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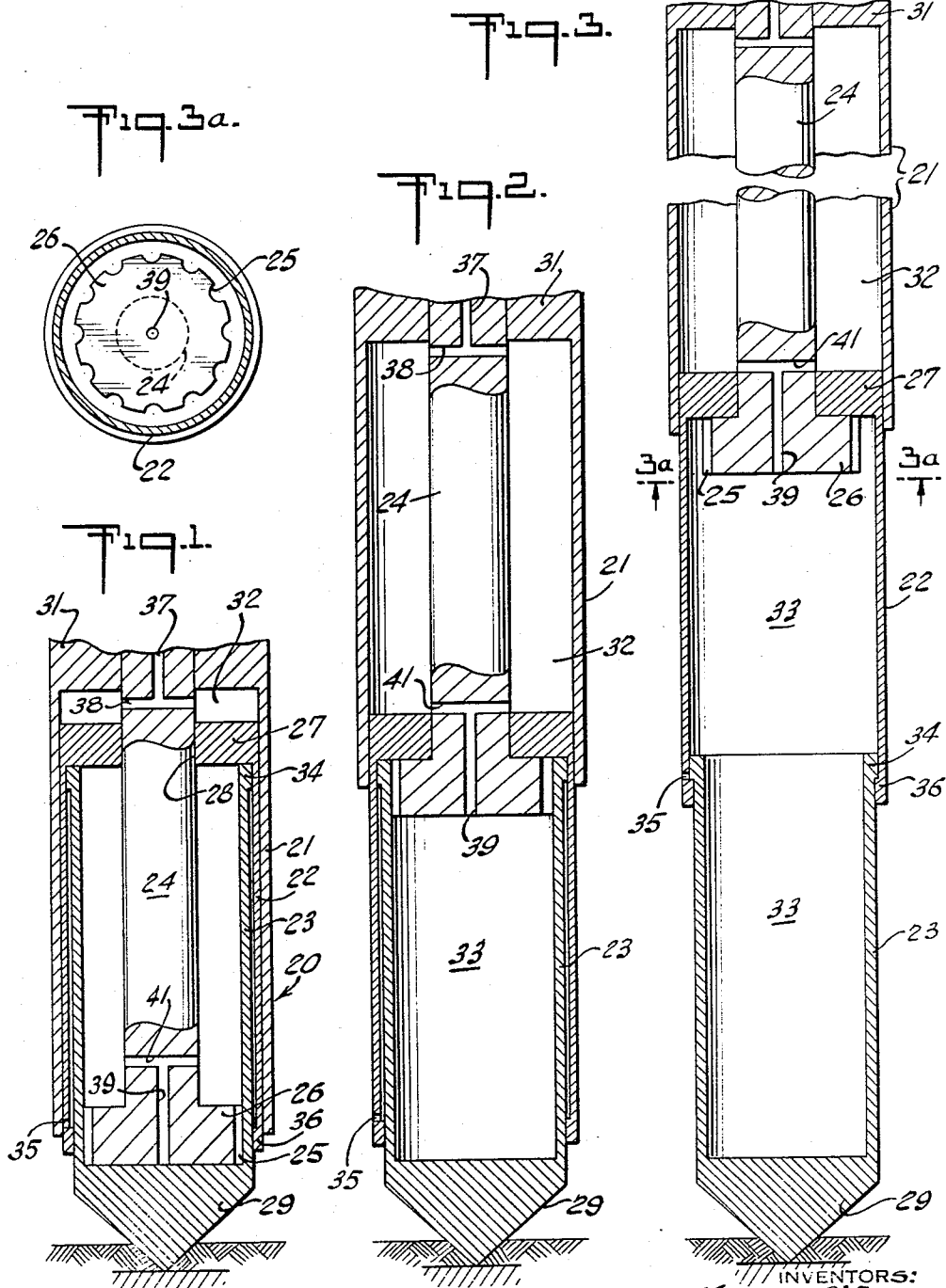
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2,804,848

DRILLING APPARATUS

Filed Sept. 30, 1954

5 Sheets-Sheet 1



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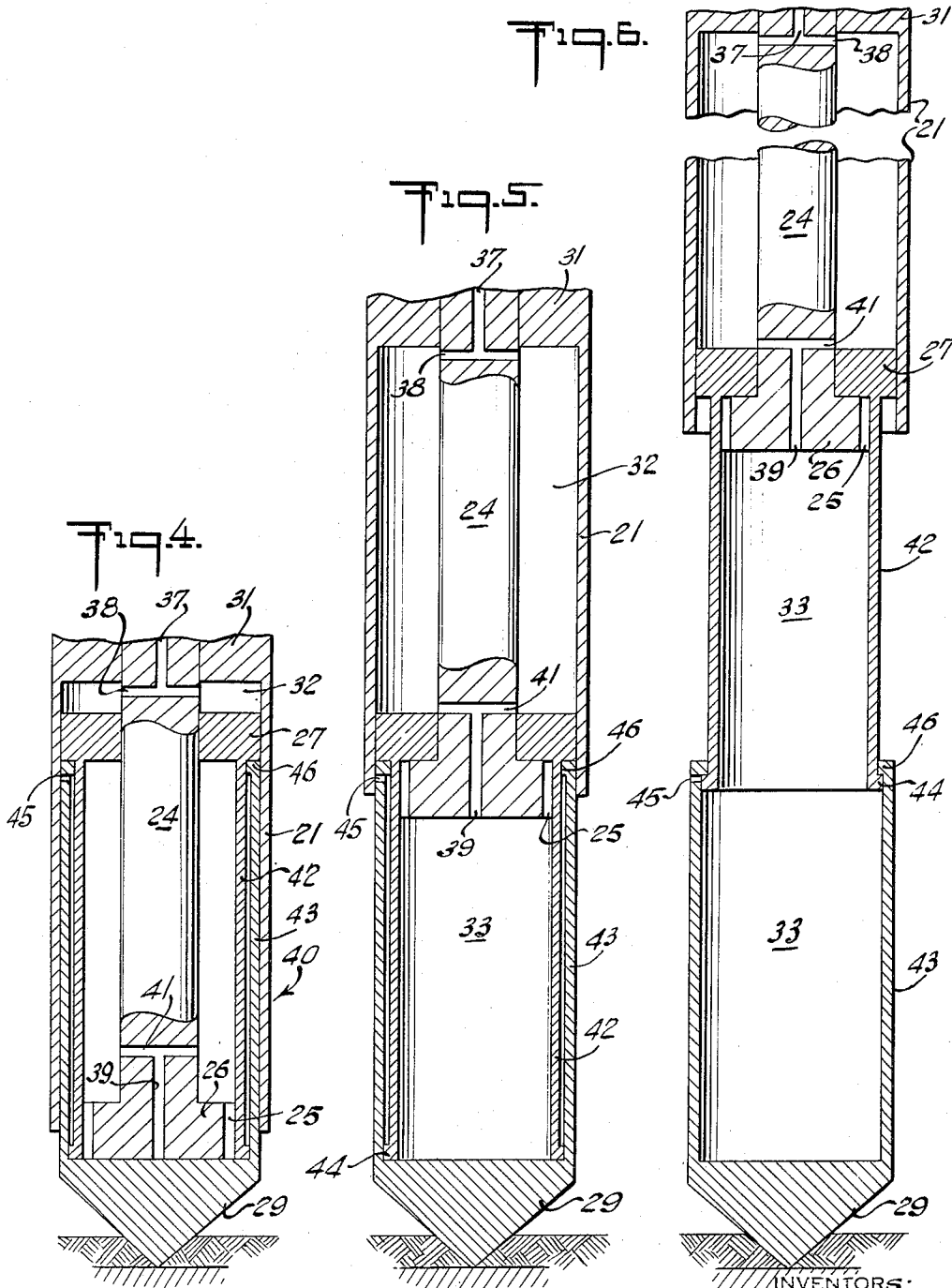
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5 Sheets-Sheet 2



