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M. HARDSOCG.

PNEUMATIC DRILL.

APPLICATION FILED APR. 15, 1907.

Fig. 1.

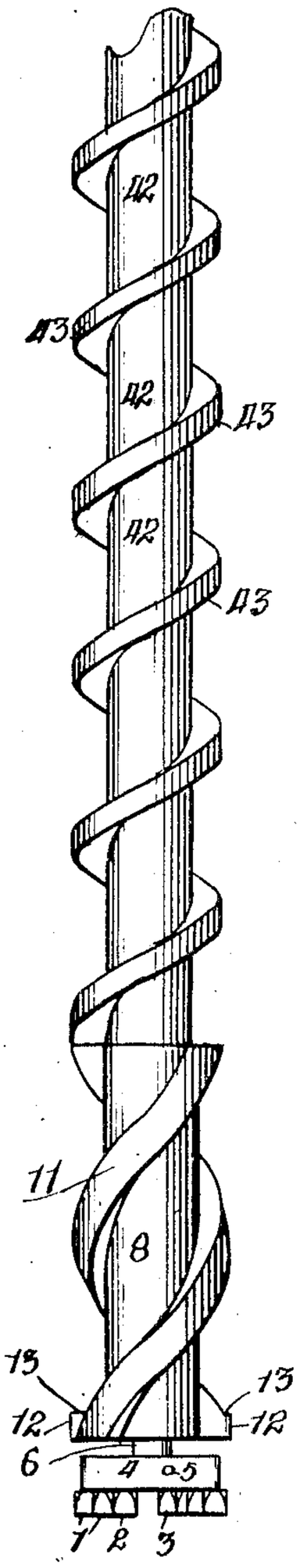


Fig. 5.

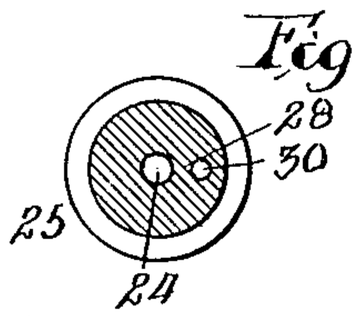


Fig. 4

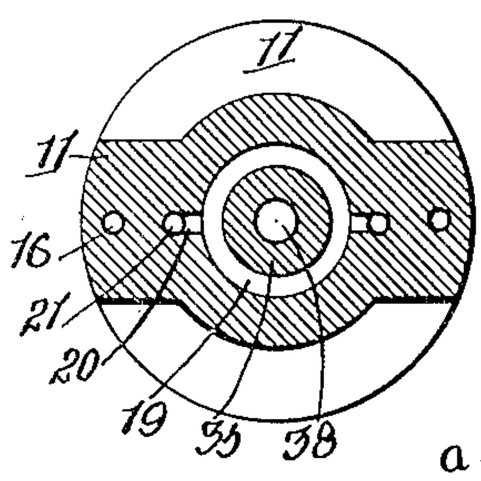


Fig. 3.

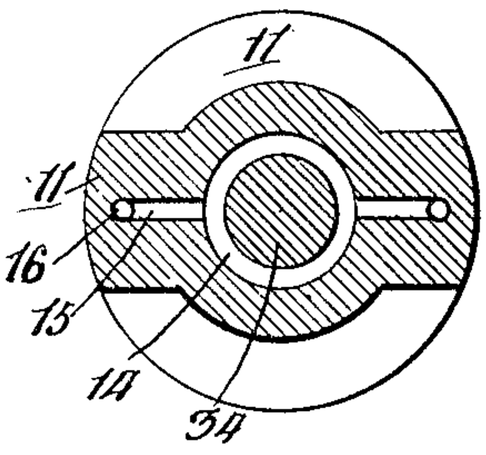
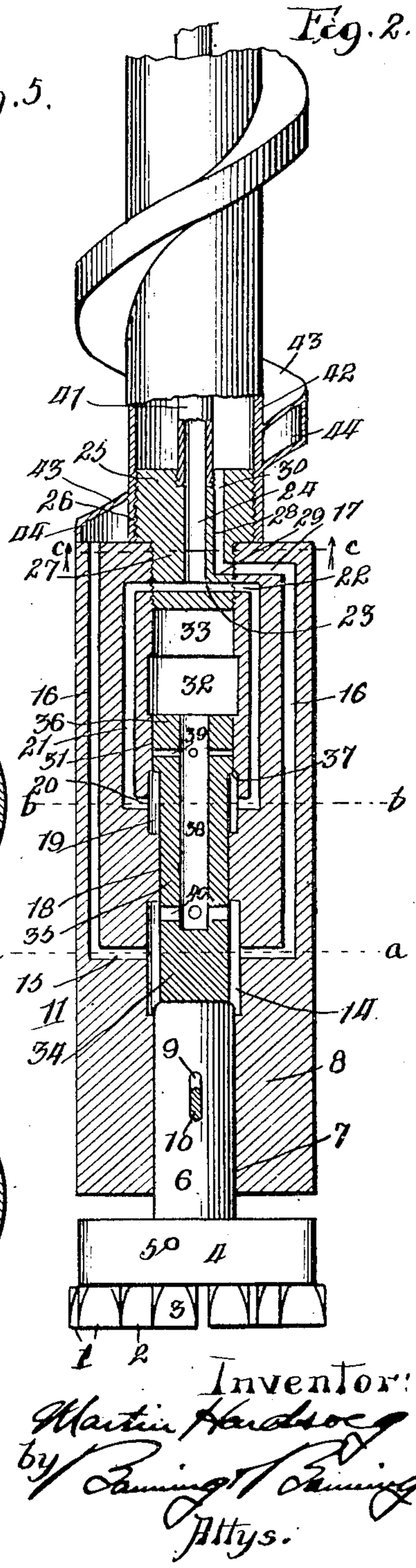


