Aug. 1, 1933. J. N. BAKER 1,920,673

AIR CIRCULATING MEANS FOR PORTABLE HAMMERS

Filed Aug. 14, 1931 3 Sheets-Sheet 1

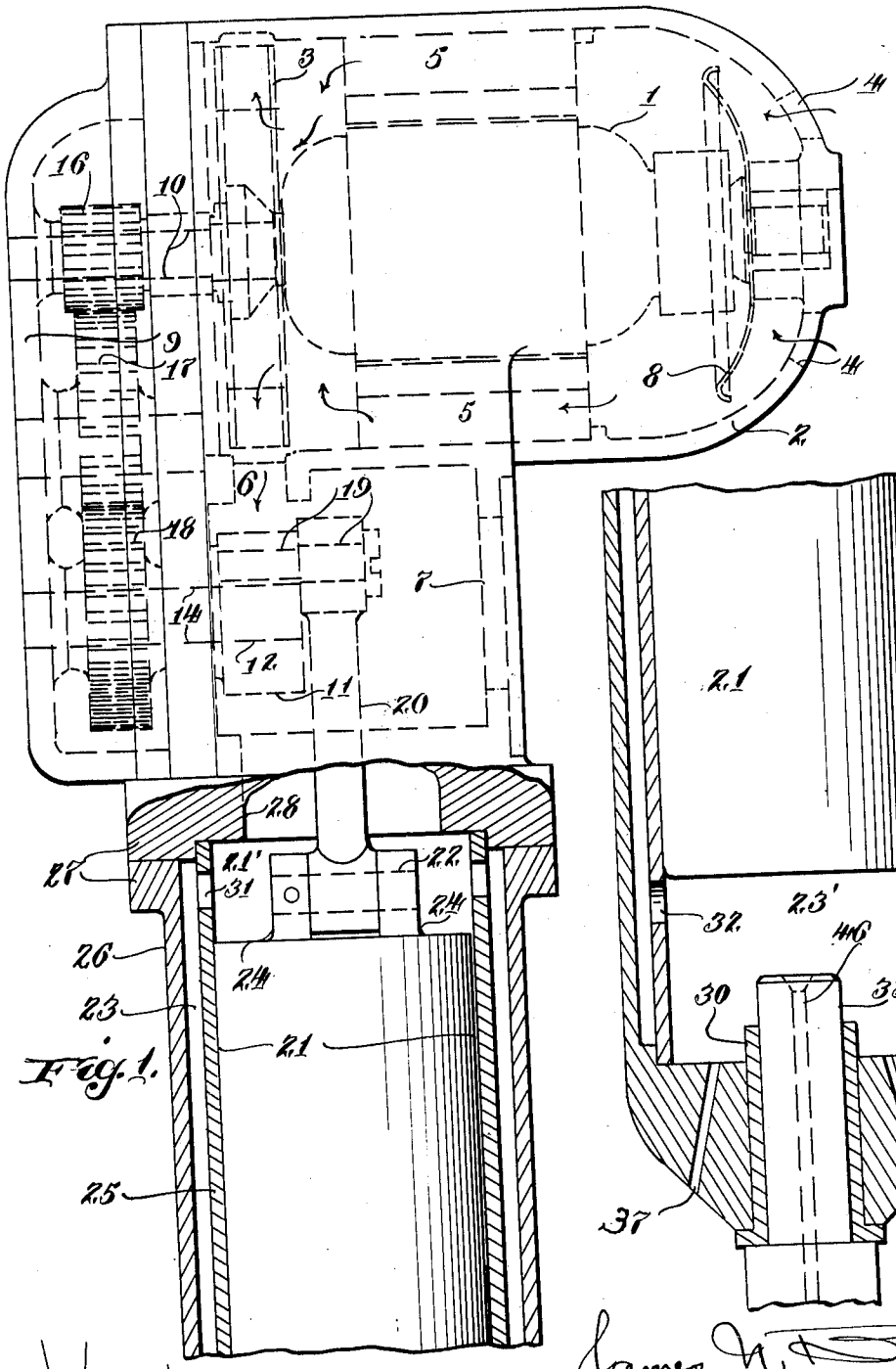


Fig. 1.