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DRILLING APPARATUS

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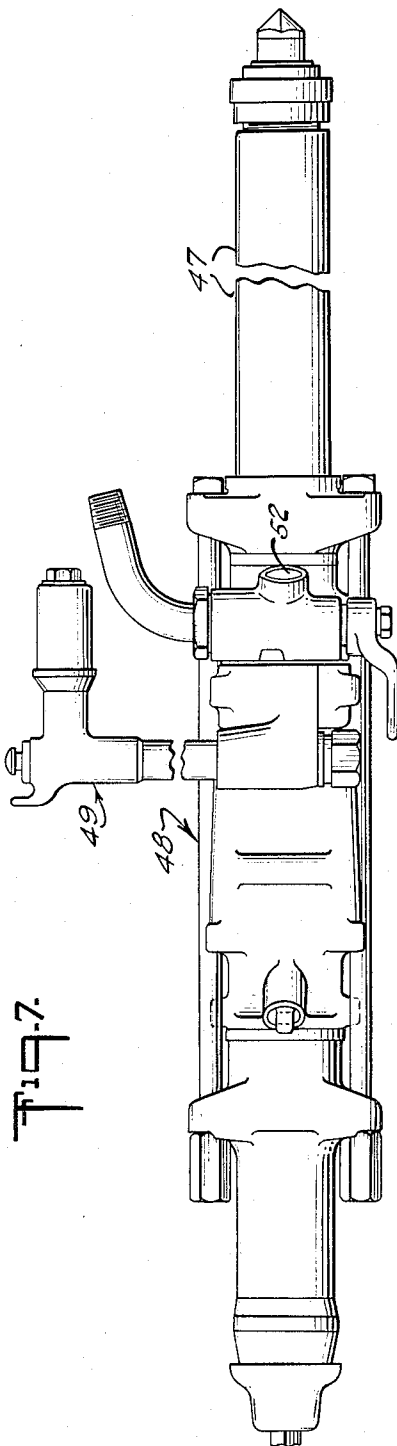
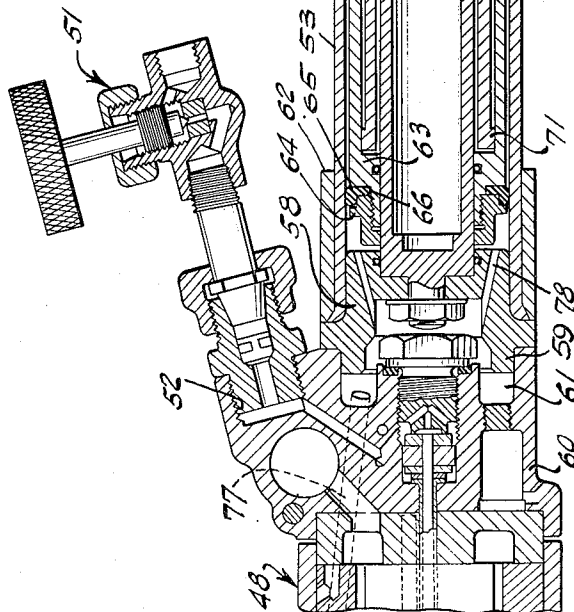


Fig. 8.



