Nov. 29, 1966 L. CHAPPUIS 3,288,229

DRILLING SLIDE FOR LARGE HOLES WITH TRAVERSING BAR CONCENTRIC TO THE DRILL AND AUTOMATIC REGULATION OF THE DRILLING FEED

Filed Dec. 23, 1963 5 Sheets-Sheet 1

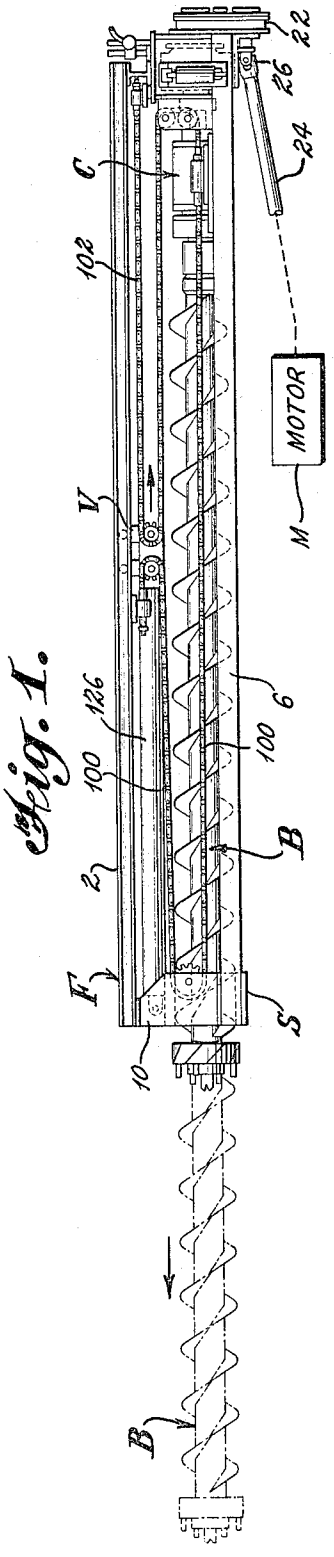


Fig. 1.

