Jan. 28, 1964 G. H. FUEHRER ETAL 3,119,455

MULTIPLE STAGE FEED LEG ASSEMBLY

Filed Feb. 17, 1961 3 Sheets-Sheet 1

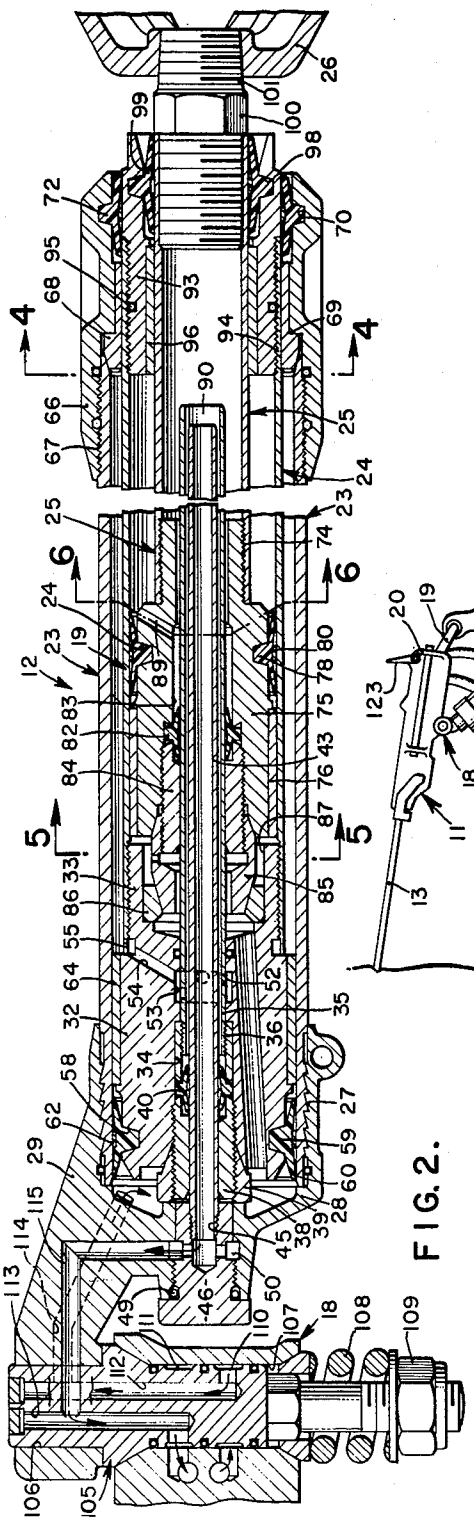


FIG. 2.

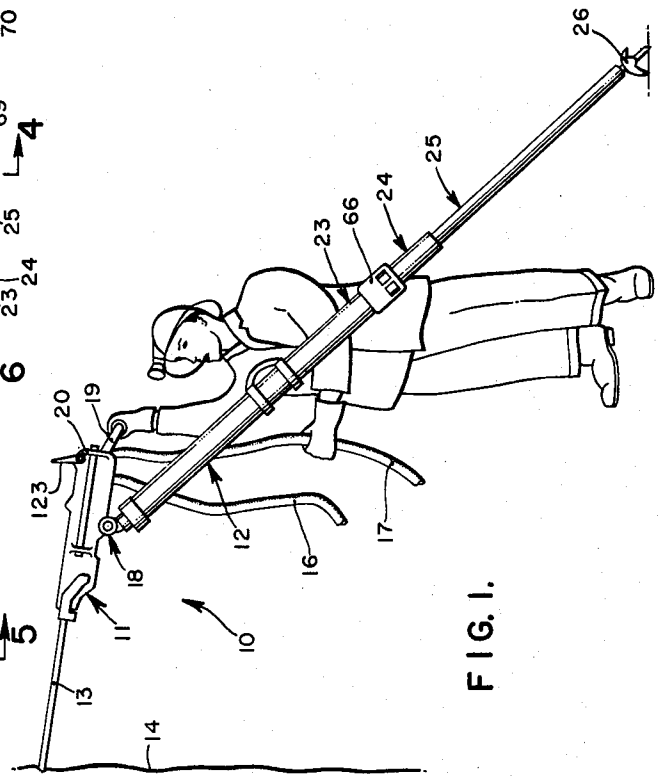


FIG. 1.

