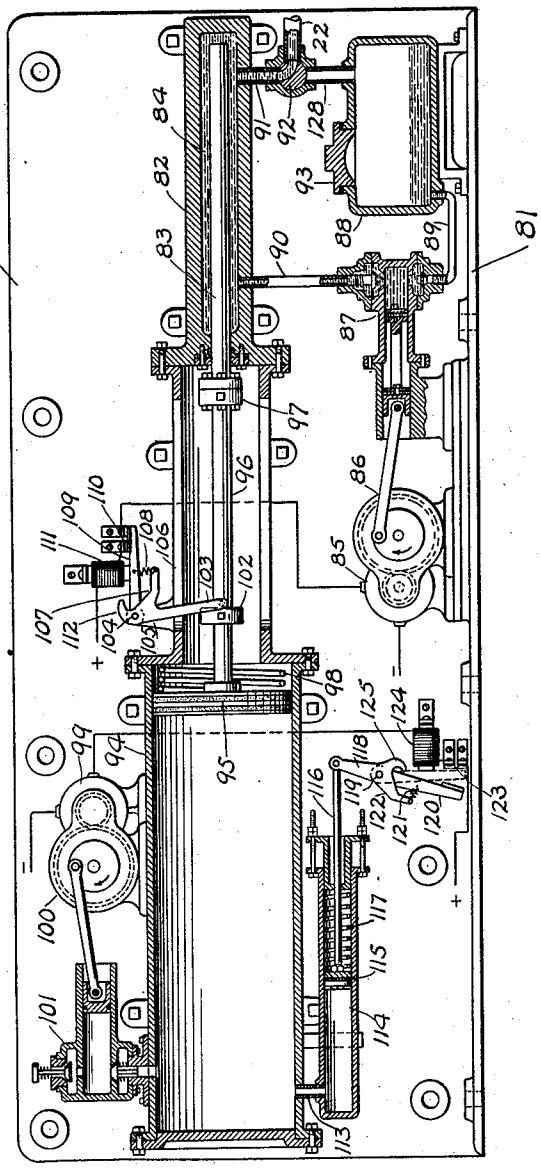
June 9, 1931. E. C. MORGAN 1,809,283

MEANS FOR CONTROLLING FLUID PRESSURE BREAKING MECHANISM FOR MINING MACHINES

Original Filed June 25, 1920 3 Sheets-Sheet 1

Fig. 1



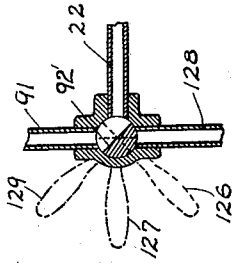


Fig. 12

Olive Eugenie Morgan
Executrix of the Estate of
Edmund C. Morgan, Inventor,
deceased

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Attys.

June 9, 1931. E. C. MORGAN 1,809,283

MEANS FOR CONTROLLING FLUID PRESSURE BREAKING MECHANISM FOR MINING MACHINES

Original Filed June 25, 1920 3 Sheets-Sheet 2

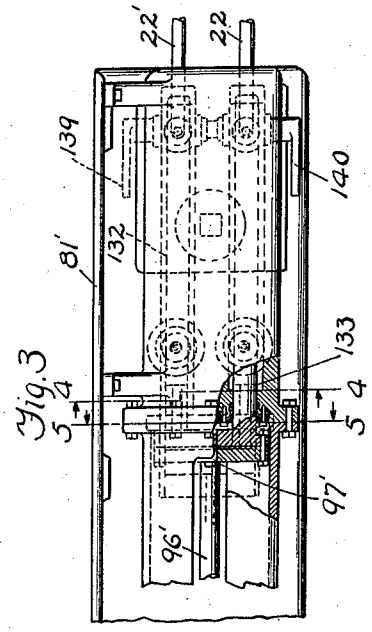


Fig. 3

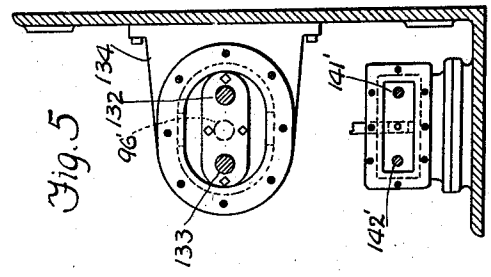


Fig. 5

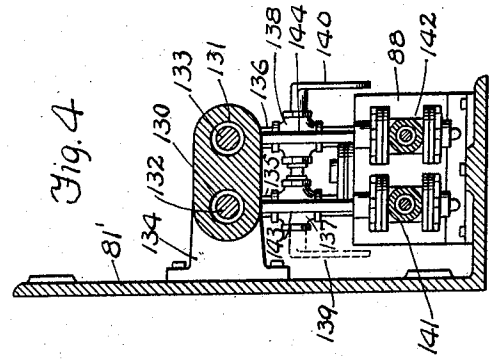


Fig. 4

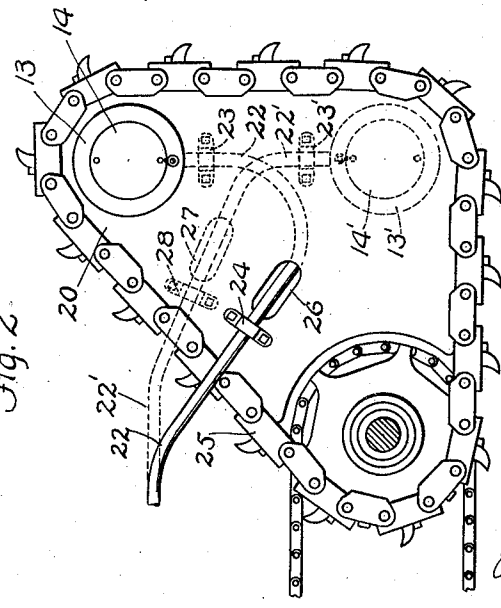


Fig. 2

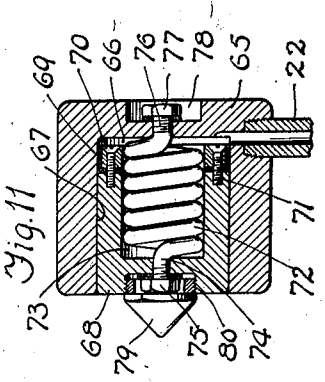


Fig. 11

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June 9, 1931. E. C. MORGAN 1,809,283

