No. 865,148. PATENTED SEPT. 3, 1907.

E. ALSLEBEN.

DRILLING MACHINE.

APPLICATION FILED MAY 23, 1907.

2 SHEETS—SHEET 1.

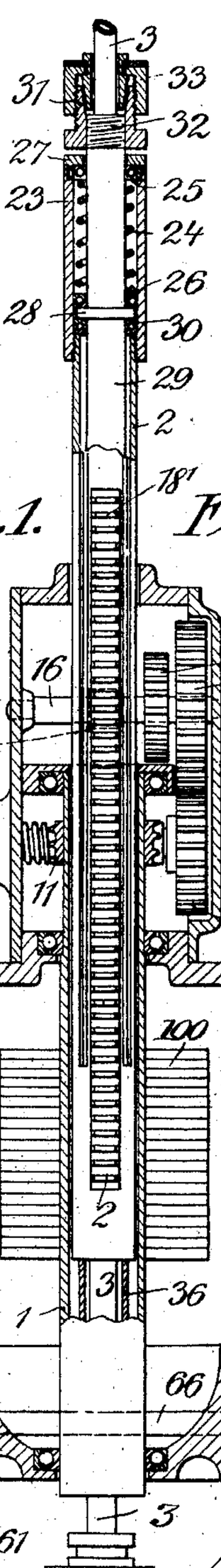

Fig. 1.

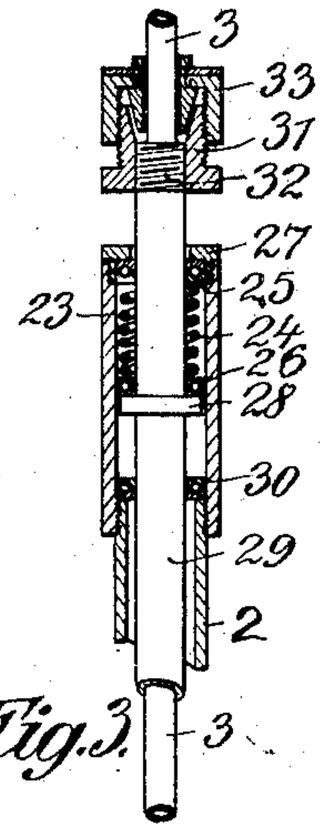

Fig. 3.

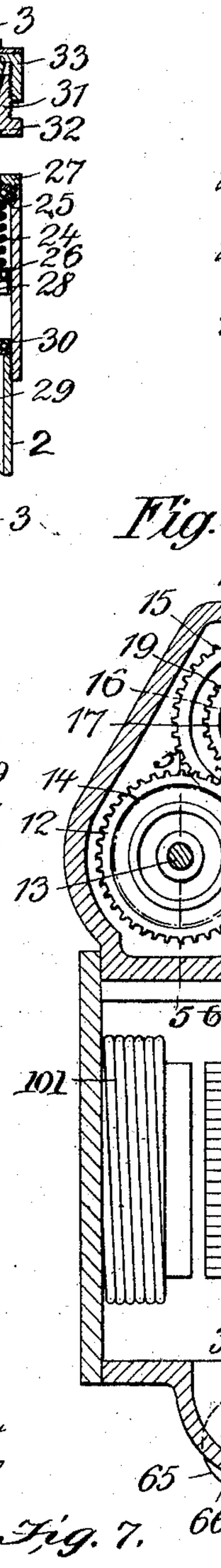

Fig. 2.

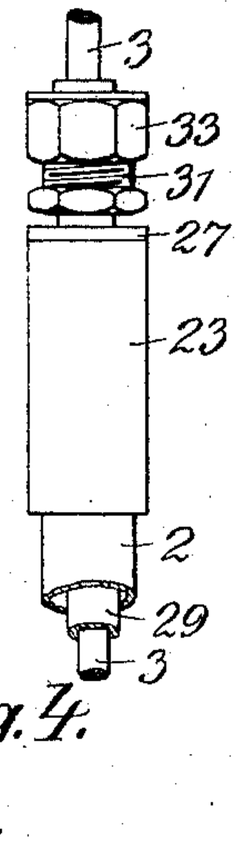

Fig. 4.

Fig. 7.

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2 SHEETS—SHEET 2.

Fig. 5.