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MULTIPLE STAGE FEED LEG ASSEMBLY

Filed Feb. 17, 1961 3 Sheets-Sheet 2

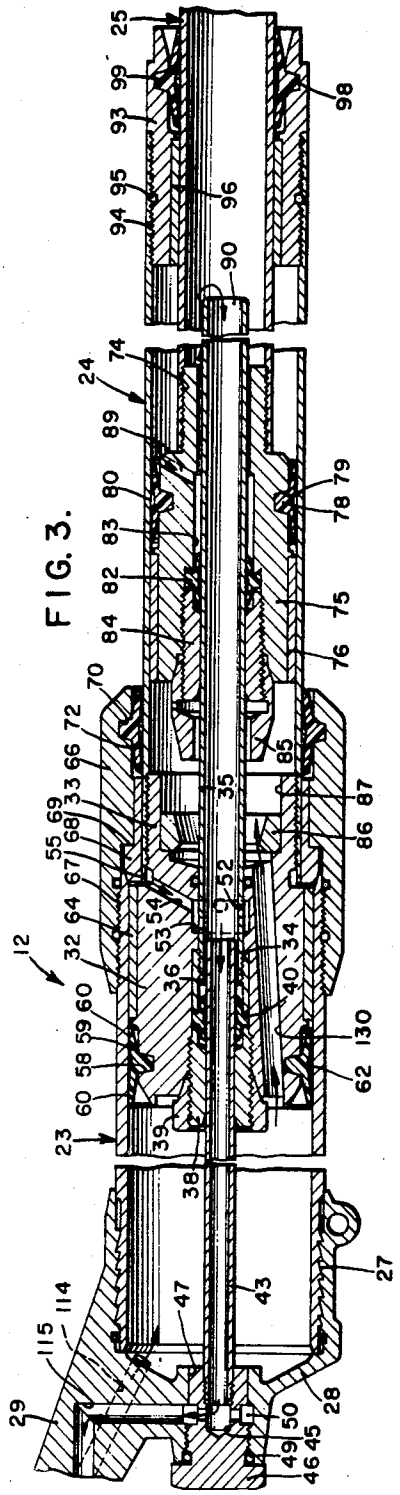


FIG. 3.

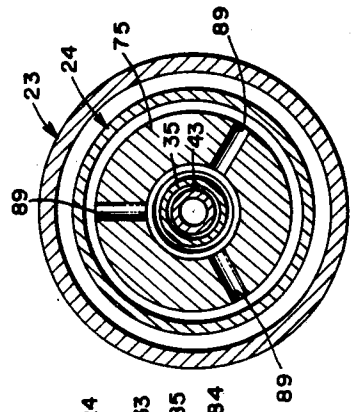


FIG. 6.

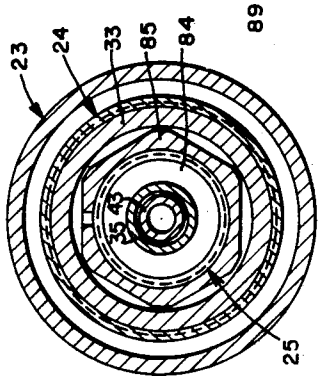


FIG. 5.

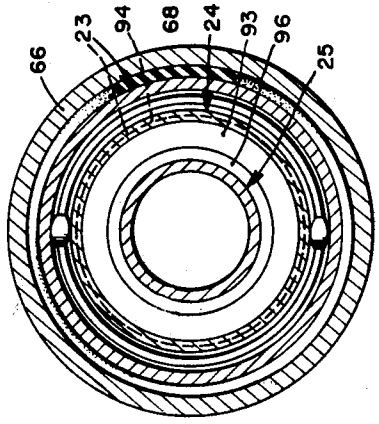


FIG. 4.

