

[54] **CABLE FEED DEVICE**

[72] Inventor: **John Edward Gordon**, 337 Main Street
East, Galt, Ontario, Canada

[22] Filed: **June 3, 1970**

[21] Appl. No.: **43,138**

[52] U.S. Cl. **173/147, 92/137**

[51] Int. Cl. **E21c 5/06**

[58] Field of Search 173/147, 43; 308/9; 92/137;
175/220, 203, 162

1,834,701 12/1931 Gustafson 173/147 X
2,958,514 11/1960 Lee 173/147 X
3,181,630 5/1965 Coburn 173/147 X

FOREIGN PATENTS OR APPLICATIONS

556,484 4/1958 Canada 173/147
928,702 6/1955 Germany 173/147

Primary Examiner—David H. Brown

Attorney—E. Wallace Breisch

[57] **ABSTRACT**

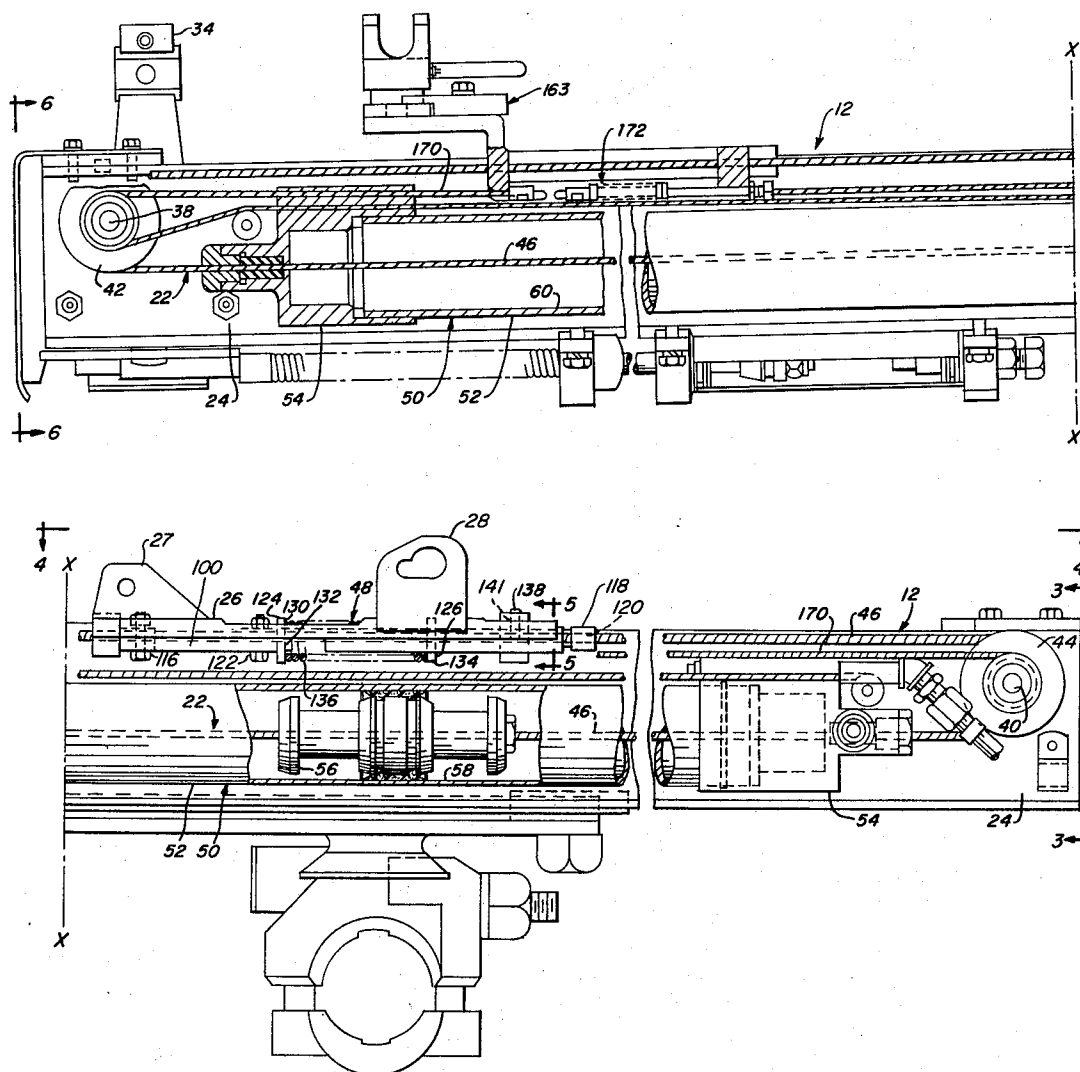
A cable feed device for a drilling apparatus and more particularly improved means for maintaining tension in a feed cable during the feeding of a drill rod.

