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SAFETY CONTROL APPARATUS FOR ROCK DRILLS

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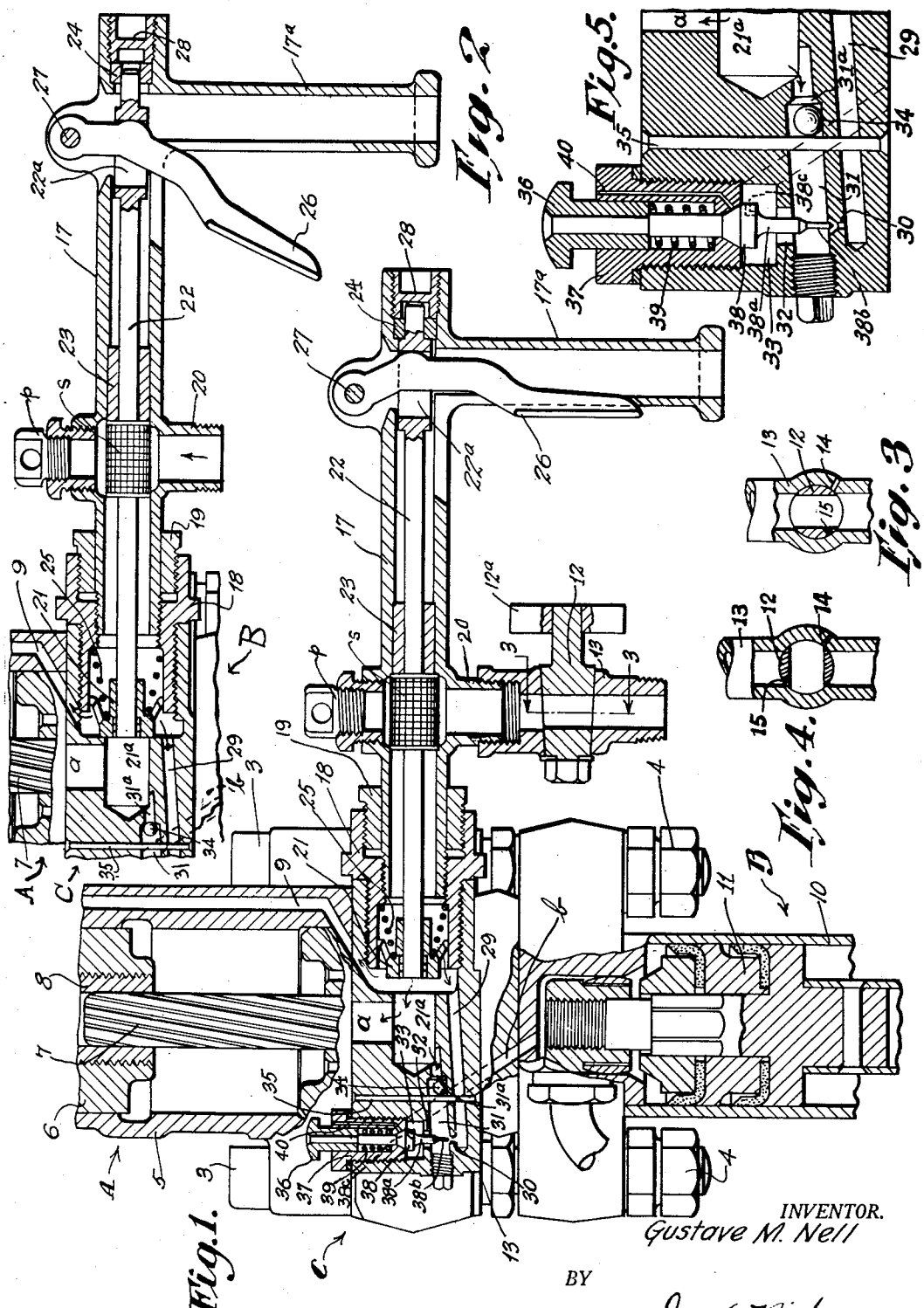


Fig. 1.

Fig. 2

Fig. 5.

Fig. 3

Fig. 4.