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MULTIPLE STAGE FEED LEG ASSEMBLY

Filed Feb. 17, 1961 3 Sheets-Sheet 3

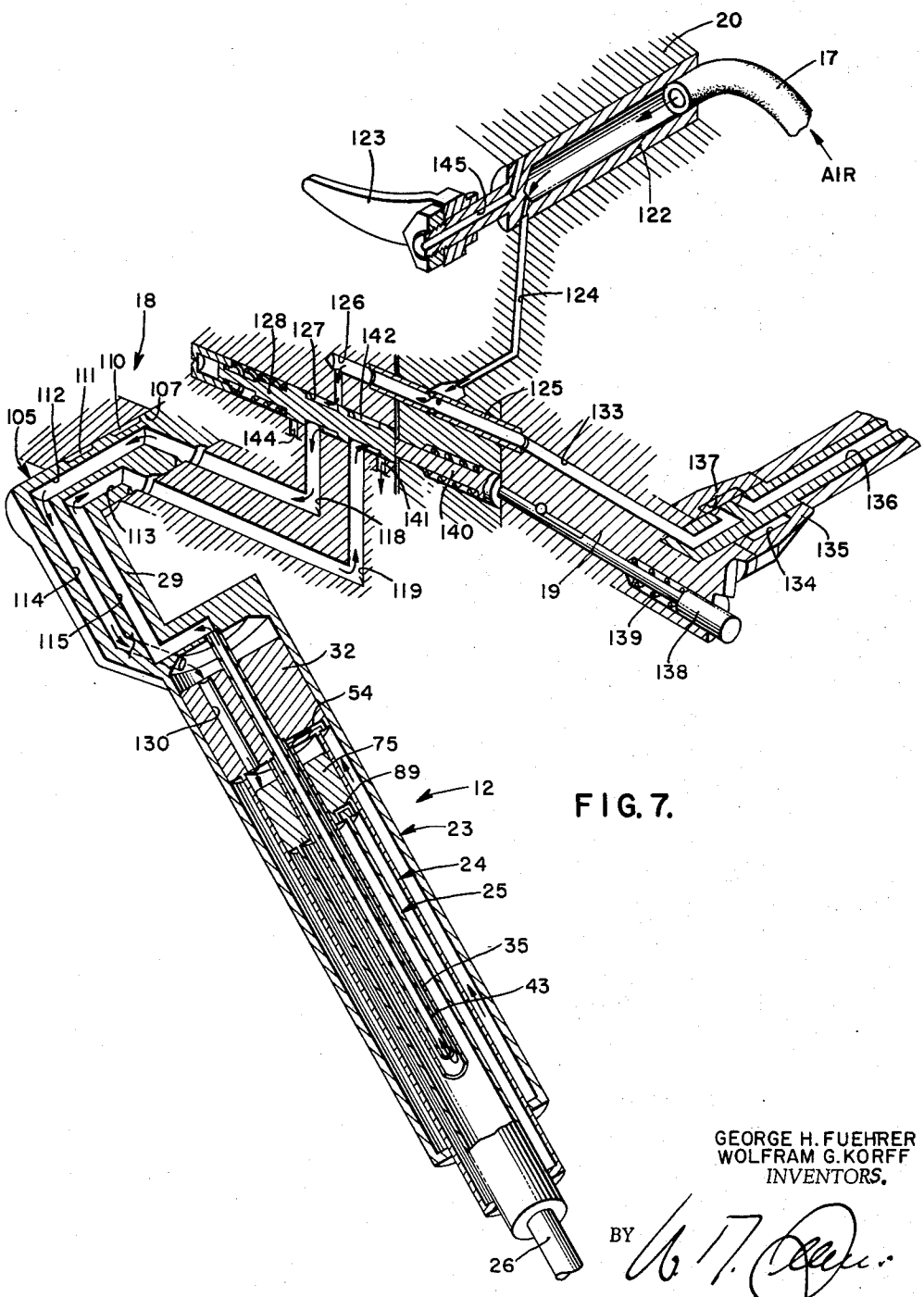


FIG. 7.

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United States Patent Office 3,119,455
Patented Jan. 28, 1964

3,119,455

MULTIPLE STAGE FEED LEG ASSEMBLY

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Filed Feb. 17, 1961, Ser. No. 89,985
5 Claims. (Cl. 173—36)

This invention relates to power-operated feed leg assemblies and more particularly to a multiple stage power-extended and power-contracted feed leg of simplified improved design incorporating various novel features described in detail below.

There have been increasing demands for power operated feed leg assemblies having operating range capabilities appreciably in excess of these obtainable from two stage units. Owing to the bulk and weight of prior art assemblies having more than two stages, it has been considered mandatory to locate the larger and heavier end of the leg on the ground and to expand the leg from its smaller upper end. In actual practice, however, experience with these designs has been found highly unsatisfactory for various reasons including in particular the frequent and costly servicing required because of the unavoidable exposure of the seals provided at the upper ends of the upwardly expandable stages. In other words, the referred to dirt and liquid seals were necessarily exposed to falling contaminants of every character which tended to underride the seals as well as to become lodged between the exterior side walls of the stages and the seals. Inevitably much foreign matter found its way into the interior of the feed leg necessitating disassembly of the leg and thorough cleaning. Efforts to avoid fouling and contamination of the components have been notably unsuccessful.

