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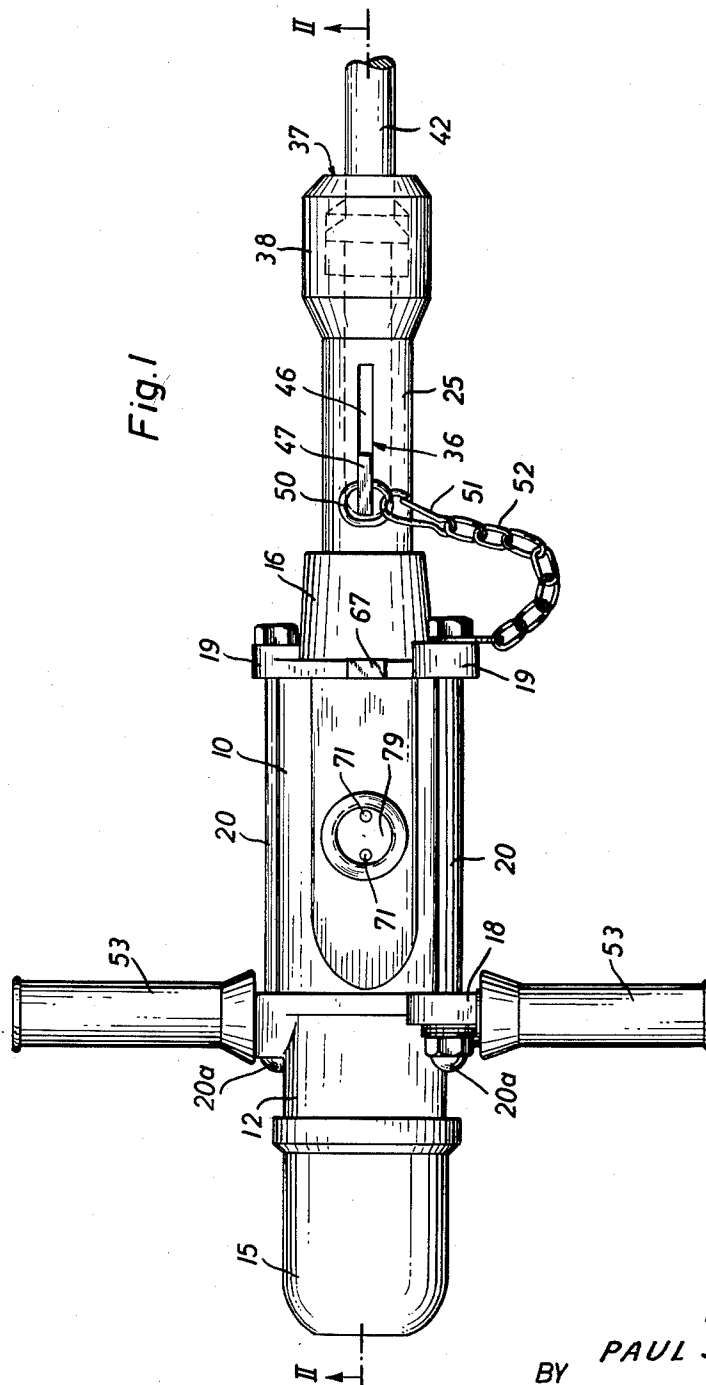
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3,016,964

