

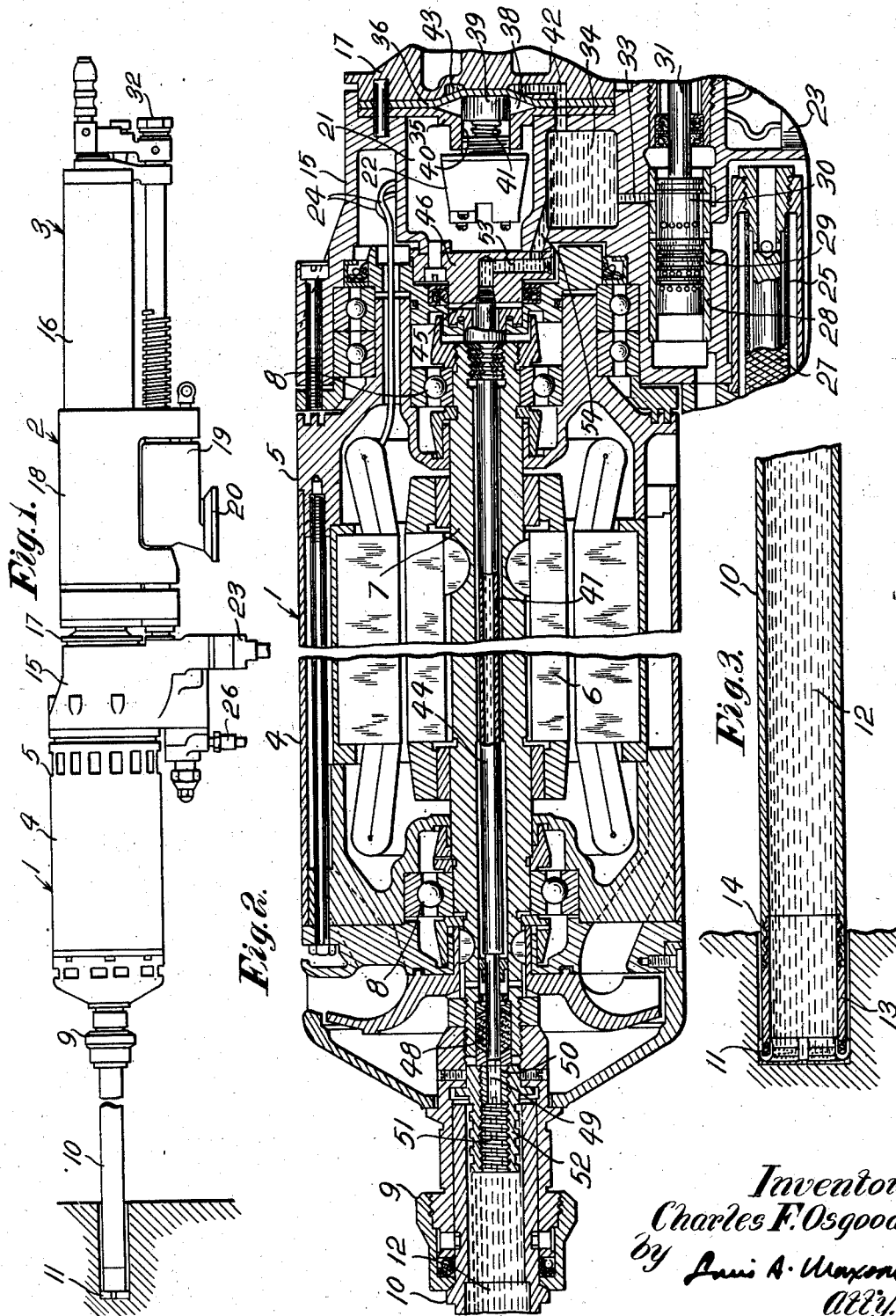
June 30, 1942.

C. F. OSGOOD

2,288,545

DRILLING APPARATUS

Filed July 26, 1940



Inventor:
Charles F. Osgood.
by Ann A. Maxson
Atty.

UNITED STATES PATENT OFFICE

2,288,545

DRILLING APPARATUS

Charles F. Osgood, Claremont, N. H., assignor to
Sullivan Machinery Company, a corporation of
Massachusetts

Application July 26, 1940, Serial No. 347,716

15 Claims. (Cl. 255—47)

This invention relates to drilling apparatus, and more particularly, but not exclusively, to improvements in drilling apparatus of the high speed rotary type especially designed for use with abrasive type bits such as diamond core bits.