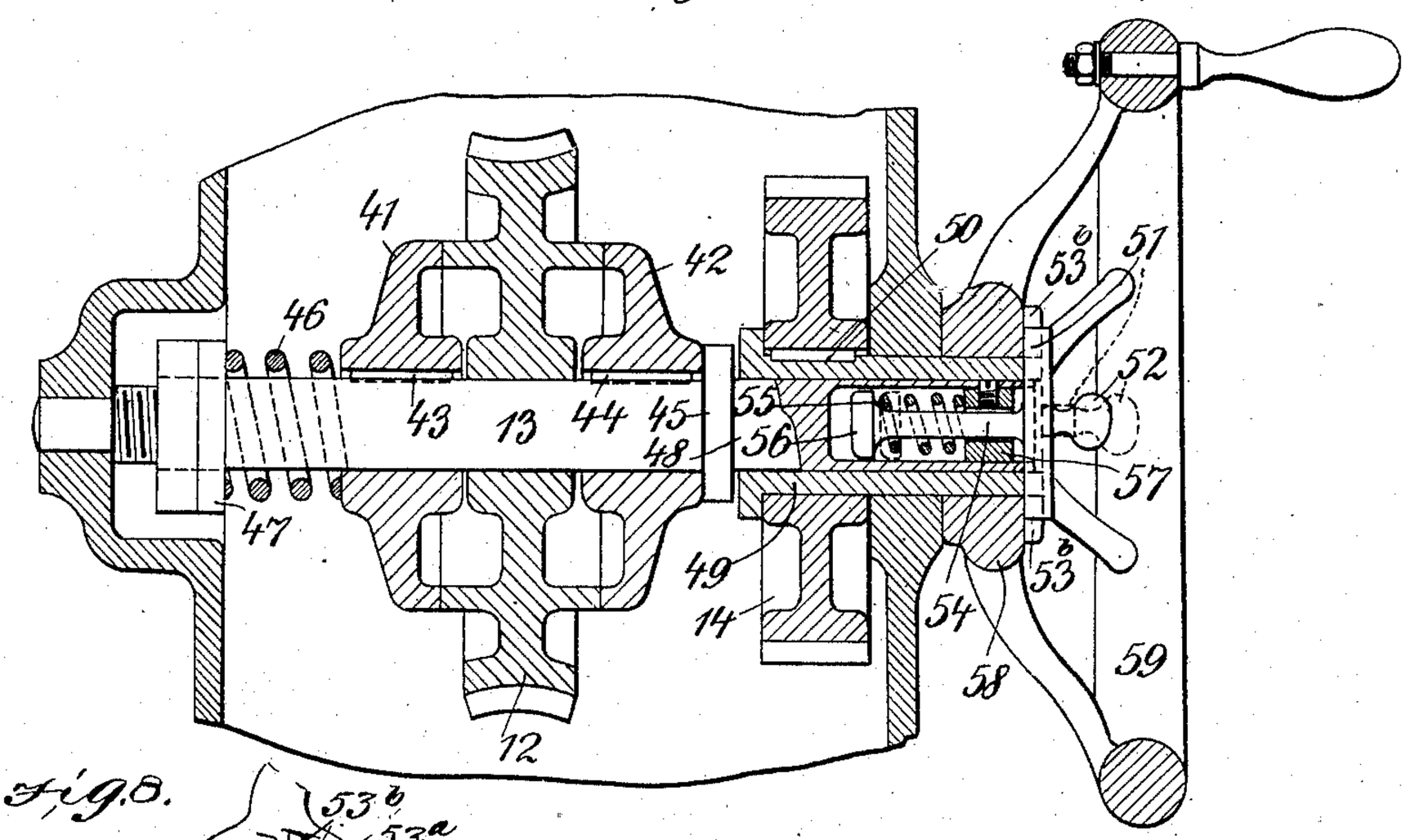


Fig. 8.