MEANS FOR CONTROLLING FLUID PRESSURE BREAKING MECHANISM FOR MINING MACHINES

Original Filed June 25, 1920 3 Sheets-Sheet 3

Fig. 7

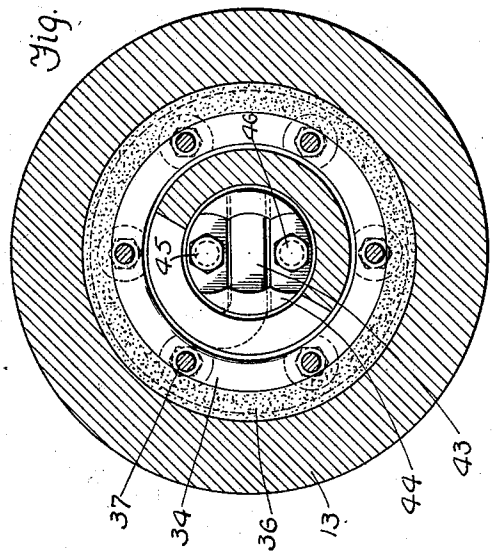


Fig. 8

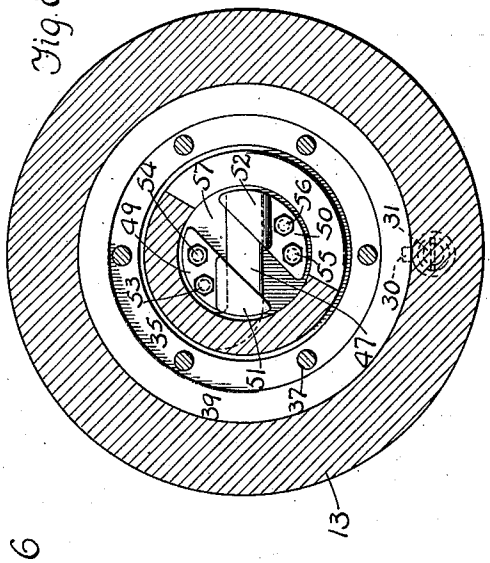


Fig. 6

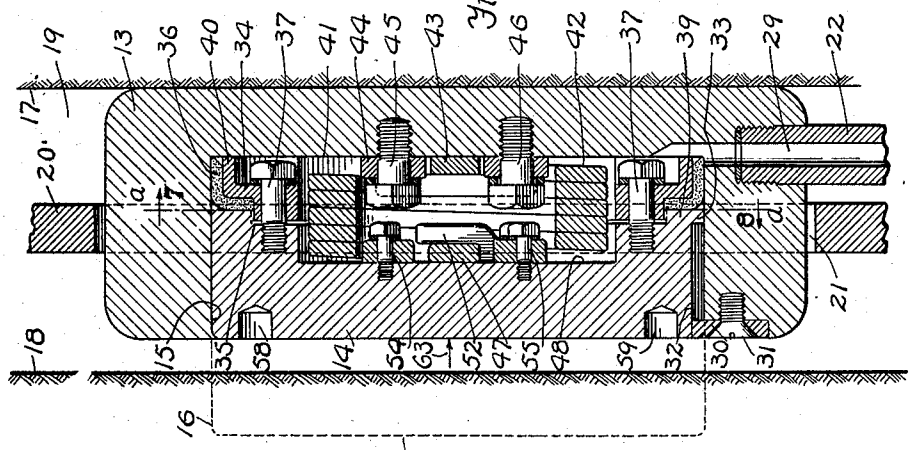
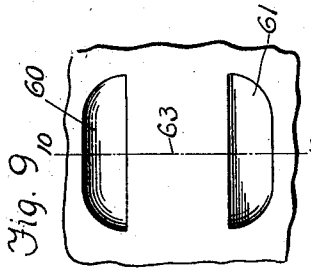


Fig. 9



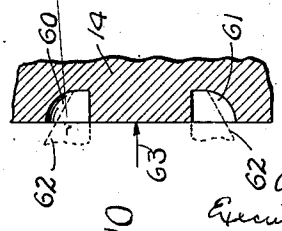


Fig. 10

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Patented June 9, 1931 1,809,283

UNITED STATES PATENT OFFICE

EDMUND C. MORGAN, DECEASED, LATE OF NEW YORK, N. Y., BY OLIVE EUGENIE MORGAN, EXECUTRIX, OF NEW YORK, N. Y.

MEANS FOR CONTROLLING FLUID PRESSURE BREAKING MECHANISM FOR MINING MACHINES

Original application filed June 25, 1920, Serial No. 391,844. Divided and this application filed December 31, 1924, Serial No. 758,971. Renewed March 7, 1929.

This invention relates to apparatus operated by fluid pressure to dislodge material in a mine and is particularly adapted for use in mining machines for mining coal.

An object of the invention is the provision of improved and efficient mechanism for controlling the operation of hydrostatic breaking devices adapted to be mounted for movement with a kerf-cutter into the kerf cut by the latter.

A further object of the invention is the provision of apparatus for exerting fluid pressure suddenly on expansible breaking device adapted to be inserted into an incision in a mine wall.

A further object is the provision of improved and efficient automatic controlling mechanism for a hydraulically operated expansible breaker adapted to be inserted in a kerf in a mine wall.

Other objects of the invention will appear hereinafter, the novel features and combinations being set forth in the appended claims.

The present application is a division of co-pending application, Serial No. 391,844, filed June 25, 1920, for an improvement in fluid pressure breaking mechanism for mining machines. In the latter is claimed the hydrostatic breaker per se and the combination of the same with the kerf-cutter and broadly, such mechanism combined with means for controlling the same, whereas in the present application is claimed the controlling apparatus disclosed in Figs. 1 to 5, inclusive, and Fig. 12, and the combination of such controlling apparatus with the breaker broadly, particularly as applied to incision making mechanism, such as the kerf-cutter illustrated in Fig. 2.

Referring to the accompanying drawings:

Fig. 1 is a sectional elevational view illustrating the automatically controlled hydraulic mechanism for transmitting pressure to hydraulic breaking devices;

Fig. 2 is an elevational view of an upright kerf-cutter showing the application of hydraulic breakers to a mining machine for operation in a kerf produced by such mining machine;

Fig. 3 is a plan view partly in horizontal section of a plurality of hydraulic impulse producing devices;

Fig. 4 is a sectional view on the line 4—4 of Fig. 3, looking in the direction of the arrows;

Fig. 5 is a sectional view of Fig. 3 on the line 5—5, looking in the direction of the arrows;

Fig. 6 is a sectional elevation taken through the center of the upper hydraulic breaker shown in Fig. 2;

Fig. 7 is a sectional view of Fig. 6 on the line *a*—*a*, looking in the direction of the arrow 7;

Fig. 8 is a sectional view on the line *a*—*a* of Fig. 6, looking in the direction of the arrow 8;

Fig. 9 is an elevational view of a modification of the removable plunger of Fig. 6;

Fig. 10 is a sectional elevation on the line 10—10, of Fig. 9;

Fig. 11 illustrates a modification of the structure shown in Fig. 6; and

Fig. 12 is a diagrammatic view in sectional elevation of a modification of the valve structure shown at the right hand portion of Fig. 1.

Referring to Figs. 6, 7 and 8, which show the type of hydraulic breaker particularly adapted for use in connection with kerf-cutters in mining machines, as shown in Fig. 2, it will be seen that this breaker comprises two principal elements relatively expansible. One of these elements is in the form of a shallow cup, as shown at 13 in Fig. 6. The other element 14 is in the form of a disc adapted to fit in the cylindrical recess 15 of the casing 13. The disc 14 is movable axially relatively to the casing 13 and therefor in effect constitutes a plunger which is expansible to the dotted line position shown in Fig. 6, assuming that 17 designates the solid portion of the unmined mass of coal and 18 designates the material between the kerf 19 and a kerf distant therefrom toward the left, as viewed in Fig. 6.