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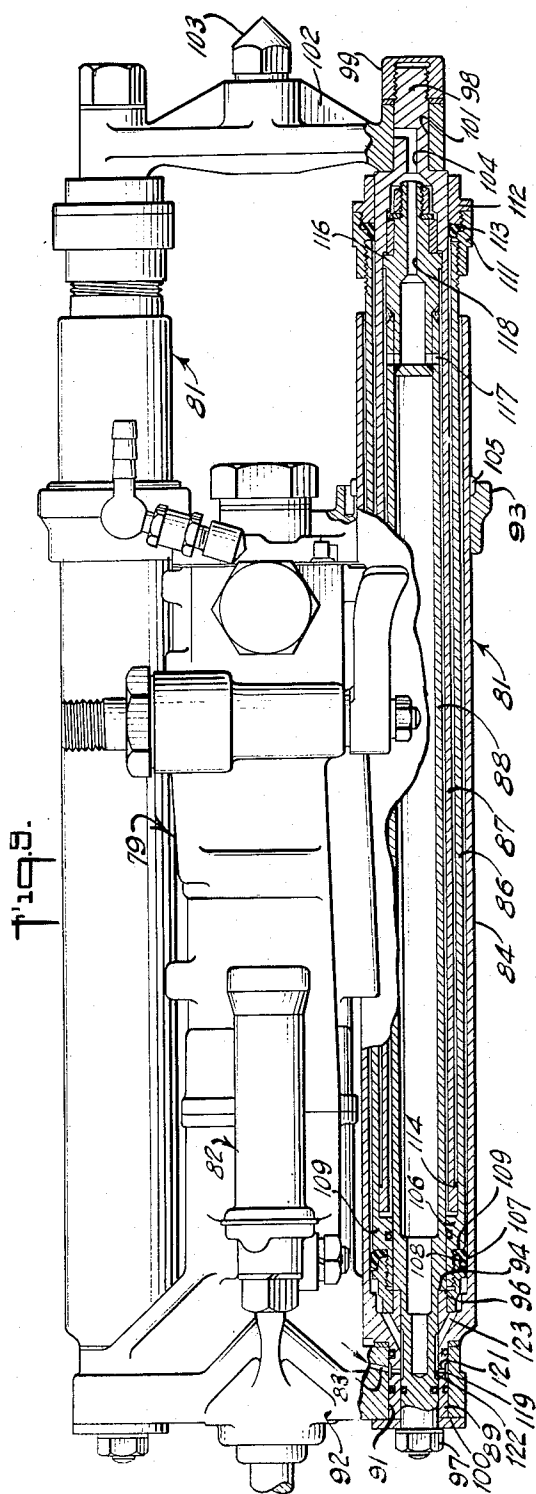
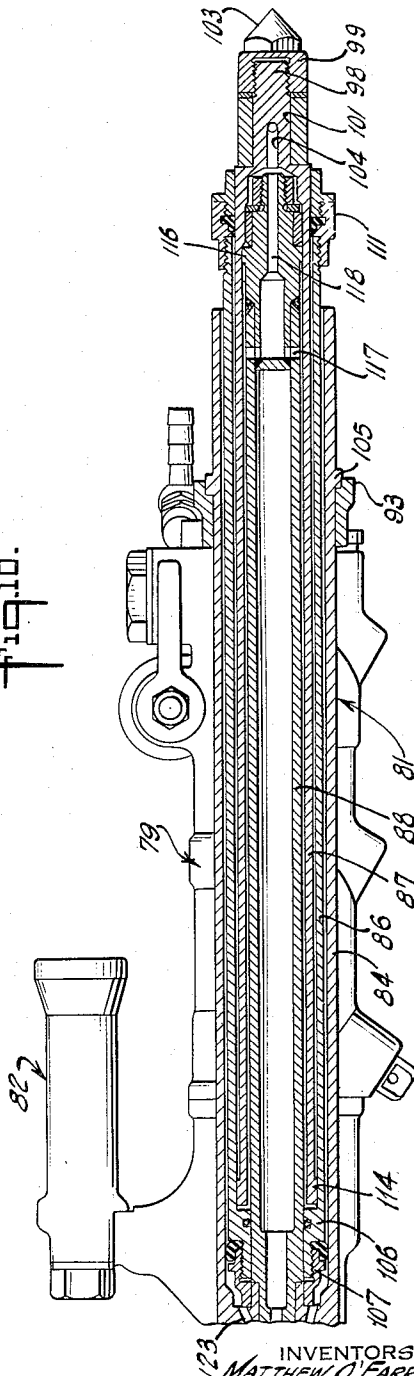


Fig. 10.



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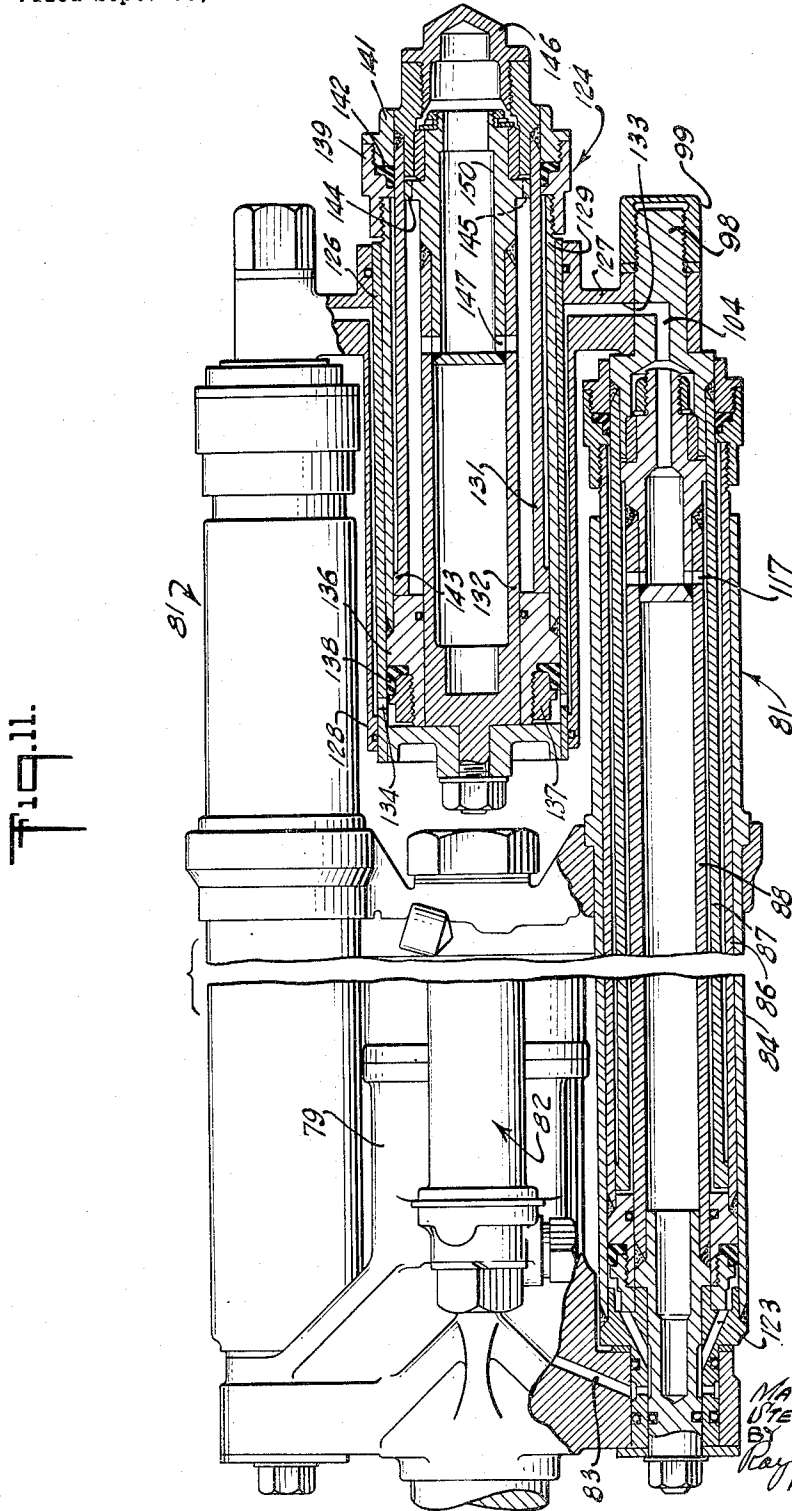
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DRILLING APPARATUS

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2,804,848

DRILLING APPARATUS

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Application September 30, 1954, Serial No. 459,483

12 Claims. (Cl. 121—9)

This invention relates to drilling apparatus, and more particularly to a feed leg arrangement for drilling tools.

