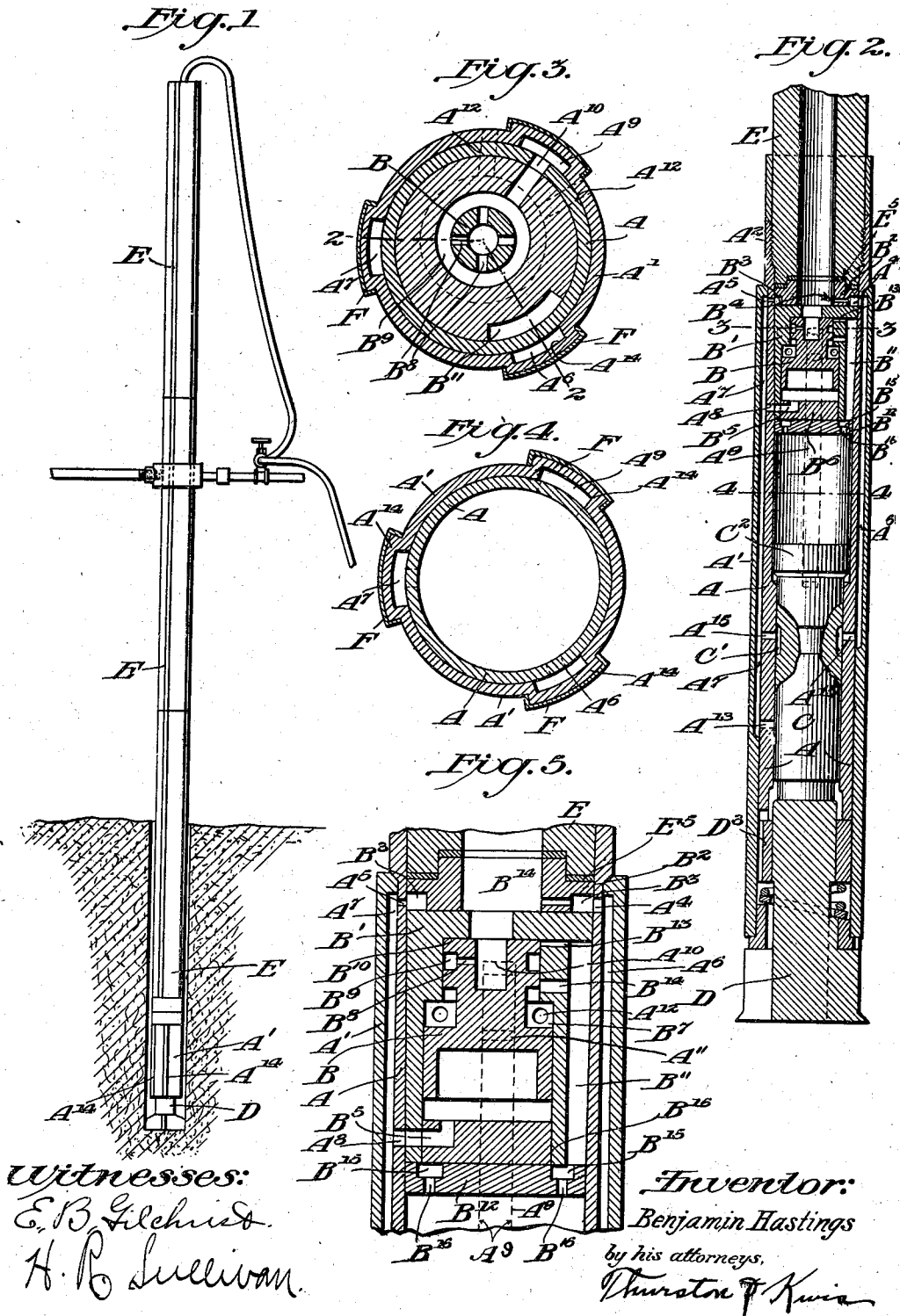


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ENGINE FOR ROCK DRILLS.
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ENGINE FOR ROCK-DRILLS.

1,015,798.

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To all whom it may concern:

Be it known that I, BENJAMIN HASTINGS, a citizen of the United States, residing at Barberton, in the county of Summit and State of Ohio, have invented a certain new and useful Improvement in Engines for Rock-Drills, of which the following is a full, clear, and exact description.

