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ELECTROPNEUMATIC HAMMERING DEVICE

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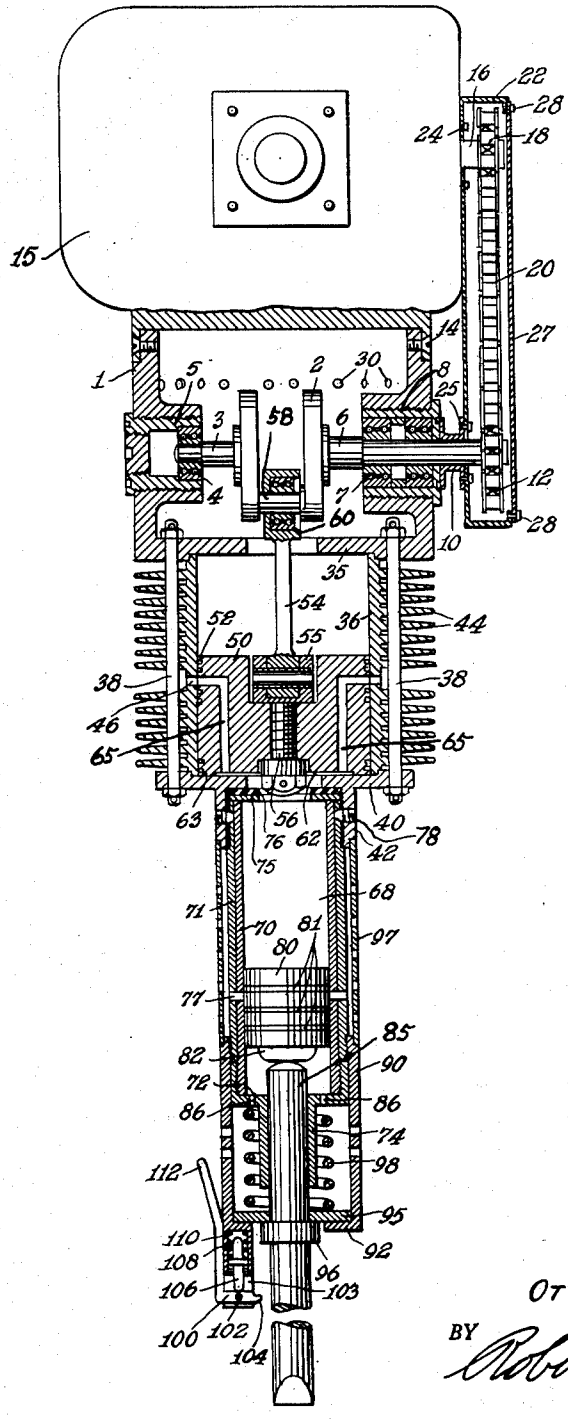

INVENTOR.
OTTORINO SPARANO
BY Robert E. Burns
ATTORNEY.

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ELECTROPNEUMATIC HAMMERING DEVICE

Ottorino Sparano, Turin, Italy, assignor to Henry J. Clay and Joseph Carlino, both of New York, N. Y., attorneys for Enrico Squeri

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7 Claims. (Cl. 60—62.5)

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This application relates to a pneumatic hammering device and is more particularly concerned with a portable electropneumatic hammering device adapted for use in rock breaking, riveting, ramming, chiseling and like operations.

Hammering devices of various types are known, for example pneumatic devices operated by compressed air supplied from an external source. while compressed air hammering devices are widely used, the necessity of providing a continuous supply of compressed air is in some cases a serious disadvantage.

It is the principal object of the present invention to provide an improved pneumatic hammering device.

It is another object of the invention to provide a device of the character indicated which does not require an external supply of compressed air.

It is a further object of the invention to provide an electrically-driven pneumatic hammering device which is easy to operate and efficient in operation.