Fig. 2.



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MARTIN HARDSOCG, OF OTTUMWA, IOWA.

PNEUMATIC DRILL.

No. 888,164. Specification of Letters Patent. Patented May 19, 1908.

Application filed April 15, 1907. Serial No. 368,383.

To all whom it may concern:

Be it known that I, MARTIN HARDSOCG, a citizen of the United States, residing at Ottumwa, in the county of Wapello and State of Iowa, have invented certain new and useful Improvements in Pneumatic Drills, of which the following is a specification.

The present invention relates more particularly to the construction and arrangement of the hammer frame and the cross head carrying the operating tool, such as the bit or cutter of a pneumatic drill, so as to have the hammer frame coact with a conveyer or flight for removing the cuttings, dust and fine particles produced by the operation of the tool.

The objects of the invention are to improve the construction of the frame of a pneumatic hammer so as to enable air, or other medium under pressure, to act and operate the hammer, and to be rearwardly discharged for maintaining a perfect clearance in front of the hammer for each forward thrust or blow of the hammer; to construct a frame for a pneumatic hammer so as to provide a barrel, with a chamber for the hammer and for the shank or stem of the cross head of the tool, and having passages for admitting air, or other medium under pressure, to reciprocate the hammer, and passages to discharge air, or other medium under pressure, rearward from in front of the hammer, with an exterior formation to furnish a means for removing cuttings, dust and fine particles from in front of the tool head; to construct a frame having a central barrel with a hammer therein, and having, circumferentially around the barrel, oppositely running spiral flanges rearwardly extending from end to end of the barrel and furnishing oppositely running spiral pathways of travel for removing the cuttings, dust and fine particles, produced by the operation of the drill, or other tool, or instrument, from in front of the tool head; to construct the frame of a pneumatic hammer so as to provide a central straight barrel, with a chamber for the hammer and for the driven shank or stem of the tool head, and having, circumferentially around the barrel, oppositely running spiral flanges extending from end to end of the barrel, each spiral flange having a passage for admitting air, or other medium under pressure, to reciprocate the hammer, and each spiral flange having a passage rearwardly extending for discharging the air from in front of the chamber, so as to leave a perfect clearance in the chamber in advance of the hammer; to construct a frame for a pneumatic hammer having a central straight barrel, with a hammer therein and a driven stem in advance of the hammer, and having, circumferentially around the barrel, oppositely running spiral flanges with a passage and port in each flange for admitting compressed air, or other medium under pressure, to the hammer chamber for driving the hammer forward, and with a passage and port in each spiral flange and extending rearwardly for discharging air, or other medium under pressure, from in front of the hammer, so as to leave a perfect clearance in the chamber in advance of the hammer; to provide a frame with a central chamber and having oppositely running spiral flanges on its exterior and extending the length of the frame from end to end, each spiral flange having a spiral passage for inducting fluid, and each spiral flange having a spiral passage for educting fluid rearwardly for discharging fluid at the rear of the frame and into a conduit or passage for final escape; to construct a frame for a pneumatic hammer having a central straight barrel to receive a driving hammer and driven stem, and having, circumferentially around the barrel, oppositely running spiral flanges, with an induction passage for fluid in each flange and an eduction passage for fluid in each flange, and a closing plug for the end of the frame and a hammer chamber, the plug having an induction passage in communication with the induction passages of the spiral flanges and an eduction passage in communication with the eduction passage of one of the spiral flanges; to furnish a frame consisting of a central barrel and oppositely running spiral flanges circumferentially around the barrel and extending from end to end of the frame, with an induction passage in each flange for admitting fluid to the chamber of the barrel, and an induction passage in each spiral flange, both passages rearwardly extending for educting fluid from the chamber of the barrel in front of the hammer, for the flanges to furnish a conveyer or flight for withdrawing cuttings, dust and fine particles from in front of the tool head, the conveyer or flight coöperating with a conveyer or flight on a rearwardly extending tube connected with the hammer frame; to furnish a conveyer or flight circumferential around a hammer frame, and a conveyer or flight circumferen-