This invention is directed to engines for rock drills, more particularly those drills designed for use in mines, tunnels and quarries.

The type of drill to which my improvements are particularly applicable is that generically described in my prior Patent No. 916,703, issued March 30, 1909.

The principal object of this invention is to improve the engine of a rock drill, and specific description of its features will be made in the specification below, with reference to the accompanying drawings, in which:

Figure 1 is a general elevation illustrating a preferred form of drilling apparatus with which my invention is shown in operative position. Fig. 2 is a vertical section of the engine taken on two planes meeting at an angle of 120 degrees as shown by the line 2-2 of Fig. 3, the wearing covering of the ribs being omitted. Figs. 3 and 4 are enlarged transverse sections taken respectively on the lines 3-3 and 4-4 of Fig. 2. Fig. 5 is an enlargement of the valve and valve chest structure shown in Fig. 2.

Referring to the drawings for the details, it will be seen that the drill involves the use primarily of a body composing an engine barrel A and an outer casing A'. In the upper end of the engine barrel is placed the controlling valve B mounted in a chest B' fitted into the interiorly tapered upper end of the barrel. In the lower end of the barrel is a piston hammer C which strikes upon the upper end of a drill bit D having a free reciprocation within suitable limits at the lower end of the drill. To the upper end of the barrel is secured, by means of a screw thread and suitable lock, a handle section E which is a hollow pipe through which the motive fluid is conveyed to the engine. Succeeding pipe sections E are added, as shown in Fig. 1, within the limitations imposed both by the height of the tunnel or overhead room within which the work is being conducted and also by the depth of hole required.

For the purpose of securing the first han-

dle section E to the drill I extend the upper end of the barrel A beyond the outer casing in order that its wall may be thickened and have great strength at the zone A² where it is joined to the handle section. The upper end of the barrel is provided with an interior screw thread which receives a corresponding thread on the lower end of the handle member E, the said handle member screwing down firmly upon a packing E⁵, see Fig. 5, interposed between it and a metallic ring B² on top of the valve chest.

Beneath the handle end and the ring B² against which it presses is the valve chest B'. This chest is tapered to have a driving fit with the corresponding taper in the engine barrel A, the taper of the engine barrel extending substantially the length of the chest, as shown in Fig. 5. This method of securing the valve and its housing in position is quite important as by this means I am enabled to obtain, better than by any other means, an air tight fit between the walls of the chest and the barrel and thus avoid leakage between the various ports. Further, upon release of the chest from position it comes away from its seat without dragging and scoring the walls to which it is fitted, thus presenting an advantage over any other method of securing it in place.

Immediately above the chest will be noted an annular channel B³ having free and constant communication through a port B⁴ with the motive fluid supply, the said channel being in the present structure formed in the annular ring B² interposed between the chest and the end of the handle. Communicating with this channel are two ports A⁴, A⁵ each extending through the engine barrel, and so located that they communicate with longitudinal channels or conduits A⁶ and A⁷ respectively, on the interior wall of the drill casing A'. The two longitudinal channels referred to are shown as substantially 120 degrees apart and each of them communicates at the lower end by means of a port A¹⁵ through the engine barrel with the chamber in which the body of the piston hammer C slides. A peripheral channel C' on the body of the piston hammer coincides with the zone of these ports when said piston hammer is at the bottom of its stroke, thus affording a means of communication between the two longitudinal conduits A⁶ and A⁷. One of these conduits A⁶ has its upper port A⁴, through the engine

