

Oct. 9, 1923.

M. P. HOLMES

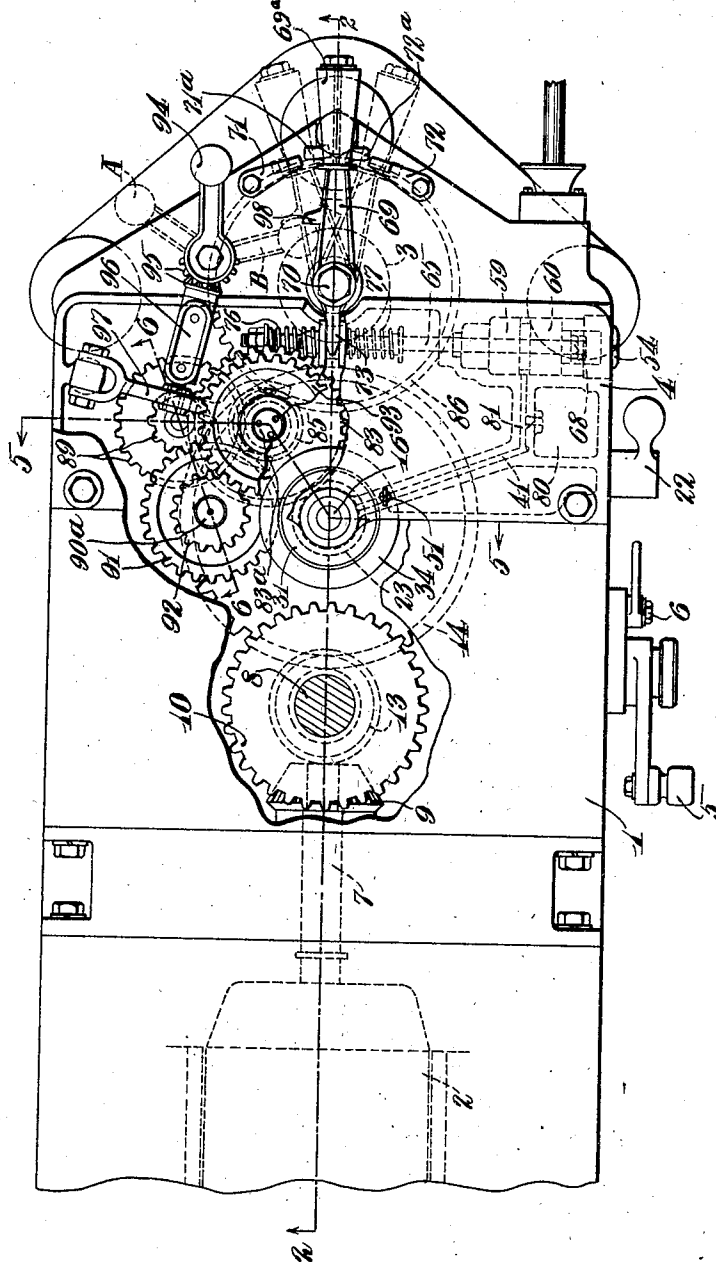
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MINING MACHINE

Filed July 16, 1919

5 Sheets-Sheet 1

Fig. 1.



Inventor.
Morris P. Holmes.

By

Atty.

Oct. 9, 1923.

M. P. HOLMES

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5 Sheets-Sheet 2

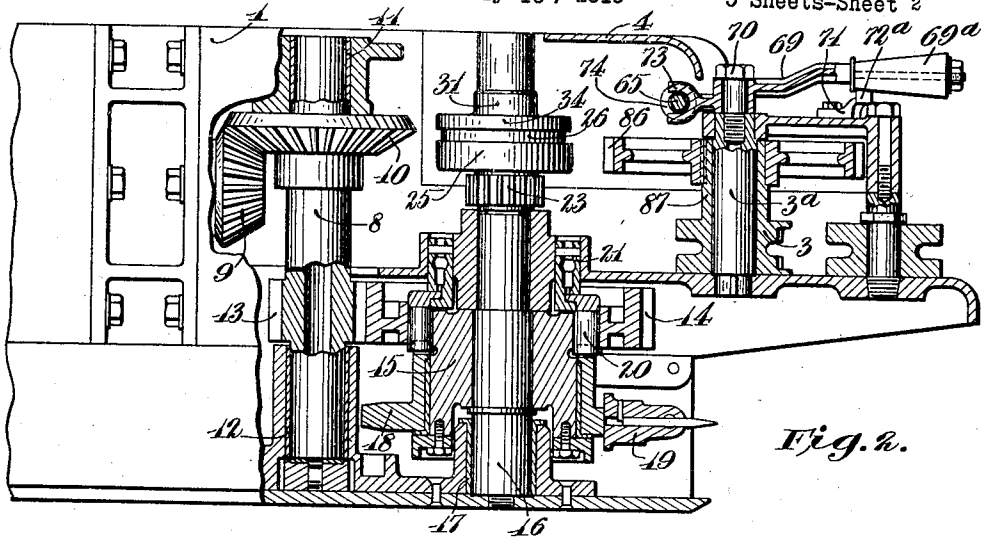


Fig. 2.

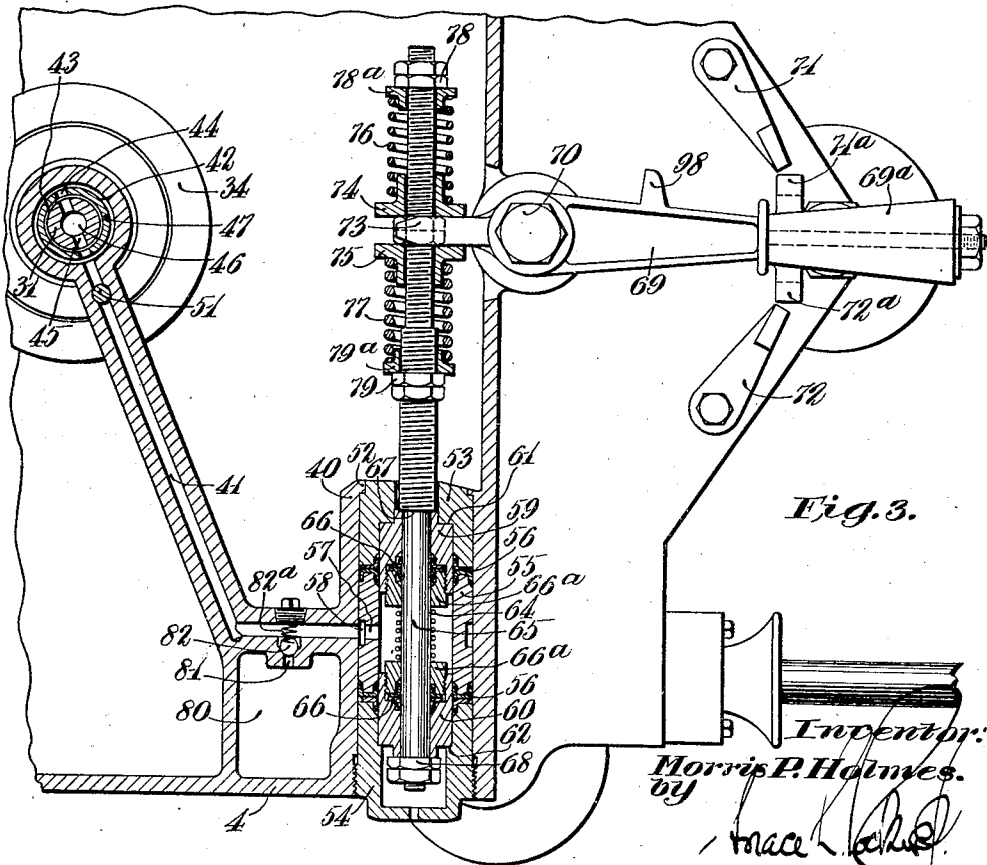


Fig. 3.