14 Claims, 7 Drawing Figures

[56] **References Cited**

UNITED STATES PATENTS

2,103,252 12/1937 Gartin 173/147 X
1,844,157 2/1932 Gustafson 92/137 X



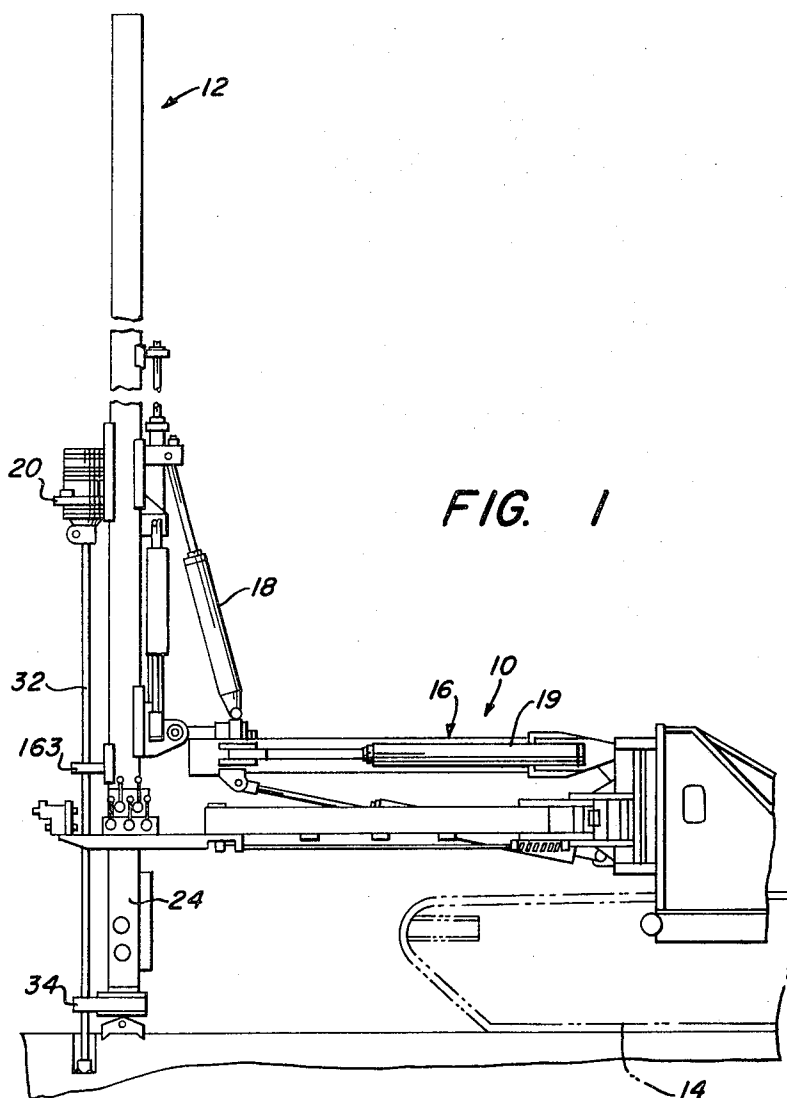


FIG. 1

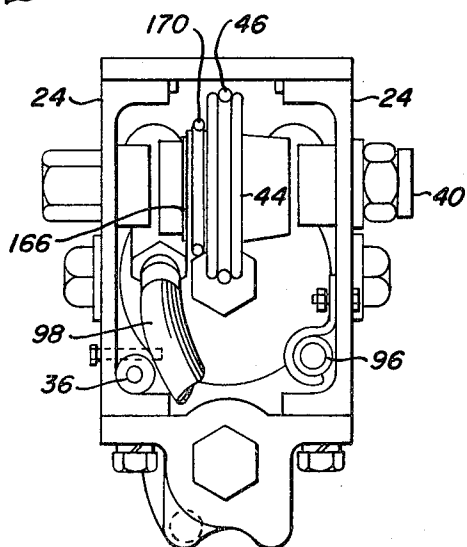
