Oct. 2, 1962 B. V. NYHOLM 3,056,390

INTERNAL COMBUSTION PERCUSSION TOOLS AND HAMMER PISTONS FOR SUCH TOOLS

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Fig. 1

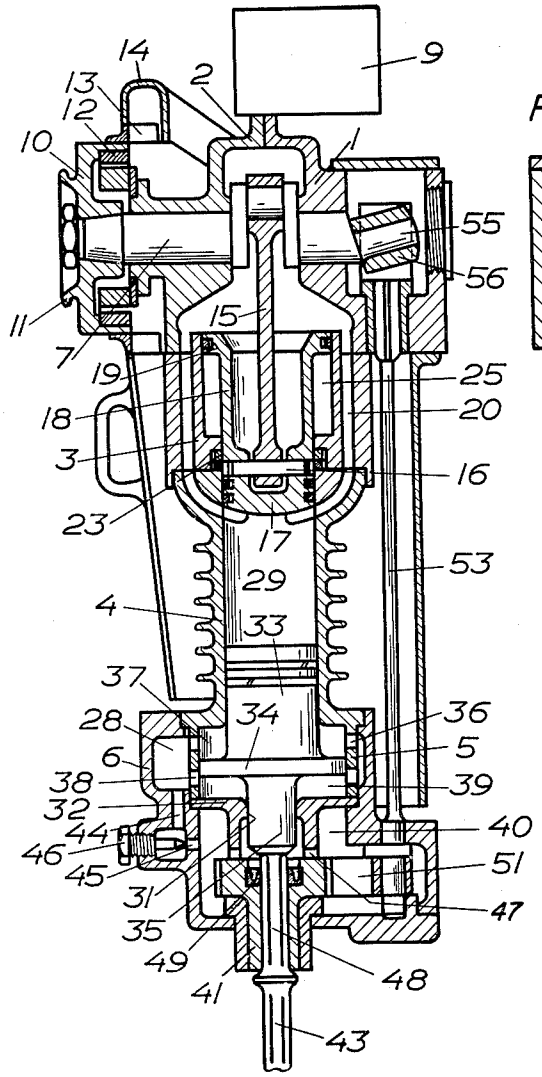


Fig. 3

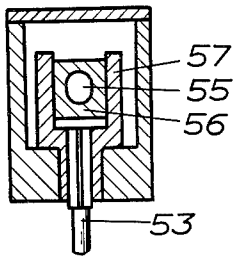
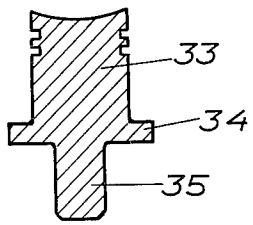
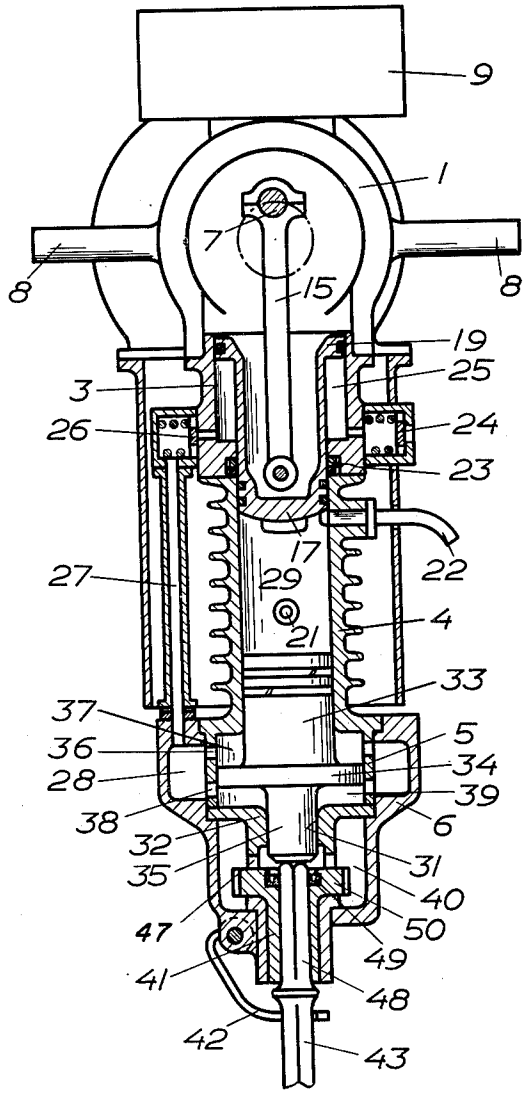