tially around a tube carrying the hammer frame for effecting a withdrawal of the cuttings, dust and fine particles from in front of a tool head, without interference from fluid educted from the hammer frame; to furnish a hammer frame having a central barrel, and having, circumferentially around the barrel, oppositely running spiral flanges, each spiral flange having an induction passage for fluid and each spiral flange having an eduction passage for fluid discharging at the rear of the frame, for the flanges to furnish a conveyer or flight for withdrawing the cuttings, dust and fine particles, and coöperating with a spiral flange having a longitudinal passage and circumferentially encircling a tube carrying the hammer frame, so that the eduction passage of one flange discharges into the carrying tube, and the eduction passage of the companion flange discharges into the passage of the spiral flange around the carrying tube, to educt fluid from in front of the driving hammer without obstructing the withdrawal of the cuttings, dust and fine particles, by the operation of the conveyer or flight formed by the spiral flanges on the hammer frame and on the supporting tube; and to improve generally the construction, arrangement and operation of the frame and the correlated conveyers or flights entering into the formation of the drill as a whole.

The invention consists in the features of construction and combinations of parts hereinafter described and claimed.

In the drawings Figure 1 is a full elevation of the hammer frame and supporting tube therefor, with oppositely running spiral flanges on the hammer frame and the spiral flange around the supporting tube constituting the conveyer flight for withdrawing the cuttings, dust and fine particles; Fig. 2 a sectional elevation of the pneumatic hammer and frame and the conveyer or flight, showing the construction for the frame as if the spiral flanges were unfolded in order to clearly illustrate the induction and eduction passages in the two spiral flanges, and with the supporting tube and the supply tube for fluid partly in section and broken away; Fig. 3 a cross section on line *a*—*a* of Fig. 2; Fig. 4 a cross section on line *b*—*b* of Fig. 2; and Fig. 5 a cross section of the closing plug, for the end of the barrel chamber and the frame on the line *c*—*c* of Fig. 2, looking in the direction of the arrow.

The drill shown has a head with a plurality of bits or cutters, but other forms of bits or cutters could be used, and other forms of tools or instruments than drills are capable of use with the frame and the conveyer or flight. The arrangement has, at each end of the drill head, an outer or end bit or cutter 1, with an intermediate bit or cutter 2 and an intermediate bit or cutter 3, so that the head has a plurality of bits or cutters. The head 4 is of a shape, as to length and width, to receive the bits or cutters; and, as shown, the head has a cross hole 5 so as to facilitate the removal, from the head, of the bit or cutter in line with the shank or stem. The head has a shank or stem 6 to enter the chamber 7 of the barrel 8 of the frame, which shank or stem constitutes a driven shank or stem, and, as shown, the driven shank or stem has a slot 9 through which passes a key or bar 10 secured in the wall of the barrel, and by which slot and bar the head has a limited end movement for operating the bits or cutters.

The frame has, circumferentially extending therearound, two spiral flanges 11, with the run of the spirals in opposite directions so as to furnish a double spiral pathway of travel around the barrel; and each spiral flange, at the forward end of the frame, has a projection 12 forming a shoulder 13 against which the end of an encircling tube, when used, can rest. The chamber 7 terminates in a chamber 14 of a greater diameter in cross section than the chamber 7; and from this chamber 14, on opposite sides, a port 15 leads. Each port 15 communicates with a longitudinal spiral passage 16 formed in each of the spiral flanges, with the passage 16 of one flange opening through the rear end of the flange and frame, and with the passage 16 of the other flange opening at its rear end into a lateral port 17, inwardly leading from the end of the passage, as shown in Fig. 2.

The barrel 8 has an interior circumferential wall 18 located between the chamber 14 and a chamber 19, and from the chamber 19, on opposite sides, a port 20 leads. Each port 20 is in communication with a longitudinal spiral passage 21, formed in each spiral flange of the frame, and each spiral passage 21, at its rear or receiving end, has a port 22 inwardly leading therefrom. Each port 22 communicates with a common port or cross passage 23 with which a longitudinal passage 24 communicates, and the cross passage 23 and longitudinal passage 24 are formed in a head 25, having a shoulder 26 and a neck 27, with an exterior screw thread on the head and the neck, for the neck to be entered into the end wall of the frame and barrel, as shown in Fig. 2, so that the passages 23 and 24, in the head and neck, furnish a conduit or passage for supplying compressed air, or other medium under pressure, to the spiral passages 21 of the frame. The head 25 and neck 27 have a wall or partition 28 separating the passages 23 and 24 from a cross passage or port 29 and a longitudinal passage 30, which opens to the rear end of a head 25, as shown in Fig. 2. The port 17 is in communication with the cross passage or port 29, so that fluid inducted from the chamber 14, on one side and forward of the acting end of the hammer, will flow through port 15 and

passage 16, and by the ports 17 and 29 discharge into the passage 30 and escape at the mouth or opening of said passage at the rear end of the head, and the fluid inducted through the companion spiral passage 16 will escape at the mouth or opening of said passage at the rear end of the spiral flange and the frame, so that the educted fluid will escape at the rear of the hammer frame and the closing plug and will maintain a perfect clearance for the acting end of the hammer, and prevent back pressure from interfering with the strike or blow of the hammer in use.