In drilling apparatus utilizing abrasive type bits, such as diamond core drills, and particularly those of the high speed type, it is essential that a steady stream of cleansing fluid be supplied to the drill bit to prevent damage to the bit by overheating due to friction and abrasion. In high speed drills such as diamond core drills for drilling blast holes in relatively hard rock, the diamond bit would be quickly destroyed if it were operated without an adequate supply of cooling fluid, and it therefore must be certain that cooling fluid has reached the drill bit at the hole bottom prior to the starting of the bit rotating motor. In previously known types of drilling apparatus the motor control is operable independently of the cleansing liquid supply control, so that it has been possible to start the motor while the liquid supply to the bit was cut off.

It is a primary object of the present invention to provide improved drilling means wherein the bit rotating motor is started only after the cleansing fluid has been conducted to the drill bit. Another object is to provide an improved control means for the bit rotating motor of a rotary drilling apparatus wherein the control means is responsive to the pressure of fluid in the cleansing fluid supply for automatically starting the bit rotating motor when the cleansing fluid has reached the bit and when the rod line bore and the associated fluid supply passages are completely filled with fluid. Yet another object is to provide an improved fluid actuated motor control means responsive to the pressure of the fluid in the cleansing fluid supply to the drill bit whereby when the fluid has reached the bit, the bit rotating motor is automatically started. A still further object is to provide an improved motor control means operable to stop the bit rotating motor upon failure of the supply of cleansing fluid to the drill bit, or in the event the fluid supply is inadvertently cut off. Yet another object is to provide improved means for automatically stopping the bit rotating motor during withdrawal of the bit from the drill hole. These and other objects and advantages of the invention will, however, hereinafter more fully appear.

In the accompanying drawing there is shown for purposes of illustration one form which the invention may assume in practice.

In this drawing:

Fig. 1 is a side elevational view of a drilling apparatus in which an illustrative embodiment of the invention is incorporated.

Fig. 2 is an enlarged view in longitudinal vertical section taken through a portion of the drilling apparatus shown in Fig. 1 and illustrating the improved cleansing fluid supply and motor control means.

Fig. 3 is an enlarged view in longitudinal section taken through the drill rod and drill bit.

In this illustrative embodiment of the invention the improved cleansing fluid supply and motor control means is incorporated in a drilling apparatus of the high speed rotary core type especially adapted to use with abrasive type bits, such as diamond core bits. The drilling apparatus may be of the same general character as that disclosed in the copending application of one Win W. Paget, Serial No. 268,792, filed April 19, 1939. It will be evident, however, that the invention may be embodied in drilling apparatus of various other types.

The drilling apparatus disclosed generally comprises bit rotating means, generally designated 1, supporting and guiding means, generally designated 2, and bit feeding means, generally designated 3. The bit rotating means 1 comprises a rotary motor 4, herein preferably a totally-enclosed, high speed electric motor comprising a motor casing 5 containing an armature rotor 6 keyed to a shaft 7 journaled in ball bearings 8, 8 suitably supported within the motor casing. Carried by the motor shaft 7 is a chuck 9 for receiving the shank of a drill rod 10, the latter in turn carrying a diamond core bit 11. As shown in Fig. 3, the drill rod 10 has a bore 12, and the drill bit 11 is in the form of an annulus secured to a tubular member 13 coupled at 14 to the drill rod, the bore in the tubular member communicating directly with the rod bore. The motor is mounted in a control head 15 in the manner described in the application above referred to, and the control head is supported by an element of the feeding means 3. The feeding means is of the fluid actuated type and comprises a feed cylinder 16 containing a reciprocable feed piston having its piston rod extending forwardly through the front cylinder head. Secured to the front end of the piston rod is an end plate 17 to which the control head 15 is rigidly secured. The supporting and guiding means 2 comprises a guide member 18 in which the feed cylinder of the feeding means is supported and guided, and this guide member is mounted on a trunnion member 19 having a

swivel plate 20 adapted to be clamped in the saddle mounting of a conventional drill support.

The control head 15 has a chamber 21 in which is arranged a motor switch 22 for controlling the stopping and starting of the motor 4. Electric power may be conducted to the motor from any convenient source through a conventional connector plug 23 mounted on the control head and connected through wiring 24 to the motor.