Inventor:
Morris P. Holmes.

by
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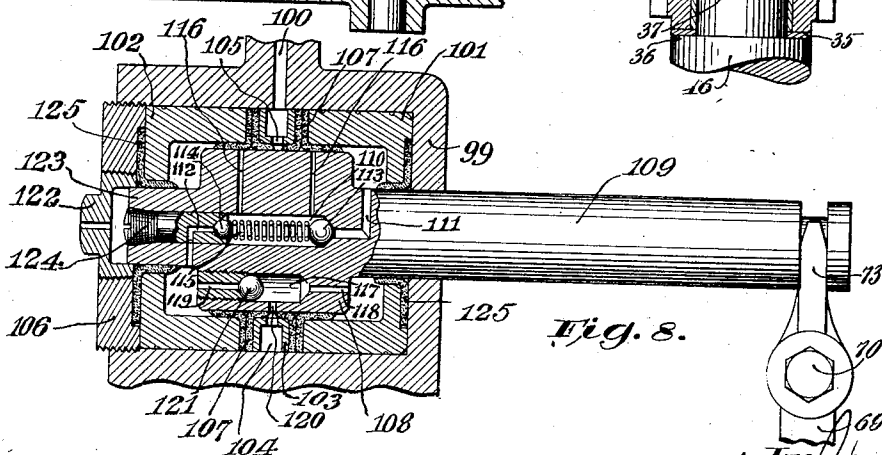
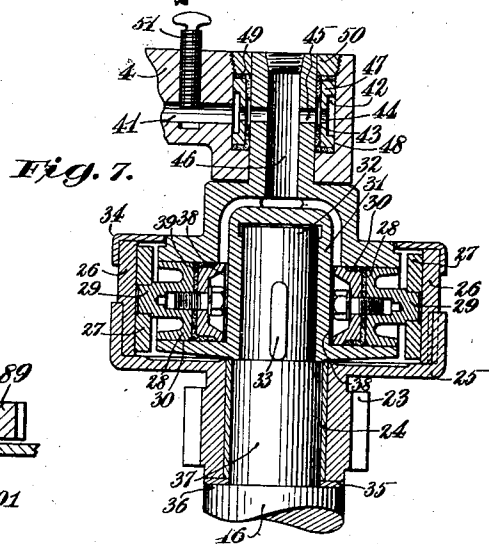
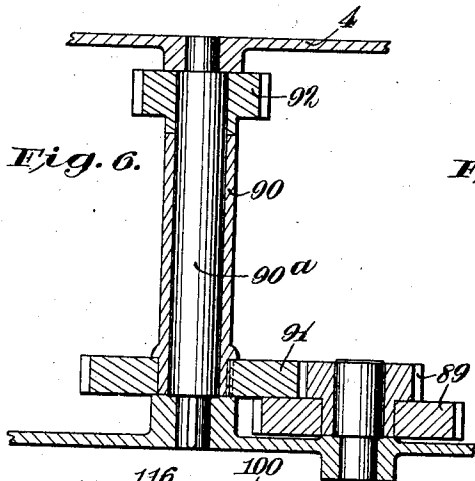
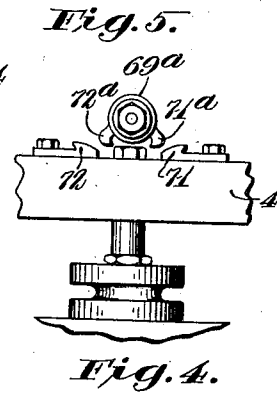
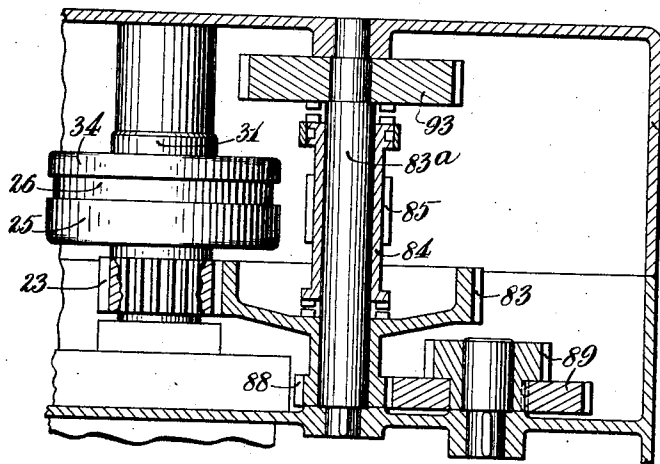
M. P. HOLMES

1,470,573

MINING MACHINE

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5 Sheets-Sheet 3



Inventor
by Morris P. Holmes.
Wm. L. Chap.
Atty.

Oct. 9, 1923.

M. P. HOLMES

1,470,573

MINING MACHINE

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5 Sheets-Sheet 4

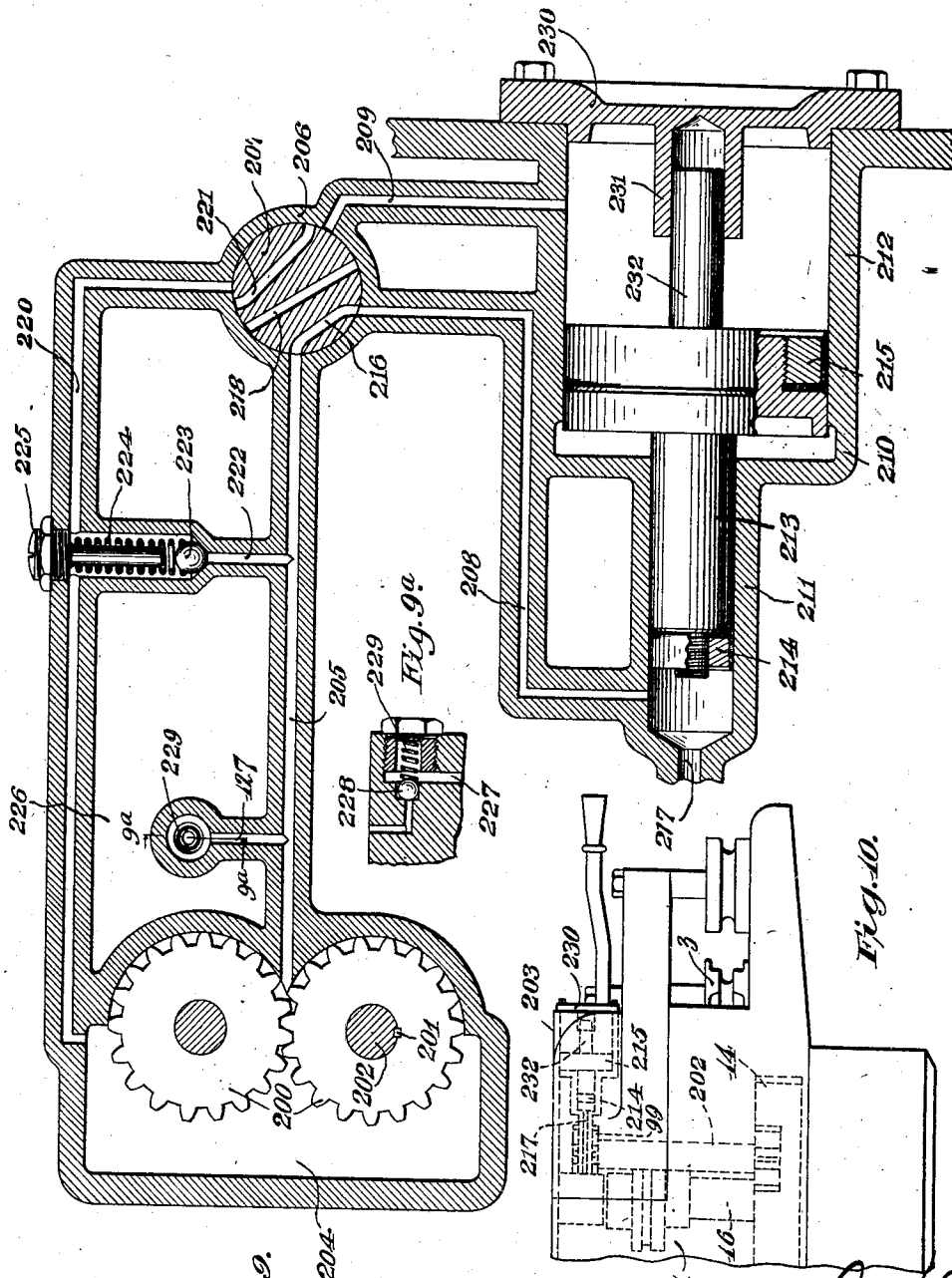


Fig. 9.

Fig. 10.

Inventor:
Morris P. Holmes.

by

M. P. Holmes

Atty.

Oct. 9, 1923.

