

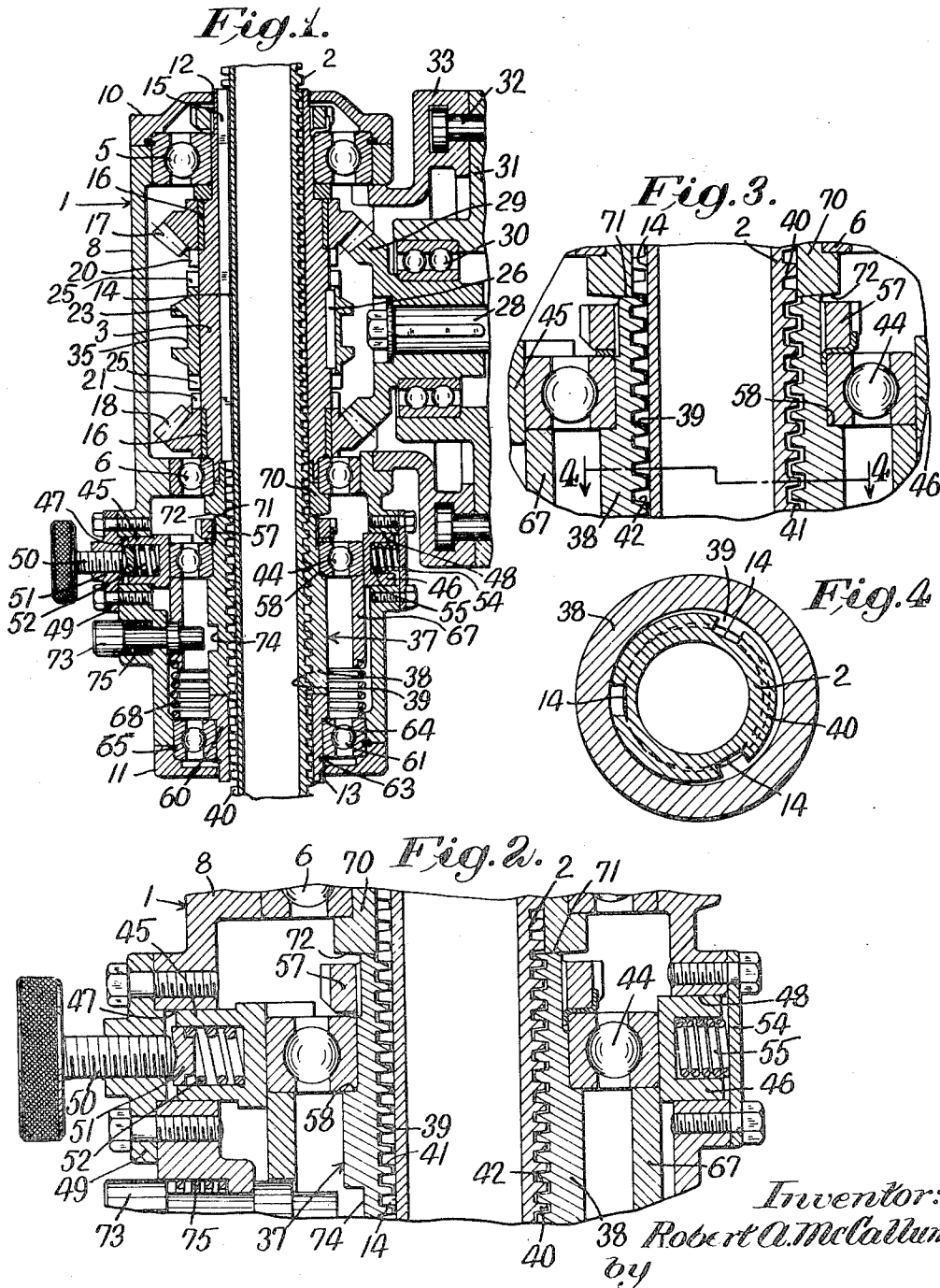
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VARIABLE FEED FOR DRILLING APPARATUS

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VARIABLE FEED FOR DRILLING APPARATUS

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My invention relates to drilling apparatus, and more particularly to feeding means for such apparatus.