The means for supplying cleansing fluid, herein in water under pressure, to the drill bit comprises a fluid supply chamber 25 having a usual fluid supply connection 26 leading to any convenient source of fluid pressure supply. Arranged in this chamber is a strainer 27 through which the fluid must flow to reach the space in the chamber 25 surrounding the strainer. Also formed in the control head 15 is a bore 28 receiving a ported valve bushing 29 in which is slidably mounted a valve 30. This valve is of the sliding spool type and has suitable operating rod connections 31 provided with an operating handle 32 herein located at the rear end of the feeding means 3. This slide valve is adapted to control the flow of liquid in the chamber 25 through a passage 33 to a chamber 34 also formed in the control head.

In this illustrative construction, clamped between a member 35 and the end plate 17 carried by the feed piston rod is a diaphragm 36, and the adjacent faces of the elements 17 and 35 are recessed to provide a diaphragm chamber 38 therebetween. The diaphragm 36 engages at its forward side a spring-pressed plunger 39 guided in an axial bore 40 in the member 35; and this plunger is constantly urged by a coil spring 41 toward its rearmost position, as shown in Fig. 2. The plunger 39 engages the operating means for the switch 22. When the plunger 39 is in the position of Fig. 2 the motor circuit is open. When the central portion of the diaphragm moves a predetermined distance toward the left in Fig. 2, the switch 22 will close to start the motor. A passage 42 connects the chamber 34 to an annular recess 43 opening directly into the diaphragm chamber at the rear side of the diaphragm. The spring offers substantial resistance to closing of the switch, as will later be explained.

Cleansing fluid may be supplied to the drill bit through a fluid conducting tube 44 threadedly secured at 45 within a member 46 secured to the control head 15 and providing a closure for the forward side of the control head chamber 21. The tube 44 extends axially through a bore 47 in the motor shaft 7 and passes at its forward end through a stuffing box 48 arranged within the forward end of the motor power shaft. Fluid may flow from the tube 44 through a bore 49 in a packing adjusting plug 50 and through a bore 51 in a coupling member 52 to the bore 12 of the drill rod and thence to the drill bit. A passage 53 in the member 46 communicates with a passage 54 in the control head, the latter passage leading to the chamber 34. The flow area of the passages 54, 53 to the drill rod bore should be at least as great as the flow area from the control valve through the passage 33 to the chamber 34, so that no very substantial pressure will build up at the rear side of the diaphragm 36 prior to the complete filling of the drill rod bore and the associated fluid conducting passages. The strength of the spring 41 will be made such that the switch will not

close until such filling has been completed, under normal conditions.

The mode of operation of the improved drilling apparatus is as follows. When the drilling apparatus is set up in proper drilling position with respect to the working face, as shown in Fig. 1, the swivel plate 20 of the supporting and guiding means 2 is clamped in the saddle mounting of a drill support in the manner well known to those skilled in the art. The drill rod 10 carrying the drill bit 11 has its shank inserted within the chuck 9, and the drill bit is fed forwardly by the feeding means 3 into its initial drilling position within a starting hole previously formed in the working face. The operator may then adjust the manual slide valve 30 to admit liquid under pressure from the supply chamber 25 to the chamber 34. Liquid may flow freely from the chamber 34 through the passages 54, 53 to the fluid conducting tube 44 and thence through the bores 49 and 51 and the drill rod bore 12 to the drill bit at the bottom of the drill hole. Liquid may also flow through the passage 42 to the annular recess 43 to act on the rear surface of the diaphragm. During flow of liquid through the drill rod bore to the drill bit, until the passageways become filled with liquid the pressure of the liquid in the chamber 34, passage 42 and annular recess 43 is insufficient to overcome the spring 41 which opposes movement of the plunger 39 forwardly from the position shown in Fig. 2, so that starting of the bit rotating motor is prevented. However, when the drill rod bore and the associated liquid supply passages are completely filled and cleansing liquid has reached the drill bit, the pressure of the liquid in the chamber 34 builds up to substantially line pressure, and this built up pressure acts on the diaphragm to move the plunger 39 forwardly against the tension of the spring 41 into its position to operate the switch 22 to start the bit rotating motor.

In the event of failure of the liquid supply or inadvertent movement of the slide valve 30 into its position to cut off the flow of liquid to the chamber 34, the pressure in the chamber 34 would drop sufficiently to cause the coil spring 41 to move the plunger 39 rearwardly into its position to operate the switch 22 to stop the bit rotating motor. It is accordingly evident that liquid supply to the drill bit is assured prior to starting of the bit rotating motor, thereby preventing the possibility of destruction of the drill bit due to the lack of sufficient cooling liquid. This safety feature also assures stopping of the bit rotating motor in the event the liquid pressure supply fails for any reason or is inadvertently manually cut off. It is also evident that there is substantial delay in the starting of the bit rotating motor while the liquid flowing through the drill rod bore to the bit completely fills the drill rod bore and the associated supply passages so that access of liquid to the bit is assured prior to the starting of the bit rotating motor. To prevent whipping of the drill rod in the drill hole and possible injury to the diamond bit due to engagement with the walls of the drill hole during withdrawal of the drill bit from the hole, it is desirable to stop rotation of the bit during this operation. Upon retraction of the drill bit from the drill hole a substantial drop in the pressure of the liquid in the drill rod bore will occur, and this drop in pressure causes the coil spring 41 to move the plunger 39 rearwardly to operate the motor switch to stop the motor.

