M. HARDSOCG.

PNEUMATIC DRILL.

APPLICATION FILED APR. 18, 1907.

899,729.

Patented Sept. 29, 1908.

4 SHEETS—SHEET 1.

Fig. 1.

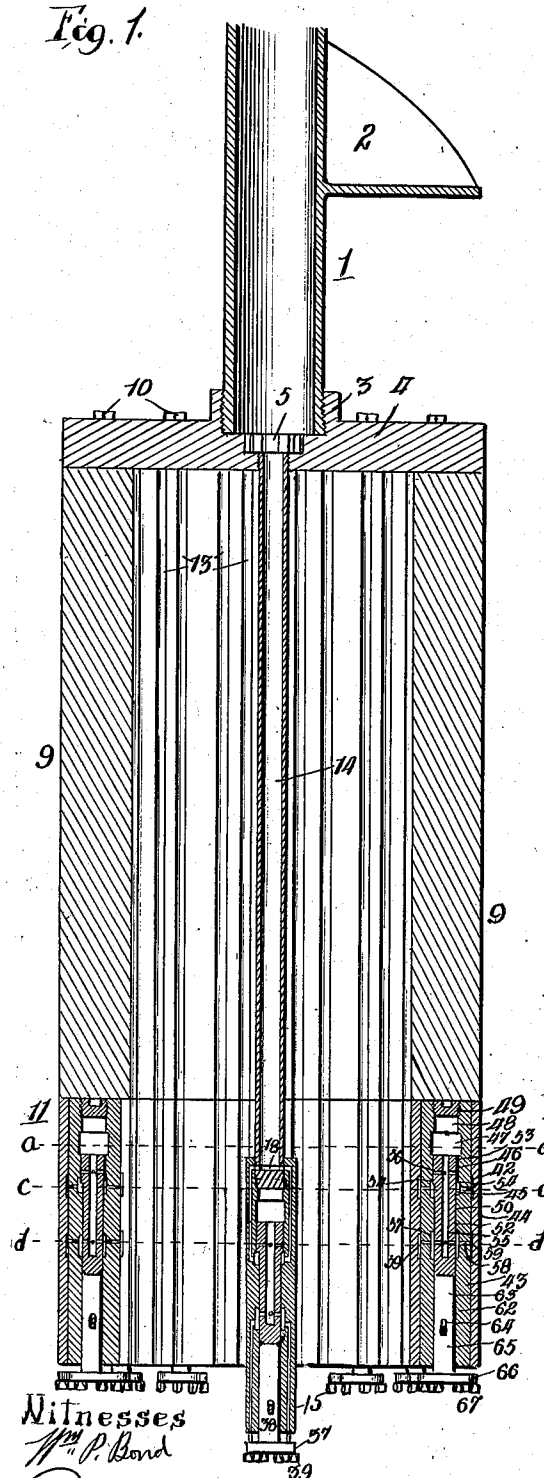
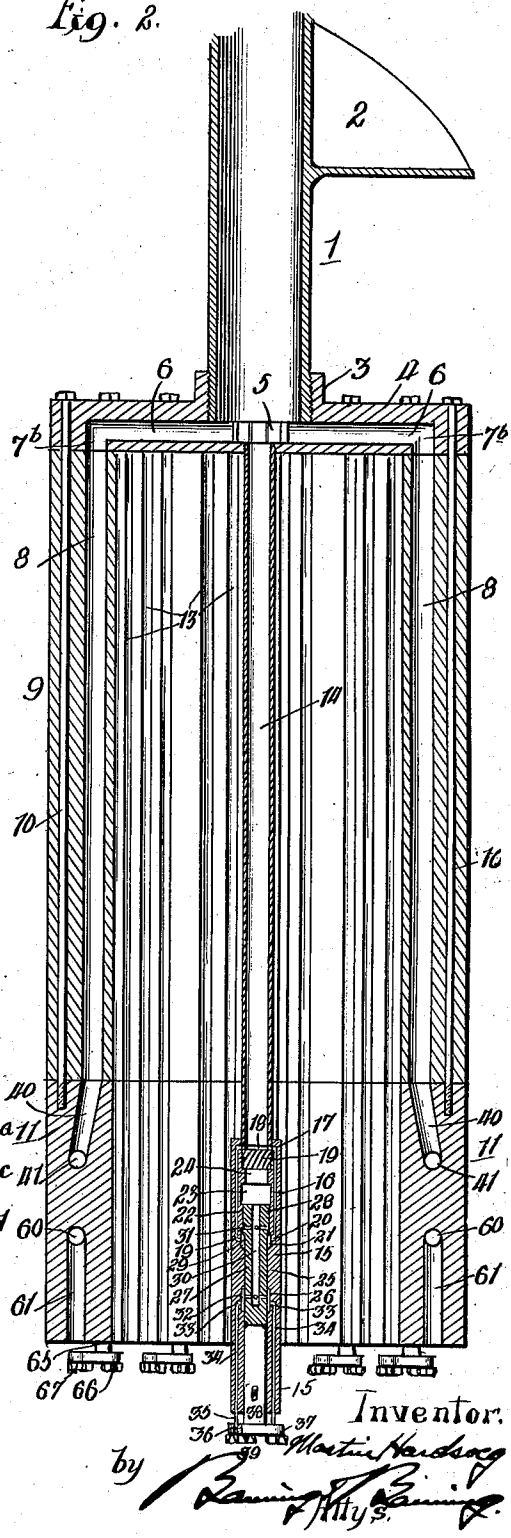


Fig. 2.



Witnesses

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Inventor.

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4 SHEETS—SHEET 2.

Fig. 3.