DEVICE FOR EXTRACTING JAMMED ROCK DRILLS

Filed Dec. 17, 1957

3 Sheets-Sheet 1



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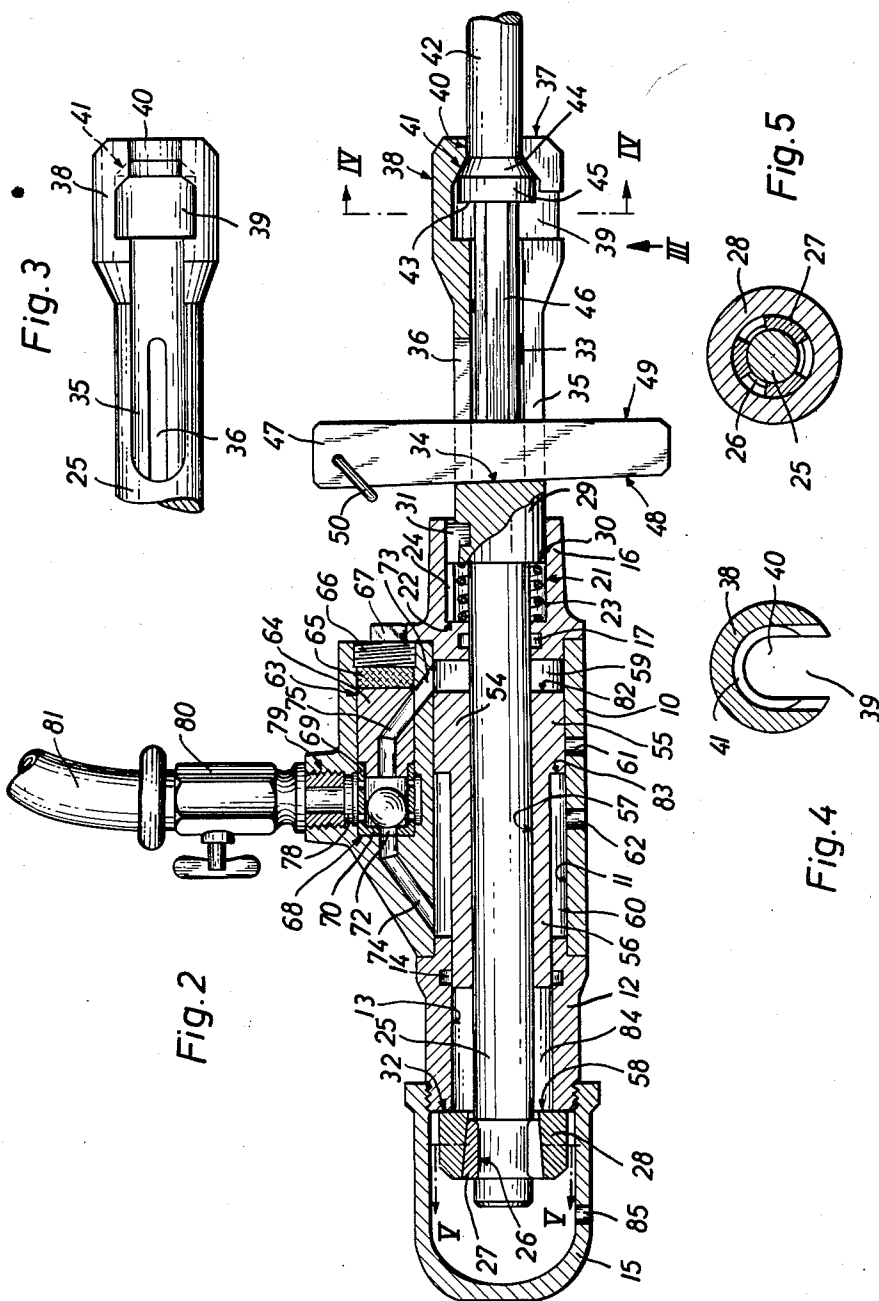
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DEVICE FOR EXTRACTING JAMMED ROCK DRILLS