Also in the event the drill bit encounters a cavity or large crevice during the drilling operation, a substantial drop in the liquid pressure will occur, also resulting in the stopping of the motor to prevent damage to the bit due to deflection or jamming. Other uses and advantages of the improved drilling apparatus will be clearly apparent to those skilled in the art.

While there is in this application specifically described one form which the invention may assume in practice, it will be understood that this form of the same is shown for purposes of illustration and that the invention may be modified and embodied in various other forms without departing from its spirit or the scope of the appended claims.

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

1. In a drilling apparatus, the combination comprising means for rotating a drill bit, valve-controlled means for conducting cleansing fluid to the drill bit, fluid actuated means for controlling said bit rotating means, and means for starting said bit rotating means after the cleansing fluid flowing through the conducting means reaches the drill bit including means for subjecting said fluid actuated control means to the pressure of the fluid in said conducting means, said subjecting means including a passage connecting with said conducting means at a point at the bit side of the control valve for said conducting means.

2. In a drilling apparatus, the combination comprising a motor for rotating a drill bit, valve-controlled means for conducting cleansing fluid to the drill bit, fluid actuated control means for starting said motor, and means for effecting starting of said motor after the cleansing fluid flowing through the conducting means reaches the drill bit including means for subjecting said fluid actuated control means to the pressure of the fluid in said conducting means, said subjecting means including a passage connecting with said conducting means at a point at the bit side of the control valve for said conducting means.

3. In a drilling apparatus, the combination comprising a hollow drill rod carrying a drill bit, means for rotating the drill rod and bit, means for conducting cleansing liquid through the drill rod to the drill bit, fluid actuated control means for controlling the operation of said bit rotating means, and means for automatically effecting starting of said drill rod and bit rotating means after the cleansing liquid flowing through said conducting means reaches the drill bit and has filled all unoccupied space within the hollow interior of the drill rod and is under a predetermined pressure in said conducting means, including continuously open means for subjecting said control means to the pressure of the cleansing liquid flowing through said conducting means, said fluid actuated control means including means for precluding operation thereof to start said drill rod and bit rotating means until said fluid actuated control means is subjected to such a predetermined pressure.

4. In a drilling apparatus, the combination comprising a hollow drill rod carrying a drill bit, a motor for rotating the drill rod and bit, means for conducting cleansing liquid through the drill rod to the drill bit, and means subjected at all times when any such pressure exists to the pressure of the liquid in said conducting means and operative to effect motor starting only when the

pressure of such liquid reaches a predetermined value for automatically starting the bit rotating motor when the liquid supply reaches the drill bit and has completely filled the hollow interior of the drill rod and a predetermined pressure has built up in said conducting means.

5. In a drilling apparatus, the combination comprising means for rotating a drill bit, means for conducting cleansing liquid to the drill bit, and means for controlling the operation of said bit rotating means including a fluid actuated control element, and means for automatically effecting initiation of operation of said bit rotating means after the liquid flowing through said conducting means reaches the drill bit, including means subjecting said control element to the pressure of the liquid in said conducting means whenever any exists therein.

6. In a drilling apparatus, the combination comprising a motor for rotating a drill bit, means for conducting cleansing liquid to the drill bit, and control means for automatically starting said motor after the liquid in said conducting means reaches the drill bit, said control means including liquid actuated motor control means subjected to the pressure of the liquid in said conducting means whenever any exists therein, said motor control means including means for precluding actuation thereof to effect motor starting until the pressure of the liquid in said conducting means reaches a value in excess of that which is attained during free liquid discharge from said liquid conducting means.

7. In a drilling apparatus, the combination comprising a motor for rotating a drill bit, means for conducting cleansing liquid to the drill bit, and control means for automatically starting said motor after the liquid in said conducting means reaches the drill bit, said control means including liquid actuated motor control means subjected to the pressure in said liquid conducting means and having means preventing liquid actuation to effect motor starting until said control means is subjected to substantially line pressure, said control means operating to start said motor whenever the liquid in said conducting means reaches the drill bit and a substantially line pressure is built up in said conducting means.