In the rock drilling art, particularly where stoper drills are used, various types of feeding mechanisms have been designed for the purpose of advancing the drilling tool toward the work surface as drilling progresses. One type of feeding mechanism comprises a feed leg which incorporates expandable chamber elements telescopically arranged, and which are operated by fluid pressure to urge one of the elements against the ground, or other supporting surface, whereby the reactive force can be utilized for the purpose of causing feeding movement of the drilling tool.

The present invention represents an improvement in such type of feeding mechanism and briefly, comprises three telescopic cylinders arranged so that the innermost cylinder is adapted to contact a supporting surface, while the outer cylinder is attached to the body of the drilling tool. An elongated center portion, affixed to the body of the drilling tool, extends within the cylinders to provide means for an automatic distribution of pressure fluid, whereby the outer cylinder will be operatively moved to full extension followed by movement of the intermediate cylinder to full extension. The effective pressure areas of the cylinders are made as nearly equal as possible so that relative operative movement between the cylinders will proceed under constant pressure for all practical purposes. The cylinders are arranged for positive limitation in fully extended position, and will quickly collapse upon release of fluid pressure therefrom. The overall assemblage is one of improved ruggedness, greater compactness and less complication as compared with the prior art devices, as will be more apparent from the disclosure following.

The general object of this invention is to provide a telescopic feed leg for attachment to a drilling tool which will provide uniform feeding pressure.

Another object is to provide a telescopic feed leg that can be used in tandem, or in multiple arrangement, to obtain an extremely long drill feeding drive.

A further object is to provide a telescopic feed leg that is rugged, compact, smooth operating, and simple in design.

These and further objects and features of the invention will become apparent from the following disclosure when considered with the accompanying drawings wherein:

Fig. 1 is a schematic illustration of a representative embodiment of a feed leg according to the invention, and showing the parts in non-operative, or collapsed condition;

Fig. 2 is similar to Fig. 1 but showing the parts in an intermediate state of operation, or expansion;

Fig. 3 is similar to Fig. 1 but showing the parts in fully expanded condition;

Fig. 3a, is a cross-sectional view as seen from line 3a—3a in Fig. 3;

Fig. 4 is a schematic illustration of a modified embodiment of a feed leg according to the invention, and

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showing the parts in non-operative, or collapsed condition;

Fig. 5 is similar to Fig. 4 but showing the parts in an intermediate state of operation, or expansion;

Fig. 6 is similar to Fig. 4 but showing the parts in fully expanded condition;

Fig. 7 is a plan view of a stoper drill having a telescopic feed leg of the invention affixed thereto;

Fig. 8 is an enlarged longitudinal section view of the telescopic feed leg of the tool in Fig. 7, the arrangement conforming substantially with the embodiment of Figs. 1 to 3;

Fig. 9 is a plan view of a modified stoper drill having telescopic feed legs of the invention applied on each side of the drill, and showing one of the feed legs in longitudinal section;

Fig. 10 is a side view of the tool of Fig. 9, showing the feed leg in longitudinal section; and

Fig. 11 is a broken plan view of another modified stoper drill having three telescopic feed legs of the invention, one on each side and one concentrically located with respect to the axis of the tool.

Referring to Figs. 1-3 of the drawings a general assembly 20 of an embodiment of the feed leg of the invention is shown therein in schematic form for an easy understanding of the principles of the invention. The feed leg comprises an outer cylinder 21, an intermediate cylinder 22, and an inner cylinder 23, all slidably arranged for relative longitudinal movement. The outer cylinder 21 has a centrally disposed shaft, or stem, 24 which has a head portion 26, arranged to slidably engage the inner surface of the cylinder 23. A head portion 27 is formed on the inner end of the intermediate cylinder 22, which has a centrally disposed hole 28, to slidably receive the shaft 24. The head portion 26 has a plurality of vertical grooves 25 formed on its periphery, as seen in Fig. 3a, which provide venting of the region between head portion 26 and head portion 27. The inner cylinder 23, has a pointed head portion 29 at its lower end, which is adapted for abutment with the ground or other supporting surface. Outer cylinder 21 is affixed to a head piece 31, which may be part of a drilling tool (not shown), or which may be attached to the latter.

An enclosed expansion chamber 32 is formed between the top of head portion 27 and the inside of the outer cylinder 21, while another enclosed expansion chamber 33 is formed between the bottom of the shaft head portion 26, and the inside of the inner cylinder 23. The chamber 33 when fully expanded includes the inside of intermediate cylinder 22, as best seen in Fig. 3. An annular flange 34 is formed on the outer periphery of the inner cylinder 23 at the open end thereof, which flange 34 slidably engages the inside of the intermediate cylinder 22, while a similar annular flange 36 is formed on the inner periphery of the intermediate cylinder 22 at the open end thereof, flange 36 slidably engaging the outside of the inner cylinder 23 in an air tight manner. At full expansion of the feed leg, the annular flanges 34, 36 abut each other, as seen in Fig. 3, and thereby positively limit the intermediate and inner cylinders against further relative longitudinal movement. A vent hole 35 is positioned in the intermediate cylinder 22 adjacent annular flange 36, to vent the clearance space between the cylinders 22 and 23.

A pressure fluid passageway 37 is arranged in the head piece 31, said passageway extending into the shaft 24 and terminating in radial ports 38, whereby pressure fluid, such as compressed air, is conducted into chamber 32. Another pressure fluid passageway 39 is arranged to extend through the head portion 26 and into the shaft 24, and terminate in radial ports 41, which are located rearward of the head portion 26 a distance somewhat greater

than the thickness of the intermediate cylinder head portion 27. It will be seen in Figs. 2 and 3, that the arrangement of passageway 39 and radial ports 41 is such as to afford communication between expansion chambers 32 and 33, in the Fig. 2 position and during later stages of feed leg expansion as illustrated. The passageway 39 and radial ports 41 also serve to transfer the pressure fluid entrapped in the space behind the head portion 26 and surrounding the shaft 24, into chamber 33, during initial feed leg expansion.

For purposes of which will later be discussed, the cross-sectional area of expansion chamber 32, i. e., area based upon interior diameter of outer cylinder 21 minus area of shaft 24, is made to be substantially equal to the average cross-sectional area of expansion chamber 33.