Fig. 2.

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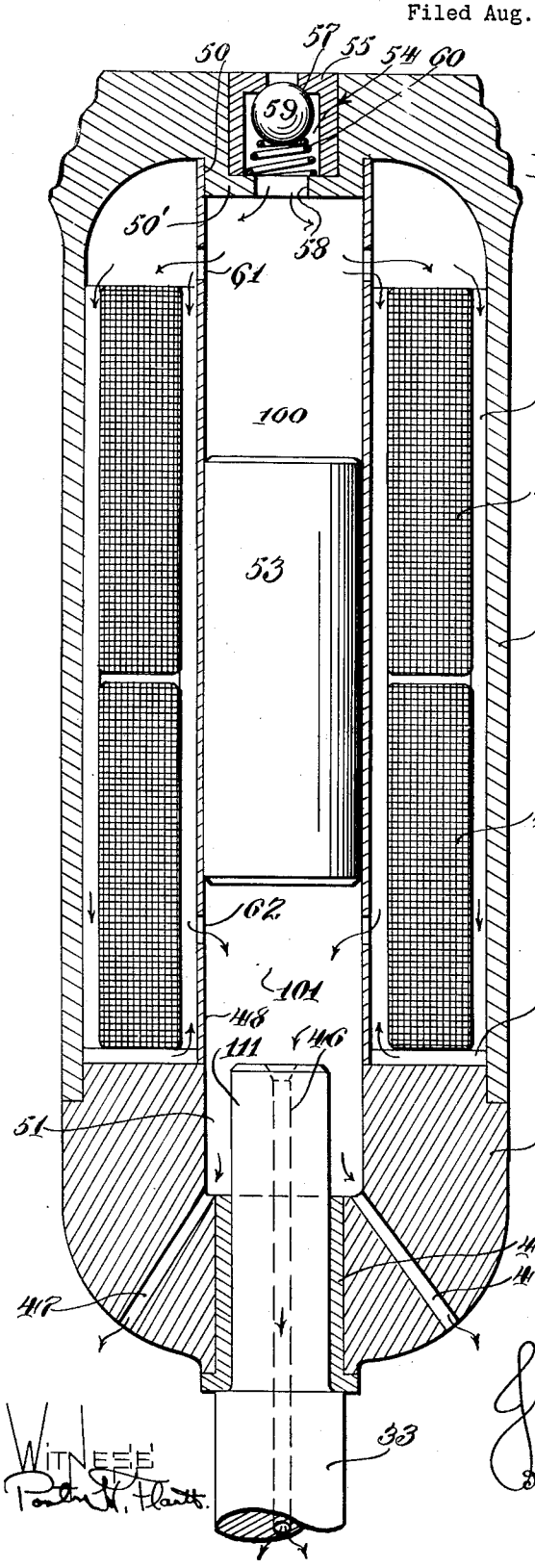


Fig. 3.

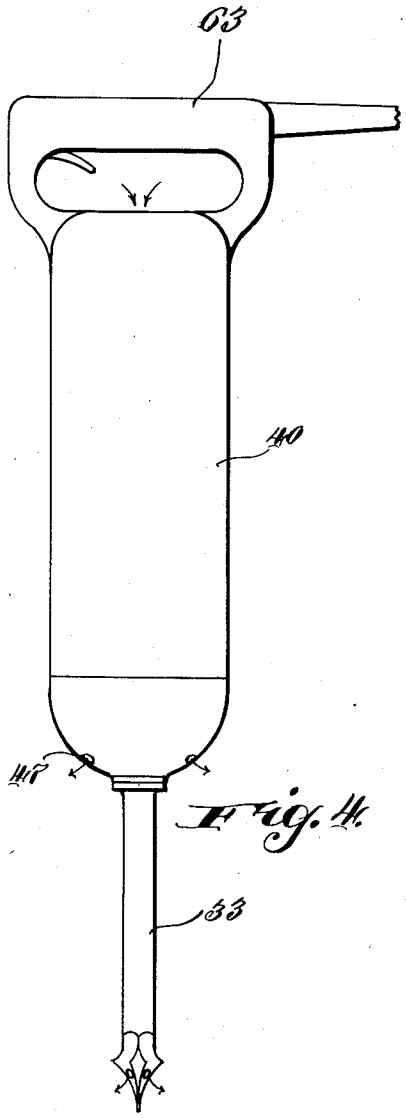


Fig. 4.