Fig. 9



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Fig. 2



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Fig.4

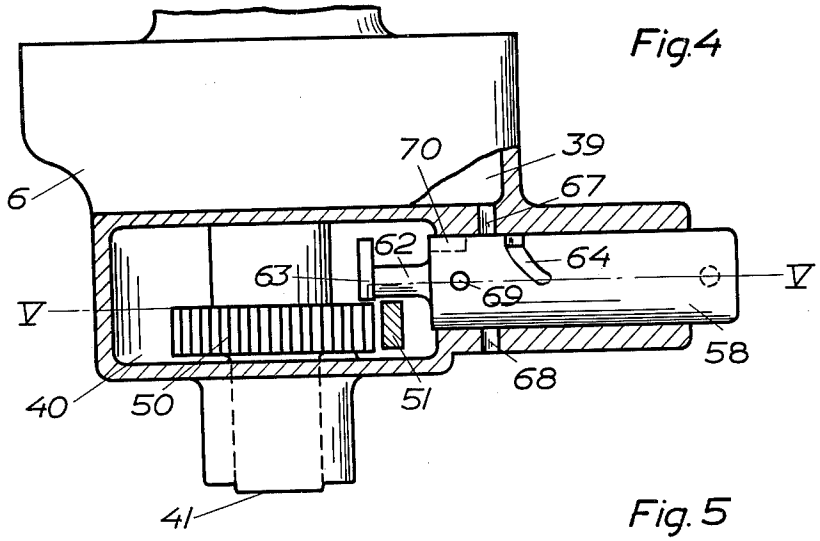


Fig. 5

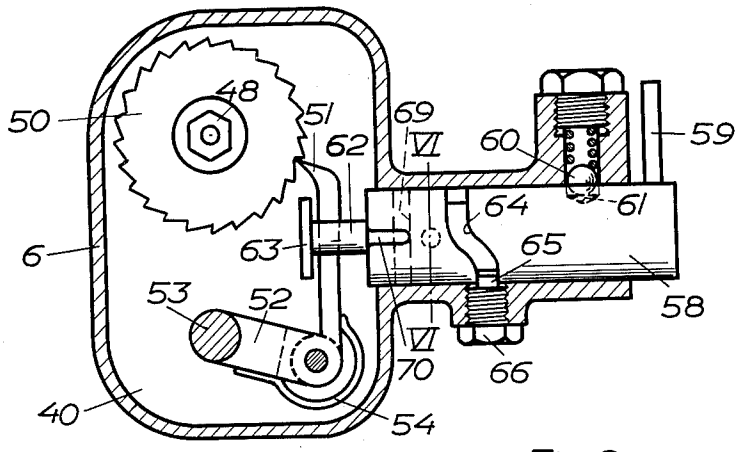


Fig.6

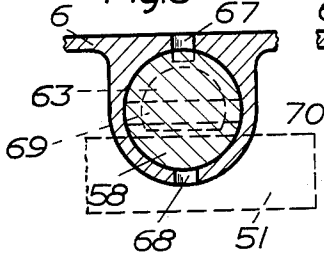


Fig.7

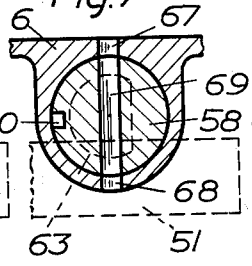
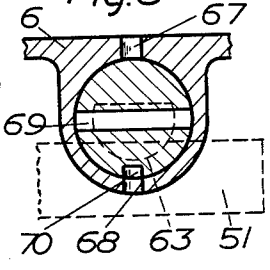


Fig.8



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United States Patent Office

3,056,390
Patented Oct. 2, 1962

3,056,390

INTERNAL COMBUSTION PERCUSSION TOOLS AND HAMMER PISTONS FOR SUCH TOOLS

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Filed Mar. 31, 1959, Ser. No. 803,168
1 Claim. (Cl. 123—7)