The shallow cylinder 13 as well as the plunger 14 are relatively thick and of material to give them considerable strength for action in a hydraulic breaker of the expansi-

ble type. The cylinder 13 may be rigidly secured to the kerf-cutter frame shown in Fig. 2, or the cylinder 13 may be inserted through a circular opening in the kerf-cutter frame 20 so as to leave an annular space 21 between the frame 20 and the cylinder 13, as shown in Fig. 6. In that event the pipe 22 extending through a strap 23, as shown in Fig. 2, may be relied upon to support the hydraulic breaker in proper position in the circular opening of the kerf-cutter frame 20. The pipe 22 may also be secured by an additional strap 24 to the kerf-cutter frame 20, as shown in Fig. 2. Preferably the pipe 22 passes by the cutter chain 25 on the inside or distant from the solid mine wall 17 shown in Fig. 6. This is effected by extending the pipe 22 through an opening 26 in the kerf-cutter frame 20. In a similar manner an additional hydraulic breaker 13′, 14′, may be mounted at the lower portion of the kerf-cutter frame 20, as shown in the dotted lines in Fig. 2. The pipe 22′ is extended through a bracket 23′ and thence through an opening represented by the oval dotted line 27, in order that the pipe may be secured by the strap 28 to the inside surface of the frame 20.

The type of hydraulic breaking mechanism shown in Figs. 2, 6, 7 and 8 is particularly applicable to the two upright spaced-apart side kerf-cutters shown in the Levin Patent No. 1,290,591, granted January 7, 1919, or to the upright side kerf-cutters shown in the Morgan Patent No. 1,116,356, granted November 3, 1914, for Coal mining apparatus. It should be understood that one or more of such hydraulic breakers may be mounted upon each of the upright spaced-apart kerf-cutters on their respective frames thereof within the boundaries or within the path of travel of the chain-cutters, as shown in Fig. 2 of drawings in the present application.

When fluid pressure is exerted through the passage 29 the plunger 14, shown in Fig. 6, may be forcibly moved out to the dotted line position 16 while the cylinder 13 rests firmly against the unmined mass 17, thereby effecting the breaking down of the coal 18. Therefore, when spaced-apart upright kerf-cutters are pivoted with such hydraulic breaking devices, such as that shown in Fig. 6, the plungers 14 should face toward each other so that the opposite breaking devices will move toward each other to break down the material between the kerfs.

In order to limit the outward movement of the plunger 14 a key 30 is secured to the cylinder 13 by means of the screw 31. The key 30 fits into a slot 32 on the periphery of the plunger 14 parallel to the axis of the latter. This slot 32 terminates short of the inner surface of the plunger 14 so as to leave an abutment 33 to engage the key 30 and thus limit the outward movement of the plunger 14 relatively to the cylinder 13.

By means of the ring 34 fitting in an annular recess 35, an annular packing 36 angular in cross-section may be secured on an annular seat by means of the bolts 37 screw-threaded into the plunger 14. The packing 36 is therefore in the nature of a piston packing to prevent leakage of the fluid pressure medium from the chamber within the cylinder 13.

It should be noted that Fig. 7 is a section taken on the line *a*—*a* of Fig. 6, looking in the direction of the arrow 7, the parallel dotted lines adjacent the section line indicating the hidden edges of the circular opening in the plate 20. Fig. 8 is a section of Fig. 6 on the line *a*—*a*, looking in the direction of the arrow 8. It should be noted that the annular portion 39 is the annular seat on the plunger 14 against which the annular packing 36 rests when secured in position. It should also be noted that the ring 34 is provided with a cylindrical portion 40 in position to contact with the bottom 41 of the cup-shaped recess or opening in the frame 13.

Within the hydraulic breaker shown in Fig. 6 is a spring 42 the convolutions of which are flat and fit closely against each other when the plunger 14 is within the cylinder 13. One end of the spring 42 is connected to the bottom 41 of the cylinder 13 and the other end of the spring is connected to the inner central face of the plunger 14. Inasmuch as Fig. 7 is a sectional view on the line *a*—*a* of Fig. 6, looking in the direction of the arrow 7, reference is made to Fig. 7 as well as the right-hand portion of Fig. 6 to understand the mechanism for connecting one end of the spring 42 to the bottom 41 of the cylinder 13. One end of the spring 42 is turned to a diametrical position, as shown at 43, and a circular frame 44 may be placed over the extension 43 and then the bolts 45 and 46 relied upon to secure the frame 44 against the bottom 41 and thereby clamp the extension 43 securely in position or rigidly in connection with the frame 13.

The opposite end of the spring 42 is provided with a diametrical extension or latch 47, as shown in Fig. 8, which is a sectional view on the line *a*—*a*, looking in the direction of the arrow 8. Bolted to the inner face or inner cup-shaped central recess 48 of the plunger 14 are two sector plates 49 and 50 each provided with off-sets to form notches 51 and 52. The plate 49 may be secured in place by means of the bolts 53 and 54, and the plate 50 may be secured in position by means of the bolts 55 and 56. As shown in Fig. 8, the sector plates 49 and 50 are spaced apart to form a slot between them of sufficient width to permit the free insertion therein of the diametrical extension or latch 47 of the spring 42.

After the spring 42 is secured to the bottom 41 of the cylinder 13 by means of the

construction shown in Fig. 7 and at the right-hand central portion of Fig. 6, the plunger 14 may be inserted into the cylinder 13 by sliding the piston packing 36 along the cylindrical surface 15. The plunger 14 may then be adjusted in position until the spring extension or latch 47, shown in Fig. 8, fits in the slot 57. A spanner wrench may then be inserted in the recesses 58 and 59 in the outer flat surface of the plunger 14 and the latter turned relatively to the cylinder 13 in clockwise direction, looking from the left to the right in Fig. 6, so that the extension or latch 47 will move under the off-sets 51 and 52 and so that the latter will act as notches or cavities to lock the plunger 14 to the spring 42.

In lieu of the spaced-apart diametrically arranged recesses 58 and 59 in the outer flat surface of the plunger 14, the spaced-apart recesses 60 and 61 shown in Figs. 9 and 10 may be provided of such shape and distance apart as to receive a wrench shown in position in dotted lines 62 in Fig. 10. Such spaced-apart recesses 60 and 61, especially adapted for receiving a wrench, may be provided in addition to the spanner recesses 58 and 59, and in any event such recesses are preferably located symmetrically with respect to the center 63 of the plunger 14.

When the plunger 14 is inserted the key 30 is disconnected from the cylinder 13. The position of the slot 32 in the plunger 14 relative to the key itself enables the operator to readily determine when the spring extension or latch 47 is in proper position to enter the slot 57, and after the slot 32 has been turned to receive the key 30, the latter will lock the extension 47 against turning movement relatively to the notches 51 and 52. It will thus be seen that the key 30 and the slot 32 not only form limit stop mechanism for the plunger 14 but also lock the plunger 14 in the position where the extension 47 is under the off-sets 51 and 52, as shown in Fig. 8. The spring is effectively and entirely enclosed in a very compact manner within the space which receives the pressure medium and therefore the operation of the spring is not interfered with by coal dust or other extraneous material. The spring acts automatically to restore the plunger to its initial position when the pressure medium is withdrawn and therefore the fluid pressure breaker will always be in readiness whenever desired for insertion into a comparatively narrow kerf. This arrangement assures continuous forward movement of the mining machine since the latter does not have to be withdrawn for manual restoration of the relatively movable parts of the breaker. In other words, by providing the spring on the interior of the breaker, the latter may be located within the boundaries of the chain kerf-cutter and intermittently operated while the mining machine is continuing its forward feeding movements.