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M. P. HOLMES

MINING MACHINE

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5 Sheets-Sheet 5

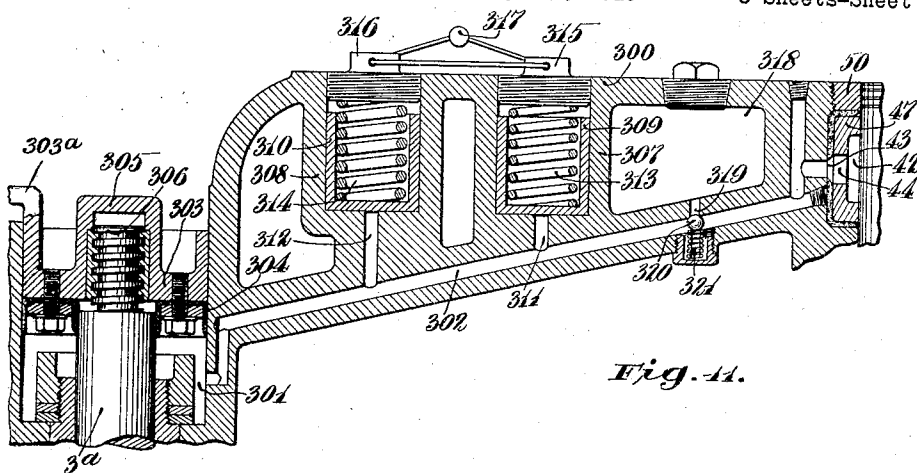


Fig. 11.

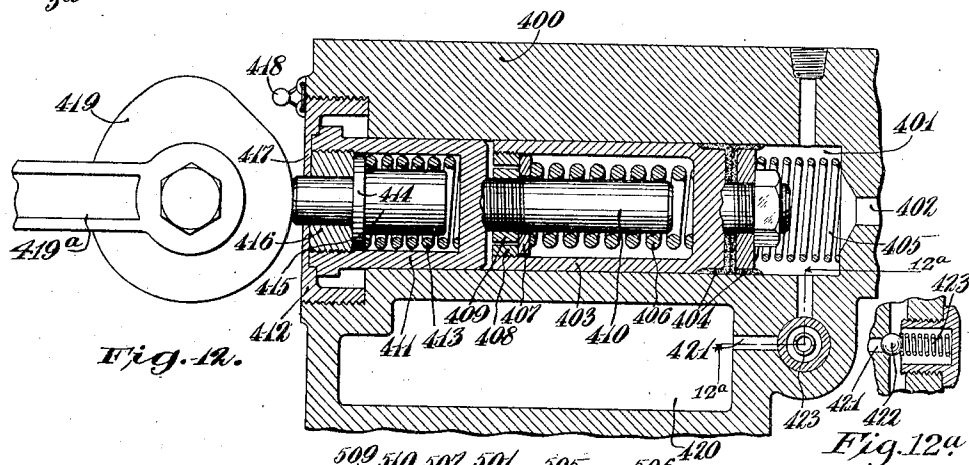


Fig. 12.

Fig. 12a.

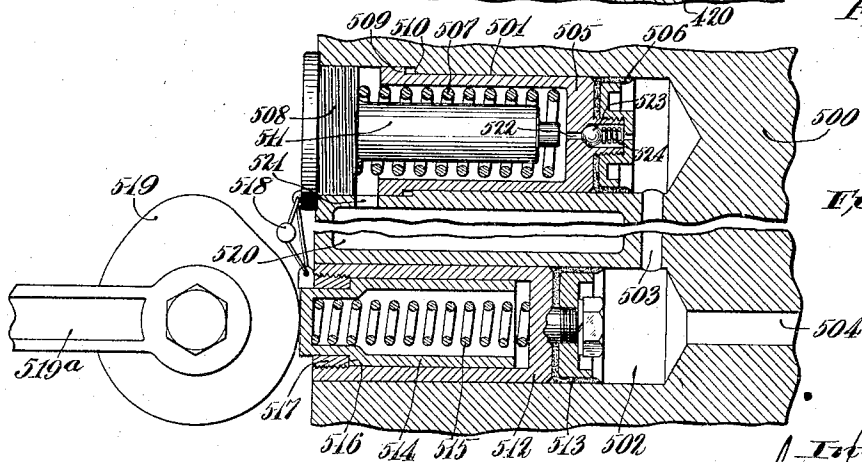


Fig. 13.

Inventor:
Morris P. Holmes
by
[Signature]
Att'y.

UNITED STATES PATENT OFFICE.

MORRIS P. HOLMES, OF CLAREMONT, NEW HAMPSHIRE, ASSIGNOR TO SULLIVAN MACHINERY COMPANY, A CORPORATION OF MASSACHUSETTS.

MINING MACHINE.

Application filed July 16, 1919. Serial No. 311,321.

To all whom it may concern:

Be it known that I, MORRIS P. HOLMES, a citizen of the United States, residing at Claremont, in the county of Sullivan and State of New Hampshire, have invented certain new and useful Improvements in Mining Machines, of which the following is a full, clear, and exact specification.

This invention relates to mining machines and more especially to that type of mining machine used for cutting kerfs in the material to be mined.

In mining machines heretofore used the feeding or driving means and the controlling means therefor have been rather complex and have absorbed energy in mechanical connections which render the operation and control of the mining machine somewhat difficult, and the constructions have been such as to render accessibility of the mining machine for inspection and repair somewhat difficult. Further, the construction and operation of these machines have been such that, when the controlling devices were operated to increase the pull on the cable or chain which advances the machine along the face of the material to be mined, increased wear resulted in bearings which were very difficult to get at, causing these bearings to wear rapidly.

In mining machines of the character referred to it is customary to provide, in the feeding mechanism, a yielding element, or "friction," adapted to yield when excessive resistance is encountered in order to prevent breakage of or other injury to the machine. Means are also usually provided for loading the "friction," or varying the resistance to yielding interposed thereby, it being desirable to permit a greater resistance under some conditions of use than under others. In practice, however, machine runners will frequently, either by accident or design, overload the friction, or load the same under improper conditions, particularly in order to avoid the trouble of properly sharpening the cutter bits, thereby causing serious damage to the machine.

The present invention has for its general object to overcome the defects above referred to and to provide improved and simplified means for controlling the feeding mechanism of mining machines adapted to permit convenient and accurate regulation of the "friction" and prevent accidental or in-

tentional overloading thereof under improper conditions, said controlling means being of such a character that the parts thereof may be easily removed for inspection or repair. These and other objects and advantages will however hereinafter more fully appear.

In the accompanying drawings are shown for illustrative purposes several embodiments which the invention may assume in practice.

In said drawings:

Fig. 1 is a plan view of a part of a mining machine embodying one form of the invention.

Fig. 2 is a longitudinal vertical sectional view substantially on the line 2—2 of Fig. 1.

Fig. 3 is a sectional plan view of a part of the machine cover and controlling means.

Fig. 4 is a detail rear elevation of a part of the controlling means.

Fig. 5 is a transverse vertical sectional view taken substantially on the line 5—5 of Fig. 1.

Fig. 6 is another vertical sectional view taken substantially on the line 6—6 of Fig. 1.

Fig. 7 is a detail vertical sectional view through the friction clutch of the feeding mechanism.

Fig. 8 is a detail horizontal section of a modified form of controlling means.

Fig. 9 is a similar view of still another modified form of controlling means.

Fig. 9^a is a detail sectional view on line 9^a—9^a of Fig. 9.

Fig. 10 is a side elevation of one end of a mining machine provided with the controlling means illustrated in Fig. 9.

Fig. 11 is a longitudinal vertical sectional view through the machine cover showing a further modified form of controlling means.

Figs. 12 and 13 are horizontal sectional views illustrating still further modifications.

Fig. 12^a is a detail sectional view on line 12^a—12^a of Fig. 12.

In Fig. 1 is shown a mining machine having a frame 1 and provided with actuating means, as an electric motor 2, which is adapted to drive, through a suitable train of driving gears or other means, the feeding member, herein shown as a feed sprocket 3 rotatably mounted on an upright shaft 3^a (Fig. 2). The mining machine is also provided, near the rear end thereof, with a cover plate 4 which supports, in a

manner to be hereinafter described, a part of the controlling mechanism of the machine. The motor 2 may be controlled to rotate in either direction through the operation of a suitable controller 5 and a reverse switch 6, herein shown as mounted on one side of the mining machine.