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3 Sheets-Sheet 2



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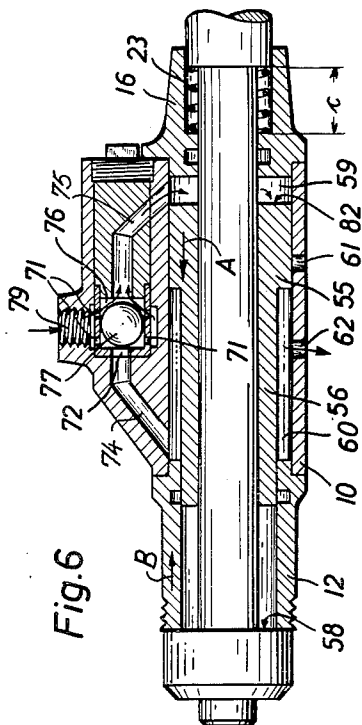
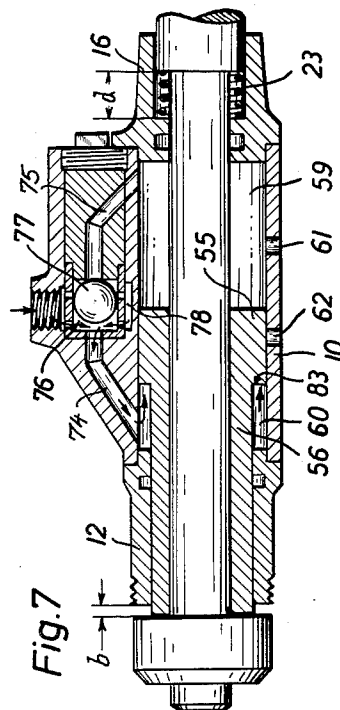
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DEVICE FOR EXTRACTING JAMMED ROCK DRILLS

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3 Sheets-Sheet 3



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DEVICE FOR EXTRACTING JAMMED ROCK DRILLS

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4 Claims. (Cl. 175-136)

This invention relates to a device by means of which it is possible in a simple manner and in a short space of time to loosen and extract from a borehole a rock drill which has become jammed therein.

It is a known fact that when drilling holes in rock, the drill frequently becomes jammed in the rock. If it is then still possible to turn the drill, it can often be loosened by tedious work. As a rule, however, it remains firmly stuck and cannot be withdrawn from the borehole even by exerting a strong pull and applying heavy blows. In many cases the drilling of one or several additional holes in the vicinity of the jammed drill is also of no avail. On the contrary, the additional drills used for drilling these holes frequently also become jammed. It is then necessary to blast the drill out of the rock with the aid of explosives. But to effect this more holes must also be drilled in the rock for receiving the charges of explosive and it may happen the bits used for this purpose also will become jammed.

The object of my invention is to produce a pneumatic device which enables a jammed rock drill to be extracted even when all other means have failed.

Another object of my invention is to construct a device for extracting jammed rock drills so that the extraction can be effected in a short space of time and with little trouble.

Yet another object of my invention is to design a device for extracting jammed rock drills so that the device can be connected to the rear head of the drill even when it has already penetrated deeply into the rock and consequently only a short end projects therefrom.

An important feature according to my invention is a pneumatic reciprocating piston arranged concentrically with a rod on which it is longitudinally slidable. I connect this rod with the drill or bit in such a manner that it forms, so to speak, a rearward extension thereof in alignment with the drill and I provide it near the end remote from the drill with an abutment, collar, head or the like against which the piston strikes in carrying out its reciprocating movement.

Other details will become apparent from the following description of a preferred embodiment of my invention illustrated by way of example in the accompanying drawing. I wish to emphasize the fact that only the claims at the end of this specification indicate the matter which I seek to protect by Letters Patent. In the drawing:

FIG. 1 is a top plan view of the device according to the invention showing the drill to be extracted;

FIG. 2 is a section taken on line II-II of FIG. 1;

FIG. 3 shows the part of the device serving for connecting it to the rear head of the drill, viewed in the direction of the arrow III in FIG. 2;

FIG. 4 is a section taken on line IV-IV of FIG. 2, but without the drill or bit;

FIG. 5 is a section on line V-V of FIG. 2;

FIG. 6 is a section corresponding to that shown in FIG. 2 taken through the middle portion of the device, with arrows indicating the function, and

FIG. 7 is a section similar to FIG. 6 but with the movable parts in a different position.