Moreover, whenever desired, for repair, cleaning or otherwise, the key 30 may be removed and the plunger 14 turned anti-clockwise to release the same from the spring 42 so that such plunger may be withdrawn from the cylinder 13.

Fig. 11 shows a modification of the structure shown in Fig. 6 in that the dimensions are smaller with respect to the diameters and the spring may be released or secured in position by the turning of exposed nuts. The pressure pipe 22 is connected to the cylinder 65 so as to communicate with the interior of chamber 66 which is provided with a cup-shaped or cylindrical recess 67 in which fits the plunger or piston 68 having an annular packing 69 secured to the inner end thereof by means of screws 70 and 71. A strong spring 72 fits in a cylindrical chamber 73, the convolutions of the spring being in contact with each other so that this spring may act as an expansion spring to restore the plunger 68 to its initial position when the pressure medium in the chamber 66 is withdrawn. One end of the spring 72 which is located in a recess in the outer surface of the plunger 68. It will be seen that the screw-threaded end 74 of the spring 72 passes through the center of the outer portion of the plunger 68.

The outer screw-threaded end 76 of the spring 72 passes through the center of the bottom of the cylinder 65 and receives a nut 77 in the recess 78. A conically shaped projection or spear-head 79 may be screw-threaded at 80 into the recess in which the nut 75 is located. This conical projection may be added to the plunger 68 when desired to form a pointed instrument or spear-head for penetrating the kerf cut material such as that shown at 18 in Fig. 6 while the bottom of the cylinder 65 rests against the solid unmined mass such as that shown at 17 in Fig. 6. Such a pointed instrument 79 will assist in initially splitting the material thus assisting in breaking it down and dislodging it from the unmined mass between the spaced-apart upright side kerf-cutters and above the undercutting kerf-cutters.

Referring now to Fig. 1, the apparatus for producing fluid pressure in such hydraulic breakers as those shown in Figs. 6 and 11 will be described. Mounted on the stationary frame 81 is a hydraulic cylinder 82 along which is longitudinally movable a plunger 83 for forcing the pressure medium 84 into the pipe 22 and thence to the hydraulic breakers.

An electric motor 85 is connected by means of gearing 86 to the hydraulic pump 87. By means of this pump the liquid is pumped from the tank 88 through the pipe 89 into the pipe 90 and thence into the cylinder 82. From the cylinder 82 the liquid is passed through

the pipe 91 into the pipe 22 when the valve 92 is in the position shown in Fig. 1. By means of this electrically operated hydraulic pump, pressure may be exerted through the pipe 22 into the hydraulic breaker to move the plunger thereof relatively to the cylinder against the action of the expansion spring within the breaker. This operation is comparatively slow, however, and therefor additional mechanism is provided for securing comparatively quick action of the plungers and thereby effect hammer blows by said plungers on the material to be broken down. When the breaker is operated by means of the pump mechanism alone it may be automatically restored to initial position by turning the valve 92 so that the pipe 22 will communicate through the valve 92 to the tank 88. The spring within the breaker will then restore the plunger to initial position and cause the pressure medium therein to flow back through the pipe 22 into the tank 88. The latter may be provided with a screw-threaded cap 93 to close a filling opening.

The apparatus for producing the hammer blow action comprises a large cylinder 94 in which fits a piston 95 connected to a piston rod 96 coupled at 97 to the plunger 83. A spring 98 is located between one end of the air pressure cylinder 94 and the piston 95 back of the latter. This spring tends to force the piston 95 and the plunger 83 toward the left, but when the electric motor 99 operates the gearing 100, the air pump 101 will force air under compression into the cylinder 94, thereby moving the piston 95 toward the right against the action of the spring 98 until the collar 102 secured to the piston rod 96 engages the lever 103 and swings the latter on its pivot 104 at the upper end of the bracket 105 which is mounted on the frame 106.

Swinging of the lever 103 to the right will cause its arm 107 to transmit upward movement to the spring 108 to lift the switch lever 109 and close the switch 110. Closing of the switch 110 will connect the positive and negative mains through the electromagnet 111 and the motor 85. The electromagnet 111 will retain the switch 110 in closed position even after the electric motor 85 has operated the hydraulic pump 87 sufficiently to cause the plunger 83 to move to the left and the collar 102 to move away from the lever 103.

When, however, the plunger 83 has moved to the left sufficiently to cause the coupling 97 to engage the lever 103 its upper curved extension 112 will engage the top of the lever 109 and thereby automatically and forcibly open the switch 110 and cut off the current from the electric motor 85 and thus automatically stop the operation of the pump 87.

The motor for the air pump is also automatically controlled. Whenever the air pressure in the cylinder 94 is sufficient to hold the piston 95 to the right, as shown in Fig. 1, the air pressure exerted through the pipe 113 into the auxiliary cylinder 114 will move the piston 115 and piston rod 116 to the right against the action of the spring 117. The piston rod 116 is pivoted at its right-hand end to the lever 118 which is pivoted at 119 to the frame 81. Also pivoted at 119 for movement relatively to the lever 118 is a switch lever 120 which is connected by a spring 121 to an arm 122 extending from the lever 118.

When the pressure within the cylinder 94 falls below a predetermined amount, particularly when the coupling 97 engages the lever 103, the spring 117 will move the switch lever 120 to the dotted line position and thereby cause the closure of the switch 123. The electromagnet 124 will then be energized to hold the switch 123 in closed position and the circuit through the motor 99 will be closed to cause the operation of the air pump 101. When the air pressure in the cylinder 114 is sufficient to move the piston 115 to the right a sufficient distance to cause the finger 125 to engage the switch lever 120 and move the latter to the left, the switch 123 will be automatically opened and the current automatically cut off from the motor 99 to effect an automatic stopping of the operation of the air pump 101.

From the foregoing it will be seen that considerable air pressure may always be maintained on the piston 95 tending to move the plunger 83 to the right. Therefore, whenever the valve 92 is opened to establish communication between the cylinder 82 and the pipe 22, the air pressure accumulator will act very quickly to cause the flow of the liquid from the cylinder 82 through the pipe 22 into the hydraulic breaker and operate the latter with a hammer blow whether the pump 87 is operating at such time or not. When the valve 92 is opened and such hammer blow on the hydraulic breaker is effected, the plunger 83 will move to the right. When the plunger 83 has been moved to the right to the position shown in Fig. 1, the switch 110 will be closed and the motor 85 automatically started to operate the pump 87 and produce sufficient pressure in the cylinder 82 to again move the plunger 83 to the left, until the coupling 97 effects the opening of the switch 110 and the stopping of the motor 85 which in turn stops the pump 87. It will thus be seen that while the hydraulic pump 87 supplies the pressure to the liquid in the cylinder 82 the quick initial operation of the hydraulic breaker depends primarily on the air pressure accumulator. The apparatus therefore operates automatically to effect a quick hammer blow initially which may be supplemented automatically by the operation of the pump when the plunger 83 moves a sufficient distance to the right, as viewed in Fig. 1.