The motor 2 (Fig. 1) drives a shaft 7 which in turn drives a jack shaft 8 (Fig. 2) through suitable driving means, as a bevel gear 9 carried on one end of the shaft 7 and a bevel gear 10 mounted on the jack shaft 8. This jack shaft turns in suitable bearings 11 and 12 and carries a driving pinion 13 which drives a relatively large spur gear 14 whose hub 15 is attached to an upright shaft 16 herein shown as supported in a bearing 17 carried by the bottom plate of the mining machine frame. Rotatably mounted on the hub 15 is a driving sprocket wheel 18 adapted to drive a cutter chain 19, the connection between the driving sprocket 18 and the spur gear 14 comprising a clutch mechanism 20 controlled through well known connections (not shown) by a shipper ring 21 and a controlling handle 22 in such a manner that when the handle 22 is depressed the gear 14 and the sprocket 18 are disconnected, and when the handle 22 is elevated the gear 14 is positively connected to the sprocket wheel to drive the cutter chain 19 to cut a kerf in the coal or other material to be mined.

The feed sprocket 3, which drives the usual cable or chain for advancing the machine along the mine face, is preferably driven from the vertical shaft 16 through gearing hereinafter further described and including a pinion 23 rotatably mounted on a bushing 24 carried by a reduced portion 37 of said shaft. The pinion 23 carries on its upper end an enlarged hollow casing 25 which in turn carries and is attached to an annular frictional clutch member 26. Co-operating with this frictional clutch member 26 is a second annular frictional clutch member or friction band 27 which is preferably carried by and rotatable with the shaft 16 through a plurality of radially reciprocable plungers or pistons 28 which are connected to and preferably support the friction band 27 by radially projecting pins 29, the pistons 28 in turn being supported in radial cylinders 30 carried by a hub 31 secured to a reduced portion 32 of the shaft 16, as by splines 33. An annular cover or ring 34 is preferably provided to close the joint between the normally rotating hub 31 and the friction band 26 to prevent dirt or other foreign particles from working into the clutch mechanism.

When the motor 2 is rotating, the shaft 16 will be rotated thereby, but the pistons 28 are normally in retracted position, so

that the clutch members 26 and 27 will not frictionally engage to drive the pinion 23 with the shaft 16, and this pinion will normally remain stationary, the shaft 16 turning within the bushing 24, and the pinion 23 resting on and being supported by a bushing 35 herein shown as supported by a shoulder 36 adjacent the reduced portion 37 of the shaft 16. When it is desired to rotate the pinion 23 to actuate the feed sprocket 3 to move the mining machine, the annular friction band 27 is expanded and forced outwardly into a predetermined frictional engagement with the friction band 26 by the pistons 28, which may be moved radially outward from the shaft 16 by the application of fluid pressure to the rear surfaces 38 of these pistons. For this purpose, I have preferably used a hydraulic mechanism for applying the pressure to these pistons, suitable packing means as, cup leathers 39, being provided on the pistons 28 to prevent leakage of the oil or other liquid employed.

In the form of the invention illustrated in Figs. 1 and 3, the oil or other liquid used in the hydraulic controlling means is caused to transmit a pressure, generated in a cylindrical casing 40 formed in the cover plate 4, through a passage or conduit 41, annular recesses 42, 43 (Fig. 7), and radial ports 44, 45, to a passage 46 formed in the hub 31 and having branches leading to the rear heads 38 of the pistons 28.

The annular recess 42 and ports 44 are formed in an annular channel iron 47 which surrounds the upper end of the hub 31 and is preferably held in a cylindrical chamber 48 in the cover plate 4 between packing leathers 49 by a screw cap or plug 50. By this improved construction the cover 4, which carries the cylindrical casing 40, passage 41 and channel iron 47, is removably connected to the hub 31 in such a manner as to provide a bearing for said hub and consequently an upper bearing for the shaft 16. When it is desired to remove the cover 4, and with it the parts formed therewith or carried thereby, the passage 41 is preferably closed, as by means of a valve 51 which prevents leakage from the hydraulic system.

The pressure may be applied to the oil or other liquid in the passage 41, and there-through to the pistons 28, in a variety of ways, means being preferably provided for applying a graduated pressure up to either of two predetermined limits, so that when the mining machine is operated for one purpose one predetermined limiting frictional engagement of the members 26 and 27 may be maintained, and when the mining machine is operated for another purpose or in another way another frictional engagement between the members 26 and 27 may be main-

tained. As shown in Fig. 3, the devices for accomplishing these results are as follows: Located within one end of the cylindrical casing 40, and seated against a stop shoulder 52 therein, is a cylinder head 53 having a sleeve portion which extends part way through the bore of the casing 40, while threaded into the opposite end of said casing is a similar cylinder head 54 between which and the head 53 is interposed a spacing member 55; suitable packing means, as cup leathers 56, being provided between the spacing member 55 and the cylinder heads 53 and 54 to prevent leakage of oil therebetween. The central spacing member 55 is preferably provided with a series of radial openings 57 which communicate with an annular groove 58 also formed in the member 55 and communicating with the passage 41. The spacing member 55 and heads 53 and 54 with their oppositely disposed sleeve portions collectively constitute a cylinder lining within which is a pair of oppositely disposed pistons 59 and 60, said pistons being normally held in spaced relation against shoulders 61 and 62 formed on the heads 53 and 54 respectively by a light spring 64 interposed between said pistons. Each of the pistons 59 and 60 is preferably axially apertured to receive a piston rod 65 and is also provided with a plurality of cup leathers 66 to prevent leakage of oil through the axial passage about the piston rod, said cup leathers being held in place by plugs 66^a seated in threaded recesses formed in the inner faces of the pistons. The pistons 59 and 60 are independently movable upon reciprocation of the piston rod 65, the piston 59 being moved toward the center of the cylinder by a shoulder 67 formed on the piston rod, and the piston 60 being moved toward the center of the cylinder by suitable nuts 68 threaded onto the end of the piston rod, it being apparent that when one piston is being moved with the piston rod the other piston is held stationary against the cooperating shoulder formed on one of the cylinder heads by the spring 64. To reciprocate the piston rod 65 to actuate either of the piston heads there is preferably provided a controlling lever 69 suitably pivoted, as to the upper end of the shaft 3^a (Fig. 2), by a bolt 70, said lever being retained in either adjusted position by means of catches 71, 72 which are engaged by hooked lugs 71^a, 72^a (Fig. 4) on a swiveled handle 69^a carried by said lever. This pivoted lever 69 carries on the inner end thereof a shipper yoke 73 which partially encircles the piston rod 65 and is normally in engagement with two collars 74 and 75 which are held against the opposite sides of said shipper yoke by springs 76 and 77, preferably of different strength, the tension of these springs being regulated by suitable nuts 78 and 79 in threaded engagement with

the piston rod and between which and said springs are interposed collars 78^a and 79^a.

As will now be seen, pressure applied in either direction to the lever 69 will be transmitted, through the collar 74 or 75, spring 76 or 77, collar 78^a or 79^a, and nut 78 or 79, to the piston rod 65. Consequently, by moving the lever 69 in one direction or the other, one of the pistons 59 or 60 will be moved toward the center of the cylinder, and pressure will be applied to the liquid in the system, and through said liquid to the rear heads of the pistons 28, to force the annular normally rotating friction element 27 into frictional engagement with the normally non-rotating frictional element 26 and thereby drive the pinion 23.

Each of the springs 76 and 77 is held under an initial compression determined by the adjustment of the nuts 78 and 79, it being possible to place them under different initial compressions by reason of the abutment of the collars 74, 75 upon nuts 73' located between the nuts 78, 79, so that when the lever 69 is moved in either direction said springs will act as rigid elements to transmit the pressure of said lever to the piston rod 65 until said pressure becomes sufficiently great to exceed the initial tension of the springs, after which said springs will yield and prevent any considerable additional pressure from being transmitted from said lever to said piston rod. The spring 77 is preferably heavier than the spring 76, so that a greater pressure may be applied to the piston 59 than to the piston 60. Consequently, when the lever 69 is moved in a counter-clockwise direction, the frictional members 26 and 27 will be forced together with a greater pressure than when said lever 69 is moved in a clockwise direction.