According to the invention I provide a pneumatic hammering device comprising a freely reciprocatable piston adapted to act upon the tool being driven and a second reciprocatable piston in air-tight communication with the cylinder containing the first piston and driven from a suitable power source, e. g. an electric motor.

It is a feature of my device that the driven piston may be continuously actuated but that the free tool-engaging piston may be actuated at will and automatically without the use of switches, valves or the like.

It is another feature of my device that it may be embodied in a readily portable form and may be employed with a plurality of interchangeable tools for rock breaking, riveting, ramming, chiseling or like operations which require an intermittent striking force.

Other objects and features of my invention will be readily apparent from the following detailed description of one illustrative embodiment of my invention and from the accompanying drawing wherein there is shown, in vertical longitudinal section partly in elevation, a portable electropneumatic hammer embodying features of the invention.

Referring to the drawing, the reference numeral 1 designates a casing in which is rotatably mounted a crank 2, the free end 3 of the crank shaft being journalled in bearing 4 carried in a bearing housing 5 secured in the wall of casing 1. The driven crank shaft 6 is rotatably mounted in bearings 7 secured in bearing housing 8 disposed in the wall of casing 1 opposite housing 5. The shaft 6 extends exteriorly of the casing 1 through a flanged sleeve 10 and is provided at its outer end with a sprocket wheel 12. Mounted over the casing 1 and removably secured thereto, as by screws 14, is a motor 15 having a shaft 16 provided with a sprocket wheel 18. A sprocket chain 20 connects sprocket wheel 12 with sprocket wheel 18 to provide a direct driving connection between the motor shaft 16 and the crank shaft 6. A protective housing 22 secured, as by screws 24, to the face of motor 16 and the flange 25 of sleeve 10 encloses the sprocket chain 20 and the related portions of the device. A cover plate 27 is removably secured, as by screws 28, to housing 22 to permit ready accessibility of the sprocket chain 20 and the sprocket wheels 12 and 18. The casing 1 is provided with a plurality of apertures 30 to permit ready influx and efflux of air.

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The lower end of casing 1 is provided with an inwardly directed flange 35, and a cylinder 36 having a finned external surface is secured by means of stud bolts 38 between the flange 35 of casing 1 and a centrally apertured plate 40 which has a downwardly-projecting integral sleeve portion 42. The outer surface of cylinder 36 is formed with a plurality of spaced radial fins 44 which are suitably apertured to permit the passage of stud bolts 38 and which are adapted to permit air cooling of the wall of cylinder 36 to provide rapid dissipation of any heat which may be generated therein. On a line slightly below its center line the cylinder 36 is provided with aligned apertures 46 which provide communication between the interior of cylinder 36 and the atmosphere, for a reason which will be apparent as the description proceeds.

Positioned in cylinder 36 is a reciprocable piston 50 suitably provided with piston rings 52 and connected by means of connecting rod 54 to crank 2. The connecting rod 54 is secured to piston 50 by a pivot mounting 55 which is secured, as by bolt 56, to the piston 50, and the connecting rod 54 is mounted upon the pin 58 of the crank 2 by means of a bearing 60 in the usual manner. It will be observed that the lower face of the piston 50 is provided with a recessed central portion 62 whereby a clearance is provided between the lower face of the piston 50 and the inner surface of plate 40 when the piston 50 is in its lowermost position with the peripheral portion of its lower face 63 in engagement with the plate 40, as shown in the drawing. The piston 50, as may be clearly seen in the drawing, is formed with channels 65 extending vertically through the

piston from the recess 62 and turning at right angles to extend outwardly to the side wall of the piston in alignment with the apertures 46 when the piston is in its lowermost position as shown in the drawing. The channels 65, when the piston is in its lowermost position, thus provide direct communication between the space below the piston and the atmosphere.