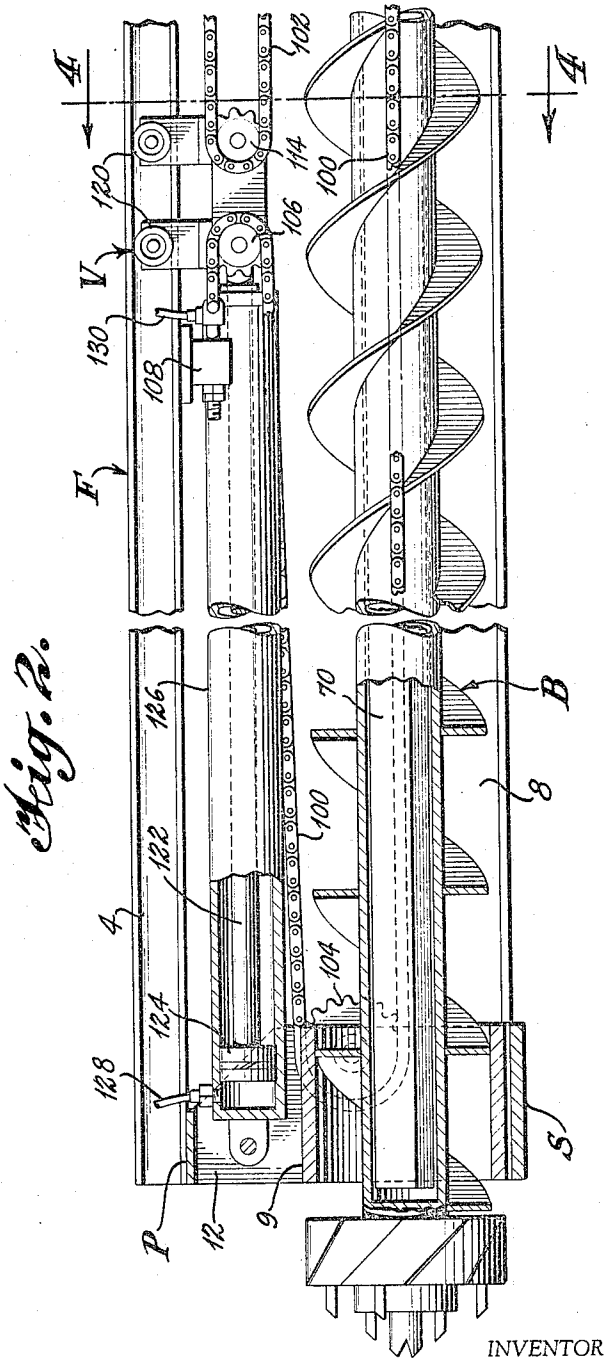


Fig. 2.

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Filed Dec. 23, 1963 5 Sheets-Sheet 2

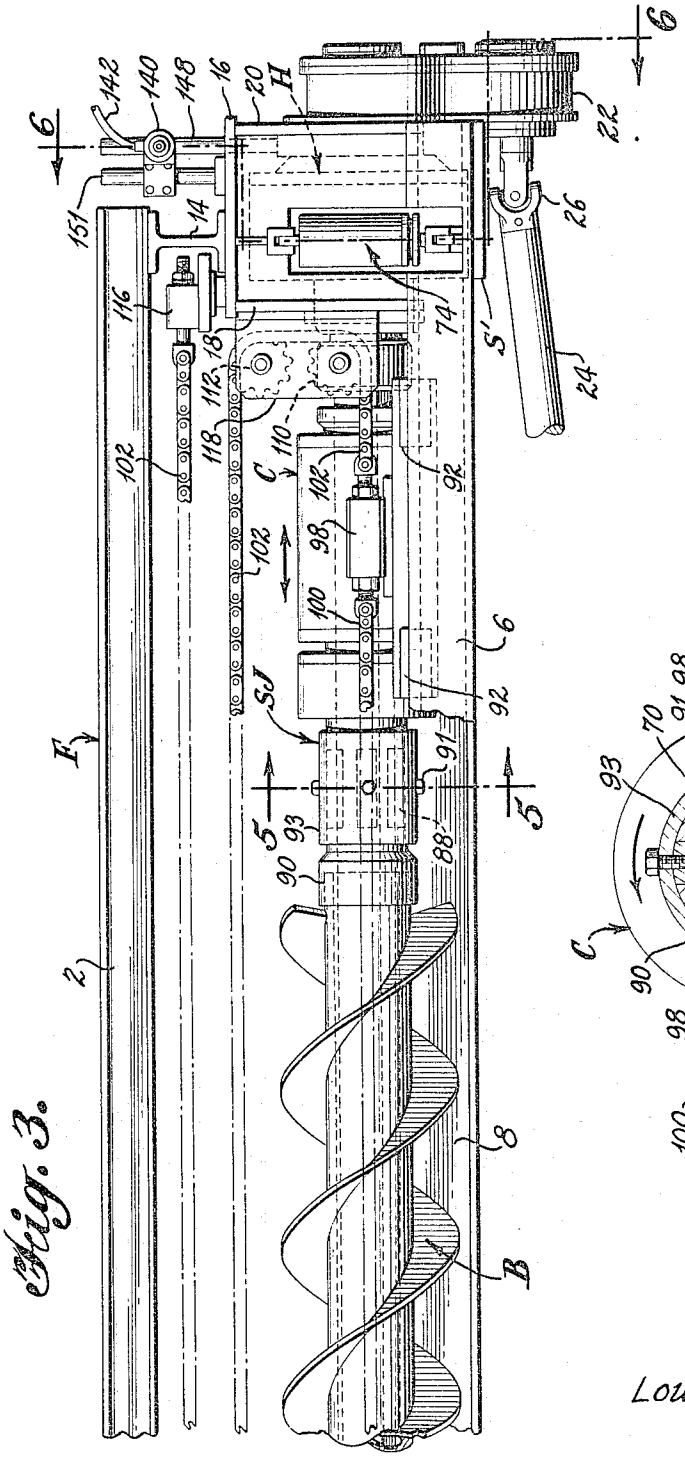


Fig. 3.