A further and serious shortcoming of prior multiple stage feed leg designs has been the lack of a practical mode of providing for power retraction of these devices in addition to the usual power extension capability. The lack of power retraction is particularly serious in the larger and heavier assemblies unavoidable in multiple stage designs.

In view of the foregoing and other shortcomings and disadvantages of prior feed leg assemblies it is a primary and principal object of the present invention to provide a unitary design of this type entirely avoiding these shortcomings and providing an unusually rugged, thoroughly reliable, non-fouling, foolproof multi-stage feed leg capable of long service in the field under the most rigorous conditions. The fouling and frequent servicing characteristics so commonplace in prior constructions are avoided by highly effective re-design including reversing the position of the stages with the larger diameter stage being connected directly to the power unit and the remaining stages expanding downwardly. By reason of a greatly simplified and unique interior design, a simple highly reliable construction was created of greatly reduced size and weight. A particular feature of the present design is provision for the use of pressurized fluid to retract as well as to extend the feed leg under fully controlled conditions and with minimum effort on the part of the operator. Liberal use of high-strength lightweight alloys greatly minimize the overall weight of the structure and make it feasible to locate the larger, heavier end of the assembly uppermost and connected directly to the power unit, all without handicapping the ease and convenience with which the power tool itself can be manipulated in use.

The use of high-strength bonding agents between mating surfaces of many components is another feature positively safeguarding against loosening due to vibration and shock loads encountered in use and discourages attempts to perform field repairs by unauthorized personnel.

Accordingly, it is a primary object of the present invention to provide an improved multiple stage feed leg assembly featuring both power extension and power retraction.

Another object of the invention is the provision of an improved simplified pneumatically actuated power tool in combination with a multiple-stage power-actuated feed leg assembly.

Another object of the invention is the provision of a unitary multiple stage power-driven feed leg assembly having means movably connecting one end of its larger diameter stage directly to a power tool and including a plurality of stages extendable from one another and from the other end of the larger stage.

Another object of the invention is the provision of a lightweight rugged, multiple stage feed leg assembly having concentrically-related axially disposed air tubes one of which is mounted in the end cap of the larger diameter stage and others of which are mounted in respective ones of the pistons and ported in a manner requisite for the use of pressurized fluid to extend as well as to retract the various stages.

These and other more specific objects will appear upon reading the following specification and claims and upon considering in connection therewith the attached drawings to which they relate.

Referring now to the drawings in which a preferred embodiment of the invention is illustrated:

FIGURE 1 is a general perspective view of the present invention showing the unit in a typical operating position;

FIGURE 2 is a central longitudinal section through the feed leg proper with the several stages in their fully contracted positions;

FIGURE 3 is a fragmentary view generally similar to FIGURE 2 but showing the several stages undergoing extension;

FIGURES 4, 5 and 6 are cross-sectional views taken along lines 4—4, 5—5 and 6—6 on FIGURE 2; and

FIGURE 7 is a schematic view of the entire unit and of the control valves therefor with air entering to extend the stages.

Referring more particularly to FIGURES 1 and 7, there is shown a preferred embodiment of the invention designated generally **10** and including a pneumatic power unit **11** supported mid-way of its main body by a three stage power-extended power-contracted feed leg assembly **12**. Operating unit **10** is shown supported in a typical operating position with its drill steel **13** sinking a hole generally horizontally into rock face **14**. Power tool **11**, in accordance with customary practice, is supplied with a flushing liquid through flexible hose **16** and pressurized air through another flexible hose **17**. Feed leg assembly **12** is pivotally connected to power unit **11** by a swivelling joint assembly **18**. A single operator is enabled to control and manipulate the assembly by operating controls conveniently accessible to a handgrip **19** projecting rearwardly from backhead **20** of the power unit.