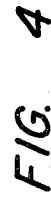
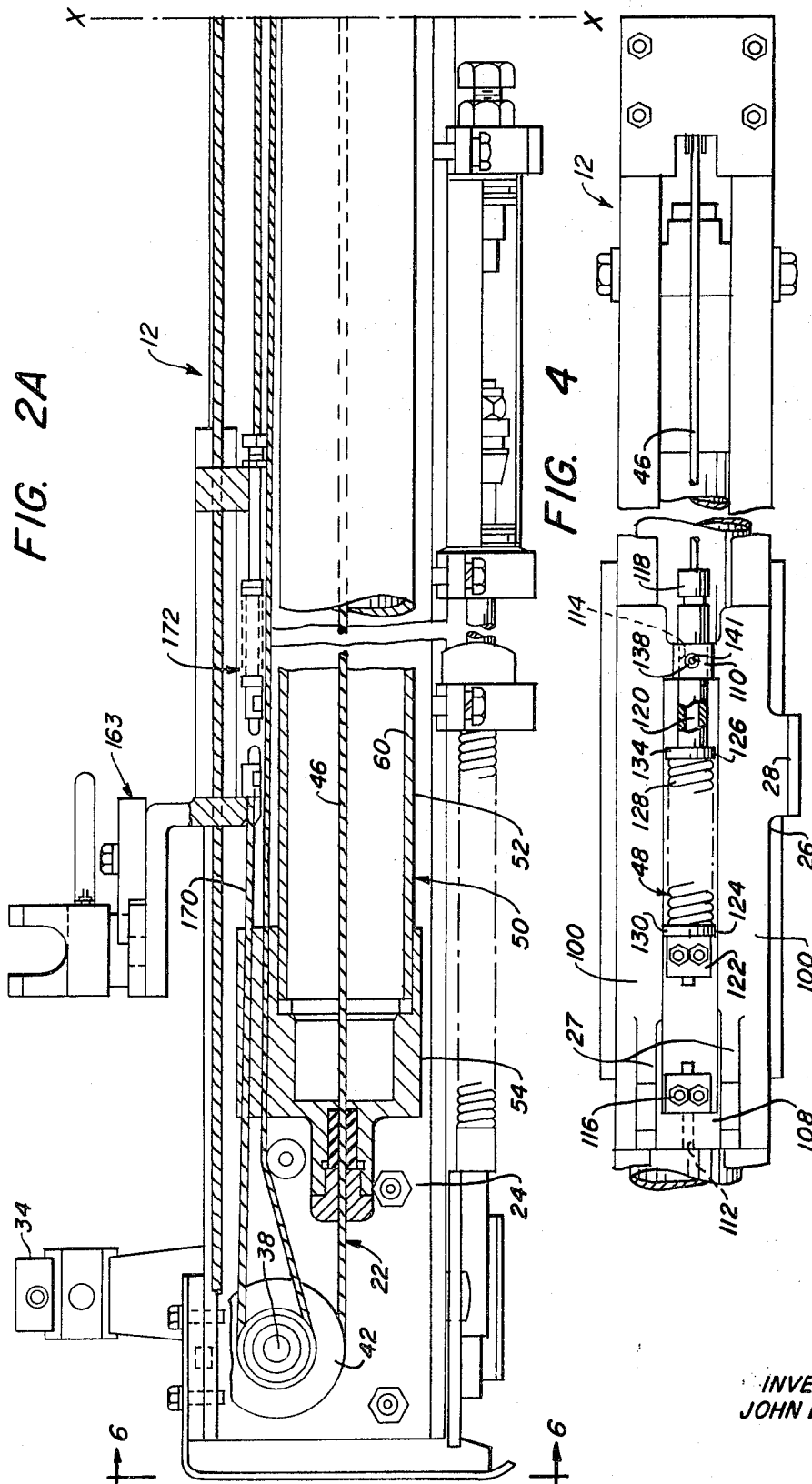


FIG. 3

INVENTOR
JOHN E. GORDON



INVENTOR
JOHN E. GORDON

FIG. 2B

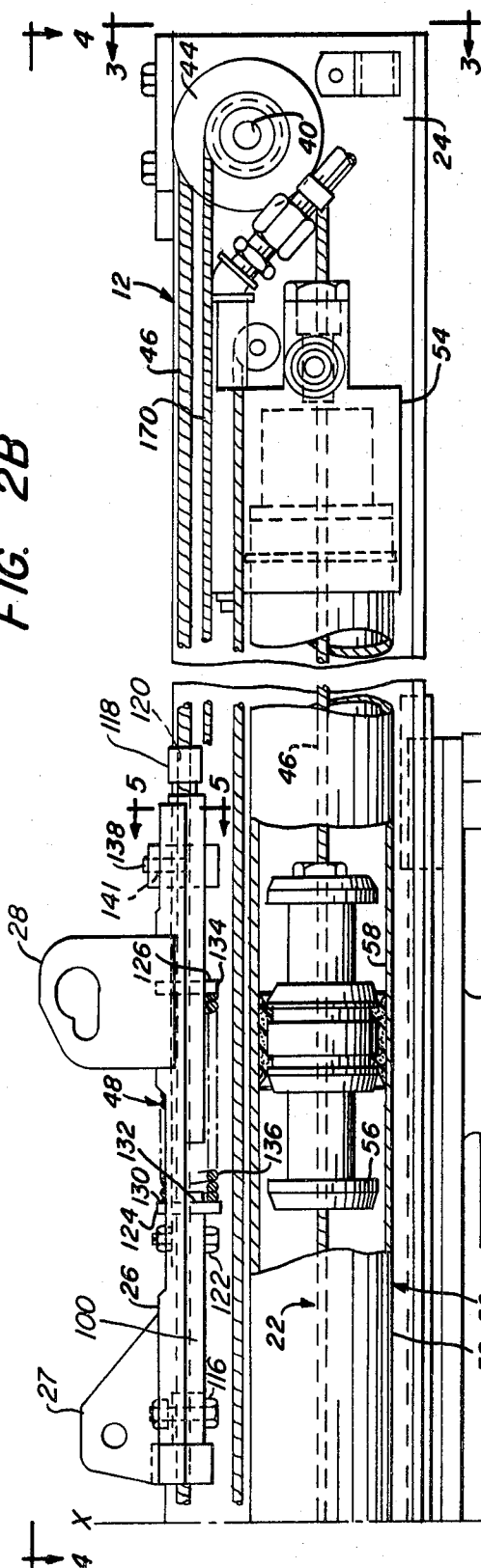
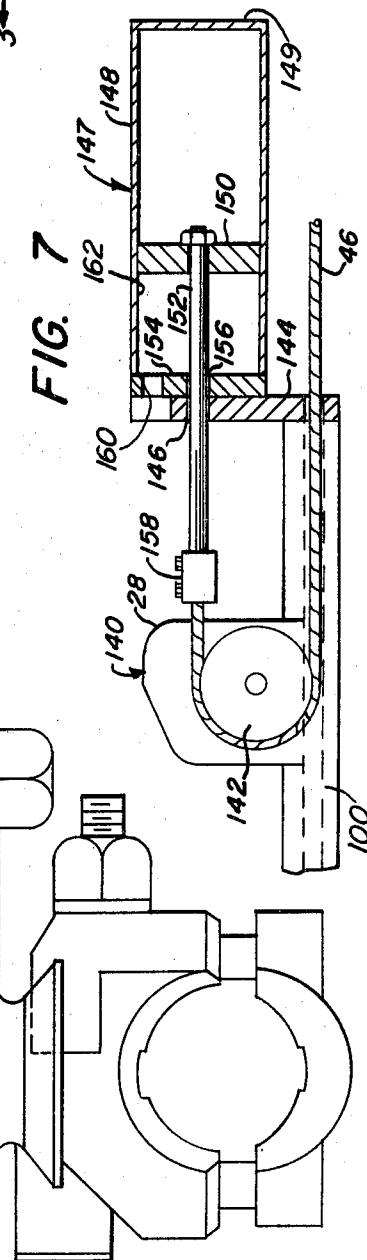