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SAFETY CONTROL APPARATUS FOR ROCK DRILLS

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20 Claims. (Cl. 121—9)

This invention relates to fluid pressure rock drilling machines of the percussive type provided with power means for feeding the same to the work. Such drills with extensible feed legs are ordinarily referred to as stopers. More particularly the invention relates to improved apparatus for maintaining control of the machine in emergencies and during hole starting.

As is well known considerable danger is involved in operating a stoping drill, particularly when it is of the self-rotating type, due to the fact that when the drill steel becomes stuck the machine as a whole revolves winding up the hose which supplies motive fluid to the machine. When this happens suddenly it may cause the operator to lose his balance and fall, or he may be struck by parts of the revolving machine before he can shut off the motive fluid. Another dangerous situation develops when the drill steel breaks. The sudden expansion of the pneumatic feed leg causes the drilling machine to shoot forward and if the operator attempts to close the ordinary type of throttle valve he may be injured by the broken drill steel. If he succeeds in closing the throttle valve, the machine is liable to collapse and may fall upon him.

Among the objects of the invention are to give the operator complete control of his machine at all times and especially in critical situations such as indicated above; to place certain of the control mechanism within his grasp while guiding the machine so as to be instantly available; to arrange certain parts of the control mechanism to operate automatically; to prevent both sudden extension and sudden collapse of the feed motor, and in general to improve prior arrangements in the interest of safety as well as of efficiency.

The invention provides for the automatic throttling either partially or completely of some or all of the motors of a rock drilling machine when the operator releases his guiding grasp upon the same. By preference the percussive motor and the rotation mechanism may be stopped abruptly and completely. Sudden movement of the feed motor in either direction is prevented. The best arrangement provides for a slow extension of the feed motor when the percussive motor is stopped but with supplementary controls which will permit a gradual retraction but prevent a sudden collapse. Provision may also be made for passing pressure fluid to the chuck parts of the machine subject to or independently of the previously mentioned controls. All of the above is additional to but preferably subordinated to a main throttle or control valve.

In order to illustrate the invention one concrete embodiment thereof is shown in the accompanying drawing in which:

Fig. 1 is a fragmentary view largely in section of so much of a fluid pressure stoping machine as is necessary to illustrate the invention, the controls being shown in the operating position for both the percussive motor and the feed motor;

Fig. 2 is a detail sectional view showing the safety control for the percussive motor in closed position;

Fig. 3 is a detail sectional view of the main throttle valve substantially on the line 3—3 of Fig. 1;

Fig. 4 is a view similar to Fig. 3 but showing the valve in closed position; and

Fig. 5 is a detail sectional view of part of the safety control shown in Fig. 1, but on a larger scale.

The embodiment of the invention chosen for the purpose of illustration comprises a self-rotating stoper having a percussive motor indicated generally at A, a feed motor indicated generally at B, and an intermediate portion C containing the controls. The parts may be maintained in assembled relation by suitable means such as clamping bolts having heads 3 at one end and nuts 4 at the other. Both motors may be of any suitable or desired type. The percussive motor, which is supplied with motive fluid through a passage *a*, comprises cylinder 5 within which reciprocates a hammer piston 6 which is stepped around during reciprocations by suitable rotation mechanism including a rifle bar 7 and rifle nut 8. A passage 9 leads down through the wall of cylinder 5 to direct pressure fluid carrying entrained lubricant to the chuck parts (not shown) and to prevent the cuttings from falling back into the front end of the machine, when the latter is used in upright position. The feeding motor B takes the form of a conventional feed leg having an outer cylinder 10 and an extensible piston member 11 therein, the movement of which is effected by motive fluid reaching the interior of the cylinder by a passage *b*. Since the percussive motor and the feed motor form no part of the present invention, further description thereof is omitted.

The admission of motive fluid to the stoping machine is controlled by a main throttle valve 12 of conventional form adjustably mounted in a fitting 13 and provided with a control handle 12*a*. The fitting has a restricted port 14 therethrough and the valve has a restricted port 15 for a puspose presently to be described.