It is customary to provide for a drilling apparatus a feeding means including intermeshing feed screw and nut elements rotatable relative to each other to effect feed. These elements are usually mounted to rotate on fixed axes, and means are provided for rotating one or both at such speeds as to produce the relative rotation necessary to effect the desired rate of feed.

If, as contemplated by my invention, both of the elements are mounted for rotation and are adjustable to rotate on a common axis or on spaced parallel axes, it will be seen that, where one is caused to rotate by its threaded engagement with the other, there will be a difference in the rates of rotation varying directly with the spacing of the axes. When the elements rotate on a common axis their rates of rotation will be the same, but, when one of the elements is moved transversely from the position in which the elements are concentric, the pitch diameters of the two elements are different and the rates of rotation vary by a corresponding amount. By providing the threads of the elements with inclined engaging surfaces, a pressure tending to move the elements into their coaxial positions will be obtained, this pressure varying directly with the feeding pressure. If yielding means are provided for moving the elements out of their coaxial positions to effect feeding, it will be seen that the elements will be forced against the yielding means toward their coaxial positions when the feeding pressure reaches a predetermined value.

An object of my invention is to provide an improved drilling apparatus. Another object of my invention is to provide a drilling apparatus having improved feeding means. Still another object of my invention is to provide an improved feeding means having feeding elements threadedly engaging each other and movable relative to each other for varying the rate of feed. Yet another object of my invention is to provide in an improved feeding means for a drilling apparatus, intermeshing feed screw and nut elements adjustable to rotate on a common axis or on spaced parallel axes while maintaining threaded engagement. Another object of my invention is to provide an improved feeding means having feed screw and nut elements adjustable transversely relative to each other for varying the rate of feed, and having yielding means for regulating the transverse adjustment of the elements. Still another object of my invention is to provide an

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improved feeding means operative automatically to limit the feeding pressure. Other objects of my invention will hereinafter more fully appear.

In the accompanying drawing, in which there is shown one illustrative embodiment which my invention may assume in practice:

Fig. 1 is a longitudinal sectional view through a portion of a drilling apparatus having my improved feeding means.

Fig. 2 is an enlarged fragmentary sectional view showing my improved feeding means, and taken on the plane of Fig. 1.

Fig. 3 is a fragmentary sectional view similar to Fig. 2 but showing parts of the feeding means in different positions.

Fig. 4 is a cross sectional view taken on the planes of the line 4-4 of Fig. 3.

In the illustrative embodiment of my invention there is shown in Fig. 1 a portion of a drilling apparatus, generally designated 1, the drilling apparatus being herein of the bit rotating type and comprising an elongated screwlike member 2 adapted to effect rotation and feeding of a bit, not shown. It will be understood that the member 2 may as well act merely as a feed screw for feeding a drill mechanism or some other mechanism relative to its work. The feed screw 2 extends through a sleeve-shaped member 3 which is rotatably supported at its ends by bearings 5 and 6 mounted within a casing 8. Attached in any suitable manner to the ends of the casing are caps 10 and 11 having openings 12 and 13 through which the feed screw extends. Formed in the feed screw along its length are grooves 14 which receive keys 15 fixed to the sleeve-shaped member 3 so that the feed screw and the member 3 are caused to rotate together but are permitted to move longitudinally relative to each other. Supported by the sleeve member 3 at points spaced along its length are bearings 16 on which beveled gears 17 and 18 are journaled. Formed integral with the gears 17 and 18, respectively, at their adjacent sides are clutch teeth 20 and 21, and a clutch member 23 is slidably mounted on the sleeve member 3 and is provided at its ends with teeth 25 adapted to intermesh with the teeth 20 or 21. The sleeve member 3 and the clutch member 23 are connected, as by a key 26, for rotation together. Extending through an opening in the side of the casing 8 is a power shaft 28 carrying a beveled gear 29 which meshes with the gears 17 and 18. The power shaft is rotatably supported by a bearing 30 mounted in a frame 31 which is attached, as by T-bolts 32, to a collar 33 fixed in any suitable manner to the

side of the casing 8. It will be seen that a rotation of the gear 29 will cause the gears 17 and 18 to rotate in opposite directions, and that the sleeve member 3 may be caused to rotate in either direction by sliding the clutch member 23 in one direction or the other into engagement with the teeth 20 or 21. The clutch member may be moved manually to its different positions by any suitable actuating member, not shown, extending into an annular groove 35 formed in the clutch member. The power shaft 28 may be the shaft of an electric motor attached to the frame 31, or may be connected through a suitable transmission mechanism to any power unit.