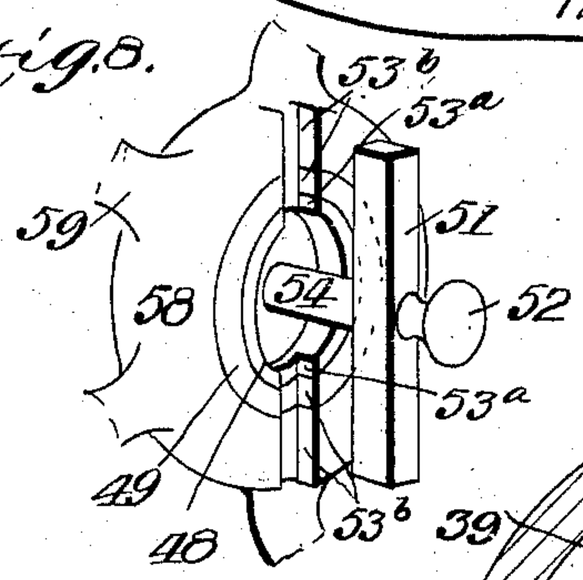
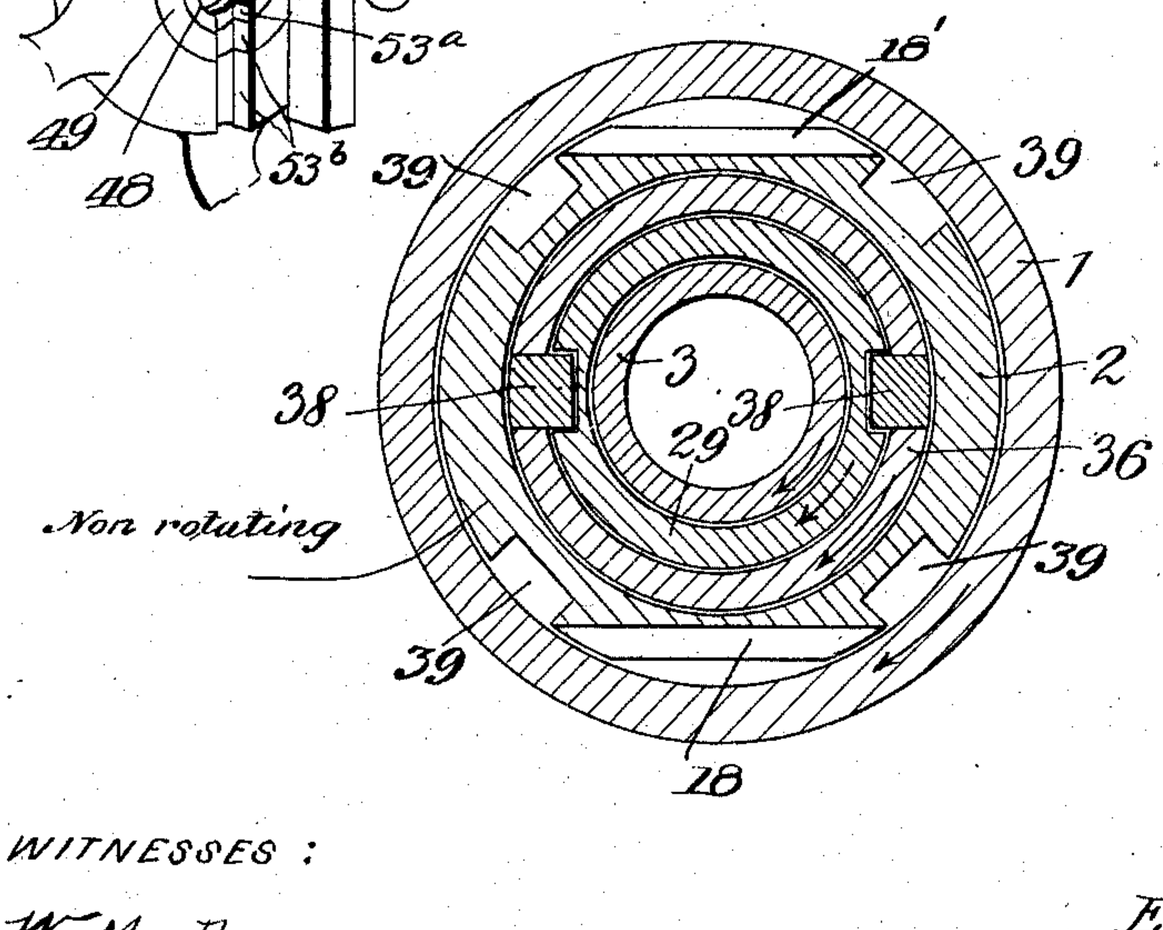


Fig. 6.