The invention involves additional means for controlling or varying the operation of one or both of motors A and B independently of and without changing the adjustment of throttle valve 12. Such means include a safety device for stopping percussive motor A in an emergency. In the preferred arrangement herein shown the guide handle 17 is utilized for this purpose. It is se-

cured to a threaded cap 18 which closes the large end of a transverse bore in part C. A threaded locking collar 19 may be used to clamp guide handle 17 securely in place. Handle 17 is made hollow to serve as the inlet for motive fluid, a threaded nipple being provided at 20 to which fitting 13 of main throttle valve 12 is conveniently connected. A screen *s* may be disposed in handle 17 to prevent passage of foreign material in the motive fluid and lubricant may be supplied through plug *p*.

The safety device comprises a valve or head 21 mounted on a rod 22 slidably supported in bearings 23 and 24 in hollow handle 17, the head 21 being normally forced by the pressure of the entering motive fluid and by a coil spring 25 to close bore 21*a* (Fig. 2) of intermediate member C so as to cut off the admission of motive fluid through passage *a* to percussive motor A. The grip extension 17*a* of guide handle 17 is cut away to receive a manual control lever 26 which is pivoted at 27 and extends through a loop portion 22*a* of rod 22 for the purpose of retracting plunger valve 21. As indicated in Fig. 1, the operator holds lever 26 in retracted position when he grasps handle extension 17*a* thus permitting percussive motor A to operate. But the instant he releases his grip the pressure of the entering motive fluid and spring 25 force the plunger head 21 to closed position (Fig. 2) and stop the percussive motor. A plug 28 retains bearing 24 in place and serves as a stop for rod 22.

The safety device just described does not fully cut off motive fluid to feed motor B since it does not close a passage 29 which has a restricted port 30 communicating with passage 31 whence a port 32 leads to bore 33 from which extends passage *b* to the feed motor. Hence, even when safety valve 21 is closed, as indicated in Fig. 2, motive fluid in restricted amount determined by the size of port 30 continues to pass to feed motor B so that the latter will not collapse but rather will feed forward or extend slowly.

Passage 31 is restricted slightly at 31*a* to form a port opening into bore 21*a* which port is controlled by a check valve in the form of a ball 34 maintained adjacent the port by a stop pin 35. This valve is important since it admits motive fluid in considerable volume from bore 21*a* when safety valve 21 is in retracted or open position (Fig. 1) to insure adequate power for feeding the stoper forward when percussive motor A is in operation, but immediately closes port 31*a* to prevent venting of the feed motor through the percussive motor when safety valve 21 is closed (Fig. 2). Accordingly, check valve 34 is essential to prevent sudden collapse of the feed motor when the safety valve 21 is closed to stop percussive motor A.

To give the operator complete control at all times of the feeding motor a normally inoperative control member is provided for effecting a gradual relief of the pressure in the feed leg. In the form shown a push member 36 is slidably supported in a guide member or plug 37 threaded into bore 33 in intermediate member C for moving valve head 38 into contact with a seat in port 32. A spring 39 normally maintains plunger 36 and valve 38 at the limit of their outward movement and port 32 unobstructed save for an extension 38*a* on the valve head which projects through port 32 and carries a needle end 38*b* in line with restricted port 30. When plunger 36 is forced inwardly, head 38 closes port 32 but permits motive fluid to flow in lesser degree through a small angular passage 38*c*. At the same time valve head 38 permits partial escape of pressure in the feed leg to atmosphere by uncovering a vent passage 40 in guide member 37. The quantity of fluid escaping through vent passage 40 exceeds that supplied through restricted passage 38*c* with the result that pressure in the feed leg is gradually weakened. Needle end 38*b* is smaller than port 30 and its sole purpose is to clean port 30 in the event that the same becomes clogged with foreign matter such as rust, dirt, chips, etc.

The operation of the stoping machine may be described as follows. Assuming that the operator is about to start the drilling of a hole he supports the machine with his hand on grip 17*a* but with safety control handle 26 in the closed position shown in Fig. 2. He then opens main throttle valve 12 sufficiently to close ports 14 and 15 but to allow a restricted flow of motive fluid into the stoping machine. The percussive motor is shut off since safety valve 21 is seated over bore 21*a* but passage 29 is open and motive fluid enters the feed motor through port 30, passage 31, port 32, bore 33 and passage *b*, slowly feeding the drill upwardly until the drill steel strikes the face of the rock. Ball valve 34 will go to closed position to prevent the escape of motive fluid from the feeding motor to atmosphere through the percussive motor. The operator then extends his hand over safety control lever 26 retracting safety valve 21 whereupon the percussive motor operates, striking the drill steel with a force and speed depending upon the amount of opening of throttle valve 12. When the hole in the rock is "collared" to a sufficient depth to support the stoper, main throttle valve is opened to "full on" position and the drilling proceeds with a full power. It will now be noted that check valve 34 is against its stop 35 thereby admitting motive fluid in considerable volume through large port 32 to augment the air previously admitted through restricted port 30 to the feed motor. Due to the small size of the port 30, the air previously admitted through this port does not have sufficient pressure to hold the check valve 34 on its seat against the pressure of live air admitted through passage 39*a*.