Operatively connected to the feed screw are feeding means, generally designated 37, for effecting longitudinal movement of the feed screw. This feeding means includes a feed nut 38 having internal threads 39 intermeshing with threads 40 formed on the outer surface of the feed screw. The threads 39 and 40, respectively, are provided with inclined side surfaces 41 and 42 which engage each other during the feeding of the bit, and the threads are so formed that the feed nut and the feed screw may be moved transversely relative to each other out of coaxial relationship, as shown in Fig. 3. The feed nut 38 is rotatably supported by a ball bearing 44 which has its outer ring clamped between plungers 45 and 46 fitting within diametrically opposite openings 47 and 48 in the side walls of the casing 8. The point of support of the feed nut by the bearing 44 is such that the forces on the feed nut are in balance, and the nut is held at all times with its axis parallel to the axis of the feed screw. A plate 49 is bolted over the opening 47, and an adjusting screw 50 is threaded through an opening in the plate into engagement with a movable abutment 51 between which and the plunger 45 a spring 52 is arranged. The opening 48 is covered by a plate 54, and a spring 55 acting between this plate and the plunger 46 holds the latter against the outer ring of the bearing 44. Attached to the upper end of the feed nut is an annular member 57 for clamping the inner ring of the bearing 44 against a shoulder 58 formed on the feed nut. Below the feed nut is a sleeve-shaped member 60 rotatably supported by a ball bearing 61 in a position to be engaged at its upper end by the lower end of the feed nut. The inner ring of the bearing 61 fits between a locking ring 63 and a shoulder 64 on the sleeve member 60 so as to prevent longitudinal movement of the latter, and the outer ring of the bearing is held in the casing 8 by the cap 11 and a locking ring 65. Surrounding the feed nut is a sleeve member 67 yieldably held in engagement with the outer ring of the bearing 44 by a spring 68 acting between the lower end of the sleeve member and the outer ring of the bearing 61. Supported within the lower end of the sleeve member 3 and the inner ring of the bearing 6 is a thrust collar 70 adapted to be engaged by the upper end of the feed nut for limiting the upward movement of the latter. The spring 68 and the sleeve member 67 operate to hold the bearing 44 so that the upper end of the feed nut engages initially the lower end of the thrust collar 70. The feeding pressures set up during normal operation of the machine act to hold the feed nut more firmly in engagement with the thrust collar. The adjacent ends of the feed nut and the thrust collar are provided, respectively, with inclined surfaces 71 and 72 which act in the same manner as the surfaces on the threads 39 and 40 to produce a feeding pressure

when the feed nut is moved out of coaxial relationship with the feed screw. The thrust collar and the sleeve member 60 are spaced apart a sufficient distance to permit a slight longitudinal movement of the feed nut. Projecting through an opening in the casing 8 is a plunger 73 adapted to have its inner end moved into a recess 74 in the feed nut for holding the latter against rotation and effecting rapid feed of the feed screw. A spring 75 acting between the casing 8 and the plunger 73 urges the latter outwardly toward its released position.

The operation of the mechanism described is as follows: The power shaft 28 is caused to rotate and drive the gears 17 and 18 through the gear 29, and the clutch member 23 is moved into engagement with the clutch teeth 20 or 21 to effect rotation of the feed screw 2 in the desired direction. The feed screw may be fed rapidly as it rotates by forcing the plunger 73 into the recess 74 in the feed nut so that the latter is held stationary. When the plunger 73 is released from the recess 74 and the feed nut is in a position coaxial with the feed screw, the feed nut and the feed screw will rotate at the same speed and no feeding of the screw will take place. If the adjusting screw 50 is screwed in to compress the spring 52 and increase the force of the plunger 45 against the outer ring of the bearing 44, the bearing and the feed nut will be moved transversely against the action of the plunger 46, and, since the thread surfaces 41 and 42 are inclined, the threads will engage each other theoretically in line contact at the side where the threads of the feed nut are nearer to the axis of the feed screw. It will be seen that the threads 39 and 40 will then roll on unequal pitch diameters, the feed nut rotating slower than the feed screw and causing a feeding of the latter. The feeding pressure on the feed screw produces a force, by reason of the inclined thread surfaces, which tends to move the feed nut against the action of the plunger 45 toward a position in which it is coaxial with the feed screw. Since the screw 50 may be adjusted to vary the yielding pressure on the plunger 45, an automatic control is obtained for limiting the feeding pressure to any desired value.

