Nov. 29, 1966 J. T. DOYLE 3,287,996

DRILL FEED

Filed Nov. 23, 1964

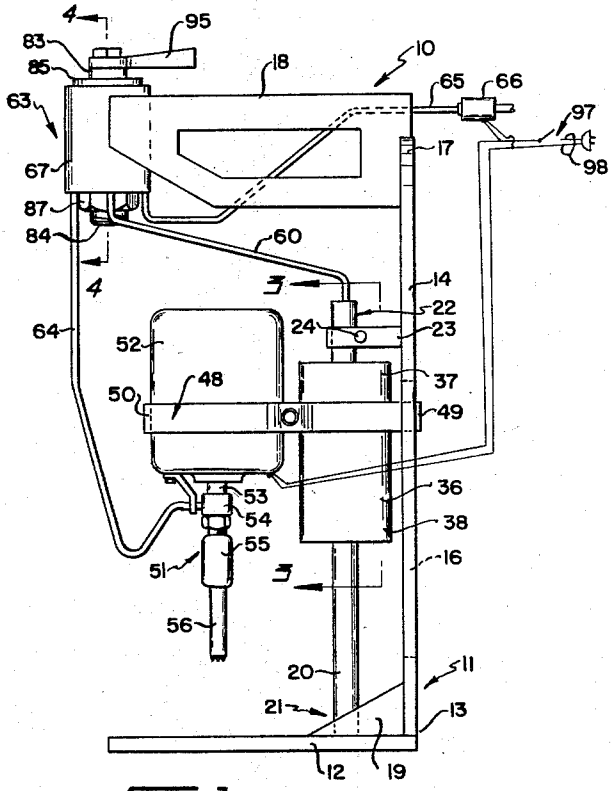


Fig. 1.

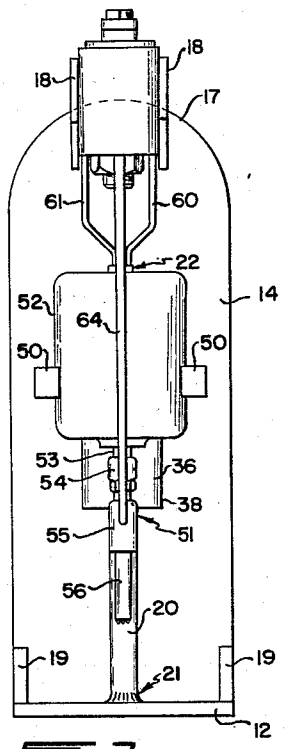


Fig. 2.

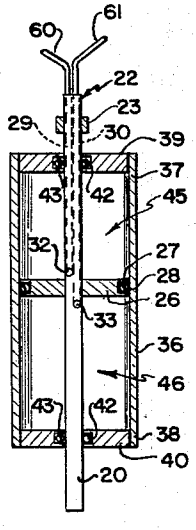


Fig. 3.

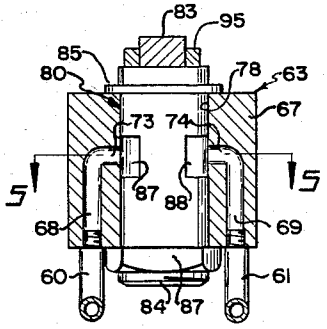


Fig. 4.

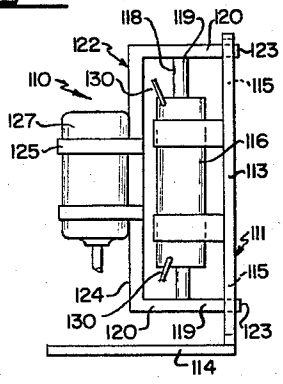


Fig. 6.

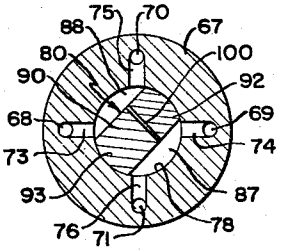


Fig. 5.

INVENTOR
JAMES T. DOYLE
BY
Fetherstonhaugh & Co.
ATTORNEYS

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DRILL FEED

James T. Doyle, 2220 E. 6th Ave., Vancouver, British Columbia, Canada

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This invention relates to power drills and more particularly to the feed apparatus by means of which a drill may be advanced towards the work.

In the use of power drills, particularly where a relatively hard material is to be drilled, the use of a coolant to lower the temperature of the drill at the work face, is essential. Most drilling apparatus therefore is provided with means whereby a cooling fluid may be directed between the drill bit and the work. However, in such apparatus there is usually no correlation between the movement of the bit into the work and the ejection of the cooling fluid. The ejection of cooling fluid and the advancement of the drill bit into the work being independent of one another sometimes results in damage to the work and to the drill should the flow of cooling fluid, for one reason or another, stop.