The greater the number of times that the

hydraulic breakers are operated, the more often must the hydraulic pump 87 be automatically operated to restore the pressure in the cylinder 82. During normal operation the piston 95 may occupy a position intermediate the ends of the cylinder 94 where the collar 102 and coupling 97 will be equally spaced from the lever 103. After the hydraulic breakers have been operated a number of times the collar 102 will engage the lever 103 to effect the starting of the pump 87 and when pressure has been restored sufficiently in the cylinder 82 the coupling 97 will engage the lever 103 and cut off the current from motor 85. After this occurs the hydraulic breakers may still be operated by the air pressure accumulator until there has been sufficient flow of the pressure medium 84 from the cylinder 82 to cause the collar 102 to engage the lever 103 and close the switch 110. The entire system is automatic and under the control of an operator who merely manipulates the valve 92.

It should be noted that when desired the hydrostatic expansible device shown in Fig. 6 may be operated so as to be expanded to a limited extent where the bottom of the cylinder 13 and the outer face of the plunger 14 will engage the walls 17 and 18 of the kerf and slide along the same during the feeding operation of the kerf-cutter shown in Fig. 2. After the expansible structure shown in Fig. 6 has been expanded to a limited extent so as to act as a spacer it may be locked in such position by closing the valve 92 against any ingress or egress of water from the pipe 22. As the feeding operation continues and the expansible device slides along the walls of the kerf, the kerf is kept open by preventing the walls 17 and 18 from moving toward each other and thereby binding of the kerf-cutter in the kerf is prevented and free feeding movement of such kerf-cutter is facilitated. Whenever desired the valve 92 may be operated to secure the breaking down operations hereinbefore mentioned.

In Fig. 12 is shown a modification of the valve 92 of Fig. 1. The full line position of the valve 92′ is obtained when the lever for operating this valve occupies the position indicated by the dotted line 126. Communication will then be established between the pipes 91 and 22. When the operating lever is in the position indicated by the dot-and-dash line 127, communication will be established between the pipes 91 and 128 and also between the pipes 22 and 128. When the operating lever is in the position of the dot-and-dash line 129, communication will be established between the pipes 22 and 128. By means of the valve thus arranged, communication may first be established between the pipe 91 and pipe 22 to a hydraulic breaker to fill the same entirely with the pressure medium such as water. Now, if the lever is turned to the position shown at 127 the plunger 83 will tend to move rapidly toward the right and then if the lever is turned back to the position 126 the continued movement of the plunger 83 will cause a sudden hammer blow to be exerted on the plunger of the hydraulic breaker. When the operating lever is turned to the position shown at 129 the breaker will be automatically restored to initial position. It should also be noted that the operating lever may be turned to establish communication between the pipes 91 and 22 and then quickly moved to the position shown at 129 to establish communication between the pipe 22 and the pipe 128. Furthermore, whenever it is desired to effect the operation of the pump 87, the position 127 could be effected so that the plunger 83 would move to the right until the lever 103 closes the switch 110 and starts the motor 85.

In Figs. 3, 4 and 5 is shown a modification of the structure shown in Fig. 1, in that separate cylinders 130 and 131 are provided instead of the single cylinder 82 of Fig. 1. In this manner independent control of the pressure medium through the pipes 22 and 22′ leading to the hydraulic breakers is obtained, one located on one upright side kerf-cutter and the other located on another upright side kerf-cutter, the kerf-cutters being spaced apart.

As shown in Fig. 3, the piston rod 96′ is connected by a coupling 97′ to two spaced-apart plungers 132, 133, respectively movable in the cylinders 130 and 131, which are located in a casting 134 secured to the frame 81′. Leading downwardly from the right-hand end portions of the cylinders 130 and 131 are pipes 135 and 136 in which valves 137 and 138 are located, these valves being similar to that designated 92 in Fig. 1, which are separately and independently controllable by means of the levers 139 and 140.

There are two pumps 141 and 142 each similar to that designated 87, and both connected to be operated simultaneously by the power transmission mechanism 86 shown in Fig. 1. Pipes 143 and 144 lead upwardly from these pumps to the cylinders 130 and 131 in the same manner that the pipe 90 leads upwardly from the cylinder 82 in Fig. 1. This may be seen by referring to Fig. 4 which is a sectional elevation of Fig. 3 on the line 4—4, looking in the direction of the arrows. Fig. 5 is a sectional elevation of Fig. 3, looking in the direction of the arrows or from right to left.

It should also be understood that the kerf-cutter shown in Fig. 2 may be mounted on a long wall machine or on any other type of kerf-cutter making a kerf spaced back from the face of the mine wall so that a hydraulic breaker mounted on the frame of the kerf-cutter may act to exert pressure towards the free face to dislodge coal from the unmined

mass. In other words. the breaking mechanism herein disclosed is adapted to be mounted on a kerf-cutter which forms a kerf in a mine wall spaced from the free face or working face of the coal. The breaking mechanism will then constitute hydrostatically actuated means carried by the kerf-cutter to exert pressure towards such free face to dislodge the coal.

Obviously those skilled in the art may make various changes in the de ails and arrangements of parts herein disclosed without departing from the spirit and scope of the invention as defined by the claims hereto appended, and it is therefore desired not to be restricted to the precise construction herein disclosed.

Having thus fully disclosed an embodiment of the invention, what is desired to be secured by Letters Patent of the United States is:

1. In apparatus for producing fluid pressure, the combination with a hydraulic cylinder, of a reservoir, a pump for supplying liquid to said cylinder from said reservoir, a conduit to convey liquid from said cylinder to a hydraulic breaker adapted to be used in a mine vein, and a valve in said conduit for controlling the flow of liquid from said cylinder to said reservoir in one predetermined position of the valve and to direct the flow from said cylinder through said conduit to said breaker when said valve is in another predetermined position.

2. In apparatus for producing liquid pressure for operating a hydraulic breaker for use in a mine vein, the combination with a hydraulic cylinder, of a reservoir, a pump to supply liquid to said hydraulic cylinder from said reservoir, a plunger for displacing some of the liquid in said cylinder, means for exerting pressure on said plunger tending to move the latter into and along said cylinder, a conduit to convey liquid from said hydraulic cylinder to the hydraulic breaker to operate the latter, and a valve to permit the flow of liquid from said cylinder to said reservoir to secure movement of said plunger along said cylinder when said valve is in one predetermined position and to connect said cylinder through said conduit to said breaker when the valve is in another predetermined position and while the said plunger is moving along said cylinder.

3. In apparatus for producing fluid pressure, the combination with an air accumulator comprising a cylinder, of a piston positioned with said cylinder, a piston rod connected to said piston to move therewith, a hydraulic cylinder having a central longitudinal axis common with the central longitudinal axis of said first-named cylinder, a plunger connected to said piston rod to move bodily therewith and extending into said hydraulic cylinder to move along the latter, means for introducing air under compression into said cylinder to act on said piston to urge the latter to move said plunger into and along said hydraulic cylinder, and means controlled by the pressure in said cylinder for automatically stopping said air introducing means.

4. In apparatus for producing fluid pressure, the combination with a hydraulic cylinder, of a plunger for displacing some of the fluid in said hydraulic cylinder, a pump for replacing said displaced fluid when said plunger is retracted, means for automatically operating said pump when said plunger is in a predetermined position, and an air cylinder for forcing said plunger into said hydraulic cylinder.