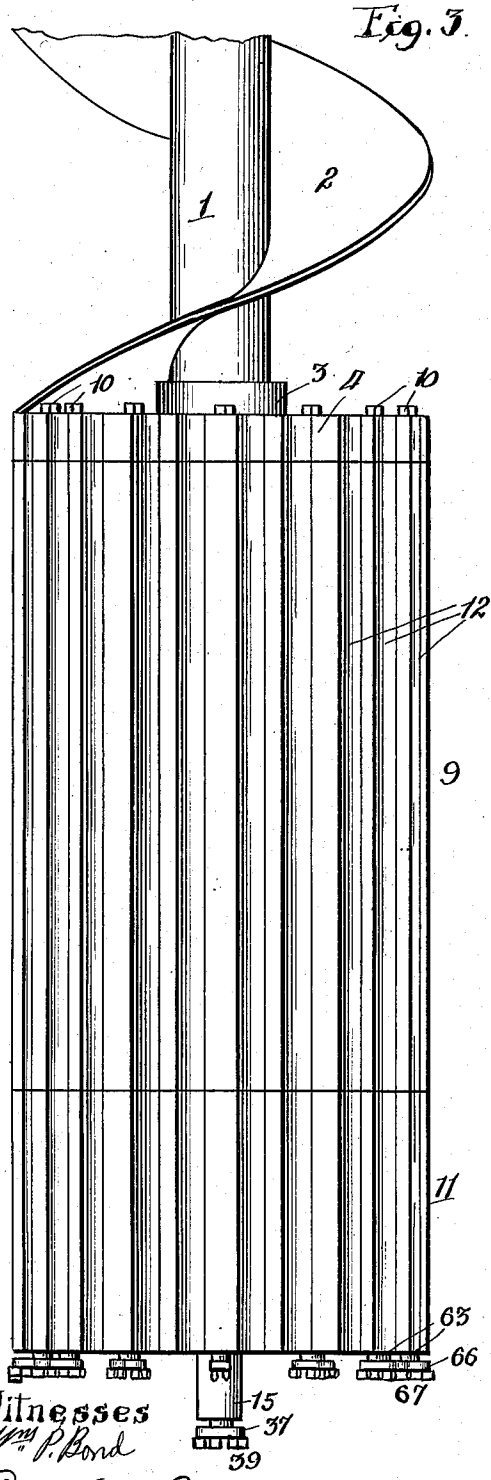


Fig. 4.

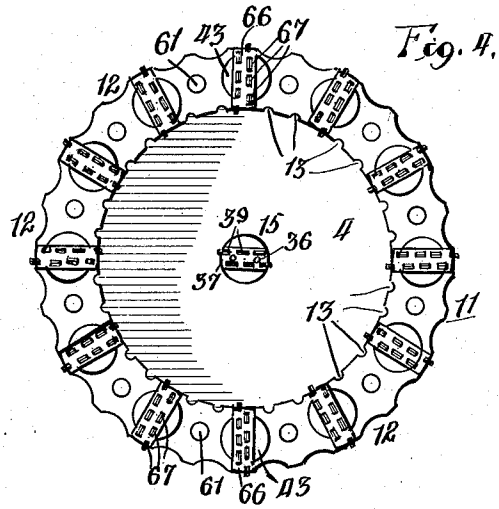
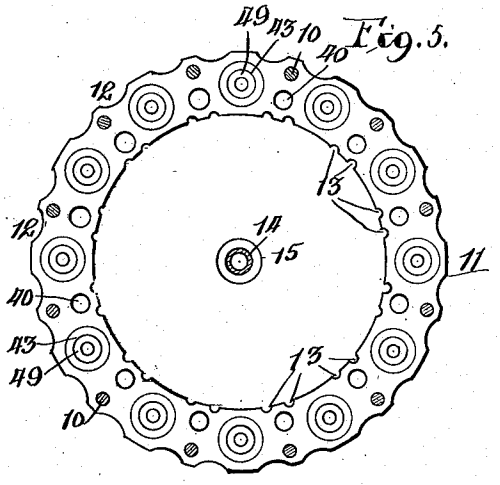


Fig. 5.



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4 SHEETS—SHEET 3.

Fig. 6.

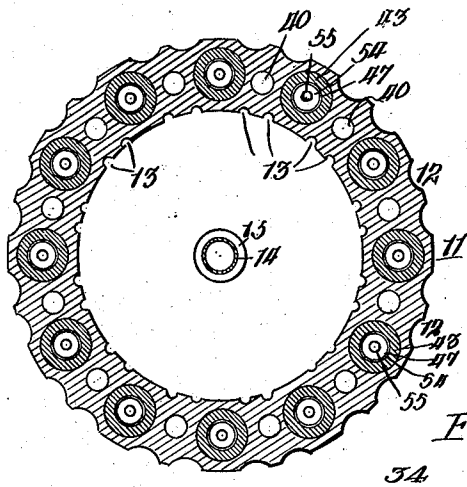


Fig. 7.

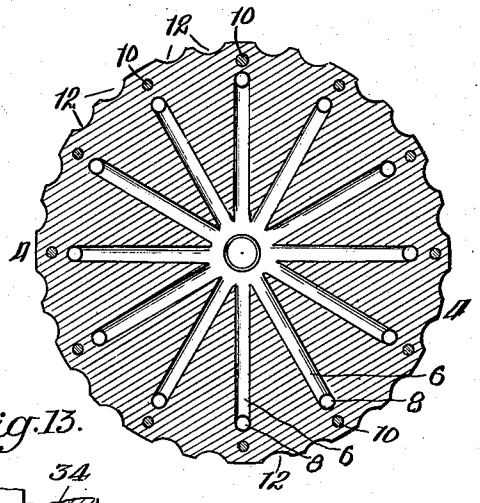


Fig. 13.

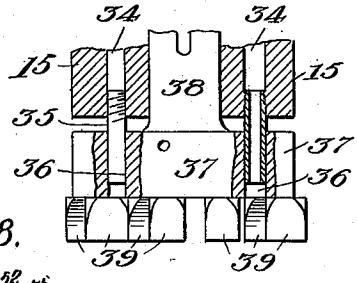


Fig. 8.