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UNITED STATES PATENT OFFICE.

ERNST ALSLEBEN, OF CHARLOTTENBURG, NEAR BERLIN, GERMANY, ASSIGNOR OF ONE-HALF TO MAX STEINBERG, OF CHARLOTTENBURG, NEAR BERLIN, GERMANY.

DRILLING-MACHINE.

No. 865,148. Specification of Letters Patent. Patented Sept. 3, 1907.

Application filed May 23, 1907. Serial No. 375,239.

To all whom it may concern:

Be it known that I, ERNST ALSLEBEN, a subject of the German Emperor, and a resident of Charlottenburg, near Berlin, 11 Spielhagenstrasse, in the German Empire, engineer, have invented certain new and useful Improvements in Drilling-Machines, of which the following is a specification.

The invention relates to an electrically operated stone drillin gmachine, the feed bar of which is arranged in the hollow driving shaft.

Stone drilling machines are known in which the drill pressure is regulated automatically by means of a spring interposed between feed spindle and the drill. It is also usual in stone drilling machines to include a friction clutch in the feed mechanism, which clutch is automatically thrown out when a given drill pressure is exceeded.

In accordance with the present invention, the friction clutch which is included in the transmission gear of the feed bar is dependent upon the pressure regulating spring in such a manner that the clutch is thrown out, that is to say the feed bar is disconnected from the motor, only when the spring is loaded beyond the permissible limit. This coöperation between the spring and the clutch presents, among others, the advantage that with stone of a varying nature, the feed of the machine may be supplemented by hand feeding. There is no objection, when the drill encounters a stratum of softer stone, to using the hand feed gear in addition to the mechanical feed until harder stone is again encountered. The danger of breaking the drill owing to the sudden change in the character of the stone is here obviated by the coöperation of the friction clutch and the pressure regulating spring. As soon as the spring is overloaded by an excessively fast feed, the friction clutch is thrown out, thereby disconnecting the feed mechanism from the motor.

In accordance with this invention, the hand feed gear is preferably provided with a clutch adapted to be thrown in and out by hand in order to render it independent of the mechanical feed when the clutch is disconnected, so that it may be used independently. When the clutch is thrown in, however, the hand feed may still be utilized for assisting the mechanical feed. The arrangement is such that the hand feed may be thrown into gear without it being necessary to stop the motor feed gear. Accordingly, there is no break in the operation.

The object of the invention is illustrated by way of example in the accompanying drawing, in which

Figures 1 and 2 represent longitudinal sections through the machine at right angles to each other. Fig. 3 is a longitudinal section, and Fig. 4 a side view of the ends of the drill bar and the feed bar, illustrating the movable relation of said drill bar in the feed bar. Fig. 5 is a longitudinal section on a larger scale, on line 5—5 of Fig. 2, showing the friction clutch inserted in the transmission gear in combination with the hand feed mechanism. Fig. 6 is an enlarged cross section on line 6—6 of Fig. 2, through the several bars guided one within the other. Fig. 7 is a cross section on line 7—7 of Fig. 2, looking downwardly; and Fig. 8 is a perspective detail of the hand wheel clutch.

The hollow shaft 1, operated by the electric motor, is mounted in ball bearings in the casing. The motor consists of an armature 100 attached to hollow shaft 1, and field magnets 101 attached to the case 6. The feed bar 2 is inclosed in the hollow shaft 1, and the drill spindle 3 (which is connected in the manner hereinafter described with the feed bar by the interposition of a spring for regulating the operative pressure on the drill) is inclosed in the feed bar 2. The feed bar 2 is toothed for effecting the feed.

The shaft 1 has rigidly attached to it the driving worm wheel 11, meshing with the driving wheel 12, and rotating the transverse shaft 13. The feed transmission gear is driven from the shaft 13 by the pinion 14 meshing with the pinion 15 of the shaft 16. The latter carries a pinion 17 which meshes with the teeth 18 on the feed bar 2. In order that the pressure of the feed mechanism may not thrust the feed bar 2 to one side, a pinion 19 is mounted on the shaft 16 and meshes with a pinion 20 on a shaft 21 mounted in the casing 6 of the drill on the opposite side of the feed bar. This shaft 21 carries a pinion 22 which meshes with the teeth 18′ on the feed bar 2. Owing to this driving of the bar 2 from two opposite sides, any one-sided pressure is avoided.