Constructional details of power unit **11** and particularly the control components thereof are fully disclosed in the application for United States Letters Patent of George H. Fuehrer, Serial No. 17,288, filed March 24, 1960, entitled Sinker Drill. The significant details of these controls are shown schematically in FIGURE 7 of the present drawings. It is also pointed out at this time that novel aspects of the piston assemblies and the sealing rings therefor constitute important features of the feed leg assembly but are the invention of George H. Fuehrer, one of the joint inventors of the present invention, and are being disclosed and claimed in co-pending application for United States Letters Patent Serial No. 92,013, filed February 27, 1961.

Referring now more particularly to FIGURES 2 to 6,

it is pointed out that feed leg assembly 12 comprises a large diameter main cylinder 23, an intermediate diameter second stage cylinder 24, and a small diameter final stage cylinder 25, the latter being provided at its lowermost end with a pronged or spiked support spider 26 of any suitable construction. The outer end of main cylinder 23 is threaded and detachably but rigidly secured by threads 27 to a pivot head assembly or end cap 28 integral with a bracket arm 29. A description of further details of pivot assembly 18 will be given following a description of the feed leg stages.

The second or intermediate stage 24 is provided at its inner end with a one-piece aluminum piston 32 having a reduced diameter skirt 33 threaded onto the tubular body of stage 24. Piston 32 is provided with a shouldered axial bore 34 extending centrally therethrough in which is mounted an open-ended air flow tube 35. The inner end of tube 35 is threaded onto a sleeve 36 having a snug sliding fit within bore 34. A threaded bushing 38 is mounted in the threaded outer end of bore 34 and locked securely in position by a lock nut 39 having a tapered inner flange seating against the complementally tapered outer end of bore 34. The inner end of bushing 38 cooperates with the juxtaposed end of sleeve 36 to hold securely mounted therebetween a double-lipped resilient sealing ring 40.

A second and smaller air flow tube 43 is axially aligned with air tube 35 with its accurately finished exterior surface in a close sliding fit with the inner side wall of bushing 38. As is made clear by FIGURE 3, the lips of sealing ring 40 have resilient wiping contact with air tube 43 and cooperate therewith in preventing leakage of air. The outer end of tube 43 is threaded into a well 45 formed in the shank end of a cap screw 46 assembled into the threaded outer end of a bore 37 passing centrally through end cap 28. An O-ring or other suitable gasket 49 seals cap screw 46 to cap 28. An annular groove 50 surrounding the shank of cap screw 46 communicates by radial passages with the interior of tube 43. From the foregoing it will be recognized that tube 43 is removable for inspection and servicing along with end cap 46.

Air flowing in tube 43 passes to or from the axially aligned tube 35 rigidly supported in piston 32. The inner end of tube 35 is provided with radial ports 52 opening into an annular groove 53 formed in the side wall of bore 34. Groove 53 opens through radial passages 54 into the lower end of the first or large diameter stage 23. To assure that air in passages 54 can flow into the space below piston 32, the upper end of second stage 24 is preferably formed along its rim with notches 55 (FIGURE 2).

The foremost end of piston 32 is provided with an annular groove 58 having outwardly diverging side walls seating therein a one-piece resilient sealing ring 59 having wide, thin generally cylindrical lips 60, 60 the tips of which are in close wiping contact with the interior wall of the first or larger stage 23 of the feed leg. The slightly reduced mid-portion of sealing ring 59 is provided with a wide shallow groove seating a continuous thin-walled retainer ring 62 effective to lock the sealing gasket seated within groove 58, it being understood that retainer 62 is sufficiently smaller in diameter as to be out of contact with the interior wall of tube 23.

A further feature of piston 32 is the provision of a thin-walled axially long bearing sleeve 64 of appropriate material, the exterior wall of this sleeve being accurately finished to have a close sliding fit with the interior of tube 23. Sleeve 64 preferably has a press fit with the underlying portion of piston 32 and has far greater ability to resist wear than does the aluminum alloy employed for piston 32.

The first and second stages of the feed leg are held in assembled relation by an end ring 66 having threaded engagement at 67 with the threaded lower end of stage 23. The end ring bushing 68 is made of suitable bearing material and its shouldered inner end is held seated against the complementally shaped interior shouldered end 69 of ring 66 by the nesting of its inner tapered end with the juxtaposed tapered end of stage 23. The engaging surfaces of ring 66 and bushing 68 may be bonded or otherwise permanently sealed in assembled position. The cylindrical interior wall of bushing 68 has a close sliding fit with the accurately finished exterior surface of stage 24.