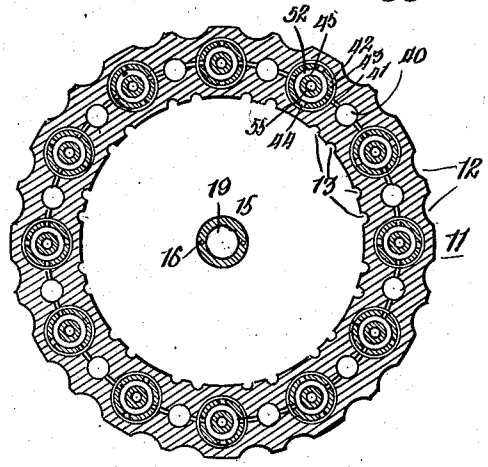
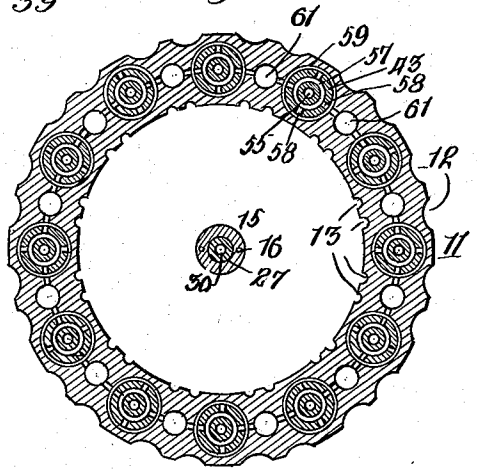


Fig. 9.



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899,729. **Patented Sept. 29, 1908.**

4 SHEETS—SHEET 4.

Fig. 12.

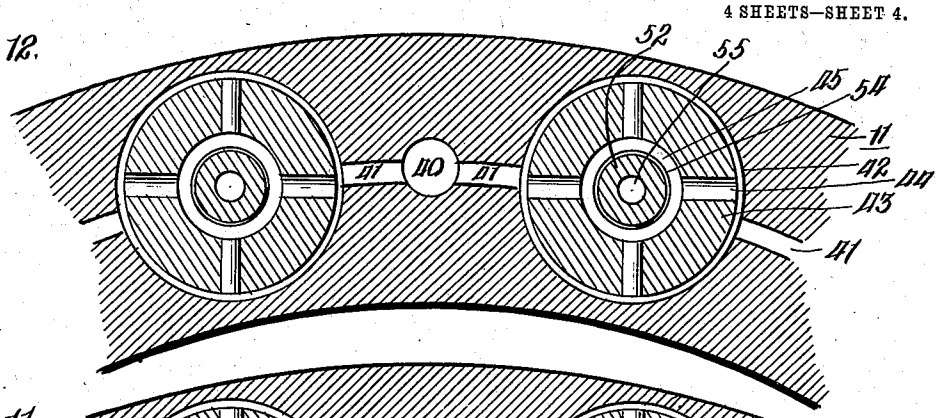


Fig. 11.

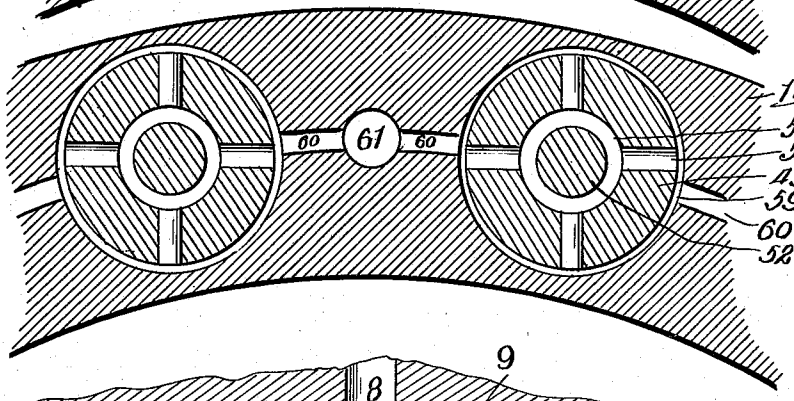
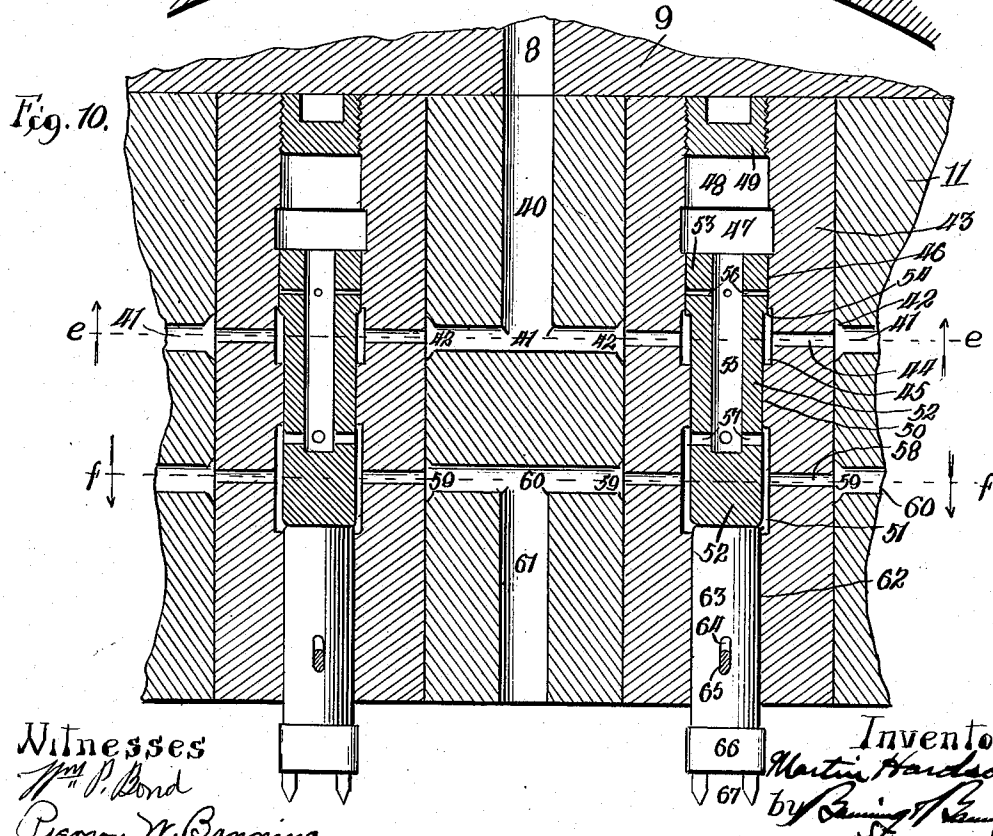


Fig. 10.