If the drill steel becomes stuck the operator releases safety lever 26 whereupon safety valve 21 closes automatically (Fig. 2), immediately stopping the percussive motor and the rotation of the drill steel so that there is no rotating of the machine as a whole. Also, the feed leg cannot collapse because check valve 34 promptly closes port 31*a* and motive fluid continues to be fed to the feed motor through restricted port 30, which takes care of any possible leakage. Auxiliary control plunger 36 may be manipulated by the operator while he pushes and pulls upon guide handle 17 to release the steel. Having released the drill steel he again grips safety lever 26 and the drilling continues as before. When the operator is ready to bring the machine to collapsed position to change the drill steel, safety lever 26 is released to stop the percussive motor and main throttle valve 12 is turned to the "off" position (Fig. 4) whereupon the pressure fluid in the feed motor may bleed back through restricted port 15 in throttle valve 12 and atmospheric port 14 in casing 13 with the result that the feed motor will collapse slowly. If it is desired to cause the feed to collapse more quickly, auxiliary control plunger 36 may be pressed in whereupon the feed will also bleed through additional vent 40.

In view of the function of the passage 29 in admitting air to the feed motor, it might appear at first that the passage 31a is unnecessary. However, if the passage 29 is designed to perform the functions described above, it will not have sufficient capacity to obviate the necessity of passage 31a and check valve 34. The passage 29 may be of area equal to that of passage 31a but its entrance to the feed motor is very materially restricted at the port 30. If passage 29 did not have the restriction 30 the feed would jump more or less violently when the valve 12 is opened. The relatively small capacity of port 30 is insufficient in itself, because there is almost always a certain amount of leakage present, particularly past the feed cup leathers, which is considerable when the latter have been in use for any appreciable time. Furthermore, face joints become battered and leaky after use, largely as a result of muck entering when disassembled and again assembled and being forced hard on the faces. Even assuming all faces are of perfect shape and there is no leakage whatsoever, when the hammer motor is operated by the opening of valve 21, the hammer piston reciprocations may cause a violent relative reciprocation of the feed piston in the feed cylinder, and the feed therefore does not have its full power because the compression reciprocation forces air out of the feed faster than it can reenter back through the small port 30 and the mean effective pressure in the feed is thereby lowered. Furthermore, in the usual application of this type of machine, gravity has considerable effect on the rearward impulse and is added to the force of the rearward piston reciprocation. Therefore, in practice, the check valve 34 opens during the relative reciprocation of the feed piston when the top feed piston chamber is suddenly enlarged, and being less restricted than the port 30 permits a sufficient volume of air to re-enter and on the opposite reciprocation prevents its rapid egress so that the mean effective pressure in the feed is higher than it would be if port 30 were used alone without the aid of passage 31a. From the above, it will be clear that the present device prevents sudden fluctuations in the pressure of the feed.

From the above it will be apparent that this system of controls takes care of all situations encountered in operating a self-rotating stoper and is of especial value in starting or collaring a hole in which case there is a tendency for the machine as a whole to crawl and get away from the operator. It is also of importance, in cases of a broken or stuck steel, in that danger is avoided due to the fact that the operator has practically instantaneous means of shutting off his hammer motor without liability of the feed motor collapsing suddenly. Many other advantages will be apparent to the experienced operator.

While the invention has been herein disclosed in what is considered to be a preferred form, it is to be understood that the invention is not limited to the specific details thereof but covers all changes, modifications, and adaptations within the scope of the appended claims.