Below cylinder 36 is a second cylinder 68 of lesser diameter which is defined by two concentric sleeve members 70 and 71 and an end member 72 which has a downwardly extending integral tubular portion 74 and is threadedly engaged with sleeve member 70. The sleeve members 70 and 71 extend upwardly into sleeve portion 42 of plate 40, the sleeve member 71 threadedly engaging sleeve portion 42, and the upper ends of the sleeve members 70 and 71 being separated from the lower face of plate 40 by a metal washer 75 and a resilient washer 76, which may be formed from rubber or other resilient shock absorbing material. The sleeve members 70 and 71 are provided in their lower portion with aligned apertures 77 which provide communication between the interior of cylinder 68 and the atmosphere. Set screws for maintaining the relative relationship of parts are shown at 78.

Freely reciprocable in cylinder 68 is a piston 80 provided with piston rings 81. The lower face of the piston 80 is formed with a centrally-positioned boss 82 which is adapted to engage the upper end of a removable tool shank 85 extending through the tubular portion 74 of the end member 72. As shown as 86, the end member 72 is formed with apertures permitting continual access of air below the piston 80. Surrounding the lower ends of sleeve members 70 and 71 and end member 72 is an outer cylindrical member 90 which threadedly engages sleeve member 71 and has a lower inwardly extending flange 92 on which is supported an apertured disc 95 through which the tool shank 85 extends, the tool shank 85 being provided with a collar 96 which limits the upward movement of the tool shank through the disc 95. An apertured tubular section 97 extends between sleeve portion 42 and cylindrical member 90. A coil spring 98 is disposed between the disc 95 and the lower face of end member 72 to provide a shock absorbing means for the tool shank 85. As will be apparent from the drawing, the tool shank is freely movable in disc 95 and tubular portion 74 and may be removed therefrom at will. Accidental removal of the tool shank 85 is prevented by a catch 100 pivotally mounted at 102 in a downwardly-extending projection 103 of flange 92. The end 104 of catch 100 is positioned to engage the collar 96 of the tool shank 85 when in the position shown in the drawing, i. e. its normal position maintained by a spring pressed member 106 seated in a bore 108 formed in projection 103 and normally urged downwardly by spring 110. Release of the tool is effected by pivoting the catch 100 by means of handle 112.

The lower end, i. e. the working end of the tool 85, which in the embodiment illustrated is in the form of a chisel, may have any desired form depending upon the type of work to be performed by the device. The tool, as previously mentioned, is readily removable and a tool having the desired end formation may be inserted in the device, thus a plurality of tools having different end formations may be used interchangeably.

The operation of the device shown in the drawing is as follows.

When the motor 15 is energized, the crank 2 is driven through the sprocket chain 20 and a regular reciprocating movement is imparted to piston 50. As the piston 50 moves upwardly during its up-stroke, the movement of channels 65 above apertures 46 closes off communication between the atmosphere and the space below piston 50, and the portion of cylinder 68 above piston 80 when the tool shank 85 is in the position shown in the drawing, i. e. the operating position with its working end in engagement with the surface to be worked. Continued upward movement of piston 50 thus causes a partial vacuum to be created in the upper portion of cylinder 68 and the lower piston 80 is raised by the pressure of the atmosphere entering the lower portion of cylinder 68 through the apertures 86 and, after the piston 80 has risen a short distance in cylinder 68, through the apertures 77. When the piston 50 begins its down stroke, the air in the cylinder 68 between the lower surface of piston 50 and the upper surface of piston 80 is compressed and the piston 80 is driven downwardly with force against the upper end of tool shank 85, thereby imparting a sharp stroke to the tool shank. As the piston 50 reaches the bottom of its down stroke, communication with the atmosphere through channels 65 is again established and any pressure is released. The cycle is then repeated, and in this manner a continuous intermittent hammering action upon the end of tool shank 85 is effected. The resilient washer 76 dampens the shock of the free piston 80 at the top of its up stroke and the coil spring 98 partly absorbs the shock of the tool against the device.