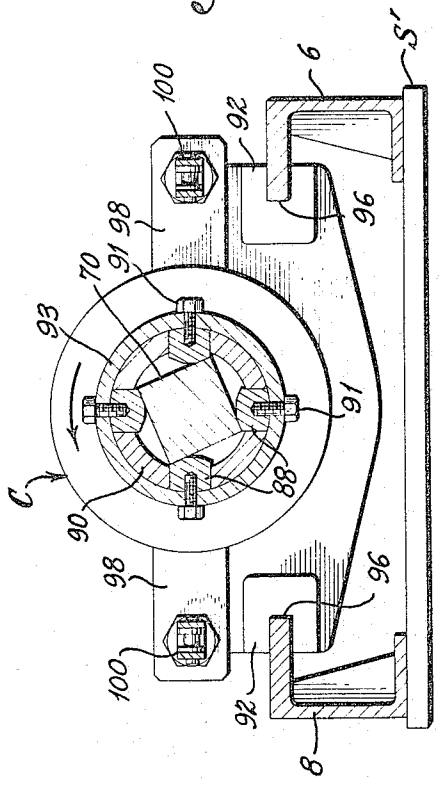


Fig. 5.

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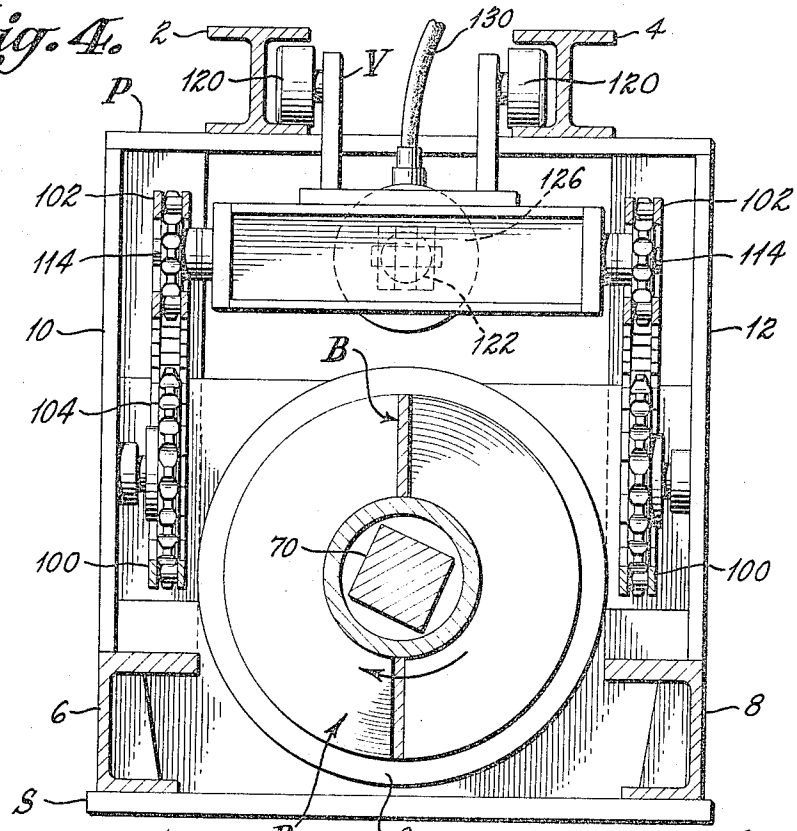
Fig. 4.