I claim as my invention:

1. A fluid pressure operated machine comprising a percussive motor, a feed motor therefor, a manually retractable valve for controlling the motive fluid supply to said percussive motor and a portion of the motive fluid supply to said feed motor, means automatically moving said valve to closed position when manually released, and means for preventing sudden fluctuations of motive fluid pressure in said feed motor when said valve cuts off the motive fluid supply to said percussive motor.

2. In a fluid pressure operated stoping drill, a percussive motor, a feed motor therefor, a motive fluid control member having means operating automatically to shut off the motive fluid to said percussive motor, a fluid passageway for the feed motor and means controlling the admission of motive fluid to and the venting of the same from said feed motor, the last-mentioned means being so constructed and arranged to maintain the feed motor against sudden collapse and sudden extension when said member cuts off the motive fluid supply to said percussive motor, and including a valve for automatically blocking the fluid passageway to the feed motor.

3. In a drilling machine having a percussive motor and a feeding motor, control means for said motors including a valve having means automatically actuating the same to shut off the motive fluid supply to said percussive motor, means providing for the admission and egress of pressure fluid to and from said feeding motor including a relatively small port and a relatively larger port, and means effective when said valve goes to closed position for preventing egress of pressure fluid from said feeding motor through said larger port.

4. A stoping machine having a percussive motor and a feeding motor, means for supplying motive fluid to said motors including a passage having a small port and a second passage having a relatively larger port for passing pressure fluid to and from said feeding motor, a spring-pressed valve arranged to be held manually in retracted position and when released automatically shutting off the supply of motive fluid to said larger port, and means preventing egress of pressure fluid from said feeding motor through said larger port to said percussive motor while permitting fluid to flow to and from said feeding motor through said small port.

5. In a drilling machine having a percussive motor and a feeding motor, a single control for fluid for both said motors, additional subordinate and mutually independent controls for said motors, and means yieldingly maintaining one of said additional controls in closed position to provide a safety cut-off for one of said motors.

6. In a drilling machine having a percussive motor and a feeding motor, a single control for fluid for both said motors, additional subordinate and mutually independent controls for said motors, means yieldingly maintaining one of said additional controls in closed position to provide a safety cut-off for one of said motors, and means yieldingly maintaining the control for the other motor in open position.

7. In a drilling machine having a percussive motor and a feeding motor, a main throttle valve for controlling the admission of motive fluid to the machine, a spring pressed plunger for cutting off the supply of motive fluid to one of said motors, a guide handle on said machine, and manual means on said handle for moving said plunger from closed position to admit motive fluid.

8. In a drilling machine having a percussive motor and a feeding motor, a main throttle valve for controlling the admission of motive fluid to the machine, means including a spring-pressed plunger for cutting off the supply of motive fluid entirely from one motor and partially from the other motor, a guide handle on said machine

having a grip portion, and means including an actuating lever on said grip portion for moving said plunger to open position.

9. A fluid pressure stoping machine having a percussive motor, a feed leg for advancing said motor, a main throttle valve for controlling the admission of motive fluid to the machine, a resiliently actuated safety cut-off valve normally in closed position to close off the percussive motor from the fluid supply, said stoper having a restricted port uncontrolled by said cut-off valve for passing motive fluid to said feed leg, a larger supply port for motive fluid for said feed leg under control of said cut-off valve, and valve means for controlling both said ports.

10. A fluid pressure stoping machine having a percussive motor, a feed leg for advancing said motor, a self-closing valve normally in closed position for cutting off the supply of motive fluid to said percussive motor, a normally open passage uncontrolled by said valve having a restricted port for passing motive fluid in limited amount to said feed leg, an additional passage under control of said valve having a port for supplying motive fluid in larger quantity to said feed leg, and means for preventing reverse movement of fluid in said additional passage.

11. A fluid pressure stoping machine having a percussive motor, a feed leg for advancing said motor, a self-closing valve normally in closed position for cutting off the supply of motive fluid to said percussive motor, a normally open passage uncontrolled by said valve having a restricted port for passing motive fluid in limited amount to said feed leg, an additional passage under control of said valve having a port for supplying motive fluid in larger quantity to said feed leg, and a manually operable valve member for controlling one of said ports.

