

April 22, 1952

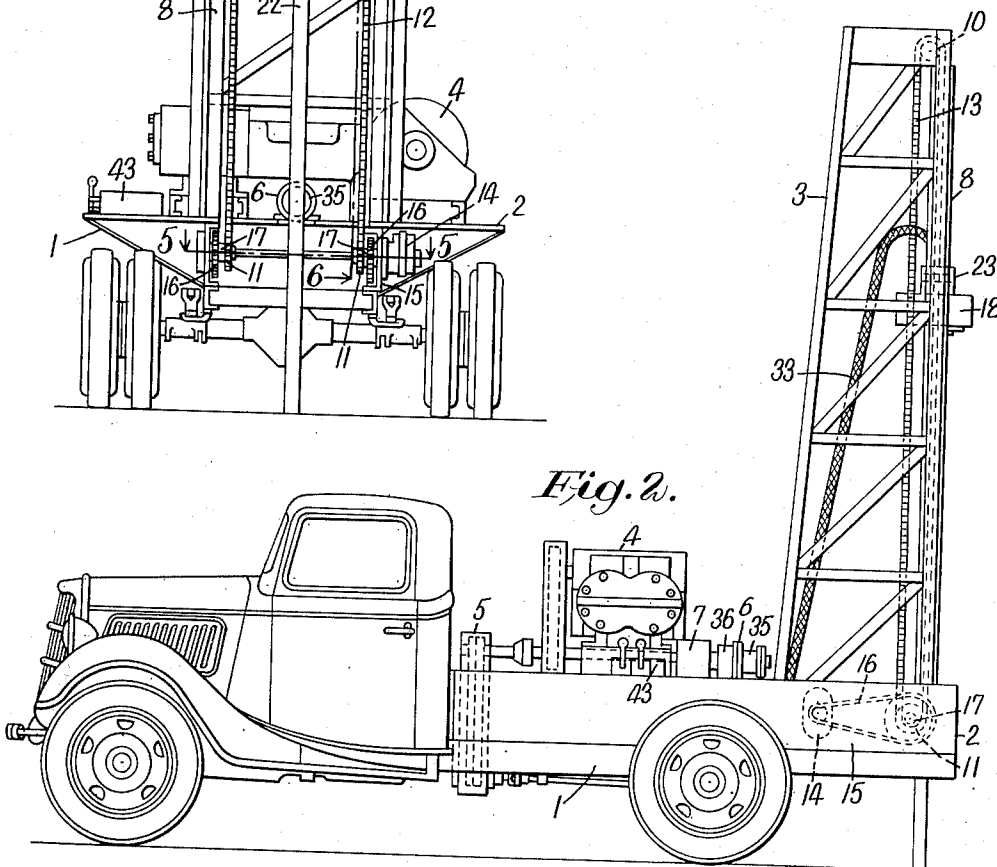
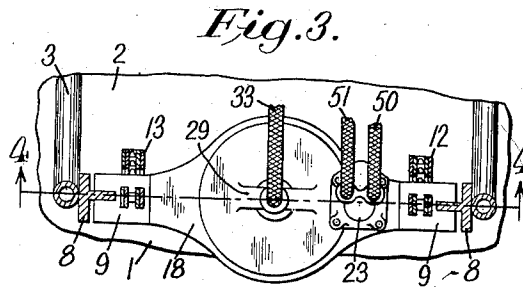
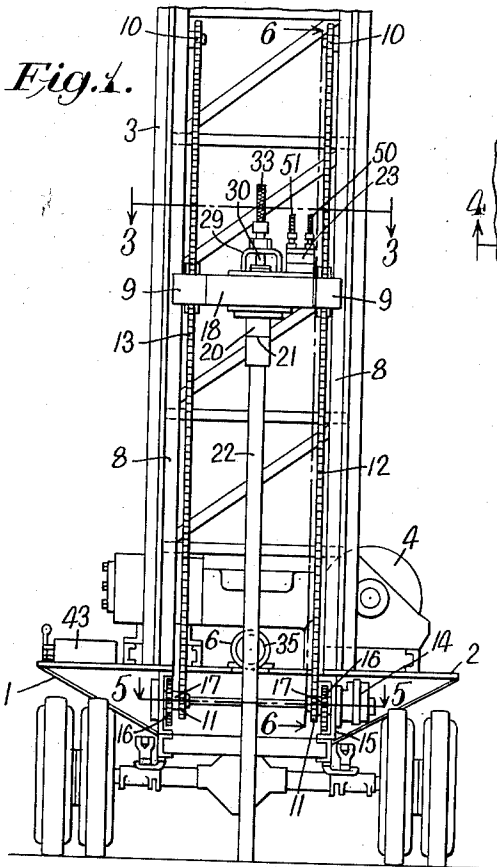
H. H. VANDERZEE