The cylinder 40 and the conduit 41 connected therewith are preferably formed integral with the cover 4, while the other parts of the pressure generating mechanism are also carried by said cover, so that it is only necessary to take this comparatively small cover to the shop in order to repair any part of the apparatus. Further, the cylinder lining, herein shown as composed of the cylinder heads 53 and 54 and the spacing member 55 therebetween, is preferably formed separately from the cylindrical casing 40 in order that these parts may be easily and correctly machined. The construction also prevents unauthorized readjustment of the pressure limiting means (that is, the nuts 78 and 79) by the operator, so that he can not apply an excessive pressure when hard work is to be done and then, after he has broken parts of the machine through this excessive pressure, return the parts to the previous position so that an inspector cannot determine why these parts have given way. This is a common practice

among mining machine runners but one which is impracticable with the present construction, because of the labor, difficulty, and time required in removing the heavy cover in order to get access to nuts 78 and 79.

In order to compensate for any slight leakage from the pressure generating apparatus, there is provided, preferably adjacent the cylinder casing 40, and carried by the cover 4, an oil reservoir 80 having a port 81 opening into the passageway 41, this port being preferably normally closed by a check valve 82 having a light closing spring 82^a. After the lever 69 has been released and assumes the neutral position illustrated in Fig. 3, oil will automatically flow from the reservoir 80 through the port 81 into the passageway 41 to offset any leakage in the system. But when the lever 69 is thrown in either direction to generate pressure in the hydraulic controlling means, oil will be kept from returning to the reservoir 80 by the check valve 82.

The driving pinion 23, whose rotation by the shaft 16 is controlled by the operation of the controlling lever 69, in turn drives the feed sprocket 3 in either direction through suitable driving connections. As herein shown the pinion 23 meshes with a gear 83 (Figs. 1 and 5) rotatably mounted on an upright shaft 83^a fixed in the machine casing and having slidably mounted thereon a reciprocating double ended clutch sleeve 84 carrying a pinion 85 and movable in opposite directions from the neutral position shown in Fig. 5 to engage the same with either the gear 83 or a gear 93 also rotatably mounted on the shaft 83^a. The pinion 85 meshes with a spur gear 86 (Fig. 2) mounted on the hub 87 of the feed sprocket 3. Engagement of the sleeve 84 with the gear 83 causes the pinion 85 to be directly driven by said gear 83, thereby rotating the feed sprocket 3 in one direction. If it is desired to rotate said feed sprocket in the opposite direction, the clutch sleeve 84 may be shifted in the opposite direction into engagement with the gear 93, the gear 83 then driving the pinion 85 through a train of gearing comprising a pinion 88 formed on the hub of the gear 83 and a pair of connected coaxial gears 89, one of which meshes with the pinion 88 and the other of which meshes with a gear 91 (Fig. 6) secured to a sleeve 90 rotatably mounted on an upright shaft 90^a and carrying a gear 92 which meshes with the gear 93. It will be seen that by moving the clutch sleeve 84 into one extreme position the feed sprocket 3 will be driven relatively slowly in one direction, and that when said clutch sleeve is shifted to the limit of its movement in the opposite direction said feed sprocket will be rotated more rapidly in the opposite direction. When the sleeve 84 is in the neutral position illustrated in Fig. 5

the feed sprocket is not driven, and the mining machine is not moved thereby.

The clutch sleeve 84 is shifted by means of a shipper lever 97 (Fig. 1) which is operated by an eccentric pin on a shaft 96 connected by bevel gears 95 with a pivoted operating handle 94. The handle 94 is shown in full lines in Fig. 1 in the neutral position from which it may be moved into the dotted line position A to produce the fast feed or into the dotted line position B to produce the slow feed. When moving a mining machine along the mine face during the kerf cutting operation, the slow feed is employed, and it is desirable at this time that an excessive force shall not be used for advancing the machine in order that the cutter bits may not be crowded against the work when the cutting is difficult or the bits are dull. As above explained, the lever 69 is moved in a clockwise direction in order to produce a relatively light frictional engagement between the clutch members 26 and 27, and in a counter-clockwise direction to produce a relatively heavy frictional engagement of said parts. In order to prevent the latter movement of the lever 69 when the handle 94 is in the slow feed position B, the lever 69 is provided with a projection 98 adapted to engage the handle 94 when the latter is in the position B, thereby preventing counter-clockwise movement of the lever 69 while permitting clockwise movement thereof.

In Fig. 8 is illustrated a modification of the pressure generating mechanism shown in Fig. 3. As shown in Fig. 8, the pressure cylinder 99, having a passage 100 leading to the friction devices and corresponding to the passage 41, is provided with a lining comprising head members 101 and 102 and a spacing member 103 having an annular groove 104 communicating with the passage 100 and having radial ports 105 communicating with the interior of the cylinder. The several members of the lining are held in assembled position in the cylinder 99 by a screw plug 106, and have between them suitably disposed cup leathers 107. Mounted to reciprocate within the cylinder lining, is a piston 108 having a piston rod 109 provided with a groove to receive the forked end 73 of the controlling lever 69. The piston 108 is provided with an axially disposed chamber 110 communicating through passages 111 and 112 with the cylinder at opposite sides of the piston, the inner ends of said passages being controlled by valves 113 and 114 between which is interposed a spring 115. The valve 114 and passage 112 are preferably smaller than the valve 113 and passage 111, so that the area of that portion of the valve 114 which is subjected to the pressure in the passage 112 is smaller than the area of that portion of the valve

113 which is subjected to the pressure in the passage 111. The chamber 110 also communicates with the lateral face of the piston 108 through radial ports or passages 116.

5 The piston 108 is further provided with a chamber 117 connected by longitudinal passages 118 and 119 with the opposite ends of the piston and with a radial port 120 affording communication between said chamber
10 and the ports 105. Within the chamber 117 is a preferably spherical valve 121 adapted to seat itself at the inner end of either of the passages 118 or 119.

With the parts in the position shown, if
15 the lever 69 be moved in a clockwise direction, pressure will be generated in the right end of the cylinder 99, which pressure will be transmitted through the passage 118, chamber 117, ports 120 and 105, groove 104,
20 and passage 100 to the friction mechanism. The valve 121, being at this time seated at the inner end of the passage 119, will prevent flow of liquid from the right to the left end of the cylinder. The pressure above referred to will also be transmitted through
25 the passage 111 to the valve 113, and when said pressure becomes sufficient to overcome the tension of the spring 115, said valve 113 will be unseated and liquid from the right
30 end of the cylinder will pass through the chamber 110 and left passage 116 to the left end of said cylinder, the cup leathers 107 being so disposed as to permit the liquid to flow in this manner.

35 If the lever 69 be moved in a counter-clockwise direction, the pressure of the fluid in the left end of the cylinder will cause the valve 121 to be unseated from the inner end of the passage 119 and to seat itself at the
40 inner end of the passage 118. Thereafter, pressure will be built up in the left end of the cylinder and will be transmitted through the passage 119, chamber 117, ports 120 and 125, and passages 104 and 100 to the friction mechanism. This pressure will also act
45 through the passage 112 upon the valve 114, and, when sufficient to overcome the tension of the spring 110, will unseat said valve, thereby limiting the amount of pressure
50 which may be generated in the left end of the cylinder.

Inasmuch as the valves 113 and 114 are held to their seats with the same initial spring pressure but have different areas exposed to the pressures in the passages 111
55 and 112, respectively, it will be seen that a greater pressure in the left end of the cylinder is required to unseat the valve 114 than is required in the right end of the cylinder to unseat the valve 113. Consequently,
60 it will be seen that by moving the lever 69 in a counter-clockwise direction the friction devices may be loaded with a greater pressure than by moving said lever in a clockwise direction.
65

For convenience, the plug 106 is preferably formed with a central opening which is closed by a second plug 122 having a recess in which an extended stem 123 on the piston 108 is guided. The chamber 110 is extended
70 to the end of the stem 123, the outer end thereof being closed by a plug 124 in which the seat for the valve 114 and a portion of the passage 112 are formed. With this construction, by removing the plugs 122 and
75 124, access may be had to the valves 113 and 114 without disassembling the entire pressure mechanism.

In order to avoid leakage about the piston rod 109 and stem 123, cup leathers 125 are
80 preferably clamped between the cylinder head member 101 and the end of the cylinder 99, and between the plug 106 and the cylinder head member 102, respectively.