The device illustrated in FIGS. 1 and 2 comprises a main housing 10 with a cylindrical bore 11 which extends through the housing 10 from one end to the other. A

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sleeve 12 is fitted in the housing 10 and has a cylindrical bore 13 with an annular groove 14 for accommodating a lubricant. A bell-shaped cap 15 is screwed onto the end of the sleeve 12 remote from the housing 10.

A sleeve 16 is fitted into the bore 11 at the end of the housing 10 opposite the sleeve 12 and also has an annular groove 17 for holding a lubricant. The sleeve 12 has a pair of lugs 18 and the sleeve 16 has a pair of lugs 19, both shown in FIG. 1. Screw bolts 20 extend throughout the lugs along the outer side of the housing 10 parallel to the longitudinal axis thereof and, in conjunction with nuts 20a, serve for tightening the sleeves 12 and 16 against the housing 10, thereby producing a reliable connection between these parts capable of withstanding a heavy load. A cylindrical bore 21 of sleeve 16 is open at the end remote from the housing 10 and is partly closed by a shoulder 22 at the sleeve end facing the housing 10. Shoulder 22 serves as a seat for a helical spring 23 surrounded by the sleeve 16. The sleeve 16 also has a longitudinal groove 24 extending along the entire length of the cylindrical bore 21 in an axial direction.

A cylindrical rod 25 passes through sleeve 16, housing 10 and sleeve 12 into the bell-shaped cap 15, the diameter of this rod corresponding to the internal diameter of sleeve 16 in the region of shoulder 22. Rod 25 has near one of its ends (i.e. the end shown on the left in FIG. 2) a recess 26 for receiving segment-shaped fillers 27 as illustrated in FIGS. 2 and 5. These fillers are conical on their outer surface and form the means for holding a ring 28 the inner surface of which is conically tapered to fit the fillers 27. It will be apparent that the ring 28, owing to the wedging effect of its conical surface, is reliably held on the rod 25 by the fillers 27. The external diameter of this ring 28 is considerably larger than the internal diameter of the bore 14 in the sleeve 13 but smaller than the internal diameter of the cap 15.

At the point where the rod 25 extends through the bore 21 in the sleeve 16 it has a section 29 of enlarged diameter forming a shoulder 30 for supporting the spring 23. A guide member 31 is fitted laterally in the section 29 and projects into the groove 24, so as to prevent the rod 25 from turning about its axis in relation to the sleeve 16. I prefer to make the spring 23 relatively strong and of such dimensions that it is compressed to a certain extent during the assemblage. With the parts in the position shown in FIG. 2, the spring 23 then exerts a force which presses the ring 28, rigidly connected to the rod 25, with a certain pressure against the end face 32 of the sleeve 12.

In the section extending outwards from the section 29 the rod has a longitudinal bore 33 closed by a face 34 formed by the solid section 29. This bore is accessible from one side—that directed downwards in FIG. 2—through a relatively wide longitudinal slot 35. It is also accessible from the side opposite the slot 35 through another slot 36 of narrower width. Whereas the slot 35 extends from the face 34 up to the free end 37 of the rod 25, the slot 36 extends in forward direction from the face 34 only along a relatively short distance. The rod 25 is provided on its free end with a head 38 of larger diameter, in which a groove 39 is cut in the shape indicated in FIGS. 2 and 4. The bore 33, which extends up to the groove 39, has an extension leading outwards into a bore 40 from which a conical recess 41 extends inwards into the neighborhood of the groove 39.