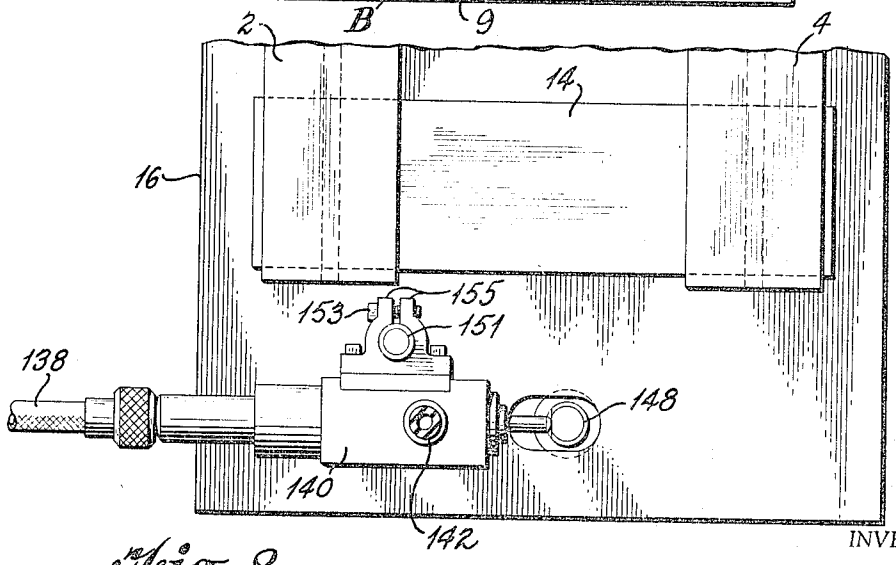




Fig. 8.

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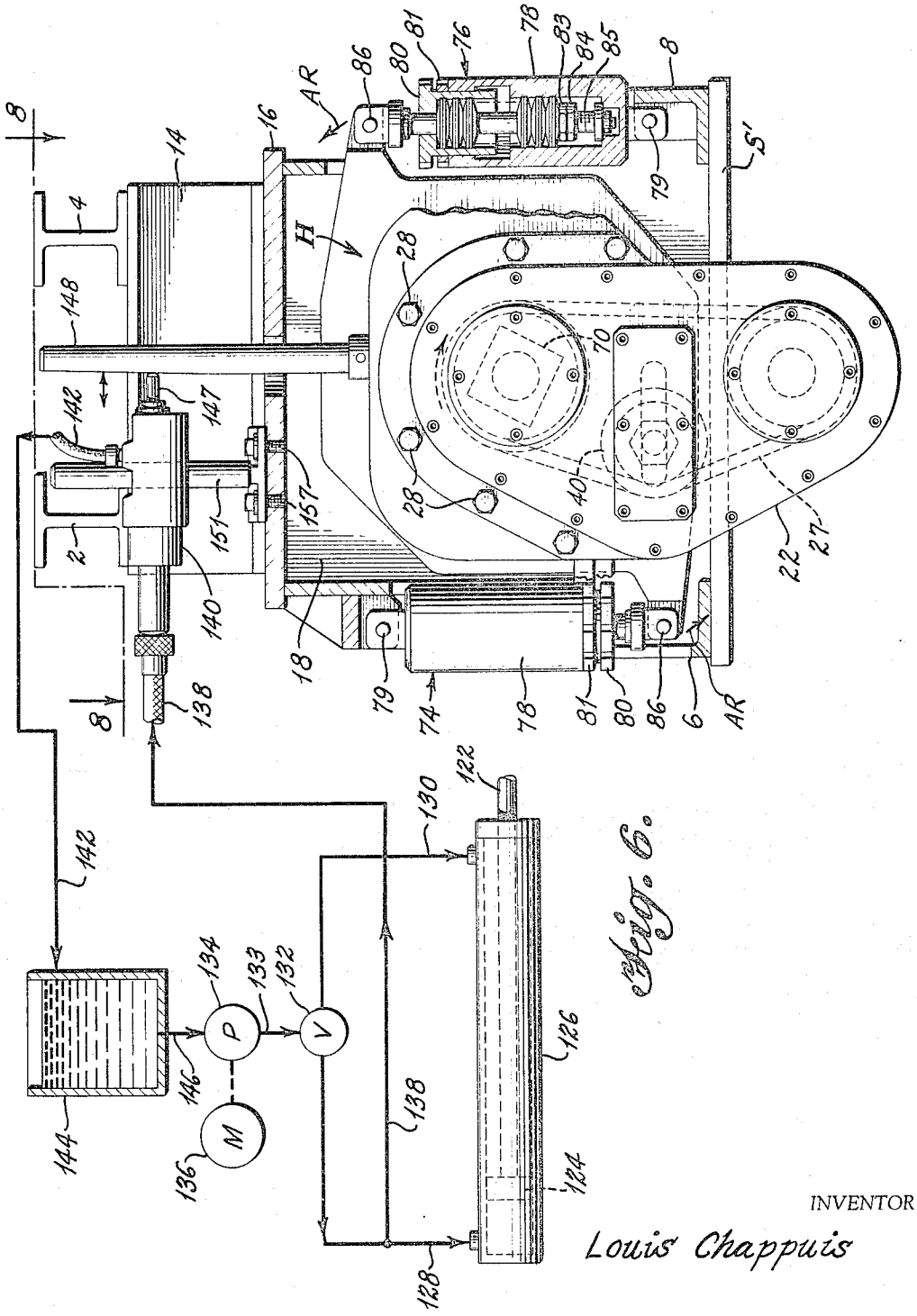