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UNITED STATES PATENT OFFICE.

MARTIN HARDSOCG, OF OTTUMWA, IOWA.

PNEUMATIC DRILL.

No. 899,729. Specification of Letters Patent. Patented Sept. 29, 1908.

Application filed April 18, 1907. Serial No. 368,885.

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.

This invention relates to pneumatic drills more especially designed for cutting large openings, and particularly adapted for use in tunneling or making lateral cuttings in mining and rock drilling, and other similar operations.

The objects of the invention are to construct a drill having a plurality of cutters or bits, each cutter or bit independently operative, and all the cutters or bits simultaneously operative; to construct a casing having a closing head with a chamber and radial passages leading therefrom, each radial passage connected with a longitudinal passage in the casing for supplying air, or other medium under pressure, to each passage; to construct a head carrying a plurality of pneumatic hammers and a plurality of driven stems, each stem having connected therewith a tool head with bits or cutters; to furnish a plurality of casings located in a carrying head, each casing having a central chamber to receive a driving hammer and a driven stem, and each casing having an induction passage for admitting fluid to drive the hammer and an eduction passage for exhausting fluid from in front of the driving end of the hammer; to furnish a plurality of drills, each drill operated by a driven hammer, with the drills arranged in a circle and coöperating with a central drill operated by a driven hammer; to construct a main shell or casing having a plurality of longitudinal passages and a carrying casing or head having a plurality of passages coinciding with the longitudinal passages of the main shell or casing and supplying compressed air, or other medium under pressure, to a plurality of barrels arranged in a circle, and each barrel having a chamber to receive a driving hammer and a driven stem; to construct a pneumatic drill having a plurality of tool heads, each carrying bits or cutters and arranged in a circle, and having also a central tool head carrying bits or cutters, with all the tool heads operated by pneumatic hammers; and to improve generally the construction, arrangement and operation of the plurality of pneumatic drills and central drill in their relation one to the other.

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

In the drawings Figure 1 is a sectional elevation of the complete drill, taken through two of the outer drills and the central drill; Fig. 2 a similar view to Fig. 1, taken on a line passing between two outer drills and through the central drill; Fig. 3 a side elevation of the complete drill of the invention; Fig. 4 an end elevation of the drill of the invention, showing the tool head with the bits or cutters; Fig. 5 a face view on the dividing line between the main shell or casing and the casing or head carrying the drills; Fig. 6 a cross section on line *a*—*a* of Fig. 1; Fig. 7 a cross section on line *b*—*b* of Fig. 2; Fig. 8 a cross section on line *c*—*c* of Fig. 1; Fig. 9 a cross section on line *d*—*d* of Fig. 1; Fig. 10 an enlarged section in detail, showing two of the drills and a portion of the main shell or casing, and the casing or head carrying the drills, with the supply and discharge passages for compressed air, or other medium under pressure; Fig. 11 a cross section on line *e*—*e* of Fig. 10, looking in the direction of the arrow; Fig. 12 a cross section on line *f*—*f* of Fig. 10, looking in the direction of the arrow; and Fig. 13 a detail, partly in section, of the lower end of the central barrel and its tool head.

The construction shown has a supply pipe 1 for compressed air, or other medium under pressure, with an encircling flange 2 forming a conveyer or flight for removing the cuttings, dust and fine particles produced in the operation of the drill. The forward end of the supply and carrying tube 1 is threaded into a neck or wall 3 on a closing head 4, and the closing head 4 has a central chamber 5 in line with the interior of the supply and carrying tube 1, from which chamber 5 radial passages 6 lead outwardly, each passage terminating in a port 7 downwardly opening through the inner face of the head, as shown in Figs. 2 and 7. Each port 7 communicates with and is in line with a longitudinal passage 8, formed in a main shell or casing 9 constituting the rear section of the frame, and the head 4 and main shell or casing 9 are connected with a casing or head 11, constituting the front section of the frame, by tie rods 10, passing through the head 4 and the main shell or

casing 9 and threaded into the inner end of the head or casing 11, as shown in Fig. 2. The exterior face of the head 4, the main shell or casing 9 and the head or casing 11, have a plurality of grooves 12, and the interior face of the head 4, the main shell or casing 9, and the casing or head 11, have grooves 13, as shown in Figs. 3, 4 and 5. The exterior grooves or passages 12 are for withdrawing the cuttings, dust and fine particles from in front of the bits or cutters, and the interior grooves or passages, allow dust and fine particles to escape from the interior of the pneumatic drill, as a whole, to be discharged around the exterior of the drill.

A central tube 14 is, at its outer end, threaded into the head, 4, so as to be in communication with the chamber 5, and the inner end of this tube 14 is threaded into the end head of a barrel 15, and the barrel 15 has, on opposite sides, longitudinal passages 16, each passage terminating at its outer or rear end in a radial or laterally extending port 17, each port in communication with a cross passage or chamber 18 at the end of the supply tube 14, so as to admit fluid into the side or longitudinal passages 16, for operating or driving the hammer in the chamber of the barrel.