barrel, of such size as to admit the live motive fluid freely from the hollow handle through which the fluid pressure is supplied. The other of said conduits A' has its port A⁵ through which such communication is established, of such small diameter as to afford but a slow transmission of pressure to the conduit, for a reason to be subsequently pointed out. This last named conduit A' communicates, through an opening A⁸ in the engine barrel, and a conduit B⁵ in a plug B⁶ in the bottom of the valve chest, with the space in the valve chest beneath the controlling valve B. The lower end of the controlling valve thus becomes exposed to the full fluid pressure whenever the piston hammer is in its lowest position, and communication established between the two longitudinal conduits A⁶ and A'. The upper end of the controlling valve is constantly exposed to the live pressure coming directly from the handle itself, but inasmuch as the superficial area of the lower end of the valve is greater than that of the upper end, the valve will always be thrown upward when the piston hammer is in its lowest position. The upward and downward movement of this valve controls the admission or exhaust of fluid beneath the head C² of the piston hammer, this flow taking place through a third longitudinal conduit A⁹ on the interior wall of the casing A', having two ports A¹⁰, A¹¹ at its upper end. One of these two ports, A¹⁰ serves to admit live pressure; the other A¹¹ serves as an outlet for the exhaust into a space B' in the valve chamber intermediate the two ends of the valve, which space has constant communication through two or more perforations A¹², as shown, with the outside atmosphere through the valve chest B', the engine barrel A and the casing A'. The admission of live pressure to the conduit A⁹ takes place through a series of transverse openings B⁸ in the upper wall of the valve, the valve being, as shown, hollowed out like a cup at each end. The said ports B⁸ open into an annular channel B⁹ between two flanges; and the proportions of the parts are so arranged that the live pressure is admitted to the said longitudinal channel A⁹ through port A¹⁰ when the valve is at the upper position and is cut off by one of the flanges B¹⁰ when the valve is at its lower position. Similarly, the exhaust port A¹¹ is cut off when the valve is at its upper position and open when the valve is at its lower position. The detail of this arrangement is not material so long as the operative effect is achieved.

On the exterior wall of the valve chest is a longitudinal groove B¹¹ which, in conjunction with the interior wall of the barrel, forms a conduit communicating through an annular channel B¹⁵ and ports B¹⁶ in a

disk B¹² at the lower end of the chest, with the piston chamber above the head of the piston hammer. This groove in the wall of the valve chest serves, by means of a port B¹³ at the upper end thereof, communicating with the upper end of the valve chamber, to admit live pressure into the piston chamber when the valve is in its lower position. The admission of such pressure is cut off by the valve when it is in its upper position. A second port B¹⁴ through the wall of the valve chest places this groove in communication with the exhaust space B' in the intermediate portion of the valve chamber. This last named port is opened and closed by the movement of the valve so that the chamber above the piston head is in communication with the exhaust at the time the controlling valve is in its uppermost position, but is cut off from the exhaust when said valve is in its lower position.

For the purpose of relieving the pressure beneath the lower end of the valve and permitting it to be thrown to its lower position after the piston hammer itself has been raised, I provide an exhaust port A¹³ at the lower end of that longitudinal channel A' which communicates with the space beneath the controlling valve. This exhaust port is itself controlled by the lower end of the piston hammer, being opened only when the piston is at its upper stroke. When the piston has reached its upper stroke, of course, the controlling valve will immediately drop owing to the relief through a port A¹⁸ of pressure on the lower side and the constant existence of pressure above. Dropping of the controlling valve in this manner will, as above stated admit live pressure above the piston head and again drive the piston hammer downward against the bit at the lower end of the drill, which downward movement of the piston will again result in establishing communication between the live pressure and the lower side of the valve through the two channels A⁶, A', as above indicated. With the live pressure again beneath the valve, it will be raised in the operation and repeat itself. I have found, however, that a certain appreciable time is required for transmission of the live pressure to the lower face of the valve owing to the fact that the distance of transmission is rather long and to the fact that the longitudinal conduit A' immediately communicating therewith is in a state of exhaustion which must be changed to a state of pressure before the operation takes place. I have discovered that this slowness of action may be overcome by creating a communication between the live pressure supply and the said conduit of such a character as to admit a small amount of fluid to the conduit, but so slowly as not to raise the pressure therein to the point at which the valve is operated prematurely.

For this purpose I provide the small opening A⁵ at the upper end of the conduit through the engine barrel into the live pressure space at the upper end of the valve chest. I have found that this overcomes the difficulty noted, perfectly, and the comparatively small leakage of fluid therethrough does not raise the pressure in the conduit quickly enough, after it has been once exhausted, to throw the valve prematurely, but it will raise the pressure therein sufficiently to assist in the quick throwing of the valve after the full pressure has been admitted to the conduit through the annular channel C' about the middle of the piston body.