This invention relates to improvements in internal combustion percussion tools having a reciprocable free piston actuated by combustion gases for producing the percussion stroke and by pressure gas or air in a chamber in the tool for producing the return stroke of the free piston. Such tools are primarily used as concrete breakers and as rock drills for drilling holes of moderate depths as may be needed for erection of power line posts, building foundations, sewage and water pipe trenches and the like. For all these different jobs the low weight of the tool is of outstanding importance for the ease of handling it. Another very important feature is to provide a tool which produces a heavy blow without injury to the hammer piston or the working implement. One object of the invention is to provide a tool which incorporates a hammer piston making possible the design of a tool in which the above features are combined in a manner resulting in a dependable efficient tool of a weight about fifty five pounds or less and are capable of drilling holes from a few feet up to 10—15 feet and to do the other work demanded from the tool.

In the accompanying drawings one embodiment of an internal combustion percussion tool according to the invention is illustrated by way of example it being understood, however, that various modifications of the invention may be made within the scope of the claim. FIG. 1 is a longitudinal section of the tool on a plane including a crank shaft incorporated in the tool which has a combined motor and compressor piston connected to the crank shaft and a free opposed motion piston. FIG. 2 is a longitudinal section of the tool on a plane perpendicular to the crank shaft. FIG. 3 is a detail section of one end of the crank shaft and cooperating means for transmitting motion to a drill steel rotation mechanism. FIG. 4 illustrates on a larger scale a lower housing forming a part of the tool and containing means for engaging and disengaging a drill steel rotation mechanism. FIG. 5 is a view substantially on line V—V in FIG. 4, and FIGS. 6, 7 and 8 are cross sections on line VI—VI in FIG. 5 showing a disengaging and valve member in various positions. FIG. 9 is a longitudinal section of the free moving piston of the tool.

The percussion tool illustrated on the drawings has a casing comprising a crank case 1, 2, a compressor cylinder 3, a motor cylinder 4, an auxiliary cylinder 5, and a lower housing 6. The motor cylinder 4 and the auxiliary cylinder 5 may preferably be made integral. A crank shaft 7 is journalled for rotation in the crank case 1, 2, which has two handles 8, 8 provided thereon. The crank case carries a fuel tank 9 and the crank shaft carries a flywheel 10 provided with a rope starter drum 11 for starting of the tool, a magneto 12 for generating ignition current, and a cooling fan 13 operating in a spiral housing 14 formed in the crank case portion 2. A connecting rod 15 is journalled on the crank pin of

the crank shaft 7 and connected by means of a piston pin 16 to a combined motor and compressor piston. Said piston which is a differential trunk piston consists of a motor portion 17, a sleeve portion 18, and a compressor portion 19. The motor portion 17 in conventional manner controls openings in the cylinder 4 through which scavenging air and fuel is supplied to the combustion chamber 29 in the motor cylinder through passages 20 leading to the combustion chamber from the crank case. Scavenging air is drawn into the crank case and compressed therein by the combined motor and compressor piston 17, 19. Fuel is supplied to the scavenging air from the fuel tank 9 by means of a carburetter (not illustrated) in conventional manner. 21 indicates a spark plug and 22 an exhaust manifold. 23 indicates sealing rings provided between the combustion and compressor cylinders and forming a seal with the sleeve portion 18 of the differential piston.

The compressor portion 19 draws air through an opening controlled by a valve 24 into an annular compressor cylinder chamber 25 and compresses the air therein and delivers it over a valve 26 through a conduit 27 to a chamber 28 in the lower housing 6. A free piston, FIG. 9, formed as a combined motor, hammer, damper and return stroke producing piston is reciprocable in the combustion cylinder chamber 29, an auxiliary cylinder chamber 39 with larger diameter than said combustion cylinder chamber, and in a bore 31 in a guide member 32 having a diameter which is half the diameter of the combustion cylinder bore or more. The free piston consists of a motor portion 33 fitting in the combustion cylinder chamber 29 and provided with piston rings, a portion 34 with larger diameter, movable in the auxiliary cylinder, and a blow delivering hammer portion 35 with a smooth cylindrical surface extending over substantially the whole length of said hammer portion and sealing the bore 31 in the guide member 32. In order to give sufficient weight to the free piston said piston is made solid and with the motor portion 33 at least as long as the hammer portion 35 and the damper portion 34 together. The smooth comparatively large hammer portion 35 is strong enough to withstand the stresses produced by the blows for a long time and still the whole free piston is sufficiently elastic not to expose the working implement to undesirable stresses. Finally the free piston is so short that the whole tool length and the weight of the tool may be kept within permissible limits and in practice a tool weight of 50–55 pounds is maintained according to the invention.