The operation, or expansion cycle, of the feed leg assembly 20 is as follows: Considering Fig. 1, compressed air, at say 90 p. s. i., is admitted to chamber 32 by way of passageway 37 and radial ports 38, resulting in the upward movement of the outer cylinder 21 and associated elements, viz., head piece 31 and affixed tool (not shown), and shaft 24 with head piece 26. During this part of the expansion cycle the intermediate cylinder 22 does not move from original position, because of the absence of pressure fluid in chamber 33. The upward movement of the head portion 26, forces the air thereabove and surrounding the rod 24, into the chamber 33 via ports 41 and passageway 39. When the outer cylinder 21 approaches the position illustrated in Fig. 2, ports 41 will be open to the interior of chamber 32, whereupon pressure fluid from chamber 32 will flow into chamber 33 via passageway 39. Under such conditions the intermediate cylinder 22 will be caused to move upwardly, together with the outer cylinder 21, until the feed leg attains the maximum expansion condition as illustrated in Fig. 3. Since the cross-sectional areas of chambers 32 and 33 are substantially equal, feed leg expansion will proceed at substantially uniform pressure, throughout the complete expansion cycle. To collapse the feed leg, it is only required to release the air pressure via passageway 37, by suitable valve means (not shown), whereupon the chambers 32 and 33 will be evacuated, and the feed leg will collapse to the condition illustrated in Fig. 1.

A feed leg assembly 40 which is a variation of the feed leg of the first form of invention is illustrated in Figs. 4 to 6; the main difference between this variation and the feed leg arrangement 20 is that the cylinder which corresponds to inner cylinder 23 is arranged exteriorly of the cylinder which corresponds to intermediate cylinder 22. Considering briefly the arrangement of the feed leg assembly 40, the outer cylinder 21 and associated parts, viz. head piece 31, shaft 24, head portion 26, passageways 37, 39 and radial ports 38, 41 are identical with the feed leg assembly 20. An inner cylinder 42, having a head portion 27, adapted to slidably engage the inside surface of cylinder 21, is arranged with a major portion inside of an intermediate cylinder 43. The inner cylinder 42 has an annular flange 44 formed on the outer periphery and at the open end thereof, which is adapted to slidably engage the inside of the intermediate cylinder 43 in an air tight manner, while annular flange 46 is formed on the inner periphery and at the open end thereof, which flange 46 is adapted to slidably engage the outside of the inner cylinder 42 in an air tight manner. A vent hole 45 is positioned in the cylinder 43 adjacent annular flange 46, to vent the clearance space between the cylinders 42 and 43. At full expansion of the feed leg, the annular flanges 44, 46 abut each other, as seen in Fig. 6, and thereby positively limit the intermediate and inner cylinders against further relative longitudinal movement. The feed leg assembly 40 is provided with expansion chambers 32, 33, which are arranged in the same manner, and for the same purpose as the like chambers described in the feed leg assembly 20. Accordingly,

expansion in feed leg assembly 40, will proceed at constant pressure, as in the case of the feed leg assembly 20.

Referring now to Figs. 7 and 8, an embodiment of the invention is illustrated in the form of a feed leg assembly 47 affixedly arranged concentric with the axis of a rock drill 48 of the stoper type. A feed leg control assembly 49 is arranged upon the drill 48 in the manner and for the purpose of controlling a feed leg assembly, as set forth in the U. S. Patent of M. O'Farrell, No. 2,298,720 of October 13, 1942. A valve assembly 51 is threadably affixed to the drill 48 at inlet port 52, for conducting water, or other fluid to the drill for hole clearing purposes, as is well known in the art.

The feed leg assembly 47 includes an outer cylinder 53, an intermediate cylinder 54 slidably arranged within the outer cylinder, and an inner cylinder 56 slidably arranged within the intermediate cylinder. Inner and intermediate cylinders 56 and 54 respectively are slidably supported upon a centrally disposed projecting member, or rod 57, which is of hollow construction, one end of which is rigidly affixed to a connecting piece 58. The connecting piece has a reduced diameter end portion 59 which is tightly fitted into an annular recess 61 formed on the backhead 60 of the drill, and may be maintained in position by holding means, such as welding. A sleeve member 62, surrounds the end of the outer cylinder 54 and serves to maintain the latter upon the connecting piece 58, in the manner shown.

The rear end of the intermediate cylinder 54, has a head portion 63 to which is threadably affixed a sleeve 64 which compressively maintains a cup leather washer 65 against an end shoulder 66 of the intermediate cylinder 54, said cup leather washer slidably engaging the inside surface of the outer cylinder 53 to provide an air tight seal. The forward end of the intermediate cylinder 54 has a sleeve 67 threadably affixed thereto, and a further sleeve 68 threadably affixed to sleeve 67, in a manner as to positionally maintain a cup leather washer 69 in air tight engagement upon the outer surface of the inner cylinder 56.

The rear end of inner cylinder 56 has an increased diameter portion 71 which slidably engages the inner surface of the intermediate cylinder 54, and which abuts an inner edge of the sleeve 67 at one extreme position of the inner cylinder. The forward end of inner cylinder 56 is of reduced diameter, and threadably receives a hollow point element 72. Toward the forward end of the rod 57 is arranged an enlarged diameter portion 73 which slidably engages the inside surface of the inner cylinder 56. A plurality of radially disposed holes 74 are formed in the rod 57 at a distance from the enlarged diameter portion 73, greater than the width of intermediate cylinder head portion 63 and the end of the sleeve 64. In other words, when the intermediate cylinder 54 is at extreme forward, or extended position upon the rod 57, the holes 74 will not be covered by the head portion 63, or any part of the sleeve 64. At the forward end of the rod 57, a horizontal passageway 76 is provided which connects the interior of the rod 57 with the interior of the inner cylinder 56.

Formed within the rock drill 48, and extending rearwardly from the feed leg control assembly 49, is a passageway 77 which conducts pressure fluid, such as compressed air, from the feed leg control assembly to the annular recess 61 in back head 60. The connecting piece 58 has a plurality of passageways 78 which conduct pressure fluid from the recess 61 to the variable volume chamber formed between the outer cylinder 53 and the rod 57.

In arranging the various cylinders of the feed leg assembly 47, it is necessary for the effective internal cylinder areas to be nearly as equal as possible, that is, the area defined by the inside diameter of the outer cylinder 53 minus the area defined by the outside diameter of the rod 57, should be equal to the area defined by the inside diameter of the inner cylinder 56. If such balance

ing of areas is observed, the feed leg will operate to provide constant holding pressure over its full range of expansion, as will be described hereinafter.