2,594,098

DRILLING APPARATUS

Original Filed Nov. 29, 1943

3 Sheets-Sheet 1



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Fig. 4.

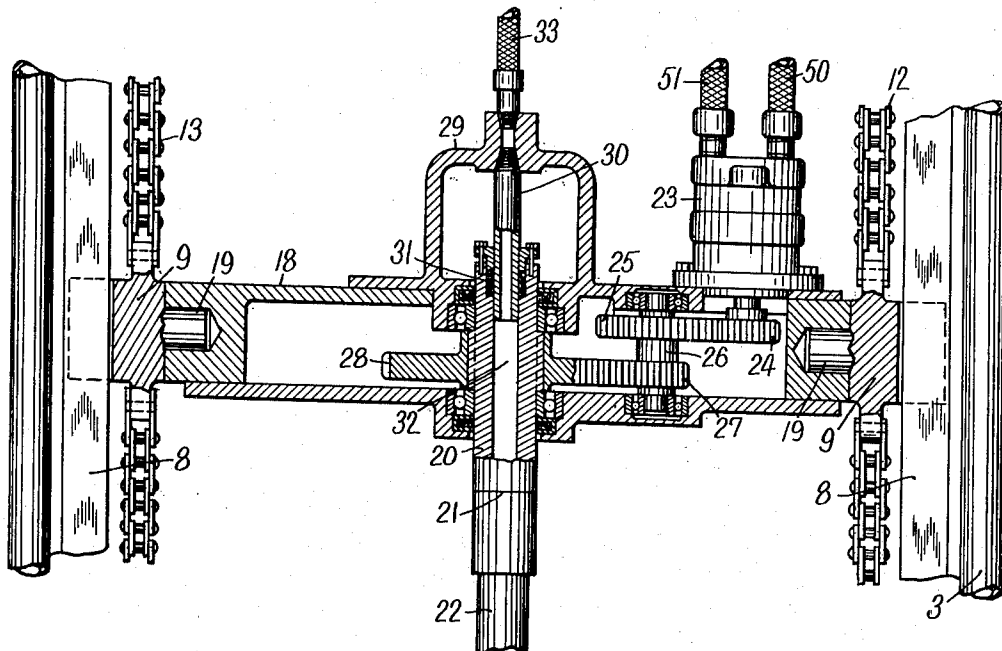
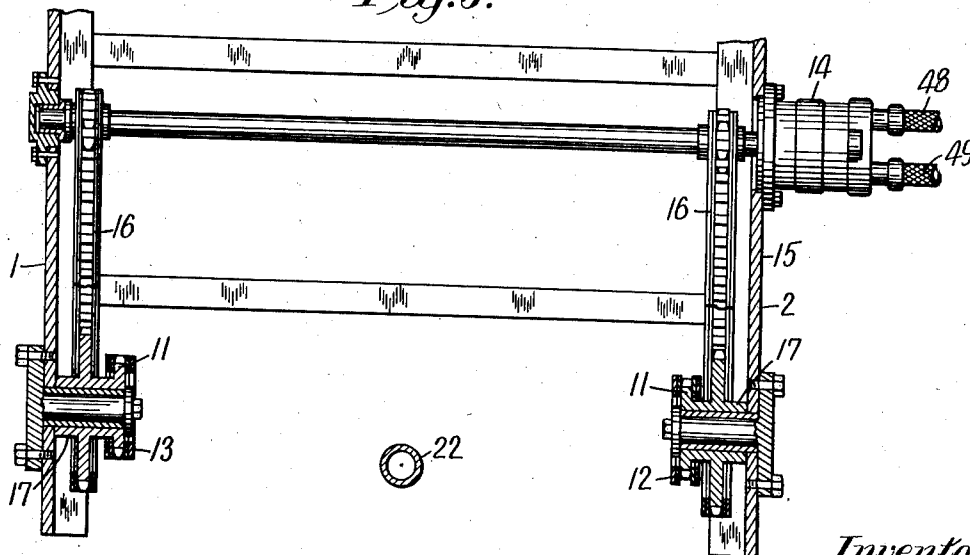


Fig. 5.