The present invention provides a feed apparatus for drills in which the cooling fluid also serves as a means whereby the drill may be advanced into the work, the operation of the cooling fluid being such that the drill may not be advanced unless, at the same time, a cooling fluid is ejected to cool both the bit and the work.

The present invention also provides a drill feed apparatus in which the rate of flow of the cooling fluid is entirely dependent upon the rate of the advancement of the drill into the work so as to provide sufficient cooling fluid where high boring speeds and, consequently, high rate of advancement produces excessive heat between the parts.

The present invention comprises a supporting frame, means for slidably mounting a drill on said frame for reciprocal movement towards and away from the work, a hollow cylinder member, a piston member in said cylinder member dividing the latter into two chambers of variable size, each of said chambers being arranged to be filled with a fluid, means rigidly connecting one of the members to the frame, means connecting the other member to the drill for cooperative movement therewith, valve controlled distributor means for selectively and alternately connecting a selected one of either of the chambers with the drill bit, and means directionally controlled by said distributor means, operable when one of the chambers is connected to the bit, for supplying the other chamber with a fluid under pressure to thereby move the movable member and hence the drill.

In the drawings which illustrate the embodiments of the invention,

FIGURE 1 is a side elevation of one embodiment of the invention showing the drill mounted thereto,

FIGURE 2 is a front elevation of the invention of FIGURE 1,

FIGURE 3 is a sectional view taken on the line 3—3 of FIGURE 1,

FIGURE 4 is an enlarged view taken along line 4—4 of FIGURE 1,

FIGURE 5 is a sectional view taken on line 5—5 of FIGURE 4, and

FIGURE 6 is a side elevation illustrating another embodiment of the invention.

Referring to the drawings, FIGURES 1 to 5 thereof illustrate one embodiment **10** of the invention which comprises a heavy frame **11** having a horizontal base **12** at one edge **13** of which is welded a heavy vertical back

plate **14** having a longitudinally extending vertical slot **16** formed therein. At the upper end **17** of the back plate are fixed, as by welding, a pair of spaced parallel side plates **18**, the latter extending outwardly over said base **12**. Gussets **19** are provided between the back plate **14** and base **12** in order to strengthen the frame.

Mounted on the frame adjacent to but spaced outwardly from the slot **16** is an elongated vertical rod or shaft **20**, the lower end **21** being fixed to the base **12** as by welding, and passes at its upper end **22** through a suitably sized hole in a horizontal bracket **23**, the latter being secured as by welding to the back plate **14**. A set screw **24** is provided in the bracket **23** by means of which the rod or shaft **20** may be firmly and immovably positioned therein relative to said frame **11**. Rigidly secured to the shaft **20** at or near its middle length, is a thin piston **26**. This piston may be formed as an integral part of the shaft when machining the latter, or may be welded thereto, and is provided with a peripheral groove **27** adapted to receive a rubber O-ring **28**. The rod or shaft **20** is also provided with a pair of longitudinally extending internal passages **29** and **30** extending from the upper end **22** of said rod, passage **29** having a port **32** adjacent to but above the piston **26** and passage **30** having a port **33** adjacent to but below said piston.

A thick walled elongated cylinder **36** is arranged over the shaft and piston **26** and has an inside diameter a little less than the diameter of the O-ring so that a tight but yet slidable seal is obtained. Each of the ends **37** and **38**, respectively, of the cylinder is provided with annular cylinder heads **39** and **40**, respectively, each being provided with internal annular grooves **42** adapted to receive rubber O-rings **43** by means of which each affects a tight yet slidable seal with the rod or shaft **20**. The piston **26** thereby divides the cylinder into two variably sized chambers, an upper chamber **45** and a lower chamber **46**.

Secured to the cylinder **36** is a horizontally extending bracket **48** having a dog or lug **49** extending outwardly of the walls of the cylinder and into the slot **16** of the back plate **14**. The lug **49** is slidable in said slot and permits vertical movement of the cylinder but prevents rotation of the latter. The bracket **48** is formed at its side opposite the lug **49** with a pair of spaced arms **50**.

In the use of the apparatus, it is proposed to employ an electrically powered drill which may be secured either as a permanent element of the apparatus or, if desired, may be temporarily affixed thereto.

The numeral **51** designates a relatively standard type of drill having an enlarged motor or casing **52** and extending therefrom a drive shaft **53**. The drill is arranged and located relative to the apparatus with the arms **50** extending around and embracing the casing **52** so that the drive shaft **53** extends vertically downwardly in parallel alignment with the rod or shaft **20**. The arms **50** may be either welded to said casing if it is desired to permanently mount the drill. However, if it is desired to temporarily mount the drill, the arms may be formed so that they extend completely around the casing and tightened thereover by means of a wing nut or the like, not shown. The type of drill chosen shall be such that the drive shaft **53** thereof may be provided with a water swivel **54** and chuck **55** adapted to hold a hollow bit **56**. This type of drive and the component parts thereof are of known manufacture and usage and need not be further described.