The operation of the feed leg assembly will be seen to involve two stages as follows: assume that the rock drill 48 is in position and drilling operation is about to commence, the feed leg control 49 is manipulated by the operator to cause live air to enter the annular recess 61 from passageway 77, and to flow into the interior of the outer cylinder 53, by way of the connecting piece passageways 78. As a result of air pressure built up within the outer cylinder, the intermediate cylinder 54 will be forced outwardly from the outer cylinder 53, or more accurately speaking, since the intermediate cylinder head portion 63 is in contact with the end of the inner cylinder 56 which is immovable due to engagement with the ground, the outer cylinder 53 together with the rod 57 will move upwardly relative to the ground upon intermediate and inner cylinders, thus forcing the rock drill toward the work surface.

Such movement, constituting the first stage of feed leg expansion, will continue until the head portion 63 of the intermediate cylinder 54 abuts the enlarged diameter portion 73 of the rod 57, at which time the radial holes 74 will be uncovered thus completing the first stage. The second stage of feed leg expansion begins when live air, within outer cylinder 53 flows through radial holes 74 and passageway 76 of the rod 57 and into the inner cylinder 56, in the region of the outer end thereof. As a result of air pressure built up within the inner cylinder, the rod 57 will be forced upwardly within the inner cylinder relative to the ground, and due to engagement between the diameter portion 73 with head portion 63 of the intermediate cylinder, the latter will be moved upwardly also. Such movement will continue until the increased diameter portion 71 of the inner cylinder, abuts the inner end of intermediate cylinder sleeve 67, ending the second stage of feed leg expansion, and resulting in the cylinders being restricted against further relative movement.

To collapse the extended cylinders, it is only necessary to release the air pressure in the annular recess 61 by manipulation of the feed leg control 49, whereupon the feed leg will collapse by movement of the cylinders toward original position due to action of gravity, or if the drill is being worked in a horizontal position, due to movement of the rock drill by the tool operator, in a manner as to cause telescoping action of the cylinders, as will be understood.

The relative positions of the various cylinders of the feed leg assembly 47, relative to the drill 48, during the two stages of feed leg expansion, are summarized in the following chart:

Stage	Cylinders Moving	Cylinders Stationary	Stage begins when—	Stage ends when—
1	53	54, 56	air enters 77, 78	63 abuts 73.
2	53, 54	56	64 uncovers 74	71 abuts 67.

Referring to Figs. 9 and 10, a rock drill 79 is shown having a pair of telescopic feed leg assemblies 81 arranged on each side of the rock drill, which feed leg assemblies have their respective axes in a plane coincident with the axis of the rock drill. The rock drill 79 is of a common type hereinbefore referred to, and contains a feed leg control arrangement 82, which is used by the tool operator to control flow of live air, via a passageway 83, into a feed leg assembly 81. It is pointed out that the feed leg assemblies 81 are identical in structure, hence whatever description is made of the feed leg illustrated in longitudinal-section, will apply to the other feed leg as well. The feed leg assembly 81 is generally similar in structure to the feed leg assembly 47 above described, and comprises an outer cylinder 84, an intermediate cylin-

der 86 slidably arranged within the outer cylinder, an inner cylinder 87 slidably arranged within the intermediate cylinder, and a centrally disposed projecting member or rod 88.

One end of the outer cylinder 84 has a reduced diameter portion 89 which is snugly maintained in a hole 91 formed in a front head casting 92 of the rock drill. Toward the other end of the outer cylinder 84, the latter is supported within a backhead portion 93 of the rock drill. The rod 88 has a shoulder portion 94 which abuts a shoulder 96 formed upon the interior of the outer cylinder 84, whereby turning of a nut 97 drawn against a washer 100, pulls the rod and outer cylinder so that a collar 105 on outer cylinder 84 seats against the backhead portion 93.

The end of the inner cylinder 87 has a reduced diameter portion 98 which is snugly maintained by a nut 99 within a hole 101 formed in a feed piston cross head 102. The latter serves to couple the respective ends of the inner cylinders 87, and has a centrally disposed point 103 for positionally supporting the assemblage upon the ground. A passageway 104 in the reduced diameter portion 98, extends from the inside of the inner cylinder 87 to the side of reduced diameter portion 98, is arranged for operation of a third feed leg, as will later be described; however, in the Fig. 9 embodiment of the invention, the passageway 104 is closed as shown.

The intermediate cylinder 86 has a head portion 106 to which is threadably affixed a sleeve 107, which compressively maintains a cup leather washer 108 against an end shoulder 109 of the intermediate cylinder 86, said cup leather washer slidably engaging the inside surface of the outer cylinder 84 to provide an air tight seal. At the other end of the intermediate cylinder 86, is threadably arranged a sleeve 111, and a further sleeve 112 threadably affixed to sleeve 111 in a manner as to positionally maintain a cup leather washer 113 in air tight engagement upon the outer surface of the inner cylinder 87.

The inner cylinder 87 has an increased diameter portion 114 which slidably engages the inner surface of the intermediate cylinder 86, and which abuts an inner edge of the sleeve 111 at a fully extended position of the inner cylinder. Toward the end of the rod 88 is arranged an enlarged diameter portion 116, which slidably engages the inside surface of the inner cylinder 87. A plurality of radially disposed holes 117 are formed in the rod 88 at a distance from the enlarged diameter portion 116, greater than the width of intermediate cylinder head portion 106 and the end of the sleeve 107. In other words, when the intermediate cylinder 86 is at extreme forward, or extended position upon the rod 88, the holes 117 will not be covered by the head portion 106, or any part of the sleeve 107. At the forward end of the rod 88, a horizontal passageway 118 is provided which connects the interior of the rod 88 with the interior of the inner cylinder 87.

The passageway 83 conducts live air, upon manipulation of the feed leg control arrangement 82, to a circumferential recess 119 of the outer cylinder reduced diameter portion 89, which recess is joined by a plurality of radially disposed holes 121, to a circumferential recess 122 formed in the end of the rod 88. Arranged at the reduced diameter portion 89 of the outer cylinder 84, are a plurality of passageways 123 which conduct live air from the recess 122, to the interior of the outer cylinder in the region of the sleeve 107.

In arranging the various cylinders of the feed leg assembly 81, as in the case of the feed leg assembly 47, it is necessary for the effective internal cylinder areas to be nearly as equal as possible, that is, the area defined by the inside diameter of the outer cylinder 84 minus the area defined by the outside diameter of the rod 88, should be equal to the area defined by the inside diameter of the inner cylinder 87. If such balancing of areas is ob-

served, the feed leg will operate to provide constant holding pressure over its full range of expansion.