The barrel has an interior circumferential wall 31, located between the chamber 19 and a chamber 32, which chamber is continued as a chamber or hole 33, which receives the neck 27 of the closing plug, as shown in Fig. 2, so that the chamber of the barrel, as a whole, is closed at the outer or rear end by the plug, the shoulder 26 of which abuts tightly against the rear end of the barrel, so as to form a joint against the escape of admitted fluid. The barrel has located in the chamber thereof, rearward of the shank or driven stem 6, a hammer having a driving end or head 34, continued as a body 35, guided and held between the circumferential wall 18 and terminating at its rear end in an enlarged portion or head 36, guided and held in the circumferential wall 31 and forming an abutment or end face 37 against which the compressed air, or other medium under pressure, admitted to the chamber 19 from the spiral passages 21, through the ports 20, acts to recede or force back the hammer, as a whole, into striking position. The body 35 of the hammer has a central passage 38 extending longitudinally therein, and opening at its rear end through the head 36, from which passage 38 lateral ports or passages 39 lead through the head 36, so that when the hammer is receded communication is established with the chamber 32, admitting compressed air, or other medium under pressure, to the passage 38, for the air, or other medium under pressure, to act and thrust or drive forward the hammer as a whole. The passage 38, adjacent to its forward end, has leading therefrom lateral ports or passages 40 to furnish communication between the passage 38 and the chamber 14, for compressed air, or other medium under pressure to flow from the passage 38 through the ports 15, into the spiral passages 16 and be discharged on one side at the rear end of the hammer frame and at the other side through the port 17 into the cross passage 29 and longitudinal passage 30, maintaining a clearance against back pressure for the acting end of the hammer.

The head or plug 25 has a screw threaded hole at the end of the longitudinal passage 24, which receives a tube 41 leading from a source of compressed air, or other medium under pressure, for supplying compressed air, or other medium under pressure, to the passage 24, for the air, or other medium under pressure, to enter the spiral passage 21 in each spiral flange through the ports 22, and be discharged through the ports 20 of the spiral flanges into the chamber 19 to act against the abutment or end face 37 of the hammer and force back or recede the hammer, as a whole, into its striking position.

The supply tube 41 is encircled by a tube 42, the end of which is threaded onto the head 25, so that the tube 42 supports and carries the hammer frame with the hammer and the operating tool; and the supporting tube 42 has a circumferential spiral flange 43 therearound, which flange is hollow so as to furnish a passage 44 within the spiral flange. The passage 30 discharges into the interior of the tube 42, and the passage 16 discharges into the passage 44, so that the educted fluid from one spiral flange 11 is discharged into the interior of the supporting tube 42, and the educted fluid from the other spiral passage 16 is discharged into the passage 44 of the spiral flange 43, thereby effecting a perfect discharge of the fluid from each spiral passage 16, with an independent travel for each discharge.

The supporting tube 42, with its spiral flange 43, forms a conveyer or flight to coact with the spiral flanges of the hammer frame, for removing the cuttings, dust and fine particles produced by the drill, or other tool or instrument, with the result that the removal of the cuttings, dust and fine particles from in front of the tool head is not interfered with by the educted fluid from the hammer chamber, as the cuttings, dust and fine particles have a pathway of travel rearwardly independent of the educted fluid, for the educted fluid to furnish a perfect clearance for the driving end of the hammer, and for the withdrawn cuttings, dust and fine particles to furnish a perfect clearance for the operation of the bits or cutters, or other tool.

The parts are assembled by entering the shank or stem 6 in the chamber 7 of the barrel 8, and securing the shank or stem 6 and the head 4, with the bits or cutters thereon, against dropping out from the chamber, by means of the bar or key 10 entered into the wall of the barrel and passing through the slot 9 of the shank or stem. The hammer, as a whole, is entered into the chamber of the barrel rearward of the driven stem 6 of the head, and after the hammer is entered, the plug or head 25 is entered into the end of the frame and the barrel, so as to close the chamber of the hammer and have the port or passage 23 in communication with the ports 22, as shown in Fig. 2. The supply tube 41, and the supporting tube 42 with its spiral flange 43, are connected respectively to the center

and exterior of the closing plug or head, completing the connecting up of the parts, ready for the operation of the drill.