Each passage or chamber 18, as shown, is formed between the end of the supply pipe or tube 14, and a closing head or plug 19, for the rear end of the chamber of the barrel. Each side or longitudinal passage 16, at its inner or forward end, terminates in a radial or laterally extending port 20, and each port 20 is in communication with a chamber 21 formed in the wall of the barrel 15, so as to admit fluid into the chamber 21 for receding the hammer. The chamber of the barrel has a circumferential wall 22, located between the chamber 21 and a chamber 23, and the chamber 23 is continued as a chamber or hole 24 into which is threaded the body of the plug 19, so as to effectually close the rear end of the chamber of the barrel, as shown in Fig. 2. The interior of the chamber of the barrel has a circumferential wall 25, located between the chamber 21 and a chamber 26, and the wall 25 furnishes a guide and support for the body 27 of a pneumatic hammer, having a striking end at the front and an enlargement or head 28 at the rear; and the enlargement or head 28 furnishes an abutment or end face 29 against which fluid acts to recede the hammer into a striking position. The hammer has a central longitudinal hole 30 opening through the end of the enlargement or head 28, and adjacent to the rear end of the passage 30 are lateral passages 31 leading through the enlargement or head; and at the front end of the longitudinal passage 30 are lateral ports or passages 32 leading through the body of the hammer.

A port 33 leads from opposite sides of the chamber 26, and each port 33 is in communication with a side or longitudinal passage 34, leading to the front end of the barrel of the hammer. Each side or longitudinal passage 34 is in communication with a tube 35, and each tube 35 enters a hole or passage 36 in a tool head 37, which tool head is carried by a shank or stem 38, forming the driven shank or stem operated upon the hammer. The cross or tool head 37 carries, in the construction shown, a plurality of bits or cutters 39, for performing the cutting or drilling operation by which a central hole is made in the material being operated.

The compressed air, or other medium under pressure, flows through the supply tube 14 into the cross passage 18, and through the ports 17 enters the side or longitudinal passages 16, to discharge at the ports 20 into the chamber 21, for the compressed, air, or other medium under pressure, to act on the abutment or end face 29 of the enlargement or head 28, and recede the hammer to its striking or driving position. The hammer is receded a sufficient distance for the lateral passages or ports 36 to pass the rear end of the wall 22, for compressed air, or other medium under pressure, to enter the chamber 23 and flow into the central passage 30 of the hammer, and act against the front end of the passage and rear end of the hammer, and cause the hammer to deliver the blow; and when in the receded position, the ports or passages 32 are closed by the entry of such ports or passages within the wall 25, preventing the escape of compressed air, or other medium under pressure, through the passages or ports 32, until the hammer has delivered its blow. The forward thrust or drive of the hammer carries the ports or passages 31 within the inclosing wall 22, closing such ports or passages, and carries the ports or passages 32 into communication with the chamber 26, for the compressed air, or other medium under pressure, to escape from the passage 30 into the chamber 26, and flow through the ports 33 into the passages 34, and discharge through the tubes 35 and passages or holes 36, in the front of the cross or tool head 37, and act to carry away the cuttings, dust and fine particles from the bits or cutters, giving a perfect clearance, after each blow of the hammer, for the next succeeding operation of the bits or cutters.

The central drill, by its bits or cutters, makes a hole, central of the core, cut out by the bits or cutters of the drill, so that, if desired, a dynamite cartridge, or other explosive, can be entered into the central hole for breaking up the core, so as to permit of the easy removal of the broken mass; and, as shown, the central drill acts slightly in advance of the outer drills in doing its work, which is desirable, as the barrel, with its drill, furnishes a center pin or bearing for the

revolving or turning of the drill, as a whole, in the operation of the drill.

The casing or head 11 has, in its inner end face, a plurality of holes or passages 40 coinciding with and in communication with the holes or passages 8 in the main shell or casing; and, as shown, the passages 8 are nearer the inner face than the outer face of the shell or casing 8, and the holes or passages 40 start from the end of the passages or holes 8 and have a slight outward inclination, so as to terminate at their inner ends at a central point between the inner and outer faces of the head or casing 11, as shown in Fig. 2. The passage 40 communicates with a cross passage 41, formed in the body of the head or shell 11, as shown in Fig. 10; and at each end of each passage 41 is a circumferential passage 42, into which the passage 41 discharges compressed air, or other medium under pressure. The head or shell 11 has entered thereinto a plurality of hammer barrels 43, the number of hammer barrels varying with the size of the head or shell, but enough hammer barrels being provided to entirely fill the end of the head or shell, as clearly shown in Fig. 4. Each barrel 43 has, on opposite sides, lateral ports or passages 44 communicating with the circumferential passages 42 around each barrel, and each port or passage 44, at its inner end, communicates with a chamber 45 formed within the interior of the barrel. A circumferential wall 46 is formed on the inner face of the wall, and is located between the chamber 45 and a chamber 47, which chamber is continued as a chamber or hole 48 to receive a closing plug 49, by means of which the chamber of the hammer barrel is tightly closed at its rear end, as shown in Fig. 10. A circumferential wall 50, on the inner face of the barrel, is located between the chamber 45 and a chamber 51, and the circumferential wall 50 furnishes a guide and bearing for the body of the hammer 52, having a front or striking end with an enlargement or head 53 at its rear end, furnishing a shoulder or abutment 54 for fluid to act and recede the hammer to striking position. The body of the hammer has a central longitudinal passage 55 extending through the enlargement or head 53; and adjacent to the rear end of the passage 55 are lateral ports or passages 56, extending through the enlargement or head; and at the front end of the passage 55 are lateral ports or passages 57, which are brought into communication with the chamber 51, when the hammer has completed its strike or blow, as shown in Fig. 10. The chamber 51, on opposite sides, has lateral ports 58 communicating with a circumferential passage 59, formed in the body of the head or shell 11 around each hammer barrel 43, and each circumferential passage 59 communicates with a cross passage 60, leading from which is a longitudinal passage 61 terminating at the end of the head or shell 11, so as to discharge compressed air, or other medium under pressure, in front of the head or shell.