In the modified form of the invention
85 shown in Figs. 9 and 10, pressure in the hydraulic clutch operating mechanism is preferably generated by a pump, herein shown as composed of a pair of gears 200, one of which is preferably detachably secured, as
90 by a keyway 201, to a vertical shaft 202 which is constantly driven by the gear 14. The pump is preferably located in the cover 203 of the mining machine frame, and forces oil or other liquid from a small reservoir
95 204 through a passage 205 to a valve casing 206 containing a rotary controlling valve 207. From the valve casing 206, passages 208 and 209 lead to opposite ends of a cylinder 210 comprising coaxial small and large
100 cylinder portions 211 and 212, respectively, and containing a differential piston 213 having small and large piston heads 214 and 215, fitting said small and large cylinder portions, respectively. When the valve 207
105 is turned to the position shown in Fig. 9, a passage 216 therein connects the passages 205 and 208, and the pressure generated by the pump is exerted on the oil in the outer end of the small cylinder portion 211 from
110 which a passage 217 leads to the clutch mechanism. The pressure is transmitted as just described when it is desired to feed the mining machine slowly. When it is desired to feed the machine more rapidly and to use
115 a greater frictional engagement between the clutch members, the controlling valve 207 is turned to move the passage 216 out of communication with the passages 205 and 208 and cause a second passage 218 in said valve
120 to connect the passage 205 with a passage 209 leading to the large cylinder portion 212, so that the pressure from the pump is exerted upon the large piston head 215. As will be obvious, the pressure on this large piston
125 head creates a much higher pressure per square inch on the smaller piston head 214, and since the liquid acted on by said smaller piston head cannot escape through the valve 207, a higher pressure is generated in the
130

friction mechanism. If it is desired to relieve the pressure on the small piston head, the valve 207 may be turned to cause the passage 218 in said valve to connect the passage 208 with a return passage 220 leading to the reservoir 204. Or if it is desired to relieve the pressure on the large piston head 215, the valve 207 may be turned to cause a third passage 221 therein to connect the passages 209 and 220.

Since the pump is constantly operated, and since there is no fluid flow through the friction mechanism and back to the reservoir 204, a pressure governed bypass 222 is provided between the supply passage 205 and the return passage 220, a pressure governed valve 223, herein shown as of the spring pressed check valve type, being provided in this bypass to govern the pressure impressed by the pump on the liquid. The valve 223 is held seated by a spring 224 whose pressure, or load upon the valve, is adjustable by means of a screw plug 225.

Means are also provided for automatically replenishing the supply of liquid in the passages above described should any loss occur through accidental leakage, said means preferably comprising a reservoir 226 formed in the cover 203 and communicating with the passage 205 through a passage 227, back flow from the passage 205 to the reservoir being prevented by a small spring pressed check valve 228. This check valve is, however, held in position by a very light spring 229, so that when the pump is not operating oil will flow past the check valve into the passage 205 to replace the oil which may have been lost through leakage.

The construction above described provides for an easy control of the flow of fluid from the pump to generate either of two pressures in the friction mechanism, these pressures being readily governed by adjustment of the valve 207 controlling the communication between the several passages. It will be seen that no other adjustment of the mechanism is necessary, as the supply of oil or other liquid in the pressure system is automatically maintained constant by the provision of the reservoir 226 and check valve 228. The cylinder 210 is preferably provided with a removable outer head 230 having a guide 231 for a stem 232 on the differential piston 213, the removal of said head permitting inspection of the cylinder, withdrawal of the piston, and renewal of the packings without removing the entire cover or otherwise disassembling the machine.

A somewhat simplified form of the invention is illustrated in Fig. 11, wherein the cover 300 is formed with a pressure cylinder 301 communicating with the friction mechanism through a passage 302 in said cover. Within the cylinder 301 is a piston 303 hav-

ing the usual packing leathers 304 and adapted to be forced downwardly in said cylinder to generate pressure therein and, through the passage 302, in the friction mechanism by means of a controlling lever 303^a, herein shown as formed integral with the piston 303 and having a hub 305 cooperating with an upright threaded stud 306, preferably formed integral with the shaft 3^a at the upper end thereof. As will be seen, angular movement of the lever 303^a will cause a corresponding longitudinal movement of the piston 303 in the cylinder 301.

For limiting the pressures which may be transmitted from the cylinder 301 through the passage 302 to the friction mechanism, there is provided a pair of relief devices comprising cylinders 307 and 308, preferably formed integral with the cover 300 and containing hollow plungers 309 and 310, respectively, said cylinders communicating at their inner ends with the passage 302 through passages 311 and 312. The plungers 309 and 310 are normally forced inwardly by means of springs 313 and 314 within said plungers and engaging at their outer ends screw plugs 315 and 316 in threaded engagement with the outer ends of the cylinders 307 and 308, whereby said springs may be placed under an initial tension, said plugs being secured in adjusted position by means of a suitable seal 317.

One of the springs, for example, the spring 314, is heavier or stronger than the other of said springs. When, therefore, the lever 303^a is operated to depress the piston 303, the pressure generated in the cylinder 301 will be transmitted to the friction mechanism until said pressure equals or exceeds the initial tension of the spring 313, whereupon said spring will yield, permitting upward movement of the plunger 309. Further depression of the piston 303 will, therefore, not result in any considerable increase in the pressure applied to the friction mechanism until the plunger 309 engages the plug 315 and is arrested thereby. Thereafter, further downward movement of the piston 303 will cause an increased pressure to be transmitted to the friction mechanism until said pressure equals or exceeds the initial tension of the spring 314, whereupon said spring will yield, permitting an upward movement of the plunger 310 and preventing the transmission of further pressure to the friction mechanism. The proportion of the parts is preferably such that the piston 303 cannot be moved a sufficient distance to cause the plunger 310 to engage the plug 316, so that the maximum pressure which may be transmitted in the friction mechanism is limited by the adjustment of the plug 316 and consequent initial tension of the spring 314.

As in the constructions previously described, the volume of liquid in the pressure system is maintained against leakage loss by a reservoir 318 communicating with the passage 302 through a port 319 controlled by a check valve 320 normally held seated by a light spring 321.

Another modification of the invention is shown in Fig. 12, wherein the cover 400 is formed with a cylinder 401, the inner end of which communicates through a passage 402 with the friction mechanism. Working in the cylinder 401 is a hollow piston 403 having the usual packing leathers 404 and normally held in the outermost position shown by means of a light spring 405. Within the piston 403 is a spring 406 engaging at its outer end a washer 407, which is normally seated against a bushing 408 in threaded engagement with the interior of the piston at the outer end thereof, whereby, by adjusting said bushing, the spring 406 may be held under initial tension between the washer 407 and the inner end of the piston. The washer 407 also engages a nut 409 on a threaded stem 410 projecting inwardly from a hollow plunger 411 guided for movement in the outer end of the cylinder 401 and retained therein by a cap or bushing 412. Within the plunger 411 is a spring 413 bearing at its outer end against a flange or collar 414 on a second plunger 415 retained in the plunger 411 by means of a bushing 416 in threaded engagement with the outer end of the plunger 411, whereby, by adjusting said bushing, the spring 413 may be held under a predetermined initial tension between the collar 414 and the inner end of the plunger 411. The cap or bushing 412 is preferably formed with an turned lip or flange 417 overlying the bushing 416, so that by applying a suitable seal 418 to said bushing 412 unauthorized adjustment of the bushing 416 is prevented.

The outer end of the plunger 415 engages the periphery of a cam 419 carried by a pivoted controlling lever 419^a, whereby angular movement of said lever will cause longitudinal movement of the plunger 415.

The spring 406 is preferably stronger or under a greater initial compression than the spring 413. When, therefore, the lever 419^a is operated, the initial compression of the springs 406 and 413 will cause the plungers 415 and 411 and the piston 403 to move inwardly as a unit, thereby generating in the inner end of said cylinder a pressure which will be transmitted through the passage 402 to the friction mechanism. When this pressure equals or exceeds the initial compression of the spring 413, said spring will yield, permitting further inward movement of the plunger 415 without corresponding inward movement of the

plunger 411 and piston 403, and consequently without transmitting any very substantial additional pressure to the friction mechanism. When, however, the inner end of the plunger 415 engages the inner end of the plunger 411, the parts will again move forward as a unit with a resultant increased pressure upon the friction mechanism. When this increased pressure exceeds the initial tension of the spring 406, however, the latter spring will yield, permitting inward movement of the plungers 415 and 411 without corresponding movement of the piston 403, and consequently without very greatly increased additional pressure upon the friction mechanism.

Oil or other liquid is supplied to the cylinder 401 from a reservoir 420 communicating with said cylinder through a passage 421 controlled by a check valve 422 normally seated by a light spring 423.