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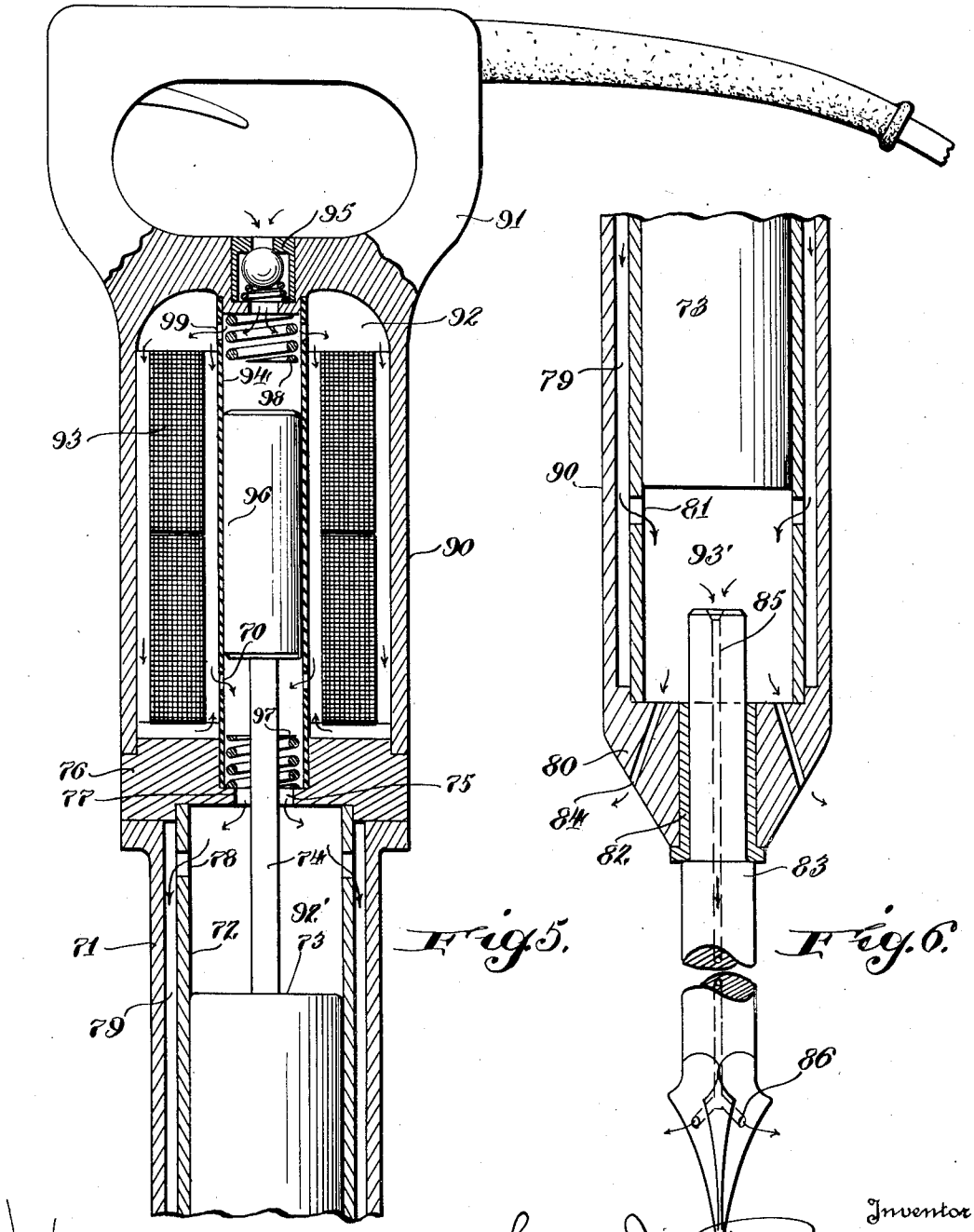


Fig. 5.