FIG. 7



INVENTOR
JOHN E. GORDON

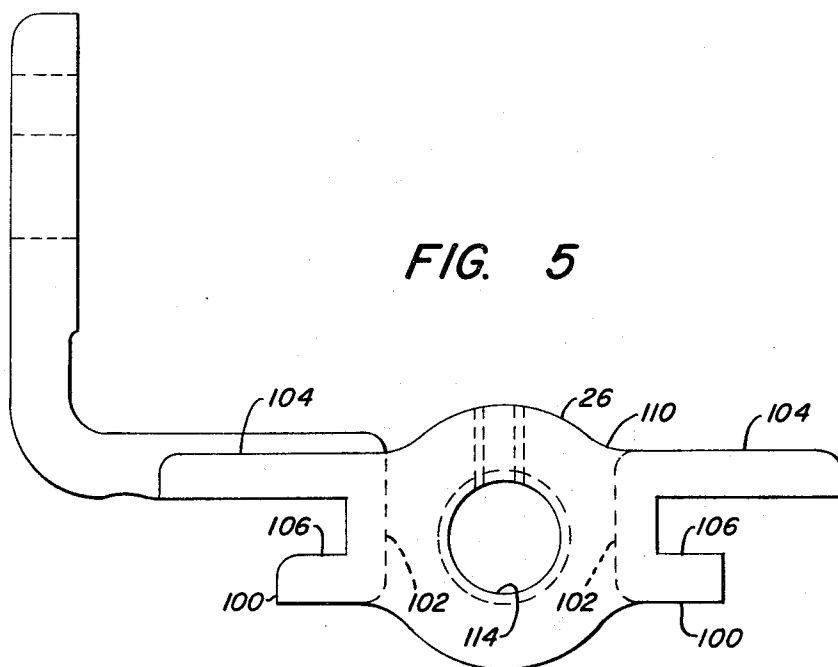
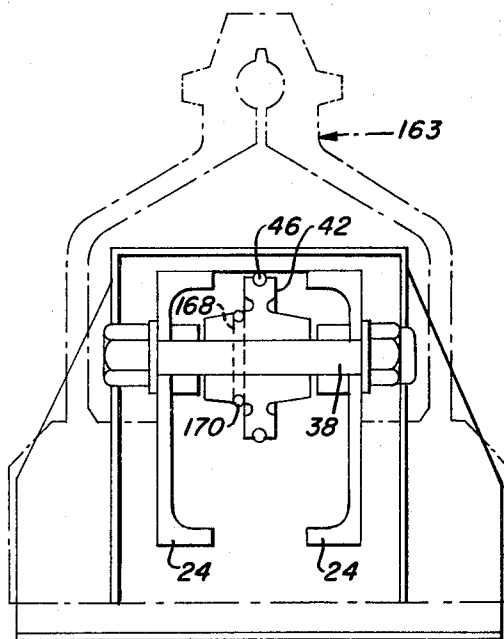


FIG. 6



INVENTOR
JOHN E. GORDON

CABLE FEED DEVICE

Some drilling devices for drilling in rock and the like have the drill pulled back and forth over the feed frame by means of a rope or cable feed arrangement. Prior drilling devices with such a cable feed arrangement have proved to be somewhat unsatisfactory in their ability to drill in hard rock formations, such unsatisfactory performance being due mainly to the inability of such prior feed arrangements to remove slack out of the cable at assembly and to compensate for rope stretch in service, thereby resulting in machine bounce while drilling and a relatively shortened life for the feed cable.