Each hammer barrel has, at its front end, an inner circumferential wall 62, forming a guide and bearing for a shank or stem 63, which is retained in the chamber therefor of the barrel by means of a slot 64 in the shank or stem, and a bar or key 65, secured in the wall of the barrel and passing through the slot, as shown in Fig. 10, so as to hold the shank against dropping out and at the same time permitting of the necessary end movement for the operation of the cross head with the drill bits or cutters. The shank or stem 63 extends from a cross or tool head 66, carrying drill bits or cutters 67 of a suitable formation to operate and drill or cut a hole, and the arrangement of and the length of the cross head with the bits or cutters is such as to cause each tool to make a hole of greater diameter than the thickness of the wall or shell 11, as shown in Fig. 4; and the drill heads are spaced apart a sufficient distance, so as to have a clearance between the heads and the bits or cutters, by which a hole or circular channel is cut of a greater diameter than the diameter of the main shell or casing in cross diameter, with a central core inside of the main shell or casing and the head or casing carrying the hammer barrels, such core having a central hole, cut by the central drill or tool as already described.

The operation for all of the outer bits or cutters is the same, so that a general description will answer for each outer pneumatic hammer with its tool head and bits or cutters. The supply and carrying pipe 1 delivers compressed air, or other medium under pressure, to the chamber 5, and the compressed air, or other medium under pressure, flows through the plurality of radial passages 6, to discharge at each port 7 into the companion longitudinal or side passage 8 in the main shell or casing 9; and from the passages 8 the compressed air, or other medium under pressure, enters the passages 40 in the head or shell for the barrel hammers, to flow into the cross passages 41 from the several passages 40 and enter the circumferential passage or chamber 42 of each hammer barrel. The compressed air, or other medium under pressure, supplied to the chamber 45 by the lateral ports 44 from the circumferential chamber or passage 42, acts against the abutment or end face 54, and recedes or forces back the hammer into striking position. The hammer is receded a sufficient distance for the lateral ports or passages 56 to pass the rear end face of the circumferential wall 46, allowing fluid to enter the chamber 47 and pass into the longitudinal passage 55 of the driving hammer, for the hammer to act against the forward end of the passage 55

and rear end of the hammer, and advance the hammer to strike the blow. The compressed air, or other medium under pressure, enters the passage 55 through the lateral ports 56, and when the ports 56 are opened to admit fluid the ports 57 are closed, against the escape or eduction of fluid, by the withdrawal of the ports 57 within the circumferential wall 50, so that the fluid can act fully to cause the hammer to strike the blow. The ports or passages 56 are closed, when the hammer is advanced by the ports entering the circumferential wall 46, and with the delivery of the blow by the hammer the lateral ports or passages 57 open into the chamber 51, allowing compressed air, or other medium under pressure, to escape into the chamber 51 and flow out therefrom, through the lateral ports or passages 58, into the circumferential passage 59 to enter the cross passage 60 and discharge through the longitudinal passage 61, in front of the head or shell carrying the pneumatic hammers and the tool. The forward thrust or drive of the hammer 52 advances the driven shank or stem 63 to the limit of the slot 64, advancing the cross head 66, and causing the bits or cutters of the drill to act on the material being operated upon, and the blow or strike of the plurality of outer hammers will be simultaneous, giving a simultaneous advance and cutting operation for the plurality of bits or cutters.

The arrangement shown has an induction passage for admitting compressed air, or other medium under pressure, to operate the hammer between two adjoining hammer barrels, and the cross passage 41 for each induction passage is common to the two adjoining hammer barrels, and this is also true of the induction passages, each cross eduction passage being common to two adjacent hammer barrels, and each longitudinal eduction passage being located between two adjoining hammer barrels, so that the educted compressed air, or other medium under pressure, will discharge between the two adjoining bits or cutters. The construction shown has twelve hammer barrels, each with a drill bit or cutter, but a greater or less number could be used, the number varying according to the diameter of the head or shell.

It will be understood that in arranging the bits or cutters, in a circle around a common center, that the cutting of each drill shall be greater than the thickness of the wall of the head or shell, so as to have the plurality of drills act and cut a circular channel, leaving a central core which can be broken up and destroyed or removed, after withdrawing the drill, as a whole, from the cutting or tunnel made by the drill.

The compressed air, or other medium under pressure, discharged in front of the drill, will force the cuttings, dust and fine particles around the periphery of the drill, and the cuttings, dust and fine particles will be forced rearward, in the space between the shell or casing and the wall of the hole cut, by the force of the compressed air, or other medium under pressure, which escapes around the periphery of the main shell or casing, and the cuttings, dust and fine particles, forced rearwardly and held, in passing, by the grooves on the exterior of the main shell or casing, will be caught, by the conveyer or spiral encircling the supply and carrying tube, and be conducted rearwardly and discharged at the end of the supply and carrying tube, or otherwise, as may be desired.

The main shell or casing 9, with the head or shell 11, constitute a frame for the drill, which frame has therein passages for inducting fluid to a plurality of hammer barrels and passages for educting fluid from a plurality of hammer barrels. The frame with the induction passages for compressed air, or other medium under pressure, furnishes a means for supplying compressed air, or other medium under pressure to operate a plurality of hammers, and after operating the hammers, the compressed air or other medium under pressure, is discharged so as to serve as the means for removing, from the cutting or forward end of the drill, the cuttings, dust and fine particles that would interfere with the operation of the drill, and the discharge of the air, or other medium under pressure, from each of the barrels, leaves a perfect clearance for the acting or forward end of the hammer against back pressure, from the compressed air, or other medium under pressure, that would interfere with the blow struck by the hammer.

The compressed air, or other medium under pressure, discharged in advance of the forward end of the frame, in connection with the spiral flange of the supporting tube, furnishes a means by 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 to prevent the cuttings, dust and fine particles from interfering with the operation of the bits or cutters.