The above-described construction of the portion of the rod located outside the sleeve 12 enables the rod to be firmly connected to a rock drill or bit 42. Only the rear shank end and the rear head 43 of this drill are shown

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in the drawing. This head consists of a conical shoulder 44 and a cylindrical extension 45. The bore 40 and the conical surface 41 of the head of the rod 25 are so dimensioned that they fit the shank 42 and the shoulder 44 of the drill. The drill also has a hexagonal extension 46 projecting rearwardly from the end face of the extension 45. The slot 35 is slightly wider than the diameter of the extension 46 and the axial width of the groove 35 is slightly larger than the axial length of the head 43 of the drill 42 comprising the sections 44 and 45. Thus it is possible to connect the drill with the rod 25 in such a manner that the head 38 of the rod 25 can be slipped over the rear end of the drill from above. The head of the drill then passes through the groove 39 and its extension 46 through the slot 35 and is thus in a position in which it is coaxial with the rod. When it is in this position, a wedge 47 is driven laterally into the slot 36 sufficiently far to project through the slot 35 to the other side thereof. This wedge has a beveled surface 48. The face 34 is inclined to a plane at right angles to the axis of the rod 25 and to the wedge surface 48. Consequently when the wedge 47 has been driven home, surface 49 of wedge 47, opposite surface 48, is then at right angles to the axis of rod 25. When inserting the wedge, the surface 49, owing to the incline of surface 34, shifts in axial direction and therefore exerts pressure in outward direction on extension 46 of drill 42. As a result thereof, surfaces 41 and 44 bear tightly and under pressure one against the other, and the drill is thus firmly connected with rod 25 as if it and the drill were in one piece.

The drill 42 with its head 43 and extension 46 as illustrated corresponds in shape to the internationally standardized type of rock drills. Another type differs therefrom only in that the extension 46 is slightly shorter than shown. To enable such a drill to be connected with the device, slot 36 is extended so far that, instead of the normal wedge above described, a wedge can be inserted which is so constructed that the distance between the surfaces 48 and 49 is greater by an amount corresponding to that by which the extension 46 of the drill is shorter.

The wedge 47 in permanent use for some period of time is preferably attached by a ring 50 to a snap hook 51 on a chain 52 which is attached to the device by means of one or two bolts 20, as shown in FIG. 1. This prevents the wedge from being lost at the working site.

The sleeve 12 has on its periphery two strong handles 53 extending transversely to the axis of the housing from diametrically opposite locations. They serve for holding the device in operative position and may be coated with rubber.

A sleeve-like body or piston 54 is slidable in the cylindrical bore 11 of housing 10 and comprises a relatively short section 55 of a diameter fitting bore 11 and a relatively long section 56 of a diameter fitting bore 13. Piston 54 has a longitudinal bore 57 enabling it to slide axially on the rod 25. Its stroke is limited in one direction by the end face of sleeve 16 closing the housing 10 and in the other direction by the end face 58 of ring 28. The piston forms within the housing 10 a chamber 59, the cross-section of which is determined by a relatively wide ring, and a second chamber 60 the cross-section of which is in the form of a relatively narrow ring. The wall of the housing 10 has two vent holes 61 and 62. When piston 54 is in the position illustrated in FIGS. 2 and 6, chamber 60 communicates with the atmosphere through vent hole 62, whereas vent hole 61 is closed by the section 55 of piston 54. The vent holes 61 and 62 are so spaced that, when the piston moves towards the left, vent hole 61 is slightly uncovered by section 55 at the moment when vent hole 62 has just been completely closed by this same section 55.

The housing has a lateral chamber 63 to accommodate a cylindrical block 64 and sealed by a gasket 65 and a nut 66, the latter having a square head 67 for a wrench. The nut is fitted before the sleeves 12 and 16 are con-

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nected with the housing 10. When all the parts are assembled, the edge of sleeve 16 bearing against head 67 prevents the nut from working loose under vibration.

Chamber 63 serves for accommodating a valve, generally designated 68. This valve comprises a sleeve 69 provided with an end face or end wall 70 and held in position, as shown, by the block 64 after the nut 66 has been inserted. Sleeve 69 is provided with several apertures 71 in its side wall. Of these apertures, four are visible in the sections shown in FIGS. 2, 6 and 7, and two of these also appear in the plan view shown in FIG. 1. The end wall 70 of sleeve 69 has a single aperture 72.