The passages **29** and **30** in the rod **20** are each connected through conduits **60** and **61**, respectively, to a valve-controlled distributor **63**, the latter being secured firmly between side plates **18**. The distributor **63** also has a connection by a flexible conduit **64** to the water swivel **54** and is also connected by a conduit **65** to an

electrically driven pump **66**, the latter being connected to a source of fluid, such as water, not shown.

The distributor **63** takes the form of a short, thick walled, hollow cylinder **67**, having four passageways **68**, **69**, **70** and **71** extending through its wall and terminating in ports **73**, **74**, **75** and **76**, respectively, spaced equidistantly apart and in the same radial plane, at the inner surface **78** of the cylinder walls. Conduits **60** and **61** are each connected to passageways **68** and **69**, respectively, while conduits **64** and **65** are each connected to passageways **70** and **71**, respectively. The distribution of coolant entering the distributor by the conduit **65** is controlled by a valve **80**, the latter being cylindrical in shape adapted to make a tight, yet slidable contact with the inner surface **78** of the hollow cylinder. The valve extends outwardly at each of its ends **83** and **84**, respectively, beyond the ends of the cylinder and is provided with an annular shoulder **85** adjacent its end **83**, and with a nut **87** at its other end **84** by means of which it may be restrained from axial movement relative to cylinder **67**. The valve **80** is also provided with a pair of transversely extending parallel slots formed diametrically opposite each other near its middle length and located in the same radial plane, when the valve is properly located, as the ports **73–76**. The slots **87** and **88** are spaced apart, extending between them an oblong portion **90**, the ends **92** and **93** of which still maintain a slidable, yet tight fit with the walls of the cylinder **67**.

The end **83** of the valve is provided with a handle **95** by means of which the valve may be rotatably moved between its operative positions. One of these operative positions of the valve is shown in solid lines in FIGURE 5, in which the latter is located so that ports **74** and **76** are connected through slot **87**, while ports **73** and **75** are connected through slot **88**. With this setting of the valve, it will be seen that chamber **46** is therefore connected to the source of pressurized coolant, whereas chamber **45** is connected to the water swivel **54**. It may be observed that the valve **80** may also be positioned so that its ends **92** and **93** may confront and close ports **76** and **75** to thereby shut off the flow of coolant to the distributor.

In the operation of the apparatus, the conduit system and chambers **45** and **46** are first filled with a coolant, and the drill **51** and pump **66** set in operation through the closure switch **97** which is connected to both the electric motor driving the pump and the drill through leads **98**. The valve **80** is then positioned so as to connect chamber **45** with a source of pressurized coolant so as to move cylinder **36** and with it the drill upwardly along the rod **20**. This action exhausts the pressurized coolant from chamber **46** through the distributor and into the water swivel **54**. When the drill has been moved upwardly to provide sufficient room for the work to be placed thereunder, the position of the valve is then reversed to connect chamber **46** with the pressurized source coolant and to connect chamber **45** with the swivel, thereby moving the cylinder **36** and with it the drill towards the work and, at the same time, exhausting through the distributor, the coolant in chamber **46**, said coolant flowing into the swivel and through the drill bit. The pressurized coolant acting on the cylinder **36** to continually feed the latter into the work and, at the same time, exhaust the coolant fluid in chamber **45** into the swivel and through the drill bit. As the drill advances, it will be seen that coolant is continually fed through the drill bit, the rate of advancement of the drill through the work governing the rate of flow of the coolant fluid from chamber **45**. It will be seen, therefore, that the drill cannot be advanced into the work without the emission of coolant through the drill bit. This safety feature will always insure the continual flow of coolant while the drill is working. In some cases where the material to be drilled is extremely hard, a feature which naturally tends to retard the progress of the drill through the work, and therefore perhaps result in an insufficient flow of coolant fluid. A valve may be employed having a thin passageway **100** extending between the slots **87** and **88**. The provision of this passageway **100** which must be of a sufficiently small diameter so as not to reduce the operative pressures in the conduit **65**, will always insure that when the drill is working, coolant will be supplied via slots **87** and **88** directly from conduit **65** into the water swivel **54** to supplement the coolant being exhausted from chamber **45**.