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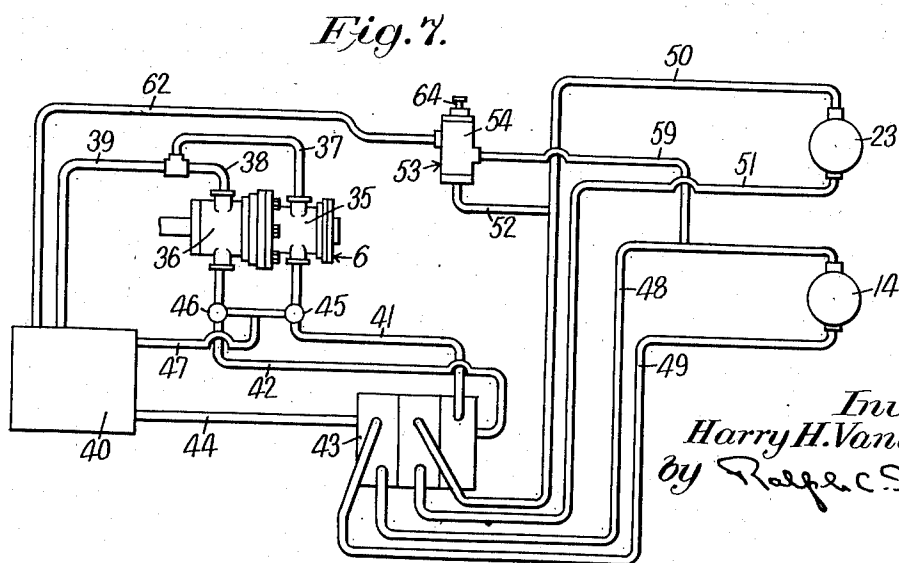
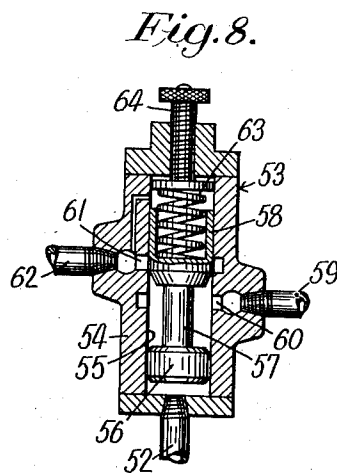
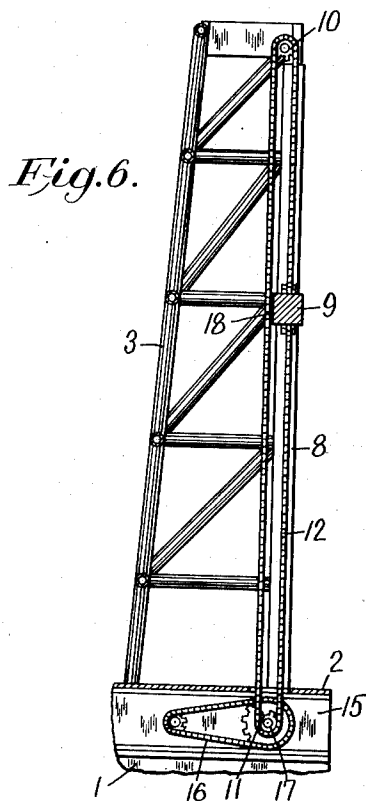
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UNITED STATES PATENT OFFICE

2,594,098

DRILLING APPARATUS

Harry H. Vanderzee, Chicago, Ill., assignor to Joy Manufacturing Company, a corporation of Pennsylvania

Original application November 29, 1943, Serial No. 512,131. Divided and this application March 7, 1946, Serial No. 652,729

11 Claims. (Cl. 255-22)

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This invention relates to drilling apparatus and more particularly to an improved rotary drilling apparatus of the portable type especially designed for use in drilling shallow holes in relatively soft formations such as are encountered in quarry or seismograph work.