Fig. 6.

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Filed Dec. 23, 1963 5 Sheets-Sheet 5

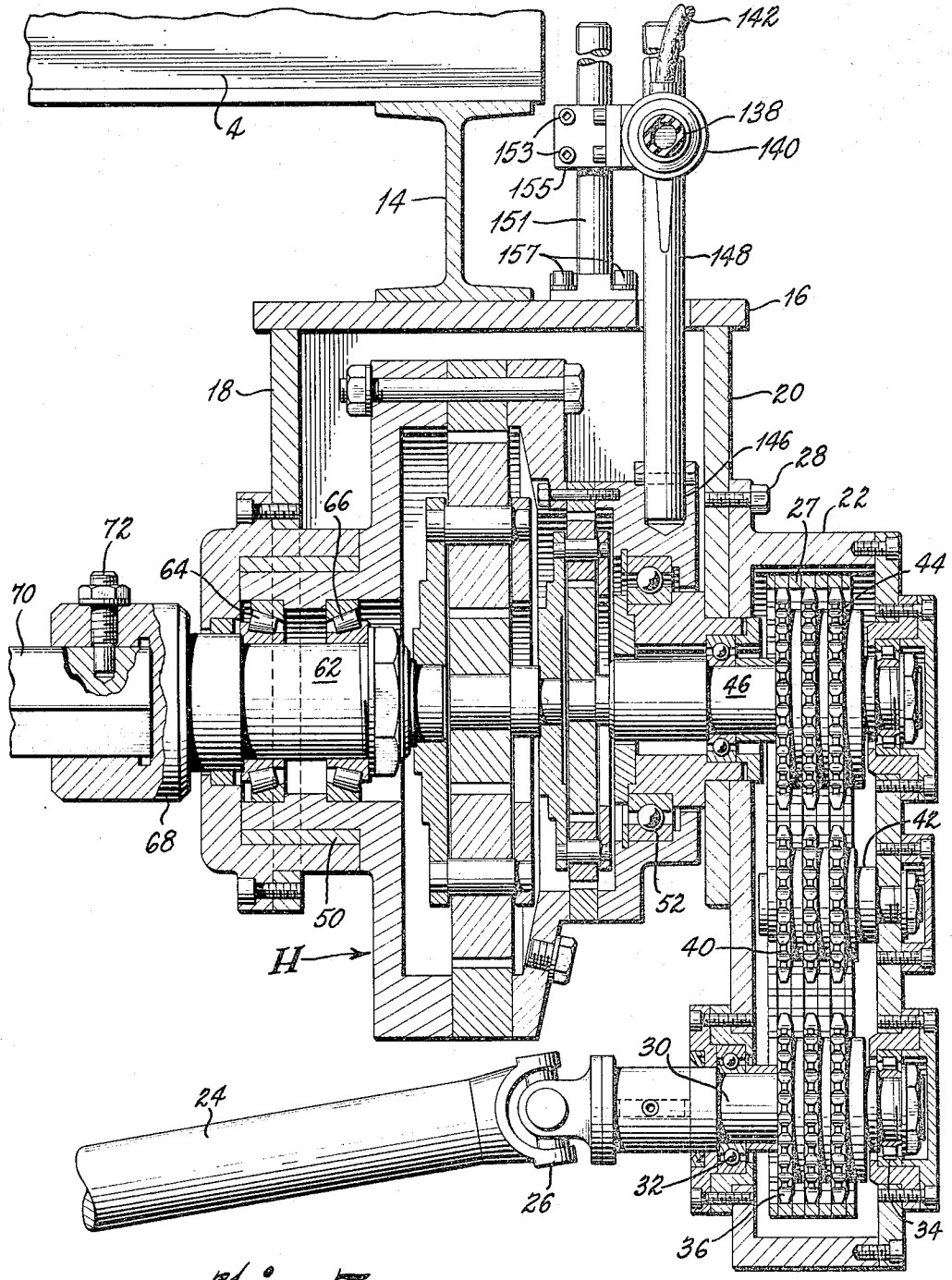


Fig. 7.

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United States Patent Office 3,288,229 Patented Nov. 29, 1966



3,288,229

# DRILLING SLIDE FOR LARGE HOLES WITH TRAVERSING BAR CONCENTRIC TO THE DRILL AND AUTOMATIC REGULATION OF THE DRILLING FEED

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9 Claims. (Cl. 173—9)

This invention relates to an earth drilling machine.

In drilling tunnels, galleries, etc., it is customary to drill a central hole of large diameter and a plurality of smaller holes distributed around the central hole. The smaller holes are charged with explosives but the central hole is not charged and serves as an "escape" during the explosion.

The resistance of the earth to drilling is variable and when a "hard" part of the earth is encountered the sudden increase of the drilling load on the drill can damage the drill.

It is therefore an object of this invention to provide a drill which will not be damaged by encounters with hard spots in the drilling medium during the drilling operation.

It is a further object of this invention to provide a protective mechanism for the drill which is relaible and positive in operation.

It is a further object of this invention to provide a protective mechanism for a drill which will discontinue the feed of the drill bit when the resistance to drilling becomes too great.

It is a further object of the invention to provide a drill wherein the feed of the drill can be regulated.

It is a further object to provide a drive for the drill bit which is concentric with the drill.

It is a further object of this invention to provide a drive for the drill whereby the drill can be rotated and fed in the drilling direction with a minimum amount of friction thereby reducing the wear and power requirements.

It is a further object of this invention to provide a quick response drive for feeding the drill.