In operation, the compressed air, or other medium under pressure, flows through the supply tube 41, into the passage 24, and through the cross port or passage 23, and the ports 22, enters both spiral passages 21 to discharge through the ports 20 into the chamber 19 and act against the abutment or end face 37 to force back or recede the hammer into striking or driving position. The hammer is receded a sufficient distance to carry the abutment or end face 37 clear of the rear face of the wall 31, so that fluid can enter the chamber 32 to act against the end of the hammer, and from the chamber through the lateral passages or ports 39 the fluid can enter the center passage 38 and act against the front end of the passage 38 for the pressure against the rear face of the hammer and against the end of the passage 38 to overcome the pressure against the abutment or end face 37 and drive forward the hammer, as a whole, and in such driving forward of the hammer the admitted fluid cannot escape from the passage 38 owing to the closing of the lateral passages or ports 40 with the passing of such passages or ports within the circumferential wall 18, by the recession or forcing back of the hammer. The forward drive or thrust of the hammer causes its acting end or head 34 to contact the end of the driven shank or stem 6 and drive forward the shank or stem and with it the head 4 and the bits or cutters, or other tool, carried by the head, for the bits or cutters, or other tool, to act and perform the cutting or drilling operation.

The forward throw or drive of the hammer, as a whole, closes the ports or passages 39 by the wall 31, and opens the ports or passages 40 for communication between the passage 38 and the chamber 14, admitting fluid to the chamber 14 for the fluid to flow through the ports 15 and enter the spiral passage 16 on one side to discharge at the rear end of such passage into the spiral passage 44 of the spiral flange 43, for final discharge at the end of the flange, and for the educted fluid to enter the companion spiral passage 16 and discharge through the ports 17 and 29 into the passage 30 to flow through the interior of the supporting tube 42, for final discharge at the end of such tube. The compressed air, or other medium under pressure, discharged by the passages 16, from in front of the hammer, has a free passage rearward through the spiral passages 16 in each spiral flange, for final discharge through the interior of the supporting tube 42 and the passage 44 of the spiral flange 43, leaving a clear drive for the hammer at each succeeding operation.

The cuttings, dust and fine particles, produced by the cutting or boring operation, enter the spiral pathways furnished by the spiral flanges on the exterior of the hammer frame and are carried upward or rearward by such flanges and spiral pathway to be caught by the conveyer or flight, formed by the spiral flange 43 on the supporting tube 42, and carried upward and rearward to the discharge end of the tube, so that the cuttings, dust and fine particles are removed or carried back as fast as produced and cannot accumulate around the bits or cutters, or other tool, and interfere with the operation of the drill, or other tool, thus maintaining a perfect clearance for the operation of the bits or cutters, or other tool.

The frame of the present invention, in connection with the hammer chamber and exterior spirals and the hammer and cross head having bits or cutters, furnishes a drill by which the frame supplies the air, or other medium under pressure, to operate the hammer and discharges the compressed air, or other medium under pressure, from in front of the acting end of the hammer, so that the acting or forward end of the hammer has a perfect clearance against back pressure from the compressed air, or other medium under pressure, that would interfere with the blow struck by the hammer. The spiral flanges of the frame, in connection with the spiral flange of the supporting tube, furnishes a conveyer or flight by means of which the cuttings, dust and fine particles will be carried away from the acting end of the drill, or other tool, as fast as produced, and so as not to interfere with the operation of the bits or cutters.

It will thus be seen that the frame of the present invention, consisting of a straight barrel with exterior spiral flanges around the barrel, furnishes, by the passages in the flanges, a means for supplying compressed air, or other medium under pressure, to operate a hammer, and means for educting compressed air, or other medium under pressure so as to prevent the creation of back pressure against the acting end of the hammer, and the spiral flanges furnish a means for initially drawing away or removing the cuttings, dust and fine particles produced by the bits or cutters, or other tool, for final removal or drawing away by the conveyer or flight on the supporting tube, making such removal or drawing away of the cuttings, dust and fine particles positive, effectual and reliable, during the operation of the drill, or other tool, and giving an independent and separate pathway of travel for the educted fluid and for the removal of the cuttings, dust and fine particles, so that the educted fluid will not interfere with the removal of the cuttings, dust and fine particles.

The frame of the present invention, with its straight barrel and exterior spiral flanges, and the conveyer or flight coöperating with the spiral flanges, is especially adapted for

use in deep drilling or boring, as the spirals of the frame, in conjunction with the conveyer or flight, will operate to carry upward or rearward of the head carrying the tool, all the cuttings, dust and fine particles, and such carrying upward or rearward of all the cuttings, dust and fine particles is positively performed by the spiral flanges and the conveyer or flight, and at the same time the frame permits compressed air, or other medium under pressure, to be inducted for operating the hammer, and to be educted for keeping the acting end of the hammer clear of back pressure, and this without in any manner interfering with the removal of the cuttings, dust and fine particles; and while the pneumatic hammer, with its exterior flanges, in connection with the conveyer or flight, is shown in conjunction with a tool head carrying drill bits or cutters, it is to be understood that the hammer, with its straight barrel and spiral exterior flanges for the frame, is intended for use, and can be used, with a tool head of other formation than the one shown, and for other purposes than deep drilling or boring.