Fig. 6.

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UNITED STATES PATENT OFFICE

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AIR CIRCULATING MEANS FOR PORTABLE HAMMERS

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Application August 14, 1931. Serial No. 557,013

8 Claims. (Cl. 125—33)

One of the important difficulties encountered in the operation of the various portable hand controlled power hammers which it is necessary to provide for and overcome in the development of a tool of this type to make the tool convenient to use and satisfactory in its operation, is due to the generation of heat incident to the percussion or impact of the ram upon the bit or anvil and to a lesser degree to the reaction of this impact upon the mechanical parts of the hammer, and to some extent to the friction of the reciprocating parts.

The heat thus generated in the operation of the tools now in use is communicated to the working parts of the hammer increasing the friction and the wear. It is also transmitted by conduction to the barrel and other parts which come in contact with the hands of the operator, making it difficult and unpleasant to operate the tool, detracting to a degree from the precision of the work.

The present invention relates to improvements whereby the heat generated in the operation of the tool is dissipated and the harmful effects incident to heating are completely overcome resulting in an increase in the length of life of the tool and increased comfort to the operator, and increased facility in its use.

In some instances, notably the drilling of holes in concrete, brick, stone or other gritty substances which form a dust having an abrasive action, it is essential that the dust from the operation be prevented from entering the working chamber of the tool where it would result in decreasing the efficiency and in very rapid deterioration of the parts. The dust and chips also accumulate in the hole being drilled, and interfere with the efficient operation of the tool by increasing the friction and shielding or tending to shield the material being cut.

In the operation of the improved tool the dust is excluded from the working chamber and from the vicinity of the work, aiding the vision of the operator, and the dust and cuttings are expelled from this hole being drilled or cut in the work.

In the accompanying drawings I have illustrated a power hammer both of the type having a rotary motor and crank and also the solenoid type of hammer showing the application of the invention to tools of these various types.

In the drawings:

Figure 1 is a fragmentary elevation of a hammer constructed in accordance with the invention, the barrel being shown in section on a plane of the vertical axis and the lower half being broken away for convenience of illustration.

Figure 2 is an axial section showing the lower end of the hammer barrel and the parts contained therein, the same being continuous with Figure 1.

Figure 3 is a vertical section taken on a plane of the axis showing a hammer of the solenoid type equipped in accordance with the invention.

Figure 4 is an external elevation on a reduced scale of a hammer constructed in accordance with the illustration, Figure 3.

Figure 5 is a section on a plane of the hammer axis illustrating the application of the invention to a hammer of a construction embodying the features of both types of Figure 1 and Figure 3, the lower end of the barrel being broken away.

Figure 6 is a section in the same plane as Figure 5, showing the lower end of the barrel and the parts therein, Figure 6 being continuous with Figure 5.

Referring to the drawings by numerals, and first having reference to the hammer shown in Figures 1 and 2, the construction includes an electric motor 1, enclosed in a motor housing or casing 2. This casing as shown contains in addition to the motor a centrifugal fan 3 mounted on the motor shaft 10 at the left in Figure 1. This fan draws the air in at openings 4 in the casing at the opposite end from the fan leading it through passages 5 through and around the field and armature windings and projecting it downwardly through a passage or passages 6 into the crank case 7. The construction as shown also includes a centrifugal rotary dust separator 8 mounted on the motor shaft at the right immediately adjacent the openings 4. This dust separator is of a well known type.

The crank casing 7 is integral with the motor housing 2 extending downwardly therefrom adjacent the fan and there is a gear casing 9 closing the ends of the motor casing 2 and the crank case 7. The crank case 7 contains a crank disk 11 secured to a shaft 12 having suitable bearings at 14 in the frame or casing. The crank disk 11 is driven from the motor by the reducing gear train 16, 17 and 18.