Air compressed by the compressor portion 19 in the chamber 25 flows from the chamber 28 through openings 36 into an annular space 37 on the upper side of the free piston portion 34 and through openings 38 into the chamber 39 in the auxiliary cylinder 5 defined by the lower face of the piston portion 34 and the guide member 32 which forms the lower head or bottom of the chamber 39. Below the guide member 32 a chamber 40 is formed in the lower housing 6 which in the illustrated embodiment accommodates drill steel turning mechanism. However, in tools not used for rock drilling said rotation mechanism may be dispensed with.

In the illustrated tool, a drill steel chuck 41 is rotatably journalled in the lower housing 6, which also carries a drill steel retainer 42, swingably mounted on the lower

housing 6 as is obvious from FIG. 2, and capable of retaining a drill steel 43 or other working implement. The upper end face of the drill steel chuck 41 together with the lower end face of the guide member 32 form a thrust bearing with large bearing surfaces for transmitting the axial thrust on the working implement from the tool casing, i.e. the feed pressure. The drill steel chuck may be provided with interlocking means, such as a transverse pin inserted in the lower casing and entering a corresponding hole in the chuck so that turning of the chuck may be prevented when it is desired to use the tool as a concrete breaker, or as a spade tool, or the like.

The openings 36 and 38 serve to admit compressed air into the chambers 37 and 39 as aforesaid. The air cushion in the chamber 37 prevents the free piston from hitting the upper end wall of the annular chamber 37 with the annular piston portion 34. A passage 44, 45 leads from the chamber 28 to the chamber 40, said passage being controlled by an adjusting screw 46. From the chamber 40 passages 47 in the guide member 32 lead to a space surrounding the blow receiving end of the shank 48 of the drill steel 43 which has a conventional flushing passage (not illustrated) normally opening in said space but for the short moments when the free piston delivers the blows. A packing 49 prevents flushing air in the chamber 40 from leaking to the atmosphere between the shank 48 of the drill steel and the drill chuck 41.

In order to make possible turning of the drill steel 43 the chuck 41 forms a ratchet wheel 50 provided with teeth cooperating with a pawl 51 operated to rotate the ratchet wheel 50 in a certain direction. For this purpose the pawl 51 is hingedly connected to an arm 52 provided on a shaft 53 which oscillates during the operation of the tool. A spring 54, FIG. 5, normally keeps the pawl 51 in a position in which it engages the ratchet wheel 50. The oscillating turning movement of the shaft 53 is derived from the crank shaft 7 which for this purpose has a pin 55 at one end set at an angle with respect to the longitudinal rotation axis of the shaft 7, as is obvious from FIGS. 1 and 3. A block 56 is mounted on said pin 55 and said block is slidable in the forked end 57 of the oscillatable shaft 53. When the crank shaft 7 turns one revolution this well known motion transmission causes the shaft 53 and arm 52 to produce an oscillating turning movement which causes the pawl 51 to reciprocate and turn the ratchet wheel 50 and the drill steel chuck 41 thereby turning the drill steel.

A disengaging and valve member 58 is rotatably and axially displaceably mounted in the lower housing 6. The member 58 may be said to be a combined sleeve valve and disengaging means for the pawl 51. The member 58 is provided with a handle 59 accessible from the outside of the lower housing 6 so that the member 58 may easily be turned. A spring loaded ball lock 60 cooperates with a number of notches 61 in the member 58 to retain said member in various positions of adjustment. The member 58 forms a seal in the lower housing 6 and is provided at its inner end with an arm or finger 62 ending with a head 63 having a disc shape as indicated in chain dotted lines in FIGS. 6, 7 and 8 and arranged in such a manner that the head in the position of the member 58 illustrated in FIGS. 4, 5 and 6 leaves the pawl 51 free to move for turning the ratchet wheel 50. The member 58 is provided with a cam groove 61 cooperating with a lug 65 formed on a screw 66 in such a manner that the member 58 when turning by means of the handle 59 is displaced axially. Two passages 67, 68 are provided in the lower housing 6 and lead, as is obvious from FIG. 4, from the chamber 39 to the atmosphere, said passages being controlled by the member 58. The member 58 has a transverse passage 69 and an axial peripheral goove 70 extending from the inner end of the sleeve portion of the member in the peripheral portion thereon.