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

1. In a pneumatic drill, a hammer frame consisting of a straight central barrel with oppositely running spiral flanges encircling the barrel and extending from end to end of the barrel, the barrel having a central chamber divided into sections, one section to receive a driven stem and another section to receive a driving hammer, and each spiral flange having a spiral induction passage and a spiral eduction passage, with the eduction passage of one flange terminating at the end of the flange and frame, and the eduction passage of the other spiral flange terminating in a port laterally extending inwardly, substantially as described.

2. In a pneumatic drill, a hammer frame consisting of a straight central barrel with oppositely running spiral flanges encircling the barrel and extending from end to end of the barrel, the barrel having a central chamber divided into sections, one section to receive a driven stem and another section to receive a driving hammer, and each spiral flange having a spiral induction passage and a spiral eduction passage, with the eduction passage of one flange terminating at the end of the flange and frame, and the eduction passage of the other spiral flange terminating in a port laterally extending inwardly, and a closing plug for the rear end of the frame and chamber of the barrel, the plug having an induction passage in communication with the induction passages of both spiral flanges, and an eduction passage in communication with the eduction passage of one spiral flange, substantially as described.

3. In a pneumatic drill, a hammer frame consisting of a straight central barrel with oppositely running spiral flanges encircling the barrel and extending from end to end of the barrel, the barrel having a central chamber divided into sections, one section to receive a driven stem and another section to receive a driving hammer, and each spiral flange having a spiral induction passage and a spiral eduction passage, with the eduction passage of one flange terminating at the end of the flange and frame, and the eduction passage of the other spiral flange terminating in a port laterally extending inwardly, a closing plug for the rear end of the frame and chamber of the barrel, the plug having an induction passage in communication with the induction passages of both spiral flanges, and an eduction passage in communication with the eduction passage of one spiral flange, a fluid supply tube connected with the closing plug and in communication with the induction passage of the plug, substantially as described.

4. In a pneumatic drill, a hammer frame consisting of a straight central barrel with oppositely running spiral flanges encircling the barrel and extending from end to end of the barrel, the barrel having a central chamber divided into sections, one section to receive a driven stem and another section to receive a driving hammer, and each spiral flange having a spiral induction passage and a spiral eduction passage, with the eduction passage of one flange terminating at the end of the flange and frame, and the eduction passage of the other spiral flange terminating in a port laterally extending inwardly a closing plug for the rear end of the frame and chamber of the barrel, the plug having an induction passage in communication with the induction passages of both spiral flanges, and an eduction passage in communication with the eduction passage of one spiral flange, a fluid supply tube connected with the closing plug and in communication with the induction passage of the plug, and a supporting tube encircling the fluid supply tube and into the interior of which the eduction passage of one spiral flange discharges, substantially as described.

5. In a pneumatic drill, a hammer frame consisting of a straight central barrel with oppositely running spiral flanges encircling the barrel and extending from end to end of the barrel, the barrel having a central chamber divided into sections, one section to receive a driven stem and another section to receive a driving hammer, and each spiral flange having a spiral induction passage and a spiral eduction passage, with the eduction passage of one flange terminating at the end of the flange and frame, and the eduction passage of the other spiral flange terminating in a port laterally extending inwardly, a closing plug for the rear end of the frame and

chamber of the barrel, the plug having an induction passage in communication with the induction passages of both spiral flanges, and an eduction passage in communication with the eduction passage of one spiral flange, a fluid supply tube connected with the closing plug and in communication with the induction passage of the plug, a supporting tube encircling the fluid supply tube and into the interior of which the eduction passage of one spiral flange of the hammer frame discharges and a hollow spiral flange, on the exterior of the supporting tube, and into the interior of which the eduction passage of the other spiral flange of the hammer frame discharges, substantially as described.

6. In a pneumatic drill, a frame consisting of a straight central barrel and spiral flanges encircling the barrel and running in opposite directions on the barrel and extending from end to end of the barrel, the barrel having a central chamber divided into a plurality of sections, providing a section forming a bearing for a driven stem, a section forming an eduction chamber for discharging fluid, a section forming a bearing for a driving hammer, a section forming an induction chamber for fluid to act and recede the hammer, and a section forming a chamber to receive fluid for acting on and driving the hammer, and each spiral flange having an induction passage for fluid in communication with the fluid induction chamber of the barrel, and each spiral flange having an eduction passage for fluid in communication with the fluid eduction chamber of the barrel, with the eduction passage of one spiral flange terminating at the end of the frame, and with the eduction passage of the other spiral flange terminating in a port laterally and inwardly extending, substantially as described.