By use of the present invention which includes means for insuring a tensile force in the feed cable during all contemplated drilling conditions, machine bounce is greatly reduced and the feed cable useful life is increased.

These and other objects and advantages of this invention will become more readily apparent from a reading of the following description and drawings, in which:

FIG. 1 is a side elevational view of a drilling device constructed in accordance with the principles of this invention and with a portion of the mobile side supports and frames being omitted;

FIG. 2 (illustrated as 2A and 2B matching on line X—X) is a side cross-sectional view of the drilling guide frame portion of the drilling apparatus shown in FIG. 1;

FIG. 3 is an end view of the drill guide frame viewed on lines 3—3 of FIG. 2B;

FIG. 4 is a partial plan view of the drill guide frame viewed on lines 4—4 of FIG. 2B and showing a feed cable tensioning assembly of this invention;

FIG. 5 is an end view of a drill saddle taken on lines 5—5 of FIG. 2B;

FIG. 6 is an end view of the drill guide frame viewed on lines 6—6 of FIG. 2A;

FIG. 7 is a side cross-sectional view of another embodiment of a feed cable tensioning assembly of this invention.

A drilling apparatus 10 includes a drill guide frame assembly 12 supported and rendered movable over a surface by a crawler support 14 of a type well known in the art. Frame assembly 12 is suitably supported by a well known boom assembly 16. Boom assembly 16 includes the usual extensible jacks 18 and 19 for swinging frame assembly 12 in the vertical and horizontal direction, respectively. Frame assembly 12 supports a drill motor 20 thereon, which motor 20 is axially movable with respect to a frame assembly 12 by means of a cable feed assembly 22 of this invention.

Inasmuch as a portion of the invention herein resides in the cable feed assembly 22 and the balance of elements set forth above are generally well known in the art, further description of such elements will not be set forth except as necessary in the description of a preferred embodiment of feed assembly 22.

For purposes of description hereinafter, forward and rearward shall refer respectively to the left and right of the drill guide frame assembly 12 as viewed in FIGS. 2A and 2B and upper and lower shall refer to the respective surfaces of assembly 12 viewed in FIGS. 2A and 2B.

Guide frame assembly 12 comprises a pair of elongated U-shaped channels 24 being parallel to each other in a laterally spaced relationship and having the respective flange portions thereof toed inwardly. A suitable drill saddle 26 is mounted on the upper side of channels 24 for selective longitudinal movement thereon, as hereinafter described in detail. Saddle 26 is adapted to fixedly receive drill motor 20 thereon in any suitable manner, for example, forward and rearward upwardly extending saddle lug portion 27 and 28, respectively, which portions 27 and 28 have transverse bores therethrough which align with cooperating connecting bores (not shown) in drill motor 20 for receiving mounting pins (not shown) therethrough. Drill motor 20 receives a drill rod 32 in the forward chuck end thereof and rod 32 extends forwardly thereof and is centered along its longitudinal extent with respect to guide frame assembly 12 by means of a forward end centralizer 34. Centralizer 34 is fixedly secured across channels 24

adjacent the forward ends thereof and is of any suitable construction, for example, as shown centralizer 34 has a pneumatically powered opening and closing motion having air under pressure supplied thereto by means of centralizer air hose 36.

Saddle 26 is rendered movable by means of cable feed assembly 22. Cable feed assembly 22 comprises: forward and rearward spindles 38 and 40 which extend transversely between channels 24 and have the respective ends thereof rotatably secured to channels 24 inwardly adjacent the respective ends thereof; forward and rearward guide rollers 42 and 44 fixedly secured to spindles 38 and 40 respectively; a feed cable 46 which is trained about rollers 42 and 44 and has one end thereof secured to the forward end of saddle 26 and the other end thereof secured to a feed cable tensioning assembly 48; and an elongated piston assembly 50 which is disposed between channels 24 intermediate the axial ends thereof and which extend in the axial direction thereof. Tensioning assembly 48 is secured to saddle 26.

Piston assembly 50 is suitably fixedly secured to channels 24 such that the axial centerline thereof is disposed in substantially the same plane with the lowermost extent of guide rollers 42 and 44. The uppermost extent of guide rollers 42 and 44 lies in a plane in substantial alignment with the ends of feed cable 46 which are fixed to the saddle 26 and tensioning assembly 48 as hereinbefore described. Feed cable 46 passes through piston assembly 50 substantially along the centerline thereof; is trained about respective guide rollers 42 and 44 such that the direction of the axial ends thereof are reversed; and the ends thereof are fixedly secured to saddle 26 and tensioning assembly 48 respectively.

Piston assembly 50 comprises: an elongated hollow cylindrical piston casing 52; casing end caps 54 which sealingly receive respective ends of casing 52 within the inner ends thereof; and a double acting piston head 56 which is slidingly and sealingly received within casing 52 thereby separating casing 52 into a retracting chamber portion 58 intermediate the rearward ends of head 56 and casing 52 and a feeding chamber portion 60 intermediate the forward ends of head 56 and casing 52. Piston head 56 is fixedly secured to feed cable 46 in any suitable manner, for example as shown and illustrated in the copending U.S. Application Ser. No. 42,789, filed June 2, 1970, and assigned to the same assignee as is this invention. Additionally, as the feed cable 46 passes through the piston assembly 50 such cable is wiped by an elastomeric sleeve of a type shown in the before mentioned copending application.