The frame of the present invention, with its central drill, and its plurality of outer drills, arranged in a circle makes a drill which is especially adapted for use in making channels or cuts having a large diameter, the diameter of the channel or cut varying with the diameter of the drill, and with the drill of the present invention, having a plurality of outer bits or cutters arranged in a circle, a hole or tunnel of a sufficient size in cross section to admit the body of a workman or operator, or even larger, can be made without any trouble or inconvenience, as the outer circle of bits or cutters will operate to cut a circular channel, leaving a central core, and this core can be pierced, by the central bit or cutter so as to form a hole for placing

therein a dynamite cartridge or other explosive by which the core can be broken up and removed. The tie rods connecting the two parts of the frame can be withdrawn, so that the supplemental or front section of the frame, serving as a casing or head for a plurality of pneumatic hammer barrels, can be removed from the rear section or main casing or shell of the frame, when necessary, for repairing any hammer barrel, or hammer, or operating tool, which becomes broken, or nonusable from any cause, and to repair a barrel, or a hammer, or tool, it is only necessary to detach the supplemental or front section of the frame from the rear or main section and force the barrel needing repair from the head or casing, leaving the barrel so that the tool can be withdrawn, or the hammer withdrawn, or the barrel replaced by a new barrel, or any repair necessary can be made. It is to be understood that the whole frame is shown for use in connection with a plurality of pneumatic hammers, and with a plurality of drills, each having bits or cutters, the construction and arrangement can be used with other tools than the special head with bits or cutters shown and described.

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

1. In a pneumatic drill, a frame having formed therein a plurality of fluid induction passages in communication with a circumferential passage, and a plurality of fluid eduction passages in communication with a circumferential passage, for supplying fluid to and discharging fluid from a plurality of pneumatic hammers carried by the frame, substantially as described.

2. In a pneumatic drill, a frame having formed therein a plurality of fluid induction passages in communication with a circumferential passage, a plurality of fluid eduction passages in communication with a circumferential passage, for supplying fluid to and discharging fluid from a plurality of pneumatic hammers carried by the frame, and a plurality of longitudinal passages on the exterior of the frame, substantially as described.

3. In a pneumatic drill, a frame having formed therein a plurality of fluid induction passages in communication with a circumferential passage, a plurality of fluid eduction passages in communication with a circumferential passage, for supplying fluid to and discharging fluid from a plurality of pneumatic hammers carried by the frame, and a plurality of longitudinal passages on the interior of the frame for the escape of the dust and fine particles from within the frame, substantially as described.

4. In a pneumatic drill, a frame having formed therein a plurality of fluid induction passages in communication with a circumferential passage, a plurality of fluid eduction passages in communication with a circumferential passage, for supplying fluid to and discharging fluid from a plurality of pneumatic hammers carried by the frame, a plurality of longitudinal passages on the exterior of the frame for the withdrawal of the cuttings, dust and fine particles from in front of the tool, and a plurality of longitudinal passages on the interior of the frame for the escape of the dust and fine particles from within the frame, substantially as described.

5. In a pneumatic drill, the combination of a frame having formed therein a plurality of fluid induction passages in communication with a circumferential passage, a plurality of fluid eduction passages in communication with a circumferential passage for supplying fluid to and discharging fluid from a plurality of barrels, and a plurality of barrels in communication with said passages and entered into the front end of the frame, each barrel adapted to receive and retain a driving hammer and a driven stem in operating the drill, substantially as described.

6. In a pneumatic drill, the combination of a frame having formed therein a plurality of fluid induction passages in communication with a circumferential passage, a plurality of fluid eduction passages in communication with a circumferential passage for supplying fluid to and discharging fluid from a plurality of barrels, a plurality of barrels in communication with said passages and entered into the front end of the frame, each barrel adapted to receive and retain a hammer, and a driven stem, carrying a tool head and cutting tools, and the fluid eduction passages of the frame discharging in front of the tool heads in operating the drill, substantially as described.

7. In a pneumatic drill, the combination of a circular frame having formed therein a plurality of induction passages in communication with a circumferential passage, a plurality of fluid eduction passages in communication with a circumferential passage for supplying fluid to and discharging fluid from a plurality of pneumatic hammers carried by the circular frame, a plurality of barrels entered into the front of the frame, each barrel having a central circular chamber provided with a fluid induction section in communication with the induction passages of the frame for admitting fluid to the chamber in operating a driving hammer, and each central circular chamber provided with a fluid eduction section in communication with the eduction passage of the frame for discharging fluid from the chamber of the barrel at the front end of the frame, and each circular chamber adapted to receive and retain a driving hammer in operating the drill, substantially as described.

8. In a pneumatic drill, the combination of a circular frame having formed therein a

plurality of fluid induction passages in communication with a circumferential passage, a plurality of fluid eduction passages in communication with a circumferential passage, for supplying fluid to and discharging fluid from a plurality of pneumatic hammers carried by the frame, a plurality of barrels in communication with said passages, each barrel adapted to receive a driving hammer and a driven stem and carried by the front section of the frame, each barrel having a central circular chamber provided with a fluid induction section in communication with the induction passages of the frame for admitting fluid to operate the hammer, and each barrel having the chamber provided with an eduction section in communication with the eduction passages of the frame, for discharging fluid from the chamber of the barrel at the front end of the frame, a driving hammer operative in the chamber of each barrel, and a driven stem operative in the chamber of each barrel forward of the hammer and carrying an operating tool, substantially as described.