5. In apparatus for producing fluid pressure, the combination with an air accumulator, of automatic means controlled by pressure in said accumulator to stop and restart the same, a pump to supply compressed air thereto, a piston within said accumulator, a piston rod secured to said piston to move therewith, a hydraulic cylinder, a plunger extending into and movable along said hydraulic cylinder, said plunger being connected to said piston rod to move bodily therewith and having a central longitudinal axis common with the central longitudinal axis of said piston rod and of said hydraulic cylinder, means for conducting liquid from said hydraulic cylinder, and means for supplying liquid to said hydraulic cylinder.

6. In apparatus for producing fluid pressure, the combination with an air accumulator comprising a cylinder, of a pump to supply compressed air to said accumulator, a piston for movement in said cylinder, an auxiliary cylinder connected to said first-named cylinder, and mechanism connected to said auxiliary cylinder for starting the operation of said pump when the air pressure in said first-named cylinder drops to a predetermined amount and to discontinue the operation of said pump when the air pressure in said first-named cylinder reaches a predetermined amount.

7. In an apparatus for producing fluid pressure, the combination with a fluid pressure reservoir, of a hydraulic cylinder, a plunger for displacing some of the liquid within said hydraulic cylinder, a pump connected to said hydraulic cylinder and operable to refill said hydraulic cylinder when said plunger is partially withdrawn therefrom, and means controlled by said plunger for operating said pump.

8. In apparatus for producing fluid pressure, the combination with an air accumulator comprising a cylinder, of a hydraulic cylinder out of communication with said first-named cylinder and spaced therefrom and having its axis in alinement with the axis of said accumulator cylinder, a piston in said accumulator cylinder, and a plunger ex-

tending into said hydraulic cylinder, the latter being connected to said piston to move bodily therewith when the same moves along said accumulator cylinder.

9. In apparatus for producing fluid pressure, the combination with an air accumulator, of a hydraulic cylinder out of communication with said air accumulator, a plunger extending into said hydraulic cylinder, and a piston rod coupled between said piston and said plunger to cause the latter to partake of the movements of the piston along said accumulator.

10. In apparatus for producing fluid pressure, the combination with an air accumulator, of a piston within said accumulator, a hydraulic cylinder positioned apart from said accumulator and out of communication therewith but having a central longitudinal axis common with the central longitudinal axis of said accumulator, a plunger comprising an extended piston rod positioned for movement into said hydraulic cylinder, and a spring within said air accumulator for withdrawing said plunger from within said hydraulic cylinder.

11. In apparatus for producing fluid pressure, the combination with a hydraulic cylinder, of a plunger positioned for longitudinal movement within said hydraulic cylinder, an air accumulating means comprising a cylinder and a piston for the same for operating said plunger, a reservoir, a conduit to convey fluid from said hydraulic cylinder to said reservoir, a pump for pumping fluid from said reservoir to said hydraulic cylinder, and a manually operated valve disposed in said conduit for controlling the flow of the liquid from said hydraulic cylinder and to said reservoir.

12. In apparatus for producing fluid pressure, the combination with an accumulator, of means comprising a pump for maintaining a constant moderate pressure in said accumulator, a hydraulic cylinder, a plunger for said hydraulic cylinder connected to said accumulator for producing sudden increased pressure and impact, and a valve for controlling the frequency of such impacts, and automatic means for controlling said pump.

13. The combination with mechanism for producing fluid pressure, of an air accumulator, a pump for supplying compressed air to said accumulator, an auxiliary cylinder having a spring opposed piston operable by the pressure within said accumulator for controlling said pump, and means motivated by said air accumulator for producing a plurality of successive impulses.

14. In apparatus for producing fluid pressure, the combination with an extended piston rod having a plunger secured at one end thereof and a piston secured at the other, of a hydraulic cylinder positioned to receive said plunger, an adjustable stop positioned on said piston rod near the piston end of the same, a stop positioned on said piston rod near the plunger end of the same, an electrically driven pump for supplying fluid to said hydraulic cylinder, and a pivotally mounted lever extending into the path of both of said stops for controlling said electrically driven pump.

15. In apparatus for producing fluid pressure, the combination with an air accumulator, of an electrically driven pump for supplying fluid pressure to said accumulator, an auxiliary fluid pressure cylinder in communication with said accumulator and having a spring opposed piston therein, and an electric switch connected to said piston to open the switch and stop the electrically driven pump when the pressure in the accumulator reaches a predetermined amount, the said spring moving the piston in the opposite direction to effect closure of said switch and the starting of said electrically driven pump when the pressure in said accumulator is reduced to a predetermined amount.

16. In apparatus for producing fluid pressure, the combination with a fluid reservoir, of a hydraulic cylinder, a plunger positioned to be moved into said hydraulic cylinder, a piston equipped air accumulator for forcing said plunger into said hydraulic cylinder, a conduit communicating with said hydraulic cylinder for conveying fluid under pressure to expandable mechanism, and a valve in said conduit for controlling at will the flow of said fluid pressure medium to said reservoir or to said expandable mechanism.

17. In apparatus for producing fluid pressure, the combination with an air operated plunger, of a hydraulic cylinder positioned to receive said plunger, a conduit communicating with said hydraulic cylinder, and a manually operated valve disposed within said conduit for controlling the passage of fluid therethrough and for controlling the movement of said plunger into said cylinder, and means dependent upon the position of said plunger to secure automatic retraction thereof.

18. In apparatus for producing fluid pressure, the combination with a hydraulic cylinder having an inlet and an outlet thereto, of an electrically operated pump for supplying fluid to said hydraulic cylinder through said inlet, a conduit communicating with said hydraulic cylinder through said outlet, expandable means operatively secured to said conduit apart from said hydraulic cylinder, means for causing a sudden increase of pressure in said conduit and in said expandable means, and a valve disposed in said conduit for controlling the impulses created by said sudden increase in pressure.

19. In apparatus for producing fluid pressure, the combination with an accumulator cylinder, of means for introducing fluid under

pressure therein, a piston in said cylinder, a hydraulic cylinder, a plunger extending into said hydraulic cylinder, means connecting said piston and plunger to impart to the latter the reciprocating movements of said piston in said accumulator cylinder, a reservoir for receiving liquid direct from said hydraulic cylinder, a pump for pumping liquid from said cylinder to said hydraulic reservoir, and means for controlling the flow of liquid under pressure from said hydraulic cylinder to said reservoir and to a hydraulic breaker and the return of such liquid from said hydraulic breaker to said reservoir.

20. In apparatus for producing hydraulic pressures, the combination with a hydraulic cylinder having an outlet, of a fluid pressure accumulator comprising a fluid pressure cylinder having a piston movable therein, automatic means for controlling the pressure in said accumulator, a plunger extending into said hydraulic cylinder and connected to said piston to move bodily with the latter, and valve mechanism for controlling the flow of liquid from said hydraulic cylinder and the movement of the plunger therein by the pressure in said accumulator exerted on said piston.

21. In apparatus for producing fluid pressure to operate a hydraulic breaker, the combination with a hydraulic cylinder, of a conduit for conducting liquid pressure from said hydraulic cylinder to the hydraulic breaker, a fluid pressure operated piston, automatic means for controlling the fluid pressure exerted on said piston, a plunger connected to said piston to move bodily therewith and extending into said hydraulic cylinder to displace some of the liquid pressure medium therein, and means disposed in said conduit for controlling the flow of the liquid pressure medium through said hydraulic cylinder to said hydraulic breaker and the movement of said plunger into said hydraulic cylinder by the fluid pressure exerted on said piston.