With a piston assembly 50 as described hereinabove, the saddle 26 is rendered axially movable along channels 24 by means of the selective supplying of air under pressure to such assembly 50. To move saddle 26 forwardly along channels 24, air under pressure is supplied to feeding chamber 60 by any suitable means, for example feed air hose 96 which communicates between chamber 60 and an external fluid pressure source (not shown). The pressurization of chamber 60 results in piston head 56 moving rearwardly and accordingly, because the forward end of cable 46 is reversely trained about forward guide roller 42, saddle 26 is pulled forwardly along channels 24. The forward movement of saddle 26 feeds the drill rod 32 which is held by the drill motor 20 seated on saddle 26. Similarly, to move saddle 26 rearwardly along channels 24, air under pressure is supplied to retracting chamber 58 by means of the retracting air hose 98 which communicates between chamber 58 and an external fluid pressure source (not shown). The pressurization of chamber 58 results in piston head 56 moving forwardly and accordingly, because the rearward end of cable 46 is reversely trained about rear guide roller 44 and the feed cable tensioning assembly 48 is secured to saddle 26, saddle 26 is pulled rearwardly along channels 24.

Saddle 26 comprises a pair of elongated J cross-sectional shaped guide members 100 being parallel to each other in a laterally spaced relationship and oriented such that the respective bases 102 thereof are bounded by the same trans-

verse planes and the long and short sides 104 and 106 thereof respectively, lie in the same transverse planes. The parallel spacing of guide members 100 is such that when saddle 26 is mounted on channel 24, the long sides 104 are bearing on the upper surface of the upper flange of respective channels 24 and the short side 106 thereof are downwardly adjacent such upper flanges. Guide members 100 are maintained in spaced relationship by means of respective forward and rearward spacing portions 108 and 110 which communicate between members 100 adjacent the respective ends thereof. Portions 108 and 110 have respective bores 112 and 114 therethrough which, as shown, extend axially in a direction parallel to the axial extent of members 100. The forward end of cable 46 is passed through bore 112 and thereafter such end is prevented from passing back through bore 112 by means of a suitable forward cable clamp 116 which is fixedly secured to such forward cable end. Bore 114 is threaded along the axial extent thereof for a purpose hereinafter described.

Tensioning assembly 48 is positioned between guide members 100 such that the axial centerline thereof is disposed in substantial alignment with the axial centerline of the upper run of cable 46. Assembly 48 includes an elongated adjusting screw 118 which has a forward portion thereof threadably received through bore 114. As hereinafter described in detail, tension on cable 46 is controlled by varying the extent of screw 118 passing through bore 114. Screw 118 has a bore 120 extending axially therethrough. The rearward end portion of cable 46 is passed through bore 120.

Tensioning assembly 48 additionally includes a suitable rear cable clamp 122 which is fixedly secured to the forwardmost end of the rear cable portion which has passed through bore 120. Intermediate clamp 122 and the forward end of screw 118 are positioned: a generally cylindrical forward tensioning spring guide member 124; an elongated generally cylindrical rear tensioning spring guide member 126; and an elongated tensioning spring 128.

Guide member 124 and 126 have respective axially extending bores therethrough, through which the rearward end portion of cable 46 is passed. Member 124 includes a radially outwardly extending flange portion 130 at the forward end thereof and a guide portion 132 which extends axially rearwardly from flange portion 130. Member 126 includes a radially outwardly extending flange portion 134 at the rearward end thereof and a guide portion 136 which extends axially forwardly from flange portion 134. The inner diameter of tensioning spring 128 is substantially equal to the outer diameter of guide portions 132 and 136 and the outer diameter of spring 128 is shown as slightly less than the outer diameter of flange portions 130 and 134. The forward and rearward end portions of spring 128 are positioned about guide portions 132 and 136 respectively and such positioning is retained by flange portion 134 and 130 which are engageable with the respective ends of spring 128. The natural bias of spring 128 maintains an axial spacing between the rearward end of guide member 126 and the forward end of guide member 124, however the axial extent of such spacing is variable by means of the adjusting screw 118.

With the elements of the tensioning assembly 48 positioned as described hereinabove, it is possible to maintain the feed cable 46 under a constant tension and thereby overcome any cable stretching or slack and accordingly, increase the life of the cable 46 and additionally, eliminate practically all machine bounce during drilling. The above desired results are accomplished by the preloading the spring 128 to any desired amount, for example, a load equivalent to that which the piston assembly 50 would apply to the cable 46 in feeding the drill rod 32. If a slack develops during the drilling, such as by cable stretch, the tensioning spring 128 extends, thereby maintaining the cable 46 under considerable tension even though there is some drop from the initial load. The preloading is accomplished by threading adjusting screw 118 forwardly through the bore 114 of the rear spacing portion 110. The forward end of screw 118 is in engagement with the rear-

ward end of guide member 124 and as such any forward movement of screw 118 causes guide member 124 to move forwardly and thereby compress spring 128. To insure that screw 118 retains the relative position thereof after preloading spring 128, a set screw 138 extends through a bore 141 which communicates between the outer periphery of portion 110 and bore 114. When adjusting screw 118 is in the desired position thereof, set screw 138 is tightened in to engagement with adjusting screw 118, thereby limiting any axial movement of screw 118.