A further modification of the invention is shown in Fig. 13, wherein the cover 500 is formed with two cylinders 501 and 502, the cylinder 502 communicating with the cylinder 501 through a passage 503 and with the friction mechanism through a passage 504. Within the cylinder 501 is a hollow plunger 505 having suitable packing 506 and normally forced inwardly by a spring 507 engaging at its inner end the inner end of said plunger and at its outer end a plug 508 in threaded engagement with the outer end of the cylinder 501, whereby, by adjustment of said plug, the spring 507 may be placed under a predetermined initial tension, inward movement of the plunger 505 being limited by engagement of an exterior shoulder 509 thereon with a corresponding interior shoulder 510 in the cylinder, and outward movement of said plunger being limited by a stem 511 extending inwardly from the plug 508 within the plunger 505 and adapted to engage the inner end thereof.

Within the cylinder 502 is a piston having the usual packing 513. Guided for longitudinal movement in the piston 512 is a sleeve 514 having an open inner end and a closed outer end between which and the closed inner end of the piston is interposed a spring 515. The sleeve 514 is formed adjacent its outer end with an exterior shoulder 516 which is engaged by a bushing 517 in threaded engagement with the outer end of the piston 512, whereby, by adjusting said bushing, the spring 515 may be held under a predetermined initial tension between the inner end of the piston and the outer end of the sleeve.

The plug 508 and bushing 517 may be held against unauthorized adjustment to vary the initial tensions of the springs 507 and 515 by means of a suitable seal 518 connecting said plug and bushing. The initial

tension of the spring 515 is preferably greater than that of the spring 507.

The closed outer end of the sleeve 514 engages the edge of a cam 519 carried by a pivoted controlling lever 519*, whereby angular movement of said lever will cause longitudinal movement of said sleeve. By reason of the initial tension of the spring 515, inward movement of said sleeve will be accomplished by a corresponding inward movement of the piston 512, thereby applying to the liquid in the inner end of the cylinder 502 a pressure which will be transmitted through the passage 504 to the friction mechanism. When this pressure exceeds the initial tension of the spring 507, said spring will yield, so that further inward movement of the piston 512 will be accompanied by a corresponding outward movement of the plunger 505 without greatly increasing the pressure upon the friction mechanism. When, however, the plunger 505 engages the inner end of the stem 511, thereby arresting the outward movement of said plunger, further inward movement of the piston 512 will result in a more pronouncedly increased pressure upon the friction mechanism. When this increased pressure equals or exceeds the initial tension of the spring 515, the latter will yield, permitting continued inward movement of the sleeve 514 without corresponding movement of the piston 512, and consequently without further very substantially increasing the pressure on the tension mechanism.

The cover 500 is formed, between the cylinders 501 and 502, with an oil reservoir 520 communicating with the cylinder 501 and with the interior of the piston through a port 521. The head of the piston 505 is formed with a port 522 controlled by an inwardly opening check valve 523 normally held seated by a light spring 524, whereby the supply of liquid in the pressure system may be maintained against leakage losses from the reservoir 520.

While I have in this application specifically described several embodiments which my invention may assume in practice, it will be understood that these forms are shown for purposes of illustration and that the invention may be further 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 combination, an actuator, a driving member, power transmission connections between said actuator and driving member including cooperating friction clutch members and means for manually imparting any one of a plurality of automatically limited hydraulic pressures to said clutch members to effect engagement thereof for rotation at

equal angular speeds including a manually movable member upon which force is exerted to effect engagement of said clutch members and yielding means associated with said manually movable member and through which the force applied acts to effect application of said hydraulic pressures to said clutch members.

2. In combination, an actuator, a driving member, power transmitting connections between said actuator and driving member including cooperating friction clutch members, and controlling means for applying hydraulic pressure to said clutch members to engage them for rotation at equal angular rates including a plurality of yielding means respectively yielding when subjected to different pressures operative to effect application of different definite pressures to said clutch members to effect engagement thereof.

3. In combination, an actuator, a driving member, power transmitting connections between said actuator and driving member and including cooperating friction clutch members, and controlling means for applying hydraulic pressure to said clutch members to engage the same, said controlling means having a plurality of yielding elements adapted respectively to limit said hydraulic pressure to different predetermined amounts.

4. A mining machine comprising fast and slow feed mechanism, a friction clutch controlling each of the same, and hydraulic control mechanism for said friction clutch having provision for automatically maintaining different loading limits for said fast and slow feeds.

5. A mining machine having feeding mechanism comprising, in combination, an actuator, a feeding member, power transmitting connections between said actuator and feeding member and including cooperating friction clutch members, and means including a friction controlling member for generating and applying an automatically limited hydraulic pressure to said clutch members to engage the same.

6. A mining machine having feeding mechanism comprising, in combination, an actuator, a feeding member, power transmitting connections between said actuator and feeding member and including cooperating friction clutch members, and controlling means including a friction controlling member for generating and applying hydraulic pressure to said clutch members to engage the same, said controlling means having a yielding element for limiting the amount of said hydraulic pressure.

7. A mining machine having feeding mechanism comprising, in combination, an actuator, a feeding member, power transmitting connections between said actuator

and feeding member and including cooperating friction clutch members, hydraulically operated means for engaging said clutch members, and pressure generating means including a friction controlling member for generating and applying hydraulic pressure to said hydraulically operated means, said pressure generating means having a yielding element for limiting the amount of said hydraulic pressure.

8. A mining machine having feeding mechanism comprising, in combination, an actuator, a feeding member, power transmitting connections between said actuator and feeding member and including cooperating friction clutch members, and means including a friction controlling member for generating and applying any one of a plurality of automatically limited hydraulic pressures to said clutch members to engage the same.

9. A mining machine having feeding mechanism comprising, in combination, an actuator, a feeding member, power transmitting connections between said actuator and feeding member and including cooperating friction clutch members, and controlling means for applying hydraulically pressure to said clutch members to engage the same, said controlling means having a plurality of yielding elements adapted respectively to limit said hydraulic pressure to different predetermined amounts.

10. A mining machine having feeding mechanism comprising, in combination, an actuator, a feeding member, power transmitting connections between said actuator and feeding member and including cooperating friction clutch members, hydraulically operated means for engaging said clutch members, and pressure generating means for applying hydraulic pressure to said hydraulically operated means, said pressure generating means having a plurality of yielding elements adapted respectively to limit said hydraulic pressure to different predetermined amounts.

11. A mining machine having feeding mechanism comprising, in combination, an actuator, a feeding member, power transmitting connections between said actuator and feeding member and including cooperating friction clutch members, hydraulically operated means for engaging said clutch members, pressure generating means including a friction controlling member for generating and applying hydraulic pressure to said hydraulically operated means, and means for actuating said pressure generating means, said actuating means having a yielding element for limiting the amount of said hydraulic pressure.

12. A mining machine having feeding mechanism comprising, in combination, an actuator, a feeding member, power trans-

mitting connections between said actuator and feeding member and including cooperating friction clutch members, hydraulically operated means for engaging said clutch members, a cylinder and piston for applying hydraulic pressure to said hydraulically operated means, and actuating means for said piston including a member rigidly connected thereto, said actuating means including a yielding element for limiting the amount of said hydraulic pressure.

13. A mining machine having feeding mechanism comprising, in combination, an actuator, a feeding member driven thereby, cooperating friction clutch members between said elements, hydraulically operated means for engaging said members, controlling means including pressure generating means for applying any one of a plurality of predetermined pressures to a liquid in said hydraulically operated means, and means for adjusting the limits of said pressures.

14. A mining machine having feeding mechanism comprising, in combination, an actuator, a feeding member driven thereby, friction clutch members between said elements, hydraulically operated means for engaging said members, and pressure generating means for applying any one of a plurality of predetermined pressures to a liquid in said hydraulically operated means, a reservoir, and connections between said reservoir and said hydraulically operated means for automatically maintaining a substantially constant quantity of liquid in said hydraulically operated means and said pressure generating means.

15. A mining machine having feeding mechanism comprising, in combination, an actuator, a feeding member driven thereby, cooperating friction clutch members between said elements, hydraulically operated means for engaging said members, pressure generating means for applying any one of a plurality of predetermined maximum pressures to a liquid in said hydraulically operated means, means for adjusting the limits of said pressures, a reservoir, and connections between said reservoir and said hydraulically operated means for automatically maintaining a substantially constant quantity of liquid in said hydraulically operated means and said pressure generating means.

