, with consequent elimination or substantial minimization of recoil. Further, the transverse component reacts with the laterally spaced, longitudinally extending baffle portions 31 to counteract the side thrust applied to the barrel by the issuing gas. Being sealed, the chamber 24 also muffles the shock wave, so that noise is greatly reduced.

With the arrangement disclosed, the gas-venting ports 25 need not be so restricted in size as to prevent gas-borne particles from being blown into the blast chamber, inasmuch as such particles cannot adversely affect op-

eration of the tool. Actually, the number and the size of the ports will depend upon the counter-recoil force desired, but the ports should be located near the muzzle, although not so close as to be blocked by the fastening element after it has been embedded in the work and before the tool is removed.

Although the gas-venting ports 25, in the embodiment of the invention illustrated in FIGS. 1 and 2, are inclined for cooperation with transverse recoil-counteracting partition or baffle portions, similar action can be obtained with ports more nearly transverse, as in the embodiment of the invention illustrated in FIG. 3. In such embodiment, the tool barrel 110 is provided with a plurality of generally transverse ports 125, and the blast chamber 124 is provided with a plurality of baffles 130 having inclined partition or baffle portions. These baffles have portions inclining forwardly toward the barrel, with their inner ends in spaced relation to the barrel and slightly forwardly of the ports 125. As will be readily understood, the force of the gas issuing from the ports applies a forward and lateral component on the body of the tool and thereby counteracts the recoil and side thrust of the barrel.

In the embodiment of the invention illustrated in FIG. 4, which is particularly useful for heavy-duty tools, the barrel 210 is provided with a plurality of circumferentially spaced rows of gas-venting ports 225, and the blast chamber 224 is more or less uniformly disposed about the axis of the tool barrel. As in the embodiment of the invention illustrated in FIGS. 1 and 2, the ports 225 of each row are longitudinally or axially spaced and slant forwardly and radially outwardly. Although front closure wall 228 of the blast chamber 224 of the embodiment of FIG. 4 may be of flat form and a separate member, as in the previously described embodiments, said closure wall is shown as rearwardly offset by a tapering marginal portion 228a and as an integral part of the surrounding wall of the blast chamber. Wall 228 serves as a baffle for reacting with the jets emerging from ports 225 and having a transversely extending central annular baffle portion and another annular baffle portion 228a inclined forwardly away from the barrel.

From the foregoing description of the present invention, those skilled in the art to which it relates will understand the structure, function and mode of operation of the three embodiments of the invention herein illustrated, and will appreciate the features and advantages of the present invention. Although three embodiments of the invention have been illustrated and described, it is to be understood that the invention is not limited thereto, as the invention may take other forms. It also is to be understood that the terminology or phraseology herein used is for purposes of description and not of limitation, as the scope of the present invention is denoted by the appended claims.

What is claimed is:

1. In a powder-actuated tool having a barrel; the improvement comprising a row of ports along the barrel, a plurality of baffles, and means mounting said baffles opposite said ports to intercept the issuing gas at an oblique angle; said tool being characterized in that said ports open forwardly and in that said baffles are substantially perpendicular to the barrel, thereby to be urged generally forwardly by the issuing gas, and in that there are parts projecting from said baffles opposite said ports, said parts reacting generally radially outward to the issuing gas.

2. In a powder-actuated tool having a barrel and a surrounding housing; the improvement wherein said housing flares outwardly to form a chamber of substantial volume, gas venting port means leading from the bore of the barrel into said chamber, and a plurality of baffles in said chamber spaced along the barrel with said baffles increasing in at least one dimension progressively in the direction of increasing flare.

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