Seated in inwardly opening groove 70 of cap ring 66 is a dirt wiper sealing ring 72 having the same structural features as sealing ring 59. However, it will be understood that the composition of seal 72 may differ and be selected to withstand long service without lubricant and to resist abrasion by dirt and the like foreign material to which the lips thereof are normally subjected in use.

The inner end of the third or lower stage 25 of the feed leg assembly is threadedly seated at 74 with the threaded shank end of a second aluminum piston 75 generally similar to piston 32. However, there are certain differences in the third stage piston. For example, the position of the bushing sleeve 76 is reversed with respect to the double-lipped sealing ring 78. The latter ring is seated in an annular groove 79 at the outer end of piston 75 and it is held in place by a retainer ring 80 similar to retainer 62 of the first described piston. Bushing sleeve 76 has a press fit with the piston and a close sliding fit with the interior side wall of the second stage 24. The double-lipped sealing ring 82 is held seated against a shouldered portion of through bore 83 by a threaded bushing 84 locked in place by a specially formed lock nut 85. A further difference resides in the fact that the outer converging end of lock nut 85 cooperates with a buffer ring 86 adhesively bonded or otherwise securely seated within the inner end of skirt 87 forming an integral part of piston 32. The engagement of lock nut 85 with buffer ring 86 limits the contraction movement of the final stage with respect to the second stage and thereby avoids risk of damage to pistons 32 and 75. To be noted also is the fact that the portion of axial bore 83 through piston 75 is of greater diameter than tube 35 to provide for air flow to radial distributing ports 89 of piston 75 into the outer end of second stage 24 in the manner made clear by FIGURE 3. Under the conditions illustrated in FIGURE 3 air from the outer end of stage 24 is entering passage 89 for flow about the exterior of tube 35 and into its open end 90.

The outer end of second stage 24 is closed by an end ring 83 threaded into the end of stage 24 as is indicated at 94. An O-ring 95 intermediate the opposite ends of threads 94 serves to prevent leakage, as do similar O-rings in other of the threaded connections. Having a press fit with the interior end of ring 93 is a bearing sleeve 96, the inner surface of which has a close sliding fit with the smooth exterior of stage 25. It is also pointed out that the inner end of cap ring 93 abuts the shank end of piston 75 to limit the extension of the third stage relative to the second stage.

Inwardly opening groove 98 formed in the outer end of ring 93 seats a dirt wiper seal ring 99 having the same configuration and composition as the first described dust wiper seal ring 72. To be noted is the fact that rings 66 and 93 both extend axially beyond the outer lips of wiper rings 72 and 99 thereby affording protection for these rings as well as serving to deflect fluid and foreign matter therefrom. The outer end of lower stage 25 is closed by a bushing plug 100 (FIGURE 2) threaded at its outer end 101 to the center of the pronged spider 26.

Insofar as is feasible and consistent with long service life, substantially all components of the feed leg are fabricated from lightweight high-strength aluminum alloy, notable exceptions being air tubes 35 and 43 as well as the outer tubes of the two lower stages 23 and 24. These are formed of thin-walled seamless steel stock owing to the strength requirements of these members. It is further pointed out that in substantially all cases the threaded

connections are locked assembled by the application of a suitable bonding agent known to withstand severe vibration and shock operating conditions. Not only does this assure against loosening of the parts in the field which would otherwise occur, but it also discourages disassembly of the feed leg in the field and requires that the feed leg be returned to a servicing facility having trained personnel and proper equipment for breaking the joint and servicing the equipment.

Before proceeding to describe the control facilities for the pressurized fluid supply to the feed leg, reference should be had to FIGURE 2 for an understanding of the structural details of pivot connection 18 between power tool 11 and the feed leg assembly. This joint includes a pivot stem 105 brazed, welded or otherwise securely fixed in a transverse opening 106 through the outer end of bracket 29. Pivot stem 105 is journaled in a transverse bore 107 formed crosswise beneath the lower side of power tool 11 and is held rotatably assembled in this bore by means of a stiff spring 108 held adjustably assembled to pivot stem 105 by the high friction nut 109.