It will be noted that I have devised a structure of valve and valve chest which is of material assistance in reducing the diameter of the engine to the lowest possible point, bearing in mind that the walls should be of a given thickness. By placing the valve eccentrically in the body of the valve chest as shown in Figs. 2 and 3, I secure a sufficient thickness of metal at one side, in addition to that thickness required for the walls of the chest, to enable me to place the groove B¹¹ in the exterior wall thereof, which, in conjunction with the inside wall of the barrel, forms a passageway for the flow of fluid to and from the upper end of the piston chamber. This is a feature of construction which is of importance where a given thickness is maintained in the walls of the chest and the barrel with a given area of passageway required. It will be observed that the passageway in question is of some considerable width, and in order to prevent the crushing in of the barrel at this point, I have provided a transverse support or brace in the disk B¹² for the wall at the lower end of the channel-way B¹¹, substantially as shown. The manner by which I have accomplished this does not in any manner obstruct the free flow of fluid into the chamber. I would at this point call attention to the fact that the conduits between the valve chest and the piston chamber are formed on the interior wall of the drill casing immediately beneath a portion thickened to form exterior ribs A¹⁴ which are provided for spacing the drill casing from the walls of the hole being drilled. The presence of the ribs is advantageous for the purpose of scraping the walls of the hole being drilled and for concentrating the exhaust air in vertical columns as it passes out of the hole, thus giving it sufficient velocity to carry out the debris from the lower end of the drill and provide for the conduct of air between the valve and the piston with a reduction in the diameter of the outside circumference of the casing equivalent to twice the thickness of the wall of the casing in comparison with other possible arrangements having the

same area of passageways and same diameter of piston. Inasmuch as the thickness of the wall of the casing is in practice about one-sixteenth of an inch, it will be seen that I am enabled by this feature alone, to save in the diameter of the casing as much as one-eighth of an inch, which is quite important, having in view the object which I have above outlined.

I have shown and preferred to provide upon the exterior of the drill an easily applied wearing cover F which may be replaced from time to time as the wear shall necessitate. This covering is shown in the present instance as applied to the exterior ribs only, these ribs obviously being the part subjected to the greatest wear.

The drill bit D is held at the lower end of the apparatus in such manner as to receive the full blow of the piston hammer and to have free longitudinal play within prescribed limits.

While it is not absolutely essential, nevertheless, I prefer, as I have indicated in the drawings, to provide the several handle sections with exterior ribs similar to those provided on the drill casing, the object of this being to concentrate the outward flow of the exhaust and thus cause it to better clear away the debris.

Having thus described my invention, I claim:

1. A drill comprising a piston and an engine barrel interiorly tapered near its rear end, a tapered valve chest containing a controlling valve and fitted to said tapered portion of the barrel.

2. A drill having an engine barrel and a valve chest in the rear end of said barrel, a valve chamber in said chest located eccentrically relative thereto, a fluid conduit in that wall of the chest thickened by the eccentric location of the valve chamber.

3. A drill having an engine barrel and a valve chest in the rear end of said barrel, a valve chamber in said chest located eccentrically relative thereto, and a fluid conduit formed on the face of the exterior wall of the valve chest substantially on that diameter of the valve chest passing through the axis of the valve chamber and on the face farthest removed from the valve chamber.

4. A drill comprising a piston and an engine barrel interiorly tapered near its rear end, a tapered valve chest containing a controlling valve and fitted to said tapered portion of the barrel, and supporting means for the wall of the barrel at the forward end of the valve chest for preventing the pinching in or collapsing of said barrel.

5. A drill having a controlling valve, a conduit communicating with one side of said valve, means for admitting live pressure to said conduit to such extent as to operate the valve, and means for exhausting

said conduit and additional means for admitting live pressure to said conduit slowly to assist in the ready operation of the valve substantially as described.

- 5 6. A drill having a body composed of two sections, an inner barrel and an outer casing, said outer casing having longitudinal ribs on the exterior wall thereof and channels on the interior wall where the casing is

thickened by said ribs, said channels being 10 adapted to conduct the motive fluid.

In testimony whereof, I hereunto affix my signature in the presence of two witnesses.

BENJAMIN HASTINGS.

Witnesses:

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H. R. SULLIVAN.