The operation of the feed leg assembly 81, is similar to that of the feed leg assembly 47, it being noted however that the pair of feed leg assemblies 81 operate simultaneously throughout the full range of expansion thereof. Expansion of a feed leg assembly 81 occurs in two stages, the first stage beginning when live air enters each feed leg assembly via passageway 83, recess 119, holes 121, recess 122 and passageways 123, to the interior of the outside cylinder 84 in the region of sleeve 107, thereby causing longitudinal movement of the outer cylinder 84 and rod 88 relative to the intermediate and inner cylinders 86, 87. As a result, the rock drill 79 is forced in the direction of the work surface, assuming of course, that the point 103 is in solid engagement with the ground. Such movement continues until the head portion 106 of the intermediate cylinder abuts the enlarged diameter portion 116 of the rod, thus completing the first stage of feed leg expansion. The second stage of feed leg expansion begins when the radial holes 117 are uncovered, and live air flows to the interior of the inner cylinder 87, via passageway 118. As a result, longitudinal movement is effected between the inner cylinder 87 on the one hand, and the rod 88, intermediate cylinder 86 and outer cylinder 84 on the other hand, so that the rock drill 79 is further forced in the direction of the work surface. Such movement will continue until the increased diameter portion 114 abuts the inner end of the intermediate cylinder sleeve 111, ending the second stage of feed leg expansion, and resulting in the cylinders against further relative movement. To collapse the extended cylinders, it is only necessary to release the air pressure in the passageways 83, by manipulation of the feed leg control 82, whereupon the feed leg will collapse by movement of the cylinders toward original position due to action of gravity.

The relative positions of the various cylinders of each feed leg assembly 81, relative to the drill 79, during the two stages of feed leg expansion, are summarized in the following chart:

Stage	Cylinders Moving	Cylinders Stationary	Stage begins when—	Stage ends when—
1.....	84	86, 87	Air enters 83, 123.....	106 abuts 116.
2.....	84, 86	87	107 uncovers 117.....	114 abuts 111.

In Fig. 11 is illustrated a further modified rock drill assemblage which is identical in all respects with that illustrated in Figs. 9 and 10 and described above, with the exception that a third feed leg assembly 124, is arranged concentric with the rock drill axis, in place of the cross head 102 and point 103. The feed leg assembly 124, has the same arrangement of cylinders as feed leg assemblies 47 and 81, with very little difference in structure, such differences relating in general to structural proportions, and method of mounting.

Feed leg assembly 124 includes an outer cylinder 126 supported in a cross head piece 127, and which is surrounded by a casing 128 connected to the cross head piece 127, an intermediate cylinder 129, an inner cylinder 131, and a centrally arranged projecting member, or rod 132. The casing 128 is spaced from the outer cylinder 126, to provide clearance for flow of live air from passageway 104, and a passageway 133 arranged in the cross head piece 127. Such air flow enters the outer cylinder 126 by way of holes 134 arranged near the end thereof. A head portion 136 is arranged at one end of the intermediate cylinder, which threadably supports a sleeve member 137 for use in maintaining a cup leather washer 138 in engagement with the inside of the outer cylinder 126. At the other end of the intermediate cylinder are threadably arranged two sleeves 139, 141, which positionally maintain a cup leather washer 142 for sliding en-

gagement on the outer surface of the inner cylinder 131.

The inner cylinder 131 has an enlarged diameter portion 143 which is adapted to abut the inner edge of the sleeve 139 when the inner cylinder is fully extended during feed leg expansion, while the rod 132 has an enlarged diameter portion 144 which is adapted to abut the head portion 136 of the intermediate cylinder 129, when the latter has been fully extended during feed leg expansion. A plurality of vertical slots 145 are formed on the periphery of the enlarged diameter portion 144, to vent the region between portion 144 and head portion 136. The inner cylinder 131 has a point member 146 on the outer end thereof for engagement with the ground or other supporting surface during drilling operations. A plurality of radially disposed holes 147 are arranged in the rod 132, such holes being uncovered to allow live air flow to the interior of the inner cylinder 131 via an opening 150, when the intermediate cylinder 129 has moved its maximum amount during feed leg expansion.

As in the case of the feed leg assemblies previously described, viz., 47 and 81, it is important that a proper balance of areas is observed for full feed leg expansion at constant pressure. In other words the area defined by the inner diameter of the outer cylinder 126 minus the area defined by the outer diameter of the rod 132, should be equal to the area defined by the inside diameter of the inner cylinder 131.

The operation of the feed leg assembly 124 is the same as with the feed leg assemblies 47 and 81, and includes two stages of feed leg expansion as follows: the first stage occurs when live air enters passageway 133, after the feed leg assemblies 81 have completed their first stage of expansion. The second stage of expansion of the feed leg assemblies 81, will occur at the same time as first stage of expansion of the feed leg assembly 124. The second stage of expansion of feed leg assembly 124 will occur when the holes 147 are uncovered to allow flow of live air via opening 150, to the inside of the inner cylinder 131.

The relative positions of the various cylinders of the feed leg assemblies 81 and 124, relative to the drill 79 during the two stages of feed leg expansion of each assembly, are summarized in the following chart.

Feed Leg	Stage	Movable	Stationary	Stage begins when—	Stage ends when—
81.....	1	84	86, 87, 124	Air enters 83, 123.	106 abuts 116.
81.....	2	84, 86	87, 124	107 uncovers 117.	114 abuts 111.
124.....	1	126	129, 123	Air enters 133.	136 abuts 144.
124.....	2	126, 129	131	138 uncovers 147.	143 abuts 139.

¹ These stages occur together.

The relative proportions of the feed leg assemblies 81 and 124 are arranged so that the second stage of expansion of the feed leg assembly 124, will be terminated before completion of the second stage expansion of feed leg assemblies 81; likewise the feed leg assembly 124 will be fully collapsed, during the period of feed leg retraction, before the holes 117 of the feed leg assembly 81 are covered during reverse movement of the intermediate cylinder 86 relative to the rod 88 so that full collapse of feed leg assembly 124 is assured. The feed leg arrangement 124, in combination with the feed leg assemblies 81, will provide greater overall movement of the rock drill during drilling operations, as compared with the feed leg assemblies discussed hereinbefore.