In the drilling of such formations, there is usually encountered a varying resistance to rotation of the drilling implement, making it desirable that some means be provided for regulating the rate of feed in response to the changes in resistance to rotation. To obtain such regulation of feed, there may be provided a feeding means including a fluid actuated motor to which an actuating fluid is supplied in varying amounts depending upon the pressure at the intake side of a fluid actuated motor which operates to rotate the drilling implement. The regulation of the fluid supply to the feeding motor may be obtained in a preferred form of the invention by providing a pressure responsive valve mechanism which operates to vent fluid from the supply side of the feeding motor in increasing amounts as the pressure at the intake side of the rotating motor increases above a predetermined value.

An object of my invention is to provide an improved drilling apparatus having feeding and rotating motors of the rotary fluid actuated type and having associated therewith improved automatic control means for regulating the feeding motor automatically in accordance with changes in load on the drill rotating motor. Another object is to provide an improved fluid operated control means for a rotary drilling apparatus, whereby the feed is automatically regulated in accordance with the requirements of the work. Yet another object is to provide an improved means which operates in response to the pressure in the intake side of a fluid actuated drill rotating motor for regulating the supply of operating fluid to a fluid actuated drill feeding motor. Other objects and advantages of the invention will, however, hereinafter more fully appear.

This application is a division of my pending application, Serial No. 512,131, filed November 29, 1943, now abandoned.

In the accompanying drawings there is shown an illustrative embodiment which the invention may assume in practice.

In these drawings:

Fig. 1 is a front elevational view of a drilling apparatus constructed in accordance with an illustrative embodiment of the invention.

Fig. 2 is a side elevational view of the drilling apparatus shown in Fig. 1.

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Fig. 3 is an enlarged horizontal cross sectional view, with parts in plan, taken substantially on line 3-3 of Fig. 1.

Fig. 4 is an enlarged vertical sectional view taken substantially on line 4-4 of Fig. 3.

Fig. 5 is an enlarged horizontal sectional view taken substantially on line 5-5 of Fig. 1.

Fig. 6 is a vertical sectional view taken substantially on line 6-6 of Fig. 1, illustrating details of the improved feeding mechanism.

Fig. 7 is a diagrammatic view of the hydraulic system.

Fig. 8 is a detail sectional view taken through the automatic control valve.

In this illustrative construction there is shown a portable drilling apparatus especially designed for use in drilling shallow holes in relatively soft formations such as are encountered in quarry or seismograph work. It will be evident, however, that various features of the invention will be embodied in drilling apparatus of other types.

The drilling apparatus, as illustrated, comprises a portable base 1 herein illustrated as an automobile truck having mounted on its platform 2 a vertical support, herein a derrick mast 3. Also mounted on the truck platform is a mud pump 4 driven through a conventional power take-off 5 from the engine of the truck. Driven through this same power take-off is a dual-capacity liquid pump generally designated 6; and there is provided a conventional variable speed or selective transmission 7 for driving the pump at different speeds. The upright derrick mast 3 carries parallel vertical guides 8, 8 having vertical guideways along which sliding end blocks of a crosshead 9 are slidable. Guided by chain sprockets 10 and 11 respectively at the top and bottom of the crosshead guides at the opposite sides of the derrick mast are feed chains 12 and 13 attached to the sliding crosshead. In this improved construction, there is provided a reversible hydraulic motor 14 of a well known design mounted on a vertical side plate 15 of the truck platform, and the power shaft of this motor is connected by chain and sprocket drives 16 to tubular transverse shafts 17, one at each side of the truck platform and to which the bottom chain sprockets 11 are respectively secured. Thus by operating the motor 14 the crosshead may be moved up and down along the mast guideways as desired.

A drill head 18 is swiveled by trunnions 19 on the end blocks of the crosshead for a purpose to be later explained. The drill head 18 has journaled therein a drive sleeve or quill 20 coupled

at 21 to a drill rod line 22, the latter carrying a usual drill bit. Mounted on the top of the drill head 18 is a reversible hydraulic motor 23 similar to the feed motor 14. The power shaft of the motor 23 has keyed thereto a spur pinion 24 meshing with a spur gear 25 fixed to a vertical shaft 26, the latter suitably journaled within the drill head. Driven by the shaft 26 is a spur gear 27 meshing with a spur gear 28 keyed to the drive sleeve 20, as shown in Fig. 4. Mounted at the top of the drill head is a fluid swivel 29 having a supply conduit 30 extending downwardly through a packing 31 into the bore 32 of the drive sleeve 20. Thus the drill rod line may be rotated in either of opposite directions by the motor 23.