The shank portion of stem 105 is provided with a pair of annular grooves 110, 111 the bottoms of which open into bores 112, 113, respectively, extending lengthwise of pivot stem 105. Passage 112 communicates with a passage 114 and passage 113 communicates with passage 115 both extending lengthwise of bracket 29 integral with the upper end of the feed leg assembly. Passage 114 opens into the upper end of stage 23 whereas passage 115 opens into the outer end of air tube 43.

Referring now to FIGURE 7, it will be understood that grooves 110 and 111 in pivot stem 105 communicate respectively with passages 118, 119 formed in the body of tool 11 and are under the control of the valving mechanism carried with the tool backhead 20 and handgrip 19. As was pointed out above, the valving mechanism shown in FIGURE 7 by way of example is identical with that shown in FIGURE 20 of co-pending application Serial No. 17,288.

In the position of the parts shown in FIGURES 3 and 7, the valves are positioned to admit pressurized air to the feed leg for its extension to a new operating position. The air under pressure entering the tool through hose 17 flows through the stem of valve cock 122 rotatable by an operating handle 123, and thence into passage 124 and into the midportion of open-ended tube 125. The main portion of the air then flows to the left through passage 126 and around groove 127 of a spool valve 128 and into passage 118, groove 110, into passages 112 and 114 and then into the upper end of the larger diameter stage 23 of the feed leg. This air is effective to press piston 32 of the second stage downwardly as other portions of the pressurized air flow through passage 130 of piston 32 and into the upper end of second stage 24. Pistons 32 and 75 of the lower stages of the feed leg are thereby placed under pressure to extend these stages as desired.

Control of the described extension is obtained by permitting variable quantities of the pressurized air to escape to the atmosphere. Thus a portion of the air entering the mid-portion of tube 25 (FIGURE 7) flows to the right and into passage 133 into an annular groove 134 of a rotatable valving member 135 so designed and arranged as to permit variable quantities of the pressurized air to escape into a vent passage 136 exhausting to the atmosphere. By rotating valve member 135 it will be understood that more or less air can be vented to the atmosphere past variable area porting indicated at 137 thereby to control the pressure of the air existing in the several stages of the feed leg.

Should an emergency arise in the operation of the drill, making it desirable to release the drill unit or to collapse the feed leg abruptly, the operator's thumb of the hand grasping the tool handgrip is used to depress quick release button 138 normally held in its extended position by spring 139. Depression of button 138 reciprocates plunger 140 bearing against the right hand end of spool valve 128 shifting the latter to the left from the position shown and closing off the supply of pressurized air into groove 127 of valve 128. The outlet vent 141 previously in communication with the outlet upper end of air passage 119 is also closed by the depression of the quick release button 138 as is the flow of pressurized air from supply passage 126 into the previously vented passage 119 leading into the lower ends of the respective feed leg stages.

In consequence of the foregoing, pressurized air now flows into groove 142 of valve 128 and from there into passages 119, groove 111 of the pivot stem and then through passages 113, 115 into the upper end of tubes 43 and 35 extending centrally through the feed leg. In this manner, pressurized air is delivered into the lower end of upper stage 23 and intermediate stage 24. High pressure air flows from the lower end of tube 43 through passages 52, 53, 54, to the underside of the larger piston 32. Other portions of the pressurized air pass downwardly through larger tube 35 and upwardly around the lower end of this tube into radial passages 89 of piston 75 and against the lower end of this piston. Accordingly, this pressurized air will be understood as effective against the undersides of pistons 32 and 75 to contract both the lower stages quickly and under power into larger stage 23. Pressurized air present in the upper ends of the stages is forced outwardly through passages 114, 112, groove 110, along passage 118, into groove 127 and thence to the atmosphere through vent passage 144 (FIGURE 7).

While the particular multiple stage feed leg assembly herein shown and disclosed in detail is fully capable of attaining the objects and providing the advantages hereinbefore stated it is to be understood that it is merely illustrative of the presently preferred embodiments of the invention and that no limitations are intended to the details of construction or design herein shown other than as defined in the appended claims.