Two passages 73 and 74 are formed in the body of the housing 10, passage 73 being connected to chamber 59 and passage 74 connecting aperture 72 with chamber 60. One passage 75 is formed in block 64 and connects passage 73 with the space 76 inside sleeve 69 and thereby also connects space 76 with chamber 59. A ball 77 is accommodated in the space 76 and represents the operative member of the valve. The side wall of sleeve 69 is surrounded by an annular space 78 with which a bore 79 communicates. The connecting piece of a cock 80 provided with a screw thread is screwed into bore 79 and the cock can be connected to a source of compressed air by means of a hose 81. Cock 80 is omitted from FIG. 1 in order to render visible the apertures 71.

The device operates in the following manner:

If a bit or drill has jammed in the rock so that it can no longer be rotated by the drilling machine, the head of the drilling machine is removed from it, the drilling machine run back a certain distance and the device according to my invention is fitted to it. To effect this, the head 38 of the rod 25 is slipped from above over the rear head 40 of the end of the drill still projecting from the rock in the manner already described. The wedge 47 is then driven in so that a rigid connection is established between the drill 42 and the rod 25. The device, which is kept ready at hand for this purpose, is preferably already connected to a source of compressed air by means of tube 81 with the cock 80 closed. The source of compressed air is not shown in the drawing but is always available on the site. As long as the cock 80 is closed, the ball 77 adjusts itself to the actual inclined position of the device. Let it be assumed that it is in the position shown in FIG. 2.

If the cock 80 is now opened, compressed air will flow, as shown in FIG. 6, through the apertures 71 into the sleeve 69, then through the passages 75 and 73 into the chamber 59 where it will shift the piston 54 towards the left in the direction A with a force corresponding to the relatively large piston face 82 until the piston, acting as a hammer, strikes against the anvil surface 58 exerting a heavy blow thereon. This blow acts directly on the drill 42 in the direction away from the drillhole and commences to loosen the drill. It will have been noticed that the piston is a sleeve composed of cylindrical parts, the axis of which coincides with the axis of the rod 25. Consequently, its center of gravity is located on the axis of the rod 25. An important result of this arrangement is that the vector of the force which is exerted by the blow on the rod 25 coincides with the axis of the drill. The blow therefore acts centrally. While the piston is moving, air is forced out of the chamber 60 through the vent 62 until this vent is closed by the section 55 of the piston. Shortly previously, the section 55 has commenced to uncover the vent 61 so that the air escapes from the chamber 59 into the atmosphere and the pressure in this chamber drops. After the vent 62 has been closed, pressure builds up in chamber 60 which pressure, when sufficiently high, will act upon ball 77 through passage 74 and aperture 72 and will shift the ball into its left-hand extreme position. Thus communication is established between the source of compressed air through the aperture 71 and the passage 74 to the chamber 60 and at the same time

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the communication to chamber 59 is shut off. Therefore the compressed air now tends to shift the piston towards the right but with reduced force owing to the smallness of the surface 83. Owing to the amount of kinetic energy stored in the piston, the return movement commences only after the blow has been struck on the surface 58. During this return movement the vents 61 and 62 are opened and closed in the reversed sequence. When the vent 61 is finally closed and the pressure in the chamber 59 is increased by the piston 54, the ball 77 automatically returns into the position shown in the drawing and the cycle of operations described is repeated as long as the cock 80 is open.

It follows from Newton's First Law that the mechanical system comprising the piston 54 and the housing 10 including all the parts rigidly connected to the latter tends to retain the position of its common center of gravity in space while the piston moves. Consequently, the housing 10 with connected parts will move from left to right in the direction of arrow B when the piston 54 moves from right to left in FIGS. 6 and 7. However, since the mass of the housing and parts connected is considerably greater than the mass of the piston, the displacement of the housing is less than that of the piston. During these movements the rod 25, not being rigidly connected to the housing 10, is at rest. FIG. 7 shows the position of the parts when the displacements have attained their maximum values. The piston is just striking face 58. The housing has moved a distance b in the opposite direction to the piston. At the same time the spring 23 has been compressed from the length c to the length d .