The motors 14 and 23 may be of the conventional intermeshing, rotary, variable speed type and may be regulated to vary the speeds of rotation and feed. Speeds may be controlled by variable throttling, and, moreover, by the provision of the variable speed drive for the pump, the volume of liquid under pressure supplied to the motors may be varied, if desired, to vary the motor speeds. Liquid under pressure may be supplied from the mud pump to the fluid swivel 29 through a usual flexible hose connection 33.

Now referring to the improved hydraulic system shown diagrammatically in Fig. 7, it will be observed that the dual capacity pump 6 has a low capacity unit 35 and a high capacity unit 36, and the pump intakes are connected through branch conduits 37 and 38 to a conduit 39 leading to a liquid tank 40. The pump discharges are connected by conduits 41 and 42 to the pressure chamber of a valve box 43 conveniently located on the truck platform and containing usual control valves. The exhaust chamber of the valve box is connected by a discharge conduit 44 back to the tank. The pump discharge conduits 41 and 42 have conventional pressure relief valves 45 and 46 respectively set to open at a predetermined pressure and connected by a conduit 47 to the tank. The feed motor 14 has supply and discharge conduits 48 and 49 connected to the valve box, and the rotation motor 23 has similar conduits 50 and 51, although the latter are flexible to permit movement of the motor with the drill head. The control valves in the valve box may control the flow of fluid to the feed and rotation motors, from the small and large capacity pumps respectively. The relative volumes of the flow of fluid to the feed and rotation motors may be determined as desired, but herein the fluid to the rotation motor is preferably from the high capacity pump and that to the feed motor from the low capacity pump. The conduit 50 which supplies fluid under pressure to the rotating motor 23 during drilling may be connected by a conduit 52 to an automatic control valve 53 (see Fig. 8). Under certain conditions, however, this automatic control valve may be omitted, and at that time the feed and rotation may be manually controlled. This automatic control valve has a casing 54 provided with a bore 55 containing a reciprocable valve operating piston 56. This piston is secured by a reduced stem 57 to a hollow valve 58, likewise contained in the casing bore. The conduit 48 which supplies fluid to the feed motor 14 to effect downward feed is connected by a conduit 59 to a passage 60 communicating with the valve bore 55. A passage 61 communicating with the valve bore is connected by a conduit 62 to the liquid tank, and an adjustable coil spring 63 having an adjusting screw 64 constantly urges the valve

toward the position wherein the passages 60 and 61 are out of communication. When the load on the drill rotating motor 23 varies, i. e. when the resistance to cutting of the work by the drill bit varies, the pressure in the conduit 50 correspondingly varies, and upon increase in pressure in the drill rotating motor supply line above a predetermined level due to increased resistance to drill bit rotation above a desired point, the fluid acts on the valve operating piston 56 with such force as to move the valve 58 upwardly, as viewed in Fig. 8, thereby to connect passage 60 with the discharge passage 61, and, as a result, pressure in the supply conduit 48 for the feeding motor 14 is reduced, with a resultant reduction in the feeding pressure on the drill bit. Thus the mechanical feed is automatically controlled by the varying resistance to rotation of the drill bit, so that a substantially constant torque is applied to the bit, increasing the efficiency of the drill.