The crank disk 11 carries a crank pin 19 which operates a depending connecting rod 20, which in turn operates the ram 21 being connected thereto by means of wrist pin 22 mounted in ears 24 projecting upwardly from the ram. The ram is shown as in the form of an elongated piston arranged to fit and slide in a guide sleeve 25 and to cooperate therewith after the manner of

a piston with its cylinder. This sleeve 25 is enclosed within and spaced inwardly from the hammer barrel 26, which extends downwardly from the crank case 7, being secured thereto by flanges 27, and the spacing of the sleeve 25 from the barrel 26 forms an annular air space or jacket 23 which in the preferred form extends practically from one end of the sleeve to the other and around the sleeve forming a jacket which is as nearly complete as is found convenient. The space 21' within the sleeve 25 at the top is connected to the crank case 7 by a port or opening 28.

The guide sleeve 25 is provided at its upper end with ports 31 above the top of the ram 21 in its uppermost position and with ports 32 near its lower end and spaced upwardly therefrom to be covered by the ram as it approaches the lower end of its stroke where it contacts the shank of the tool or bit 33 in the tool bushing 30 provided for this purpose in the lower end of the barrel. The air in the path of the ram as it descends is directed into contact with the work through openings 47 at the sides of the bushing and opening 46 leading downwardly through the tool along its axis.

Figures 3 and 4 show a hammer of the solenoid type having an external cylindrical casing or barrel 40 in which solenoids 41 and 42 are mounted one above the other concentric with the barrel. These solenoids are shown as spaced inwardly from the barrel forming a peripheral air chamber or jacket 43. The barrel shown in this figure is provided at its lower end with a removable plug or closure 44 forming the lower end of the barrel and this plug or closure 44 is equipped with a tool and bit bushing 45 containing a bit 33 having an axial opening or air passage 46 identical with that shown in Figure 2, and there are also downwardly disposed air passages 47 at the sides of the bushing 45, as in Figure 2.

The passages 46 and 47 are, in this instance, supplied with air from a central guide sleeve 48 which extends substantially from one end of the barrel to the other coaxially therewith, being supported at its upper end in a circular seat 50 having a cylindrical protuberance 50' which fits tightly within the end of the sleeve, and at its lower end as shown it bears against the plug 44, being seated between the ends of the ribs 44' thereon. This plug or end 44 is centrally apertured at 51 surrounding the upper end of the shank of the tool or bit 111, which is seated in the tool bushing 45, the shank of this bit projecting upwardly therefrom.

The sleeve or guide sleeve 48 serves as a guide for the reciprocating ram 53 which is the core of solenoids 42 and 43. This ram as shown is cylindrical in form and adapted to fit and slide in the sleeve or bushing 48 after the manner of a piston in its cylinder.

The top of the casing or barrel overlying the upper end of the guide or guide sleeve 48 is provided with an air inlet opening 54 shown containing a valve bushing 55. This bushing has a seat 57, and the air is admitted through the seat by way of the port 58 which leads to the upper end of the sleeve 48 and there is a ball valve 59 engaging the seat 57 and supported on the seat by means of a coil spring 60. The guide sleeve 48 has in addition to the port 58 a port 61 near its upper end and port 62 near its lower end. Figure 4 shows this hammer equipped with a handle 63.

In Figures 5 and 6 I have shown a hammer of the solenoid type embodying features of both of the constructions previously described. This construction includes an outer casing 90, having a handle 91 at its upper end, and containing a chamber 92 in which is a double solenoid 93 surrounding a central guide sleeve 94 mounted at the center of the chamber 92 within the casing 90 in line with the axis of the same, being secured in the casing at its upper and lower ends. The casing is provided at its upper end at the center of the guide sleeve 94, with an air inlet passage controlled by valve 95 which opens inwardly, i. e., into the guide sleeve. A solenoid core 96 operates in the guide sleeve as a piston in its cylinder being actuated by the solenoid coils 93 as they are energized alternately in accordance with the regular practice in the operation of such a solenoid.

The core 96 is cushioned and checked at the opposite ends of its stroke by helical springs 97 and 98 mounted in the opposite ends of the guide sleeve and bearing against the ends of the casing within the guide sleeve, the upper and lower ends of the casing within the guide serving as abutments for the respective upper and lower springs. The core guide sleeve 94 is provided at its upper end with ports 99 opening into the chamber 92 and near its lower end with ports 70 spaced upwardly from the end of the sleeve, and leading from said chamber 92 into the sleeve as indicated by the arrows.