When it is desired to stop the device, that is, to stop the hammering action upon the shank 85 of the tool, it is merely necessary to remove the working end of the tool from the surface being worked. When the piston 80 strikes the top of the tool shank 85 under these conditions the shank 85 is driven downwardly until the collar 96 strikes the end 104 of catch 100, or at least until the upper end of the shank 85 is below the level of the inner surface of bottom member 72. When the tool shank 85 is thus ejected, the piston 80 moves downwardly until the boss 82 strikes bottom member 72. In this position, as will be readily seen by reference to the drawing, the top surface of the piston 80 will be below the level of the apertures 77 so that upon upward movement of piston 50, which continues to reciprocate as long as motor 15 is energized, a vacuum will no longer be created above piston 80 and piston will therefore not rise. When it is desired to resume use of the device, it is merely necessary to press the working end of the tool against the surface being worked, thereby driving the tool shank 85 upwardly into cylinder 68 until the piston 80 is moved upwardly a sufficient distance that it closes apertures 77, e. g. when collar 96 strikes disc 95 as shown in the drawing. The next upward stroke of piston 50 will then create a partial vacuum in cylinder 68 which will permit the atmospheric pressure to raise piston 80, and operation of the device will be automatically resumed.

While my device is particularly adapted to be carried from place to place and is thus completely portable, it can also be mounted in a fixed support of any convenient kind. Advantageously, the device may be provided with suitable handles or hand grips (not shown).

While I have thus shown and described a preferred illustrative embodiment of my invention,

it will be observed that various changes and modifications may be made without departing from the scope of the invention as defined in the appended claims, and it is intended therefore that all matter contained in the foregoing description and in the drawing shall be interpreted as illustrative and not in a limiting sense.

What I claim and desire to secure by Letters Patent is:

1. A pneumatic hammering device comprising means defining a first cylinder, a driven piston reciprocable in said first cylinder, means defining a second cylinder coaxial with the first, adjacent ends of said cylinders being in constant communication with one another, a free piston reciprocable in said second cylinder by alternate pressure and suction produced by the reciprocation of said driven piston, a tool having a shank and means for slidably receiving the shank of said tool in the lower end of said second cylinder below said free piston, said tool shank being movable axially between an inner position in which it projects into said second cylinder and thereby limits the downward movement of said free piston and an outer position in which it permits further downward movement of the free piston, a portion of said second cylinder intermediate its ends being provided with an aperture open to the atmosphere and positioned to be covered by said free piston when downward movement of said free piston is limited by said tool shank in its inner position and uncovered when further downward movement of said free piston is permitted by the tool shank being in its outer position.

2. A pneumatic hammering device comprising means defining a first cylinder, a driven piston reciprocable in said first cylinder, means defining a second cylinder communicating with the first, a piston freely reciprocable in said second cylinder by alternate pressure and suction produced by the reciprocation of said driven piston, a tool having a shank and means for slidably receiving the shank of said tool in the lower end of said second cylinder, said tool being movable between an inner position in which it projects into said second cylinder and thereby limits the downward movement of said free piston and an outer position in which it permits further downward movement of said free piston, a portion of said second cylinder intermediate its ends being provided with an aperture open to the atmosphere and positioned to be covered by said free piston when downward movement of said piston is limited by said tool shank in its inner position and uncovered when said free piston is in its lowermost position to open to the atmosphere the space between the two pistons.

3. A pneumatic hammering device comprising means defining a first cylinder, a driven piston reciprocable in said first cylinder, means defining a second cylinder of lesser diameter than said first cylinder, said first cylinder and said second cylinder being coaxial and in communication with each other, a free piston reciprocable in said second cylinder, and means for slidably receiving the shank of a tool in the lower portion of said second cylinder below said free piston, a portion of said upper cylinder normally disposed between the ends of said driven piston being provided with apertures communicating with the atmosphere, and said driven piston being provided with passageways extending from the bottom to the side walls thereof, said passageways being positioned in such manner that their outer ends are in alignment with the apertures in the first cylinder when the driven piston is in its lowermost position.