The mode of operation of the improved apparatus will be clearly apparent from the description given. The portable base of the apparatus may be propelled from one working place to another by the usual truck wheel drive through the usual automobile transmission. The drill head 18 is swiveled on its trunnions 19 on the end blocks of the sliding crosshead 9 so as to facilitate attachment of the rod line to the drive quill. When a rod section carrying a drill bit is coupled to the drive quill, the feed motor 14 may be operated to actuate the feed chains 12 and 13 to raise the crosshead 9 upwardly along the mast guides 8, 8 and the drill head is at that time swung into its upright position with respect to the crosshead. The truck platform may carry a suitable guide for the rod line for guiding the drill bit during starting of a hole in a well known manner, although under certain conditions such a starting guide is unnecessary. The drill rotating motor 23 carried by the crosshead 9 may then be started to rotate the rod line in the proper direction, thereby to rotate rapidly the drill bit. The feed motor 14 may then be reversed to actuate the feed chains 12 and 13 to effect downward movement of the crosshead along the mast guides to feed the drill bit toward the work to effect drilling. As the resistance to drill bit rotation varies during penetration of formations having different characteristics, the position of the automatic by-pass valve 58 is changed to vary the fluid supply to the drill feeding motor 14. Thus the load changes on the drill bit during drilling automatically effect regulation of the feeding pressure on the drill bit. During uncoupling of the rod line sections, the rotation motor 23 may be reversed to unthread the joints.

As a result of this invention an improved portable drilling apparatus is provided especially designed for drilling shallow holes in relatively soft formations such as are encountered in quarry or seismograph work. It will also be evident that by the provision of the separate motors for rotating and feeding the drill bit the drill is made more flexible in operation, and at the same time the structure is greatly simplified. Further by the provision of the reversible motors, the feed and rotation may be readily reversed, thereby eliminating relatively complicated reverse drive connections. The variable speed fluid motors enable a wide range of feeding and rotating speeds to be obtained as desired; and when the improved automatic control valve is provided, there is en-

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abled control of the feed automatically in accordance with the varying resistance to drill bit rotation while the power of rotation remains substantially constant. These and other 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 embodiment which the invention may assume in practice, it will be understood that this embodiment 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, feeding mechanism for positively feeding a drill toward the work including a rotary fluid operated feeding motor and connections operated by said motor for applying a substantially continuous forward feeding pressure on the drill during drilling, drill rotating mechanism including a rotary fluid operated rotation motor which is subjected to load changes during drilling, means for supplying fluid under pressure to said motors, and means including a fluid actuated control valve responsive to pressure changes in said supply means of said rotation motor due to load changes on said latter motor for automatically regulating the flow of fluid in said supply means of said feeding motor to vary the forward feeding pressure on the drill.

2. In a drilling apparatus, feeding mechanism for positively feeding a drill toward the work including a rotary fluid operated feeding motor and connections operated by said motor for applying a substantially continuous forward feeding pressure on the drill during drilling, drill rotating mechanism including a rotary fluid operated rotation motor which is subjected to load changes during drilling, means for supplying fluid under pressure to said motors, and means including a fluid actuated control valve responsive to pressure changes in said supply means of said rotation motor due to load changes on said rotation motor for automatically reducing the flow of fluid in said supply means of said feeding motor to vary the forward feeding pressure on the drill.

3. In a drilling apparatus, feeding mechanism for positively feeding a drill toward the work including a rotary fluid operated feeding motor and connections operated by said motor for applying a substantially continuous forward feeding pressure on the drill during drilling, drill rotating mechanism including a rotary fluid operated rotation motor, means for supplying fluid under pressure to said motors, and means for automatically regulating the flow of fluid in said supply means of said feeding motor to vary the forward feeding pressure including a fluid actuated bypass valve responsive to pressure changes in said rotation motor supply means for bypassing fluid from said supply means of said feeding motor.

4. In a drilling apparatus, feeding mechanism for positively feeding a drill toward the work including a rotary fluid operated feeding motor and connections operated by said motor for applying a substantially continuous forward feeding pressure on the drill during drilling, drill rotating mechanism including a rotary fluid operated rotation motor, means for supplying fluid under pressure to said motors, and means for au-

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tomatically regulating the flow of fluid in said supply means of said feeding motor to vary the forward feeding pressure including a fluid actuated bypass valve for bypassing fluid from said supply means of said feeding motor when the pressure in said supply means of said rotation motor exceeds a predetermined amount.

5. In a drilling apparatus, mechanism for positively feeding a drill toward the work during drilling including a fluid operated feeding motor and connections operated by said motor for applying a forward feeding pressure to the drill, mechanism for rotating the drill including a fluid operated rotation motor which is subjected to load changes during drilling, a pumping means, fluid supply means including a control valve mechanism for conducting fluid from said pumping means to said motors, and regulating means automatically responsive to load changes on said rotation motor to vary the flow of fluid to said feeding motor, said regulating means including fluid actuated control valve means responsive to pressure conditions in said supply means of said rotation motor for regulating the flow of fluid in said supply means of said feeding motor.