As a result of my invention there is provided an improved feeding means adapted for use with a drilling apparatus. It will be noted that a rapid feed or a variable slow feed may be obtained, the feeding means being operative automatically to vary the slow feed so that the feeding pressure does not exceed a predetermined value. It will be noted further that the slow and rapid feeding of the screw may be obtained in either direction.

While there is in this application specifically described one form which the invention may assume in practice, it will be understood that this form of the same is shown for purposes of illustration and that the invention may be modified and embodied in various other forms without departing from its spirit or the scope of the appended claims.

What I claim as new and desire to secure by Letters Patent is:

1. In a feeding device, in combination, a feed screw element, a feed nut element threadedly engaging said feed screw element, means for rotatably supporting said feed screw and nut elements, the supporting means for one of said elements permitting movement of said element transversely relative to the other of said elements, means for moving said last mentioned element transversely relative to the other of said elements, and means for rotating one of said elements.

8. In a feeding device, in combination, a feed screw element, a feed nut element threadably engaging said feed screw element, means for rotatably supporting said feed screw and nut elements, the supporting means for one of said elements permitting movement of said element between positions in which its axis coincides with and is in spaced parallel relation with, the axis of the other of said elements, means for moving

14. In a feeding device, in combination, a feed
0 screw element, a feed nut element threadably
engaging said feed screw element, means for ro-
tatably supporting said feed screw and nut ele-
ments, the supporting means for one of said
elements including yielding means adapted to
5 support said element so that it is movable be-

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tween positions in which its axis coincides with and is in spaced parallel relation with, the axis of the other of said elements, manually controlled means operable to effect a holding of one of said elements against rotation, and means for rotating the other of said elements.

15. In a feeding device, in combination, a feed screw element, a feed nut element threadedly engaging said feed screw element, the threads of said feed screw and nut elements having radially inclined engaging surfaces arranged to permit longitudinal and transverse movements of said elements relative to each other, means for rotatably supporting said feed screw and nut elements, the supporting means for one of said elements including yielding means adapted to support said element so that it is movable between positions in which its axis coincides with and is in spaced parallel relation with, the axis of the other of said elements, and means for rotating one of said elements.

16. In a feeding device, in combination, a feed screw element, a feed nut element threadedly engaging said feed screw element, the threads of said feed screw and nut elements having radially inclined engaging surfaces arranged to permit longitudinal and transverse movements of said elements relative to each other, means for rotatably supporting said feed screw and nut elements, the supporting means for said feed nut element including yielding means adapted to support said element so that it is movable between positions in which its axis coincides with and is in spaced parallel relation with, the axis of said feed screw element, and means for rotating said feed screw element.

17. In a feeding device, in combination, a feed screw element, a feed nut element threadedly engaging said feed screw element, the threads of said feed screw and nut elements having radially inclined engaging surfaces arranged to permit longitudinal and transverse movements of said elements relative to each other, means for rotatably supporting said feed screw and nut

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elements, the supporting means for one of said elements including yielding means adapted to support said element so that it is movable between positions in which its axis coincides with and is in spaced parallel relation with, the axis of the other of said element, means for adjusting said yieldable supporting means so that the element yieldably supported thereby is urged toward a position in which its axis is in spaced parallel relation with the axis of the other of said elements, and means for rotating one of said elements.

18. In a feeding device, in combination, a feed screw element, a feed nut element threadedly engaging said feed screw element, the threads of said feed screw and nut elements having radially inclined engaging surfaces arranged to permit longitudinal and transverse movements of said elements relative to each other, means for rotatably supporting said feed screw and nut elements, the supporting means for said feed nut element including yielding means adapted to support said element so that it is movable between positions in which its axis coincides with and is in spaced parallel relation with, the axis of said feed screw element, means for adjusting said yieldable supporting means so that the feed nut element is urged toward a position in which its axis is in spaced parallel relation with the axis of said feed screw element, and means for rotating said feed screw element.

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