The feed bar 2 carries, at its end (see Figs. 2 and 3) an adjustable cap 23 inclosing a spring 24, the ends of which bear against two rings 25 and 26 which are provided with ball bearings, one set of which act against the upper end 27 of the cap 23, and the other set against a collar 28 on a bar 29, which is coupled with the drill bar 3 by the adjustable clamping clutch 31, 33, at the end, and which latter parts are termed the spindle bar. Under normal conditions, the collar 28 also bears by means of a ball bearing 30 against the end of the feed bar 2. In a known manner, the spring 24 provides for a uniform application of pressure to the drill.

The provision of the clutch 31, 33, presents the advantage that on the one hand the spindle 3 may readily be released from the machine and removed without the necessity for taking the machine apart, and on the other hand that the spindle 3, and accordingly the drill also, may be adjusted in common relatively to the driving mechanism, and arranged at any desired distance from the casing.

If the drill spindle 3 and consequently the drill 35, say a diamond crown drill, is fed forward, and if the

resistance opposing the drill is excessive, that is to say greater than the pressure exerted by the spring 24, the drill spindle 3, together with the spindle bar 29 coupled with it, are able to move longitudinally, while compressing the spring 24, as shown in Fig. 3. If the resistance diminishes, that is to say when it again corresponds to the normal working pressure, (the utmost limit of which is defined by the tension of the spring 24) the spindle bar 29 and the spindle 3 will gradually return to the position shown in Fig. 1.

Inside the hollow shaft there is provided a driver tube 36—see Fig. 6—which is arranged between the spindle bar 29 and the feed bar 2. This tube is connected by a collar 37 on its lower end with the hollow shaft 1 in such a manner as to constitute a rigid whole therewith. The collar 37 is bored for the passage of the spindle 3. As shown in Fig. 6, the driver tube 36 is connected by keys 38 with the spindle bar 29 in such a manner that the latter is able to move in the longitudinal direction, but is obliged to participate in the rotary movement of the driver tube 36. Accordingly, as on the one hand the tube 36 is connected with the driving shaft 1, and on the other hand the driven spindle bar 29 is connected with the tubular spindle 3 by the clamping clutch 31, 33, the common rotation of all the parts shown in Fig. 6, with the exception of the feed bar 2, is obtained. This feed bar 2 is prevented from rotating—see Figs. 2, 6 and 7—owing to the fact that projections 40 (on a ring attached to the casing) engage in longitudinal recesses 39 in the feed bar.

In case the regulation of the feed provided for by the spring 24 is not sufficient, that is to say, if the spring 24 has been completely compressed owing to an excessive resistance, in accordance with the invention a second means of regulation is provided for preventing breakage of the tool, the drill or feed bar, the feed mechanism or other parts of the machine. This means consists of a friction clutch inserted in the transmission gear, and which becomes operative as soon as the spring 24 has been compressed to a certain extent. This arrangement is shown in Fig. 5. In this construction the worm wheel 12, driven by the hollow shaft 1, is mounted loosely upon the shaft 13. The two parts are coupled by means of friction plates 41, 42, which are connected with the shaft 13 by means of grooves and feathers 43, 44, in such a manner as to be axially displaceable, and are pressed by means of a spring 46 against the collar 45 on the shaft 13. The tension of the spring 46 may be varied by means of the adjusting nuts 47 mounted on the shaft 13, in order to bring the action of this friction clutch into a definite relationship with the action of the spring 24. It is obvious that after the spring 24 has been compressed, the motive power disconnects the clutch 41, 42, so that the worm wheel 12 is able to rotate freely on its shaft 13, and the transmission gear consequently comes to rest.