7. In a pneumatic drill, a frame consisting of a straight central barrel and spiral flanges encircling the barrel and running in opposite directions on the barrel and extending from end to end of the barrel, the barrel having a central chamber divided into a plurality of sections, providing a section forming a bearing for a driven stem, a section forming an eduction chamber for discharging fluid, a section forming a bearing for a driving hammer, a section forming an induction chamber for fluid to act and recede the hammer, and a section forming a chamber to receive fluid for acting on and driving the hammer, and each spiral flange having an induction passage for fluid in communication with the fluid induction chamber of the barrel, and each spiral flange having an eduction passage for fluid in communication with the fluid eduction chamber of the barrel, with the eduction passage of one spiral flange terminating at the end of the frame, and with the eduction passage of the other spiral flange terminating in a port laterally and inwardly extending, and a closing plug for the rear end of the frame and chamber of the barrel, the plug having an induction passage in communication with the induction passages of the spiral flanges, and an eduction passage in communication with the eduction passage having the lateral port of the one spiral flange, substantially as described.

8. In a pneumatic drill, a frame consisting of a straight central barrel and spiral flanges encircling the barrel and running in opposite directions on the barrel and extending from end to end of the barrel, the barrel having a central chamber adapted to receive a driving hammer and provided with an eduction section for discharging fluid and an induction section for fluid to act and recede and drive forward the hammer, and each spiral flange having an induction passage for fluid in communication with the fluid induction section of the chamber of the barrel, and each spiral flange having an eduction passage for fluid in communication with the fluid eduction section of the chamber of the barrel, with the eduction passage of one spiral flange opening through the rear end of the frame and with the eduction passage of the other spiral flange terminating in a port at the rear end of the frame and laterally and inwardly extending, and a closing plug for the rear end of the frame and chamber of the barrel, the plug having an induction passage in communication with the induction passage of the spiral flanges and an eduction passage in communication with the eduction passage of the spiral flange having the lateral port, substantially as described.

9. In a pneumatic drill, a frame consisting of a straight central barrel and spiral flanges encircling the barrel and running in opposite directions on the barrel and extending from end to end of the barrel, the barrel having a central chamber adapted to receive a driving hammer and provided with an eduction section for discharging fluid and an induction section for fluid to act and recede and drive forward the hammer, and each spiral flange having an induction passage for fluid in communication with the fluid induction section of the chamber of the barrel, and each spiral flange having an eduction passage for fluid in communication with the fluid eduction section of the chamber of the barrel, with the eduction passage of one spiral flange opening through the rear end of the frame and with the eduction passage of the other spiral flange terminating in a port at the rear end of the frame and laterally and inwardly extending, a closing plug for the rear end of the frame and chamber of the barrel, the plug having an induction passage in communication with the induction passage of the spiral flanges and an eduction passage in communication with the eduction passage of the spiral flange having the lateral port, and a driving

hammer operative in the chamber of the barrel, substantially as described.

10. In a pneumatic drill, a frame consisting of a straight central barrel and spiral flanges encircling the barrel and running in opposite directions on the barrel and extending from end to end of the barrel, the barrel having a central chamber adapted to receive a driving hammer and provided with an eduction section for discharging fluid and an induction section for fluid to act and recede and drive forward the hammer, and each spiral flange having an induction passage for fluid in communication with the fluid induction section of the chamber of the barrel, and each spiral flange having an eduction passage for fluid in communication with the fluid eduction section of the chamber of the barrel, with the eduction passage of one spiral flange opening through the rear end of the frame and with the eduction passage of the other spiral flange terminating in a port at the rear end of the frame and laterally and inwardly extending, a closing plug for the rear end of the frame and chamber of the barrel, the plug having an induction passage in communication with the induction passage of the spiral flanges and an eduction passage in communication with the eduction passage of the spiral flange having the lateral port, a driving hammer operative in the chamber of the barrel, and a driven stem operative in the chamber of the barrel in advance of the hammer, substantially as described.

11. In a pneumatic drill, a frame consisting of a straight central barrel and spiral flanges encircling the barrel and running in opposite directions on the barrel and extending from end to end of the barrel, the barrel having a central chamber adapted to receive a driving hammer and provided with an eduction section for discharging fluid and an induction section for fluid to act and recede and drive forward the hammer, and each spiral flange having an induction passage for fluid in communication with the fluid induction section of the chamber of the barrel, and each spiral flange having an eduction passage for fluid in communication with the fluid eduction section of the chamber of the barrel, with the eduction passage of one spiral flange opening through the rear end of the frame and with the eduction passage of the other spiral flange terminating in a port at the rear end of the frame and laterally and inwardly extending, a closing plug for the rear end of the frame and chamber of the barrel, the plug having an induction passage in communication with the induction passage of the spiral flanges and an eduction passage in communication with the eduction passage of the spiral flange having the lateral port, a driving hammer operative in the chamber of the barrel, a driven stem operative in the chamber of the barrel in advance of the hammer, and a tool head carried by the driven stem, substantially as described.