12. A fluid pressure stoping machine having a percussive motor, a feed leg for advancing said motor, a valve normally in closed position for cutting off the supply of motive fluid to said percussive motor, a normally open passage uncontrolled by said valve having a restricted port for passing motive fluid in limited amount to said feed leg, an additional passage under control of said valve having a port for supplying motive fluid in larger quantity to said feed leg, said ports being in alignment, and a normally open manually operable valve for controlling one of said ports and for cleaning the other.

13. A fluid pressure stoping machine having a percussive motor, a feed leg for advancing said motor, a valve normally in closed position for cutting off the supply of motive fluid to said percussive motor, a normally open passage uncontrolled by said valve having a restricted port for passing motive fluid in limited amount to said feed leg, an additional passage under control of said valve having a port for supplying motive fluid in larger quantity to said feed leg, means for preventing reverse movement of fluid in said additional passage, and manually operable means arranged to control one of said ports and to provide a vent for said feed leg.

14. A fluid pressure stoping machine having a manually operable valve member for controlling said larger port, said stoper having a normally closed vent controlled by said member.

14. A fluid pressure stopping machine having a percussive motor, a feed leg for advancing said motor, a valve normally in closed position for cutting off the supply of motive fluid to said percussive motor, a normally open passage uncontrolled by said valve having a restricted port for passing motive fluid in limited amount to said feed leg, an additional passage under control of said valve having a port for supplying motive fluid in larger quantity to said feed leg, means for preventing reverse movement of fluid in said additional passage, and manually operable means arranged to control one of said ports and to provide a vent for said feed leg.

15. A percussive drilling machine having a fluid pressure feed motor for advancing the machine to the work and a plurality of supply passages for motive fluid, said passages having differential ports in alignment, and a normally open spring actuated valve plunger having a head to close the larger of said ports and an extension projecting through said larger port to clean said smaller port.

16. A percussive drilling machine having a fluid pressure feed motor for advancing the machine to the work and a plurality of supply passages for motive fluid, said passage having differential ports in alignment, and a normally open spring actuated valve plunger having a head to close the larger of said ports and an extension projecting through said larger port to clean said smaller port, said machine having a venting passage uncovered by said head when said plunger is moved to close said port, and means on said head permitting fluid in limited amount to pass the same when said plunger is moved to port-closing position.

17. A percussive drilling machine having a fluid pressure feed motor for advancing the machine to the work and a passage for supplying motive fluid to said feed motor, a manually controlled valve plunger having a head for controlling said passage, said machine having a venting passage uncovered by said head when said plunger is moved to close said port, and means on said head permitting fluid in limited amount to pass the same when said plunger is moved to port-closing position.

18. In a drilling machine having a percussive motor and a feeding motor, a single control for the motive fluid to said machine, additional subordinate and mutually independent controls for said motors, means yieldingly maintaining the independent control for said percussive motor in closed position to provide a safety cut-off, and means preventing sudden release of motive fluid from said feeding motor.

19. In a drilling machine having a percussive motor and a feeding motor, a single control for the motive fluid to said machine, additional subordinate and mutually independent controls for said motors, a fluid connection between said motors, means yieldingly urging the independent control for said precussive motor to closed position to provide a safety cut-off, and means preventing venting of said feeding motor through said connection and said percussive motor when said safety cut-off operates to stop said percussive motor.

20. In a drilling machine having a percussive motor and a feeding motor, a single control for the motive fluid to said machine, additional subordinate and mutually independent controls for said motors, a fluid connection between said motors, means yieldingly urging the independent control for said percussive motor to closed position to provide a safety cut-off, and a check valve in said fluid connection for preventing venting of said feeding motor through said connection and said percussive motor when said safety cut-off operates to stop said percussive motor.

GUSTAVE M. NELL.

CERTIFICATE OF CORRECTION.

Patent No. 1,928,700. October 3, 1933.

GUSTAVE M. NELL.

It is hereby certified that error appears in the printed specification of the above numbered patent requiring correction as follows: Page 4, line 62, claim 13, strike out the numeral and words "14. A fluid pressure stoping machine having" and insert instead fluid in larger quantity to said feed leg, and; and line 66, claim 14, for "stopping" read stoping; and that the said Letters Patent should be read with these corrections therein that the same may conform to the record of the case in the Patent Office.

Signed and sealed this 21st day of November, A. D. 1933.

(Seal)

F. M. Hopkins
Acting Commissioner of Patents.