22. In fluid pressure apparatus adapted to be connected to a hydraulic breaker for use in a mine vein, the combination with a fluid pressure accumulator, of automatic mechanism for operating and controlling said accumulator and the pressure from the medium therein, a reservoir, means for controlling the connection of the accumulator to the breaker and the connection of the breaker to said reservoir, and means for operating the accumulator to exert pressure on the operating medium therein to effect operation of the breaker when connected to the latter and restoration of the breaker when connected to said reservoir.

23. In fluid pressure apparatus adapted to be connected to a hydraulic breaker for use in a mine vein, the combination with a hydraulic accumulator, of a reservoir, a valve connecting the operating medium to said breaker from said accumulator to effect operation of the breaker and for connecting the breaker to said reservoir to effect restoration of the breaker, and automatic means for operating the accumulator to restore pressure in the operating medium therein.

24. In fluid pressure apparatus adapted to be connected to a hydrostatic breaker for use in a mine vein, the combination with an accumulator having a fluid pressure medium adapted to be connected to the breaker to operate the same, of automatic mechanism for operating and controlling said accumulator and the pressure from the medium therein, and a single valve for controlling the supply of fluid pressure medium from said accumulator to the breaker and back from the latter.

25. In an accumulator for fluid pressure breakers, the combination with a hydraulic cylinder, of a plunger therein, a source of liquid supply, a pump connected between said source of liquid supply and said cylinder, automatic means controlled by the position of the plunger for intermittently operating said pump, a valve for controlling the flow of pressure medium from said cylinder to a breaker for use in a mine vein and also for controlling the flow of pressure medium back from said breaker to said source of liquid supply.

26. In an accumulator for fluid pressure breakers, the combination with fluid pressure producing apparatus comprising a pump, of pneumatic mechanism connected thereto, means comprising an additional pump for operating said pneumatic mechanism, and means for controlling said pumps to effect intermittent operation thereof respectively.

27. In fluid pressure apparatus for breakers, the combination with a hydraulic pressure producing device adapted to be connected to a breaker and comprising a hydraulic cylinder with a plunger movable therein, of a pneumatic pressure device connected to said plunger for accumulator purposes, automatic mechanism controlled by the pressure in said pneumatic pressure device for intermittently pumping fluid into said device, and automatic mechanism controlled by the position of the said plunger relative to said cylinder for intermittently pumping liquid into said cylinder to move the plunger along the cylinder against the pressure in said pneumatic device.

28. In apparatus for producing hydraulic pressure in hydraulic breakers for use in kerfs in coal veins, the combination with a fluid pressure cylinder, of a plunger for displacing some of the fluid in said fluid pressure cylinder, a pump for replacing displaced fluid when said plunger is operated or when the hydraulic breaker is operated, fluid pressure mechanism for forcing said plunger along said cylinder, means dependent upon

the position of said plunger for controlling said pump, and a manually operated valve for controlling the flow of fluid from the said cylinder to the hydraulic breaker.

29. In apparatus for producing fluid pressure, the combination with a fluid pressure accumulator comprising a cylinder, of a pump for supplying fluid under pressure to said accumulator cylinder, a piston movable along said cylinder, means for operating said pump when the fluid pressure in said cylinder falls to a predetermined amount, an auxiliary cylinder connected to said accumulator cylinder, and means connected to effect the auxiliary cylinder to effect the discontinuance of the operation of said pump when the pressure in said cylinder is raised to a predetermined amount.

30. In apparatus for producing fluid pressure, the combination with a hydraulic cylinder, of a plunger for displacing fluid in said cylinder, a pump to refill said cylinder when said plunger is partially withdrawn therefrom, and mechanism operated at the limits of movement of said plunger for controlling the operation of said pump to stop the same when the plunger is withdrawn from the cylinder a predetermined amount and to restart the same when the plunger moves into the cylinder a predetermined distance.

31. In apparatus for producing fluid pressure, the combination with a hydraulic cylinder adapted to contain an operating medium connected to a hydraulic breaker for use in a mine vein, of a plunger extending into and movable along said cylinder, means for exerting and maintaining a moderate pressure on said plunger to move the same along said cylinder to force the said operating medium to said breaker, mechanism for controlling said operating medium to cause said plunger to exert a sudden increased pressure and impact on the operating medium extending to said breaker, and automatic means controlled by the position of said plunger for restoring hydraulic pressure in said cylinder.

32. In apparatus for producing fluid pressure, the combination with a fluid pressure cylinder, of a plunger therein, means for moving said plunger into and along said cylinder, a pump for supplying fluid under pressure to said cylinder, and mechanism actuated by the plunger reaching a predetermined position in said cylinder to effect the operation of said pump to supply fluid pressure to said cylinder and force the said plunger the predetermined distance from said cylinder.

33. In fluid pressure apparatus adapted to operate hydrostatic breakers for use in a mine vein, the combination of a hydrostatic ram adapted to be connected to such breakers, and means for securing movement of said hydrostatic ram while disconnected hydrostatically from a breaker and then its connection to such breaker to operate the latter with a hammer blow.

34. In fluid pressure apparatus adapted to be connected to a hydraulic breaker for use in a mine vein, the combination with a hydraulic ram comprising a cylinder with a plunger movable therein, of a reservoir, a conduit connecting said cylinder to said reservoir, means for pumping liquid from said reservoir to said cylinder, means for exerting pressure on said plunger to move the same into and along said cylinder, and a controlling valve for first directing liquid from said cylinder through said conduit to said reservoir to effect movement of said ram and then connecting said cylinder to a breaker to effect a hammer blow of the liquid from the cylinder to the breaker.

35. In apparatus for producing fluid pressure, the combination with a hydraulic cylinder, of a plunger positioned for longitudinal movement within said hydraulic cylinder, an air accumulating means comprising a cylinder and a piston for operating said plunger, automatic means for intermittently restoring the fluid pressure in said air accumulating means, a reservoir, a conduit to convey fluid from said cylinder to the hydraulic breaker to be operated, a pump for pumping liquid from said reservoir to said hydraulic cylinder, and a manually operated valve disposed in said conduit for controlling the flow of liquid from said hydraulic cylinder to the conduit leading to the breaker.

36. In fluid pressure apparatus adapted to be connected to a hydraulic breaker for use in a mine vein, the combination with a hydraulic ram comprising a cylinder with a plunger movable therein, of a reservoir, a conduit adapted to be connected between said cylinder and the hydraulic breaker to be operated, means for pumping liquid from said reservoir to said cylinder, means for exerting pressure on said plunger to move the same into and along said cylinder, means for intermittently restoring such pressure and a controlling valve for connecting said cylinder through said conduit to the hydraulic breaker and also for connecting said conduit to said reservoir to connect the hydraulic breaker thereto.

37. In fluid pressure apparatus adapted to be connected to a hydrostatic breaker for use in a mine vein, the combination with an accumulator having fluid pressure medium adapted to be connected to the breaker to operate the same, automatic mechanism for operating and controlling said accumulator and the pressure from the medium therein, and valve mechanism for controlling the supply of fluid pressure medium from said accumulator to the breaker and back from the latter.