We claim:

1. In combination with a pneumatically operated drilling unit, a feed leg assembly pivotally connected to said drilling unit and having multiple stages movable simultaneously either toward their retracted or their extended positions, said feed leg assembly having a combined bracket and end cap at its upper end provided with a spindle supported at one end on said bracket and extending transversely of the exterior of said end cap, said spindle being journaled to the midportion of said drilling unit and having a first and a second air passage therein in communication respectively with air-venting and pressurized air supply means in said drilling unit, the opposite ends of said first and second passages extending along said bracket and through the interior bottom portion of said end cap, the main body portion of said feed leg assembly comprising a plurality of elongated concentric tubes and the two lower ones of which are provided at their upper ends with pistons having a close sliding fit axially of said tubes, the upper end of the larger one of said tubes being rigidly secured to said end cap, said pistons each having an axial air passage therethrough, a first open-ended tube secured axially to the interior bottom of said end cap and having a fluid-tight sliding connection through the upper one of said pistons and connected at its upper end directly to said first air passage, a second open-ended tube closely surrounding said first open-ended tube and having its upper end mounted in and sealed to the underside of said upper piston and also having a sliding fit in an axial opening through the piston immediately below said upper piston, said upper piston having a second air passage therethrough spaced to one side of first open-ended tube, said second air passage through said end cap opening into the space above all of said pistons in all operating positions of said feed leg thereby to supply air to or bleed air from the interior space of said feed leg above each of said pistons simultaneously to extend and retract each

stage thereof by proportional amounts and radial passage means through the lower portions of each of said pistons having their inner ends in communication with the lower ends of said first and second tubes and their outer ends in communication respectively with the annular spaces between said main tubes below the lower ends of said pistons in all operating positions of said feed leg thereby to maintain substantially the same pressure conditions in each of said annular spaces.

2. The combination defined in claim 1 characterized in that said end cap and said first open-ended tube are removable as a unit from the uppermost one of said main body tubes of said feed leg assembly, and means accessible from the upper end of the upper piston removably holding said second open-ended tube assembled to said upper piston.

3. The combination defined in claim 1 characterized in the provision of means holding said combined bracket and end cap detachably assembled to the upper end of the larger diameter main body tube, and being further characterized in that the removal of said bracket and end cap permits each lower main body tube to be withdrawn from one another and from said largest tube through the open top end of the latter.

4. In combination, a pneumatic power drilling unit having a multiple stage feed leg assembly pivotally connected to the midportion thereof and provided with operating controls for said drilling unit and for said feed leg grouped together for manipulation by the same hand of the operator used to grasp the drilling unit, said feed leg assembly having more than one extendable stage with the larger diameter one thereof being closest to said drilling unit, bracket means pivotally connecting said assembly to said drilling unit and having a pair of air passages therein in communication with said operating controls, each extendable stage of said feed leg having a piston at its upper end, a plurality of relatively small bore concentric tubes extending axially of said stages and through each of said pistons, the inner one of said tubes being fixed at its upper end to said bracket means and in continuous communication with one of the air passages in said bracket and another of said concentric tubes being carried on the lower end of the upper piston and extending slidingly through the next lower piston, radial passage means in the lower ends of said pistons connecting the lower ends of said concentric tubes to the spaces below the outer rim portions of said pistons, passage means connecting the second one of said air passages in said bracket to the upper ends of each of said pistons, and said control means including means for maintaining a pressurized air supply to the opposite sides of said pistons and for selectively increasing the air pressure on one or the other side of all pistons simultaneously thereby to extend or to retract all of said movable stages simultaneously as desired by the operator.

5. In combination, a pneumatically actuated drilling unit having a power-retracted power-extended feed leg assembly operable to advance the drilling unit under controlled pressure into material being drilled, said feed leg assembly having at least three telescopically arranged main body tubes with the largest one uppermost and pivotally connected to said drilling unit by bracket means journaled transversely of the midportion of said drilling unit, said bracket means having first and second air passages extending therethrough from control means located on the backhead of the drilling unit, a plurality of long relatively small bore tubes extending axially of said main body tubes, the two lower ones of said main body tubes each having a piston at its upper end, said small bore tubes extending through each of said pistons and being in communication with one another and with said first air passage in said bracket means, said pistons each having an air passage therethrough which is in communication with the upper ends of said pistons and with said second air passage, radial air passage means through the lower portions of each of said pistons providing communication between the lower ends of said relatively small bore tubes and the annular spaces between said main body tubes and located below the lower outer rim areas of said pistons, said air control means on said drilling unit manipulatable by the operator using the hand employed to guide said drilling unit to supply air at a greater effective pressure selectively to either the upper or the lower ends of said pistons thereby to extend and to retract all of the movable stages of said feed leg assembly simultaneously as well as to retract the same under power quickly and positively.

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