The swinging movement of the housing can be felt on the handles 53. However, I have found that it is by no means objectionable or even criticized by the operator as disagreeable. If, however, the housing were rigidly connected to the rod 25, the hard blow exerted by the piston against the surface 58 would be fully felt. It would then not be possible for physiological reasons to hold the device even if the handles were covered with a very soft coating. Moreover the loosening effect on the drill would be considerably reduced, because in that case the blow of the piston would have to set in motion not only the relatively small mass of the rod 25 and the drill 42 by exerting a thrust thereon, but also the considerable mass of the housing and the parts attached thereto.

I wish it to be understood that the operator is not required to exert a pull on the handles 53 when working. The operator holds the device loosely without any effort, only occasionally exerting a slight pull to find out whether the drill has been loosened. When this has occurred, the cock may be closed and the device be used as a handle for extracting the drill from the hole, if it is not considered preferable to leave the loosened drill in the hole, connect the drill head of the drilling machine thereto and continue the drilling operation.

The device according to the invention, which is shown on a proportionately reduced scale in the drawing, is actually only about 22 inches in length. It operates most satisfactorily when it is connected to a source of compressed air producing about 70 pounds per square inch. But it can also be used with advantage with much lower pressures, although it then takes somewhat longer to loosen the drill. I have found that at a pressure of 70 pounds per square inch the piston oscillates at a frequency in the order of magnitude of 1,500 per minute, which is also the number of blows performed per minute. I have also found that my device, even in the case of drills which are jammed particularly firmly and cannot be loosened by any other means except blowing them out with dynamite, seldom requires more than 20 to 25 seconds, that is 500 to 600 blows, to loosen the drill. Up to the present there has not been a single instance of a jammed drill which could not be loosened with my device.

It will have been noticed that when the piston 54 commences to move towards the left, the cylinder 10

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surrounding it and the other parts rigidly connected to it always shift towards the right whereas the piston rod 25 remains stationary. Consequently, the chamber designated by 84 in FIG. 2 opens into the internal space of the cap 15 because the ring 28 lifts off the end face 32 of the sleeve 12. If then the piston 54 continues its movement, the air in the chamber 84 and in the cap 15 will be compressed. If such compression is undesirable, it can be eliminated by providing an aperture 85 in the cap 15, allowing the air to escape into the atmosphere. I have, however, found that the device operates satisfactorily in the manner described without the aperture 85.

I claim:

1. A device for loosening jammed rock drills, comprising generally cylindrical housing means; a rod disposed axially and longitudinally in said housing means; connecting means integral with one end of said rod and adapted to secure said rod to a drill in a position in which said rod and said drill are substantially coaxial; a shoulder fixed to said rod and spaced from said connecting means, said shoulder having a face extending beyond the perimeter of said rod and facing said connecting means; a piston disposed on and shiftable along said rod while being slidable within said housing means between said connecting means and said shoulder, said shoulder providing an anvil on said rod adapted to be struck by the piston upon the movement of the piston in one direction; means for limiting the movement of said piston in an opposite direction; said piston having a shape such that its center of gravity lies substantially along the axis of said rod; said housing means and said piston forming inside said housing means a chamber whose volume increases whenever said piston is shifted towards said shoulder; and pneumatic means for applying intermittent pressure to said chamber, said pneumatic means comprising a source of fluid under pressure, said housing means being provided with inlet means for said fluid, air ducts interconnecting said inlet means and the interior of said housing means on either side of said piston, respectively, and valve means for alternately closing said ducts.