FIGURE 6 illustrates another embodiment **110** of the apparatus. Apparatus **110** includes the provision of a frame **111** constructed in the same manner as frame **11** of apparatus **10** having a back plate **113** and a base **114**, said back plate also having a vertically extending slot **115** formed therein. Apparatus **110**, however, differs from apparatus **10** in the provision of a cylinder **116**, similar in construction to cylinder **36**, but ridigly secured by brackets **117** to the back plate **113**. Apparatus **110** is also provided with a piston carrying rod **118** extending through the cylinder **116** and secured at its ends **119** to spaced horizontal arms **120** of a carrying bracket **122**. The arms **120** slidably extend through the slot **115** at their ends **123** and are secured in spaced apart relationship by means of a vertically extending frame member **124** at their other end, said frame member being provided with clamps or brackets **125** by means of which a drill **127** may be secured to said carrying bracket for cooperative reciprocal movement with the rod **118**.

In apparatus **110**, as the cylinder **116** is fixed, it may be connected directly from each end thereof by means of conduits **130** to a distributor, in the same manner as passageways **29** and **30** of the rod **20** are connected to the distributor **63**. The operation of apparatus **110** is exactly the same as the operation of apparatus **10**, the only difference lying in a reciprocating rod rather than a reciprocating cylinder.

What I claim as my invention is:

1. Feed apparatus for a drill having a tubular bit comprising a supporting frame, means for slidably mounting a drill on said frame for reciprocal movement towards and away from the work, a hollow cylinder member, a piston member in said cylinder member dividing the latter into two chambers of variable size, each of said chambers being arranged to be filled with a fluid, means rigidly connecting one of the members to the frame, means connecting the other member to the drill for cooperative movement therewith, valve controlled distribution means for selectively and alternately connecting a selected one of either of the chambers with the drill bit, and means directionally controlled by said distribution means, operable when one of the chambers is connected to the bit, for supplying the other chamber with a fluid under pressure to thereby move the movable member and hence the drill.

2. Feed apparatus for a drill having a tubular bit comprising a supporting frame, means for slidably mounting a drill on said frame for reciprocal movement towards and away from the work, a hollow cylinder member, a piston in said cylinder member dividing the latter into two chambers of variable size, each of said chambers being arranged to be filled with a fluid, an elongated piston rod member connected to the piston and extending outwardly beyond the cylinder, said piston rod having a pair of fluid passageways extending longitudinally of the rod from an end thereof, and each terminating at opposite chambers, one of said members being rigidly connected to the frame and the other to the drill for cooperative movement with the latter, valve controlled distributor means having a conduit connected to each of the passageways and to the bit for selectively and alternately connecting a selected one of either of the chambers with said bit, means directionally controlled by said distributor when one of the chambers is connected to the bit for supplying the other chamber with a fluid under

pressure, to thereby move the movable member and hence the drill.

3. Feed apparatus for a drill having a tubular bit comprising a supporting frame, means for slidably mounting a drill on said frame for reciprocal movement towards and away from the work, a hollow cylinder connected to the drill for reciprocal movement therewith, a piston slidably mounted in the cylinder and rigidly connected to the frame, said piston dividing the cylinder into two variably sized chambers, valve controlled distributor means for selectively and alternately connecting a selected one of either of the chambers with the drill bit, and means directionally controlled by said distribution means, operable when one of the chambers is connected to the bit, for supplying the other chamber with a fluid under pressure to thereby move the movable member and hence the drill.

4. Feed apparatus for a drill having a tubular bit comprising a supporting frame, means for slidably mounting a drill on said frame for reciprocal movement towards and away from the work, a hollow cylinder connected to the drill for reciprocal movement therewith, said cylinder having annular sealing means at each end, an elongated rod extending through both annular sealing means and rigidly connected at each end to the frame, a piston fixedly mounted on the rod adjacent the latter's middle length, said piston dividing the cylinder into two variably sized chambers, a pair of fluid passageways formed through the rod extending longitudinally thereof from one end and each terminating in ports in each chamber adjacent opposite sides of the piston, valve controlled distributor means having a conduit connected to each of the passageways and to the bit for selectively and alternately connecting a selected one of either of the

chambers with said bit, means directionally controlled by said distributor when one of the chambers is connected to the bit for supplying the other chamber with a fluid under pressure to thereby move the movable member and hence the drill.

5. Feed apparatus for a drill having a tubular bit comprising a supporting frame, means for slidably mounting a drill on said frame for reciprocal movement towards and away from the work, a hollow cylinder rigidly connected to the frame, said cylinder being closed at one end having annular sealing means at the other end, a piston mounted in the cylinder for reciprocal movement, said piston dividing the cylinder into two variably sized chambers, the latter arranged to be filled with a fluid, a piston rod connected at one end to the piston and extending at its other end through the annular sealing means, said piston rod operatively connected to the drill for mutual reciprocal movement with the latter, a valve controlled distributor having a conduit connected to each of the chambers, the bit and a source of fluid under pressure adapted to be alternately and selectively operated to selectively connect a selected one of either of the chambers with the drill bit and at the same time connect the chamber not connected with the bit, to the source of fluid under pressure, to thereby move the piston and hence the drill.

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FRANCIS S. HUSAR, *Primary Examiner.*