6. In a drilling apparatus, mechanism for positively feeding a drill toward the work during drilling including a fluid operated feeding motor and connections operated by said motor for applying a forward feeding pressure to the drill, mechanism for rotating the drill including a fluid operated rotation motor which is subjected to load changes during drilling, a pumping means, fluid supply means including a control valve mechanism for conducting fluid from said pumping means to said motors, and regulating means automatically responsive to load changes on said rotation motor to vary the flow of fluid to said feeding motor to vary the feeding pressure on the drill, said regulating means including fluid actuated bypass valve means responsive to pressure conditions in said supply means of said rotation motor for reducing the flow of fluid in said supply means of said feeding motor.

7. In a drilling apparatus, mechanism for positively feeding a drill toward the work during drilling including a fluid operated feeding motor and connections operated by said motor for applying a forward feeding pressure to the drill, mechanism for rotating the drill including a fluid operated rotation motor which is subjected to load changes during drilling, a fluid reservoir, a pumping means having its intake connected to said fluid reservoir, fluid supply means including a control valve mechanism for conducting fluid from said pumping means to said motors, and regulating means automatically responsive to load changes on said rotation motor for varying the flow of fluid to said feeding motor to vary the feeding pressure on the drill, said regulating means including fluid actuated control valve means responsive to pressure conditions in said supply means of said rotation motor for connecting said fluid supply means of said feeding motor back to said reservoir to reduce the flow of fluid to said feeding motor.

8. In a drilling apparatus, drill feeding mechanism for positively feeding a drill toward the work during drilling including a rotary fluid pressure drill feeding motor and connections operated by said motor for applying a forward feeding pressure to the drill, drill rotating mechanism including a rotary fluid pressure drill rotating motor, a fluid reservoir, pumping means including a high capacity pump and a low ca-

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capacity pump, means for connecting the pump intakes to said reservoir, means for conducting fluid from the discharge of said high capacity pump to the intake of said rotating motor, means for conducting fluid from the discharge of said low capacity pump to the intake of said feeding motor, means for connecting the discharge sides of said motors back to said reservoir, and operator controlled valve means for controlling the flow of fluid from said pumps through said conducting means to said motors.

9. In a drilling apparatus, a base, an upright frame on said base, a crosshead slidable vertically along said frame, feeding connections on said frame and operatively connected to said crosshead for feeding the latter along said frame, a drill rotating element journaled within said crosshead, a motor on said crosshead having a rotary driving element for rotating said drill rotating element, a fluid pressure motor on said frame having a rotating driving element for actuating said feeding connections for moving said crosshead to effect positive forward feed of the drill, and dual pumping means on said base for concurrently supplying a relatively large volume of fluid under pressure to said drill rotating motor and a relatively small volume of fluid under pressure to said feeding motor.

10. In a drilling apparatus, a frame on said base, a crosshead slidable longitudinally along said frame, a drill rotating element journaled in said crosshead, feeding connections on said frame and operatively connected to said crosshead, a rotary fluid pressure motor mounted on

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said crosshead for driving said drill rotating element, a rotary fluid pressure motor mounted on said base for actuating said feeding connections to effect feeding movement of said crosshead to apply a positive forward feeding pressure to the drill, and dual pumping means on said base for concurrently supplying a relatively large volume of fluid under pressure to said drill rotating motor and a relatively small volume of fluid under pressure to said feeding motor.

11. In a drill apparatus, the combination comprising a high speed hydraulic motor for rotating a drilling implement, a low speed hydraulic motor, connections operated by said low speed motor for positively feeding the drilling implement toward the work, pumping means including a low capacity pump and a high capacity pump, and operator controlled control valve means for concurrently connecting said low capacity pump to said feeding motor and said high capacity pump to said rotating motor.

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REFERENCES CITED

The following references are of record in the file of this patent:

UNITED STATES PATENTS

Number	Name	Date
1,798,797	Jones et al.	Mar. 31, 1931
1,883,013	Shinn	Oct. 18, 1932
2,168,655	Rose	Aug. 8, 1939
2,265,987	Anderson et al.	Dec. 16, 1941
2,410,959	Brown	Nov. 12, 1946