9. In a pneumatic drill, the combination of a circular frame having formed therein a plurality of fluid induction passages in communication with a circumferential passage, a plurality of fluid eduction passages in communication with a circumferential passage, for supplying fluid to and discharging fluid from a plurality of pneumatic hammers carried by the frame, a plurality of barrels in communication with said passages, each barrel adapted to receive a driving hammer and a driven stem and carried by the front section of the frame, each barrel having a central circular chamber provided with a fluid eduction section for discharging fluid, and a fluid induction chamber for fluid to act and recede and drive forward the hammer, and each barrel having a radial port in communication with a fluid induction passage of the frame and a radial port in communication with the fluid eduction passage of the frame and each barrel having a fluid induction passage in communication with the fluid induction section of the chamber of the barrel, and a fluid induction passage in communication with the fluid eduction section of the chamber of the barrel, substantially as described.

10. In a pneumatic drill, the combination of a frame having formed therein a plurality of fluid induction passages in communication with a circumferential passage, a plurality of eduction passages in communication with a circumferential passage, for supplying fluid to and discharging fluid from a plurality of pneumatic hammers carried by the frame, and a plurality of pneumatic hammers arranged in circular relation around the frame in communication with said passages and operated by fluid inducted through the fluid induction passages of the frame, substantially as described.

11. In a pneumatic drill, the combination of a frame having formed therein a plurality of fluid induction passages in communication with a circumferential passage, a plurality of eduction passages in communication with a circumferential passage, for supplying fluid to and discharging fluid from a plurality of pneumatic hammers carried by the frame, a plurality of pneumatic hammers arranged in circular relation around the frame in communication with said passages and operated by fluid inducted through the fluid induction passages of the frame, and a central pneumatic hammer operated by fluid supplied from the fluid induction passage of the frame, substantially as described.

12. In a pneumatic drill, the combination of a circular frame having formed therein a plurality of fluid induction passages in communication with a circumferential passage, a plurality of fluid eduction passages in communication with a circumferential passage, for supplying fluid to and discharging fluid from a plurality of pneumatic hammers carried by the frame, a plurality of barrels for pneumatic hammers carried by the front section of the frame, and arranged in circular relation and in communication with said passages, a plurality of driving hammers one for each barrel, a plurality of driven stems one for each barrel, an operating tool for each stem, and a fluid supply tube connected with the frame and supplying fluid to all the passages of the frame, substantially as described.

13. In a pneumatic drill, the combination of a frame having formed therein a plurality of fluid induction passages in communication with a circumferential passage, a plurality of fluid eduction passages in communication with a circumferential passage, for supplying fluid to and discharging fluid from a plurality of pneumatic hammers carried by the frame, a plurality of barrels for pneumatic hammers carried by the front section of the frame in communication with said passages and arranged in circular relation, a plurality of driving hammers one for each barrel, a plurality of driven stems one for each barrel, each stem carrying an operating tool, and a fluid supply tube connected with the frame and having circumferentially around its exterior a flight or conveyer, substantially as described.

14. In a pneumatic drill, the combination of a frame having formed therein a plurality of fluid induction passages in communication with a circumferential passage, a plurality of fluid eduction passages in communication with a circumferential passage, for supplying fluid to and discharging fluid from a plurality of pneumatic hammers carried by the frame, a plurality of barrels for pneumatic hammers carried by the front section of the frame in

communication with said passages and arranged in circular relation, a plurality of driving hammers one for each barrel, a plurality of driven stems one for each barrel, an operating tool for each stem, a central barrel for a pneumatic hammer, a driving hammer within the central barrel, a driven stem within the central barrel, an operating tool for the driven stem, and a fluid supply tube connected with the frame and supplying fluid to the plurality of barrels and the central barrel, substantially as described.

15. In a pneumatic drill, the combination of a fluid supply tube, a closing head for a frame and having a central chamber in communication with the fluid supply tube, with radial passages leading from the central chamber and each terminating in a port, a frame having a plurality of longitudinal passages, one passage for each radial passage and port of the closing head, a plurality of barrels carried by the frame in communication with said passages and arranged in circular relation, a driving hammer for each barrel, and a driven stem for each barrel, each stem carrying a tool head and tool and passages in the frame, and barrels for inducting and educting fluid in operating the driving hammers, substantially as described.

16. In a pneumatic drill, the combination of a fluid supply tube, a closing head for a frame and having a central chamber in communication with the fluid supply tube, with radial passages leading from the central chamber and each terminating in a port, a frame having a plurality of longitudinal passages, one passage for each radial passage and port of the closing head, a plurality of barrels carried by the frame in communication with said passages and arranged in circular relation, a driving hammer for each barrel, and a driven stem for each barrel, each stem carrying a tool head and tool and passages in the frame, and barrels for inducting and educting fluid in operating the driving hammers, a central supply tube within the frame and connected with the central chamber of the closing head, a barrel carried by the central supply tube, a driving hammer in the barrel, a driven stem in the barrel and carrying a tool head and tool, and passages in the barrel of the central tube for inducting and educting fluid and operating the driving hammer, substantially as described.

17. In a pneumatic drill, the combination of a frame consisting of a closing head having a central chamber and radial passages for inducting fluid, a main section having longitudinal passages for inducting fluid, a front section having longitudinal and cross passages for inducting and educting fluid, a plurality of barrels for pneumatic hammers arranged in a circle in the front section of the frame and in communication with said passages, a driving hammer for each barrel, and a driven stem for each barrel, each stem carrying a head with operating tools, substantially as described.

18. In a pneumatic drill, the combination of a frame consisting of a closing head having a central chamber and radial passages for inducting fluid, a main section having longitudinal passages for inducting fluid, a front section having longitudinal and cross passages for inducting and educting fluid, a plurality of barrels for pneumatic hammers arranged in a circle in the front section of the frame and in communication with said passages, a driving hammer for each barrel, a driven stem for each barrel, each stem carrying a head with operating tools, a central tube for inducting fluid from the central chamber of the closing head, a barrel carried by the central tube and having induction and eduction passages for fluid, a hammer in the barrel, and a driven stem in the barrel and carrying a head with operating tools, substantially as described.

MARTIN HARDSOCG.

Witnesses:
FRED B. HARDSOCG,
W. A. WORK.