The member 58 operates in the following manner. When the percussion tool is operated as a rock drill and is started the handle 59 is at first turned 90° from the position illustrated in FIGS. 4–6 causing the member 58 to take the position illustrated in FIG. 7. During this turning motion the member 58 is axially displaced so that the head 63 pulls the pawl 51 out of engagement with the ratchet wheel 50. Consequently, no turning of the drill steel chuck can be produced when the crank shaft starts to rotate. Simultaneously, the passage 69 connects the passages 67 and 68 so that the chamber 39 is vented to the atmosphere. Consequently, the free piston 33, 34, 35 remains in bottom end position. By means of a starter rope (not illustrated) the starter rope drum 11 is rotated and the motor portion of the tool is started and the tool runs idle. No percussion work is then produced since the free piston 33, 34, 35 does never lift from its bottom position. As soon as the motor portion is running and the operator is ready to start drilling he places to tool with the steel 43 against the spot to be drilled and turns the handle 59 90° in reverse direction to the position illustrated in FIGS. 4, 5 and 6 causing the venting passage from the chamber 39 to be closed and the pawl 51 to be moved into engagement with the ratchet wheel 50 by the spring 54. The weight of the tool causes the shank 48 of the steel 43 to lift the free piston 33, 34, 35 to the position in FIGS. 1 and 2. The compressed air produced by the compressor portion 19 in the chamber 25 and supplied through the conduit 27 to the chamber 28 and admitted through the openings 38 to the chamber 39 lifts the free piston 33, 34, 35 which starts to operate and to cooperate with the motor piston portion 17. Compressed air simultaneously admitted through the openings 36 to the annular chamber 37 provides an air cushion in said chamber. The tool now operates as a rock drill with air flushing of the drill hole.

If it is desired to use the tool as a concrete breaker or as a spading tool or the like in which case rotation of the working implement is not desired or permitted the drill steel 43 is replaced by a chisel or other implement which is inserted in the drill chuck 41. Starting of the tool is made after turning of the handle 59 so that the member 58 takes the position illustrated in FIG. 7. The motor portion is then started in the manner above described and the tool runs idle. When the motor portion has started the handle 59 is turned 90° to the position illustrated in FIG. 8. In this position the venting of the chamber 39 is interrupted but the pawl 51 is still kept in inoperative position. Through the groove 70 which is now connected with its inner end to the opening 68 venting of the chamber 40 is obtained so that supply of flushing air is interrupted. The shank of the implement lifts the free piston in the same way as in drilling and the free piston 33, 34, 35 now operates and reciprocates and delivers impacts to the tool implement but without turning the implement, i.e. the tool operates as a concrete breaker, a spade tool, or the like.

The tool above described and illustrated in the drawings should be considered only as an example and the details of the tool may be varied in various different ways within the scope of the claim. The invention may for instance be employed in combustion gas driven tools in which no rotation mechanism for the implement is provided.

What I claim is:

An internal combusion percussion tool comprising in combination a casing, a combustion cylinder in said casing, a combustion cylinder in said caisng, an auxiliary cylinder of larger diameter than said combustion cylinder in said casing, a guide member having a bore with less diameter than said combustion cylinder coaxial with said combustion cylinder, a free differential piston having a motor portion reciprocable and guided in said combustion cylinder and an integral cylinder hammer portion reciprocable and guided in said bore and having a cylindrical sealing surface extending along substantially the

whole length of said hammer portion and a damper and return stroke producing portion reciprocable in said auxiliary cylinder, the length of the motor portion of said differential piston being at least as great as the combined lengths of said hammer and damper portions, a tool chuck rotatable in said casing, a motor piston reciprocable in the combustion cylinder in opposition to said free piston, a crank mechanism mounted for rotation in the casing and connected to said motor piston, positive air compressing means having a greater displacement than the displacement of said motor piston connected to said crank mechanism, means connecting said air compressing means to said auxiliary cylinder for delivering air under

pressure to said air auxiliary cylinder for producing said return stroke and a chuck rotation mechanism capable of being coupled to said chuck for rotation of the chuck and driven by said crank mechanism.

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