A complete understanding of the invention can be had by reference to the following description and the accompanying drawings wherein:

FIG. 1 is a side elevation of the completed device;

FIG. 2 is an enlarged view of the front end of the drill with parts broken away;

FIG. 3 is an enlarged view of the back end of the machine;

FIG. 4 is a section taken on the line 4—4 of FIG. 2;

FIG. 5 is a section taken on the line 5—5 of FIG. 3;

FIG. 6 is a section taken on line 6—6 of FIG. 3 and showing schematically the hydraulic system for operating the piston;

FIG. 7 is a sectional view showing the planet-gear speed reducer; and

FIG. 8 is a section taken on the line 8—8 of FIG. 6.

A frame or support F is made of spaced parallel I beams 2, 4 and spaced parallel channel section 6, 8. At one end the beams 2, 4 are secured to a mounting plate F and the channel sections are secured to a support plate S. Spacers 10, 12 are secured to the channels and support plate to provide a rigid construction for the front end of the frame. At the other end the spaced I beams are secured to a cross beam 14 to which is secured a plate 16. Spaced plates 18 and 20 are secured to plate 16 and to channel sections 6, 8 and the channel sections are secured to a plate S' to provide a rigid construction for the other end of the frame.



A drill bit B is supported at one end in a bearing 9 carried by plates 10, 12 and is supported at the other end for rotation and for feeding in the drilling direction in a carriage C.

The bit is rotated by a motor M which drives a reduction gear in housing 22 through a shaft 24 and a universal joint 26. The gearing is shown as a chain and sprocket drive in FIG. 7 but it could be a gear train just as well. The purpose of the reduction gear is to reduce the speed of the output shaft and increase the effective torque of the motor since the motor is of a high speed low torque type in order to conserve weight and may be an electric, hydraulic, pneumatic or thermal motor.