Secured to the lower end of the solenoid casing 90 in alignment therewith is the hammer barrel 71. Within this barrel and preferably concentric therewith is a ram guide sleeve 72 containing a ram 73 which fits and slides in the sleeve after the manner of a piston in its cylinder. The ram 73 is connected to the solenoid core 96 by a tie rod or piston rod 74, which passes through an axially arranged opening 75 leading from within the solenoid guide sleeve 94 downwardly into the ram guide sleeve 72 allowing a considerable air passage around the rod from one guide sleeve to the other as indicated by the arrows. The spring 97 as shown encircles the rod 74 bearing on the portion of the end wall 76 of the casing 90 where it forms a shoulder 77 surrounding the opening 75, it being noted that the end wall 76 is countersunk to admit the guide sleeve 94. The ram guide sleeve 72 is provided with air ports 78 at its upper end leading outwardly from within the sleeve into an annular space 79 which forms a pocket or air jacket between the barrel and the guide sleeve, and the sleeve is provided near its lower end spaced upwardly from the end wall 80 or plug at the lower end of the barrel with air ports 81.

The lower end of the barrel or plug 80 is provided with a tool bushing 82 enclosing a bit 83, and it is shown as provided with air discharge openings 84 discharging in the general direction of the work. The tool or bit 83 is shown as having a central axially placed air passage 85 with discharge openings 86 near the lower end and disposed downwardly in the general direction of cutting.

Referring now to the operation of the type of hammer shown in Figure 1, when the ram 21 is in its uppermost position, the ports 32 at the lower end of the guide sleeve 25 are uncovered and the air in the annular space 23 being under pressure somewhat in excess of atmosphere as hereinafter described, flows freely into the space beneath the lower end of the ram indicated by reference character 23' in Figure 2. As the ram 21 descends, these ports 32 are covered by the ram and closed, and the air contained in the

chamber 23' is compressed and discharged either through the ports 47 in the lower end of the barrel, or through the opening 46 in the bit or tool 33. In either case the air so exhausted serves to clear the surface of the work near the cutting edge of the tool of accumulated dust and chips. The ejection of the air through the tool operates to particular advantage to clear the surface of the work or the hole being cut of debris which might interfere with the cutting operation. The air from the fan 3 forced downwardly into crank case 7 is admitted to the space 21' over the ram as the ram advances on the down stroke and is expelled through ports 31 into jacket 23 on the upstroke. A slight pressure maintained in crank case 7 by the fan prevents the return of the air through port 28. From port 31 the air passes downwardly through jacket 23 nearly to the lower end of the barrel where it passes through ports 32 into working chamber 23' in the guide sleeve below the ram. From this space it is ejected as described maintaining a continuous circulation through jacket 23. The slight pressure in the port 28 assists in this circulation to the extent that it prevents a back draft through ports 46 and 47 with consequent entrance of grit into working chamber 23' which would cause rapid and very harmful wear of the guide sleeve and ram. The air circulation described has a very important effect in carrying away the heat caused by the friction of the ram 21 upon the walls of the sleeve 25 as well as that produced by the impact upon the tool, thus tending to retain the temperature of the barrel which is grasped by the operator in guiding the tool and also the temperature of the casing with which the hands of the operator must come in frequent contact within limits comfortable to the operator.

In the performance of this function the construction shown whereby the air from the fan is passed through the annular jacket 23 between the barrel 26 and the guide sleeve 25 containing the ram 21, being later expelled from chamber 23' by the down stroke of the ram, is particularly effective.

Referring now to the construction disclosed in Figures 3 and 4, it is evident that the ram and solenoid core 53 upon its downward stroke draws air through the check valve 59 into the guide sleeve 48 above the core, the space being indicated by reference character 100. This air is forced by the ram or core upon its return or up stroke through the port 61 into the portion of the chamber 43 surrounding the guide sleeve 48 and containing the solenoid coils 41 and 42, and thence through this chamber and around the coils downwardly to the ports 62, and as the ram uncovers the port 62 on its upward stroke, the air from chamber 43 rushes through the port 62 into the space 101 below the ram 53, whence it is forcibly ejected by the ram on its downward stroke after the ports 62 are covered. From space 101 the air is discharged either through the ports 47 or the axial passage 46 through the tool 33 in either of which instances it serves to remove the dust from the point of cutting and from the vicinity of the work.