2. A device for loosening jammed rock drills comprising generally cylindrical housing means, a rod disposed axially and longitudinally slidable in said housing means; connecting means integral with one end of said rod and adapted to secure said rod to a drill in a position in which said rod and said drill are substantially coaxial; a shoulder fixed to said rod and spaced from said connecting means, said shoulder having a face extending beyond the perimeter of said rod and facing said connecting means; a piston disposed on and shiftable along said rod while being slidable in said housing means between said connecting means and said shoulder, said shoulder providing an anvil on said rod adapted to be struck by the piston upon the movement of the piston in one direction; means for limiting the movement of said piston in an opposite direction; said piston having a shape such that its center of gravity lies substantially along the axis of said rod; a spring exerting opposite forces upon said rod and said housing means, said forces tending to increase the distance between said housing means and said connecting means; said housing means and said piston forming inside said housing means a chamber whose volume increases whenever said piston is shifted towards said shoulder; and pneumatic means for applying intermittent pressure to said chamber, said pneumatic means comprising a source of fluid under pressure, said housing means being provided with inlet means for said fluid, ducts interconnecting said inlet means and the interior of said housing means on either side of said piston, respectively, and valve means for alternately closing said ducts.

3. A device for loosening jammed rock drills comprising generally cylindrical housing means; a rod disposed axially and longitudinally shiftable in said housing means; connecting means formed as an integral part on said rod

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externally of said housing means and adapted to secure said rod to a drill; means for axially aligning said rod and said connecting means in a position in which said rod and said drill are substantially coaxial; a shoulder fixed to said rod and spaced from said connecting means, said shoulder having a face extending beyond the perimeter of said rod and facing said connecting means; a piston disposed on and shiftable along said rod while being slidable within said housing means between said connecting means and said shoulder, said shoulder providing an anvil on said rod adapted to be struck by the piston upon the movement of the piston in one direction; means for limiting the movement of said piston in an opposite direction; said piston having a shape such that its center of gravity lies substantially along the axis of said rod; spring means in said housing means cooperating with said housing means and said rod for exerting a biasing force on the housing means, said force tending to increase the distance between said housing means and said connecting means; said housing means and said piston forming inside said housing means a chamber whose volume increases whenever said piston is shifted towards said shoulder; and pneumatic means for repeatedly applying to said chamber a fluid pressure adapted to impart to said piston a reciprocating shifting movement over said distance, said pneumatic means comprising a source of fluid under pressure, said housing means being provided with inlet means for compressed air, air ducts interconnecting said inlet means and the interior of said housing means on either side of said piston, respectively, and valve means for alternately closing either of said ducts.

4. A device for loosening jammed rock drills comprising a rod; connecting means integral with one end of said rod to secure said rod to the projecting rear head of a partially imbedded rock drill, said head having a downwardly converging conical surface and a rear face, said connecting means being adapted to hold said rod and said drill in axial alignment; a shoulder fixed to the other

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end of said rod and spaced from said connecting means, said shoulder having a face extending beyond the circumference of said rod and providing an anvil facing said connecting means; a piston disposed on and shiftable along said rod between said connecting means and said shoulder and operable to strike said anvil, said piston having a shape such that its center of gravity is substantially coincident with the axis of said rod; said rod being formed with a socket adapted to accommodate said rear head, said socket having a conical surface complementary to and at least partially surrounding the conical surface of said head, said socket being provided with a lateral opening dimensioned to allow said rear head of said drill to be inserted laterally, and clamping means adapted to exert an axial force upon said rear face of said drill thereby urging the conical surface of said head against the conical surface of said socket, generally cylindrical housing means slidably surrounding said piston and drive means for reciprocating said piston along said rod, said piston being slidable within said housing means, said drive means comprising a source of fluid under pressure, said housing being provided with inlet means for said fluid, ducts interconnecting said inlet means and the interior of said housing on either side of said piston, respectively, and valve means for alternately closing either of said passages.

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