The housing 22 is secured to plate 20 by threaded fasteners 28. Inside the housing is mounted an input shaft 30 connected to the universal joint and supported by anti-friction bearings 32, 34 and a drive sprocket 36 is secured to the shaft 30 by key means not shown. An idler sprocket 40 is mounted on an eccentric shaft 42 to serve as a chain tightener in order that the chain be properly tensioned. The driven sprocket 44 is mounted on output shaft 46 and is secured thereto by key means not shown.

A housing H is pivotally mounted in plate 18 by a plain bearing 50 and in plate 20 by an anti-friction bearing 52. The housing H carries a number of epicyclic planet spur planet-gear trains, acting as speed reducers.

The housing H is restrained against pivoting under load caused by the reaction of planet gears by a pair of spring devices 74, 76. Each such device comprises a housing member 78 mounted on the frame as by a pin 79 and a member 80 threaded into the housing and locked in fixed position by a locking ring 81. A piston element shown as consisting of a nut 83 and a lock nut 84 is threaded on a rod 85 which passes through member 80 and is pivotally connected at 86 to an arm of the housing H. A spring is mounted between the nut 83 and member 80 and is shown as consisting of a plurality of Belleville washers. Movement of the housing in the direction of the arrow AR shown in FIG. 6 is resisted by the compression of the washers. The load which will cause the housing to pivot is determined by the adjustment of the spring devices. The adjustment is made by the initial positioning of the nut 83 and the later positioning of member 80. Lock elements 81 and 84 retain the parts in adjusted position.

Square shaft 70 extends through carriage C and into the bit B a sufficient distance so that the bit can be rotated while in its most extended position as shown in dotted lines in FIG. 1.

The bit is coupled to shaft 70 by a coupling SJ comprising a plurality of bronze shoes 88 secured to the bit portion 90 by screws 91 and collar 93 and bearing against the flat sides of the shaft 70. This coupling operates in the manner of a spline joint and allows shaft 70 to rotate the bit while the bit is fed along the shaft in the drilling direction. The bronze shoes bearing on the steel shaft 70 provide a minimum amount of friction while the bit is slid along the shaft under drilling load. In the event of wear the shoes can be easily replaced.

The bit portion 90 is welded to the body of the bit and is rotatably supported in a carriage C and is fixed against longitudinal movement with respect to the carriage. Movement of the carriage longitudinally of the frame feeds the bit in the drilling direction while supporting it for rotation. The details of the carriage form no part of this invention and the carriage is therefore shown schematically.

The carriage is supported for longitudinal movement and against rotation by bearing blocks 92 which are provided with notches 96 to receive a flange of the channel sections 6, 8.

The carriage is also provided with ears **98** to which are secured, on opposite sides, the chains **100** and **102**. The chains **100** are trained about idler sprockets **104**, **106** and secured to anchor members **108** fixed to I beams **2**, **4**. The idler sprocket wheels **104** are rotatably mounted on plates **10**, **12** and idler sprocket wheels **106** and **114** are mounted on a vehicle V. The chains **102** are trained about idler sprocket wheels **110**, **112**, **114** and secured to anchor members **116** secured to the frame. Idler sprocket wheels **110**, **112** are mounted on plates **118** secured to the channel members and idler sprocket wheels **114** are mounted on the vehicle.

While a sprocket and chain drive has been shown and described it is obvious that any pulley system and flexible cord arrangement can be used.

The vehicle comprises a body member mounted on wheels **120** for guided movement in the facing channels of I beams **2**, **4** and is connected to piston rod **122** of a piston **124** mounted in cylinder **126** secured to the frame.

Conduits **128** and **130** are connected to deliver pressure fluid to opposite ends of the cylinder by the control valve **132**. The pressure fluid is supplied to the valve through conduit **133** by a pump **134** driven by a motor **136**.