The circulation of air as described is very effective in carrying away the heat caused by electrical losses in the operating coils 41 and 42, also the heat produced by the friction of the ram 53 upon the walls of the sleeve 48 as well as that produced by the impact of the ram upon the head of the tool 33. In this way the operating temperature of the parts within the barrel, i. e., the lower unit, is reduced protecting the hands of the operator and preventing the collection of dust within the chamber 101 where it would cause a considerable amount of damage on account of its abrasive action.

In the operation of the tool shown in Figures 5 and 6, the operation of the solenoid 96 which is the same so far as the pumping action is concerned as that of the solenoid core or ram 53, forces the air thus compressed downwardly through the opening 75 into the chamber 92' at the upper end of the ram guide sleeve 72 above the ram. On the upstroke of the ram 73 the air contained in this chamber is forced outwardly through the ports 78 into the annular air jacket space 79 between the barrel and the guide sleeve through which space it spreads laterally and passes downwardly toward the ports 81. The air in the jacket space 79 is drawn through ports 81 into space 93' below ram 73 by the vacuum created by the ram as it moves upwardly. On the down stroke of the ram, the ports 81 being closed by the ram, the air contained in the chamber 93' at the lower end of the sleeve 79 is compressed and ejected through the ports or passages 84 or through the passage 85 extending longitudinally through the tool 83. In either instance the air is discharged in the direction of the work and serves to clear the vicinity of the work and the cutting edge and the immediate vicinity thereof preventing the accumulation of dust and chips. The effect of the pumping action of the solenoid core 96 is of particular importance in that it maintains the pressure and prevents entrance of grit into the chamber 93', and it greatly increases the efficiency of the pumping action of the ram 73 effecting and maintaining a satisfactory cooling of the reciprocating parts, including the ram, the guide sleeve 72 with which it contacts, and particularly it serves to cool the barrel 71 which is grasped by the operator, making the operation of the tool comfortable to the operator and therefore increasing its efficiency.

In every instance the cooling action is important not only in that it contributes to the comfort of the operator and therefore the efficiency with which the work is done, but by preventing heating of the reciprocating parts, it decreases wear and increases the life of the tool. The importance of excluding the grit from the ram guide has been fully explained as has also the desirability of clearing away the dust and chips from the vicinity of the cutting operation and particularly from the point of cutting. These results are accomplished most effectively.

I have thus described specifically and in detail a power hammer in which the ram operates as a pump to provide a cooling circulation and to expel dust and grit from the vicinity of the work including in the preferred form of the invention means for forcing the air into the path of the ram to facilitate this operation. The description is specific and in detail in order that the manner of constructing, operating, applying and using the invention may be fully understood, however, the specific terms herein are used descriptively rather than in a limiting sense, the scope of the invention being defined in the claims.

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

1. In a portable power hammer a reciprocating ram, a barrel enclosing the ram and guiding means therefor with an air cooling passage extending longitudinally of the barrel, the ram fit-

ting in the guide after the manner of a piston in its cylinder, means for introducing air into the guide in the path of the ram at one end, a discharge port at the other end and ports connecting the passage to the opposite ends of the guide whereby the ram as it reciprocates forces air into the passage at one end, the guide receiving air from the passage at the other end, the port connecting the air cooling passage to the guide adjacent the striking end of the ram being in the path of the ram and spaced backwardly from the end of said path so that after admitting air to the guide the ram, as it advances, covers the port, whereby the ram in its operation forcibly expels the air thus trapped in the guide through said discharge port.

2. In a portable power hammer a reciprocating ram, a barrel enclosing the ram and having guiding means therefor with an air cooling passage, the ram fitting in the guide after the manner of a piston in its cylinder and operating therein with a pumping action at both ends, means for admitting air to the guide and into the path of the ram at one end, a discharge port leading from the path of the ram at the other end of the guide, and ports connecting the opposite ends of the guide to the opposite ends of the air passage whereby the ram as it reciprocates forces air into the passage at one end the port connecting the air passage to the end of the guide toward the work being in the path of the ram and spaced backwardly from the end of the path whereby it is covered as the ram advances whereby the air enters the guide from the passage on the backstroke of the ram, the air being compressed in the guide as the ram advances, which air the ram in its operation expels through said discharge port, said discharge port being directed into the vicinity of the work, the draft of air thus discharged serving to clear the dust from the point of operation.