What is claimed is:

1. A telescopic feed leg comprising in combination an outer cylinder affixed to a body portion and being open at one end, an intermediate cylinder slidably arranged in part in the outer cylinder and having a head portion at the end that is slidably arranged within the

outer cylinder and being open at the other end, an inner cylinder slidably arranged in part in the intermediate cylinder and having an open end at that portion that is slidably arranged within the intermediate cylinder and being closed at the other end, and a projecting member affixed to the body portion and having an enlarged head portion adapted to be enclosed by the intermediate cylinder and also having a first pressure fluid passageway opening into the outer cylinder, and a second pressure fluid passageway connecting the interior of the outer cylinder with the interior of the inner cylinder during one phase of feed leg expansion.

2. A telescopic feed leg comprising in combination an outer cylinder affixed to a body portion and being open at one end, an intermediate cylinder slidably arranged in part in the outer cylinder and having a head portion at the end that is slidably arranged within the outer cylinder and being open at the other end, an inner cylinder slidably arranged in part in the intermediate cylinder and having an open end at that portion that is slidably arranged within the intermediate cylinder and being closed at the other end, and a rod affixed to the body portion and centrally disposed relative said cylinders, said rod having an enlarged head portion adapted to be enclosed by the intermediate cylinder and also having a first live air passageway opening into the outer cylinder, and a second live air passageway connecting the interior of the outer cylinder with the interior of the inner cylinder when the intermediate cylinder is slidably positioned substantially outside of the outer cylinder.

3. A telescopic feed leg according to claim 2, wherein the rod has means to limit expansive movement of the intermediate cylinder relative the rod, and wherein the intermediate cylinder has means to limit expansive movement of the inner cylinder relative to the intermediate cylinder.

4. A telescopic feed leg according to claim 3, wherein fluid pressure sealing means are provided between the intermediate cylinder and the outer cylinder, and between the intermediate cylinder, and between the intermediate cylinder and the inner cylinder.

5. A telescopic feed leg according to claim 2, wherein the area defined by the inside diameter of the inner cylinder is substantially equal to the area defined by the inside diameter of the outer cylinder minus the outside diameter of the rod.

6. In a rock drill, a feed leg assembly arranged concentric with the axis of the rock drill and including an outer cylinder rigidly affixed to the rock drill and being open at one end, a rod member affixed to the rock drill and extending into the outer cylinder and having a head portion at the unaffixed end, an intermediate cylinder having a head portion supported for slidable movement upon the rod member and having a pressure fluid sealing means engaging the outer cylinder, an inner cylinder positioned between the rod member and the intermediate cylinder and having a head portion supported for sliding movement upon the rod member, said rod member having a first live air passageway opening into the outer cylinder, and a second live air passageway adapted to connect the interior of the outer cylinder with the interior of the inner cylinder when the intermediate cylinder is slidably positioned substantially outside of the outer cylinder, and a fluid pressure sealing means on the intermediate cylinder and engaging the inner cylinder, the cross-section area defined by the inside diameter of the inner cylinder being substantially equal to the cross-section area defined by the inside diameter of the outer cylinder minus the outside diameter of the rod member.

7. In a rock drill, a feed leg assembly according to claim 6, wherein the inner cylinder has a point on the outside end thereof for positionally locating the feed leg on a supporting surface.

8. In a rock drill, a pair of feed leg assemblies arranged one on each side of the rock drill and with their

axis in a plane coinciding with the axis of the rock drill, each of said feed leg assemblies including an outer cylinder rigidly affixed to a front head of the rock drill, a rod member affixed to the rock drill front head said rod member extending throughout the outer cylinder and having a head portion at the unaffixed end an intermediate cylinder having a head portion at one end and being open at the other end, said intermediate cylinder being supported at one end for slidable movement upon the rod member and having a pressure fluid sealing means engaging the outer cylinder, an inner cylinder positioned between the rod member and the intermediate cylinder and having a closed portion at one end and being open at the other end, and being supported for sliding movement upon the rod member, said rod member having a first live air passageway opening into the outer cylinder, and a second live air passageway adapted to connect the interior of the outer cylinder with the interior of the inner cylinder when the intermediate cylinder is slidably positioned outside of the outer cylinder, and a fluid pressure sealing means on the intermediate cylinder and engaging the inner cylinder, the cross-sectional area defined by the inside diameter of the inner cylinder being substantially equal to the cross-sectional area defined by the inside diameter of the outer cylinder minus the outside diameter of the rod member.

9. In a rock drill a feed leg assembly arrangement according to claim 8, wherein a third feed leg assembly is disposed between the pair of feed leg assemblies, said third feed leg assembly having its axis concentric with the axis of the rock drill and including, an outer cylinder which is affixed to a casing supported in a cross-head piece connected to the end of each inner cylinder of the pair of feed leg assemblies, a rod member affixed at one end to a part of the casing and having a head portion, an intermediate cylinder having a head portion at one end and being open at the other end, said intermediate cylinder being supported at one end for slidable movement upon the rod member and having a pressure fluid sealing means engaging the outer cylinder, an inner cylinder positioned between the rod member and the intermediate cylinder and having a closed portion at one end and being open at the other end, said inner cylinder being supported for sliding movement upon the rod member, a plurality of passageways arranged to allow for expansion of the third feed leg and fluid pressure sealing means on the intermediate cylinder and engaging the inner cylinder, the cross-sectional area defined by the inside diameter of the inner cylinder being substantially equal to the cross-sectional area defined by the inside diameter of the outer cylinder minus the outside diameter of the rod member.

10. In a rock drill, a feed leg assembly arrangement according to claim 9, wherein said passageways are arranged to conduct pressure fluid from the interior of the inner cylinder of the pair of feed leg assemblies to a first variable volume formed between the outer and intermediate cylinders of the third feed leg assembly, and wherein said passageways are arranged in the rod member to conduct pressure fluid from said first variable volume of the third feed leg assembly to a second variable volume therein, formed between the inner cylinder and the end of the rod member, when the intermediate cylinder has moved a substantial distance from out of the outer cylinder.

11. In a rock drill, a feed leg assembly arrangement according to claim 10, wherein the inner cylinder of the third feed leg assembly has a point on the outside end thereof for positionally locating the feed leg on a supporting surface.

12. A telescopic feed leg comprising in combination an outer cylinder enclosed at one end and open at the other end, an elongated central member within the outer portion and affixed thereto, an intermediate cylinder arranged partially within the outer cylinder and having a

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head portion slidably engaging the inner surface of the outer cylinder and the surface of the central member, and an inner cylinder slidably arranged partially within the intermediate cylinder and having a head portion slidably engaging the inner surface of the intermediate cylinder, said central member having passageways whereby live air may be directed to cause relative movement of said cylinders.

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