8. In a drilling apparatus, the combination comprising a motor for rotating a drill bit, a liquid supply, means for conducting liquid from said liquid supply to the drill bit, a control valve arranged ahead of said liquid supply and governing the admission of liquid to said liquid supply, control means for starting said motor and including a liquid actuated motor starting device, and means for conducting liquid from said liquid supply to said starting device whereby the motor is automatically started when the pressure of the liquid in said last mentioned conducting means reaches a predetermined point.

9. In a drilling apparatus, the combination comprising a motor for rotating a drill bit, a liquid supply chamber, passage means in continuous communication with said liquid supply chamber for supplying liquid from said chamber to the drill bit, fluid actuated control means for starting said motor, passage means connecting said control means and said chamber in continuous communication for supplying liquid from said chamber to said control means, and means for delaying starting of said motor until the liquid supply reaches the drill bit including means for precluding operation of said control means to start said motor until the liquid pressure in

said chamber has built up substantially to line pressure.

10. In a drilling apparatus, the combination comprising an electric motor for rotating a drill bit, a switch for stopping and starting said motor, fluid actuated means for operating said switch, control-valve-equipped means for supplying fluid to the drill bit, and means for subjecting said switch operating means to the pressure of the fluid in said supply means at a point between the bit and said control valve.

11. In a drilling apparatus, the combination comprising an electric motor for rotating a drill bit, a switch for stopping and starting said motor, fluid actuated means for operating said switch to start said motor, and means for supplying fluid to the drill bit, means for subjecting said switch operating means to the pressure of the fluid in said supply means including means effecting a continuous communication between said switch operating means and said supply means, said switch having associated therewith means yieldingly opposing the action of said fluid actuated switch operating means and operative to prevent starting of said motor so long as unrestricted flow of fluid takes place through said means for supplying fluid to the drill bit.

12. In a drilling apparatus, the combination comprising a motor for rotating a drill bit to effect drilling of a hole, means for conducting cleansing liquid to the drill bit having a control valve arrangement at the inlet end thereof, and means including a motor control device subjected to the pressure of the liquid in said conducting means for automatically stopping said motor upon a substantial drop in pressure in said conducting means during withdrawal of the drill bit from the drill hole.

13. In a drilling apparatus, the combination comprising means for rotating a drill bit, means for conducting cleansing fluid to the drill bit, a control valve past which cleansing fluid flows to enter said cleansing fluid conducting means, con-

5 10 15 20 25 30 35 40 45 50 55 60 65 70 75 80 85 90 95 100 105 110 115 120 125 130 135 140 145 150 155 160 165 170 175 180 185 190 195 200 205 210 215 220 225 230 235 240 245 250 255 260 265 270 275 280 285 290 295 300 305 310 315 320 325 330 335 340 345 350 355 360 365 370 375 380 385 390 395 400 405 410 415 420 425 430 435 440 445 450 455 460 465 470 475 480 485 490 495 500 505 510 515 520 525 530 535 540 545 550 555 560 565 570 575 580 585 590 595 600 605 610 615 620 625 630 635 640 645 650 655 660 665 670 675 680 685 690 695 700 705 710 715 720 725 730 735 740 745 750 755 760 765 770 775 780 785 790 795 800 805 810 815 820 825 830 835 840 845 850 855 860 865 870 875 880 885 890 895 900 905 910 915 920 925 930 935 940 945 950 955 960 965 970 975 980 985 990 995 1000

14. In a drilling apparatus, the combination comprising a motor for rotating a drill bit, means for conducting cleansing fluid to the drill bit, a control device for stopping and starting said motor, a control valve past which cleansing fluid flows to enter said cleansing fluid conducting means, fluid actuated means for operating said control device, and means for subjecting said control device operating means to the pressure of the fluid in said conducting means at a point nearer to the bit than said control valve is whereby the motor is automatically started when the pressure in said conducting means reaches a predetermined point and for automatically stopping said motor when the pressure in said conducting means drops below said predetermined point.

15. In a drilling apparatus, the combination comprising means for rotating a drill bit, means for conducting cleansing fluid to the drill bit having a control valve at the end thereof away from the bit, fluid actuated means for controlling said bit rotating means, and means for delaying operation of the bit rotating means until cleansing fluid flowing through said conducting means reaches the drill bit, including means for subjecting said fluid actuated means to fluid comprising passage means communicating with said conducting means between the ends of the latter.

CHARLES F. OSGOOD.