In order to adjust the feed bar 2 by hand independently of the feed mechanism, or in conjunction therewith, a journal 48, Figs. 5 and 8, is formed on the end of the shaft 13, and is made hollow and mounted in a bushing sleeve 49 on which the driving wheel 14 is fixed by means of a key 50. The sleeve 49 is coupled with the hollow journal 48 by means of a locking clutch consisting of a T-bar 51, which by means of spring pressure is caused to engage in recesses 53^a in the journal 48, and recesses 53^b, of the sleeve 49 and of the hub 58 of the hand wheel 59 fixed on this sleeve. The locking clutch bar 51 is mounted by means of a rod 54 and a head 56 in the central recess in the journal 48, and a spring 55 maintains the locking clutch bar 51 engaged with locking recesses 53^a, 53^b. This spring bears on the one hand against the head 56 and on the other hand against a fixed ring 57 inserted in the cavity in the journal 48. By means of the handle 52, the locking clutch bar 51 may be caused to occupy the position represented in broken lines in Fig. 5, and full lines in Fig. 8, which withdraws it from the locking apertures, and by being then rotated through 90°, the clutch is held open. After this disconnection, the hand wheel 59 and sleeve 49 are able to rotate freely on the shaft 13, so that by means of the feed driving wheel 14, the feed bar 2 and the drill spindle 3 may be adjusted in either direction independently of the feed mechanism. The hand feed gear may also be used even when the mechanical feed is in gear, say for example, when soft stone is encountered, which can be worked at a higher speed. The hand feed then assists the mechanical feed. As soon as hard stone is again reached and the resistance consequently increases, and if the extreme limit of the resistance of the spring 24 is attained, the friction clutch 41, 42, is thrown out, so that even with the conjoint action of the hand and mechanical feeds, no breakage of any part of the machine will occur.

The drill spindle is preferably supported in a special bearing 60, Fig. 1, outside the casing 6. This is particularly advisable when the spindle is specially long or is to operate with a long feed. The distance separating this bearing 60 from the casing 6 may be adjusted. In the example here illustrated, this is effected by two arms 61, which end in screw spindles 62, which screw spindles are arranged in guide openings in the casing 6. The spindles also pass through nuts 64 mounted in the casing, which nuts are formed as worms on their outer sides. Two driving wheels 65, Fig. 2, mesh with these two worm nuts, and are fixed on a shaft 66 provided with a hand wheel 67. By rotating the hand wheel 67, the worm nuts are thereby rotated. By this means the yoke 60, 61, may be adjusted in a simple and convenient manner.

It will of course be understood that the details of the stone drilling machine described above may vary largely. This is particularly the case as regards the construction of the motor, and the details of the gear. In the construction here illustrated the arrangement of the spring 24 between ball bearing presents the advantage that the drill spindle rotates very easily in the feed bar 2, so that the feed is effected with very little loss of energy; in other words the efficiency is very high.

What I claim as my invention and desire to secure by Letters Patent of the United States is:

1. A rotary drilling machine, comprising a rotating hollow driving shaft, a tubular and toothed feed bar arranged therein, a rotary driver tube arranged in the tubular feed bar and having a sliding key, a grooved and slidably connected hollow bar arranged in the driver tube, a drill spindle arranged inside said slidably connected and grooved bar, a back-thrust pressure regulating spring arranged concentrically behind the drill spindle and its surrounding grooved bar and between them and the feed bar, to be compressed by the drilling strain, a toothed transmission gear meshing with the tubular and toothed feed

bar and a friction clutch arranged in the transmission gear and adapted to yield under a more than normal compression of the spring behind the drill spindle and its inclosing hollow bar.

2. A rotary drilling machine, comprising a rotating hollow driving shaft, a tubular and toothed feed bar arranged therein, a rotary driver tube arranged in the tubular feed bar and having a sliding key, a grooved and slidably connected hollow bar arranged in the driver tube, a drill spindle arranged inside said slidably connected and grooved bar, a back-thrust pressure regulating spring arranged concentrically behind the drill spindle and its surrounding grooved bar and between them and the feed bar to be compressed by the drill strain, a toothed transmission gear meshing with the hollow and toothed feed bar and deriving motion from the outer driving shaft, a friction clutch arranged in the transmission gear and adapted to yield under a more than normal compression of the back-thrust spring, said friction clutch having its shaft extending through the casing and provided with a hand wheel and a rigid interlocking clutch and means for connecting or disconnecting said hand wheel to the shaft of the friction clutch at the will of the operator.

In witness whereof I have hereunto set my hand in the presence of two witnesses.

ERNST ALSLEBEN.

Witnesses:
HENRY HASPER,
WOLDEMAR HAUPT.