12. In a pneumatic drill, a frame consisting of a straight central barrel and spiral flanges encircling the barrel and running in opposite directions on the barrel and extending from end to end of the barrel, the barrel having a central chamber adapted to receive a driving hammer and provided with an eduction section for discharging fluid and an induction section for fluid to act and recede and drive forward the hammer, and each spiral flange having an induction passage for fluid in communication with the fluid induction section of the chamber of the barrel, and each spiral flange having an eduction passage for fluid in communication with the fluid eduction section of the chamber of the barrel, with the eduction passage of one spiral flange opening through the rear end of the frame and with the eduction passage of the other spiral flange terminating in a port at the rear end of the frame and laterally and inwardly extending, a closing plug for the rear end of the frame and chamber of the barrel, the plug having an induction passage in communication with the induction passage of the spiral flanges and an eduction passage in communication with the eduction passage of the spiral flange having the lateral port, a fluid supply tube connected with the induction passage of the closing plug, and a supporting tube encircling the fluid supply tube and having on its exterior a hollow spiral flange and receiving into its interior the educted fluid from one spiral flange of the hammer frame and receiving into its hollow spiral flange the educted fluid from the other spiral flange of the frame, substantially as described.

13. In a pneumatic drill, a frame consisting of a straight central barrel and spiral flanges encircling the barrel and running in opposite directions on the barrel and extending from end to end of the barrel, the barrel having a central chamber adapted to receive a driving hammer and provided with an eduction section for discharging fluid and an induction section for fluid to act and recede and drive forward the hammer, and each spiral flange having an induction passage for fluid in communication with the fluid induction section of the chamber of the barrel, and each spiral flange having an eduction passage for fluid in communication with the fluid eduction section of the chamber of the barrel, with the eduction passage of one spiral flange opening through the rear end of the frame and with the eduction passage of the other spiral flange terminating in a port at the rear end of the frame and laterally and inwardly extending, a closing plug for the rear end of the frame and chamber of the barrel, the plug having an induction passage in communication with the induction passages

of the spiral flanges and an eduction passage in communication with the eduction passage of the spiral flange having the lateral port, a fluid supply tube connected with the induction passage of the closing plug, a supporting tube encircling the fluid supply tube and having on its exterior a hollow spiral flange and receiving into its interior the educted fluid from one spiral flange of the hammer frame and receiving into its hollow spiral flange the educted fluid from the other spiral flange of the frame, and a driving hammer operative in the chamber cf the barrel, substantially as described.

14. In a pneumatic drill, a frame consisting of a straight central barrel and spiral flanges encircling the barrel and running in opposite directions on the barrel and extending from end to end of the barrel, the barrel having a central chamber adapted to receive a driving hammer and provided with an eduction section for discharging fluid and an induction section for fluid to act and recede and drive forward the hammer, and each spiral flange having an induction passage for fluid in communication with the fluid induction section of the chamber of the barrel, and each spiral flange having an eduction passage for fluid in communication with the fluid eduction section of the chamber of the barrel, with the eduction passage of one spiral flange opening through the rear end of the frame and with the eduction passage of the other spiral flange terminating in a port at the rear end of the frame and laterally and inwardly extending, a closing plug for the rear end of the frame and chamber of the barrel, the plug having an induction passage in communication with the induction passages of the spiral flanges and an eduction passage in communication with the eduction passage of the spiral flange having the lateral port, a fluid supply tube connected with the induction passage of the closing plug, a supporting tube encircling the fluid supply tube and having on its exterior a hollow spiral flange and receiving into its interior the educted fluid from one spiral flange of the hammer frame and receiving into its hollow spiral flange the educted fluid from the other spiral flange of the frame, a driving hammer operative in the chamber of the barrel, and a driven stem operative in the chamber of the barrel in advance of the driving hammer, substantially as described.

15. In a pneumatic drill, the combination of a hammer frame, consisting of a straight central barrel and spiral flanges encircling the barrel and running in opposite directions on the barrel, each spiral flange having an eduction passage for fluid, with the eduction passage of one flange terminating at the rear end of the flange, and with the eduction passage of the other flange terminating in a lateral and inwardly extending port, a closing plug having an eduction passage in communication with the port of the eduction passage of the spiral flange, and a supporting tube connected with the rear end of the hammer frame and encircled by a hollow spiral flange, and receiving into its interior the educted fluid from the eduction passage of the closing plug, and receiving into its hollow flange the educted fluid from the other spiral flange of the frame, substantially as described.

16. In a pneumatic drill, the combination of a frame having on its exterior oppositely running spiral flanges extending from end to end of the frame, a supporting tube connected with the rear end of the frame and encircled by a hollow spiral flange, the spiral flanges of the frame each having an eduction passage for fluid, one passage discharging into the interior of the supporting tube and the other passage discharging into the passage of the hollow flange, substantially as described.

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Witnesses:
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