38. In apparatus for producing liquid pressure for operating a hydraulic breaker

for use in a mine vein, the combination with a fluid reservoir, of a hydraulic cylinder, a piston equipped air accumulator, a plunger positioned to be moved into said hydraulic cylinder by said piston equipped air accumulator for forcing said plunger into said hydraulic cylinder, automatic mechanism for operating and controlling said accumulator and the pressure from the medium therein, a conduit communicating with said hydraulic cylinder for conveying fluid under pressure to an expansible hydraulic breaker, and valve mechanism in said conduit for controlling the flow of said fluid pressure medium to such hydraulic breaker and back from the same to said reservoir.

39. In apparatus for producing fluid pressure to operate a hydraulic breaker, the combination with a hydraulic cylinder adapted to be connected to a hydraulic breaker, of a plunger extending into and movable along said hydraudic cylinder, a fluid pressure accumulator comprising a cylinder with a piston therein connected to said plunger to move bodily therewith, means for maintaining uniform pressure in the accumulator cylinder, said piston connected to said plunger imparting the pressure in said accumulator cylinder to said plunger tending to move the latter along said first-named cylinder, and means for controlling the flow of the pressure medium from said first-named cylinder to the hydraulic breaker to secure sudden impact of the latter by movement of the plunger along said first-named cylinder due to the pressure in said accumulator cylinder.

40. In apparatus for producing fluid pressure, the combination with a hydraulic cylinder, of a reservoir, a pump to supply fluid to said hydraulic cylinder, a conduit to convey fluid from said hydraulic cylinder, and a valve connected to said conduit and also to said reservoir for controlling the flow of fluid through said conduit when said valve is in one predetermined position, to prevent flow of fluid from said hydraulic cylinder when in another position, and to cause fluid in said conduit to flow into said reservoir when said valve is in a third position.

41. In fluid pressure apparatus for hydraulic breakers, the combination with a source of fluid pressure supply, of a hydraulic ram comprising a cylinder with a plunger therein, means for operating said ram, a conduit for connecting said ram to a hydraulic breaker, and a valve for directing flow of liquid from said cylinder to secure movement of said plunger when said valve is in one position and to connect said cylinder through said conduit to the hydraulic breaker when said valve is in another position to produce a hammer blow in the hydraulic breaker.

42. In fluid pressure apparatus, the combination with a hydraulic accumulator adapted to be connected to a hydraulic breaker for use in a mine vein, of a source of fluid pressure supply comprising a reservoir, means for operating said hydraulic breaker including furnishing liquid under pressure and conveying the liquid under pressure to the hydraulic breaker, and valve mechanism connected between the hydraulic breaker and the accumulator and also between the hydraulic breaker and the source of supply for connecting the accumulator first to said reservoir and then to the hydraulic breaker to effect operation thereof and for connecting the hydraulic breaker to said reservoir to effect restoration of said hydraulic breaker.

43. In apparatus for producing pressure, the combination with a cylinder adapted to receive compressed air, of a piston in said cylinder, a hydraulic cylinder, a plunger extending into said hydraulic cylinder and connected to move bodily with said piston, and means for automatically returning the piston and the plunger when the pressure in said first-named cylinder is reduced.

44. In fluid pressure apparatus adapted to be connected to a hydraulic breaker for use in a mine vein, the combination with a pump, of means for operating said pump, accumulator mechanism, means for automatically regulating said accumulator mechanism, connections between said pump and the hydraulic breaker to be operated in a closed circulating system, and means associated with the accumulator mechanism for exerting a sudden impulse through said connections to effect a sudden operation of the hydraulic breaker, followed by restoration of the hydraulic breaker while the pressure medium is maintained in said circulating system.

45. In fluid pressure apparatus adapted to be connected to a hydraulic breaker for use in a mine vein, the combination with a source of liquid pressure supply, of connections between the same and the hydraulic breaker to be operated, means for confining the liquid pressure medium to said source of liquid pressure supply and said connections and said hydraulic breaker to prevent escape of the pressure medium, and means for controlling said connections to effect operation of the hydraulic breaker and the restoration thereof while the pressure medium is confined as aforesaid.

46. In fluid pressure apparatus adapted to be connected to a hydraulic breaker for use in a mine vein, the combination with a reservoir to serve as a source of fluid pressure supply, of accumulator mechanism, connections between said accumulator mechanism and the hydraulic breaker for directing the pressure medium to the latter without permitting its escape, a valve for controlling the connection between said accumulator mechanism and said hydraulic breaker to effect sudden operations of the latter, and a conduit controlled by said valve for connecting the hydraulic breaker to

said reservoir to effect restoration of the hydraulic breaker and return of the pressure medium to said reservoir.

47. In fluid pressure apparatus adapted to operate hydraulic breakers for use in a mine vein, the combination with a reservoir for the pressure medium, of a hydraulic ram comprising a cylinder with a plunger movable therein, means for exerting pressure on said plunger tending to move the same farther into said cylinder, automatic means for regulating such pressure-exerting means, a pump for pumping the pressure medium from said reservoir into said cylinder, a conduit connected between said cylinder and the hydraulic breaker, a valve for controlling the flow of the pressure medium from said cylinder through said conduit to said hydraulic breaker, and another conduit controlled by said valve for directing the pressure medium from said hydraulic breaker toward said reservoir when said hydraulic breaker is restored to initial position.

48. The combination with kerf-cutting mechanism, of a hydraulic breaking device movable into the kerf produced by said kerf-cutting mechanism, a hydraulic ram connected to said hydraulic breaking device, and means for securing movement of said hydraulic ram and then its connection to said breaking device to operate the latter with a hammer blow.

49. The combination with a flat hydraulic breaking device adapted to enter a flat kerf in a mine wall, of a hydraulic ram connected to said hydraulic breaking device, and a valve for controlling said ram to secure an initial free movement thereof while cut off from said breaking device and then connecting the ram to the latter to secure the operation thereof with a hammer blow.

50. The combination with a flat breaking device adapted to be inserted into a flat kerf in a mine wall, of means for operating said flat breaking device by expanding the same against the flat walls of the kerf, a pressure accumulator comprising a hydraulic ram connected to said operating means, and mechanism for controlling said operating means to secure movement of said ram before connection to said breaking device.

51. The combination with a hydraulic breaking device adapted to be inserted into an incision in a mine wall, of fluid pressure mechanism comprising a pump and a pressure cylinder connected to said hydraulic breaking device, a supply tank, an accumulator comprising a hydraulic ram in said cylinder, and a valve for controlling the flow from said cylinder to said breaking device and from said cylinder to said tank and from said breaking device to said tank.

52. The combination with a kerf-cutter adapted to form a kerf in a mine wall, of hydrostatically actuated means carried by said kerf-cutter to exert pressure to dislodge the coal, hydraulic pressure mechanism comprising a pressure cylinder connected to said dislodging means, a supply tank, a valve for controlling the flow of liquid from said pressure cylinder to said dislodging means and from the latter to said tank and from said cylinder to said tank, a plunger movable into said cylinder, and means for moving said plunger into said cylinder as the liquid therein flows into said tank, said plunger being adapted to exert a hammer blow on said pressure-exerting means when said cylinder is connected to said dislodging means while said plunger is moving into said cylinder.

Signed at New York city, in the county of New York and State of New York, this 26 day of December, 1924.

OLIVE EUGENIE MORGAN,
Executrix of the Estate of Edmund C. Morgan, Deceased.