At this point it is to be noted that the primary purpose of providing a tensioning assembly constructed under the principles of this invention is to maintain a feed cable under constant tension and accordingly, other tensioning assembly embodiments can be constructed without departing from the scope of this invention, for example, tensioning assembly 140 as illustrated in FIG. 7.

Tensioning assembly 140 is positioned between guide members 100. Assembly 140 includes a sheave 142 suitably rotatably mounted adjacent lug portion 28. Sheave 142 is oriented such that the lowermost periphery thereof is in approximate alignment with the uppermost periphery of the rearward guide roller 44. An upwardly extending piston assembly mounting member 144 extends transversely between guide members 100 and is fixedly secured thereto at the rearward end thereof. Member 144 has a bore 146 therethrough which is in approximate axial alignment with the uppermost periphery of sheave 142.

Tensioning assembly 140 additionally includes a piston assembly 147. Assembly 147 comprises: a tensioning cylinder 148; a piston head 150 slidably and sealingly received within cylinder 148; a piston rod 152 fixedly secured to the radial centerline of head 150 and extending forwardly therefrom; and a forward cylinder end cap 154 which is fixedly secured to the forward end of cylinder 148. The rearward end of cylinder 148 is enclosed by a rear end wall 149. End cap 154 has a bore 156 extending axially therethrough at the radial centerline thereof such that upon reception of piston head 150 within cylinder 148 rod 152 extends through bore 156 and axially forwardly therefrom.

After assembly of piston assembly 140 of a type as described above, rod 152 is inserted through bore 146 and the forward end of assembly 140 is fixedly secured to the rearward surface of retaining member 144. Thereafter the rearward end of feed cable 46 is reversely trained about sheave 142 and the rearwardmost end of cable 46 is fastened to the forward end of 142 by any suitable connector such as cable coupler 158.

With the elements of tensioning assembly 140 positioned as described hereinabove, it is possible to maintain feed cable 46 under a constant tension and thereby obtain advantages similar to those described hereinbefore with reference to tensioning assembly 48. The advantages are obtained by providing pneumatic or hydraulic fluid under pressure to piston assembly 146. The pressure fluid can be provided from any suitable source (not shown). As illustrated, the assembly 146 is provided with a pressure fluid inlet 160 at the forward end thereof such that the tensioning chamber 162, which is defined by that volume of cylinder 148 intermediate the end cap 154 and the forward end of piston head 150, is preferably pressurized an amount which would result in an initial tension in feed cable 46 in a magnitude equivalent to that which the piston assembly would apply to the cable 46 in feeding the drill rod 32. If a slack develops during the drilling, such as by cable stretch, chamber 162 will elongate because of the constant pressure being supplied thereto and as such immediately take up such slack and thereby maintain cable 46 in tension.

Inasmuch as the drill guide frame assembly 12 illustrates a relatively long drill feed, a suitable traveling mid-centralizer assembly 163 is provided to support the drill rod 32 at mid point of the portion of the axial length thereof which extends along guide frame assembly 12. Such mid point supports aids in preventing damage to drill rod 32 and also improves penetration thereof by preventing the drilling force applied

thereto from being dissipated through rod bending. Mid-centralizer assembly 163 is supported on frame assembly 12 intermediate centralizer 34 and drill motor 20 and is rendered movable with respect to frame assembly 12 by means of a centralizer cable feed assembly 163 of this invention.

Centralizer feed assembly 163 comprises: a rear sheave 166 (see FIG. 3) mounted on spindle 40 adjacent guide roller 44 and in frictional engagement therewith; a groove 168 extending circumferentially around a reduced diameter portion of guide roller 42; and a mid-centralizer feed cable 170 which is trained about sheave 166 and groove 168 and has the forward end thereof secured to the forward end of mid-centralizer assembly 163 and the rearward end thereof secured to a feed cable tensioning assembly 172. Tensioning assembly 172 is secured to mid-centralizer assembly 163 in a manner similar to the manner in which tensioning assembly 48 is secured to saddle 26. Additionally, tensioning assembly 172 is similar to tensioning assembly 48 and, accordingly, reference is made to the hereinbefore set forth description of tensioning assembly 48 for the structure and operation of tensioning assembly 172.