4. A pneumatic hammering device comprising means defining a first cylinder, a driven piston reciprocable in said first cylinder, means defining a second cylinder of lesser diameter than said first cylinder, said cylinders being coaxial and the upper end of the second cylinder being in communication with the lower end of the first cylinder, a piston freely reciprocable in the second cylinder by alternate suction and pressure produced by the reciprocation of said driven piston, a tool having a shank and means for slidably receiving the shank of said tool in the lower end of said second cylinder, said tool being movable between an inner position in which it projects into said second cylinder and thereby limits the downward movement of said free piston and an outer position in which it permits further downward movement of said free piston, a portion of said second cylinder intermediate its ends being provided with an aperture opening to the atmosphere and positioned to be covered by said free piston when downward movement of said piston is limited by said tool shank in its inner position and uncovered when said tool shank is in its outer position and said free piston is in its lowermost position to open to the atmosphere the space between the two pistons.

5. A pneumatic hammering device comprising means defining a first cylinder, a driven piston reciprocable in said first cylinder, means defining a second cylinder of lesser diameter than said first cylinder, said first cylinder and said second cylinder being coaxial and in communication with each other, a free piston reciprocable in said second cylinder, and means for slidably receiving the shank of a tool in the lower portion of said second cylinder below said free piston, a portion of said upper cylinder normally disposed between the ends of said driven piston being provided with apertures communicating with the atmosphere, and said driven piston being provided with passageways extending from the bottom to the side walls thereof, said passageways being positioned in such manner that their outer ends are in alignment with the apertures in the first cylinder when the driven piston is in its lowermost position, and said lower cylinder being provided with apertures communicating with the atmosphere and being disposed in such manner that they are above the free piston when said free piston is in its lowermost position in said second cylinder.

6. A pneumatic hammering device comprising means defining a first cylinder, a driven piston reciprocable in said first cylinder, means defining a second cylinder of lesser diameter than said first cylinder, said first cylinder and said second cylinder being coaxial and in communication with each other, a free piston reciprocable in said second cylinder, a portion of said upper cylinder normally disposed between the ends of said driven piston being provided with apertures communicating with the atmosphere, and said driven piston being provided with passageways extending from the bottom to the side walls thereof, said passageways being positioned in such manner that their outer ends are in alignment with the apertures in the first cylinder when the driven piston is in its lowermost position, a tool having a shank and means for slidably receiving the shank of said tool in the lower end of said second cylinder, said tool being movable between an inner position in which it projects into said second cylinder and thereby limits the downward movement of said free piston and an outer position in which it permits further downward movement of said free piston, a por-

tion of said second cylinder intermediate its ends being provided with an aperture opening to the atmosphere and positioned to be covered by said free piston when downward movement of said piston is limited by said tool shank in its inner position and uncovered when said tool shank is in its outer position and said free piston is in its lowermost position to open to the atmosphere the space between the two pistons.

7. A pneumatic hammering device comprising means defining a first cylinder, a driven piston reciprocable in said first cylinder, means defining a second cylinder of lesser diameter than said first cylinder, said first cylinder and said second cylinder being coaxial and in communication with each other, a free piston reciprocable in said second cylinder, and means for slidably receiving the shank of a tool in the lower portion of said second cylinder below said free piston, a portion of said upper cylinder normally disposed between the ends of said driven piston being provided with apertures communicating with the atmosphere, and said driven piston being provided with passageways extending from the bottom to the side walls thereof, said passageways being positioned

in such manner that their outer ends are in alignment with the apertures in the first cylinder when the driven piston is in its lowermost position, the lower end of said second cylinder below said free piston being apertured for communication with the atmosphere, and said lower cylinder also being provided with second apertures communicating with the atmosphere and being disposed in such manner that they are above the free piston when said free piston is in its lowermost position in said second cylinder.

OTTORINO SPARANO.

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