3. In a portable power hammer, a ram, a barrel therefor including guiding means for the ram, an air passage extending longitudinally thereof to cool the barrel and guide, the ram cooperating with the opposite ends of the guide after the manner of a double pump, a port admitting air into the guide in the path of the ram at one end, means for passing air through said port, the ram operating to expel air from the guide into said passage which has an admission port adjacent said first mentioned port for this purpose, the passage also having a port at its opposite end leading into the opposite end of the guide, said port being covered by the ram as it descends, the ram serving to compress the air from the passage when said port is covered, and to expel this air, the construction including a discharge opening for this purpose.

4. In a portable power hammer a ram and a barrel therefor including guiding means for the ram and an air passage extending longitudinally thereof to cool the barrel and ram, the ram fitting in the barrel and being arranged to operate in connection with the opposite ends of the barrel after the manner of a double acting pump, said barrel having means for admitting the air at one end into the path of the ram and for releasing it therefrom into said passage as the ram advances and means for discharging it from the opposite end of the passage into the path of the ram, said discharging means consisting of a port in the path of the ram spaced back from the striking end of the ram stroke to be covered by the ram as it advances compressing the air in the guide, the ram serving to expel the air thus withdrawn from the passage, and a motor connected to the ram to operate the ram, said motor having air circulating means whereby the compressed air supply is provided and delivered to the path of the ram.

5. In a portable power hammer a ram, power means for reciprocating the ram, a ram guide in which the ram operates as a piston, and a barrel surrounding the ram guide and spaced outwardly therefrom providing an air passage for cooling the surface of the barrel and the ram, means for delivering air to the upper end of the guide above the ram, and a port through which it is expelled by the ram into the upper end of the air passage, an admission port connecting the lower end of the air passage to the lower portion of the guide and adapted to be covered by the ram as it descends, and a discharge port for discharging the air from beneath the ram which as it descends, closes the admission port and compresses and expels the air in its path and on its upstroke uncovers the admission port admitting a new supply from said passage.

6. In a portable power hammer a ram, power means for reciprocating the ram, a ram guide and a barrel surrounding the ram guide and spaced outwardly therefrom providing an air passage for cooling the surface of the barrel and the ram and guide, means for compressing air to a pressure slightly in excess of atmosphere and a port for admitting the compressed air to the upper end of said air passage, an admission port near the lower end of the barrel to deliver air from said passage into the path of the ram, and an opening for discharging air from beneath the ram which compresses and expels the air thus delivered on its down stroke and on its upstroke draws in a new supply from said passage into the space beneath the ram.

7. In a portable power hammer, a ram, means for reciprocating the ram, a guide in which the ram operates as a piston, a jacket for the guide forming an air passage for cooling the jacket, means for supplying air at a pressure in excess of atmosphere to the upper end of the jacket, means for supporting a bit in the path of the ram at the lower end of the guide, a port for leading air from the jacket into the guide between the ram and the bit, a passage for delivering the air therefrom in the direction of the work, the port being covered by the ram as it moves downwardly toward the bit expelling the air through said passage in the direction of the work, the ram on the upstroke serving to draw the air from the jacket into the guide beneath the ram, thus maintaining a continuous circulation.

8. In a portable power hammer, a ram, a guide for the ram in which the ram operates as a piston in its cylinder, means for reciprocating the ram, a barrel surrounding the guide and having at its lower end a support for a bit in the path of the ram, a passage for discharging air from the lower end of the barrel, means for delivering air under pressure in excess of atmosphere into the path of the ram on its upward stroke and a port whereby the ram is caused to force the air into the barrel, a passage for conducting this air along the barrel in contact with the guide and barrel to the lower end of the barrel, means for delivering the air thus passed along the barrel into the path of the ram in the vicinity of the bit, the ram on its downward stroke serving to eject the air from the barrel and on its upward stroke drawing in a new supply from said passage.

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