A conduit **138** connects conduit **128** with a pressure relief valve **140** and a conduit **142** connects the pressure relief valve with reservoir **144** which supplies fluid to the pump through a conduit **146**. Pressure relief valve **140** is actuated by a plunger **147** to relieve the pressure of the fluid going to the cylinder via conduit **128** by by-passing fluid and returning it to the reservoir. The plunger **147** is operated by a rod **148** carried by the pivotally mounted housing H and is shown in FIG. 7 as mounted in a bore **146**. The pressure relief valve is adjustably secured to a pedestal **151** by threaded fasteners **153** and spaced ears **155**. The spaced ears are drawn together by the fasteners to frictionally grip the pedestal and retain the relief valve in adjusted position. Raising and lowering the valve on the pedestal adjusts the sensitivity of the apparatus to a high degree of accuracy. The pedestal is secured to plate **16** by threaded fasteners **157**.

In operation the motor M is energized to rotate the bit B through the chain or gear reducer located in the housing **22**, the epicyclic reducer in the housnig H, the square shaft **70** and the coupling SJ. The valve **132** is operated to deliver pressure fluid to the cylinder **126** through conduit **128** to thereby move the vehicle V to the right as viewed in the drawings. The sprocket chains **100** pull the carriage C in the feeding direction (to the left as viewed in the drawings). In the event the bit encounters a hard spot in the drilling medium, the increase in resistance to rotating the drill is reflected in the entire gear assembly. The planet gears then react on the gear-ring integral with the housing H and carry the same to pivot about bearings **50**, **52** against the resistance of the spring devices **74**, **76**. Rod **148** operates plunger **146** to by-pass fluid by the pressure reducing valve **140**. This reduces the pressure supplied to the cylinder and the forward feed of the bit is reduced or discontinued depending upon the increase of the resistance to drilling. When the resistance to rotation of the bit is reduced the forward feed is resumed at a speed commensurate with the resistance to rotation of the bit as determined by the position of the housing H.

What is claimed is:

**1.** A drilling apparatus comprising a support, a drive shaft rotatably mounted on said support, a hollow drill bit mounted over said shaft for longitudinal movement with respect thereto, first coupling means coupling said bit to said shaft during rotation of said shaft while permitting said longitudinal movement, drive means external of said support, second coupling means coupling said drive means to said shaft, mounting means



mounting at least a portion of said second coupling means for pivotal movement in said support in response to a predetermined change in resistance to drilling, feeding means mounted on said support for feeding said bit along said support, and sensing means mounted on said support and cooperating with said second coupling means and said feeding means to regulate the feeding of said bit in response to pivotal movement of said second coupling means.

**2.** The apparatus of claim **1** wherein said shaft has a plurality of flat outer surfaces and wherein said first coupling means comprises a spline joint having a plurality of bearing shoes engaging said flat surfaces.

**3.** The apparatus of claim **1** wherein said mounting means comprises a housing in which at least a portion of said second coupling means is operatively mounted, and resilient means connecting said housing to said support and normally resisting the pivoting of the housing produced by the reaction of at least a portion of said second coupling means in response to resistance to drilling.

**4.** The apparatus of claim **1** wherein said second coupling means comprises a multiple gear and chain drive operatively connected to said drive means and a planetary gear system operatively connecting said multiple gear and chain drive to said drive shaft.

**5.** The apparatus of claim **4** wherein said mounting means comprises a housing in which said planetary gear system is operatively mounted, and resilient means connecting said housing to said support and normally resisting the pivoting of the housing produced by the reaction of said planetary gear system in response to resistance to drilling.

**6.** The apparatus of claim **1** wherein said feeding means comprises a carriage slidably mounted on said support and connected to said shaft through said first coupling means, a cylinder and piston therein mounted on said suport, fluid pressure means for moving the piston in the cylinder, and flexible means connecting said piston with said carriage whereby movement of the piston in the cylinder moves the carriage and the bit along the support.

**7.** The apparatus of claim **6** wherein said sensing means comprises a fluid control valve mounted on said support and adapted to control said fluid pressure, and actuating means to actuate said valve upon said pivotal movement of said housing.

**8.** The apparatus of claim **7** wherein said actuating means comprises a movable plunger mounted on said valve and disposed in the path of said housing upon said pivotal movement thereof.

**9.** The apparatus of claim **7** wherein the amount of pivotal movement of said housing required to actuate said valve is adjustable.


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