Tensioning assembly 172 is preferably preloaded an amount sufficient to insure that mid-centralizer feed cable 170 is in constant tension throughout the operations of the drilling apparatus 10. Inasmuch as cable 170 is in constant tension, cable 170 will cause mid-centralizer assembly 163 to be moved forwardly or rearwardly when motor 20 is moving in respective directions because of the constant frictional drive which exists between cable 170 and groove 168. The pitch diameters of groove 168 and sheave 166 are preferably equal to $\frac{1}{2}$ the pitch diameter of those portions of guide rollers 42 and 44 around which feed cable 42 is trained thereby resulting in mid-centralizer assembly 163 moving at $\frac{1}{2}$ the speed of motor 20 and thus insuring the drill rod 32 is supported at the mid point of the portion of the axial length thereof which extends along guide frame 12 during all phases of the drilling operation. Any friction between sheave 166 and guide roller 44 will tend to assist groove 168 in driving the feed cable 170 while allowing creep to compensate for sheave diameter error which may arise because of wearing due to friction or manufacturing tolerances.

It is to be noted that although the description hereinabove indicates that mid-centralizer feed cable 170 is tensioned by a spring loaded assembly such as assembly 172, additional types of tensioning assemblies are contemplated, for example, a tensioning assembly patterned after assembly 140 can be substituted for assembly 172 to maintain cable 170 under constant tension.

Although preferred embodiments of various features of this invention have been described and illustrated herein, one skilled in the art can readily embody the principles of this invention in other forms to obtain the same operation and advantages without departing from the scope of the invention, for example: a groove having a pitch diameter equal to the pitch diameter of groove 166 can be substituted for sheave 166; a sheave having a pitch diameter equal to the diameter of sheave 166 can be substituted for groove 166 as long as at least either such substituted sheave or sheave 166 is rotatably keyed to the respective spindle therefor; as conditions dictate the centralizer assembly 163 may not be needed; saddle 26 can be of other suitable configurations; side channels 24 can be toed outwardly rather than inward assuming suitable changes are made to other components such as guide members 100; and the like.

The description herein does not limit the structure of this invention and the invention is defined by the scope of the claims set forth hereinafter.

What is claimed is:

1. A drilling apparatus comprising; an elongated drill guide frame, cable guide members mounted at longitudinally spaced points of said guide frame, a rigid member movably supported on said guide frame for relative longitudinal movement therealong, a flexible driving cable extending continuously from a first operative connection on said rigid member about

said cable guide members seriatim to a second operative connection on said rigid member for so moving said rigid member, control means cooperable with said driving cable for selectively moving said cable in opposite directions, and at least one of said operative connections including tensioning means.

2. A drilling apparatus as specified in claim 1 wherein said tensioning means is operatively connected to at least one end of said cable and has a portion thereof fixedly connected to said rigid member.

3. A drilling assembly as set forth in claim 1 wherein said tensioning means maintains said cable in tension throughout the operation of said drilling apparatus and said tension is approximately equal to the maximum load applicable by said control means.

4. A drilling apparatus as specified in claim 2 wherein said tensioning means comprises an elongated spring assembly.

5. A drilling apparatus as specified in claim 4 wherein said one end of said cable extends axially through said spring assembly and retaining means is fixedly secured to said one end of said cable to retain said cable within said spring assembly.

6. A drilling apparatus as specified in claim 5 wherein said retaining means is movable with respect to said rigid member and said drill guide frame.

7. A drilling apparatus as specified in claim 2 wherein said tensioning means comprises: a sealed piston chamber; and a piston assembly having at least a portion thereof slidingly and sealingly received within said chamber and with said one end of said cable being in operative communication with said piston assembly.

8. A drilling apparatus as specified in claim 2 wherein said driving cable has intermediate portions thereof which are reversibly trained about said longitudinally spaced guide members and with said guide members are rotatably mounted on said guide frame.

9. A drilling apparatus as specified in claim 8 additionally including; a second rigid member mounted for relative longitudinal movement on said guide frame; a second flexible driving cable selectively orbitably movable in opposite directions with respect to said guide frame, said second cable having laterally spaced runs which extend longitudinally with respect to said guide frame and with the respective ends of said second cable being in operative communication with said second rigid member for said last mentioned longitudinal movement; second control means cooperable with said second driving cable for selectively moving said second driving cable in said opposite directions; and tensioning means for maintaining said second cable in tension, including biasing means operatively connected to said second driving cable.

10. A drilling apparatus as specified in claim 9 wherein said second control means comprises a frictional drive portion which is integral with at least one of said guide members, said drive portion frictionally engaging said second driving cable such that the friction between the contact surfaces of said drive portion and said second cable moves said second cable in said opposite directions.

11. A drilling apparatus as specified in claim 10 wherein said frictional drive portion has a pitch diameter thereof less than the pitch diameter of said one of said guide members for driving said second driving cable at a velocity thereof less than the velocity of said first mentioned driving cable.

12. A drilling apparatus as specified in claim 11 wherein said pitch diameter of said frictional drive portion is $\frac{1}{2}$ of the pitch diameter of said one of said guide members.

13. A drilling apparatus as specified in claim 12 wherein said first mentioned rigid member comprises a drill saddle adapted to receive a drill motor assembly thereon and said second rigid member comprises a drill rod centralizer and mid-point support assembly mounted on said guide frame intermediate one end thereof and said first mentioned rigid member.

14. A drilling apparatus as specified in claim 2 wherein said rigid member comprises a drill saddle adapted to receive a drill motor assembly thereon.