16. A mining machine having a machine frame and feeding mechanism comprising an actuator, a feeding member driven thereby, cooperating friction clutch members between said actuator and said shaft, hydraulically operated means for engaging said members, pressure generating means for applying any one of a plurality of predetermined pressures to a liquid in said hydraulically operated means, a liquid reservoir formed integral with said machine frame, and con-

nections between said reservoir and said hydraulically operated means for automatically maintaining a substantially constant quantity of liquid in said hydraulically operated means and said pressure generating means.

17. A mining machine having feeding mechanism comprising, in combination, an actuator, a feeding member driven thereby, cooperating friction clutch members between said actuator and said feeding member, hydraulically operated means for varying the frictional engagement of said clutch members, and a plurality of adjustable limiting means for varying the pressure limit to be applied to the hydraulically operated means.

18. A mining machine having feeding mechanism comprising, in combination, an actuator, a feeding member driven thereby, clutch mechanism controlling the operation of said shaft by said actuator, hydraulically operated controlling means for said clutch mechanism, and pressure generating means including a friction controlling member movable in opposite directions to apply pressure to a liquid in said hydraulically operated means.

19. A mining machine having feeding mechanism comprising, in combination, an actuator, a feeding member driven thereby, clutch mechanism controlling the operation of said feeding member by said actuator, hydraulically operated controlling means for said clutch mechanism, and pressure generating means movable in opposite directions to apply pressure to a liquid in said hydraulically operated means, said last named means being movable in one direction to apply a greater pressure than when moved in the other direction.

20. A mining machine having feeding mechanism comprising, in combination, an actuator, a feeding member driven thereby, clutch mechanism controlling the operation of said feeding member by said actuator, hydraulically operated controlling means for said clutch mechanism, pressure generating means movable in opposite directions to apply either of two maximum pressures to a liquid in said hydraulically operated means, and means for varying the maximum pressures.

21. A mining machine having feeding mechanism comprising, in combination, an actuator, a feeding member driven thereby, clutch mechanism controlling the operation of said feeding member by said actuator, hydraulically operated controlling means for said clutch mechanism, manually operable pressure generating means movable in one direction to apply to the liquid in said hydraulically operated means any pressure desired under a certain limit and movable in the opposite direction to apply to said liquid any pressure desired under a certain

limit, and means for varying both of said limits.

22. A mining machine having feeding mechanism comprising, in combination, an actuator, a feeding member driven thereby, clutch mechanism controlling the operation of said feeding member by said actuator, hydraulically operated controlling means for said clutch mechanism, manually operable means comprising a lever movable in opposite directions to apply either of two predetermined limited pressures to a liquid in said hydraulically operated means, and means for limiting the movement of said lever in one direction.

23. A mining machine having feeding mechanism comprising, in combination, an actuator, a feeding member, connections between said actuator and feeding member including a variable transmission mechanism and a pair of cooperating friction clutch members, a lever for controlling said transmission mechanism, hydraulically operated means for controlling the engagement of said clutch members, and pressure generating means for applying any one of a plurality of predetermined pressures to a liquid in said hydraulically operated means, said pressure generating means and controlling lever having interengaging means for limiting the operation of said pressure generating means when said lever is in one position.

24. A mining machine comprising a frame, a cover therefor, feeding mechanism comprising an actuator, a feeding member driven thereby, and cooperating friction clutch members interposed between said actuator and feeding member, said actuator, feeding member, and clutch members being mounted on said frame, and hydraulically operated means carried by said cover for controlling the engagement of said clutch members and comprising pressure generating means for applying any one of a plurality of predetermined pressures to a liquid in said hydraulically operating means and a conduit communicating with said pressure generating means and said hydraulically operated means.

25. A mining machine comprising a frame, a cover therefor, feeding mechanism comprising an actuator, a feeding member driven thereby, and cooperating friction clutch members interposed between said actuator and feeding member, said actuator, feeding member, and clutch members being mounted on said frame, hydraulically operated means for controlling the engagement of said clutch members, pressure generating means carried by said cover and detachably connected with said hydraulically operated means, said pressure generating means comprising means for applying any one of a plurality of predetermined pres-

5 sures to a liquid in said hydraulically operated means, and liquid conducting means for connecting said pressure generating means and said hydraulically operated means, said conducting means being detachably secured to the latter.

10 26. A mining machine comprising a frame, a removable cover therefor, feeding mechanism comprising an actuator, a feeding member driven thereby, and cooperating friction clutch members interposed between said actuator and feeding member, said actuator, feeding member, and clutch members being mounted on said frame, hydraulically operated means carried by said cover for controlling the engagement of said clutch members and comprising pressure generating means for applying any one of a plurality of predetermined pressures to a liquid in said hydraulically operated means and a conduit connected to said pressure generating means and said hydraulically operated means, and means in said conduit for closing communication between said hydraulically operated means and said pressure generating means.

20 27. In a mining machine, feeding mechanism, a friction clutch controlling the same, and hydraulic controlling means for said friction clutch including a cylinder, a piston rod, oppositely disposed spring pressed pistons movable thereon, an operating member, and oppositely acting resilient means operatively connected between said rod and said operating member.

25 28. In combination, a friction clutch, pressure fluid operated means for connecting the elements thereof, a conduit leading to said means, pressure generating means communicating with said conduit, a reservoir communicating with said conduit, and a valve for said conduit opened by fluid in said reservoir and closed by pressure generated by said generating means.

30 29. In combination, a friction clutch, pressure fluid operated means for connecting the elements thereof, a conduit leading to said means, pressure generating means communicating with said conduit, a reservoir communicating with said conduit, a valve for said conduit opened by fluid in said reservoir and closed by pressure generated by said generating means, and another valve between said valve and said clutch.

35 30. In combination, clutch mechanism including a plurality of clutch elements, hydraulic operating means for connecting said elements, a conduit leading therefrom, a cylinder communicating with said conduit, a piston rod extending into said cylinder, a pressure piston in said cylinder, an operating member, and a resilient connection between said operating member and said

rod to substantially limit the pressure in said cylinder. 65

31. In combination, clutch mechanism including a plurality of clutch elements, hydraulic operating means for connecting said elements, a conduit leading therefrom, a cylinder communicating with said conduit, a piston rod extending into said cylinder, oppositely disposed pistons movable thereon in said cylinder, resilient means forcing said pistons apart on said rod, an operating member, and a plurality of resilient connections of different strengths connected between said operating member and said rod. 70 75

32. In combination, clutch mechanism including a plurality of clutch elements, hydraulic operating means for connecting said elements, a conduit leading therefrom, a pressure generating cylinder communicating with said conduit, a piston rod extending into said cylinder, oppositely disposed pistons movable thereon in said cylinder, resilient means forcing said pistons apart on said rod, an operating member, a plurality of resilient connections of different strengths connected between said operating member and said rod, and means for adjusting the strength of said resilient connections. 80 85 90

33. In combination, clutch mechanism including a plurality of clutch elements, a hydraulic operating means for connecting said elements, a conduit leading thereto, a cylinder member, a removable lining therein having communications with said conduit, a piston rod extending into said lining, oppositely acting pistons movable on said rod within said lining, resilient means forcing said pistons apart on said rod, a plurality of coiled springs of different strength carried on said rod, an operating member having a portion extending between and acting upon the adjacent ends of said springs, and means for adjustably connecting the opposite ends of said springs to said rod. 95 100 105

34. A mining machine including an actuator, a feed driving member, plural train power transmitting connections between said actuator and feed driving member, hydraulic controlling mechanism for said trains including a hydraulically operated friction clutch, and means for automatically maintaining different definite loading limits for said different trains. 110 115

35. A mining machine including an actuator, a feed driving member, plural train power transmitting connections between said actuator and said feed driving member, controlling mechanism including hydraulically operated frictional controlling means for said trains, and means for automatically maintaining different definite loading limits for said frictional controlling means during the operation of said different trains. 120 125

36. A mining machine including an ac-

tuator, a feed driving member, power transmitting connections between said actuator and member including means for effecting reverse rotation of the latter and hydraulic
5 controlling mechanism for providing automatically limited different loading limits for different directions of drive.

37. In a mining apparatus, a mining machine having feeding mechanism including
10 flexible feeding means having a plurality of

flexible feeding portions having free extremities adapted for connection to fixed points, and means for winding in either of said portions at a plurality of materially different speeds including hydraulically operated frictional controlling means having
15 different predetermined loading limits for said different speeds.

In testimony whereof I affix my signature.

MORRIS P. HOLMES.